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CHAIN LESS BYCYCLE USING GEAR SYSTEM

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ABSTRACT: Vibration is the most common drive shaft problem. Small cars and short vans and trucks (LMV) are able to use a single drive shaft with a slip joint at the front end without experiencing any undue vibration. However, with vehicles of longer wheel base, the longer drive shaft required would tend to sag and under certain operating conditions would tend to whirl and then setup resonant vibrations in the body of the vehicle, which will cause the body to vibrate as the shaft whirls [1].

Keywords: Vibration, LMV, drive shaft. shaft whirls

I. INTRODUCTION

Drive shafts are carriers of torque; they are subject to torsion and shear stress, which represents the difference between the input force and the load [2]. They thus need to be strong enough to bear the stress, without imposing too great an additional inertia by virtue of the weight of the shaft [3]. Most automobiles today use rigid driveshaft to deliver power from a transmission to the wheels [4]. A pair of short driveshaft is commonly used to send power from a central differential, transmission, or transaxle to the wheels. There are different types of drive shafts in Automotive Industry:

a) 1-piece driveshaft
b) 2-piece driveshaft
c) Slip in Tube driveshaft
d)

The Slip in Tube Driveshaft is the new type which also helps in Crash Energy Management. It can be compressed in case of crash. It is also known as a collapsible drive shaft [5]. Front-wheel drive is the most common form of engine/transmission layout used in modern passenger cars, where the engine drives the front wheels. Most front wheel drive vehicles today feature transverse engine mounting, where as in past decades engines were mostly positioned longitudinally instead. Rear-wheel drive was the traditional standard and is still widely used in luxury cars and most sport cars [6,7].

II. LITERATURE SURVEY

The first shaft drives for cycles appear to have been invented independently in 1890 in the United States and England. A. Fear head, of 354 Caledonian Road, North London developed one in 1890 and received a patent in October 1891.His prototype shaft was enclosed within a tube running along the top of the chain stay; later models were enclosed within the actual chain stay. In the United States, Walter Still man filed for a patent on a shaft-driven bicycle on Dec. 10, 1890 which was granted on July 21, 1891.

The shaft drive was not well accepted in England, so in 1894 Fear head took it to the USA where Colonel Pope of the Columbia firm bought the exclusive American rights. Belatedly, the English makers took it up, with Humber in particular plunging heavily on the deal. Curiously enough, the greatest of all the Victorian cycle engineers, Professor Archibald Sharp, was against shaft drive; in his classic 1896 book "Bicycle, he writes "The Fearn head Gear.... if bevel-wheels could be accurately and cheaply cut by machinery, it is possible that gears of this description might supplant, to a great extent, the chain-drive gear; but the fact that the teeth of the bevel-wheels cannot be accurately milled is a serious obstacle to their practical success".

In the USA, they had been made by the League Cycle Company as early as 1893. Soon after, the French company Metro pole marketed their Acatane.By 1897 Columbia began aggressively to market the chainless bicycle it had acquired from the League Cycle Company. Chainless bicycles were moderately popular in 1898 and 1899, although sales were still much smaller than regular bicycles, primarily due to the high cost. The bikes were also somewhat less efficient than regular bicycles: there was roughly an 8 percent loss in the gearing, in part due to limited manufacturing technology at the time. The rear wheel was also more difficult to remove to change flats. Many of these deficiencies have been overcome in the past century.

In 1902, The Hill-Climber Bicycle Mfg. Company sold a three-speed shaft-driven bicycle in which the shifting was implemented with three sets of bevel gears. While a small number of chainless bicycles were available, for the most part, shaft-driven bicycles disappeared from view for most of the 20th century. There is, however, still a niche market for chainless bikes, especially for commuters, and there are a number of manufacturers who offer them either as part of a larger range or as a primary specialization. A notable example is Bio mega in Denmark.

III. DIFFERENT TYPES OF SHAFTS

a) Transmission shaft: These shafts transmit power between the source and the machines absorbing power. The counter shafts, line shafts, overhead shafts and all factory shafts are transmission shafts. Since these shafts carry machine parts such as pulleys, gears etc., therefore they are subjected to bending moments in addition to twisting.
b) Machine Shaft: These shafts form an integral part of the machine itself. For example, the crankshaft is an integral part of I.C engines slider-crank mechanism.
c) Axle: A shaft is called “an axle”, if it is a stationary machine element and is used for the transmission of bending moment only. It simply acts as a support for rotating bodies.
   Application: To support hoisting drum, a car wheel or a rope sheave.
d) Spindle: A shaft is called “a spindle”, if it is a short shaft that imparts motion either to a cutting tool or to a work-piece.

IV. APPLICATIONS

1. Drill press spindles-impart motion to cutting tool (i.e.) drill.
2. Lathe spindles- impart motion to work-piece.

Apart from, an axle and a spindle, shafts are used at so many places and almost everywhere wherever power transmission is required. Few of them are:

i. Automobile Drive Shaft: Transmits power from main gearbox to differential gear box.
ii. Ship Propeller Shaft: Transmits power from gearbox to propeller attached on it.
iii. Helicopter Tail Rotor Shaft: Transmits power to rail rotor fan.

Part of Drive Shaft

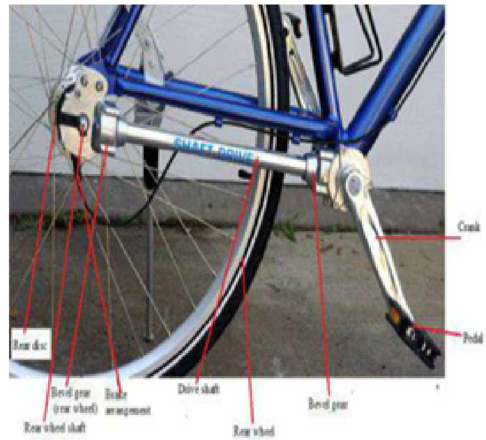

Figure 4.1 Parts of Drive Shaft

V. DEMERITS OF A CONVENTIONAL DRIVE SHAFT

a) They have less specific modulus and strength.
b) Increased weight.
c) Conventional steel drive shafts are usually manufactured in two pieces to increase the fundamental bending natural frequency because the bending natural frequency of a shaft is inversely proportional to the square of beam length and proportional to the square root of specific modulus. Ther1efore the steel drive shaft is made in two sections connected by a support structure, bearings and U-joints and hence over all weight of assembly will be more.
d) Its corrosion resistance is less as compared with composite materials.
e) Steel drive shafts have less damping capacity.

VI. MERITS OF COMPOSITE DRIVE SHAFT

a) They have high specific modulus and strength.
b) Reduced weight.
c) The fundamental natural frequency of the carbon fiber composite drive shaft can be twice as high as that of steel or aluminum because the carbon fiber composite material has more than 4 times the specific stiffness of steel or aluminum, which makes it possible to manufacture the drive shaft of passenger cars in one piece. A one-piece composite shaft can be manufactured so as to satisfy the vibration requirements. This eliminates all the assembly, connecting the two-piece steel shafts and hus minimizes the overall weight, vibrations and the total cost
d) Due to the weight reduction, fuel consumption will be reduced.
e) They have high damping capacity hence they produce less vibration and noise.

f) They have good corrosion resistance.
g) Greater torque capacity than steel or aluminum shaft.
h) Longer fatigue life than steel or aluminum shaft.
i) Lower rotating weight transmits more of available power.

VII. DRIVE SHAFT VIBRATION

Vibration is the most common drive shaft problem. Small cars and short vans and trucks (LMV) are able to use a single drive shaft with a slip joint at the front end without experiencing any undue vibration. However, with vehicles of longer wheel base, the longer drive shaft required would tend to sag and under certain operating conditions would tend to whirl and then setup resonant vibrations in the body of the vehicle, which will cause the body to vibrate as the shaft whirls. Vibration can be either transverse or torsional. Transverse vibration is the result of unbalanced condition acting on the shaft. This condition is usually by dirt or foreign material on the shaft, and it can cause a rather noticeable vibration in the vehicle. Torsional vibration occurs from the power impulses of the engine or from improper universal join angles. It causes a noticeable sound disturbance and can cause a mechanical shaking. In excess, both types of vibration can cause damage to the universal joints and bearings. Whirling of a rotating shaft happens when the centre of gravity of the shaft mass is eccentric and so is acted upon by a centrifugal force which tends to bend or bow the shaft so that it orbits about the shaft longitudinal axis like a rotating skipping rope. As the speed rises, the eccentric deflection of the shaft increases, with the result that the centrifugal force also will increase. The effect is therefore cumulative and will continue until the whirling become critical, at which point the shaft will vibrate violently.

From the theory of whirling, it has been found that the critical whirling speed of the shaft is inversely proportional to the square of the shaft length. If, therefore, a shaft having, for example, a critical whirling speed of 6000 rev/min is doubled in length, the critical whirling of the new shaft will be reduced to a quarter of this, i.e. the shaft will now begin to rotate at 1500 rev/min. The vibration problem could solve by increasing the diameter of the shaft, but this would increase its strength beyond its torque carrying requirements and at the same time increase its inertia, which would oppose the vehicle's acceleration and deceleration. Another alternative solution frequently adopted by car, van, and commercial vehicle manufacturers is the use of two-piece drive shafts supported by intermediate or centre bearings. But this will increase the cost considerably.

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