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Design and Fabrication of Paper Cutting Machine using Geneva Mechanism

Sagar R. Patil¹, Fenil Y. Manani¹, Nikhil R. Mhatre¹, Abhishek P. Poojary¹, S. M. Gaikwad²

U.G. Student, Department of Mechanical Engineering, Mahatma Gandhi Mission's College of Engineering and Technology, Kamothe, Navi Mumbai, India¹

Professor, Department of Mechanical Engineering, Mahatma Gandhi Mission's College of Engineering and Technology, Kamothe, Navi Mumbai,, India²

ABSTRACT: The main principle of the project is to reduce the human fatigue and time consumption by eliminating the marking time required to cut paper in equal lengths. Our proposed system cuts variable size paper in equal and accurate dimensions based on Geneva mechanism. Geneva mechanism converts continuous rotary motion into intermittent rotary motion. We use a shaft which is in association with the rotating handle. This shaft has a connecting rod (string) which is connected to a scissor in order to drive the cutting mechanism for cutting paper. This shaft is connected to a sprocket which is in turn connected by a chain to another sprocket. This sprocket is now connected to a Geneva wheel. This wheel is used to drive paper feed into the cutter mechanism. The paper cutting is achieved by crank and rocker mechanism. The cutter will be restored back to its original position by a restoring spring. Here we use Geneva mechanism driven by another connecting rod. This mechanism ensures paper feed of equal length inserted at proper time intervals. System uses a supporting frame that maintains proper coordination between feed and cutting mechanism. It proves to be low cost solution in production and can be used in educational institutes, stationary shops, small scale industries.

KEYWORDS: crank and rocker mechanism, Geneva mechanism, sprocket, paper roller

I. INTRODUCTION

The task of a mechanical engineer is to synthesize and implement a particular mechanism so as to get a particular output and to remodel or to develop combination of two or more different mechanisms to get the same output. The mechanisms which we have used in our project are Geneva mechanism and crank and rocker mechanism that we learnt in Theory of Machine-1.

GENEVA MECHANISM

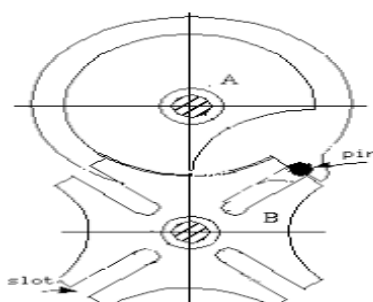


Fig.1 Geneva mechanism

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Geneva mechanism (Fig.1) is a mechanism that translates a continuous rotation into an intermittent rotary motion, using an intermittent gear where the drive wheel has a pin that reaches into a slot of the driven wheel and thereby advances it by one step, and having a raised circular blocking disc that locks the driven wheel in position between steps. The Geneva wheel is a cam like mechanism that provides intermittent rotary motion and is widely used in both low and high-speed machinery. The name derives from the device's earlier application in mechanical watches as a stop to prevent over winding of watches, it is now extensively used in automatic machinery. Geneva drive is also called as Maltese cross due to its visual resemblance when the driven wheel has four slots.

There are 3 types of Geneva drive: -

1. External Geneva mechanism

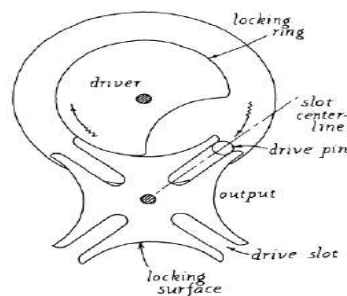


Fig.2 External Geneva mechanism

In this type of mechanism (Fig.2), the Geneva cross is connected with cam drive externally which is the most popular and can withstand higher mechanical stresses. The driver grooves lock the driven wheel pins during dwell. During movement, the driver pin mates with the driven-wheel slot.

2. Internal Geneva mechanism

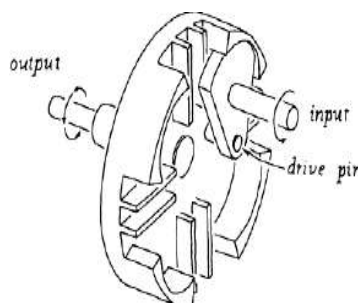


Fig.3 Internal Geneva mechanism

In this type of mechanism, the Geneva cross and cam drive are connected internally in the closed box. The driver and driven wheel rotate in same direction. The duration of dwell is more than 180° of driver rotation.

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3. Spherical Geneva mechanism

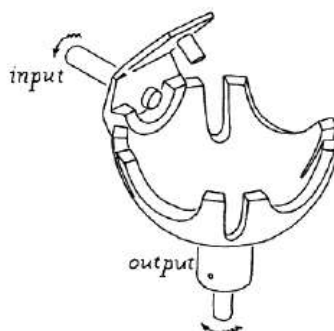


Fig.4 Spherical Geneva mechanism

In this type of mechanism(Fig.4), the Geneva cross is in spherical shape and camdrive are connected in externally, which is extremely rare. The driver and driven wheel are on perpendicular shafts. The duration of dwell is exactly 180° of driver rotation.

From the above mentioned 3 types the external type Geneva mechanism is used in our project since it can withstand high mechanical stresses.

CRANK AND ROCKER MECHANISM

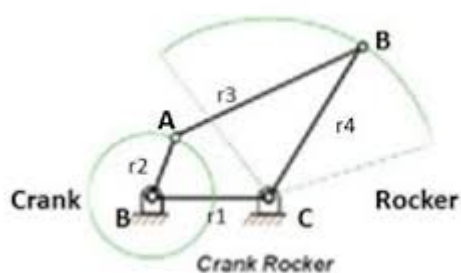


Fig.5 crank and rocker mechanism

In this mechanism (Fig.5), for one complete rotation of the crank the rocker oscillates which help in the cutting action of the paper.

II. LITERATURE SURVEY

Vijay Kumar U, Ghanshyam Kumar and Dharesh Bansod [1], studied that their machine overcomes the demerit by compact size, less cost no need for skilled people and there is no need of electrical input. The main aim of their machine is to reduce timing for paper cutting and neglect the time for marking the paper. This aim can be achieved by this machine.

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Ajay S. Parmar, Amar Singh and Avinash Singh [2], concluded that 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, they 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.

S R Durai and Arun kumar [3], concluded that their machine is very useful for small and medium scale industries. This machine is used to cut the paper and small thickness of sheet. Therefore, there may be the chances of increase in production rate by simultaneously cutting the number of sheets in a single pass. Reduction of man power. Reduction in cost as compare to conventional machines. Is the major advantage of this project.

Rakesh Prajapati, Purvik Patel and Saurabh Modi [4], concluded that the paper feed is adjusted by changing the circumference of the roller. Thus the paper cutting in accurate dimensions without marking the paper is achieved by getting the intermittent motion by Geneva mechanism. This intermittent motion is used to feed the paper between the cutting periods of the crank and lever mechanism.

Kalisindhur et al. [5], designed a mechanism for cutting by giving intermittent feed. This intermittent feed is given by continuous rotation of circular disc in Geneva mechanism. He 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.

III. EXPERIMENTAL SETUP

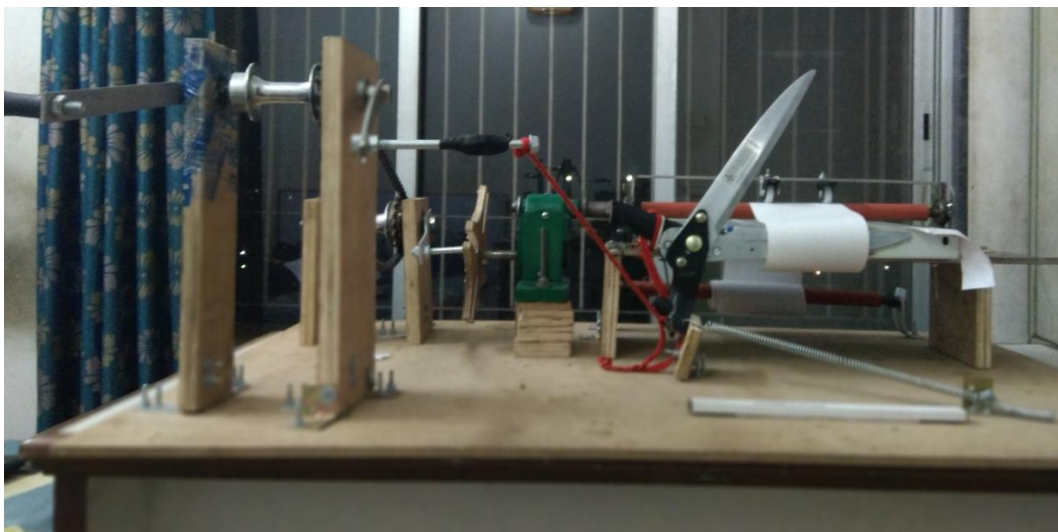


Fig. 6 side view of the machine

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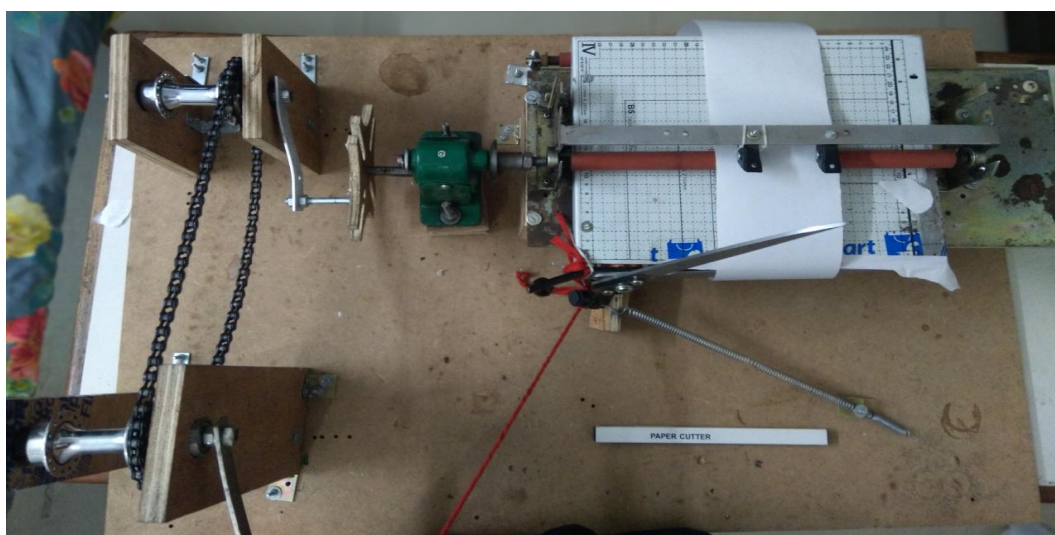


Fig. 7 top view of the machine

Overall size of the machine L 36" x W 24" x H 12"

Components used in the machine setup and specifications: -

Sr no.	Name of component	Quantity
1.	Front wooden support H12"x W4.5"	2
2.	Back wooden support H7"x W4.5"	2
3.	Front handle 9.5"x 0.5"	1
4.	Scissor handle 7"x 0.75"	1
5.	Scissor 52.6cm x 18.6cm x 6.5cm, 1kg	1
6.	Geneva 5" x 1"	1
7.	Bearing 6200 ID 11mm OD 33mm	6
8.	Roller chain	1
9.	Shaft	1
10.	L clamp 1" x 1" L clamp 1.5" x 1.5"	6 6
11.	Pinch roller	2
12.	Screw Self-tapping screw BIG M 4x13mm Self-tapping screw MEDIUM M 4x9.5mm Self-tapping screw SMALL M 4x6.5mm	4 dozen 1 dozen 1dozen 1 dozen
13.	Nut bolt 6"	2
14.	Wiser 6"	2 dozen
15.	Spring	2

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IV. WORKING

In the most common arrangement, the driven wheel has four slots and thus advances by one step of 90° for each rotation of the drive pin. The machine proposed by us also has four slots on Geneva wheel but it advances by 180° for each rotation of the drive pin. That is the basic machine uses 90° of rotation of Geneva wheel for feed and rest 270° (dwell) for cutting operation whereas our machine uses 180° for feeding and rest 180° (dwell) for cutting. Our machine primarily focuses on cutting of A4 size paper (29.7 x 21 cm) in equal intervals of time and with good accuracy.

The following steps can be seen as the handle is rotated in clockwise direction: -

1. When the driver pin is in top position i.e. engage position, the crank will be at the bottom position. here the scissor is in full open position and the paper is fed into the cutter.
2. When the driver pin is in bottom position i.e. disengage position, the crank will be at the top position here the scissor is in full cutting position and accordingly the paper is cut.

In this way the A4 size paper cutting is obtained by the above mentioned steps.

V. RESULT

The size of the paper which we obtained after the experiment is similar to that of the A4 size paper when compared with standard size of A4 paper. The feed which we get from the roller which is driven by Geneva mechanism is 29.7cm (which is length of the A4 size paper) and hence the scissor is able to cut A4 size paper.

VI. CONCLUSION

By using the above proposed machine, we can get the same length of feed and cutting in equal intervals of time. The aim of this machine is to reduce the timing for paper cutting and neglect the time for marking the paper. Further, variable sizes of paper can be obtained as per the need of the user just by changing the setting of the machine i.e. either by,

1. Changing the no. of slots on Geneva wheel
2. Changing the depth of slots on Geneva wheel
3. Increasing or decreasing the radius of the driver pin
4. Changing the length of the cutter
5. Changing the radius of paper roll

There are other paper cutting machines which have demerits like bulky in nature, costly, need skilled labour to operate and mainly it needs electrical input. But our machine overcomes the demerits of those machines up to a greater extent that is it does not require skilled labour to operate, cost effective, not bulky in nature and mainly it does not require any electrical input or power supply.

As we know that the the basic machine uses 90° of rotation of Geneva wheel for feed and rest 270° (dwell) for cutting operation whereas our machine uses 180° for feeding and rest 180° (dwell) for cutting. So it can be seen that dwell angle for Geneva wheel is reduced by 90° and the feed angle for Geneva wheel is increased by 90° which assures reduction in time for paper cutting and increasing the length of feed of the paper.

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