Design and structural analysis of single plate clutch by fea: a review

Mahendra Sahu[1], A.K.Jain[2]

[1]Research Scholar (Machine Design) [2]Associate Professor
[1,2]Department of Mechanical Engineering
Jabalpur Engineering College, Jabalpur

***Abstract*: 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. The present used material for friction disc is Cast Iron and aluminum alloys. In this thesis analysis is performed using composite materials. The composite materials are considered due to their high strength to weight ratio. In this thesis composite material kevlar and aluminium Metal Matrix Composite are taken. A single plate clutch is designed and modeled using Catia V5 software. Static analysis is done on the clutch to determine stresses and deformations using materials Grey Cast Iron, sintered iron, kevlar and aluminium Metal Matrix Composite. Analysis is done in Ansys 16.0. Theoretical calculations are also done to determine stresses.**

***Keywords*: Clutch, Static analysis, Ansys16.0, Catia V5.**

I. INTRODUCTION

Although the first use of a dry single-plate clutch was by **Duryea** in 1893, it was not until 1921 that a design was developed that would not burn out in a few hundred miles, thanks to Englishman **Herbert Frood**, who perfected more durable friction materials.In the simplest application, clutches connect and disconnect two rotating shafts (drive shafts or line shafts). In these devices, one shaft is typically attached to an engine or other power unit (the driving member) while the other shaft (the driven member) provides output power for work.While typically the motions involved are rotary while linear clutches are also possible. Some of the consideration for designing clutch assembly is Suitable Friction Material for friction liner, Sufficient torque transmitting capacity, Engagement with minimum Shock and jerking, Weight of rotating parts should be low to decrease the inertial forces to increase the sensitivity of application of forces, Suitable provision for changing the friction lining and thermal distribution due to frictional heat should be uniform and the rate of increase of temperature should be less. In case of clutch the main problem occurs in the clutch material. The material gets damaged and so the maximum performance can't be achieved further. Some important requirements of clutch material is high co-efficient of friction, co-efficient of friction should be remain constant throughout the working temperature of clutch plate, good thermal conductivity for better thermal distribution, remain unaffected by environmental conditions, moisture and dirt particles, high resistance to abrasive and adhesive wear, good resilience to provide good distribution of pressure at the connecting surfaces.

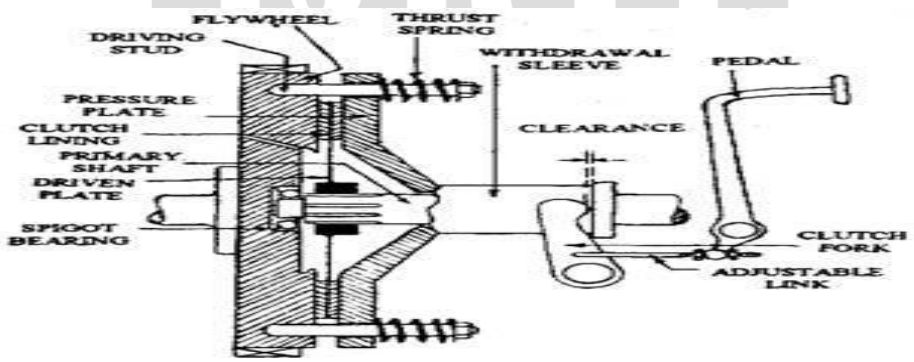

Fig: - single plate clutch

II. LITERATURE REVIEW

[1] May Thin Gyan

This paper explains the design of single plate clutch 2 drawing is drafted by using theoretical calculations. The strength of friction plate is done by using Solid Works. Friction materials used are cast iron, alloy steel and copper. By observing the analysis results are shown the stress, strain and displacement values of the three materials. When comparing the stress values of the three materials, the stress values of other two materials are greater than the stress value of cast iron. The result

of this paper, using cast iron as friction material is advantageous than using alloy steel and copper as friction material. The cast iron using as friction material is the best for single plate clutch.

[2] Ravikiran M. Tate

In this paper they have modeled a single plate clutch from theoretical calculation and the 3D drafting is done through CATIA V5.The clutch base plate and Friction liner plate are analyzed through ANSYS. The friction material is taken as FTL097 and it is found that Maximum stress in all conditions is well below the allowable limit hence both parts are safe, Negligible deformation is seen in case of clutch liner thereby suitable for clutch lining as it will result in lesser wear..

[3] Sandhya Rani

In this paper structural analysis is conducted for validating design by varying the friction surfaces material. By extracting the result, find out the best material for the lining of friction surfaces. Here Materials used as liner is composite materials. They are carbon- carbon composites, Kevlar29 and ceramic composites.Comparison is done for above materials to validatebetter lining material for clutch plate.

[4] B. Nivas

In this paper Maximum deformation in mm (pressure plate)is found out after analyzing the materials, then von misses stress in MPa (overall component)also found out by which they conclude suitability of EN GJS-400-15 steel for the production of clutch plate is better than Grey Cast Iron(FG300) . En 15 steel reduces the Stress on the support link is 167.911 MPa, where as the yield stress of FG300 is 181.033, so the life of the material should be high. Stress on the pressure plate is reduced to 46.937 MPa, whereas stress on grey cast iron is 52.145 MPa

[5] **Virendra Kumar Patel**

This paper explains the friction force produced by the clutch pressureplate should be directly proportional to the Normal load after analyzing the materials, they found out von misses stress in MPa (overall component) than conclude the suitability of EN GJS-400-15 steel for the production of clutch plate is better than Grey Cast Iron (FG300).

[6] **S. Jaya Kishore**

In this paper they have designed a multi plate clutch using theoretical calculations.2D drawings are drafted from the calculations.3D model of the multi plate clutch parts and assembly are done in CREOPro/Engineer software. Structural analysis is done on the friction plates to verify the strength. Friction materials used are Cork and Powder Metal.By observing the analysis results, the stress and strain values for copper powder metal are less than Cork respective values. So they expected that for multi plate clutches using powder metal as friction material is advantageous than using cork as friction material

[7] SyambabuNutalapati

The aim of this paper is to develop the material selection method and select the optimum material for the application of brake disc system emphasizing on the substitution of this cast iron by any other lightweight material. Two methods are introduced for the selection of materials, such as cost per unit property and digital logic methods. Material performance requirements were analyzed and alternative solutions were evaluated among cast iron, aluminium alloy, titanium alloy, ceramics and composites. Mechanical properties including compressive strength, friction coefficient, wear resistance, thermal conductivity and specific gravity as well as cost, were used as the key parameters in the material selection stages. The analysis led to aluminium metal matrix composite as the most appropriate material for brake disc system.

[8] Khamlichi

In this work, a rational approach based on Taguchi technique and Pin-on-disk test is used in order to study the friction coefficient behavior of clutch facings as function of material formulation. Experiments were designed according to the orthogonal array L8 where the chosen factors aretemperature and sliding speed. A complex interaction exists between the surface texture of theproduced clutch facings and the used manufacturing process parameters, particularly thoseassociated to molding and grinding operations. Since it is not straightforward to render this effect interms of explicit factors, it is roughly considered here as noise affecting a chosen wear path duringPin-on-disk testing. Signal over noise ratio should be sufficiently high in order that qualification testresults obtained for a given material formulation could be possible. For the set of parametersconsidered during the actual experiment, the friction coefficient behavior of clutch facings was shownto be mainly controlled by the sliding speed or by the interaction between the sliding speed andtemperature.

III. CONCLUSION

From the above literature survey we find that there are many researchers done analysis on single plate clutch and material taken by them are such as cast iron, molded asbestos, ceramics, and steel alloy.

The various factors such as: -Material is economically, less strength by weight ratio, less weight, less deformation, minimum temperature at the surface, high coefficient of friction and High wear resistance on the lining of friction plate is attributed to the higher temperature generated due to seizure between the friction plate and the mating surface.

From above literature survey (3) Sandhya Rani V find that the analysis on clutch plate the composite material has higher performance index than other materials.
Then, I have decided that I will do the analysis of single plate clutch by taking the materials such as grey cast iron, sintered iron, Kevlar, aluminium metal matrix composite and find out the total deformation, maximum stress and compare the results of composite material with grey cast iron.

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