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Flexible Coupling a New Approach

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ABSTRACT : *This paper presents the concept of flexible type of coupling for power transmission in light load conditions. In some cases of power transmission due to manufacturing limitations and/or misalignment at the time of installation, coupling may fail. It is observed that in power transmission flexible links are used in the form of belt loops. In such a design, belt subjects to shear failure. In present study belts are so mounted on flanges that it subjects to tensile load. In general it is observed that the strength of material is higher in tension than shear. In previous design of flexible couplings more axial space and material is required than the present design. For present coupling various types of belts are to be used as a flexible link in between two shafts. Various belts are selected and tested for coupling design; with this data of belt testing a flexible coupling is designed. Due to modifications in design and material selection 20 % weight reduction is achieved .This weight reduction not only reduces cost of coupling but will reduces installation and vibration problems. Radial distance also decreases by 25%.Connecting two flanges belt as a flexible element is used which reduces noise during power transmission. It will be used for single cylinder four stroke engines having rated power of 2.28 kW at 3600 rpm. This set up is being used for I.C. Engine lab. The concept originates due to frequent failure of rigid flange coupling.*

Keyword*: flexible Coupling, belt, weight reduction, misalignment, light load*

I. INTRODUCTION

A flexible coupling is a device which is use to connect two shafts for power transmission. Coupling Corporation of America [1] stated Flexible disk or ring pack couplings transmit force from one flange to another by tension in the rings from the bolts in one flange, to the bolts in opposing flange. The disks are separated from each other so that there is no sliding or no generation of heat. S.B. Jaiswal, M.D. Pasarkar [2] analyze coupling of different material which give satisfactory results. As in the analysis the failure occurred along the weld on the flange side. It is suggested that new material alloy steel can be used for better results. Lovejoy Torsional Couplings [3] uses highly versatile elastomeric element; that can allow parallel, angular, torsional and axial misalignment. It can sustain substantial shock and vibration capabilities. According to a technical report of VFD induced coupling failure [4], was generated for Kop flex KD disc Coupling. This is used to transmit torque and provide for both angular and axial misalignment. Shafts with a coupling comprised of shaft mounted hubs connected through flexible disc packs with spacer or sleeve assemblies. This type of couplings uses stainless steel discs as flexible members, providing high strength and good corrosion resistance for heavy load. Stephen Jesse, J. Wesley Hines, James Kuropatwinski, Andrew Edmondson, Thomas G. Carley[5], concluded in their paper that as the misalignment between the shaft increases it shows noticeable increase in the vibration and the generating temperature.

Literature cited revealed that for light load applications like lab testing setups, small power generator unit etc. there is scope for design and development of flexible coupling for maintenance free longer life. This type of coupling should be light, economical, easy to install, maintain and overhaul**.**

II. METHODOLOGY

The methodology includes use of flexible coupling having hub, flanges, bolts and belt. As the main theme of this project is to transfer load with the help of belts and flanges various belts were tested for their strengths and elongation for the various loads. Similarly some changes are made in the design of flange for the modification.

2.1 Belt Testing

Here in this project stage, 2 belts were tested on UTM (Universal Testing Machine) viz. polyester belt and nylon belt with the load step of 30 N. When the load was applied on the belts the main problem occurs is of slipping of belts.

The remedy for this problem is attachments of thick rubber pads. Rubber pads are attached in order to increase frictional resistance. After this again the test were taken and results are plotted as below:

2.1.1 Polyester Power Transmission Belt

Fig. 1 Polyester belt with rubber Pads for testing

The following is the graph plotted for the results obtained on UTM with load step of 30N and for the belt length as 500 mm without thick rubber pads at the ends. Whereas the average length of rubber pads is 57.5 mm.

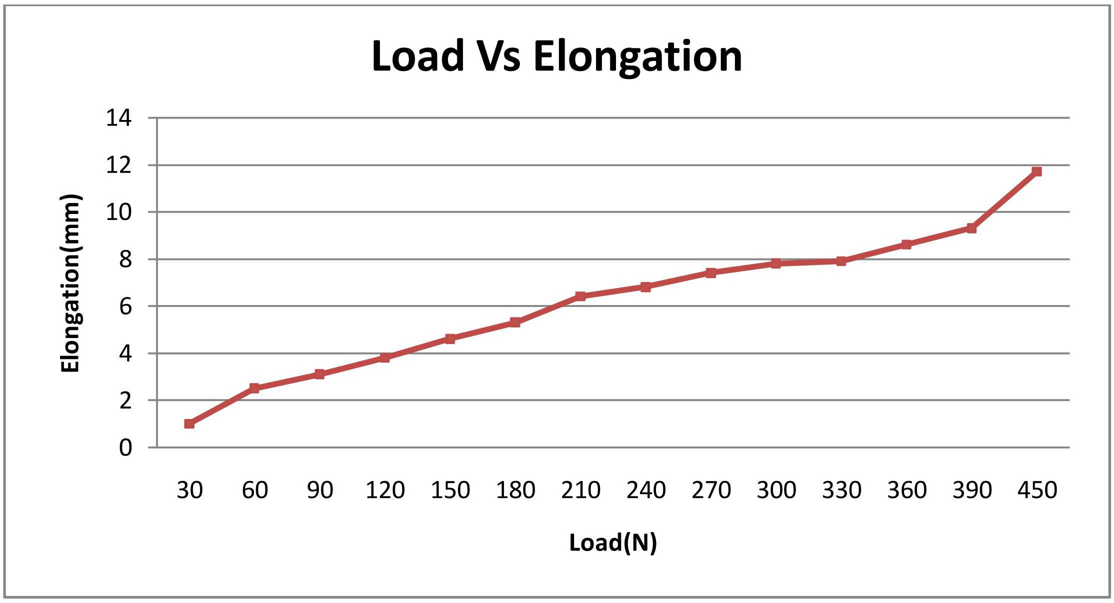


Fig. 2 Load Vs Elongation for Polyesters belt

2.1.2 Nylon Belt

While using nylon belts instead of single layer a double layer nylon belt is used for the purpose of high strength.

Fig. 3 Nylon belt with rubber pads used for testing.

The graph for two layer nylon belt for the testing using UTM is as given below for the belt length of 668.5 mm belt length without end rubber pads, whereas the average length of rubber pad is 65mm.

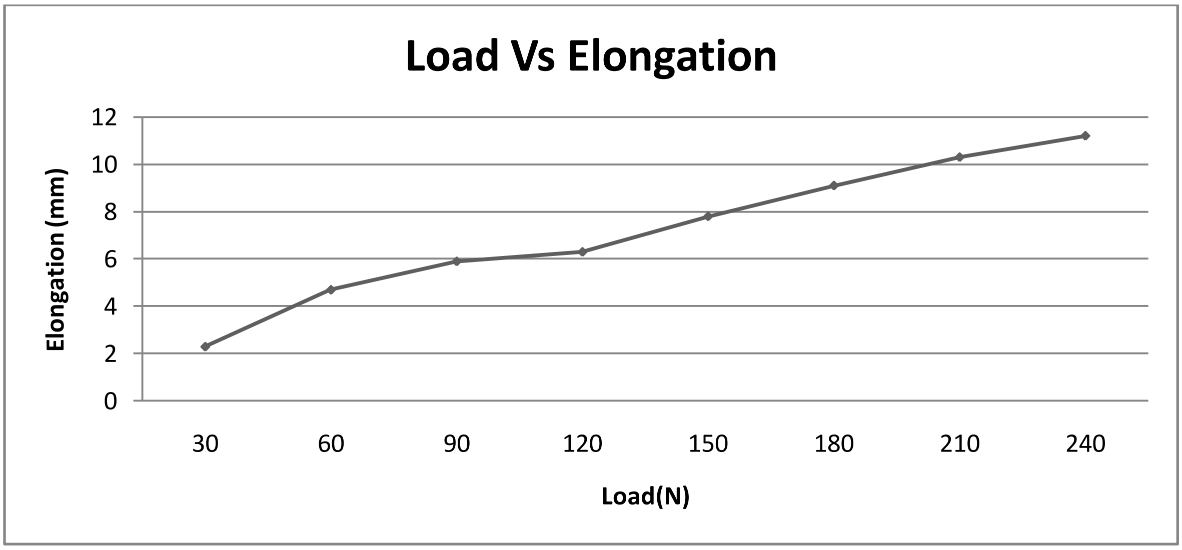


Fig. 4 Load Vs Elongation for Nylon Belt

From fig. 4 it is concluded that up to the load of 60N elongation is 0.31mm, which is negligible in regard of design of flexible coupling.

2.2 Flange Design

After testing belts the attention is paid towards design of flange for coupling. In this case both flange are taken identical and their respective dimensions are found by conventional design procedure. Keys and grub screws are selected from PSG Design Data Book. The dimensions obtained are as follows:

Diameter of shaft=d=28 mm (already known)

Inner Diameter of Hub=d= 28 mm

Outer diameter of hub=D=2d = 56mm

Length of Hub=L=1.5 d= 42mm

Width of key=w= 10mm

Thickness of key=t=8mm

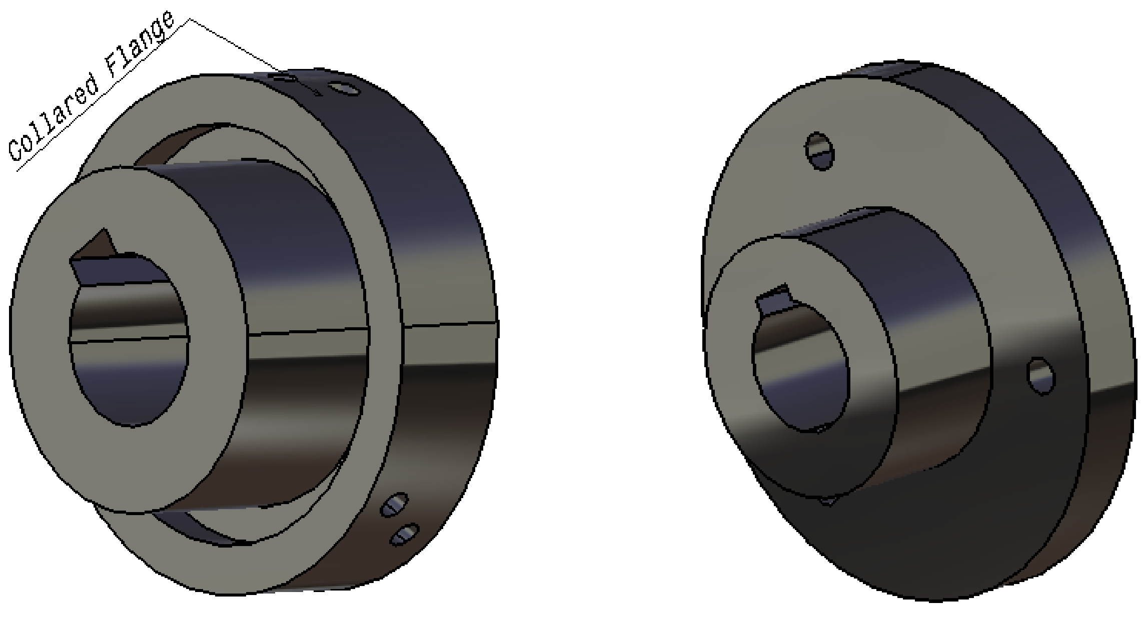
Length of key=l=L= 42 mm

Thickness of Collared flange (fig. 5a)=t_f = 21 mm

Outer diameter of flange=D_1=84mm

In conventional Pin-Bush type flexible coupling $4 \times d$ is the outer diameter of flange and $3 \times d$ is PCD. In present flexible coupling PCD of conventional coupling is considered as outer diameter of flange.

With the help of analytical design procedure hub, flange and keys are checked for safe design.



a. Modified coupling flange b. Conventional coupling flange

Fig. 5 Coupling Flanges

The total weight of conventional coupling was 2.86 kg while for present coupling it is 2.28 kg .Comparison shows weight reduction of 20%.This weight reduction not only reduces cost of coupling but will reduces installation and vibration problems. Radial distance also decreases by 25%.For connecting two flanges belt as a flexible element is used which reduces noise during power transmission. Attention is paid to impart better strength to the belts by providing metallic strips at fastening ends.
Rotational advance of driving shaft is 45^0 in comparison with driven shaft.3 belts are attached on the flange circumference as shown in fig. 8.

The details of flexible coupling are as shown in fig.6 and fig 7. Hexagonal headed bolts two on each flange, are so selected that it gives good fastening as well as minimum wear between belt and bolt. Two steel plates on each flange are attached with the help of slotted cheese head screw and spring washers for locking as shown in fig 6.Steel plates imparts strength at the fastening ends of the belt.

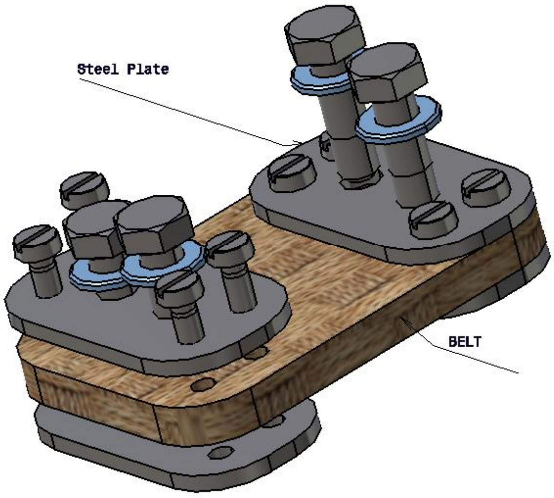


Fig. 6 Details of belt subassembly

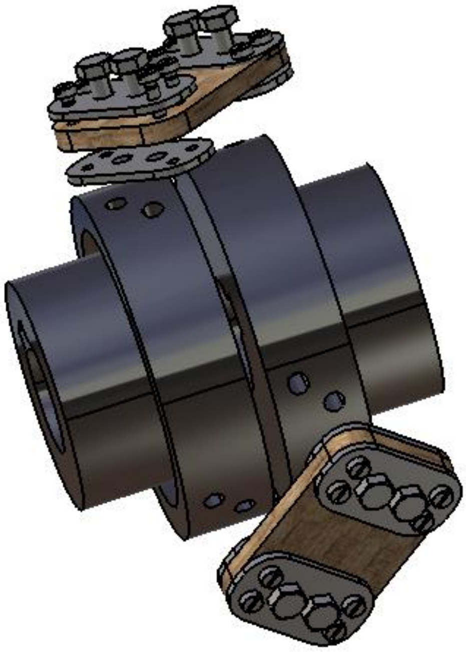


Fig. 7 Details of Flexible Coupling

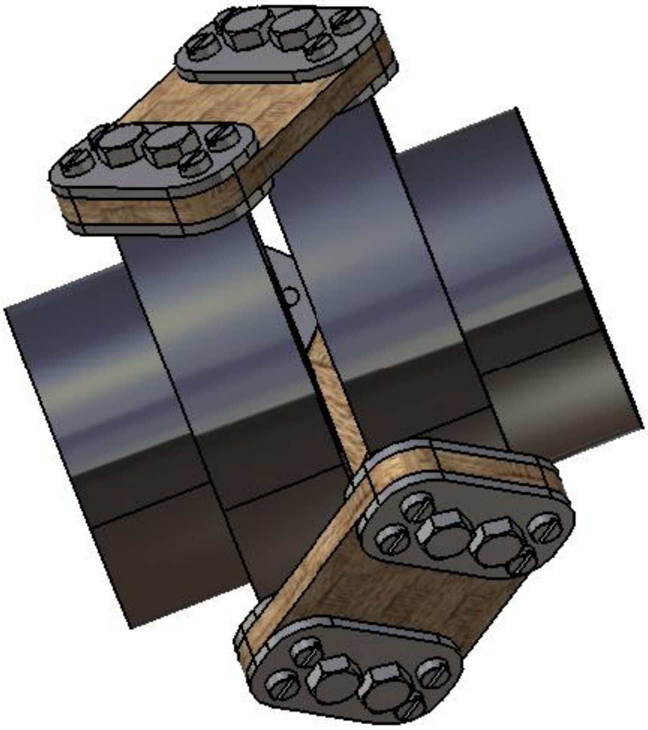


Fig. 8Assembly of Flexible coupling.

III. Conclusion

This coupling allows parallel, angular, torsional and axial misalignment. Modification in conventional coupling as a flexible coupling reduces its weight and radial space for installation considerably. As the inertia of coupling decreases so the performance will be better. During power transmission such coupling will be calm and quite. As there is no direct contact between two flanges so no problem of contact stresses as well as heat production. Also compared to previously available belt coupling the axial distance is reduced without compromise in its strength. And this coupling provide radial rigidity and angular flexibility.

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Nomenclature

UTM: Universal Testing Machine

d : Diameter of shaft (mm)

D : Outer diameter of hub(mm)

L: Length of Hub(mm)

w :Width of key(mm)

t: Thickness of key(mm)

l:Length of key(mm)

t_f : Thickness of collared flange(mm)

D_1 :Outer diameter of flange(mm)

PCD: Pitch Circle Diameter(mm)

LH : Left Hand.

RH : Right Hand