International Journal of Advanced Smart Convergence Vol.11 No.1 87-93 (2022)
http://dx.doi.org/10.7236/IJASC.2022.11.1.87

IJASC 22-1-12

A Proprietary Model of Continuously Variable Transmission System using Spline

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Abstract

In each country, efforts are being made to replace engine-driven cars and motorcycles using fossil fuels with electric drive. Electrically driven vehicles have the advantage of no harmful gas or environmental pollution and low noise. In the motorcycle market, China accounts for more than 95% of the world, and the electric motorcycle market is being revitalized due to the strengthening of regulations. Japan is actively preparing to include electric motorcycles in ISO 26262, forming a TF team centered on electric motorcycle producers. Therefore, it is necessary to respond to standardization targeting China and Japan in Korea. In this study, we propose a proprietary transmission model that can be applied to small electric vehicles that can be operated in hilly domestic terrain. The proposed continuously variable transmission model is a continuously variable transmission system which moves the pin between the basic disk and the rotary disk using a spline to perform shifting. The proposed continuously variable transmission model is used in the pulley configuration by connecting the linear type spline and the inclined spline with the central axis of the basic disk and the rotational disk, respectively. In addition, it can be divided into two types according to the application of the auxiliary disk, and the production drawing is completed for the practical use of the model.

Keywords: *Continuously variable system, Pulley, Disk, Herical spline, Auxiliary disk*

1. Introduction

Generally, the transmission has the function of transmitting the driving force generated in the engine or motor to the driving wheel according to the state of the road and the will of the driver. The transmission includes a manual transmission device which directly selects the transmission terminal according to the will of the driver, an automatic transmission which automatically shifts according to the driving conditions of the vehicle. It is largely divided into the automatic manual transmission replaced by the electronic process by the automatic transmission and the continuously variable transmission in which shift is made between each shift without the shifting area.[1, 2, 3]

Continuously variable transmissions maintain maximum engine torque and thus are recognized to have

Manuscript Received: February. 10, 2022 / Revised: February. 14, 2022 / Accepted: February. 17, 2022
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better fuel efficiency than regular automatic transmissions. In theory, the continuously variable transmission is known to have a better fuel efficiency of 30% or more than the automatic transmission, and since the gear ratio changes continuously, it is possible to drive smoothly without transmission shock. Figure 1. shows the principle of a typical continuously variable transmission.[4, 5, 6]

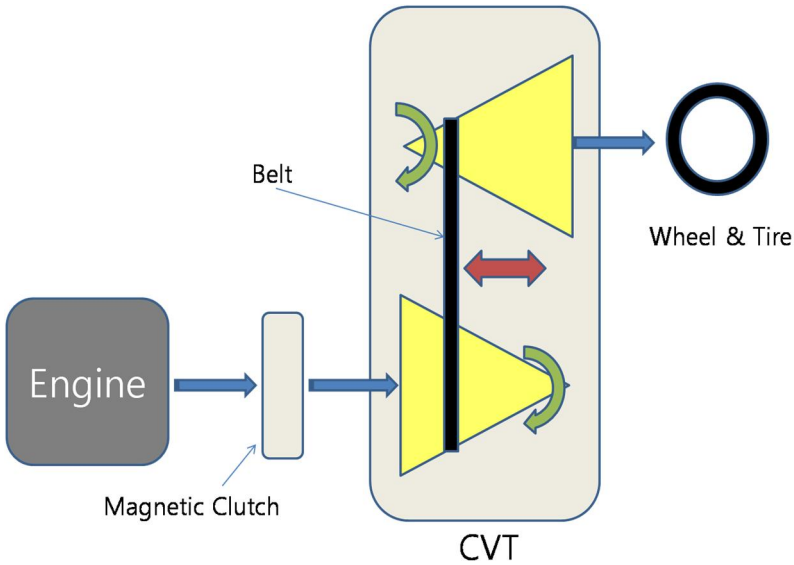


Figure 1. Principle of CVT

According to the continuously variable transmission is the power transmission media, it is divided into the belt type, chain type, toroidal type and hydraulic etc. The belt type was commercialized as a continuously variable transmission for medium and small passenger cars, but it has a disadvantage that it can not be applied to medium and large vehicles because of low transmission ratio and transmission torque. Continuously variable transmissions applicable to medium and large vehicles have difficulty in commercialization despite the good transmission performance due to problems with lubricant that generates traction force by toroidal type.[7, 8, 9. 10, 11, 12] In this study, we propose a continuously variable transmission system model using a pulley using spline. The proposed model is divided into two types according to whether the auxiliary disk is applied or not. Moreover, the belt or the chain can be applied to the power transmission medium. It is applicable to the medium and small passenger car or the electric scooter and bicycle.

2. A proprietary model of a continuously variable transmission system using spline

The continuously variable transmission system consists of driving pulley and driven pulley on the operation structure. These should be rotated and the shift function should be performed. The proposed continuously variable transmission system is equipped with a linear type spline and a inclined spline on the central axis of the pulley, and two disks are installed to guide the movement of the power transmission medium. In addition, the sliding pin is placed between the two disks to be interlocked. The basic configuration of the continuously variable transmission system pulley using spline is the same as Figure 2. Figure 2. shows components of pulley using spline. And it is composed of the basic disk in which the slot is formed and the rotary disk, and the sliding pin connecting the basic disk and rotary disk. The chain or the timing belt etc. are left on the sliding

pin and the power transmission can be done. In order to perform shift, the rotational disk is rotated and the location of the sliding pin is changed. The linear type spline and the inclined spline are interlinked to the central axis of pulley and it constitutes. If the central axis is moved the axis, the rotational disk arranged on the inclined spline is rotated and the structure of altering the pitch radius.

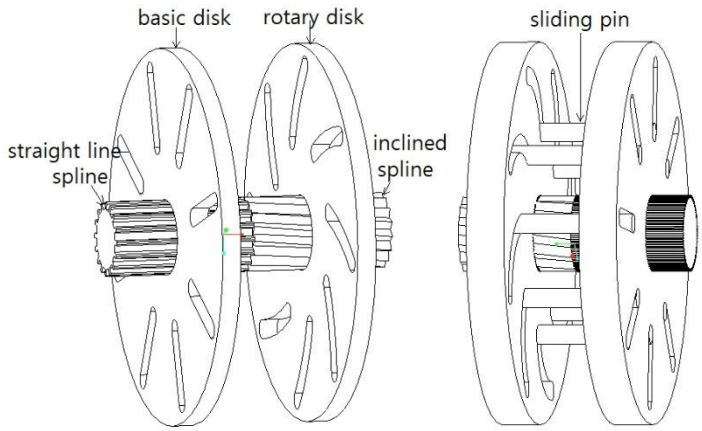
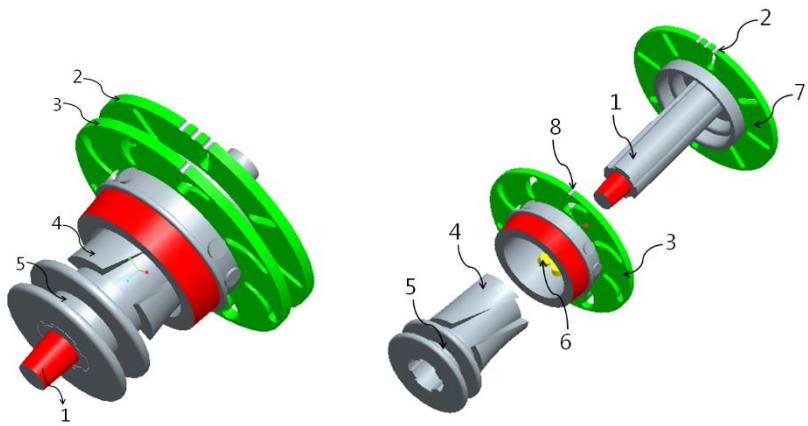


Figure 2. Continuously variable system pulley using spline

According to the continuously variable transmission system using spline is component, it can be composed of two kinds. First, the main axis of the spline is the main axis of the basic disk and the rotation disk is installed. Second, the central axis is splined, and the auxiliary disk and the link are placed between the basic disk and the rotation disk.

2.1 Continuously variable transmission system consisting of basic disk and rotational disk

The proposed continuously variable pulley has a linear type spline and a inclined spline with a central axis, and the structure commercialized in consideration of this is like Figure 3. The inclined spline, that is, the helical spline, is placed on the central axis of the pulley, and the bearing is installed in the direction in which the helical spline can move so that the rotational disk can be easily moved.



1: center shaft of pulley 2 : slot of basic disk 3 : rotary disk 4 : herical spline
5 : shift pork sleeve 6 : bearing 7 : basic disk 8 : slot of rotary disk

Figure 3. Commercial diagram of the continuously variable pulley using spline

When the chain is applied as a power transmission medium in the proposed continuously variable transmission system, the cross section of the sliding pin must be sprocket-shaped. Figure 4. represents a sprocket-shaped sliding pin.

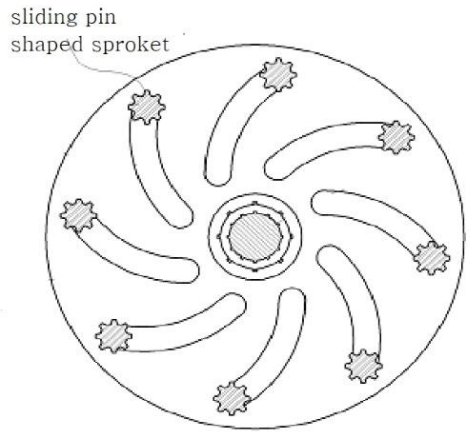


Figure 4. Disk with sprocket-shaped sliding pin

In the pulley using spline the basic disk and the rotary disk is formed slot. If the seating groove is left in this slot, the shift step can be had as the number of grooves. The transmission process of the disk in which the slot establishing the seating groove is installed is as follows.

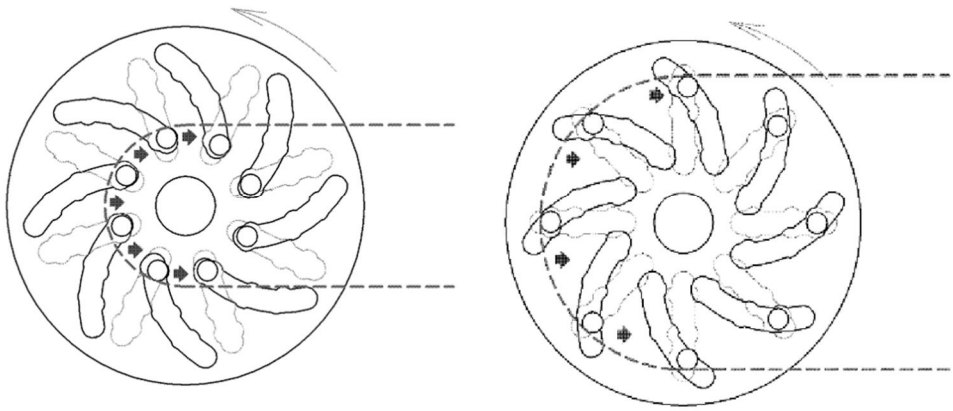


Figure 5. A change speed of disk equipped safe receipt groove

In the pulley applied the basic disk and rotary disk in which the seating groove is installed the shift ratio can be secured gradually. The length of the circumference according to the change of radius of rotation and the chain pitch by the chain specification should be considered in the seating groove design.

2.2 Continuously variable transmission system establishing the auxiliary disk between the basic disk and rotational disk

The model using the auxiliary disk in the continuously variable transmission system using spline is the form in which the auxiliary disk connected between the basic disk and rotational disk to pulley with the rotational disk is hinge-jointed. The link connected to the slot is established. The auxiliary disk and the link connected

with the rotational disk are the same as those of Figure 6. The shifting process of the continuously variable transmission pulley applying the auxiliary disk and link is the same as Figure 7. The auxiliary disk and link are connected to the rotational disk. And both sides of the sliding pin interlinking the end part of link to the sliding pin can move according to the basic disk and rotational disk slot. This form can induce stable movement of sliding pins moving along the slot.

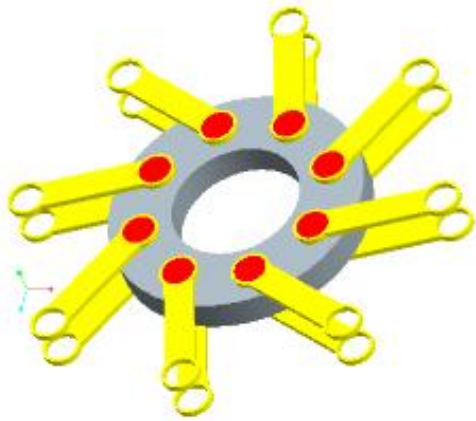


Figure 6. Auxiliary disk and link

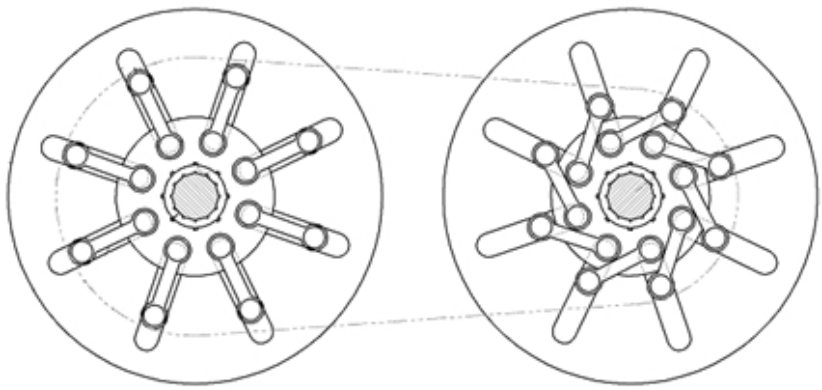


Figure 7. Driving pulley and driven pulley using auxiliary disk and link

3. Commercialization of Continuously variable transmission system using spline

According to the continuously variable transmission system using spline is the application whether or not of the auxiliary disk and link two disks and sliding pins, it can compartmentalize into the basis into 2 kinds form. The structure of the continuously variable transmission system of 2 kinds is as follows.

3.1 The continuously variable transmission system consisting of the basic disk and rotational disk

The overall configuration of the continuously variable transmission system in which the sliding pin is arranged in the driving pulley and the driven pulley applying the pulley in which the slot of the linear type is installed in the basic disk, and the slot of the arc form in the rotational disk is the same as Figure 8. In the above continuously variable transmission system, the driving pulley can adopt an engine or motor as a driving

source, and push or pull a gearshift using a shift fork for shifting to perform shifting. If the pitch radius of the driving pulley is large, the pitch radius of the driven pulley should be small. To do this, the shapes of the helical spline should be crossed, and the shapes of the rotational disk should be different.

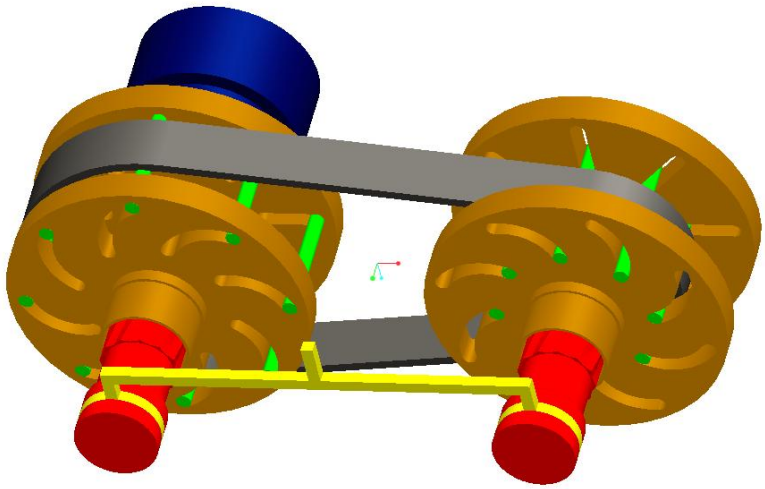


Figure 8. Assembly diagram of CVT using spline

3.2 The continuously variable transmission system using the pulley adopted the auxiliary disk and link

The spline, the basic disk and rotational disk are based, the continuously variable transmission system attaching to the auxiliary disk and link of form is as follows.

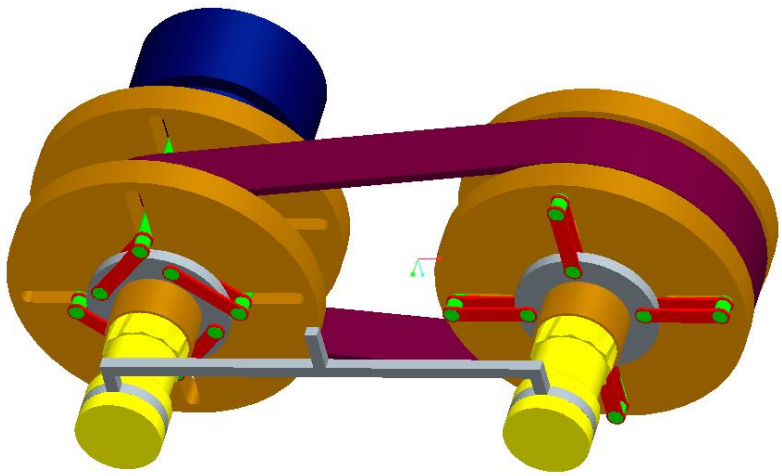


Figure 9. Assembly diagram of CVT using spline equipped auxiliary disk and link

Figure 9. is connected by a sliding pin with a basic disk and a rotary disk having the same slot. The end of the sliding pin is connected to the link and the end of the link must be hinge-jointed.

4. Conclusion

In this study, we propose a model of a continuously variable transmission system using a pulley adopted spline, and the proposed model is divided into two types according to whether the auxiliary disk is applied or not. In addition, the power transmission medium can be applied to a belt or chain, thereby being applied to a medium-sized passenger vehicle or an electric scooter, a bicycle, and a small electric vehicle. As a result of the study that proposes the proprietary model for the continuously variable transmission system using the pulley adopted spline, the following results were obtained.

1) The seating groove is established in the slot of the basic disk and rotary disk and then the gear ratio can be secured gradually.

2) When installing a link with a pulley, the end of the sliding pin is connected to the link, and the end of the link is hinge-jointed.

3) When the chain is applied as a power transmission medium in the proposed model, the cross-sectional shape of the sliding pin should have the shape of a sprocket.

4) The proposed model can be commercialized by applying shift fork.

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