Sandwich Clutch

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Abstract- *In this Paper, For transmission of power Positive and Friction Clutch is designed. This Clutch is designed to achieve both operating action of Positive (Jaw) clutch and friction Plate Clutch. As we have use two different types of clutch system i.e. Friction Clutch and Positive Jaw clutch the operating sequence must be set in a proper order to avoid any interference between them. To have smooth and quite working one must set some Logic sequence to make the working full proof.*

Keywords- Friction clutch, Dog Clutch, Jaw Clutch, CATIA

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. Clutches are also used extensively in production machinery of all types.

The power developed inside the engine cylinder is ultimately aimed to turn the wheels so that the motor vehicle can move on the road. The reciprocating motion of the piston turns a crankshaft rotating the flywheel through the connecting rod. The circular motion of the crankshaft is now to be transmitted to the rear wheels. It is transmitted through the clutch, gearbox, universal joints, propeller shaft or drive shaft, differential and axles extending to the wheels. The application of engine power to the driving wheels through all these parts is called power transmission. The power transmission system is usually the same on all modern passenger cars and trucks, but its arrangement may vary according to the method of drive and type of the transmission units. The power transmission of an automobile. The motion of the crankshaft is transmitted through the clutch to the gear box or transmission, which consists of a set of gears to change the speed.

This Study is about designing a new Sandwich clutch based on friction clutch and positive jaw clutch to reduce the losses, wear, and clutch life and also to improvement of the power transmission capacity.

II. THE CONSTRUCTION OF MODEL

A. Construction

In above figure 1 as shown, there are two shafts with respective mountings. The left shaft is input shaft which is connected to the motor or power source, and the other one is output shaft.
Is consist of friction clutch assembly with positive (jaw) clutch assembly. In friction assembly one disc is rigidly keyed to the input shaft and other disc is splined on the output shaft which is suspend by helical compression spring which can be operated by clutch lever/pedal to engages or disengage.
And the positive jaw clutch is mounted on the friction clutch. In which one jaw set is fixed on the splined friction clutch as indicated in the figure. The other jaw set is splined to the fixed friction disc as shown in the figure, which is linked to the actuator.

B. Working

The working operation of the Sandwich Clutch System is as follows.
The order of engagement of the clutch system is as

1. Consider the shaft is in motion, if output shaft is to be engaged with input; the initial engagement is carried by friction Clutch with manual mechanical input given by the operator.As soon as the operation engages the clutch, and some approximately same speed is attend by the both shafts the SMU unit will give signal to the Logic Unit.
2. Now the Logic unit will decide on basis of the LOGIC GATES the actuation the positive clutching.

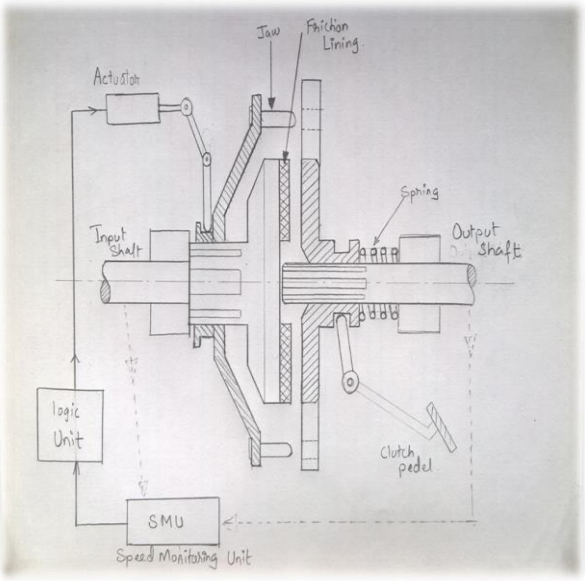
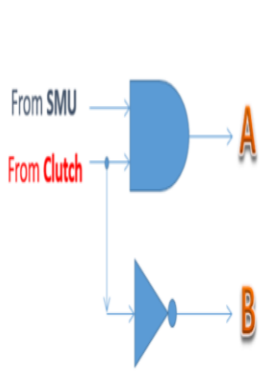


Fig 1:-Block diagram for Sandwich Clutch

III. THE SMU AND LOGIC UNIT OPERATIONS

The actuator is feed with signal which is given by the Logic Unit. This logic unit decides whether the speed of the both shafts are same and to actuate the positive jaw clutch.
This Logic Unit has two inputs i.e. one from the Speed Monitor Unit and other is from the Clutch lever sensor.

Speed Monitor Unit: is a set of transducer device which generates output signal only when the speeds of both shafts (i.e. input & output shafts) are approximately equal.
As shown in the below logic diagram and truth table, the actuation of positive jaw clutch is organized.



SMU s/g	Clutch s/g	A	B
0	0	0	1
0	1	0	1
1	0	0	0
1	1	1	0

Fig 2:-Logic Circuit With Truth table

The following above table demonstrate the various conditions

a) In Case, when both SMU & Clutch signals are absent then 'Output A' is absent. And 'Output B' will be present (i.e. this defines the positive jaw clutch disengage condition.)

b) In case, when SMU is absent and Clutch signal is present then the 'Output A' will be absent. And 'Output B' will be present.

c) In case, when SMU is present and Clutch signal is absent then the 'Output A' will be absent. And 'Output B' will be absent (i.e. the positive Jaw clutch will be at disengage condition.)

d) In case, when SMU is present and Clutch signal is present then the 'Output A' will be present. And 'Output B' will also be present. (i.e. At this condition only the Jaw clutch will get engaged.)

IV. DESIGN CALCULATIONS

Preferred Outer Diameter = 120, 125,130, 140
Inner diameter =80, 85, 90,100
Thickness =3, 3.5,4
Plate Clutch consist of pair of contacting surfaces
Inner diameter (d) =80mm
Outer diameter D =120mm
Coefficient of friction =0.3
Permissible intensity of Pressure Pa=1MPa

A. Uniform pressure Theory

Operating force

$$F=\frac{\Pi*P(D^2-d^2)}{4}$$

$$=\frac{\Pi*P(120^2-80^2)}{4}$$

$$=6283.1853\ N$$

Power Transmitting capacity

$$Mt=\frac{\mu F(D^3-d^3)}{3\,(D^2-d^2)}$$

$$=\frac{0.3(6283.1853)*(120^3-80^3)}{3(120^2-80^2)}$$

$$=95504.4165\ Nmm$$

$$Kw=\frac{2\Pi\, nMt}{60*10^6}$$

$$=2\,\frac{\Pi*n*95504.4165}{60*10^6}$$

Assume n=1000rpm

$$Kw=10.0011$$

B. Uniform Wear Theory

Operating force

$$F=\frac{\Pi*Pd(D-d)}{2}$$

$$=\frac{\Pi*1*80(120-80)}{2}$$

$$=5026.5482 \text{ N}$$

Power Transmitting capacity

$$Mt=\frac{\mu F(D+d)}{4}$$

$$=\frac{0.3(5026.5482)*(120+80)}{4}$$

$$=75398.2236 \text{ Nmm}$$

$$Kw=\frac{2\Pi nMt}{60*10^6}$$

$$=2\frac{\Pi*n*75398.2236}{60*10^6}$$

Assume n=1000rpm

$$Kw=7.8956$$

C. Diameter of shaft

Diameter of shaft=d

Shear stress for shaft material assumed to be 40MPa

$$T=\frac{Power*60}{2\Pi N}$$

$$=95504.4165 \text{ Nmm}$$

Also,

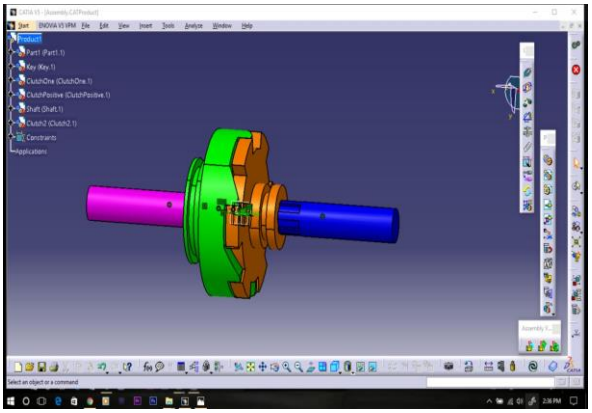
$$T=\frac{\Pi\tau (d)^3}{16}$$

$$d^3=\frac{95504.4165*16}{\Pi*40}$$

$$d=(12159)^{1/3}$$

$$d=22.99mm$$

d~=30mm



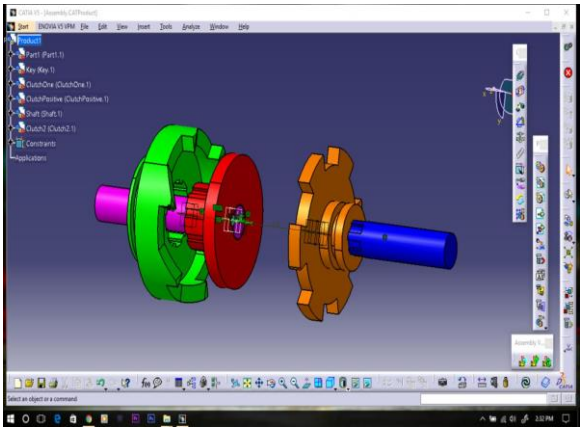


Fig 3:-CATIA model for Sandwich Clutch

V. ADVANTAGES AND DISADVANTAGES

Advantages

a) Improved high efficiency power transmission.

b) Both operating action of positive (jaw) clutch and friction plate clutch can be achieved.

c) When input and output shafts speeds are same one can turn to positive clutch from friction clutch.

d) During cruising condition positive clutching takes place resulting, no load of friction plate.

e) Since, only initial speeding and final speeding is done by friction.

f) Since intermediate clutching is performed by positive jaw clutch low heat losses.

g) Low friction plate wear.

h) Less frictional losses for intermediate clutching.

i) Low heat losses.

j) Initial engagement is done by friction clutch further, positive drive produced by means of interlocking teeth.

Disadvantages

a) Complex design.

b) System is Bulky.

c) Electronic circuitry is required.

d) Vital dynamic balancing is necessary.

VI. APPLICATIONS

It can be used for systems where moderate clutching is required with or without Transmission (gearbox).Can be used for many industrial machinery. Since in industries low or very moderate clutching is required. Can be used in CVT cars. Since in continuous variable train system the clutching is only required once. Also in Locomotives, since in locomotives train system the clutching is only required once for starting and stopping purpose For food processing industries. Can be used for frequent disengagement of machine part without switching off the main power supply motor.

VII. CONCLUSION

a. By this method of integrating two clutches one can get, both operating action of positive (jaw) clutch and friction plate clutch can be achieved.

b. In the following modification design clutch system the initial engagement is done by friction clutch further, the load of motion is transferred by means of positive drive produced by means of interlocking teeth.

c. Comparing this clutch system with respect to any other clutching methods power transmission capabilities are efficiently improved.

ACKNOWLEDGMENT

We wish to express our profound thanks to our project coordinator Prof. V. H. Shinde for helping us carries out literature survey and comparative study which have lead to our selection of Topic.

We are also grateful to the Head of Department, Mechanical Engineering at D. Y. Patil College of Engineering, Prof. Kumar for giving valuable attention and guidance..

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