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Wooden Cone Type Continuously Variable Transmission

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Abstract *- In this paper, we designed and developed a wooden cone-type power transmission CVT. Continuously Variable Transmission (CVT) transmits power from the rotary motion of the wooden cone and obtain an infinite number of gear ratios between maximum and minimum values.*

Compared with the other mechanical transmission that gives us a fixed number of gear ratios, its transmission is more compatible. We used two wooden cone of required roughness in this, and the input shaft is maintained at a constant angular velocity. The driver cone transmits the power to the driven cone through the flat belt. This belt moves along the axis of the wooden cone. Due to this, different gear ratios can be obtained. We used a wooden cone because it is more economical and easily available, and also this transmission can also provide better fuel economy than another transmission.

Keywords - *CVT, Flat Belt, Gear Ratio, Wooden Cone*

I. INTRODUCTION

A Continuously Variable Transmission (CVT) is an unconventional type of transmission in which we can change gears steplessly with a continuous and infinite number of effective gear ratios in the designed limit. CVT provides flexibility in transmission by maintaining a driving shaft at a particular angular velocity at a specific range of output velocities. It also provides better fuel economy than another transmission by allowing the engine to run at the most useful RPM for a range of vehicle speeds.

Fig. 1 Wooden Cone Continuously Variable Transmission

The concept of CVT dates to 1940, when Leonardo da Vinci first conceptualized a step-less variant. Milton Reeves then invented one of the first variable-speed transmissions, which he used in the sawmilling machine in 1879. CVT saw significant developments during the 1940s and the 1950s.

Nowadays, many automobile manufacturers and customers have focused on CVT as a primary transmission compared to conventional manual gearboxes because it provides a smooth start, high fuel efficiency, good acceleration, and a wider torque range. Different pitch circle diameters of the input and the output gears in a conventional transmission system give different gear ratios. The infinitive number of different diameters of the input and the output cone results in continuous gear ratios in CVT. Many automobiles manufacturers use the CVT transmission like Audi, Ford, Honda, Nissan, etc. In cone CVT, we used two conical-shaped wooden rollers/pulleys, and power is transmitted with the help of a belt. The diameter of the two conical rollers is different. Therefore we get different gear ratios. CVT provides infinite gear ratios, and also it helps to reduce vehicle polluting emissions.

II. WORKING

In wooden cone CVT, we used two wooden cones of identical dimensions, and a flat belt was used to transmit power from the driver cone to the driven cone. This belt moves along the axis of a cone with the help of a nut and screw mechanism. Here small pulley is connected to a DC motor, and a big pulley is connected to the driver cone shaft. These two pulleys are connected by a V belt.

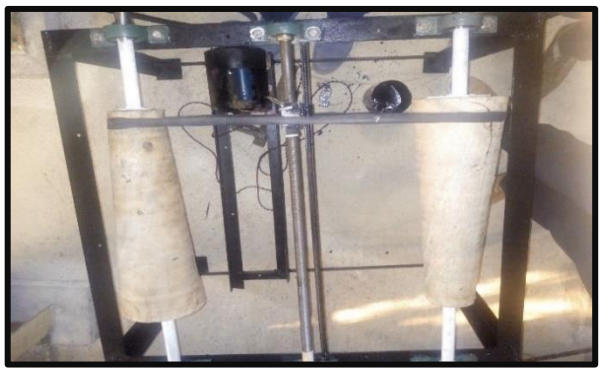

Fig. 2 CVT

When the DC motor starts rotating, it rotates the bigger pulley connected to the driver cone. As the driver cone starts rotating, it rotates the driven cone by means flat belt.

Here two cones of identical dimensions are arranged in an inverted manner. Initially, the belt is on the left side, i.e., in the smaller diameter of the driver cone and larger diameter of the driven cone. Now by using a tachometer, we measure the RPM of both cones. Driver pulley RPM is constant throughout the end.

Fig. 3 Nut and Screw Mechanism

Now, when the belt is in the middle position between two cones, the driven cone diameter has been reduced, and the driver cone diameter has been increased. Now we measure driven cone RPM. It has been found that the RPM reading has been increased from before reading. Similarly, when we displaced the belt towards the right, i.e., towards the small diameter of the driven cone, the RPM increased. According to the principle of belts and cones, when a larger cone rotates one revolution, then a smaller cone rotates more revolution based on its diameter.

III. OBJECTIVE

The main objective of CVT is to improve the efficiency by authorizing the engine to run at its optimum R.P.M, whatever the vehicle speed.

In the vehicles like low-speed special purpose, generally, RPM is set to achieve peak efficiency.

CVT gives efficient performance by maintaining the engine RPM at the level of peak power rather than efficiency.

The inverted cone-shaped gears provide many gear ratios for smooth transitions, which is important for the low-end torque required for initial tilling.

IV. METHODOLOGY

Leonardo's technologist gave the concept of the conical pulley in the 1490s, and our model is based on his concept. There are two wooden cone pulleys of similar dimensions. The two wooden cone pulleys are arranged in an inverted manner. A DC motor is used to drive a driver Cone, and the flat belt is used to drive a secondary cone.

V. DESIGN AND CALCULATION

Wooden Cone Diameter: - (D) = 150 mm DC Motor: - 1hp

(d) = 75 mm Speed: -1440 rpm

FIG. 4 Wooden Cone, Motor Belt and Pulley Arrangement

A. V BELT

To calculate tension in v belt we use basic belt friction formula

$$T1/T2 = e^{\mu\Theta\operatorname{cosec}\beta}$$

where $\Theta = 3.14$ rad; (Θ – Angle of contact)

$2\beta = 20$ degree; (β - angle)

$\mu = 0.1$; (μ - Coefficient of static friction)

$V = W \times R = 2 \times 3.14 \times 1440 / 60 \times 0.0254$

$V = 3.83$ m/s

$T1 = e^{0.1 \times \pi \times \operatorname{cosec}\beta} \times T2$

$T1 = 6.099T2$

Power is given by,

$P = (T1-T2) \times V$

$0.75 \times 10^3 = (6.099\ T2 - T2) \times 3.83$

$0.75 \times 10^3 = 5.099\ T2 \times 3.83$

$T2 = 38.404$ N

$T1 = 6.099 \times 38.404$

The tension in the belt,

T1 = 234.226 N

B. Flat Belt

The basic formula of belt friction for the flat belt is,

$T1/T2 = e^{\mu\Theta}$

where μ = 0.2 (μ - Coefficient of static friction)

Θ = 3.14 rad (Θ – Angle of contact)

V = 2x3.14x480.63 / 60 X 0.075

V = 3.77 m/s

T1 = 1.873 T2

Power is given by,

P = (T1-T2) x V

0.75 X 10^3 = (1.873T2 – T2) X 3.77

T2 = 227.879 N

T1 = 1.873 X 227.879

T1 = 426.818 N

C. Speed of Driver and Driven Cone Calculation

Speed of driver cone

N1 = 1440rpm

N1/N2 = D1/D2

1440/N2 = 152.2/50.8

N2 = 480.63rpm

Speed of driven cone at initial stage

N3/N4 = D1/D2

480.63/N4 = 150/75

N4 = 240.315rpm

Speed of driven cone at final stage

N3/N4 = D2/D1

480.63/N4 = 75/150

N4 = 961.26rpm

VI. ADVANTAGES

1) CVT allows an engine to run at its ideal RPM regardless of the vehicle's speed.

2) As there are 25% fewer moving parts to a CVT transmission, the production cost is lesser than conventional multispeed automatic.

3) It improves fuel efficiency, reduces fuel emission, and also gives better acceleration.

4) CVT gives infinite gear ratios and hence improves the performance of the vehicle.

5) CVT seamlessly changes the gear ratios without any ‘shift knock’ or delay.CVT eliminates the gear shifts of a manual transmission and the accompanying rise and fall of engine speed.

VII. DISADVANTAGES

1) Torque capacity is limited as compared to the manual transmission system.

2) Due to friction between belt and pulley, it causes greater wear.

3) The transmission fluid is a little expensive.

4) Becomes Jerky in automobile applications at slow speeds.

5) Slippage in the drive belt or rollers.

VIII. APPLICATION

CVTs have been used in aircraft electrical power generating systems since the 1950s and in SCCA Formula 500 race cars since the early 1970s. More recently, CVT systems have been developed for go-karts and have increased performance and engine life expectancy. The Tomcat range of off-road vehicles also utilizes the CVT system.

CVT is used in a small tractor for home, and garden use has simple rubber belt CVTs.Some drill presses and milling machines contain a pulley-based CVT

IX. CONCLUSION

We measure the speeds N1, N2, N3, N4 with the help of a tachometer, and the variations in speed are noted. Here the major outlook for the speed variation is the tensions in the belt and the type of cone we are using. At the start, torque is minimum, but when the belt returns, maximum torque is obtained. Greater fuel efficiency than both manual and automatic transmissions can be obtained. These CVT is cheaper and lighter than automatic transmissions and gives quiet and efficient comfort for driving. It is a generation of destiny with its higher fuel efficiency, infinite gear ratios, production cost, constant cruising speeds, and higher acceleration. As CVT development continues in the future, the cost is further reduced. CVT ultimately gives a solid foundation in the world’s automotive infrastructure.

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