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DESIGN AND THEORETICAL ANALYSIS OF SINGLE PLATE CLUTCH BY VARYING FRICTION LINING MATERIALS

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ABSTRACT : *This research paper has been related to the friction lining material in clutch plate. There are many materials available in market like, Asbestos, Ceramic-metal, organic fabric, cast iron, sintered metal etc. but According to market survey ASBESTOS is normally used as a friction lining material in clutch plate. But there are few problems in asbestos friction plate like, high heat-generation and low co-efficient of friction. So, there is requirement of change the material in clutch plate. Firstly change the friction lining material and redesign the clutch plate and after that different experiment will be carried out with the different material in clutch plate. Here mainly focus on increasing torque transmission capacity of clutch plate. According to results of different experiments, choose the best material for friction lining of clutch plate.*

Keywords: *Single plate clutch, Friction lining materials, Asbestos, Sintered metal.*

I.INTRODUCTION:

The clutch is important part in the transmission system of automobiles. It transmits the power from the engine to gear box at various speeds. No shock is caused during this transmission of power. Clutch is mechanism by means of which engine is connected or disconnected from the remaining parts of power transmission system at the will of driver by operation of a foot pedal, thus permitting the engine to run without driving the vehicle. It permits engagement or disengagement of a gear when the vehicle is stationary and engine is running. It transmits engine power to the road wheels smoothly without jerk. It facileties to engage 1st and 2nd gear to start the vehicles from rest. Disconnect the power from the gear box for easy shifting of gear, so that the noise and damage to the gears is avoided. It suddenly disconnects the engine power from the transmission system in case of an emergency, e.g. stopping the vehicle after applying brakes.

Fig. 1: Clutch plate with asbestos material

Requirement of good clutch facing:

- It should have high heat resistance against high rubbing speed and large intensity of pressure.
- It should has high co-efficient of friction.
- It should be easy to manufacture.
- It should have longer life.

The clutch facing materials may be inorganic or organic, metallic or non-metallic and composites. The main clutch facing materials are leather, cork, fabric, asbestos, sintered metal, metal-ceramic, organic fibre – composites etc.

II. LITERATURE REVIEW

- Clutch is one of the essential components in automobiles. It is located between the engine and the gear box. The main function of the clutch is to initiate the motion or increase the velocity of the vehicle by transferring kinetic energy from the flywheel. The present paper deals with the designing and analysis of friction clutch plate. Design has done by using CATIA V5 software and static structural analysis carried by using ANSYS.*(Gouse s. begum1, A.*

Balaraju - 2015) Finally the plots for equivalent stress, strains and total deformations were obtained for different friction materials for friction clutch plat, Uniform wear theory were used for the analysis.

- The accurate computation of the contact pressure distribution is considered the main key to obtain the temperature distribution of the contact surfaces of clutch with high accuracy. High number of researchers in the thermoplastic field assumed that the contact surfaces of the automotive clutches and brakes are flat, and they don't take the actual surface roughness into consideration in the numerical models. In this paper a new model of rough clutch disc has achieved to show the actual contact pressure of the new and used friction facing of clutch disc. The effect of the surface roughness of the used friction facing on the heat generated and the temperature fields are investigated as well.*(Oday I. abdullah, Michael lytkin - 2015)* The compression has been made between the results when assume the surface is rough and when it's flat. Axisymmetric finite element model has been developed to study the thermal behavior of a single-disc clutch system (pressure plate, clutch disc and flywheel) during the sliding period.
- Clutch is a mechanical device, which is used to engage or disengage the source of power from the rest of the power transmission system at the operator's will. The clutch can connect or disconnect the driving shaft from the driven shaft when necessary. Clutches are designed to transfer maximum torque with minimum heat generation. During engagement and disengagement the two clutch discs has the sliding motion between them. The research shows that that designing and analysis of two positive multi friction plates. For the designing of the friction plates 3d modeling software used and for the analysis ansys package is used. In the analysis part the two models are analyzed with different materials by conducting two types of analysis which are structural and thermal. *(Shaik Mohammad Ali - 2014)* Structural analysis is done to find out the stress values and the thermal analysis done to find out the temperature distribution on the model. By these two analysis results we are suggesting the best material to the effective model of the multiple friction plate.

III. CALCULATION OF DIFFERENT MATERIALS

Asbestos Material:

Actual data:

Outer radius(r_1):0.1145 m

Inner radius (r_2):0.0802 m

Pressure intensity of the clutch: 300 kN\m^2

Co-efficient of friction (μ):0.3

Uniform pressure intensity (W):

$$=\pi p (r_1^2-r_2^2)$$
$$=\pi (300) (10^{3)} (0.1145^2-0.0802^2)$$
$$=\pi (300)6.678$$
$$W=6290.87 \text{ KN}$$

Effective mean radius (R):

$$= \frac{2}{3}(r_1^3-r_2^3)/ (r_1^{2}-r_2^{2)}$$
$$= \frac{2}{3}(0.1145^3-0.0802^3)/ (0.1145^2-0.0802^2)$$
$$= 0.9836 \text{ m}$$

Torque transmission capacity (T):

$$=\mu W R$$
$$=0.3(6290.87) (0.0936)$$
$$T=185.631 \text{ Nm}$$

Cast iron material:

Actual data:

Outer radius (r_1):0.1145 m

Inner radius (r_2):0.0802 m

Pressure intensity of the clutch: 300 kN\m^2

Co-efficient of friction (μ): 0.15-0.2

Uniform pressure intensity (W):

$$=\pi p (r_1^2-r_2^2)$$
$$=\pi(300)(10^3) (0.1145^2-0.0802^2)$$
$$=\pi (300) (6.678)$$
$$W=6290.87 \text{ KN}$$

Effective mean radius (R):

$$=\frac{2}{3}(r_1^3-r_2^3)/ (r_1^2-r_2^2)$$

$= \frac{2}{3}(0.1145^3 - 0.0802^3) / (0.1145^2 - 0.0802^2)$

$= 0.9836$ m

Torque transmission capacity (T):

$= \mu W R$

$= 0.15\ (6290.87)\ (0.0936)$

$T = 92.8154$ Nm

Sintered metal material:

Actual data:

Outer radius (r_1):0.1145 m

Inner radius (r_2):0.0802 m

Pressure intensity of the clutch: 300 kN\m^2

Co-efficient of friction (μ): 0.29

Uniform pressure intensity (W):

$= \pi p (r_1^2 - r_2^2)$

$= \pi\ (300)\ (10^3)\ (0.1145^2 - 0.0802^2)$

$= \pi\ (300)\ (6.678)$

$W = 6290.87$ KN

Effective mean radius (R):

$= \frac{2}{3}(r_1^3 - r_2^3) / (r_1^2 - r_2^2)$

$= \frac{2}{3}(0.1145^3 - 0.0802^3) / (0.1145^2 - 0.0802^2)$

$= 0.9836$ m

Torque transmission capacity (T):

$= \mu W R$

$= 0.29(6290.87)\ (0.0936)$

$T = 179.44$ Nm

IV. COMPARISON OF PARAMETERS WITH DIFFERENT FRICTION LINING MATERIAL

No.	Materials	Pressure intensity(kN/m^2)	Outer radius(m) (r_2)	Inner radius(m) (r_1)	Co-eff. of friction	Torque transmission capacity(Nm)
1.	Asbestos	300	0.1145	0.0802	0.3	185.631
2.	Cast iron	300	0.1145	0.0802	0.15-0.2	92.5481
3.	Sintered metal	300	0.1145	0.0802	0.29	179.44

V. Redesigning of clutch plate:

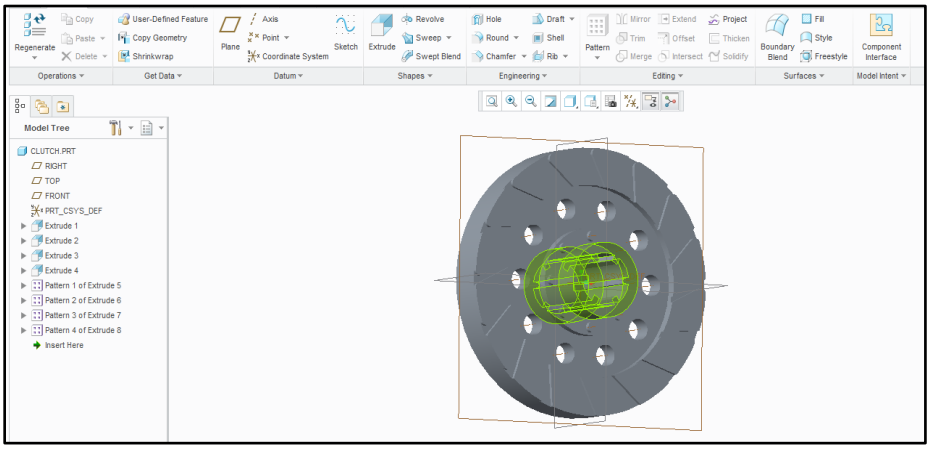

Fig. 2: geometry of splined hub

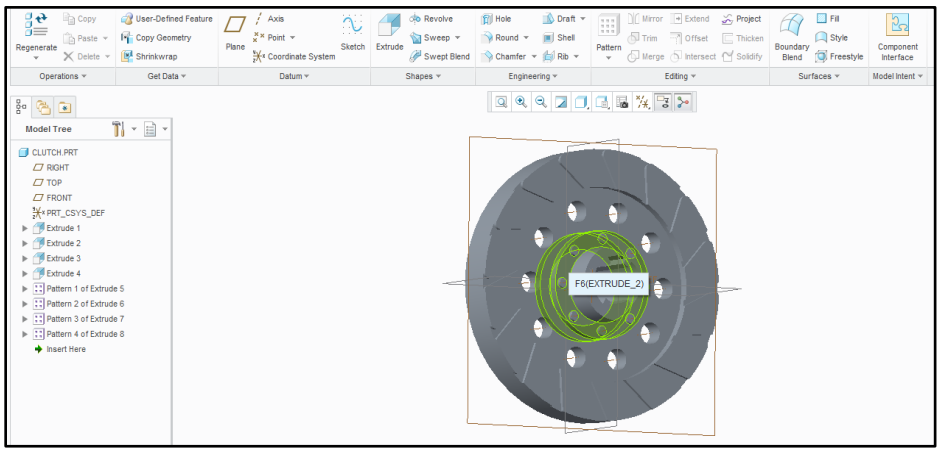

Fig. 3: Geometery of torsional spring

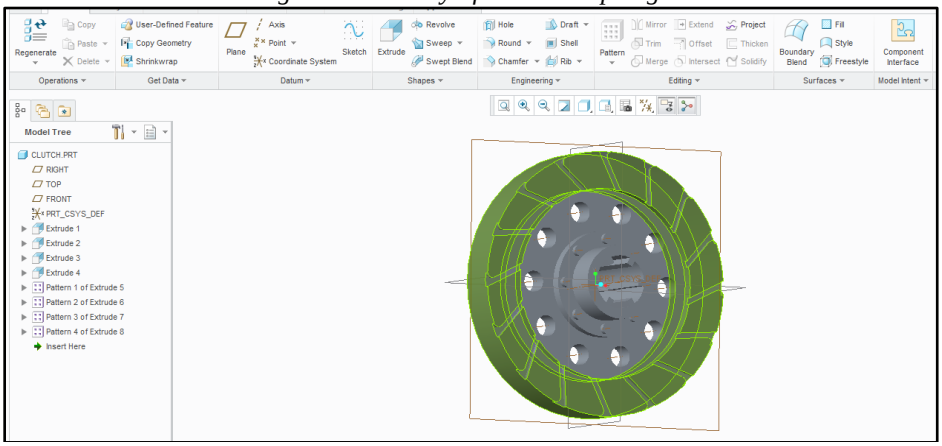

Fig. 4: Geometry of friction facing.

VI. CONCLUSION

Clutch is a prime component of the transmission system in automobile. The torque transmission capacity and life span of the clutch has been depends on the clutch plate so main focus of this research work is to improve the performance of the clutch by changing the friction lining material of the clutch plate. Normally, asbestos used as a friction lining material in clutch plate. But this research work also identifies another friction lining material.

In which we can see that the torque transmission capacity of asbestos, cast iron and sintered metal is 185.63 Nm., 92.5481 Nm., 179.44 Nm. respectively. The torque transmission capacity of asbestos material is little bit higher compare to sintered metal but life span of the asbestos material is less compare to sintered metal because of high heat dissipation rate.

As per the Theoretical analysis of different clutch lining materials, finally we conclude that the sintered metal is best material for friction lining in automobile clutch.

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