Krishna Veni/ Elixir Mech. Engg. 80 (2015) 31265-31266

Experimental work on PVC turbine blade of mill

Krishna Veni

Department of Mechanical Engineering, Bhubaneswar, Orissa, India .

ABSTRACT

The torque of the continuously variable transmission system with friction drive mechanism is transmitted by contacting roller with input and output disks. For the higher transmitted torque, it is necessary to apply large load in order to get higher friction force, which in turn generates severe high stress on the contact surfaces of roller and disks. The 'Toroidal' type CVT system has simple component arrays that have three contact points between roller and each input or output disk to get the torque transmitted. This work documents a successfully developed experimental model of a 'Toroidal' continuously variable transmission (CVT) by adjusting its geometrical configuration of CVT design and compared the experimental results of speed, torque and power delivered at the output disc with those obtained by a theoretical.

Introduction

Usage of CVT is especially in the automotive industry as they offer the potential for an improvement in fuel economy relative to discrete ratio transmissions. This arises from the ability to match the engine operating point more beneficially to vehicle requirements as a result of the continuous ratio range. The traction continuously variable transmission (CVT) drives has continued to be an object of considerable research interest within the mechanical design community, driven primarily by automotive industry's demands for more energy efficient and environmentally friendlier vehicles. An overview of the historical background of the continuously variable transmission (CVT) has been introduced [1-2], among them, primarily two types that are of interest in the automotive area, viz, half 'Toroidal' traction drives and full-'Toroidal' traction drives which are illustrated in figure1. The different characteristic in these systems is the shape of cavities in the power transmission elements [3-5]. Such traction drives rely on thin film of the traction fluid to transmit power. The thin oil film solidifies under high contact pressure [6]. The performance of the drive depends, to a large extent, on the maximum value of the Hertz stress in the contact areas, where the aspect, material properties, operating conditions, geometrical factors must be considered. The stress calculations for the contacts of the 'Toroidal' CVT for fatigue life analysis were performed by using Hamrock's method [7]. The present work attempts to study geometrical configuration of 'Toroidal' CVT design in order to determine the theoretical & experimental results of speed, torque and power delivered at the output disc.

Continuously Variable Transmission (CVT)

The continuously variable transmission (CVT) although a pretty new innovation to the automobile industries, the idea has been around since the 15th century when Leonardo Da Vinci sketches his version of a stepless continuously variable transmission. The main advantage and appeal of the CVT is the fact that there are infinite amounts of gear ratios between a maximum and a minimum (there are no gears in the CVT; however the term gear ratio is still used for what it represents).
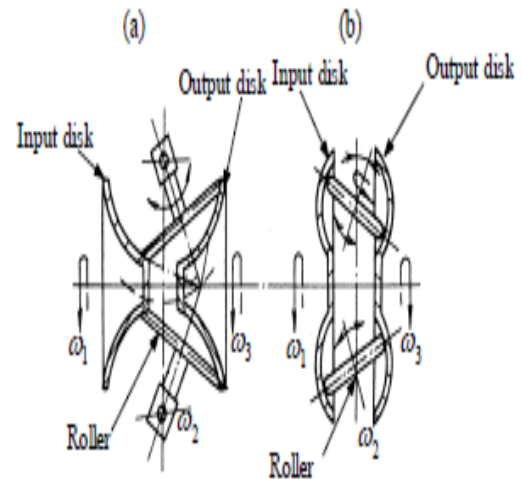

Figure 1. Configurations of 'Toroidal' traction drive CVT: (a) Half 'Toroidal' (b) Full 'Toroidal'

It provides better fuel economy, a smoother drive and more useable power than offered by an automatic transmission. With a CVT you never feel the transmission shift when driving and it changes adapting to the driving condition. The CVT operates on many different systems of which common types are variable-diameter system, 'Toroidal' system, and hydrostatic system.

Experimental Setup of C.V.T

The experimental setup of a 'Toroidal' continuously variable transmission (CVT) is shown in figure7. A 'Toroidal' CVT is made up of two disks on a central axle and a 'Toroidal' roller that transmits motion between them .Two discs are connected to each other through thrust bearing. The input disc is connected to the induction motor (3¢, 1hp, 1440rpm) through belt drive and the one opposite to it is the output disc. One power roller is kept over both the discs. This roller revolves around the vertical axis. When the axis of rotation of roller is perpendicular to the axis of rotation of discs, it contacts them at same-diameter locations and thus gives a 1:1 speed ratio. By tilting the handle of roller we can vary the speed as well as torque on output disc for same input speed. If the diameter in contact to output disc is larger, high torque and low speed is obtained at output. Reversely, if the diameter in contact to

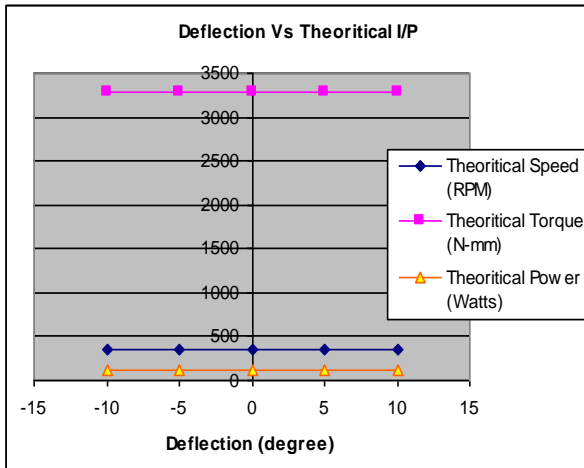output disc is smaller, low torque and high speed is obtained at output.

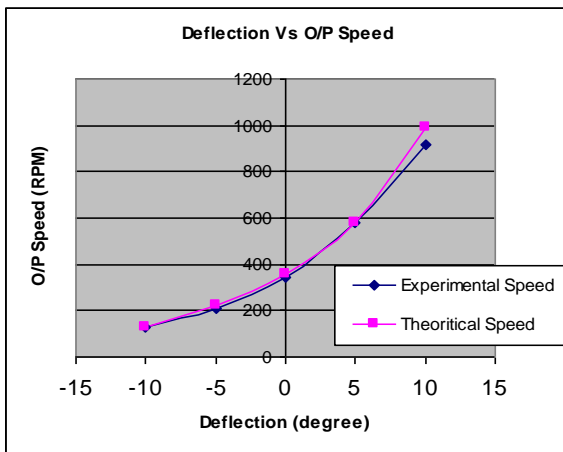**Figure 2. Theoretical Results of Input Disc**

Figure 3. Deflection Vs O/P Speed

Output disc is smaller, low torque and high speed is obtained at output.

Results and Discussion of CVT

Much of the existing literature is swift to confess that the automotive industry lacks a wide knowledge base regarding CVT whereas conventional transmissions have been continuously refined and improved since the very start of the 20th century, CVT development is just beginning. Theoretically it is found that on input disc the speed, torque & power are constant with respective of angular deflection of input disc as shown in figure8. The geometry like deflection & disc diameters are kept fixed on input and output disc as per table 1.

Theoretically & experimentally it is observed that on output disc, the geometrical configuration of disc affects results of output speed, torque & power as shown in figure 1-3.

Table 1. Geometry of output disc

Deflection θ^0	-10	-5	0	5	10
Diameter D_1(mm)	92	68	52.5	40	34

As communications is built up along with said knowledge base, CVTs will become even more prominent in the automotive industry. Even today's CVTs, which represent first generation designs at best, outperform conventional transmissions. Automakers who fail to develop CVTs now, while the field is still in its early years, risk being left behind as CVT development and implementation continues its exponential growth. Moreover, CVTs do not fall exclusively in the realm of I.C. engines. Currently it is used in numerous vehicles. Continual technology and material developments enhance feasibility. Environmental concerns and emissions regulations of fuels are CVT advancements. Because of these benefits CVTs are beneficial to use in future. In this it is targeted various geometrical configuration of 'Toroidal' CVT for development and demonstrated how well the new developments performed in a next-generation 'Toroidal' CVT mounted to a vehicle. We thus verified that real-world application of the next-generation 'Toroidal' CVT is highly possible.

References

1. Zhongtang R. et al 1999 Design & selection guidelines of mechanical Continuously Variable Transmission. Beijing: Published by Chemical Industry Press, pp2-10
2. Fredrick, W. III et al 1983. Traction Drives:Selection & Application . New York: Published by Marcel Dekker Inc., 28-119
3. Imanishi, T., H.Machida & H.Tanaka, 1996. A Geometrical Study of 'Toroidal' CVT, Comparision between Half 'Toroidal' & Full 'Toroidal's. SAE Paper No 9636411:107-111
4. Imanishi, T H.Machida, 2001. Development of power toros unit half 'Toroidal' CVT (2): Comparision between Half 'Toroidal' & Full 'Toroidal's CVTs. NSK Technical Journal.10 pp1-8. SAE Paper No9636411:107-111
5. Raghavan M. Kinematics of the full 'Toroidal' traction drive variator [J]. ASME Journal of Mech. Design, 2002 (124): 448-455.
6. Loewenthal S H, Anderson N E. Advances in traction drive technology [J]. SAE Journal, 1983: 921-934. Paper No. 831304.
7. Coy J J, Loewenthal S H, Zartsky E. Fatigue life analysis for traction drives with application to a 'Toroidal' type geometry [Z]. Nasa technical note, December 1975 (D- 8362): 1-31.