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Design and Fabrication of Bicycle Using Four Bar Mechanism

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ABSTRACT

This is model we have a fabricated easy to pedal drive and increased on efficiency, let we have introduced four bar drive bicycle, which is contain for four bar drive mechanism and chain drive also, we have to consider on new innovation thing and creativity model in cycle. Now days' bicycle usage level totally going down in India, otherwise motor bike usage going too high whereas, fuel consumption is also going too high so, we have to consider reduction of fuel consumption only one-way bicycle using in our people. This model of bicycle anybody drive too easy and increased on efficiency level.
Keywords: Four Bar Link Pedaling System

I. INTRODUCTION

We have to fabricate four bar link drive bicycle, why we have to fabricated means this is mechanism using pedaling easy way and short term radius circle pedaling system, which increased the also efficiency. The four bar mechanism totally two joint is fixing one Note that if we multiply or divide all the link lengths by a constant, the ratio of the length of the links, hence the type of four-bar or the angular rotations of the links will not be effected. Therefore, it is the ratio of the link lengths, not the link lengths as a whole, which determines the type of four-bar. If our interest is the rotation of the links only, the mechanisms with the same link length ratios will have the same motion characteristics no matter how big or small the mechanism is constructed (this scaling is like multiplying the loop equation by some constant). Out of these types of four-bar mechanisms crank-rocker mechanism has a particular importance in machine design since a continuous rotation may be converted to an oscillation through this type of a four-bar (this statement does not necessarily mean that the other four-bar proportions are not used). We shall now discuss the four-bar mechanism with crank-rocker proportions and important problem related to it.

II. METHODS AND MATERIAL

2. Design of Four Bar Linkage Mechanism

A four bar linkage is the pre-eminent mechanism building block. Four bar linkages are common in aerospace mechanical linkages. At times, a mechanism may be a four bar linkage, but the fact that a mechanism is a four bar linkage may not be obvious. An understanding of four bar linkages is essential to understanding mechanisms in a general sense. The mathematical characteristics of a four bar linkage directly apply to any general mechanism. This module provides an overview of four bar linkages. Some examples are provided. The mathematical equations and analysis techniques are provided in Four Bar Linkage – Equations.

A general four bar linkage is shown in Figure 1. A four bar linkages consists of 4 "bodies" which are the three links plus ground (ground is always considered a link when analyzing mechanisms). For analytical purposes, four bar linkages are portrayed and treated as planar mechanisms. However, in practice implementation of a four bar linkage could be spatial (non-planar). Four bar mechanisms are not always obvious in a mechanism and careful inspection may be required to determine is a linkage is indeed a four bar mechanism. For a spatial four bar linkage, an equivalent planar linkage can often be determined and the analytical techniques discussed in Four Bar Linkage – Equations and Four Bar Linkage – Design Methods apply.

The parameters in Figure are defined as follows
O_1 ground point for link 1
O_2 ground point for link 2
l_1 length of link 1
l_2 length of link 2
l_3 length of link 3
d_1 horizontal (x) distance between ground points for link 1 and link 3
d_2 vertical (y) distance between ground points for link 1 and link 3
φ_1 angle of link 1 to x axis (measured as shown in Figure 1)
φ_2 angle of link 2 to x axis (measured as shown in Figure 1)
φ_3 angle of link 3 to x axis (measured as shown in Figure 1)
μ angle between link 2 and link 3 (as shown in Figure 1)
F_c axial force in link 3

Typical terminology for a four bar linkage labels link 1 as the input link, link 2 as the coupler and link 3 as the output link. Of course, link 3 could just as easily be the input link. A four bar linkage is described by the 2 constraint equations

$$l_1 \cos\phi_1 + l_2 \cos\phi_2 - l_3 \cos\phi_3 - d_1 = 0$$
$$l_1 \sin\phi_1 + l_2 \sin\phi_2 - l_3 \sin\phi_3 - d_2 = 0$$

These equations use the parameter definitions shown in Figure 1. These constraint equations state that the sum of distances in the x direction and the sum of distances in the y direction around the four bar linkage must be zero. Note that the equations are nonlinear due to the cos and sin functions. The constraint equations hold true for all possible positions of the linkage, hence they form the basis for mathematical analysis of a four bar linkage. For more details on mathematical analysis, see Four Bar Linkage – Equations.

One characteristic of a four bar linkage is that there is a single degree of freedom (1 DOF). If we let link 1 be the input link, then the position of link 2 and link 3 are uniquely determined by the position of link 1. Thus if the l_i and d_i, plus the input link angle, ϕ_1, are known, then the positions ϕ_2 and ϕ_3 can be computed as a function of ϕ_1. Thus the four bar linkage has 1 DOF. This characteristic is true of all airplane mechanisms. If the input to the mechanism is known, then the position of all components in the mechanism can be computed. Some mechanisms may have 2 DOFs, using separate inputs such as pilot stick input and autopilot actuator input.

Four bar linkages are very versatile and have been designed to do a multitude of tasks. For example, four bar linkages can be used to have the output travel in a straight line or do general path following. Figure 2 shows a four bar linkage that can be used to draw a straight line.

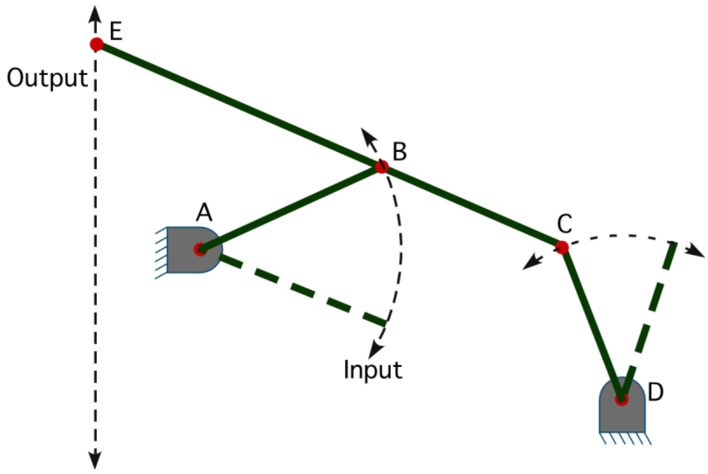

Figure 2.1 Four Bar Linkage with Straight Line Output

Referring to Figure 1, maximum efficiency of a four bar linkage is obtained when the angle μ is kept close to 90 degrees. This minimizes the compression load, F_c, acting on link 3. F_c is wasted force as it does not contribute to the output torque and adds friction and additional column loading to link 3..Another important characteristic to understand about four bar linkages is that the mechanical advantage of a four bar linkage varies with linkage position. Thus the mechanical advantage is not constant throughout the range of movement – a characteristic of all mechanisms. Mechanical advantage is discussed in Mechanisms – Overview and Mechanical Advantage. In this module, mechanical advantage is shown to be equivalent to the velocity ratio. As shown in Four Bar Linkage – Equations, velocity ratios vary with position. The variation in velocity ratio over the range of movement of a mechanism (i.e., the mechanical advantage) is an important feature to understand. Large variations could be a problem in a overall mechanism design. Generally speaking, small movements around input link angles of 90 degrees are good to minimize variations in mechanical advantage.

Examples of four bar linkages are shown in the figures below. Figure 3 shows a leading edge mechanism for the leading edge of an airplane. This mechanism is a four bar linkage that raises the leading edge section of the wing to give the wing more camber at low speed. The four bar linkage is driven by an actuator connected to one of the links.

q= time of slower stroke

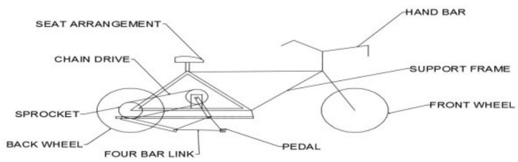

Figure 2.2 Time of quicker stroke

3. Fabrication model

Figure 3.1 Fabrication Setup

III. CONCLUSION

An overdrive test is conducted to test the efficiency of the bicycle. It has been found out that the four bar linkage supplies an energy with which the cycle could move forward by 10% of the given input. Depending upon the input given, the efficiency varies. But only 10% can be obtained by this principle. This system when installed in vehicles would save a greater amount of energy lost during the braking of the vehicle. This energy can be stored and can be reused when needed.The design displayed above is a fairly simple implementation of a kinetic energy recovery system with a non-negligible increase in the efficiency of a bicycle. Though there are quite a few parts, many of them are off the shelf and none of the custom parts require highly developed shop skills, such as computer programmed cuts.

Also, the installation of the system would not be very complicated outside of actuating the gear shift mechanism, which would mostly involve measuring the correct distance for the line along with some trial and error. Compared to Mr. von Stein's design, it is significantly simpler and lighter. However, the use of a continuously variable transmission allows for the four bar linkage to spin much faster and is more elegant in its gear shifting mechanism and long term use. The design shown above makes up for its lack of an elegantly design clutch by placing the four bar linkage in a more optimal spot on the bike and by weighing less.

It is impossible for me to use the same measurement of efficiency increase for Mr. von Stein's design because I do not know the rotational speed of the four bar linkage in his design and I don't know the total weight added to the bike by the four bar linkage system. But, by his own estimation his kinetic energy recovery system adds ten percent efficiency to the system, and with a four bar linkage on top of the additional crank, chains, and transmission, it is reasonable to assume that the four bar linkage system will add approximately ten percent of weight to the bike and its rider, thus canceling out the increased efficiency from stored braking energy. This means despite the design above being simple and unclean in some ways, it promises to be more efficient overall than Mr. von Stein's design. This, however, is contingent on the measured efficiency of the transmission.

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