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“A STUDY ON DESIGN AND ANALYSIS OF TWO WHEELER CRANK SHAFT OF SINGLE-CYLINDER PETROL ENGINE BY USING FEA METHOD”

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ABSTRACT

Crankshaft is a mechanical component with a complex geometry which transforms reciprocating motion into rotary motion; hence crankshaft plays a key role in its functioning. The crankshaft is connected to the piston through the connecting rod. The journals of the crankshaft are supported on main bearings, housed in the crankcase. The design of the crankshaft and analysis study is the most important process for an effective engine design and engine performance improvement in the internal combustion engine. The crankshaft is subjected to different pressure load with respect to crank angle and therefore the study the crankshaft subjected to different performance conditions is the most significant for an effective design in the internal combustion engines.

Key Words: Crank shaft, stress, deformation.

I. INTRODUCTION

Crankshaft is used to transfer reciprocating motion/power from piston to gear/clutch in desired velocity/torque ratios with high efficiency. However any crankshaft defect occurring deteriorate the performance of the engine. Crankshafts are basically used in rotating device like engines or generators. They transmit heavy loads of the flywheels and internal gaseous pressure of the engines at a very high rate. So, if any fault arises in the crankshaft, it must be alarmed & noticed by the operator or driver timely, to avoid the mass damage or catastrophe. Timely detection of fault/defect is very important in order to keep the entire system halt. The crankshaft consists of the shaft parts which revolve in the main bearings, the crankpins to which the big ends of the connecting rod are connected, the crank arms or webs (also called cheeks) which connect the crankpins and the shaft parts. The crankshaft, depending upon the position of crank, may be divided into the following two types :

1. Side crankshaft or overhung crankshaft
2. Centre crankshaft

II. LITERATURE REVIEW

Much research work has been done in the field of vibration analysis of crank shaft. The literature review of some papers gives more information about their contribution in design and vibration analysis of crank shaft

Silva.F.S. [2003] The crankshaft is the piece of a motor which interprets responding straight cylinder movement into pivot. Car crankshaft disappointment, aside from poor upkeep culture, is brought about by age and separation secured.

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These properties which caused crankshaft disappointment were researched utilizing poll organization and oral meetings of the support master and experienced work force in the three chose crankshaft upkeep shops in Akure, Nigeria dependent on six famous crankshaft brands. Data/information on disappointment rate and disappointment outcome edges were built up and filled in as a choice guideline on the premise at which ideal reconditioning procedure, substitution and compatibility arrangement of the crankshaft segments were distinguished on the event of disappointment rate ($R1$) and disappointment result ($\beta1$). PC calculation was produced for the product bundle, utilizing Microsoft Visual C# code. The product was tried to decide their degree of execution. The outcomes produced from the use of these frameworks were ordered into six situations whereby the MC230 Class gave the best outcome. The product will be genuine instruments in anticipating crankshaft disappointment in car, assembling, and machine apparatuses enterprises, for brief solution.[1]

Farzin H.[2007] The primary goal of this examination was to research weight and cost decrease open doors for a manufactured steel crankshaft. The need of burden history in the FEM examination requires playing out a nitty gritty unique burden investigation. Along these lines, this examination comprises of three significant segments: (1) powerful burden investigation, (2) FEM and stress examination, (3) advancement for weight and cost decrease. [2]

Ali Keskin et al, [2010] have gone for dissatisfaction assessment of nodular graphite cast press crankshaft used in oil motor. They attempted mechanical and metallurgical properties of the crankshaft including blend piece, scaled down scale hardness, flexible properties and repulsiveness and were differentiated and the foreordained properties of the crankshaft materials. In the connection, there were no metallurgical disfigurements isolated from to some degree higher carbon content. All other evaluated values were inside the predefined values. The explanation perceived for the mistake was the warm fatigue because of contact of diary and bearing surface. This condition incited the game plan and improvement of shortcoming breaks. The contact was come about due to imperfect oil or high working oil temperature.[3]

C.M. Balamurugan et al [2011] has been examined the Computer bolstered Modeling and Optimization of crankshaft and consider the shortcoming execution of two battling delivering advancements for vehicle crankshafts, to be explicit made steel and bendable cast press. The Three dimensional model of crankshaft were made by solid edge programming and a short time later remote made to Ansys programming. The headway strategy included geometry changes immaculate with the current motor, filet rolling and results in extended fatigue quality and diminished cost of the crankshaft, without changing interfacing bar and motor square[4]

Yingkui, Zhou Zhibo. [2011] have been discussed a three-Dimensional model of a diesel motor crankshaft were set up by using PRO/E programming and orderly ANSYS Software instrument, it exhibits that the high weight area generally packs in the knuckles of the wrench arm and the standard diary and the wrench arm and partner post diary ,which is the zone most easily broken.[5]

Jian meng et al,[2011] have done weight examination and model assessment of four chamber motor crankshaft using FEM .The three dimensional model of diesel motor crankshaft was made by star e and besides they analyzed the vibration show , the twisting and stress status of wrench hurl and they found the dangerous zones by pressure examination. The association between the repeat and the vibration secluded was broke down by the particular and symphonious assessment of crankshaft using ANSYS. They induced that the most extraordinary curving appeared at the point of convergence of crankpin neck surface. The most outrageous weight appeared at the filets between the crankshaft diary and wrench cheeks, and near the fundamental issue diary. The edge of basic diary was high weight locale. The failure was a result of contorting exhaustion.[6]

Rinkle garg and Sunil Baghl. [2012] have been analyzed crankshaft model and wrench hurl were made by Pro/E Software and thereafter moved in to ANSYS programming. The result exhibits that the upgrade in the nature of the crankshaft as the most extraordinary purposes of imprisonment of stress, indicate misshapening, and the strain is diminished. The greatness of the crankshaft is reduced .There by, diminishes the idleness propel. As the weight of the crankshaft is reduced this will lessen the cost of the crankshaft and augmentation the I.C motor execution.[7]

Abhishek choubey, and Jamin Brahmabhatt.[2012] have been inspected crankshaft model and 3-dimentional model of the crankshaft were made by SOLID WORKS Software and imported to ANSYS programming. The crankshaft most extraordinary distortion appears at the point of convergence of crankpin neck surface. The most outrageous weight appears at the filets between the crankshaft diaries and wrench cheeks and near the fundamental issue diary. The edge of standard diary is high weight zone. [8]

B.Kareem [2012] ,has considered mechanical crankshaft frustration for vehicle .This was done using data amassed by oral gatherings and overview on mechanical disillusionment of crankshafts. He has done research using Nissan, Datsun and other Japanese vehicles. Finally he has induced that the failure of crankshaft in vehicle came as a result of oil spillages in motors, over-troubling, misalignment, poor surface finishing the procedure of, misassembling, poor reconditioning of push bearing and adulterated motor oil. Likewise, the failure can be decreased by age of crankshafts with secretly sourced materials, improvement for the close by lanes, right mechanical help practice and instructing the clients.[9]

Jaimin Brahmabhatt [2012] Crankshaft is one of the basic segments for the powerful and exact working of the inner ignition motor. Right now unique reenactment is directed on a crankshaft from a solitary chamber 4-stroke diesel motor. A three-measurement model of diesel motor crankshaft is made utilizing SOLID WORKS programming. Limited component investigation (FEA) is performed to get the variety of stress extent at basic areas of crankshaft. Reproduction inputs are taken from the motor detail graph. The dynamic investigation is finished utilizing FEA Software ANSYS which brought about the heap range applied to wrench pin bearing. This heap is applied to the FE model in ANSYS, and limit conditions are applied by the motor mounting conditions. The examination is accomplished for finding basic area in crankshaft. Stress variety over the motor cycle and the impact of torsion and twisting burden in the examination are explored. Von-mises pressure is determined utilizing hypothetically and FEA programming ANSYS. The connection between the recurrence and the vibration modular is clarified by the modular and symphonious investigation of crankshaft utilizing FEA programming ANSYS. [10].

K. Thriveni [2013] Crankshaft is huge volume creation part with an intricate geometry in the Internal Combustion (I.C) Engine. This proselytes the responding dislodging of the cylinder in to a rotational movement of the wrench. An endeavor is made right now study the Static examination on a crankshaft from a solitary chamber 4-stroke I.C Engine. The demonstrating of the crankshaft is made utilizing CATIA-V5 Software. Limited component examination (FEA) is performed to get the variety of worry at basic areas of the wrench shaft utilizing the ANSYS programming and applying the limit conditions. At that point the outcomes are drawn Von-misses pressure actuated in the crankshaft is 15.83Mpa and shear pressure is prompted in the crankshaft is 8.271Mpa. The Theoretical outcomes are gotten von-misses pressure is 19.6Mpa, shear pressure is 9.28Mpa. The approval of model is contrasted and the Theoretical and FEA aftereffects of Von-misses pressure and shear pressure are inside the cutoff points. Further it very well may be reached out for the various materials and dynamic examination, enhancement of wrench shaft.[11]

Amit Patil [2014] This paper centers around the disappointment of crankshaft because of exhaustion which are placed into administration inseveral applications. Crankshaft is significant part in a wide range of motors utilized in applicationslike airplane, responding blower, marine motor, vehicle motor just as diesel generator.The disappointment of crankshaft is because of exhaustion coming about into splits on the outside of crankshaft andeffect of leftover worries because of filet moving procedure. The inspiration driving this paper is tostudy how exhaustion marvel prompts the disappointment of the crankshaft.[12]

Kirankumar Barangi1[2015] The pressure examination of a segment is a significant job in mechanical building plan. Here a careful report is made for four stroke diesel motor wrench shaft. First the wrench shaft is structured and determined for safe anxieties. The photoelastic model of structured wrench shaft is arranged and broke down for pressure circulation at different focuses through Research Polariscope. The outcomes are contrasted and ANSY stress investigation and results are perfect. The upsides of the photoelasticity technique are straightforward, through representation of stress design and decide worry anytime on the model since the periphery estimation of the material is known.[13]

Ms. Jagruti K [2016] In the undertaking, 3-D limited component investigation was done on the modular examination of crankshaft and the pressure investigation of crankshaft to check the wellbeing. The FEM programming ANSYS workbench was utilized to reenact the investigation of crankshaft. The aftereffects of stress and distortion disseminations and characteristic recurrence of crankshaft were gotten by utilizing ANSYS programming. The trial examination additionally completed for modular part and it approves with the FEM results. List Terms-Crankshaft, ANSYS, FEM results.[14]

Mr. V. C. Shahane [2016] Crankshaft is a mechanical part with a mind boggling geometry which changes responding movement into turning movement; subsequently crankshaft assumes a key job in its working. The crankshaft is associated with the cylinder through the interfacing pole. The diaries of the crankshaft are bolstered on principle direction, housed in the crankcase. The plan of the crankshaft and examination study is the most significant procedure for a viable motor structure and motor execution improvement in the interior burning motor. The crankshaft is exposed to various compel load as for wrench edge and consequently the examination the crankshaft exposed to various execution conditions is the most huge for a successful plan in the inner ignition engines[15]

PL. Vairakanna [2017] In this examination we are going to concentrate on structure and material streamlining of a race bicycle wrench. The goal is to look at the burdens and weight sparing of interchange wrench material with existing steel wrench. Expanding quality while diminishing or keeping up weight of the items is finding a workable pace significant research issue right now. On configuration study analyze elective structures of wrench for successful weight decreases. The best advanced structure and material will be proposed. The material will be chosen with target of expanding solidarity to weight ratio.[16]

Iain McEwen[2018] another viable work process for the laser Powder Bed Fusion (PBF) process, joining topological plan, mechanical reproduction, assembling, and approval by registered tomography is introduced, exceptionally applied to a buyer item (wrench for an elite hustling bike), a methodology that is substantial and adoptable by industry. The lightweight wrench configuration was realised using topology enhancement programming, building up an ideal structure iteratively from a straightforward crude inside a plan space and with the expansion of burden limit conditions (acquired from earlier biomechanical wrench power point models) and requirements. Parametric plan alteration was important to meet the Design for Additive Manufacturing (DfAM) contemplations for PBF to lessen assemble time, material utilization, and post-preparing work. Static testing demonstrated execution near current market pioneers with the PBF manufactured wrench saw as stiffer than the benchmark plan (static burden redirection of 7.0 ± 0.5 mm c.f. 7.67 mm for a Shimano wrench at a serious mass (155 g versus 175 g). Dynamic mechanical execution demonstrated insufficient, with disappointment at 2495 ± 125 cycles; the disappointment component was steady in the two its structure and area. This examination is significant and novel as it exhibits a total work process from configuration, make, post-treatment, and approval of an exceptionally stacked PBF produced customer segment, offering experts an approved way to deal with the utilization of PBF for parts with application outside of the acknowledged segments (aviation, biomedical, autosports, space, and force generation).[17]

Hla Min Htun[2019] The wrench arm is the segment of the bike that moves the power applied on the pedals to the wrench set. Wrench arms can split in various spots. Some of the time a break will create between the pedal mounting gap and the finish of the arm. This examination is essentially manage to break down the auxiliary investigation of wrench arm by utilizing the three diverse materials. The issue to be managed for this work is to structure and recreate utilizing SolidWorks programming for the streamlining of the wrench arm with limitations of firmness and quality is considered for plan safety. The wrench is dissected in static condition. Appropriation of various pressure parts and the most extreme von Mises stress have been found out. The most extreme von-Mises pressure 106.6 MPa and greatest diversion is 0.282 mm discovered that on the amalgam steel material. So combination steel is the reasonable material of the wrench arm for Quadracycle. It has been discovered that the greatest von Mises worry in the wrench is 106.6 MPa which is underneath the yield quality of the wrench material (620.42 MPa).[18]

Ankit Kumar Mishra[2019] The modular examination of a 4-chamber, Hero Splendor bicycle crankshaft is talked about utilizing limited component strategy right now. The examination is done on two distinct materials which depend on their piece. Three-measurement models of diesel motor crankshaft was made utilizing CATIA V5 R20 programming. The limited component examination (FEM) programming ANSYS was utilized to investigate the warm

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transient investigation of the crankshaft. The greatest emphasize point and risky regions are found by the twisting examination of crankshaft. The connection between the temperature, warm burdens and distortion is clarified by the modular investigation of crankshaft. The outcomes would give a significant hypothetical establishment to the streamlining and improvement of motor design.[19]

III. PROBLEM IDENTIFICATION

Crank shaft of IC engine is a critical component which transmits the power at a required speed and controls the complete operation. If crank shaft of the system fails then entire process will stop hence it is important to design the durable crank shaft.

IV. OBJECTIVES

This work comprises the following objectives for safe design of existing power loom system. To Select a critical component i.e. crank shaft of power loom system

- Improve durability
- To reduce crank pin failure
- To modify the component for optimization by changing the geometry then the analysis will be carried out

V. CONCLUSION

From the above review it has been observed that the experimental, and numerical analysis is carried out to check the stress, deflection and modal frequencies. The maximum deformation that appears is mainly at the centre of crankpin neck surface. The maximum stress appears at the fillets between the crankshaft journal and crank cheeks and near the central point journal. The edge of main journal is high stresses area, some researchers has measured the life of the crank shaft for safer conditions and also optimization of the crank shaft is carried out used in engine applications to reduce the material and cost. The decrease in the crank shaft weight reduces the inertia force .

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