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Power Transmission Through Timing Belt In Two Wheeler Motors

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Abstract
This paper studies the effect of noise and friction on performance of the chain drive system for motor bikes. Experiment shows that chain transmission in chain drive system leads to poor overall performance, due to its noise and chain gets loose due to aging and sprockets wear due to chain friction etc., the proposed system consists of drive and driven pulley with timing belt transmission. Compared to conventional method, proposed method give improved tension in pulleys and belt by the additional arrangement called belt tensioner. This gives good overall performance of the system, and reduces noise, vibration and gives high transmission speed.
Keywords: Timing belt, Transmission system, Belt drive.

I. INTRODUCTION

Timing belts are parts of synchronous rive which represent an important category of drives. Characteristically, these drives employ the positive engagement of two sets of meshing teeth. Hence, they do not slip and there is no relative motion between the two elements in mesh. Due to this feature, different parts of the drive will maintain a constant speed ratio or even a permanent relative position. This is extremely important in applications such as automatic machinery in which a definite motion sequence and/or indexing is involved.

The positive nature of these drives makes them capable of transmitting large torques and with standing large accelerations. Belt drives are particularly useful in applications where layout flexibility is importan. They enable the designer to place component sinmo read vantageous locationsatlarger distances without payinga price penalty. Motors, which areusually thelargesthea tsource, can be place daway from the rest of the mechanism. Achieving this with a gear train would represent anexpensive solution.

Timing belts are basically flat belts with a series of evenly spaced teeth on the inside circumference, thereby combining the advantages of the flat belt with the positive grip features of chainsandgears.There is no slippage or creep as with plain flat belts. Required belt tension is low, therefore producing very small bearing loads. Synchronous belts will not stretch and do not require lubrication. Speed is transmitted uniformly because there is no choralrise and fall of the pitch line as in the caseofrollerchains.

II. CONSTRUCTION & WORKING

Belt Construction

The load-carrying elements of the belts are the tension members built into the belts. These tension members can be madeof:

1. Spirallywoundsteelwire.
2. Woundglassfibbers.
3. Polyestercords.
4. Kevlar.

The tension members are embedded in neoprene or polyure thane. The neoprene teeth are protectedbyanylonfabricfacingwhichmakesthemwear resistant.Thecontributionsoftheconstructionmembers ofthesebeltsareasfollows:

1.TensileMember–Provides high strength, excellent flex life and higher sistance to elongation.

2. NeopreneBacking –Strong neoprene bonded to the tensile member for protection against grime, oil and moisture. It also protects from frictional wear if idlers are used on the back of the belt.

3. Neoprene Teeth– Shear-resistant neoprene compound is melded integrally with the neoprene backing. They are precisely formed and accurately spaced to assure smooth meshing with the pulley grooves.

4. NylonFacing–

To ughnyl on fabric with alowco efficient off riction covers the wearing surfaces of the belt. It protects the tooth surfaces and provides a durable wearing surface for long service

Material Selection

1. Chloroprene
2. Fibber glass cord
3. Polyester
4. Kevlar

Polyester

Tensile Strength 160,000 lbs/in2
Elongation at break 14.0%
Modulus (approx.) 2,000,000 lbs/in2

Kevlar

Tensile Strength 400,000 lbs/in2
Elongation at break 2.5%
Modulus 18,000,000 lbs/in2

Fiberglas

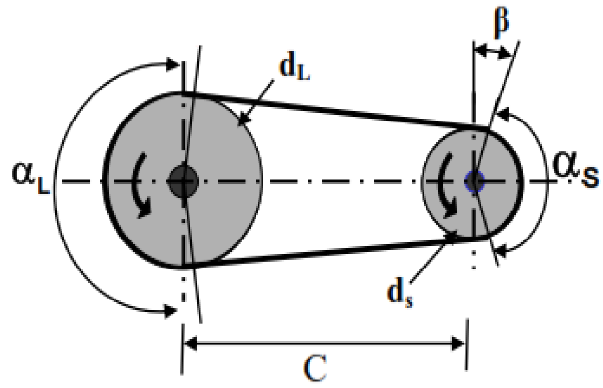
Tensile Strength 350,000 lbs/in2
Elongation at break 2.5 – 3.5%
Modulus 10,000,000 lbs/in2

Chloroprene

Tensile Strength 7 to 14 Mpa (1.0 to 2.0 x 10^3 psi)
Elongation at break 250 to 500%

Thermal Conductivity 0.19 W/m-k

III. DESIGN



Open Belt Drive

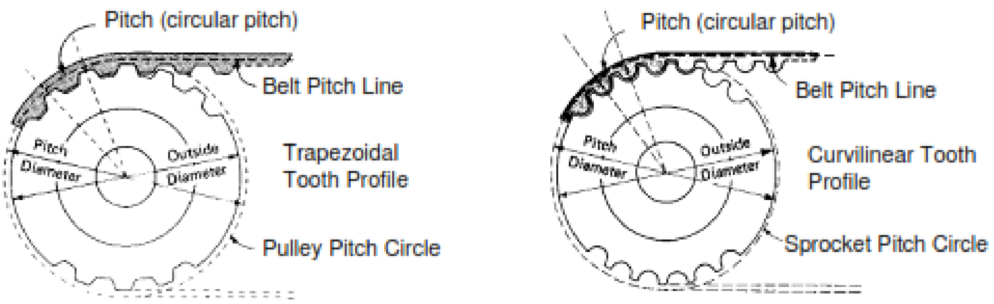
d_L-Diameter ofthelarger pulley

d_S–Diameter ofthesmaller pulley

α_L-Angle of wrap of the larger pulley

α_S-Angle of wrap of the Smaller pulley

C- Centre distance between the two pulleys



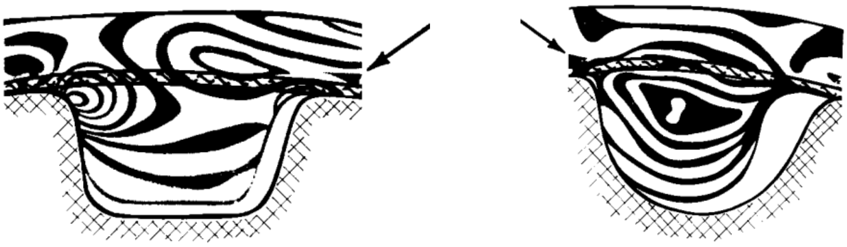
Pulley and Belt Geometry

The trapezoidal shape timing belt was supers ededbyacurvilinear tooth profile which exhibited some desirable and superior qualities. Advantage soft his type of drive are as follows: Proportionally deeper tooth; hence tooth jumping or loss of relative position is less probable. Light er construction, withcorrespondinglysmallercentrifugalloss. Smaller unit pressure on the tooth since area of contact is larger. Greatershearstrengthduetolargertoothcross section Lower cost since an arrowerbelt will handle larger load. Energy efficient, particularly if replac in ga"V" belt drivewhichincursenergylossesduetoslippage. Installationtensionissmall,therefore,lightbearingloads.

Tension member

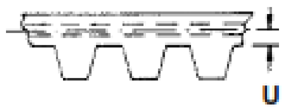
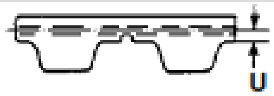
Stress pattern in belts

The photo elastic pattern shows the stress distribution within teeth of different geometry. There is a definite stress concentration near the root of the trapezoidal belt tooth, with verylowstrainselsewhere. Forth ecurvilineartooth, thereisauniform, nearlyconstant, strain distributiona crossthebelt. The loadisl argest in the directi on of the tension member to which it is transferred. Becauseoftheirsuperiorloadcarryingcapabilities,thecurvilinearbeltsaremarketedunder thenameofGates'HTDdrives. This is an abbreviation of High Torque Drives. Asa result of continuous research, a newer version of the curvilinear technology was developed by Gates, which was design a ted as Gates' Power Grip GT be lt drives.

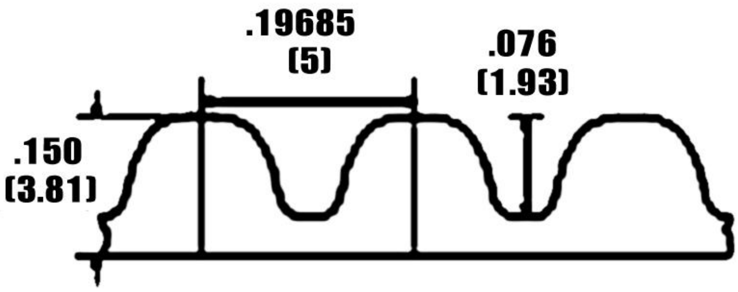


Trapezoidal Curvilinear

Basic Belt Dimensions

Distance from Pitch Line to Belt Tooth Bottom "*U*"	Common Description	Pulley O.D. O.D. = *pd* − 2*U*
.010 inches .007 inches .010 inches .015 inches	Minipitch 0.080" MXL 40 D.P. 1/5" XL 3/8" L	
.015 inches .0225 inches .027 inches	3 mm HTD 5 mm HTD 8 mm HTD	
.010 inches .015 inches .0225 inches	2 mm GT 3 mm GT 5 mm GT	
0.3 millimeters 0.5 millimeters 1.0 millimeters	T2.5 (2.5 mm) T5 (5 mm) T10 (10 mm)	

Belt tooth profile

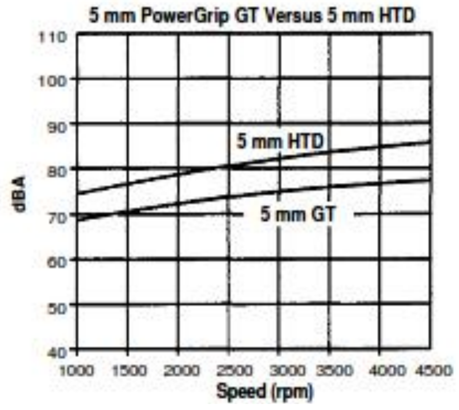


The highest density 5mm rubber belt, the Power Grip GT3 belt has twice the load carrying capacity of its predecessor HTD. In addition, less width is required compared to HTD, allowing lighter, more compact drives.

Power Grip GT3 belts are suitable for many applications such as HVAC, office machines, machine tools, hand power tools, postage handling, spindle drives, food processors, sewing machines, robotics, linear and light package conveyor.Fiberglas tensile cord provides high strength excellent flex life and high resistance to elongation. Neoprene body provides protection against grime, grease, oil, and moisture. Nylon tooth facing provides a durable wear surface for long service life. Gates patented tooth profile is designed for use with a specific sprocket groove profile. The sprocket groove-belt tooth combination increases capacity, while improving registration. Power Grip GT3 has more tooth ratchet resistance than HTD. Eliminates lubrication and re-tensioning reduce maintenance and labour as compared to roller chain drives. Power Grip GT3 belt/sprocket combinations match or exceed the positional accuracy of Power Grip Timing belt/pulley systems.

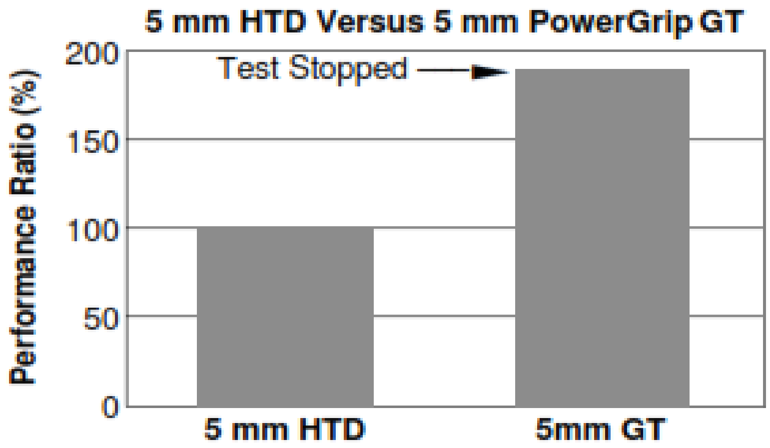
Noise Graph

The smoother meshing action of the Power Grip GT belt, with its optimized design, produces significantly lower noise levels when compared with other similar sized belt types operating under similarspeedsandtensions. These improvements are enhanced by the factthatnarrower belts can beused duetoin creased power capacities.



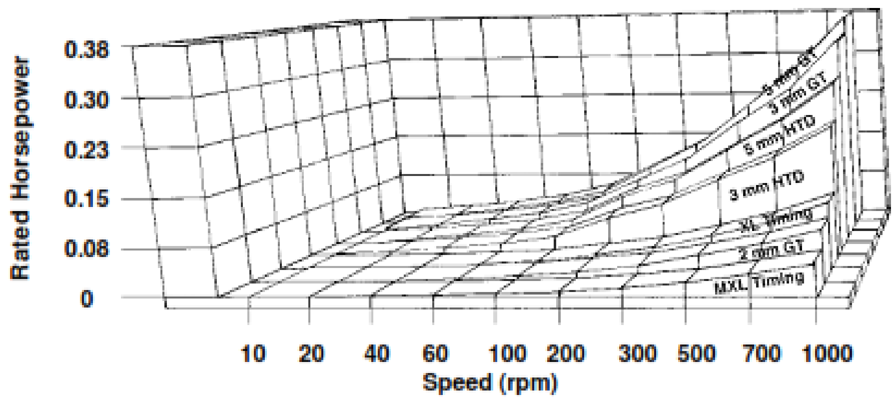
Noise Level Graph

Durability



Comparison of performance ratios for various belts

Belt Design selection



Horsepower Rating at Low Speed

WORKING

A **belt** is a loop of flexible material used to mechanically link two or more rotating shafts, most often parallel. Belts may be used as a source of motion, to transmit power efficiently, or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two pulley system, the belt

The greatly increased durability of the Power Grip GT design has resulted in power capacities far above those quoted for similar size belts of previous designs. The resulting small drive packages will increase design flexibility, space utilization and cost effectiveness.

can either drive the pulleys normally in one direction (the same if on parallel shafts), or the belt may be crossed, so that the direction of the driven shaft is reversed (the opposite direction to the driver if on parallel shafts). As a source of motion, a conveyor belt is one application where the belt is adapted to continuously carry a load. The mechanical output from an engine is transmitted to the rear wheel through the timing belt. The drive pulley is of small size and is connected to the output shaft of the engine. And the driven pulley is of medium size and is connected to the rear wheel. The drive and driven pulleys are connected by means of timing belt.

Calculation

Selection of pulley diameter.
D=126mm; d=60mm; N1=3110rpm
N2=1975rpm; R.p=7kw; v=9.77m/sec
m= 3.028kg/m; c=490; t=5mm.
Determination of Wrap angle.

$\alpha_L = 180 + 2\beta$ = 3.27 rad
$\alpha_s = 180 - 2\beta$ =3.00 rad
Length of Open Belt

$$L = \frac{\pi}{2}(d_L + d_s) + 2c + \frac{1}{4c}(d_L - d_s)^2$$

L=1274.39 mm
Velocity

$$v = \frac{\pi d_s N_1}{60 \times 1000}$$

V=9.77 m/sec.
Belt tension ratio between smaller and larger pulley

$$\left[\frac{T_1}{T_2}\right]_L = e^{\left[\frac{\mu_L \alpha_L}{\sin\left(\frac{\theta}{2}\right)}\right]}$$

$\left[\frac{T_1}{T_2}\right]_L$ = 355.66 N

$$\left[\frac{T_1}{T_2}\right]_s = e^{\left[\frac{\mu_s \alpha_s}{\sin\left(\frac{\theta}{2}\right)}\right]}$$

$\left[\frac{T_1}{T_2}\right]_s$ = 218.97 N

$$\mu_L = \mu_s$$

$$\left[\frac{T_1}{T_2}\right]_s < \left[\frac{T_1}{T_2}\right]_L$$

Therefore, smallerpulley governs the design.
Stress calculation,

$$\frac{T_1 - mv^2}{T_2 - mv^2} = e^{\left[\frac{\mu\alpha}{\sin\frac{\theta}{2}}\right]}$$

$\frac{T_1 - 29.58}{T_2 - 29.58} = 218.97$…………(1)
Therefore Power transmitted per belt = (T_1-T_2) x v
T_1-T_2 = 179.119 …………..(2)
Comparing both equations,
T_1=207.877 N
T_2=28.758 N
Recalculation of centre distance,

$$c = A + \sqrt{A^2 - B}$$

$$A = \frac{L}{4} - \pi\left(\frac{D + d}{8}\right)$$

A=245.6

$$B = \frac{(D - d)^2}{8}$$

B=544.5

C=490.08mm

IV. EXPARIMENTAL SETUP

Experiment setup

V. RESULT

This setup gives better performance compared over chain drive system.Noise will be reduced. Vibration will be arrested completely. Pulleys have life durability. High transmission speed compare to chain drive. Belt capacity is 1, 00,000 kilometres compared to chain drives.

VI. Conclusion

From the proposed system transmission efficiency is very much improved compare to chain transmission system. This system gives very narrow range of vibration, and so Noise will be arrested. The proposed system gives high performance. Future work will focus on the variation in pulley diameter and the dimension and material of the belt.

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