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Cutting Mechanism by Giving Feed through Geneva Mechanism

[1]P.Kali Sindhur, [2]Y.karthik, [3]T.vijay, [4]Y.Sasikanth and [5]G.Sri Harsha

[1] Department of Mechanical Engineering, K L University, Vijayawada, Andhra Pradesh 522502, India

[2] Department of Mechanical Engineering, K L University, Vijayawada, Andhra Pradesh 522502, India

[3] Department of Mechanical Engineering, K L University, Vijayawada, Andhra Pradesh 522502, India

[4] Department of Mechanical Engineering, K L University, Vijayawada, Andhra Pradesh 522502, India

[5] Department of Mechanical Engineering, K L University, Vijayawada, Andhra Pradesh 522502, India

Abstract

The main aim of the project is to design a mechanism for cutting by giving intermittent feed. This intermittent feed is given by continuous rotation of circular disk in Geneva mechanism. We have designed a belt drive with the help of Geneva mechanism which is used for giving feed and gives smooth operation and smooth movement of the feed at required time interval. The feed from the Geneva drive was cut by using slotted lever mechanism which was designed using slider crank mechanism. Which is placed perpendicular at the end of the Geneva mechanism and overall analysis are calculated at each link.

Keywords: *Intermittent, Geneva mechanism, slotted lever mechanism, slider crank.*

1. Introduction

The main task of the mechanical designed is to synthesize a particular mechanism that achieves a particular task and to remodel or to develop another mechanism with the help of two different mechanisms. One of the mechanisms we used was Geneva mechanism; it is one of the earliest of all the intermittent motion mechanisms. Geneva mechanisms are available on self basis from several manufactures, in a variety of sizes and shapes. They are cheaper than cams and have good performance characteristics, depending on the load factor and design requirements. The other mechanism was slotted lever mechanism or slider crank mechanism. This converts the rotary motion into straight line motion by means of a rotating driving beam, a connecting rod and a sliding body.

2. Geneva Mechanism

A classical 4-slotted Geneva wheel mechanism is illustrated in fig.1. The input was given to the input wheel and it continuously rotates. The driving pin was placed at angle of $\boldsymbol{\theta}$° to the center line of the Geneva mechanism and Geneva wheel.

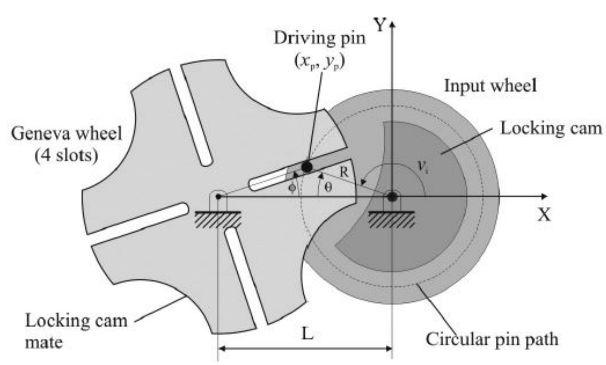

Fig.1

The rotation of the Geneva wheel is prevented when the pin is not in the slot using the locking cam illustrated in fig.1. When the pin gets locked in the slot and the input wheel rotates and this pin makes the Geneva wheel to rotate. The Geneva we used was 4-slotted so the angle between the 4-slots was exactly 90°. So when the driving pin gets locked in the slot the Geneva wheel rotates exactly 90°. The movement of the Geneva wheel will gives the required feed which is carried out.

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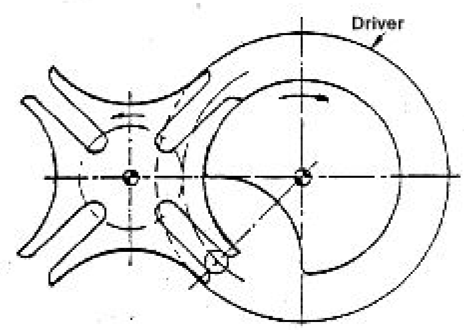
2.1 Design Procedure

A wheel of 10cm radius was taken on which a wheel of 8cm radius was mounted, which is designed such that ¼ part was removed so that the driven wheel will rotate in it.



Both the wheels are taken at a thickness of 30mm. driven wheel or Geneva wheel was designed by taking a wheel of radius of 10cm and 4 slots of 60mm depth are designed on 4 sides perpendicular to each other. A driving pin was mounted on the wheel of 10cm radius at a radius of 9cm. the sides of the driven wheel are cut down by taking a arc of radius 8cm. The driven wheel mounted on the drive wheel such a way that the arc of the driven wheel or Geneva wheel should be perfectly contacted with the surface of the smaller wheel of drive wheel or input wheel.

3. Slider Crank Mechanism

A slider crank mechanism converts circular motion of the crank into linear motion of the slider. In order for crank to rotate fully the condition L>R+E must be satisfied.
Where
L is the length of the connecting rod
R is the crank length
E is the offset of the slider

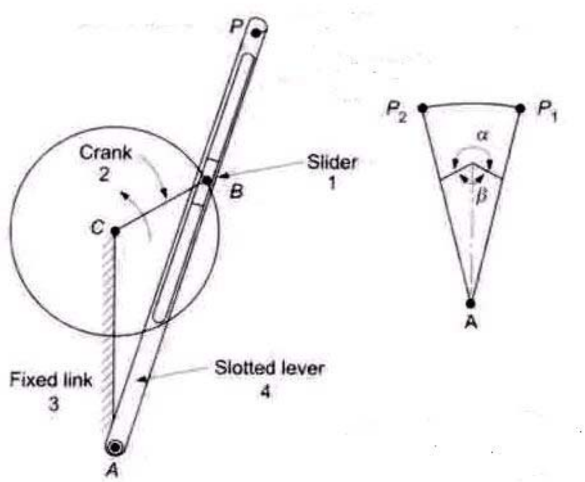


Fig 3.

A slider crank is a RRRP type of mechanism i.e. it has three revolute joints and one prismatic joint. The total distance covered by the slider between its two extreme positions P1 and P2 is the path length. Kinematic inversion of slider crank mechanism produces ordinary and white work quick return mechanism. The time required for the working stroke is greater than that of the return stroke; it is a quick return mechanism. It gives a great improvement in the machining productivity. This is currently used in machine tools, for instance shaping machines, power driven saws and other applications requiring a work stroke with intensive loading, and a return stroke with non-intensive loading.

3.1 Kinematic pairs

The relative motion between two links of a pair can take different form. Three types of pairs are known as lower pairs and these are frequently occurring ones:
Sliding: This occurs between the slotted lever and pin.
Turning: This occurs with a wheel on an axle
Screw motion: Such as occurs between a nut and a bolt.

3.2 Design Procedure

It is a four bar mechanism. So it requires four links connected in a loop by one degree of freedom (dof) joints. A joint may be either a revolute that is hinged joint denoted as a prismatic, as sliding joint.
A link connected to ground by a hinged joint is usually called crank. A link connected to ground by a prismatic joint is called slider. Sliders are sometime considered to be crank that has a hinged pivot at an extremely long distance away perpendicular to the travel of the slider. The link that connects two cranks and a slider, it is often called a connecting rod.
As one end of the slider was hinged and other end was left free, when the crank was rotated continuously and the pin in the slotted lever will be moving and giving oscillation motion to the slider which is used for cutting purpose. The edges of the slider was attached with a blade the output from the Geneva mechanism was cut.

4. Belt Drive

The belt drives are used to transmit power from one shaft to another shaft by means of pulleys which rotates at same speed or at different speed. The amount of power transmitted depends upon the following factors:

- The velocity of the belt
- The tension under which the belt is placed on the pulleys
- The arc of contact under which the belt is used.

There are three main types of belts:

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1. Flat belt
2. V-belt
3. Circular belt

The belt which we used to carry the feed which came from the Geneva mechanism was flat belt.

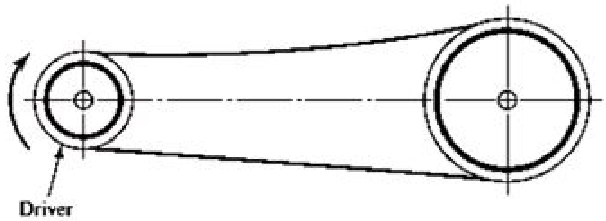


Fig 4.1

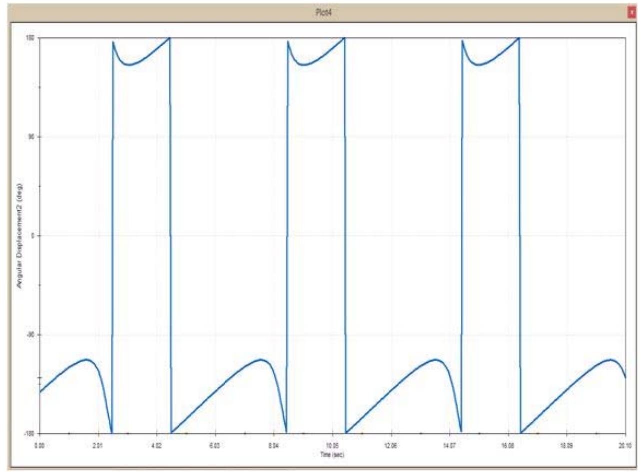
We considered flat belt because the model need to with stand the stress produced and the design procedure was not complex such as v-belt and circular belt. It was easy to remove the belt when ever required. The belt drive was connected to the Geneva Mechanism.

5. Working Procedure

When the input wheel was start rotating and when the pin get locked into the groove of the Geneva wheel and produces the feed until the pin get unlocked and for remaining 270° of rotation the Geneva wheel remains constant. As one end of the belt drive was connected to the shaft of the Geneva wheel which acts as the pulley to the belt. So when feed was produced the belt which connected to the shaft start rotation and carries out the feed to the other end through the belt and remains still until the drive pin get locked to the next groove or slot. Mean while the slotted lever which is place perpendicular to the belt drive and Geneva mechanism start oscillation and cut down the feed from which was produced by the Geneva mechanism.

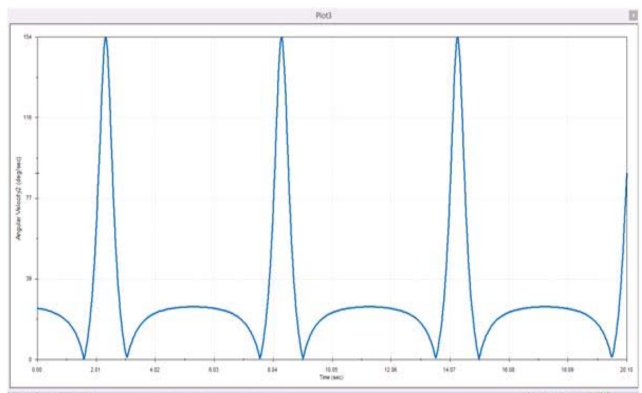
6. Analysis

The total model was designed in the solid works and angular velocity and angular displacement graphs are derived for each link.

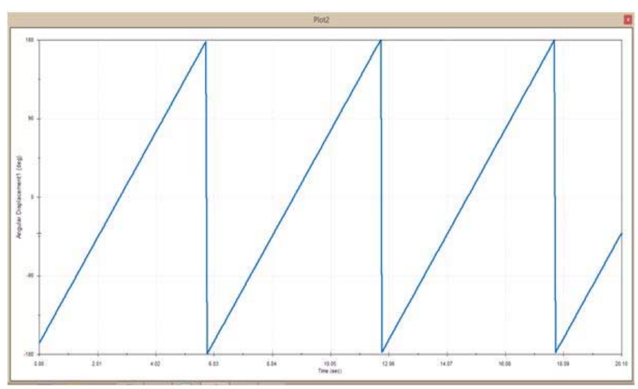


Graph 6.1 Angular displacement of slider

From graphs 6.1 and 6.2 we find out the angular displacement and angular velocity for slider with respect to the time. From graph 6.1 is observed that he angular displacement was more in the return stroke than in the forward stroke and it is also same with angular velocity which is shown in graph 6.2, the velocity of the slider was more in the return stroke than in the forward stroke.

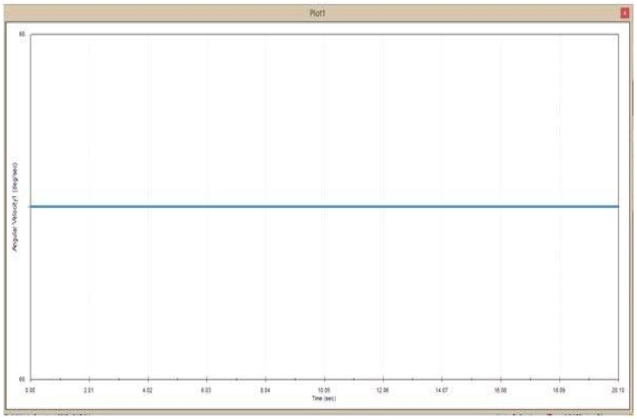


Graph 6.2 Angular velocity of slider



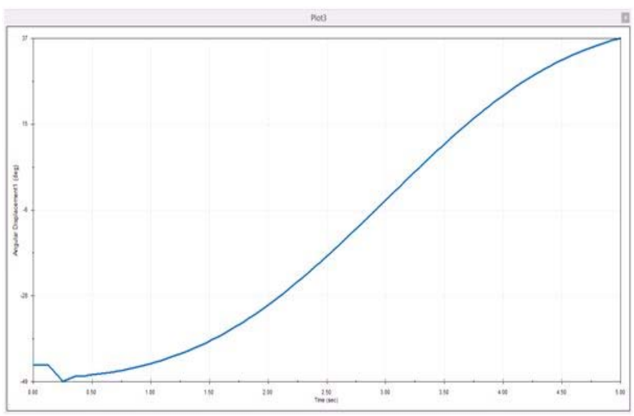
Graph 6.3 Angular displacement of crank

Angular displacement and angular velocity of the crank in the slider crank mechanism was observed with respect to time shown in graphs6.3 and 6.4



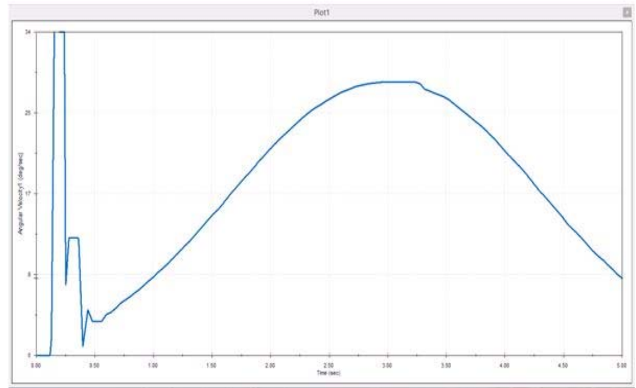
Graph 6.4 Angular velocity of crank

From graph 6.3 the angular displacement of the crank gradually increases from 0° to 180° of rotation and from then it remains constant till the completion of rotation of crank. Whereas from graph 6.4 the angular velocity of the crank remains constant throughout the rotation of the crank.



Graph 6.5 Angular displacement of Geneva wheel

The graph 6.5 and 6.6 shows the angular displacement and angular velocity of the Geneva wheel. From 6.5 the angular displacement of the Geneva wheel having a slight drop in the beginning due to locking and then it gradually increases till the unlocking of the pin.



Graph 6.6 Angular velocity of Geneva wheel

The graph 6.6 shows that the angular velocity will be constant till the locking and then it gradually increases till the unlocking of pin after it will be gradually dropping.

7. Conclusion

The feed which came from the Geneva mechanism carried by the belt drive was cut by the slotted lever mechanism which is at the end of the belt drive. With this model we can get the equal length of feed at equal interval of time. The length of the feed can be managed by changing the depth of the slots in Geneva wheel and the path length of the slider can be increased by increasing the radius of the crank and the length of the slot on the slider. The angular velocity and angular velocity are observed for each link by designing the entire model in solidworks and then calculated the analysis for each link.

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