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# Design and Fabrication of paper cutting and stamping machine by using Geneva mechanism

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## ABSTRACT

The design and fabrication of paper cutting and stamping machine using Geneva mechanism is useful to cut papers in equal and accurate dimensions. Geneva drive is an indexing Mechanism that converts continuous motion into intermittent motion, Due to which paper is moved between the equal intervals of cutting period. Then the paper cutting is achieved by crank & lever mechanism. The cutter will be back to its original position by lever crank mechanism. The objective of this concept is to design the Geneva mechanism operated paper cutting machine which eliminates the most time taking process of paper marking and helps in feed equal dimension paper in each rotation. This machine is used to reduce the manual work of paper cutting, and also time saving. This machine is very useful for paper manufacturing industry also we can avoid the human errors and also we can use this equipment also in school, colleges, stationary shop's, paper stores, etc.

## INTRODUCTION

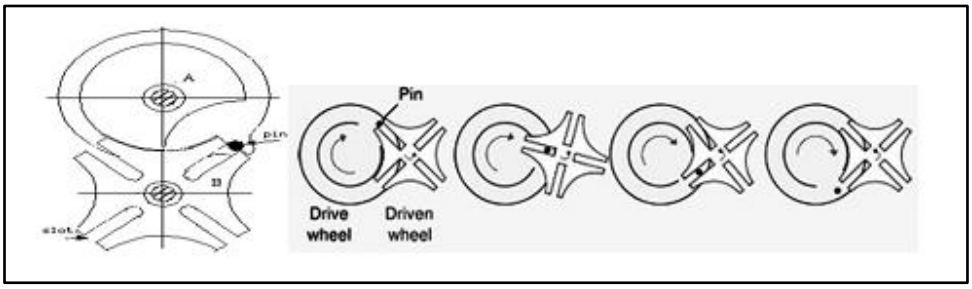
Now a day, there is lot of competition in the market. So there is need of developing a new method or process for effective manufacturing. That process or methods should fulfil the requirement about accuracy Productivity. The paper cutting machine is designed, in order to reduce the time for marking and cutting the papers. Geneva mechanism is commonly used indexing mechanism where an intermittent motion is required. The fabrication of conventional Geneva mechanism is generally simple and inexpensive because there is no special curved profile on any of the components except straight lines and circular arcs. The paper cutting is done by crank and lever mechanism. After cutting, the spring connect to the cutter will bring the cutter back to its original position. The main purpose of this machine is to reduce time for marking the papers. Hence, this is working fully based on timing. This concept will be mainly used in the paper manufacturing industry to cut the papers in huge numbers. The equipment is fabricated in less cost and good efficient. The aim of this concept is to reduce the human fatigue and time savings in industries by eliminating the paper marking time. Here it has analysed to use Geneva Mechanism. This is the mechanism used to get intermittent motions. This mechanism consists of the following parts like Geneva wheel, rotating disc, bearing, frame and DC motor. In industries the paper cutting machines go

through a time taking process of paper marking which is required to cut the paper of required dimensions, so this model is designed by using Geneva mechanism which eliminates the paper marking time and feeds the paper of equal length in each rotation. Geneva mechanism is used as a mechanism for transforming rotary motion into intermittent motion running with acceleration jumps at the beginning and the end of the active phases.

## MECHANISM

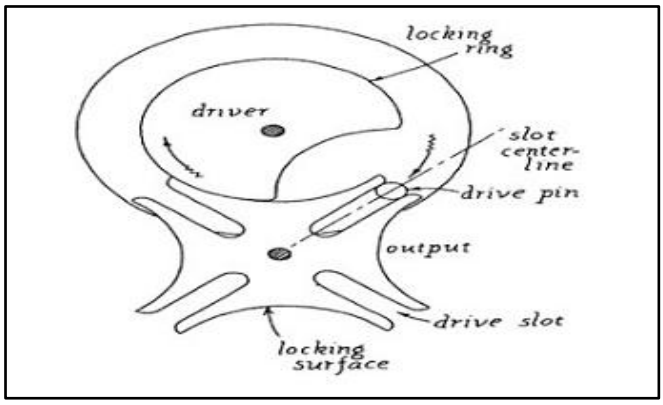
- **INDEXING GENEVA MECHANISM:**

  The Geneva is one of the earliest of all the intermittent motion mechanisms where input is in the form of continuous rotation" it is probably still the most commonly used. Geneva are available on an off the shelf basis from several manufacturers" in a variety of si1es. They are cheaper than cams or star wheels and have adequate to good performance characteristics" depending on load factors and other design requirements.



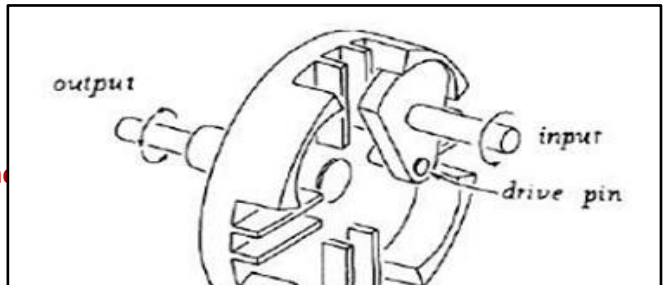

- **EXTERNAL GENEVA MECHANISM:**

  In this type of mechanism, the Geneva cross is connected with cam drive externally which is the most popular and which is represented by the device below fig




- **INTERNAL GENEVA MECHANISM**

  The Geneva cross and cam drive are connected internally in the closed box, which is also common and is illustrated by below.



## COMPONENTS

- **GENEVA WHEEL**

  Geneva wheel has four slots the one step for each rotation is 90 degree therefore, the total rotation advances by 360 degree of the driven wheel.

  The Geneva wheel is connected to the sprockets which rotate by the roller chain. Both the sprockets and roller chain are drive by motor. Geneva wheel also connected to the shaft in which the paper the roll moves towards the scissors.

- **SPROCKETS**

  Sprocket wheel has teeth is mesh with the chain, track or other perforated for indented material. Sprockets are connected to the handle through which can rotate the Geneva wheel.

- **ROLLER CHAIN**

  Roller chain drive most commonly for transmission of mechanical power on many kind of domestic and agriculture machinery including conveyors which is also used in motor cycle, bicycle, cars, etc.

- **ACTUATOR**

  An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a "mover". An actuator requires a control signal and a source of energy.

- **SELF-LINK STAMP**

  The self-link stamp performs the stamping process which is directly connected to the actuator.

- **DC MOTOR**

  In any electric motor operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. Specifications of motor is 12V 4.5amp with 30rpm.

## LITERATURE REVIEW

The design and analysis of paper cutting machine based on Geneva was analysed by J.J. Lee, K.F. Huang,. [1], they presented a comparison of the position, velocity, acceleration, and jerk between the classical Geneva wheel mechanism and the proposed mechanism. This analysis presents a kinematic study of a mechanism incorporating a Geneva wheel and a gear train to achieve intermittent motion and was declared as a designated analysis and succeeded largely due to its positive economic factors. Prof. V. B. Bhandari[3],

The design and fabrication of paper cutting machine using Geneva mechanism is useful to cut papers in equal and accurate dimension. the new design of Geneva drive to reduce the shock loading E.A. Sadek, J.L. Lloyd, M.R. Smith,[2], Mechanism an Machine Theory 25 (1990) 589–595.

Geneva mechanisms involve less jerk in operation and less cost of manufacturing. dijksman et al[3] discuss that with help of Geneva wheel the output motion was jerk less. meter et al[3] conclude that Geneva can be used as timing device and small variation in parameters of system will not affected the Geneva wheel motion. HUBERT W. MEYER JR., [11] "An Analysis of the Geneva Mechanism As a Timing Device", A Project Presented in New york, 1973.

Dickson E.A,[4]design Geneva wheel and for 4 slots of Geneva he found only 0.0014 de/s3 jerk value. Lee,J.J and Jan,B.H[13], generate virtual manufacturing of Geneva wheel. He conclude that with help of CNC program Geneva will made. for the best result.

Hrones J.A and Nelson [6], in their paper on Analysis of the Four-Bar Link age gives review that a 4-bar mechanism is a basic 1-DOF (degree of freedom) mechanism. A 4-bar is created by selecting four link lengths and joining the links with revolute joints to form a loop.

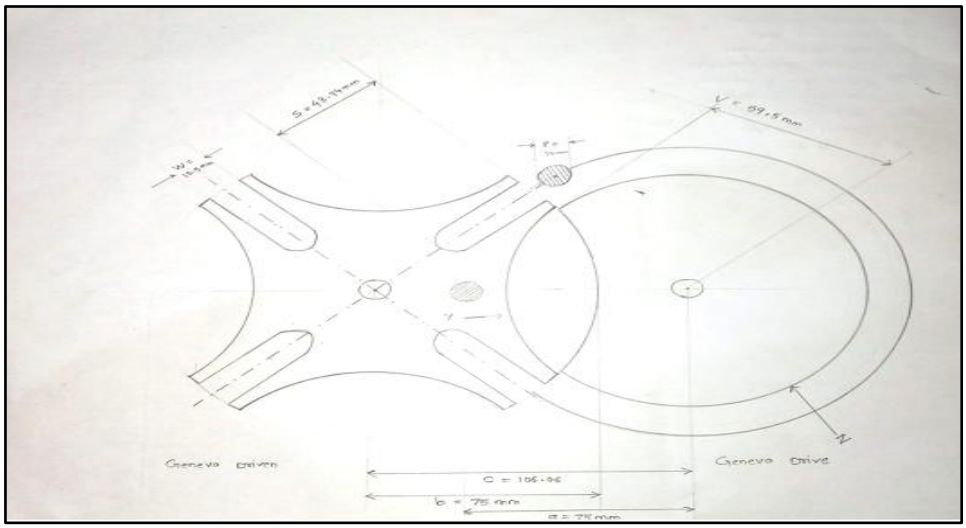
Hubert.W.Meyer Jr,[11], "The analysis and synthesis of Geneva mechanism with elliptical crank has been studied by Han Jiguang Yu Kang [2], it has been analysed that for both internal and external Geneva mechanism, the kinematics coefficient of the Geneva mechanism is a constant if the groove number of the Geneva wheel is a constant.

The design and fabrication of paper cutting machine using Geneva mechanism is useful to cut papers in equal and accurate dimension. The analysis and synthesis of Geneva mechanism with elliptical crank has been studied by Han Jiguag Yu Kang,

Kalisindhur et al. [6], designed a mechanism for cutting by giving intermittent feed. P>Kalisindhur, Y.Karthik, T.Vijay, Y.Sasikanth and G Sri Harsha [19], This intermittent feed is given by continuous rotation of circular disk in Geneva mechanism.

The 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 Vivek A.Sanjay, Marco A Megsiolaro[12]. The feed from the Geneva drive was cut by using slotted lever mechanism which was designed using four bar chain mechanism Freudenstein, F.[9].

## CALCULATIONS OF COMPONENTS



- **THE PARAMETER OF GENEVA MECHANISM ARE AS FOLLOWS:**

c = Centre distance b = Geneva wheel radius z = Stop arc radius

v = Clearance arc p = pin drive diameter a = driver crank radius

s = slot centre length y = stop wheel radius w = slot width

Number of slot (n) = 4

Centre distance(C) = 74.99mm

Drive crank radius (a) = 74.99mm

Slot centre length (s) = 43.94mm

Pin diameter

Take p = 10mm for our case

t = allowed clearance = 0.5mm

Slot width (w) = 10.5mm

Stop arc radius (y)= 60mm

Stop disk radius (z)= 59.5mm

Clearance arc (v) = 59.5mm

## OTHER COMPONENT SELECTION AND DESIGN FOR MODEL

### Roller dimension

Length of cutting paper = 1/n(rotation of roller)

Where n = number of Geneva slots

= 1/4(perimeter of roller)

=1/4($2\pi r$)

Here we are using of motor 10 rpm

If we required length of cutting paper is 40 mm then,

One rotation of roller = 4*40,

Where 4 is no. of slot Perimeter of roller = 160

2πr = 160

R = 25.46mm,

Therefore radius of roller is 25.46 mm

Length of paper cut in one minute = rpm*length of paper cut

= 10*40

=400 mm

## DESIGN CALCULATION OF ROLLER CHAIN

Power of DC motor = 18 watt

Assume,

K = 1

Uniform motion for 10 hrs.\day

Design Power (Pd)

Pd = PR*K1=18*1 = 18 watt =0.018*103 KW

Design Horse power = 0.018/0.746 = 0.0241 HP

Pitch Circular Diameter of Sprocket (PCD) DP = Pitch/sin(180/T)

DP = 63 mm (T = 28)

VP = πDpN = π*63*10-3*30 = 5.937 m\min VP = 5.937/60 = 0.0989 m/sec

Power capacity (P) of Roller chains as per A.S.A.

P = Chain Pitch, mm

T = No. of teeth on Sprocket

KC = Capacity factor to no. of strands = 1

P = 0.0424 KW

## CALCULATION OF DC MOTOR

### Specification

1. 30rpm
2. 12V
3. 18W

Torque of motor (ζ) = (P*60)(2*3.14 * N) = (18*60)(2*3.14*30)

= 5.72 Nm = $5.72*10^3$ N-mm

The shaft is made of MS and its allowable shear stress = 42 MPa

Torque (ζ) = $3.14*fs*D^3/165.72*10^3 = 3.14*42*D^3/16$

D = 8.85 mm

The nearest standard size is d = 10 mm.

## CALCULATION OF DRIVER AND DRIVEN GEAR SHAFT

- **MATHEMATICAL CALCULATION OF DRIVER SHAFT**

  Torque (ζ) = 3.14*fs*d13/16 5.73*103 = 3.14*42* d 3/16

  d13 = 8.85 mm

  Standard diameter is Available 10 mm

  This is the diameter of Driver shaft (d1) = 10 mm

- **MATHEMATICAL CALCULATION OF DRIVEN SHAFT**

T1 = T2 = 28

V1 = V2 = 0.0989 m/sec N1 =N2 = 30 rpm

Therefore, the above assumption it is prove that the diameter of Driver and Driven gear shaft is same.

Therefore the mathematical calculations for the Driven gear shaft are as follows:

Torque (ζ) = 3.14*fs*d23/16 5.73*103 = 3.14*42* d23/16

d23 = 8.85 mm

Standard diameter is Available 10 mm

This is the diameter of Driver shaft (d2) = 10 mm

## MATERIAL SELECETION

| Sr no. | Parts | Material | Quantity |
|---|---|---|---|
| 1. | Geneva wheel and Driving pin | Mild steel | 1 |
| 2. | Sprockets | Cast iron | 2 |
| 3. | Roller Chain | Stainless steel | 1 |
| 4. | Paper Roller | Steel | 1 |
| 5. | Paper cutter | Mild Steel | 3 |
| 6. | Coil Spring | Steel Alloy | 1 |
| 7. | Shaft | Mild Steel | 3 |
| 8. | Actuator | Plastic | 1 |
| 9. | Self-linked stamp | Rubber plastic | 1 |
| 10. | DC motor | Copper winding | 2 |
| 11. | Adapter | Plastic | 1 |

## Reference


- J.J. Lee, K.F. Huang, Geometry analysis and optimal design of Geneva mechanisms with curved slots, Journal of Mechanical Engineering Science, Proceedings of the Institution of Mechanical Engineers, Part C 218 (4) (2004)449–4540–45.
- E.A. Sadek, J.L. Lloyd, M.R. Smith, A new design of Geneva drive to reduce shock loading, Mechanism an Machine Theory 25 (1990) 589–595.
- Prof. V. B. Bhandari "Design of Machine Elements", Tata McGraw-Hill, Third Edition, Pg. -55,330,430,499,601,646,711.
- Dijksman E. A. , "Jerk free Geneva Wheel Driving" ,Journal of Mechanisms 1, 1966, pp. 235-283.
- S E. Filemon, "Dynamic Analysis of Geneva mechanism with Special consideration to Reverses of pin", Department for Technical Mechanics, August 1960.
- Hrones, J.A. and Nelson, G.L., Analysis of the Four-Bar Linkage, the Technology Press of MIT and J. Wiley and Sons, New York, 1951.
- Vijay Kumar U, Ghanshyam Kumar, Dharesh Bansod, Deepak Sahu, Rishabh Bendre and Aakanksha Suryavanshi, Design and Analysis of Paper Cutting Machine work on the Geneva Mechanism, IJARIIE, 2(2),2016, 35-43.
- R. C. Johnson, "How to Design Geneva Mechanisms to Minimize Contact Stresses and Torsional Vibrations," Machine Design 28, No. 6, 107-111 (1956).
- Freudenstein, F., "An analytical approach to the design of four-link mechanisms", Transactions of the ASME, Vol. 76, pp. 483–492, 1954.
- P. Kalisindhur, Y.Karthik, T.Vijay, Y.Sasikanth and G. Sri Harsha, Cutting mechanism by giving feedthrough Geneva Mechanism, IJISET,2(4), 2015, 1172-1175.