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Design Development and Analysis of Bottle capping Geneva Indexing Mechanism

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Abstract — *The aim of this work is to reduce the human fatigue and time savings in industries by converting the manual work into Automatic Mechanical work using latest technologies with low cost. in this work, we have analyzed Geneva Mechanism for capping machine. This mechanism is used for material transporting on the conveyor with some intermittent stops. Due to which Bottles for capping is moved between the intervals of Capping period. Then the Capping process is achieved by Capping Head. which is operated with same rpm motor as same as motor which drive the Geneva driving wheel. With the help of attaching Flexible Clutch, we can reduce the Emergency stop condition and Save our time and Geneva wheel .Thus material handling is carried out. With the help of Geneva drive, the time stoppage can be achieved which avoids the use of stepper motor thus reduces the cost involved.*

So the main Goal of the project is to minimize the cycle time of machine & achieve the high production rate on traditional machine. For Achieving goal We used Different types of the Engineering Knowledge and Mechanisms.

Keywords- *Geneva mechanism, Intermittent rotary motion, Geneva wheel, Feeding mechanism, Indexing time, Indexing time*

I. INTRODUCTION

The Geneva drive is normally known as a Maltese cross Mechanism. There is an enormous interest of products in market legitimately put and fixed items have numerous favorable circumstances over free one. They have shielded from earth, Dust and miniaturized scale bacterial assaults due to Capping Also before pressing they are checked for volume or Weight. In General fixing of cap done physically.

Mass measure of Packing and fixing work is finished by with Automation. A large portion of the compartments are thin metallic sticks or Plastic Bottles .Mass creation and ware things spare expense of the item .

Geneva Mechanism is a standout amongst the most normally utilized venturing instrument in light of its basic structure, unwavering quality and exactness. In topping machine Geneva Mechanism comprises Indexing Plate and Geneva stick. Geneva stick is fuelled by engine for continuous revolution. while Bottle neck happens around then we needs to stop machine promptly and necessities to do setting again . In this task I am appending Clutch instrument with update of Geneva Wheel. It will assist us with doing Setting of Indexing plate over and over. In the event that bottle neck happens as yet Indexing plate will come in the situation by utilizing grip and Spring.

The structure and creating of a regular Geneva instrument is commonly straightforward and reasonable in light of the fact that there is no extraordinarily bended profile on any of the segments aside from straight lines and roundabout circular segments. Be that as it may, because of the intermittence of the increasing speed toward the start and consummation positions, the inadequacy of utilizing traditional Geneva instrument is the substantial effect when the driving wrench draws in and withdraws with the wheel space.

Research on External Geneva Mechanism has for the most part centered around Feeding idea with ordering time, incorporates different Number of Intermittent station operations with right Angle in the middle of stops.

II. PROBLEM DEFINATION

For Capping Machine It's very hard to mounting the Bottle on indexing Plate If it's not Identical in shape and size. In case of Packaged Liquid bottle, there is a chance of crushing of bottle due to high hand grip pressure. And due to Bottle and Indexing plate's Gripping it changes the setting of machinery and production stops. Also at the time of Acceleration and De-acceleration it will create jerk and therefore it may harm to the product and liquid can be out of the bottle sometimes.

III. RESEARCH OBJECTIVE

The objectives of the thesis are listed as follow.

- Design of Geneva mechanism which able to do Smooth Jerk less operation of Acceleration , Deceleration and Dwell time.

- Kinematic analysis of mechanism using software's

IV. COMPONENTS OF MECHANISM

1 DRIVER GEAR
The input is given by motor through this Driver gear. It's a one type of continuous rotating motion.

2 CAM AND PIN
It's principle part of this system. Since it changes over The constant turning movement into irregular movement by controlling the Geneva cross along its round way. At that point it changes over this movement as require for the development of film outline.

3 GENEVA GEAR OR MALTESE CROSS
It's likewise participate as crucial job in this system. Since the rotating irregular movement created in this part as it were. Geneva cross has 4 spaces in it, stick goes into along roundabout development of cam.

4 SHAFT
Shaft holds the all parts of system by on a level plane On its strung bit. There are 2 shafts are given in this component.

5 SPROCKET
It is accommodated hold the film outline as per the revolving discontinuous movement of the Geneva cross. Weight rollers additionally accommodated ideal development of film outline.
In this component, for each turn of the driver wheel A, the determined wheel B makes a quarter turn. The stick, connected to driver wheel A, moves in the spaces causing the movement of wheel B. The contact between the lower parts of driver A with the relating empty piece of wheel B holds it in position when the stick is out of the space. Wheel An is removed close to the stick as appeared, so as to give leeway to wheel B as it moves. On the off chance that one of the spaces is shut, A can make short of what one upset in either bearing before the stick strikes the shut opening and, halting the movement.

V. Geneva Wheel Design

Existing Design Specifications

The Geneva Wheel Mechanism designed in this project has the following design specifications:
Number of Slots = 8
Radius of Crank = 25 mm
Distance between centers of Geneva Wheel and Crank = 83.44 mm
Outer radius of Geneva Wheel = 75 mm
Radius of circular locking part = 25 mm
Slot width = 8 mm
Length of Slot = 34 mm
Shaft diameter = 25 mm

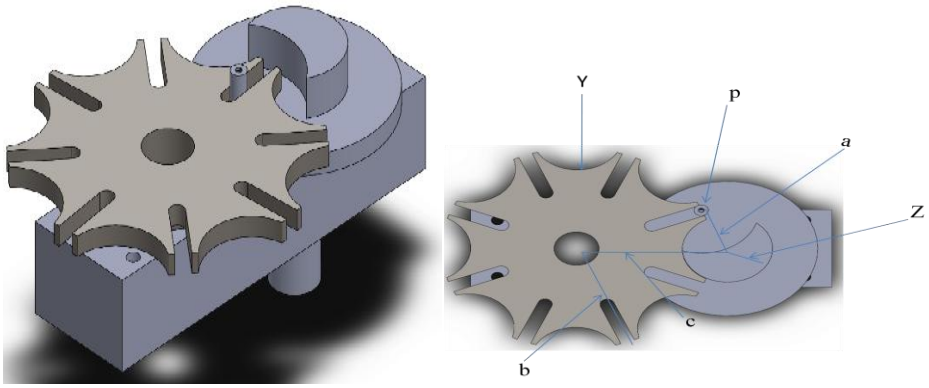

Figure 1 Classical Geneva Mechanism

a = Drive crank Radius b = Geneva Wheel Radius = $\sqrt{c^2 - a^2}$
n = Number of slots s = Slot centre length = (a + b) - C
p = Drive pin Diameter w = slot width = p + t
t = Allowed clearance Y = Stop arc Radius = a – p(1.5)
c = Center distance = $\frac{a}{\sin\frac{180}{n}}$ Z = Stop disc Radius = y – t
P = clearance arc = $\frac{bz}{a}$ Applied Force = F=$\frac{mv^2}{r}$
N = Rotational Speed of Motor = 1440 RPM Applied Torque F=Frsin θ
Given RPM to the Crank wheel shaft = 15 RPM θ = Angle between two slots
n = numbers of slots in Geneva
Load capacity of Existing Design Structure of Geneva wheel = 8 Kg
Tc = Cycle time in minute = $\frac{1}{N}$
Ts = Available service time in minute (Dwell time) = $\frac{[180+\theta]}{360N}$
Tr = Indexing Time = $\frac{[180-\theta]}{360N}$
For Geneva mechanism of Capping Machine This criteria must be fulfilled.
Ts > Tr ,

VI. Proposed 3D design

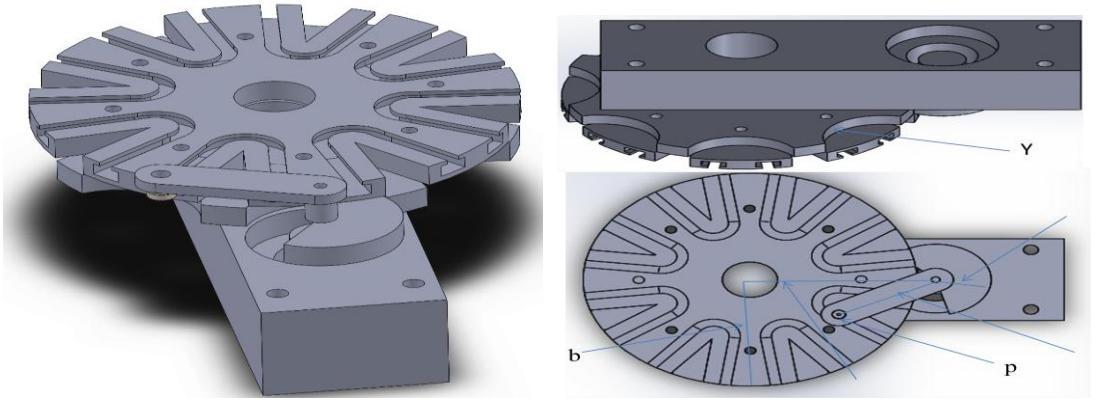

Figure 2 New Proposed Geneva Mechanism

Number of Slots = 8
Radius of Crank = 50 mm
Distance between centres of Geneva Wheels and Crank = 83.44 mm
Outer radius of Geneva Wheel 1 = 75 mm
Outer radius of Geneva Wheel 2 = 75 mm
Radius of circular locking part = 25 mm
Slot width = 10 mm
Length of Slot L1 = 33.5 mm
Length of Slot L2 = 33.6 mm
Length of Radius Curve L3 = 29.73mm
Total Length of Curve L = L1 + L2 + L3 = 96.83 mm
Shaft diameter = 25 mm
Bearing Dimensions : OD = 10mm, ID = 3mm, Thickness = 4 mm

a = Drive crank Radius p = Drive pin Diameter
n = Number of slots t = Allowed clearance
c = Center distance = $\frac{a}{\sin\frac{180}{n}}$ b = Geneva Wheel Radius = $\sqrt{c^2 - a^2}$
s = Slot centre length = (a + b) - C Radius Length L3 = rε
ε = 180 - θ
Curve Length = L1 + L2 + L3 w = slot width = p + t
Y = Stop arc Radius = a – p(1.5) Z = Stop disc Radius = y – t

P = clearance arc = $\frac{bz}{a}$

N = Rotational Speed of Motor = 1440 RPM

Given RPM to the Crank wheel shaft = 15 RPM

n = numbers of slots in Geneva

Applied Force = F=$\frac{mv^2}{r}$

Applied Torque F=Frsin θ

θ = Angle between two slots

Tc = Cycle time in minute = $\frac{1}{N}$

Load capacity of Existing Design Structure of Geneva wheel = 8 Kg

Ts = Available service time in minute (Dwell time) = $\frac{[180+\theta]}{360N}$

Tr = Indexing Time = $\frac{[180-\theta]}{360N}$

Criteria For Capping Requirement of Ts > Tr will Fulfil in New Design.

VII. Comparison of Kinematics of Existing model & New Model :

Motion Analysis of the Existing Design Model was done in the Solid works 2018, And Plots are Generated

During Motion study.

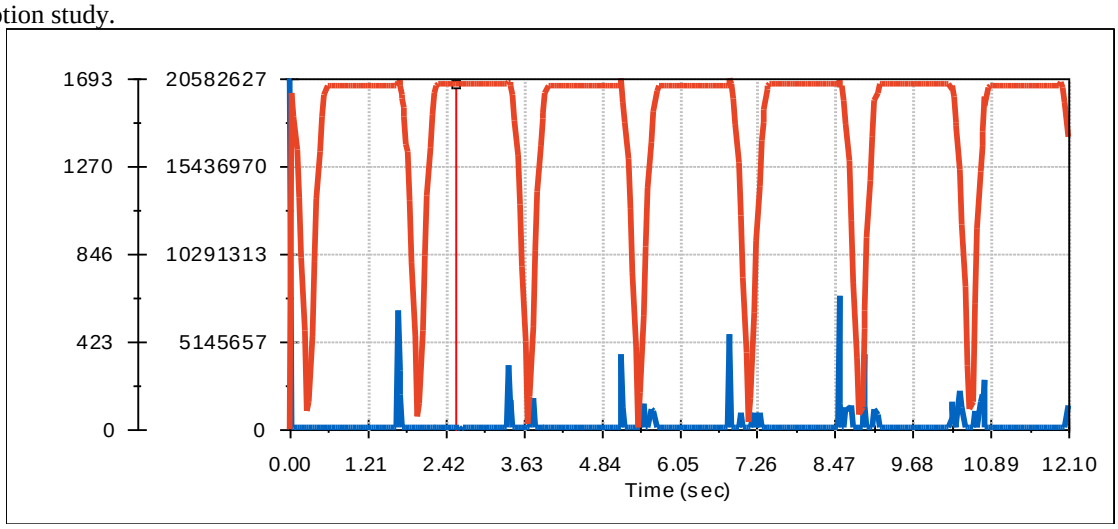

Figure 3 Angular Velocity & Acceleration vs Time for Existing Geneva Mechanism

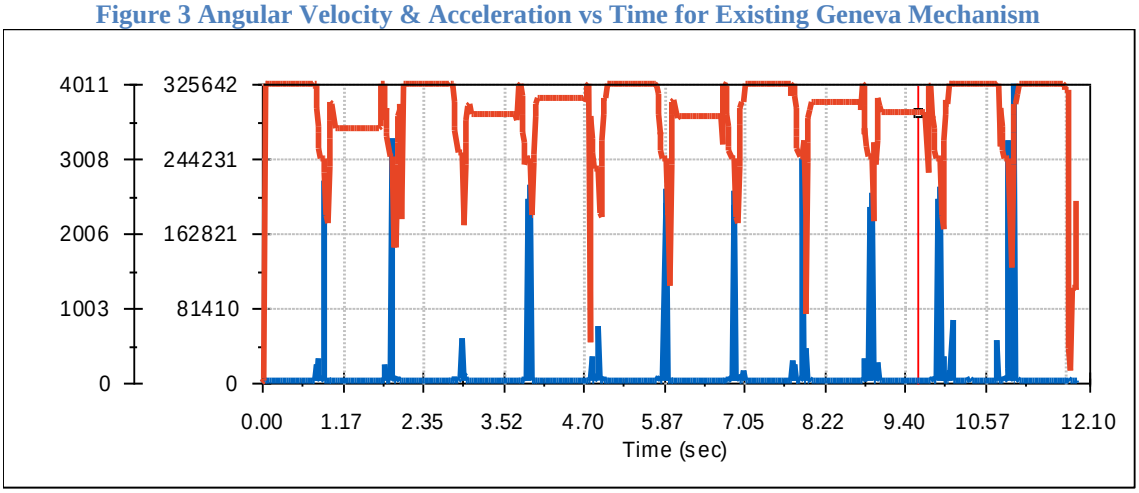

Figure 4 Angular Velocity & Acceleration vs Time for New Proposed Geneva Design

In Acceleration analysis 36.8% of Angular acceleration was reduced by using New model. That means we can reduce jerk by 36.8% by using New Proposed model.

VII. Conclusion

There is a sudden acceleration when the Geneva wheel starts rotating. Among these is the idea of using a curved slot of cam system. This does reduce the acceleration, but it increases the deceleration and consequently the wear on the other side of the slot. We can reduce the Jerk by using New Geneva Mechanism in place of Old Classical Geneva Mechanism.

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