IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 7.105 ⁜ Vol. 9, Issue 4, April 2022

DOI: 10.17148/IARJSET.2022.9451

DESIGN AND FABRICATION OF PAPER PUNCHING MACHINE USING GENEVA MECHANISM

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Abstract: The Geneva mechanism converts continuous rotation into intervals of rotary motion. The drive wheel of the Geneva mechanism is fitted with a pin which rotates and moves the driven wheel in an intermittent manner. A circular disc on the drive wheel locks the driven wheel in place between each rotation. The Geneva drive design features four slots on the client wheel, which advances the drive one step at a time for every full revolution of the master wheel. If the steering wheel has n number of slots, it advances by 360°/n for each complete rotation of the propeller wheel. This mechanism employs two shafts, one of which is driven and the other is driving. The driven shaft has radial slots in which the pin can contact. The pin enters one of the slots and, when the driver is rotated further, it drives into the slot and rotates the follower. This mechanism has several advantages, including the fact that it is the simplest and least expensive of all intermittent motion mechanisms, and that it can be built in a number of sizes depending on the application.

Keywords: Geneva, Mechanism, drive, wheel, rotation, slot, pin, intermittent, motion.

I.INTRODUCTION

Geneva mechanism is commonly used indexing mechanism where an intermittent motion is required [1]. Due to the fact that the Geneva mechanism does not have any unusually curved profiles, it is usually relatively easy and inexpensive to design and fabricate. A traditional Geneva mechanism differs from the others since it involves discontinuous acceleration at the starting and ending points [2]. Geneva Drive consists of driving crank and driven crank. The driving shaft's motion causes the client shaft to shift, resulting in intermittent motion of the driven shaft [3]. The fact that it is the simplest and least expensive of all intermittent motion mechanisms, and that it can be constructed in a number of sizes ranging from the size of instruments used in timepieces to the size of spindle carriers in conveyer belts, are just a few of its benefits [4]. Geneva maintains good load management at all times since it is fitted with locking ring surfaces. This mechanism's key advantage is that it may be utilised in conveyer belts capable of hauling loads weighing several tonnes [5]. This mechanism will mostly be used for punching in the paper punching sector. The fabrication of this equipment is cost efficient [6]. The main objective of this project is to minimize the human intervention in industries like paper production and to decrease the time for production [7].

II.METHODOLOGY

Assembly and working

1. Initially, a metal frame is built on which a wooden base is fixed.
2. An elevated stand is fixed with rollers for the paper to roll.
3. One of the roller is equipped with a sprocket which is connected to the Geneva drive wheel.
4. The Geneva drive wheel and driven wheel are fixed on the top part of the frame.
5. The Geneva driven wheel is welded with a sprocket.
6. The sprocket on the Geneva driven wheel is connected to the sprocket which is attached to the roller by the help of a chain
7. The Geneva drive wheel is equipped with a vertical rod which comprises of a punch tool.
8. When the Geneva drive wheel rotates, the punch tool moves to and fro in vertical direction making a punched hole on the paper.

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9. In the later part of the rotation of the drive wheel, the driven wheel gets rotated and the sprocket rotates the roller which moves the paper roll and makes the next part of the paper ready for punching.
10. Finally, this process gets repeated and the holes are punched at equispaced distance.

Software used for design
1. Siemens NX 12.0 is used to design each and every individual component of the project.
2. The individual components are also assembled in Siemens NX 12.0
3. Some of the commands used to design the components are Sketch, Profile, Line , Rectangle, Circle, Extrude, Revolve, Offset etc.,

III.DESIGN OF PUNCHING MACHINE

Siemens NX software is a flexible and powerful integrated solution that helps you deliver better products faster and more efficiently. NX delivers the next generation of design, simulation, and manufacturing solutions that enable companies to realize the value of the digital twin. This feature is very useful in companies that work in R&D. Since most automobile and aerospace industries need to be competitive. NX is formerly known as "unigraphics", is an advanced high-end CAD/CAM/CAE. It is used, among other tasks, for Design (parametric and direct solid/surface modelling), Engineering analysis (static; dynamic; electro-magnetic; thermal, using the finite element method; and fluid, using the finite volume method), Manufacturing finished design by using included machining modules. The design of all the parts of the paper punching machine are done in NX unigraphics and the Geneva mechanism is also designed using NX unigraphics.

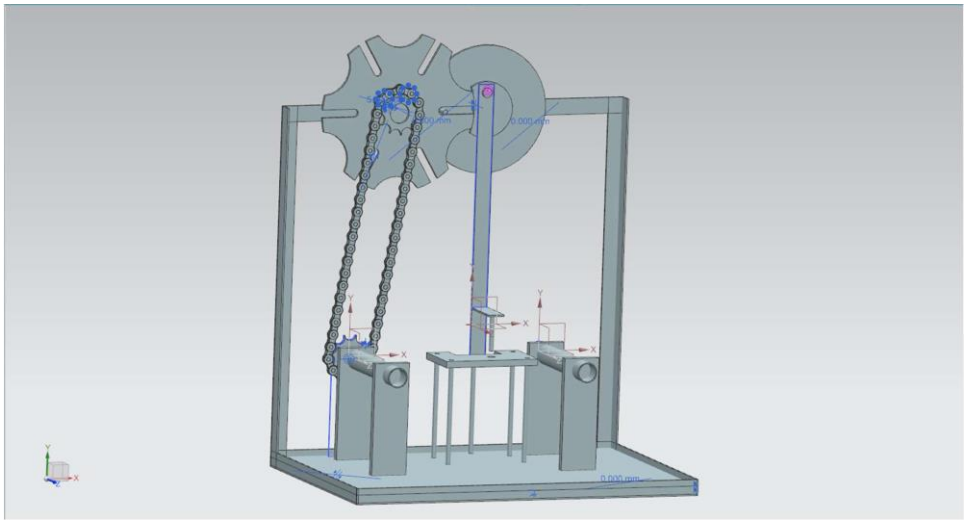

Fig. 1 Punching Machine designed in NX unigraphics

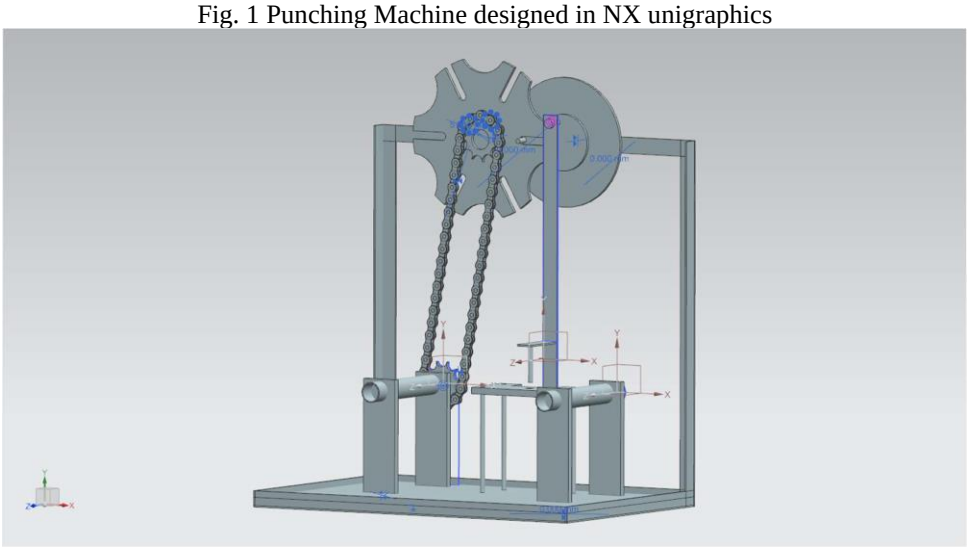

Fig. 2 Punching Machine designed in NX unigraphics

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IV.MATERIALS

The Raw materials for the fabrication of the punching machine are:

- Mild steel
- Wooden base
- Sprocket
- Chain
- Punch tool
- Rollers

V.ANALYSIS

The angular displacement and the angular velocity of the different links in the Geneva Mechanism are determined using the load transfer feature in the NX unigraphics. This requires the simulation of the basic Geneva mechanism featuring all the links and the joints of the mechanism. The mechanism is designed in NX unigraphics.

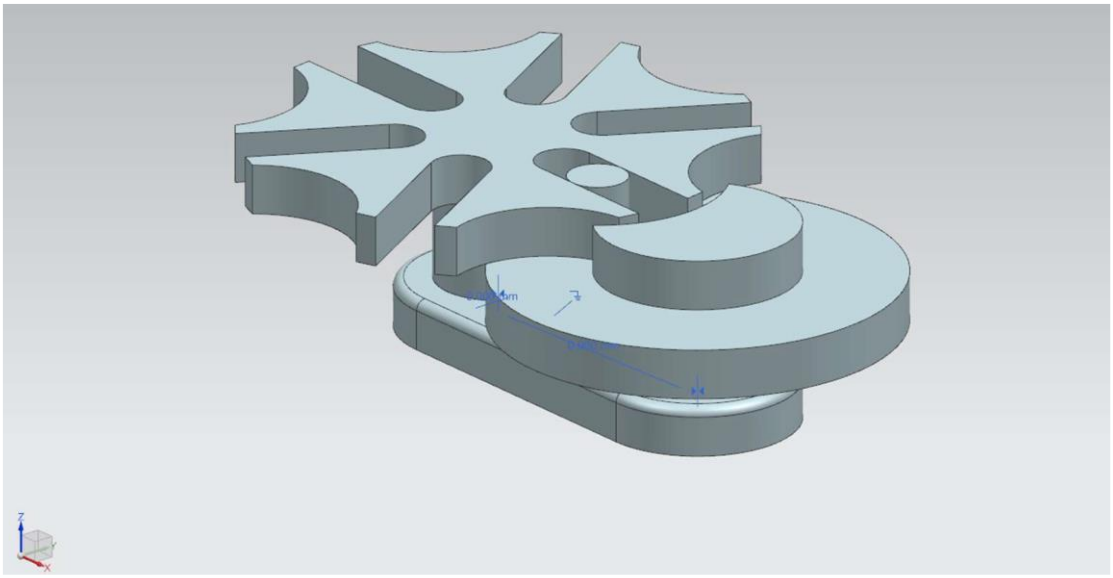

Fig. 3 Design of Geneva Mechanism using NX unigraphics

The angular velocity and angular displacement graphs for each link are derived as follows.

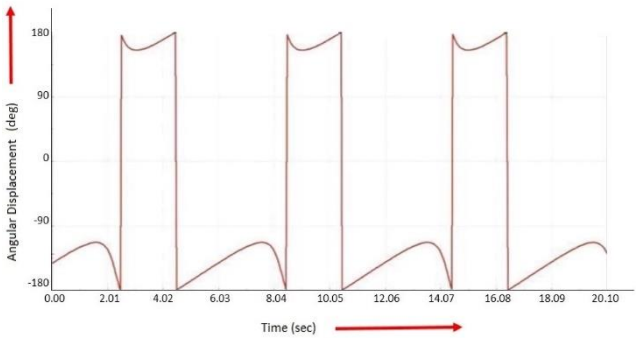

Fig 4. Angular Displacement vs Time of slider

From graphs Fig 4 [1]. describes the change in angular displacement of the slider vs time. From graph Fig 4. it can be seen that the slider's angular displacement was greater on its return stroke than on its forward stroke and even the angular velocity is acted in the same way which is shown in graph Fig 5, the slider's velocity of in the return stroke is higher compared to that of the forward stroke.

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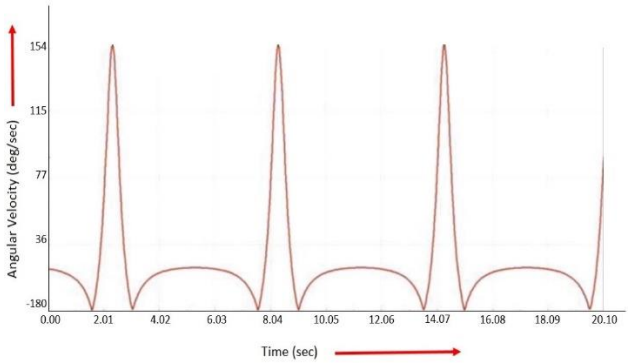

Fig 5. Angular Velocity vs time of slider

Fig 5 [1]. Describes the change in angular velocity of slider vs time. From graph Fig 5. it can be seen that the slider's angular velocity was greater on its return stroke than on its forward stroke the slider's velocity of in the return stroke is higher compared to that of the forward stroke.

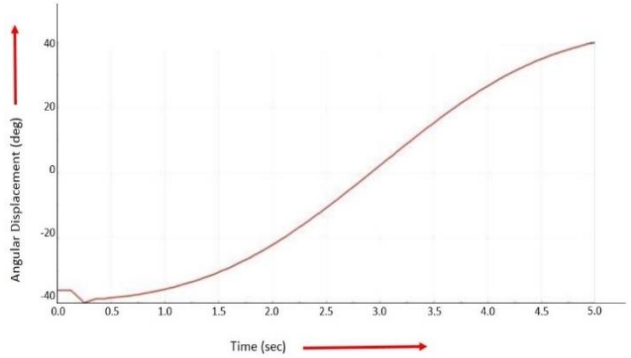

Fig 6. Angular Displacement vs time of Geneva Wheel

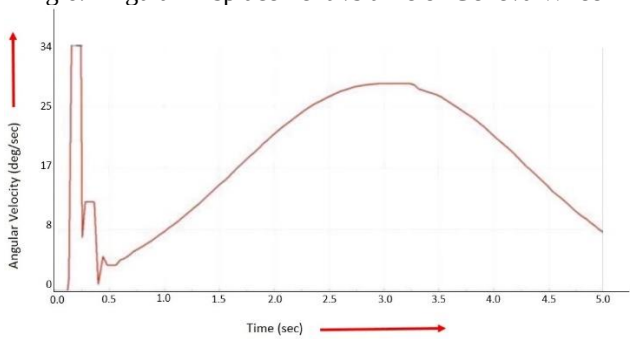

Fig 7. Angular Velocity vs time of Geneva Wheel

The graphs Fig 6 [1]. and Fig 7 [1]. shows the angular displacement and angular velocity of the Geneva wheel. From Fig 6. 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. The graph Fig 7. 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.

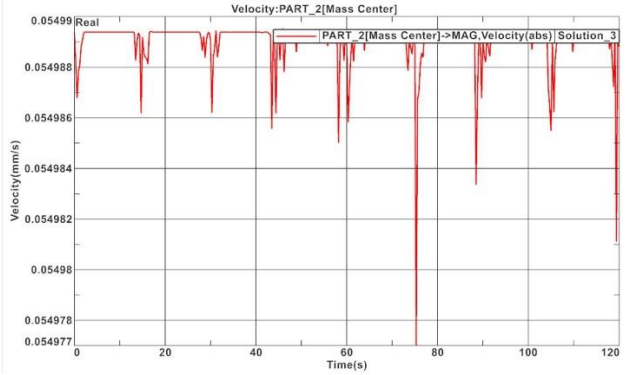

Fig 8. Velocity vs Time of crank and base

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VI.CONCLUSIONS

In this paper, the study and working of the paper punching machine using Geneva mechanism led to the following conclusions

- A paper punching machine built in accordance with the Geneva Mechanism ensures the safety of operator.
- The energy required for driving the machine is very less comparatively
- The punching machine punches equidistant holes accurately with alignment
- Decreases the operation time of punching and very efficient as compared to manual punching

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