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Design of Silent Chain Drive

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Abstract: The main aim of this project is to reduce the noise and vibrations and to transmit the power efficiently. This project is directed to decreasing noise from the onset of engagement with the sprocket teeth till seating there on and also to reduce wear to the silent chain and the sprocket. Also keep the vibration to a minimum and contribute to the smoothness of the drive.

Key words: Decreasing noise from · Chain and the sprocket

INTRODUTION

An important aspect of the machine is the design of the of the silent chain drive. It is designed to eliminate the evil effects causing by stretching and to produce noiseless running.

When the chain stretches and the pitch of the chain increases, the lines ride on the teeth of the sprocket wheel at a slightly increased radius. This automatically conelly the small change in the pitch, there is no reactive sliding between the teeth of the invested tooth chain and the sprocket wheel teeth. When properly lubricated this chain given disables service and runs very smoothly and quickly [1].

A silent chain power transmission device comprising a silent chain and sprocket used together with the silent chain, the silent chain being formed of a plurality of link plates that are pivotably interconnected to each other via connecting pins, each of the link plates having a pair of teeth each formed of an inside flank surface and an outside flank surface, wherein a face of a sprocket tooth, which contacts the silent chain at the onset of engagement, has a tooth profile that is an envelope of trajectories described by the inner flank surface of the link plat when the silent chain moves linearly towards the sprocket and engages with the sprocket without causing a chordal action, wherein a crest of the sprocket tooth, which contacts the silent chain at the time of seating on the sprocket tooth, has a tooth profile that is an envelope of trajectories described by the crotch of the link plate when the link plate rotates around the connecting pin during the wrapping motion of the silent chain around the sprocket [2].

A silent chain drive mechanism includes a silent chain for transmitting power between a larger sprocket and a smaller sprocket, with this arrangement the chordal action of the silent chain is suppressed at both the larger sprocket side and the smaller sprocket side, thereby reducing vibrations and noises accompanied with the chordal action and improving the performance and durability.

Silent chain, or inverted-tooth chain, is a type of chain with teeth formed on its links to engage with the teeth in the sprockets. Silent chains drives are not truly silent. The links in a silent chain drive, however, engage with the sprocket teeth with little impact or sliding and as a result a silent chain produces less vibrations and noise than other chains. The amount of noise generated by a silent chain drive depends of many factors including sprocket size, speed, lubrication, load and drive support. A link belt silent chain includes removable links joined by rivets or interlocking tabs. These chains offer the advantage of installation without dismantling drive components, reducing inventory and increasing temperature ranges [3, 4].

Applications of Silent Chain Drives:

- Silent Chains are used for the camshaft drive of the mid- to large-size motorcycle engines and automobile

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engines , the transfer-case drive in four-wheel-drive vehicles and the primary drive between the engine and transmission, as well as in other high-speed applications.
- Silent chain drives are used in glass and bottle conveying.

Selection and Handling:

- Silent Chains are good for high-speed transmission.
- If single- or multiple-strand roller chains are an option, they are less expensive. Wider Silent Chain becomes relatively competitive in price.
- Silent Chains must be lubricated during operation. Use an oil bath if the speed is less than 600 m/min. If the speed is more than 600 m/min., or if the shaft center distance is short, use a pump or forced lubrication. Silent Chains wear rapidly without lubrication.
- The notch on the plates can engage with the sprockets from only one direction. The chain is not for reversing applications.
- To select the right Silent Chain for your operation, refer to the manufacturer's catalog.

In Silent Chain, the pin and the plate rotate against each other. In HY-VO Chains, the pin is comprised of two pieces that have rotational contact. Due to the rotational contact of the pins, the wear life of the chain is increased. Also in HY-VO Chains, the contact point between the pins moves up when the chain engages the sprocket, This construction decreases chordal action.

Silent Chain Drives Compared with Belts:

- Higher speed and power capacity
- Detachable and therefore more easily installed
- Greater efficiency
- Larger drive ratios possible
- No slippage
- Higher drive ratios at short center distances
- Less affected by temperature or humidity
- Lower bearing load

Silent Chain Drives Compared with Roller Chain:

- Higher speed and power capacity
- Reduced noise and vibration
- Greater efficiency
- Less velocity variation
- Higher efficiency (as high as 99%)
- More uniform wear characteristics
- Longer sprocket life 8. Less affected by chordal action

Silent Chain Drives Compared with Gears:

- Reduced noise and vibration
- More economical with large center distances
- Less critical shaft location and alignment
- Lower bearing loads
- Greater elasticity and shock absorption capability
- No end thrust
- Detachable and therefore more easily replaced

Design Calculation

Factors Considered Before Designing a Silent Chain Drive

Minimizing Cost: It is usually more economical to purchase “stock” sizes of chain and sprockets rather than ordering non-stock or made to order sizes. This is often true, even when it is necessary to buy stock components that are somewhat larger than required.

Minimizing Noise and Vibration: Use smaller pitch chains and sprockets with larger numbers of teeth to reduce noise and vibration.

Sprockets: Increasing the number of teeth in sprockets will decrease noise and prolong sprocket life. Whenever possible sprockets should have a minimum of 21 teeth.

Drive Ratios: Ratios of 12:1,or greater, are possible but above 8:1 it is usually desirable to achieve the ratio in two steps.

Shaft Center Adjustment: Whenever possible it is desirable to provide adjustable shaft centers. This allows for chains to be re-tensioned as they wear and is particularly important in drives where one shaft is located vertically above the other. Typically the amount of adjustment should equal at least 1% of the center distance.

Chain Width: The use of a wider than recommended chain will result in a more rugged drive, with reduced chain stresses and potentially longer drive life.

Shaft Center Distance: The distance between shafts should be great enough that the chain wraps the small sprocket at least 120 degrees. Generally, center distances should not exceed 60 pitches.

Chain Length: Whenever possible chain length should be an even number of pitches. An odd number of pitches requires the use of an offset section which weakens the chain and increases cost.

Tensioning Devices: An adjustable idler sprocket can often be used to maintain chain tension on drives where the shafts are fixed. In some instances, tensioning arms or pads can be pressed against the back of a chain to maintain chain tension. Consult with the chain manufacturer before employing these devices since some two pin chains can be damaged by their use.

Calculation

- Select the number of teeth on the Pinion Sprocket (Zdriver):

The number of teeth on the smaller Sprocket plays an important role in deciding the performance of a chain drive. A small number of teeth tends to make the drive noisy. A large number at teeth makes chain pitch smaller which is favourable for keeping the drive silent and reducing shock, centrifugal force and friction force.

Z Driver = 15

- Calculate the number of teeth on the smaller sprocket (Zdriven):

I = 1.54
Zdriven = I x ZDriver
= 1. 54 x15
Zdriven = 23

The Driven gear must be an Odd Number

- Optimum Centre Distance (a):

a = (30 – 50) p

→ p Pitch of the Chain

p = 15
a = 30 p
= 30 x 15
= 450

a = 50 p
= 50 x 15
= 750

Take values between 450 to 750

- Permissible speed of smaller sprocket (or) Pinion:

According to no of teeth and pitch of chain (p)

N1 = 2400 rpm

Assume the chain to be duplex. Chosen chain number is

10A – 2 / DR50
8

- Chain Velocity (v):

$$V = \frac{\text{No. of teeth on the sprocket x pitch x rpm}}{60 \times 1000}$$

P = 15.875
N = 2400

$$V = \frac{15 \times 15.875 \times 2400}{60 \times 1000}$$

- Evaluate the total load, PT on the driving side of the chain:

PT = Pt + Pc + Ps

$$Pt = \frac{1020\ N}{v}$$

N = 11HP = 8.20 KW

$$Pt = \frac{1020 \times 8.20}{9.52}$$

= 878.571 N

Pc → Centrifugal Tension

$$= \frac{Wv^2}{g}$$

W = 1.78

$$Pc = \frac{1.78 \times (9.52)^2}{9.81}$$

$= 16.444$ N

Ps = Tension due to sagging

Ps = K.W.A

Our arrangement is Horizontal

So take K = 6

W = 1.78 x 9.81 = 17.46

a = 450

Ps = 6 x 1.78 x 450

= 4806 N

PT = 878.571 x 16.44 x 4806

= 6941.16 N

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