Mechanically Operated Automation System

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ABSTRACT-

This Paper objective is to know the actual working of the Automation system. A mechanism for automatically pushing up a tissues which includes a box and a pusher. The box stores a tissues in layers and has top wall with an opening formed therein for picking up tissues their through, the pusher disposed under the tissues in the box for pushing up tissues.

In this working model, we have made the actual working or simulation of automation system so that it is easy to understand. Our main goal is to make a study model of punching, stamping and power transmission in automation system. With actual working of it only placing all the component in its proper positioning and simplifying the working of it for studying purpose of student it is exactly similar to that of the actual automation system used in industries.

REVIEW AND LITERATURE SURVEY

Review of System:

While working on this project we came across various components of Mechanically operated automation system such as Main base, Geneva wheel, Geneva shaft, Crank shaft, crank, Synchronous motor, Spur gear, Bearing etc. And also we have studied the actual implementation of these components.

While designing the model we came across various difficulties such as Geneva mechanism fitting. Initially we had collected all the components required for MOA system. We arranged all the components of Mechanically operated automation system according to their function

Literature Survey:

There is a need of developing a new method or process for effective manufacturing. automats is a device which can develop a effective manufacturing process.

The model of automation system is basically small version of automation system is used in industries. Various Processes are performed on this automat or automation system. The processes like stamping, punching, embossing etc. are performed in this automation system.

Like other automation system, this system also undergoes or suffers from some issues, various mechanism like quick return mechanisms are used in our project

The automation system comprises of power various mechanism, gear pairs ,various transmission system and the various gear transmission system.

History of Automats:

Horn &Hardart was a food servicescompany in the United States noted for operating the first food service automatsin Philadelphia and New York City.Philadelphia's Joseph Horn (1861–1941) and German-born, New Orleans-raised Frank Hardart (1850–1918)opened their first restaurant together in Philadelphia on December 22, 1888. The small (11 x 17 foot) lunchroom at 39 South Thirteenth Street had no tables, only a counter with 15 stools. Formerly, the location had housed the print shop of Dunlap &Claypoole, printers to the American Congress and George Washington.

By introducing Philadelphia to New Orleans-style coffee (blended with chicory), which Hardart promoted as their "gilt-edge" brew, they made their tiny luncheonette a local attraction. News of the coffee spread, and the business flourished. They incorporated as the Horn &Hardart Baking Company in 1898.

Inspired by Max Sielaff's automat Restaurants in Berlin, they became among the first 47 restaurants, and the first non-Europeans to receive patented vending machines from Max Self’s automat GmbH Berlin factory, creators of the first chocolate bar vending machine. The first automat in the U.S. was opened June 12, 1902, at 818 Chestnut St. in Philadelphia by Horn &Hardart. The first New York Automat opened in Times Square July 2, 1912. Later that week, another opened at Broadway and East 14th Street, near Union Square.In 1924, Horn &Hardart opened retail stores to sell pre-packaged automat favourites. Using the advertising slogan "Less Work for Mother," the company popularized the notion of easily served "take-out" food as an equivalent to "home-cooked" meals.

The Horn &Hardart Automats were particularly popular during the Depression era when their macaroni and cheese, baked beans and creamed spinach were staple offerings. In the 1930s, union conflicts resulted in vandalism, as noted by Christopher Gray in The New York Times.

INTRODUCTION

Now days, 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 fulfill the requirement about accuracy Productivity etc.

It is necessary to reduce the total matching time. There are various Ways by which the total matching time can be effectively minimized. There are various time consuming steps or sub process, which can be, minimize by various methods. In mass production the time criteria is very important. Within small time limit, a single unit job has to be completed. For minimizing the job time, the handling of the job should be minimum. So that labour time considerably saved. Form minimizing the handling time; we introduce the attachment for stamping and punching as well as milling machine for the operation. Suppose for one job B, there are number of sequential operation such as stamping and punching reaming that can be effectively perform by one after

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another with greater accuracy & at faster rate. For stamping and punching on table head is using hand process, but by this attachment, there is only first initial making is required. Then automatically equipped stamping and punching machine. This attachment is very useful for small-scale industry as well as workshop.

PROBLEM STATEMENT

Now a days at small as well as at large scale industries, for various operations like punching or stamping, cold automatic pressing, embossing, coining, blanking, drawing take maximum jobs handling time, more man power requirement, more cost of attachment, high maintenance.For purpose of reducing the effort of man power, supply of electricity our design is used, to which one person can operate or handle all operation at same time**.**

PROBLEM SOLUTION

For this problem our design project is used known as Mechanical Operated Automation System. In it we used the attachment for the stamping and punching machine.

Rotary indexing' for stamping and punching machine to over come said errors in conventional machines.

In this, is try to implement 'Geneva wheel machine' which gives higher accuracy.

Using this attachment, it will be able stamping one by one simultaneously with

certain time delay in between the stamping and punching operation with small angle

of twist (0) and equipage.

"This is specially the need of manufacturing firms for mass production."

The basic principle that has taken into account for the attachment on stamping and punching machine is "The conversion of rotary motion into intermittent motion". The Geneva mechanism gives higher accuracy. The indexing of the Geneva wheel are important because of the slot of the Geneva wheel are increased or decreased because indexing is depends on the slot.

NEED OF PROJECT

1. To minimize the time required to perform various operations likeare punching or stamping, cold automatic pressing, embossing, coining, blanking, drawing.
2. To minimize the time required to mount the tool.
3. To manufacture a job with high accuracy and precision.

OBJECTIVES

a] GENERAL OBJECTIVES

At the end of student will be able to-

- Design
- Manufacturing

b] SPECIFIC OBJECTIVES

At the end of semester student will be able to-

- Survey of Automation system
- Identify suitable mechanism
- Software AutoCAD/CATIA.
- Identify the component.
- Make list of component to manufacturing.
- List of component to be available.
- Collect the component.
- Manufacturing the component.
- Assembly of component.
- Trialofmachine

CONSTRUCTION

THEORY

1. Now we have to introduce the attachment for the stamping and punching machine.
2. Rotary indexing' for stamping and punching machine to over come said errors in conventional machines.
3. In this, is try to implement 'Geneva wheel machine' which gives higher accuracy.
4. Using this attachment, it will be able stamping one by one simultaneously with certain time delay in between the stamping and punching operation with small angle of twist (0) and equipage.
5. "This is specially the need of manufacturing firms for mass production."

There are different parts used in machine/ system :-

1) Main base
2) Geneva wheel
3) Geneva shaft
4) Crank shaft
5) Crank
6) Movable table
7) Synchronous motor
8) Spur gear half
9) Spur gear
10) Bearing
11) Reduction unit (gears)
13) Bevel gear

GENEVA MECHANISM

There are many instance where it is necessary to convert continuous rotary motion intermittent rotary motion. Such motion requirements generally exit in machine tools where spindle, turret or worktable is to be indexed. The motion picture projector also demands intermittent motion to advanced the film intermittently.

Geneva wheel or is one of the mechanism, which generate intermittent motion. This mechanism was originally developed as check to prevent overweening of watches

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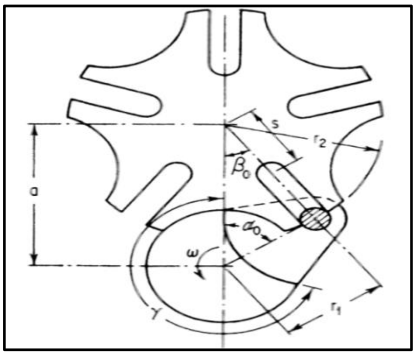

Fig.3.1:-Geneva Mechanism

Figure shows Geneva wheel it is provided with four slot. The crank, which usually rotates at uniform velocity, carries a roller that engages with slots of Geneva wheel. Notice that the centrelines of the slots and cranks are manually operated particularly when the roller and slot engage or disengage during one rotation of crank. The Geneva wheel rotates the fractional part of rotation depending upon the number of slots. It is necessary to provide the locking device, which will not allow the Geneva wheel to rotate when the roller is not engagement. This locking device has a generally circular segment, this locking device has a generally circular segment attached to the crank as shown in figure. These locking devices also position the Geneva wheel for correct engagement of the roller with the next slot. The Geneva wheel typically has three to eighteen slots.

QUICK RETURN CRANK MECHANISM

A mechanism is mostly used in machine equipment; it generated from the linkage arrangement in such a passion by which desired output for the given input can derived, Quick return mechanism is six-bar mechanism in which time of return stroke is comparatively smaller than the time of cutting stroke so it is called quick return mechanism For complete understanding of any mechanism kinematic and dynamic analysis play significant role, kinematic analysis gives the position, velocity and acceleration of each link.

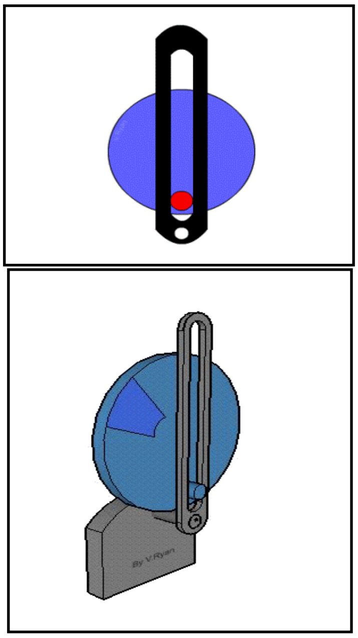

Fig.3.2:-Quick Return Crank Mechanism

DESIGN CALCULATION

Design of Geneva

R = radius of Geneva Wheel

r1 = radius of driving crank

rp = radius of driven pin

e = centre distance

α = semi indexing angle (driven)

b = semi indexing angle (driver)

z = number of slots on the driven disk

ω = angular velocity of driving crank, assume to be constant

n=speed of rotation of crank, rpm.

Θ=angle of locking

Here, t = time if indexing, sec

Our time of indexing time=5sec.

Speed of the driven wheel

Assuming number of slots on Geneva wheel=4

There for time required for complete one revolution of driven wheel = 4X5=20sec

Therefore speed of driven wheel, 20 sec-1 revolutions

60 sec –3 revolutions

Therefore

$\mathbf{N}_{driven} = 3$ rpm

Speed of driver = 3X4=12rpm OR t=60/N

S_{min} N=60/5 = 12 rpm

I = gear ratio or reduction ratio = 5

I = 5 N_{motor} / N_{driver}

= N_{motor} / 12

N_{motor}=60rpm

For Z=4

a) Semi indexing angle (driven) = α = 45 ° ------(PSG)

b) Gear ratio (E) i.e. ratio driving crank ------- (PSG)

Speed of Geneva wheel 1:1

c) Indexing Time ratio = V = (Z-2) / (2Z)

= 4 – 2 / 2x4

= 0.25

d) Semi indexing Angle (driver crank) = β= л (Z=2)

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= л (4-2)/2×4

= л/4

e) For entry without shock,

(R/e) = sin л /z

(R/e)= sin л/4 = 0.707

f) Now, on the basic of space available, we assume center distance

(e) = 35mm

(R/E)=0.707×35

R=25mm.

Radius of Geneva= 25mm

Hence, Diameter of Geneva wheel = 50mm

g) Angle of locking (Θ) =

(Θ)= л/Z (Z+2)

= л /4 (4+2)

= 270°

h) S_{min} = distance between the centre of Geneva wheel radii of curvature of slot on wheel

From PSG S_{min} = 0.2929 e

where, e = 35mm

S_{min} = 35×0.2929

S_{min} = 10 mm

Length of slot is 18mm and thickness is 10 mm

Selection of motor

Mtd – net torque on driven shaft

Mtf – frictional torque on driven wheel

I – mass moment of inertia of all attached masses reflected to driven Shaft

N – efficiency of Geneva Mechanism = 0.95

When the driven shaft mounted is mounted on antifriction bearings

Mti – inertia torque on driven shaft

Assuming Mtf = 0

Mtd = Mtf + Mti

Mtd = Mti

Mti = 1 .α d

I =mk_2

= $30×(0.05)^2$

= 0.75 $Kg.m^2$

substituting I and αd

Mti = 0.075 × 9.81 × 1.5625 = 1.1496 × 10^3 N mm

Mti = mtd (wd/w)(1/n)

= 1.149 × 0.314/1.25) × (1/0.95)

Mti = 0.303 Nm

Instantaneous power required on the driving shaft

N = (Mt w/75)H.P.

= (0.303 × 0.314)/75

= 0.00127 H.P.

From this selecting the motor having the large power than that of

(N = 0.00127) H.P.

So selecting the synchronous motor having power capacity = **0.002 H.P**.

DESIGN OF SHAFT AXLE

Consider the M. S material.

yield = 320 N/mm2

$σt= \frac{F}{A} = \frac{15×9.81}{J1×d2}$

d = 0.765 mm

Consider F.O.S = 1.2

d = 0.765 x 1.2

= 0.918mm

d = 0.918 mm

d = 10mm

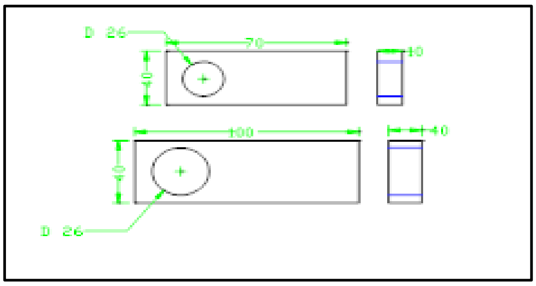

Fig 3.3 SHAFT AXLE

DESIGN OF GEAR PAIR

Material of the gears used is plastic. A non-metallic gear will carry almost as much load as a good cast iron or M.S steel gear, even though the strength is much lower, because of the low modulus of elasticity. This low

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modulus permission metallic gear to absorb the effect of tooth errors so that dynamic load is not created. It also has the advantage of operating well in the marginal lubrication.

For Plastic material,

Considering σb = 60 N/mm^2, BHN = 120

Zp = 20 , Zg = 60

As the material for the pinion and gear is same, pinion is weaker than the gear.

So design is based on the pinion.

We design the plastic gears for the wear failure. We can neglect the bending failure.

$$Yp = 0.484\frac{2.87}{20} = 0.3405$$

Beam Strength:

Fb = 6b. b. m. Yp

Fb = 60 x 12m x m x 0.3405

Fb = 240.16 m2 , N

Wear strength:

Fw = dp x b x Q x K

$$Q = \frac{Zg}{Zg + Zp} = \frac{60}{60 + 20} = 0.75$$

K = 0.16 x (B.H.N/100)^2

= 0.2304

Fw = (m x zp) x b x Q x K

= (m x 20) x 12m x 0.75 x 0.2304

= 41.472m^2 , N

V=$\frac{\pi.dp.Np}{60\times1000} = \frac{\pi\times20m\times20}{60\times1000} = 0.0209\ m/s$

Assume ,Kv = 1

$$Ft = \frac{P}{V} = \frac{0.0414}{0.0209\ m}$$

= 1.9809/m N/mm^2

$$Feff = \frac{Ka.Km.Ft}{Kv}$$

$$= \frac{1 \times 1.2 \times 1.9809/m}{1}$$

Feff= 2.37708/m , N

Considering F.O.S = 1.5,

Fb= F.O.S. x Feff

41.472 m^2= 1.5 x 2.37708/m

m = 0.44 ≈ 1 mm.

m = 1 mm.

dp = m x zp = 1 x 20

dp = 20 mm.

dg = m x zg = 1 x 60

dg = 60 mm dg = 80

m = 1 mm

dp = 20 mm.

dg = 60 mm.

Let the torque on one side of the arm = Ta, Nm

We require 60 rpm motor.

Ta = 9.81 x 330 x 10^{-3}

= 3.2373 Nm

Total Torque, T = 2 x Ta

= 2 x 3.2373

= 6.4746 Nm

P=$\frac{2\pi NT}{60}$

P=$\frac{2\pi\times60\times6.4746}{60}$ Watts

P = 40.68 W

P = 0.0545 hp

5kgcm, 60rpm synchronous motor is available in the market. So we have selected this standard motor.

WORKING

The synchronous motor transmits power to the gear at 60 rpm. This gear is mounted on same shaft of the motor. This gear is engaged with another gear having more number of teeth.

These gears works as reduction unit. It reduces rpm of the motor from 60 to 6rpm.As a result the Geneva wheel moves with the speed of 6 rpm. As the movable table and the Geneva wheel are mounted on the same shaft, the movable table also rotates with the speed of 6rpm.

The movable table contains 6 slots for the placement of tables. When the crank engages with Geneva wheel, the table slot shifts from one position to other position. This time period is known as 'Indexing time'. In this time period limit switch is in off position and it does not allow the stamping.

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When the crank disengages from the Geneva wheel and travels along its periphery, the table starts filling. This time period is known as 'Resting time'. In this time period limit switch is in on position and it does allow the stamping. Spring controlled operating the the stamping.

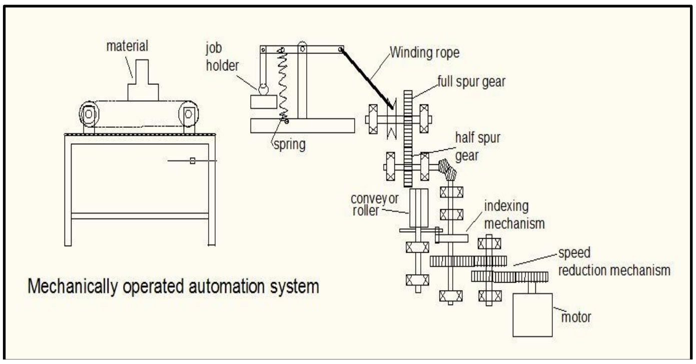

Fig .Mechanically Operated Automation System (constructional)

Fig. Mechanically Operated Automation System (Actual)

GEARS:-

Gears are a means of changing the rate of rotation of a machinery shaft. They can also change the direction of the axis of rotation and can change rotary motion to linear motion.

Unfortunately, mechanical engineers sometimes shy away from the use of gears and rely on the advent of electronic controls and the availability of toothed belts, since robust gears for high-speed and/or high-power machinery are often very complex to design. However, for dedicated, high-speed machinery such as an automobile transmission, gears are the optimal medium for low energy loss, high accuracy and low play.

Gears are of several categories, and can be combined in a multitude of ways, some of which are illustrated in the following figures.

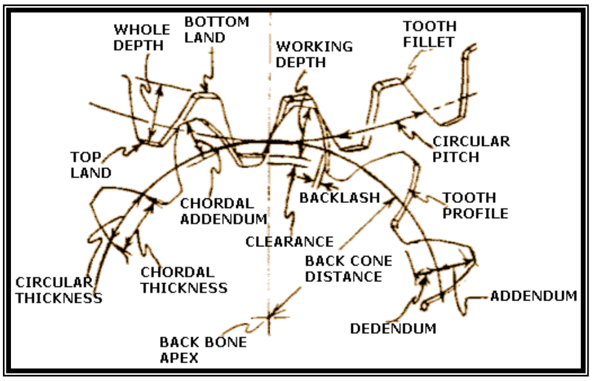

Fig.4.2:-Gear

ADVANTAGES/DISADVANTAGES

ADVANTAGES

1. It minimizes the jobs handling time of ideal time.
2. It minimizes the man power requirement.
3. Cost of this attachment is comparatively less.
4. It increases the efficiency of machine & productivity
5. It's maintenance is low
6. It's accuracy and repeatability is highly effective
7. It is effectively used on table packet or any cartons.

DISADVANTAGES

1. The proper clamping arrangement should be required for clamping the job.
2. There is restriction in number of intermediate motion because number of motion depends upon number of slots on Geneva driver wheel, number of slots maximum can be possible eighteen.

APPLICATION

In usual operations are punching or stamping, , embossing, coining, blanking, drawing such many operations are some times combined as one operation.

PIERCING :-The piercing is the operation of production of hole in a sheet metal by the punch or the die. The material punched out to form the constitutes the waste.

BLANKING:-The blanking is the operation of cutting of flat sheet to the desired shapes. The material punched out is the required product and the plate with hole left on the die goes to waste.

BENDING :-It refer to more plain bends, weather curved or shaped corners.

FORMING:-The forming operation of bending a sheet of metal along a curved axis. The metal is confined between the punch and the die and stressed in combo effort pressing and tension beyond the elastic limit. The shape of the component is governed by the shape of the punch and the die.

DRAWING: -The drawing is the operation of production of cup shaped parts from flat sheet blanks by bending and plastic flow of metal.

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EMBOSSING: -It means the forming of shapes such as letters or fancy design on fairly then material where there is design on both sides.

COINING:-The coining material of production of coins or medals or ornamental parts by squeezing operation.

PUNCHING:-The punching operation is similar to piercing operation. While punching the formation of hole is desired.

CONCLUSION

While concluding this part, we fill quite contended in having completed the project assignment well on time. We had enormous practical experience on the manufacturing schedules of the working project model. We are therefore, happy to state that the inculcation of mechanical aptitude proved to be a very useful purpose. We are as such overwhelmingly elated in the arriving at the targeted mission.

Undoubtedly the joint venture has had all the merits of interest and zeal shown by all of us the credit goes to the healthy co-ordination of our batch colleague in bringing out a resourceful fulfilment of our assignment.

Although the design criterion imposed challenging problems which however were welcome by us due to availability of good reference books. The selection of choice of raw materials helped us in machining of the various components to very close tolerances and thereby minimizing the level of wear and tear.

The design of control architecture was an important aspect of study because a strong interaction between the many different parts was needed. So we are satisfied with our project.

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