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Bottle Filling Machine Based On Geneva Mechanism

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***Abstract*: This project was 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 syncronous 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.**

***Keywords:* Geneva mechanism, gear pair, motor.**

I. INTRODUCTION

the project on which we worked is "bottle filling machine" which is based on basic 'geneva mechanism' automation plays an increasingly important role in the world economy. one of the important applications of automation is in the soft drink and other beverage industries, where a particular liquid has to be filled continuously for these kinds of applications. the trend is moving away from the individual device or machine toward continuous automation solutions. totally integrated automation puts this continuity into consistent practice. totally integrated automation covers the complete production line, from receipt of goods, the production process, filling and packaging, to shipment of goods. our project is also an application of automation wherein we have developed a liquid filling to bottles. the various processes are controlled using a geneva mechanism.

II. OBJECTIVE

The main objective of the project is to Design and Develop a Automatic liquid filling in bottles by using Geneva Mechanism. To develop a filling machine which can fill different sizes of containers on the bases of height same principle can be used in different industries like medicine, oil, chemical industries for filling liquid to different sized component by one machine.

III. COMPONENTS

A. geneva wheel:

The Geneva wheel is used in cinema film projectors to step the film on one frame at a time. This is a mechanism for intermittent motion. The lower wheel drives the upper one. The rotational movement of the lower wheel is continuous but the upper wheel only rotates intermittently (in steps). It takes four revolutions of the lower wheel to produce one revolution of the upper wheel. The drive pin on the lower wheel engages with the slots on the Geneva wheel and make it turn just enough so that it is in position when the pin comes round again.

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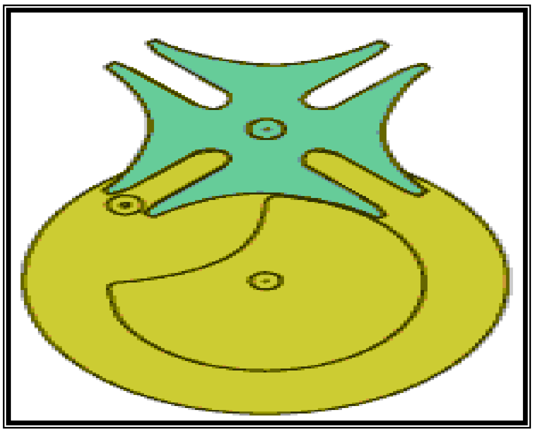

a) Geneva mechanism

B. Gear pair:

b) Gear pair

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.

C. Synchronous motor:

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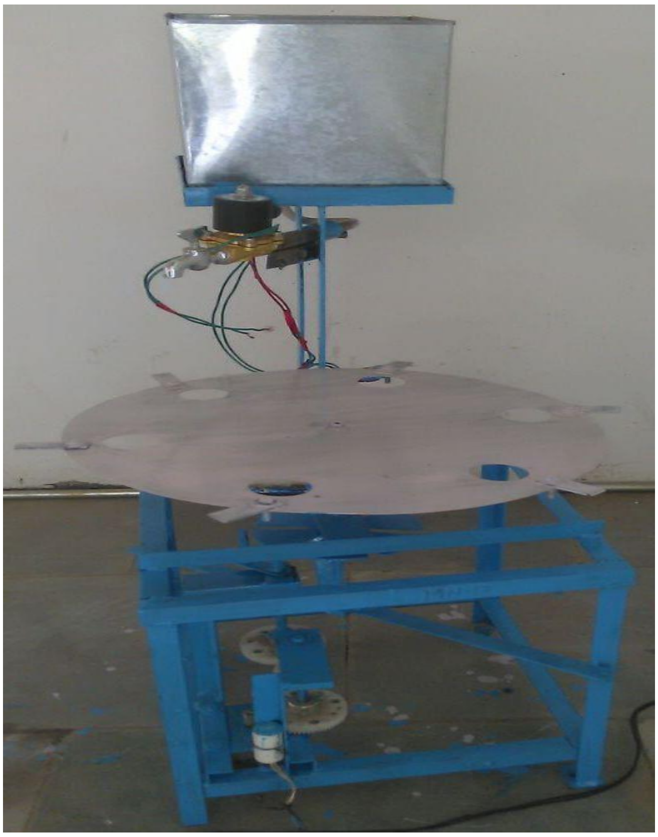
In a Synchronous motor, A.C. supply is given to the stator windings and D.C. supply is given to the rotor windings. It is used in machine tools, line shafts, reciprocating and centrifugal compressors, fan blowers, vaccum pumps etc.

Table 1. Standard Data of motor

SR NO	MOTOR TYPE	SYNCHRONOUS ELECTRIC MOTOR
1	Standard Motor Voltage	12 v
2	Weight	0.5 kg
3	Mounting	By screws
4	Life expectancy	Approx 500 hours @ max efficiency
5	Torque	7 kg-cm
6	Direction	Reversible

IV. WORKING PRINCIPAL

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 bottle base and the Geneva wheel are mounted on the same shaft, the bottle base also rotates with the speed of 6rpm.The bottle base contains 6 slots for the placement of bottles. When the crank engages with Geneva wheel, the bottle 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 flow of water. When the crank disengages from the Geneva wheel and travels along its periphery, the bottle 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 flow of water. Solenoid valve controls the flow of water.



d) Assembly

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Design Calculations:

Shaft design:-

Here shaft goes into twisting and bending moment. According to A.S.M.E. code, permissible shear stresses (τd)

For shaft without keyway is taken 30% of yield strength in tension (syt) or 18% of ultimate is minimum.

Therefore

τd = 0.3syt or

τd = 0.18 syt (which ever is minimum)

For twisting and bending moment

$\tau d = 16/\pi d^3\sqrt{(KbMb)^2+(KtMt)^2}$

where,

Kb = combined shock and fatigue factor to bending moment = 1.5

Kt = combined shock and fatigue factor to twisting moment = 1

Shaft is made of Plain Carbon Steel.

(Sut = 500 N/mm^2 and Syt = 400 N/mm^2)

τd = 0.3*Syt

= 0.3*400 = 120 N/mm^2

or

τd = 0.18*Sut

= 0.18*500 = 90 N/mm^2

The lower of the two is 90 N/mm^2 and therefore,

τd = 90 N/mm^2.

Force analysis:-

For 1^{st} step,

Tangential and radial forces on gear

Pt = Tangential force

Pt = 2Mt/d′p

= 2*294.3/17

= 34.62 N

Pr = Pt tanα

= 34.62*tan20°

= 12.6 N

PN = Resultant force

= Pt/Cosα

= 24.62/cos20

= 32.53 N ≈ 33 N

For second step:-

Pt = 2Mt/d′p

= 2*1002.9/19

= 111.433 N

Pr = Pt tanα

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= 111.433*tan 20°

= 40.558 N

PN = Pt/Cosα

= 111.433/Cos20

= 118.672 N

= 119 N

ΣMA = 0

-33*15-119*55+RD*70 = 0

RD = 100.57 N

ΣMD = 0

-70RA+119*15+33*50 = 0

RA = 51.42 N

For maximum bending moment,

ΣMC = RD*15

= 100.57*15

= 1508.55 N-mm

ΣMB = RD*55-119*40

= 100.57*55-119*40

= 771.35 N-mm

Torque at intermediate shaft is 1002.9 N-mm

Putting all these values in eqn. (A)

τd = 16/πd^3√(KbMb)^2+(KtMt)^2

90 = 16/πd^3√(1.5*1508.55)^2+(1*1002.9)^2

d^3 = 5.19

We have selected minimum dia of shaft = 8 mm

Bearing selection:-

We know that,

L = 60*n*Lh/10^6

= 60*17.27*15000/10^6

= 15.827 million rev.

Where,

L = bearing life in million rev.

n = rpm.

Lh = bearing

Also,

C = L*(p)^1/3

= 15.827*(100.57)^1/3

= 73.592 N

Where,

P = equivalent load.

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C = dynamic load capacity

For shaft diameter, d=10mm

Select bearing - **6200**.

6:- Deep-groove ball bearing, 2:- Extra light, 00; 10 mm Bore diameter

V. CONCLUSION

The thesis presents a automated liquid filling to bottles of different height using Geneva mechanism. A total control is made in a filling is achieved. The present system will provides a great deal of applications in the field of automation, especially in mass production industries where there are large number of components to be processed and handled in a short period of time and there's need for increased production. The solenoid valve to this system developed is flexible, quickly and easily. This will increase the total production output; this increase in production can yield significant financial benefits and savings. This concept can be used in beverage and food industries, milk industries, medicine industries, mineral water, chemical product industries and manufacturing industries

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