Intermittent Paper Cutting Mechanism by Giving Feed through Geneva Wheel

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Abstract - This paper presents a kinematic study of a mechanism using a Geneva wheel and a gear train to achieve intermittent motion. The main motive of this project is to design a mechanism for cutting by giving intermittent feed. The intermittent feed is given by continuous rotation of circular disk in Geneva mechanism. We have designed a chain 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 fabrication and design of paper cutting machine using Geneva mechanism is useful to cut the papers in equal and accurate dimension. Geneva drive is an indexing Mechanism that converts continues motion to intermittent motion, Due to which paper is moved between the intervals of cutting period. The paper cutting is achieved by crank& lever mechanism. The cutter will be back to its original position by spring effect.

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. A four-bar mechanism is a basic 1-dof (degree of freedom) mechanism. A four-bar is created by selecting four link lengths and joining the links with revolute joints to form a loop. A wide variety of paths is possible by arbitrarily choosing a point on the coupler curve. These different curves can be obtained by constructing a physical model of the mechanism and viewing the path of various, points without detailed mathematical analysis. There is one problem related with designing a four-bar mechanism for path generation is that the final four-bar mechanism is rarely able to produce the desired path. For this reason, optimal synthesis methods were used to design mechanisms for path generation. The objective is to minimize the structural error defined as the difference between a prescribed path and the generated path. An optimal mechanism is synthesized by summing the difference between these paths over the full operative domain and changing the mechanism parameters to reduce this net difference.

2. GENEVA WHEEL MECHANISM

The basic structure of a four-slot Geneva wheel is shown in Fig.1. The system consists of a constantly rotating disk coupled with a slotted disk, which gives rise to the desired discrete motion. A rotation of 2π radians of the former causes $2\pi/N$ radians of rotation of the latter, where N is the number of slots available on the slotted disk. Thus, one complete rotation of the slotted wheel requires N complete rotations of the other disk, thereby also increasing the total time. The converting mechanism of the disk system is as follows.

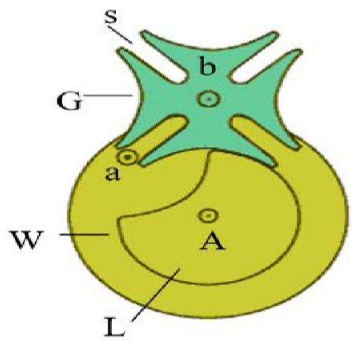


Fig.1. Mechanism of Geneva Wheel

Referring to Fig.1,The pin on wheel W rotates constantly about axis A and as shown below, has a pin 'a' attached to Geneva wheel which is drive by pin which applied a force and rotates it as long as it is engaged with the slot. While the wheel W rotates continuously, the Geneva wheel G has a discrete rotation about axis 'b'. Wheel G has a rotation time period of t_r when it is moving along with disk W and an idling time period t_i, when the pin 'a' is not inside one of the slots 's' and is moving freely. The three quarter wheel 'L' is placed in order to prevent any unintentional rotation of wheel G while it is idling.

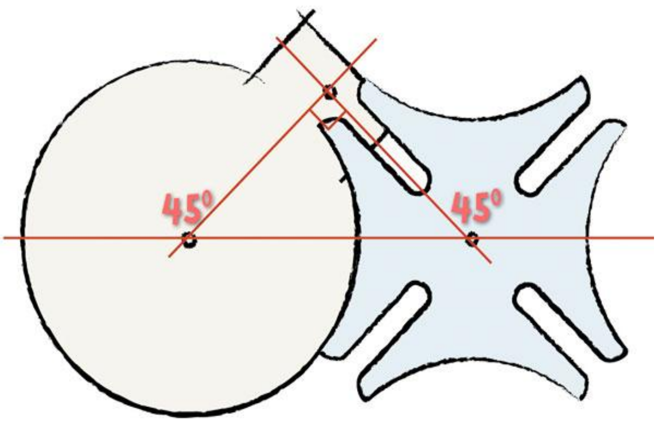
By increasing or decreasing the number of slots on Geneva wheel , we can change the time of rotation and time interval for cutting of paper .There are may be four or six slots is can be chosen.

The four slot Geneva wheel have been analyzed and a design layout has been provided. Along with the same lines, multiple slot wheels can be designed. The basic criterion that has to be maintained in designing any number of slotted Geneva wheel is that, the pin (or disk pin) has to enter and leave the slots radially. This will again be discussed in detail in the following sections.

3. WHEEL DESIGN

There is N slotted wheel and the angle by which the slotted wheel rotates for a given rotation of the constantly rotating wheel is 2π/N. The slots are thus placed at 2π/N radians is that during every rotation, the pin on the wheel 'G' should enter and leave the slots in such a way that it tangent to the constantly rotating wheel at the pin passes through the center of the slotted wheel. If 'r' is the radius of wheel which is engaged with Geneva wheel and center distance 'D'.

$$D = \frac{r}{Sin\left(\frac{\pi}{N}\right)}$$



Geneva wheel is given by-

$$R = \frac{r}{\tan\frac{\pi}{N}}$$

4. Components Used in Project

I. Geneva Wheel
II. Sprocket
III. Roller chain
IV. Paper cutter or cutting blade
V. Coil Spring
VI. Paper Roller Shaft
VII. Driving motor

5. WORKING PROCEDURE

For starting input wheel the pin get locked into the slots of the Geneva wheel and produces the feed until the pin get locked and for 90 degree of rotation the Geneva wheel and other remains constant. As one end of the chain, drive is connected to the shaft of the Geneva wheel by crank mechanism and other to the cutter with lever mechanism. So when feed is produced the chain which connected to the shaft start rotation and carries out the feed to the other end through the chain and remains still until the drive pin get locked to the next slot. The crank lever which is place perpendicular to the chain drive and Geneva mechanism start oscillation and cut down the paper feed from which was produced by the Geneva mechanism.

6. CALCULATION

Wheel radius=6

$6 = \sqrt{(7.5^2 - R^2)}$
R= 4.5cm approximate
P=Radius of crank pin is .6cm
Width of slots is
w=0.6 + 0.2
w= 0.8cm where t is .2cm that is tolerance in slots
h= (4.5 + 6) – 7.5
h= 3cm, where S is distance from the Geneva center to slots inner position
Number of slots in Geneva wheel $n = 4$
Stop arc radius y = 5.25cm Clearance Arc v = 0.0875

Power rating of motor =100 W
Current =0.7amp, Voltage= 220V
Speed of motor =50rpm
Torque rating =3kg-m
No of Gears =03
Diameter of Gears Bigger one = 8cm, Smaller one =3cm, Intermediate gear = 5cm.

Teeth on Gears Bigger Gear =67, Smaller Gear =25, Intermediate Gear =45.

Chain Geometry

Width b/w roller link plates =0.4cm

Pitch distance =1.5cm

Roller diameter =0.8cm

Bushing diameter =0.4cm

Roller link plate length =02cm

Thickness of Roller link plates =0.2cm

Paper Roller on which the size of paper depends is given as follows

Circumferences =3cm

Length = 12cm

Column structure

Bigger column height =30cm

Smaller column height= 13cm

Material Table No. 01

S. No	Components Name	Material Used	Specification
1.	Geneva Wheel	Plastic	90 MPa CYS
2.	Gear	(Acrylic)	55 MPa CYS
3.	Chain	Plastic(Nylon	11kg/cm
4.	Scissor	Steel (SS)	80 MPa
5.	Sprocket	Steel	55 MPa CYS
6.	Crank	Plastic	570MPa CYS
7.	Paper Guide	Cat iron	
8.	way	Galvanised	
9.	Paper Roller	iron	80lbs/kgf
10.	Spring	Wood & Iron	220Mpa
11.	Base or	rod	560MPa
	Foundation	Steel	
	Column	Wood	
		Cast iron	

7. CONCLUSION

The feed, which came from the Geneva mechanism carried by the chain drive, is cut by the crank lever mechanism, which is at the end of the chain drive. By using this model, we can get the same length of feed at same 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 crank can be increased by increasing the radius of the crank and the length of the lever cutter and by changing the number of slots on Geneva wheel. The angular velocity and angular acceleration can be observed for each link by designing the entire model in solid works and then calculated the analysis for each link.

8. REFERENCES

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