

A Study on the Application of Shiftable Pulley of Power-train for Bicycles Using Belt

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Abstract

A bicycle is an eco-friendly vehicle that does not emit harmful exhaust gases that pollute human beings or the earth, and is used for leisure or sports by exerting an exercise effect on the human body while a person rides a bicycle. Chains and sprocket wheels have long been used as power-trains for environmentally friendly and human-friendly bicycles. In this study, a new type of power-train device that can be applied to the center of the wheel of a bicycle using a belt and a pulley capable of performing a shift function is described. A method of applying a pulley capable of performing a shift function to a wheel of a bicycle depends on the type of a bicycle to be adopted. Bicycles that do not require a shift function, bicycles that require only one of the front and rear wheels, and front and rear wheels are all applied. The application of pulleys with shift function to these various types of bicycle wheels was studied.

Keywords: *Shifting, pulley, belt, power-train, tensioner*

1. Introduction

Currently, the common topic in each country is climate change, which is known to be caused by global warming, and mankind is experiencing catastrophic climate change, not daily climate such as floods, droughts, and typhoons due to global warming. Among the various causes of climate change are polluted emissions from vehicles such as automobiles, and countries are spurring research on eco-friendly means of transport that do not emit emissions that cause climate change[1, 2]. As one of the results of the research, we are developing and supplementing electric vehicles, electric motorcycles and electric bicycles that use batteries charged with electricity instead of fossil fuels. Regular bicycles that do not use fossil fuels or batteries do not emit exhaust gases that pollute the atmosphere[3, 4]. Rather, the exercise effect is occurred in the human body and help is given to the health. Bicycles have been studied for a long time on the change of saddle shape, frame shape and material change. However, in the field of power-trains devices, the use of chains and sprocket wheels has continued for a long time, and for this reason, some companies occupy too much market share[5, 6].

Manuscript Received: November. 11, 2024 / Revised: November. 18, 2024 / Accepted: November. 24, 2024

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In this study, in the power-train system of a bicycle using a belt as a power transmission medium, when a pulley having a shift function is installed at the center of the front and rear wheels of a bicycle, when only one of the two wheels is selected and applied, and when the shift function is not given in a low price or shared bicycle, the application method of the shiftable pulley is studied[7-10].

2. The power-train for the bicycle of the unique model

A bicycle with a power-train device using a power transmission medium as a belt and a pulley capable of shifting is shown in Figure 1 [7].



Figure 1. The bicycle equipping the proposed power-train adopting the belt

In Figure 1, the structure of the shiftable pulley applied to the center of the front and rear wheels of the bicycle is as shown in Figure 2[7, 8].

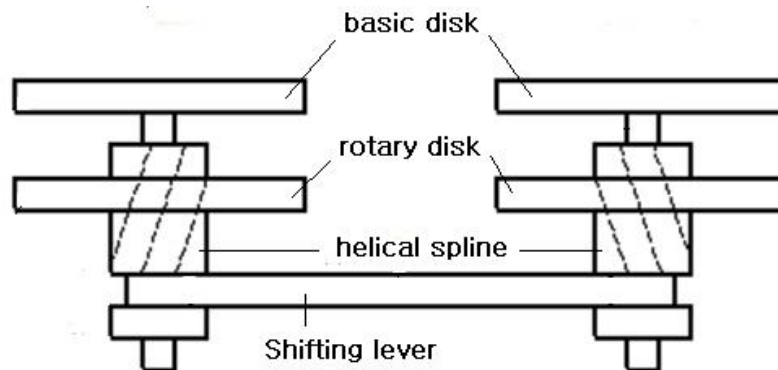


Figure 2. Pulley of power-train for bicycle used belt

The proposed new model of the bicycle power-train uses a belt as a power transmission medium, and the driving pulley and the driven pulley are equipped with a basic disk and a rotary disk. By using the power of the power source which becomes milder since the power source of bicycle is man or the motor, the rotational motion is made. In order that the rotational motion by the driving source is transferred, the central axis of

pulley establishes the spline of the linear type. Moreover, in order that shift is proceed, the helical spline moving shaft is established. The helical spline moves in the axial direction to induce rotation of the rotary disk to change the pitch radius of the sliding pin connected to the rotary disk and the basic disk[7-10]. A power-train device without a shift function may be used for a shared bicycle or a low-cost bicycle. A power-train device without a transmission function does not require a helical spline for transmission and a slot formed on the basic disk and the rotary disk in the proposed model, but a pulley structure capable of interlocking with a belt, which is a power transmission medium, is required. A pulley with a shift function can be applied to the center of the front and rear wheels of the bicycle at the same time, or it can be applied to only one of the front and rear wheels. In this study, the application of a shiftable pulley to the center of the wheel of a bicycle is described.

3. Application of shiftable pulley

The pulley structure of the power-train for bicycles proposed in this study is shiftable, but low-cost bicycles, including shared bicycles, do not have shift functions. In this chapter, we describe the application of the proposed pulley to the power-train of a bicycle that does not have a shift function, the application of a shiftable pulley to the center of the front and rear wheels, and the application of a shiftable pulley to only one wheel.

3.1 Application of pulleys without shifting function

It is common for shared bicycles and low-cost bicycles, which are commonly found on roads, to have no shift function. In the form of the power-train structure of these bicycles, the pulley of the pedal part is large and the pulley installed at the center of the rear wheel is small. In consideration of this, the figure of the power-trains device applying the pulley proposed in this study is shown in Figure 3.

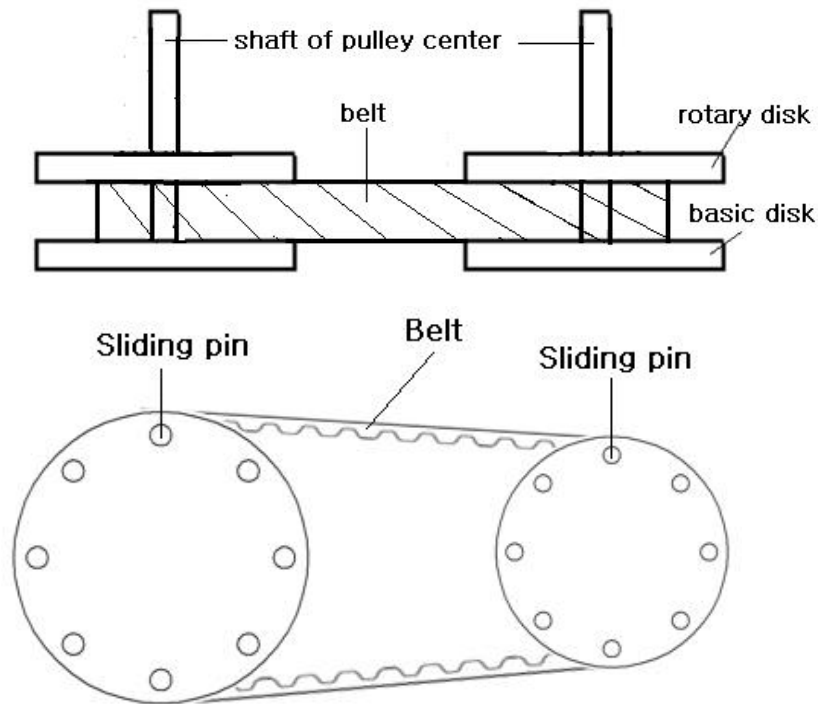


Figure 3. Power-train of bicycle without shiftable pulley

Since the belt is used as a power transmission medium, the configuration of the pulley must consist of components that can be inter-locked with the belt.

3.2 Application of two shiftable pulley

The shape and structure of the power-train applying the pulley capable of shift to the wheel center of bicycle two are as shown in Figure 4.

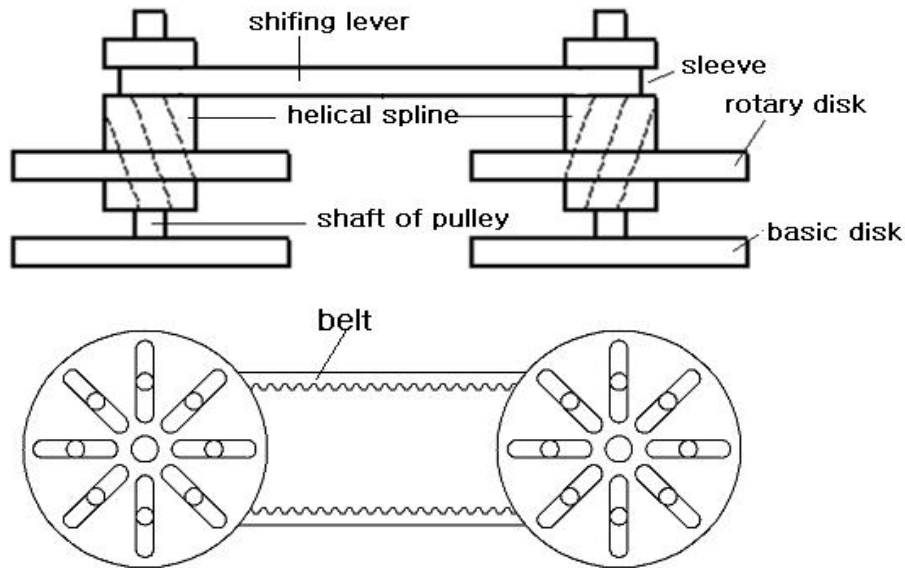


Figure 4. Power-train for bicycle with two shiftable pulleys

The pulley capable of the shift mounted on the bicycle front-wheel and rear wheel center of Figure 4. uses the power transmission media and power is delivered. The shift function performs with the demand of the operator. At this time, the shifting lever is run to the means for performing shift. It is connected to shift pulleys installed at this shifting lever is the front · rear wheel center.

3.3 Application of one shiftable pulley

The pulley structure of the power-train proposed in this study can perform the shift function by the helical spline. The shape of this pulley mounted on only one of the front and rear wheels of the bicycle is shown in Figure 5.

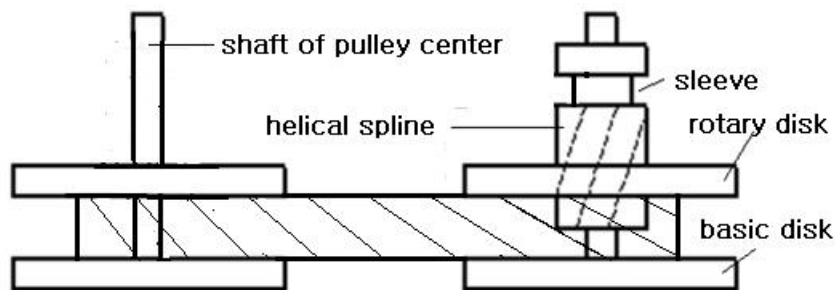


Figure 5. Power-train for bicycle with one shiftable pulleys

The structure of Figure 5. can be classified into two types. The case of applying the pulley capable of shift function to front-wheel, or the case of applying to the rear wheel. In general, in the case of a shared bicycle or a shared electric bicycle, the size of the pulley applied to the front wheel is large, and the pulley applied to the rear wheel is small. When the shiftable pulley is applied only to the rear wheel, the belt pitch radius of the rear wheel changes due to shifting, but the diameter of the pulley mounted on the front wheel does not change, which may cause sagging or expansion of the belt. At this time, the tensioner can be used to maintain the tension of the belt constantly. The power-train device of the bicycle with the tensioner is shown in Figure 6. In the figure, the tensioner is installed on the outer part of the belt. This is because the pitch is formed inside the applied timing belt.

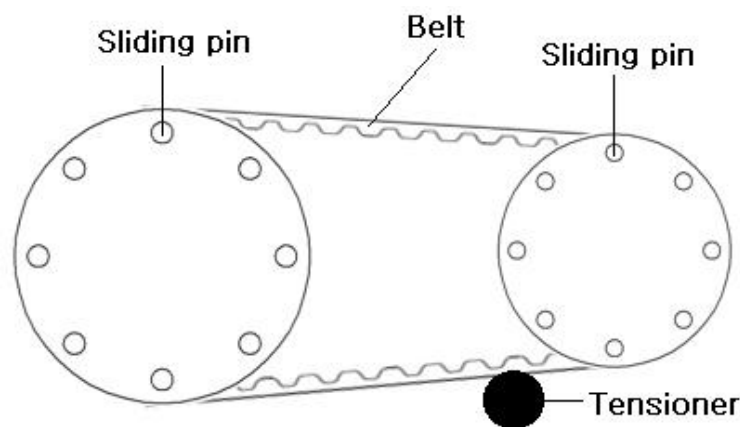


Figure 6. Power-train for bicycle with with tensioner

4. Conclusion

In the power-train of a bicycle, the core configuration is a pulley installed at the center of the front and rear wheels, and a shift function can be given according to the released configuration. Bicycles currently on the market are classified as shiftable and not. In this paper, we propose a structure that uses a belt as a power transmission medium and applies a pulley with a shiftable structure to the center of the front and rear wheels of the bicycle. The following results were obtained by studying the method of applying a shiftable pulley to the wheel of a bicycle.

(1) When a shiftable pulley is applied to the center of the front and rear wheels of the bicycle, the shift lever may be operated to perform shifting.

(2) When the shiftable pulley is applied to only one of the front and rear wheels of the bicycle, it is preferable to use a tensioner in consideration of the expansion and contraction of the power transmission medium.

(3) When the proposed pulley structure without shift function is applied to the center of the front and rear wheels of the bicycle, components capable of inter-locking with the belt should be provided.

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