



Mini Conveyor Belt Using Geneva Mechanism

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ABSTRACT

Geneva mechanism is a method to transform continuous circular motion into intermittent/fixed step circular motion i.e. a circular motion produced in equal intervals of time and resulting in the same displacement. conveyor belt is basically a linear belt usually made up of rubber or plastic compounds (of high strength) combined with one or more layers of fabrics such as nylon, polyester, neoprene, or nitrile. It has a basic function of transporting material from one point to another. A simple Geneva mechanism consists of a drive wheel (connected to motor) and a driven wheel (connected to belt pulleys). The drive wheel is a disk with a pin or a shaft near its circumference. The driven wheel consists of several slots. The drive wheel is kept next to the driven wheel in such a way that when the drive wheel is rotated, the pin or shaft fits inside the slot of driven wheel. As it reaches the inner most point of the slot, the pin exerts a force on the driven wheel. As the driven wheel is pivoted from the center, a moment is produced which causes the generation of a torque, leading to the rotation of the driven wheel and the pulley attached to it. Hence, there is an intermittent circular motion in them resulting in the movement of the belt. There are several types of Geneva rotator such as external Geneva rotator, internal Geneva rotator and spherical Geneva rotator. The mechanism that will be using for the conveyor belt is of an External Geneva rotator in which the rotating drive wheel interacts with the driven wheel externally. This mechanism results in instantaneous motion at regular intervals and can withstand higher mechanical stresses. The mechanism has numerous applications in many industries especially inexpensive mechanisms. We successfully done the fabrication and demonstrated the working of mini conveyor belt using Geneva mechanism.

Keywords: Geneva mechanism, Drive wheel, Driven wheel, Geneva rotor, External Geneva rotor, conveyor belt, Circular motion, Intermittent/fixed step circular motion.

1. INTRODUCTION

The Geneva Mechanism are Maltese cross gear mechanism which translates rotary movement into intermittent rotary motion. The Rotating wheel is equipped with a pin that reaches into a slot located in other wheel (driven wheel) that will move step by step at intervals of time that driver wheel has a circular block disc. Which is elevated and it locks while rotating the driver is positioned between the steps (slots) Geneva mechanism also known as Geneva stop, most commonly used devices for producing alternate period of motion and rest with no reversal in direction it also used for indexing (rotating a shaft through a recommended angle. Geneva Mechanism is frequently used in mechanical watches, since it can be made small and with stand substantial mechanical stresses. Geneva Mechanism has three main components – Geneva wheel, Drive Wheel and Drive Pin. Geneva Mechanism has used in many industries in movie projector, Mechanical watches, indexing tables in assembly lines, tools changers for CNC machines, pen change mechanism in plotters, automated sampling devices, bank note counting machines and many forms of manufacturing machines. Here Geneva Mechanism used in auto machine line to translate continues circular motion into fixed step circular motion. The mechanism has numerous applications in many industries especially in automobile industries due to the simple and inexpensive mechanism technique.

1.1 Geneva Mechanism

The working of Geneva mechanism was stated earlier; a continuous rotary motion is converted into the intermittent rotary motion. The 5V DC Motor is connected with the Geneva drive wheel. The voltage of the motor is being monitored and supplied by the bench top DC power supply. To control the direction of the rotation of motor, without changing the way that the leads are connected, an H-Bridge circuit can be used. Andrio microcontroller or a regulator (rheostat) can be used to vary the speed of motor. The Geneva drive wheel consists of a pin and the Geneva driven wheel consisting of 4 slots. When Voltage is applied to the motor, it rotates, making the drive wheel rotate as well. When the pin of drive wheel inserts in a slot of the driven wheel, it causes the latter to rotate. The Geneva driven wheel is coupled to a crowned flat belt pulley. When the driven wheel rotates, this pulley also rotates and as the pulley at the other end of the belt is free to rotate as well, motion is induced in the belt. Hence, an object placed on the belt can now be transferred from one position to the another.

1.2 Conveyor Belt

Conveyor belt is the carrying medium, A belt conveyor consists of two or more pulleys with a closed loop of conveyor belt medium the conveyor belt rotates about the pulleys one or both pulleys are powered moving the belt, and the material on the belt moves forward. The powered pulley is drive pulley. Belt conveyors has been in use since the 19th century First conveyor is used for coal mines in 1913. Belt conveyor belt is made of PVC and Rubber Material and thickness from 1mm to 5mm and length from 1M to 2000M and it can vary Up to 400kg weight according to the belt usage. And general purpose rubber is the most common type of rubber conveyor belt and it is used when special properties are not needed To suit an application. Grade n number is lower quality and M number has greater hardness and it is more resistant and is superior in strength when compared to grade N. Black and green belt.

1.3 Crowned Pulleys

Crown faced pulley changes in diameter from the outer edge surface to the center of the pulley, with center being slightly larger in diameter than the edge diameter. A straight-faced pulley is same diameter across the face of the pulley. The crown of the pulley creates a area higher tension in the center of the belt providing a point of balance in the tensile members across the width of the belt. If the belt venders one side, then it creates improper balance in these tension and stress in the belt.

1.4 Dc Motor (5v)

DC Motors are electrical machine that converts the electrical energy into mechanical energy and the motor speeds up to 2000 rpm and the voltage is 5V. DC represents to direct current, motorized connected to a battery by means of leads for supply power to the motor from the battery and the electrical motor operated using direct current are called as DC Motors.

1.5 Frame/Stand of The Mechanism

The part which bares the load of all the components as they are mounted on it that is called frame. The frame material has the capability to endure the loads and to work components placed on the frame/stand. The material can be metal or wooden frames as they used wooden frame because it is in expensive and simple It consists of rectangular base with six vertical rectangular columns (one column for the Geneva drive wheel, one column for the driven wheel and four for the belt and pulleys fixed on). Here they used wooden frame to withstand the load of the components and to work on the frame and if the wirings between motor and drive wheel get exposed and touch the frame there will be no danger of getting electric shock.

2. LITERATURE REVIEW

HASSAN AYUB KHAN et.al [1] Proposed Geneva mechanism is a system to convert continuous circular motion into fixed step circular motion. Geneva mechanism requires a rising circular connector extending above the rotating disc to lock between slots in the Geneva wheel and drive it. So here we propose a conveyer belt that moves products at regular time intervals, as needed by many automation lines. Our system uses a motorized disc to drive the Geneva wheel. The Geneva wheel is thus driven at regular time intervals. The wheel is connected to rollers mounted with conveyer belt. As the wheel rotates the belt also rotates at fixed intervals.

K.C. BALA et.al [2] say's. It is aimed at solving relative industrial and manufacturing problems such as product pilferage, inefficient supervision, monitoring and workmanship. It is also to improve production management system, using ICT based platform to enhance monitoring control and data acquisition system in manufacturing process. ASSEMBLY programming language was used on a programmable logic controller microcontroller for control and monitoring protocol. The method includes: simulation, counting and signaling wireless system containing sensors and a wireless radio frequency transmitter and receiver. Design calculation analysis, fabrication and operational tests were carried out on the development mini conveyor response to display time on LCD is approximately 1. 0 second. The developed mini-conveyor system is able to remotely monitor a product on a communication distance of 22 meters in which the required information is displayed on computer screen on a telnet Hyper-termina platform product monitoring control and data acquisition in material handling systems in the industries for more accountability.

NAI VAGESH RAMANBHAI et.al [3], Discuss that aim of the project of is can do different types of operation in one mechanism. The working principle of this model is based on Geneva mechanism. This project would be further beneficial in sustainable development for production industries.it is the main purpose of our project.

11 SHREYA S. CHAVAN et.al [4] Say's is valuable to cut papers in equivalent and exact measurements. Geneva drive is an ordering Mechanism that changes over ceaseless movement into irregular movement, Due to which paper is moved between the equivalent time frames period. Then, at that point the paper cutting is accomplished by wrench and switch instrument. The shaper will have returned to its unique position y switch wrench instrument. The target of this idea is to plan the Geneva instrument worked paper cutting machine which takes out the most time taking cycle of paper checking and helps in feed equivalent measurement paper in every turn. This machine is utilized to decrease the manual work of paper cutting, and furthermore efficient.

TAHER-M ABDUL LEDEH et.al [5], Say's are present in automation , robotics, mechanical transmissions, continuous variable transmissions, old clocks, especially when it comes to transmitting forces and high moments, being used instead of or with the gears. The geometry of the mechanism

consisting of two elements, the kinematics and the forces appearing in this mechanism with a fourth-class upper coupler, are studied very briefly. By studying the forces that appear within the mechanism couple, a dynamic study is also carried out.

P. KALI SINDHUR et.al [6] Proposed. 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.

E. KAVITHA et.al [7] Say's the time for job setting, marking, stamping, labor cost and maintenance cost decreases. In this research work, designing and fabricating the prototype of automatic stamping machine using Geneva mechanism is done. This work is specially designed for automatic stamping on papers and metal sheet. The major components involved in this work are dc motor, cam arrangement, chain drive, Geneva mechanism and stamping tool. In this project we are using three rollers for moving the sheet during operation. The cam has a pin which rotates the Geneva wheel. The Geneva wheel is attached to the chain drive. The other end of the chain drive is connected to the rollers which roll the metal sheet or papers and the stamping operation is performed by the stamp tool. It is suitable for making mass production of sheet stamping.

LAKILAN et.al [8] Discussed about the design and implementation of automated multiple water filling machine using Geneva mechanism. Generally, the function of the machine is to fill the water automatically into bottles through a moving bottle plate. This project is the combination of Geneva and electrical motor system. This project is divided into four sections, the loading section, the bottle plate section and filling section, where the whole sections is controlled by Geneva. The entire system is more flexible and time saving.

R. DURAI RAJU et.al [9] Proposed the paper presents some aspects theoretical and practical based on the finite element analysis and modelling of Geneva mechanism with four slots, using the CATIA graphic program. This type of mechanism is an example of intermittent gearing that translates a continuous rotation into an intermittent rotary motion. It consists of alternate periods of motion and rest without reversing direction. In this paper, some design parameters with specify a Geneva mechanism will be defined precisely such as number of driving cranks, number of slots, wheel diameter, pin diameter, etc. Finite element analysis can be used for creating a finite element model and visualizing the analysis results.

T.K. ARAVINDHAN et.al [10] Say's the paper presents briefly a mechanism with a cross of Malta. The mechanisms with a Maltese cross (Geneva driver) are present in automation, robotics, mechanical transmissions, continuous variable transmissions, old clocks, especially when it comes to transmitting forces and high moments, being used instead of or with the gears. The geometry of the mechanism consisting of two elements, the kinematics and the forces appearing in this mechanism with a fourth-class upper coupler, are studied very briefly. By studying the forces that appear within the mechanism couple, a dynamic study is also carried out.

M.V. INGALKAR et.al [11] Proposed Geneva drive is a gear mechanism that translates a continuous rotation into an intermittent rotary motion. The rotating drive wheel has a pin that reaches into a slot of the driven wheel advancing it by one step. This project will determine angular velocity and acceleration of the Geneva wheel and determine the transport time of the object to cover the entire conveyor. It will also prepare 3D modeling of the Geneva Operated Roller Conveyor using CATIA V5 R20 software.

FIROZ. D. CHOKI et.al [12] Say's Geneva mechanism is a type of indexing mechanism that converts continuous motion into stepwise circular motion. Belt conveyor systems are mechanical systems used to carry material from one place to another. This project aims to increase the dwell time or delay time of belt conveyors during various processes such as bottle filling, box packaging, and material filling in the boxes.

R. SYAM SUDHAKAR RAO et.al [13] Discuss project is designed to introduce automation in industries by designing and fabricating a prototype of Auto roll punching machine using Geneva mechanism. The major components are a dc motor, cam arrangement, chain drive, Geneva mechanism and punching

tool. Two rollers are used for moving the sheet during operation, and the Geneva wheel is attached to the chain drive. The punching operation is done by the punch tool and is suitable for mass production of sheet metal punching.

ESWARA MOORTHY.C et.al [14] Say's the Geneva conveyor is a conveyor used for material handling and noise reduction in industries. It consists of motor, rollers, belt and IR sensor. The roller shaft is linked with the Geneva drive shaft, which rotates with a required time of stop according to the Geneva drive and the belt moves along the rollers. With the assistance of Geneva drive, the time stopping can be achieved which avoids the use of stepper motor. The main aim of this project is to optimize the measuring length of work pieces and reduce the noise of conveyor. Automatic system via pneumatic comparators is used in the Project. Automation has a notable impact in a wide range of industries beyond 13 manufacturing. Filling is a task carried out by a machine that packages liquid products such as cold drinks or water. Humans were the main method for controlling a system. Electrical has been used for control and electrical control is based on microcontrollers for various purposes. Automation in bottle filling industry comes with increased electrical components. This study focuses on design, fabrication and control system for automated bottle filling system, which includes C programming in Arduino microcontroller to control various components. A conveyor system with sensors and electromagnetic valve is fabricated for this purpose. This proposed system is meant for small industries and aims to eliminate problem faced by small scale bottle filling system. With this system, every process can be smooth and the process of refilling can reduce worker cost and operation cost.

UJAIM A.J et.al [15] Proposed develop a Rig (Geneva Mechanism) for bottle washing in a typical brewery or beverage industry. A test rig was designed, fabricated and employed for a performance evaluation. The rig operates on the intermittent rotary motion from a four slot external Geneva Mechanism and requires manual loading and unloading of bottles. Centrifugal force on the driven pulley was 0.158N, bearing reaction at an end, RB 403.42N, radial

load due to inertia of driver, $FR = 20.90N$, axial load due to weight of Pulley, W , $61.70N$, and bearing load capacity $W_e = 2306.80N$. These forces were related to generate shear force and bending moment diagrams. This work presents a practical application of Geneva mechanism for worktable indexing and bottle washing.

RAHUL PAVASE et.al [16] Proposed on bottle filling and packing process, which must be completed in only 2 steps. The pneumatic solenoid valve is used for filling and cap, and the pneumatic cylinder is fitted at the next station. The machine is designed to increase efficiency and reduce maintenance, and the time setting mechanism is designed to inform the next step for complete the process. In present application machines, sensors are used to detect the bottle and pass information to the next step, but in new design machine sensor are not used.

UTKARSH KAMBLE et.al [17] Say's design procedure and analysis of inclined type belt conveyor system for coal loading application. It includes design calculations of conveyor, trajectory of material on conveyor, power and belt design and stresses on pulley due to belt tensions at and slack and tight side. The belt conveyor used for coal processing industry is considered to have a design capacity of 250 TPH and speed of 115 ft. / min. Geometrical modelling has been done using Catia V5R20 and finite element analysis is done in Solid works 2018. Material weight reduction is accomplished using ASHBY charts and ASME standards and weight optimism and performance index has been discussed.

T. NARAYANA et.al [18] Discuss about Geneva mechanism is used to move components from one place to the other in industries, especially in automobile assembly shops. It is used to stop the conveyor in regular intervals and minimize the workers involved in it. Geneva index plate made with Aluminum alloy material is used in many industries, but its main drawback is its inability to stand heavy loads. To address this, a novel model of Geneva index plate will be developed and an analyzed prototype will be prepared using milling machines.

FLORIAN ION TIBERIU PETRESCU et.al [19] Say's "the mechanism with a Maltese cross (Geneva driver) is used in automation, robotics, mechanical transmissions, continuous variable transmissions, and old clocks. The geometry of the mechanism consisting of two elements, the kinematics and the forces appearing in this mechanism with a fourth-class upper coupler, are studied. A dynamic study is also carried out.

ABHIJIT GAIKWARD et.al [20] Proposed the design calculations and considerations of belt conveyor system for press machines, in terms of length, capacity and speed, roller diameter, power and tension, idler spacing, type of drive unit, pulley location and arrangement of pulley, angle and axis of rotation, control mode, intended application product to be handled, and maximum loading capacity. The successful completion of the project will help to develop an automated belt conveyor system which is fast, safe and efficient, reducing human effort and increasing productivity and accuracy.

3. METHODOLOGY

Geneva mechanism, is otherwise called as Geneva Stop, one of the most widely used devices for generating intermittent rotary motion, characterized by alternating periods of motion and rest with no reversal in direction. It is also used for indexing. The mechanism has numerous applications in many industries especially the automobile industry. It is one of the most simple and inexpensive mechanisms.

3.1 WORKING PRINCIPLE

The working of Geneva mechanism was stated earlier; a continuous rotary motion is converted into the intermittent rotary motion. The 5V DC Motor is connected with the Geneva drive wheel. The voltage of the motor is being monitored and supplied by the benchtop DC power supplys to control the direction of the rotation of motor, without changing the way that the leads are connected, an H-Bridge circuit can be used. An Arduino micro controller or a regulator (rheostat) can be used to vary the speed of motor. The Geneva drive wheel consists of a pin and the Geneva driven wheel consisting of 4 slots. When Voltage is applied to the motor, it rotates, making the drive wheel rotate as well. When the pin of drive wheel inserts in a slot of the driven wheel, it causes the latter to rotate. The Geneva driven wheel is coupled to a crowned flat belt pulley. When the driven wheel rotates, this pulley also rotates and as the pulley at the other end of the belt is free to rotate as well, motion is induced in the belt. Hence, an object placed on the belt can now be transferred from one position to the other. Mini conveyor belt using Geneva mechanism as shown in fig-1.

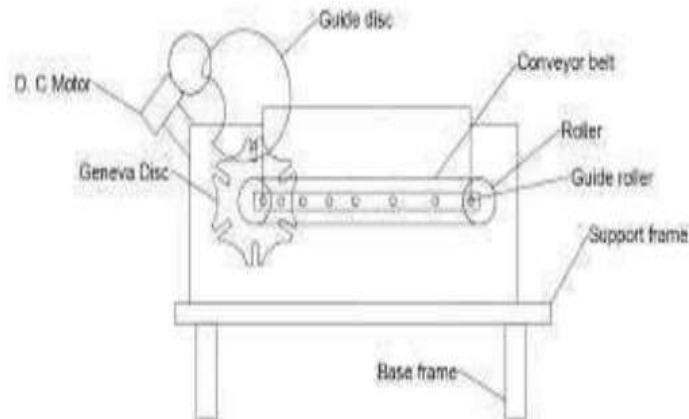


Fig-1 Geneva Mechanism Principal And Working

4. FABRICATION

Main components of Mini project:

- Frame/stand • Geneva plate • Flat belt • Crowned pulleys • 5V DC motor • Rollers • Geneva slot lever

CONSTRUCTION

Step 1: Cut a metal or plastic sheet to the desired size and shape for the base of the conveyor. Drill holes for the motor, wheels, bearings, and other components.

Step 2: Attach the motor to the base using screws and bolts. Connect the motor shaft to the timing belt pulley using a shaft coupler. Step 3: Mount the four small wheels on the base, two on each side. Make sure they are aligned and level.

Step 4: Attach the two large wheels to the shaft of the motor. Make sure they are also aligned and level.

Step 5: Install the Geneva wheel on the shaft of one of the small wheels. The Geneva wheel should be aligned with the large wheels. Step 6: Connect the timing belt to the large wheels and the Geneva wheel. Adjust the tension of the timing belt.

Step 7: Connect the motor to a power source and test the conveyor. The Geneva mechanism should advance the belt in intermittent motion. Step 8: To control the speed and direction of the conveyor, you can use an Arduino board to program the motor as shown in fig-2.



Fig-2 Model of Geneva mechanism prepared

5. RESULT AND DISCUSSIONS:

We successfully fabricated the Geneva wheel and the roller conveyor. The Geneva drive pin would smoothly insert in the Geneva driven slot. One of the crowned pulleys will be screwed to driven wheel, due to which the pulley will be able to rotate along with the driven wheel. The second pulley will be set on the other end of the belt. This results in the movement of the belt which might be a little jerky so proper lubrication between pulleys and belt should be ensured.

CONCLUSION:

We planned to fabricate it for inspection lines by Geneva Mechanism Conveyor Belt, this project can be applied to a larger scale in industries, especially in production lines, where significant amount of labour is used for the material handling purpose. Using this mechanism can cut down the cost of additional labour and also reduce the working time as few workers can complete the operation more efficiently. The primary goal of transporting the materials at regular interval of time will also be achieved.

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