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Synchronous Belt Drive for Power Transmission in Geared Motorcycles

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Abstract: *The most commonly used power transmission used in most of the two wheeled motorcycles are chain drives owing to its low cost and reliability. However, chain drives demand frequent maintenance, cleaning and lubrication. Although alternatives to chain drives such as synchronous belt drives and shaft drives are available, they are mostly seen in high-end motorcycles. This paper explores the effects of replacing chain drive in 100 cc Single stroke geared motorcycle with Synchronous Belt Drive mechanism.*

Keywords: *Synchronous belts, power transmission, two wheelers, belt drives, motorcycles*

I. INTRODUCTION

Nowadays, competition and customer demands in the automotive field is increasing and the industry has to keep up to meet requirements while at the same time focusing on the safety, economy and regulations. This has led to optimization as well as implementation of newer design in automobiles in considerably shorter span. As far as power transmission for automotive applications is considered, much effort has been extended in recent times on studying the life, noise and vibration characteristics of the transmission. However, the solutions proposed are not widely accepted partially because of higher costs involved and thus deterring the manufacturers to compromise in order to capture higher market share by keeping overall cost of the motorcycle low.

The major issue modern power transmission system using the chain drive faces are that the system needs to be cleaned and lubricated every few thousand kilometres to protect chain from getting dirty, rusted and dysfunctional, which would effectively result in reduction of life time. However, chain drives are preferred because of little power loss and capability to handle high torques. Another major drawback of chain drive is in case of wear of sprocket teeth or breakage of chain it would result in to rear wheel lock up. The cost of replacement of chain and sprocket drive is much higher, and entire chain needs to be replaced in event of loosening, breakage or deformation of individual links.

The lesser explored alternative to the chain drive is belt drive system. The use of simple belt drive would be inefficient as it would have higher power transmission loss. Hence usage of toothed/synchronous belt drive is preferred. Synchronous belts operate through engagement of belt teeth in grooves of the pulley resulting into transmission of torque because of combination of tooth loading and friction. The flexibility of belts allows them to absorb large shock loads as well as less moving parts results in lower chances of failure. The usage of belt drive would result in smoother and linear power transmission to rear wheel as compared to the chain drives. Unlike chain drive, the belts are easier to maintain as they do not require regular cleaning and degreasing. However, loss of power transmission is higher as compared to the chain drives but the belt drives are safer option because if in case of breakage of belt, the rear wheel wouldn't get locked but would be in freewheel state, thus avoiding a potential life-threatening mishap at high speeds.

II. EXPERIMENTAL SETUP

For experimentation, the motorcycle used is Hero Honda CD 100SS. After initial analysis of power transmission, the performance and design characteristics of chain drive components were obtained. (Table-I).

Table I: Chain Drive Parameters

Pitch of chain	12.7 mm
Roller diameter of chain 7.92 mm	7.92 mm
No. of teeth on pinion sprocket	14
No. of teeth on rear sprocket	44
Pitch diameter of pinion sprocket	52 mm
Pitch diameter of rear sprocket	133.5 mm

Circular pitch for pinion sprocket	11.67 mm
Circular pitch for rear sprocket	12.49 mm
Transmission ratio	3.142
ANSI chain number	40
Number of chain links	108
Required Power rating of chain	6.75 KW
Maximum torque transmission capacity	25.87 Nm

The total torque and power transmitted by chain drive was obtained by using standard calculations and based on which design of synchronous belt drive was carried out such as that changing of drive does not affect the overall performance characteristics of the motorcycle. The major components designed are front and rear sprockets, timing belt and the belt tightening mechanism. Based on rated torque characteristics of drive components based on ANSI standards and available manufacturers catalogue, the belt (Table II) was selected.

TABLE III: SELECTED BELT PARAMETERS

Selected pitch	8 mm
Number of teeth on front sprocket	25
Pitch diameter of front sprocket	63.66 mm
Number of teeth on rear sprocket	80
Pitch diameter of rear sprocket	203.72 mm
Calculated length of belt	1416.04 mm
Actual length of belt according to standard	1424 mm
Number of teeth on belt	178

The material of belt is vital for power transmission characteristics, noise and vibrations, and life expectancy of the belt. Based on the intended use, that is to transmit high torque at high speeds without significant distortion the type of belt selected is HTD (High Torque Drive) belt. The teeth of HTD - timing belts are curvilinear and shear-resistant to be precise. The tooth geometry ensures optimal meshing of the belt teeth in the timing belt pulleys and hence uniform load distribution.

With wear the slackness is induced in the belt. For the compensating the slackness of the belt with use, a tightening mechanism was designed which uses a double nut mechanism to enable the movement of a link consisting of a bearing which is free to rotate on the shaft. Tightening or Loosening of the nut allows to and fro motion of the link which results in loosening and tightening of the belt respectively. The mechanism is shown in the Figure 1 and Figure 2.



Figure 1 Belt Tightness Adjusting Mechanism



Figure 2 Overall Mechanism

III.CONCLUSIONS

After converting chain drive to timing belt drive following conclusions were obtained:

- A. The approximate life expectancy of chain-sprocket in motorcycles is between 2-2.5 years. Whereas in belt drive, only belt needs to be replaced after 2 years. Relatively cheaper and infrequent maintenance.
- B. For higher torque and power larger diameters are preferred, as for a given belt tension force, the larger the pulley, the larger the torque and hence the greater the power for a given speed. Thus in comparison with the chain drive diameter of pulley required is larger.
- C. After conversion of chain drive to belt drive, there was no significant change in mileage of the motorcycle.
- D. No changes in the noise and vibration characteristics were observed.

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