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Design and Analysis of Mechanical Assembly for the Clutch Test Rig

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ABSTRACT:The Paper intends to cover the requirements of for design of clutch test rig. The test rig should be capable of testing multi plate, wet type automotive clutches. The design of test rig is intended to cover testing of wide range of multi plate clutches considering their application in two wheelers. Based on the operating speed and torque range, design calculations of Clutch test rig components are to be calculated.

KEY WORDS: Clutches, Test Rig, Base frame, operating speed, disc coupling, pedestal, electromagnetic clutch, etc.

I.INTRODUCTION

A Clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. A clutch thus provides an interruptible connection between two rotating shafts. Clutches allow a high inertia load to be stated with a small power. A popularly known application of clutch is in automotive vehicles where it is used to connect the engine and the gear box. Here the clutch enables to crank and start the engine disengaging the transmission Disengage the transmission and change the gear to alter the torque on the wheels.
There are different types of clutches like single plate clutch, multi plate clutch, cone clutch etc. Motorcycles typically employ a wet clutch with the clutch riding in the same oil as the transmission. These clutches are usually made up of a stack of alternating plain steel and friction plates. Some plates have lugs on their inner diameters that lock them to the engine crankshaft. Other plates have lugs on their outer diameters that lock them to a basket that turns the transmission input shaft. A set of coil springs or a diaphragm spring plate force the plates together when the clutch is engaged. Selection of clutch for application depends on various parameters like size, inertia, heat dissipation etc. It is necessary to predict the life of newly developed clutch under various operating conditions such as start from rest, acceleration, and deceleration, hill climbing etc. before actually used in application.
Based on the above application suitable material is selected and design calculations are carried out.

II. METHODOLOGY

Based on the application for testing clutch, a test rig should be designed considering a thorough study of Operating speed and torque range, Critical speed, Material selection, Bearings selection, inertia range selection, couplings to be used, etc. Suitable material to be selected for base frame and other components
Design calculations of the components / subcomponents of the test rig

- Operating speed and torque ranges
- Torsional / Radial / Axial load on the components
- Material selection for the component / sub-components
- Vertical load and load distribution, particularly on base frame

Typical parameters to be considered for evaluation

- Natural frequency / critical speed
- Design limits in terms of load distribution, maximum speed etc.
- Stress strain analysis
- Material suitability

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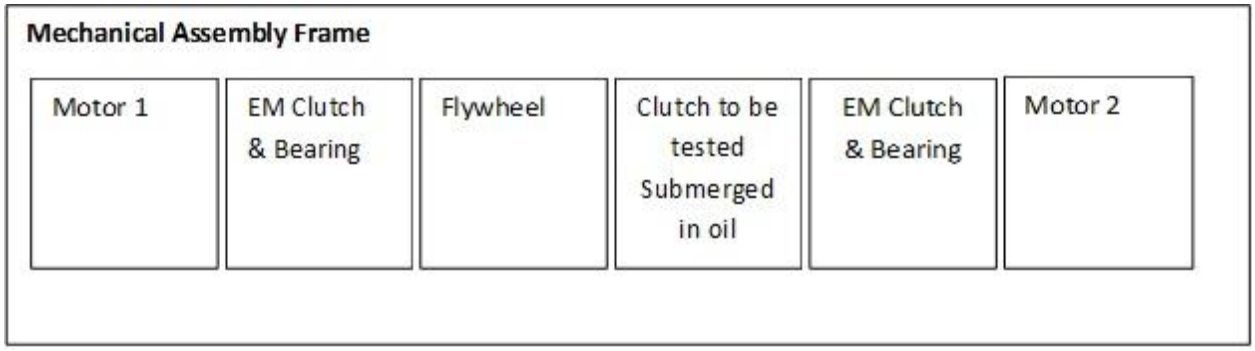
III. PROPOSED LAYOUT OF THE CLUTCH TEST RIG

Block diagram shows the proposed layout. Based on the design calculation considering inertia and other parameters modification in the block diagram will be done.



The test layout shown above represents the proposed layout for Clutch test rig. It consists of motor on both ends. Motor on the left end represents engine side and on the other end represents the chassis dynamometer. Flexible disc coupling are provided on both the ends to couple motor and pedestal assembly. The pedestal assembly is connected with disc coupling and input side bearing unit with countershaft assembly where in clutch to be tested will be placed connected to output side bearing unit. Pedestal assembly with Electromagnetic (EM) clutch is provided on the output side connected by flexible disc coupling.

The proposed test rig consists of

- Base frame
  A base frame provides a surface onto which various mechanical components are mounted. Different components, e.g. motors and gearboxes, have to be mounted at different center line heights relative to the mounting surface to provide shaft alignment. The base frame must be stiff enough to remain in correct alignment when subjected to bending, twisting and vibrational effects during operation.
- Motors
  Two motors will be used. One representing the engine side of the vehicle by providing power and other representing vehicle side and road conditions. Motor selection is important considering the application varies from testing clutches used for 100 cc to 1000 cc capacity engines.
- Disc couplings
  Disc coupling by definition, transmits torque from a driving to a driven bolt tangentially on a common bolt circle. Torque is transmitted between the bolts through a series of thin, stainless steel discs assembled in a pack. Misalignment is accomplished by deforming of the material between the bolts. A disc coupling is a high performance motion control (Servo) coupling designed to be the torque transmitting element (by connecting two shafts together) while accommodating for shaft misalignment. It is designed to be flexible, while remaining torsionally strong under high torque loads. There are two different styles of disc coupling.
  Single Disc: Style couplings are composed of two hubs (the ends of the coupling, which are typically made from aluminum, but stainless steel is used as well) and a single, flat, stainless steel disc spring.
  Double Disc: Style coupling is also composed of two hubs, but has an additional center spacer sandwiching two disc springs. The center spacer can be made out of the same material as the hubs, but is sometimes available in insulating acetyl, which makes the coupling electrically isolating.
  The difference between the two styles is that single disc couplings cannot accommodate parallel misalignment due to the complex bending that would be required of the lone disc. Double disc styles allow the two discs to bend in opposite directions to better manage parallel offset. The discs are fastened to the hubs (and center spacer on double disc styles) with tight fitting pins that do not allow any play or backlash between the disc and the hubs. The discs can be bent easily and as a result, disc couplings have some of the lowest bearing loads available in a motion control coupling.

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Torsionally stiff and still flexible, disc couplings are a great solution for high speed applications. The downside is that they are more delicate than the average coupling and can be damaged if misused. Special care should be taken to ensure that misalignment is within the ratings of the coupling

Here considering out application and torque requirement we have to select suitable Flexible coupling like RIGIFLEX-N, Steel lamina coupling.

Rigiflex Couplings are used on such applications which require a reliable and maintenance free torque transmission with shaft displacement at the same time.

- Pedestals for bearing

  Pedestals (also known as Pillow Blocks) are the most common method of mounting roller bearings. The maximum safe radial load for a pedestal is based on the static rating of the corresponding size of roller bearing. Pedestals should be fully supported on a flat, rigid surface to avoid distortion of the pedestal or deflection under load. Standard pedestals are manufactured from grey iron. Ductile iron and steel pedestals are also available and should be considered for shock or pulsating loads.
- Sliding arrangement on input side for clutch mounting

  Suitable sliding arrangement to be made considering the movement to be made for maintenance and placing the new clutch test sample for test.
- Electromagnetic clutch

  Electromagnetic clutches operate electrically, but transmit torque mechanically. This is why they used to be referred to as electro-mechanical clutches. Over the years, EM became known as electromagnetic versus electro mechanical, referring more about their actuation method versus physical operation. Since the clutches started becoming popular over 60 years ago, the variety of applications and clutch designs has increased dramatically, but the basic operation remains the same.

  Single-face clutches make up approximately 90% of all electromagnetic clutch sales.

  The electromagnetic clutch is most suitable for remote operation since no linkages are required to control its engagement. It has fast, smooth operation. However, because energy dissipates as heat in the electromagnetic actuator every time the clutch is engaged, there is a risk of overheating. Consequently the maximum operating temperature of the clutch is limited by the temperature rating of the insulation of the electromagnet. This is a major limitation. Another disadvantage is higher initial cost.EM Clutch will be used only to disconnect the output when speed is zero in our application.
- Input and output bearing shaft assembly

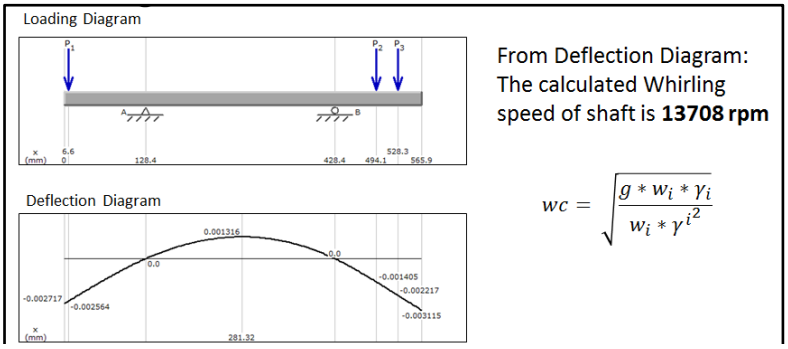
  The assembly of bearing will consist of shafts assembly to fit different types of clutches to be tested. It will be ensured that oil flow is continuous as in this case multi plate clutches will be tested.

  A separate unit for oil pumping is to be designed in order to ensure that oil flow on the clutch to be tested should represent the real vehicle condition.

Whirling Speed of Shaft

The operating speed range of the shafts is 300 to 10000 rpm. In view of the same the "Whirling Speed" i.e.; "Critical Speed" of the shaft needs to be above the operating speed range. Classical calculations were done to calculate the critical speed, formula for the same is given below.

Based on the calculations, the critical speed of the shaft is 13708 rpm which is 37% above the peak operating speed.



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IV. APPLICATION

- Clutch test rig can be used for carrying out endurance test of the multi plate clutch
- Various test cycles representing road & vehicle behaviour during hill climbing, start stop condition etc. can be tested on clutch in this clutch test rig.
- The test rig designed help in studying clutch properties like wear rate, life etc.
- It will provide a base data for future applications

V. FUTURE WORK

Based on the above calculation and study Cad modelling and analysis of all the remaining components /sub systems i.e. Base frame, couplings etc. and assembly shall be carried out

CAE analysis of the CAD models generated for parameters of evaluation like Natural frequency, critical speed, Design limits in terms of load distribution, and maximum speed etc., Stress strain analysis, Material suitability etc. will help in understanding the practical behaviour of test rig. Evaluation of CAE results for design validation and modification in design, if required any can be carried out before building actual model.

REFERENCES

[1] RikardMäki and Pär Nyman, (2005), "Measurement and Characterization of wet clutches for measurement and characterization of Anti-shudder Properties" SAE paper no 2005-01-0878

[2] Vladimir Ivanović, MatijaHoić, JoškoDeur ,ZvonkoHerold and Eric H. Tseng, (2012),"Design of Test Rigs for a Dry Dual Clutch and its Electromechanical Actuator"SAE International Paper no.2012-01-0807

[3] Simeon Simeonov, SlavcoCvetkov, SaskoDimitrov, ZlatkoSovreski, et al,2012, "Influence of the number of the clutch engagements on the wearing of friction linings of motor vehicle clutches,ISSN 1330-3651,Tehničkivjesnik 19, 2(2012), 447-44