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Bottle Filling Plant Based on Geneva Mechanism

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Abstract*: Productivity improvement is the aim of today's manufacturing system. It may relate to manufacturing, services or plants working with any other aspects of production. Increasing productivity in recent time of global competition is great affected by automation concept and strategies in the industries and plants. All the industries worldwide are moving towards the automation. Out of these all type of production types, filling is a task in which any item liquid or solid are filled into the bottle or container. At this time filling is carried out by automatically in large scale industries and manually in small scale industries. Human operated filling industry can be converted into automatic filling plant by providing indexing motion to the container or bottle. Indexing motion may be rotary or linear. Geneva Mechanism is one of the best ways to provide rotary indexing motion from the continuous rotary motion. This Research Paper focused on the design and modelling of automated water bottle filling plant by using Programmable Logic Controller (PLC) and Geneva mechanism. This system is suitable for all kind of filling operations like water bottle filling, oil bottle filling, pharmaceutical bottle filling, syrup filling and many more with appropriate modifications. This work is mainly based on filling of bottle on rotary table which is rotated by six slot Geneva mechanism. Here, the system is developed for bottle filling which is based on automation consisting PLC and sensors. Design of different components is carried out in solid works 2017 for such mechanical for the filling of required quantity with high efficiency in less time by the use of Geneva wheel.*

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I. Introduction:

The project is based on the principal of Geneva mechanism. The purpose of using Geneva mechanism is to get the time interval in the automation Geneva wheel directly works as a driver and a driving wheel in the project. The driver wheel pushes the slot mechanism after a short time so this works as a timely movement to the machine.

In our project we are using this system to fill the glasses after a short time interval one after another. The driver wheel is operated and guided by the DC motor. As the dc motor gives supply to the driver wheel the wheel starts rotating and the design is made such that in one rotation of the driver wheel there will be one short movement of the driving wheel.

The glasses are getting loaded on the driving wheel and the wheel rotates due to movement of the driver wheel the glasses are rotated for a particular interval and then it stops . In this while the pump is operated to fill the liquid whichever is filled in the tank. This tank is the source for the pump for filling the liquid into the glass. The liquid can be varied accordingly the purpose .For example if the mechanism is fitted into the malls washroom or in the college canteens then it will be used to source water while if the mechanism is fitted in corporate offices or commercial malls then it can be used to serve cold drinks or tea , coffee material

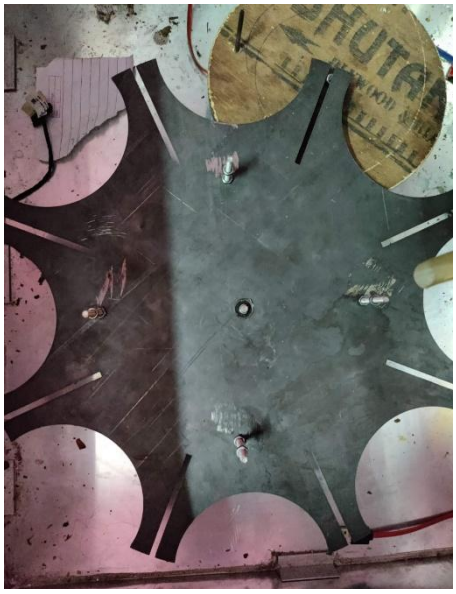
There will be one end at which the loading of glasses will take place and when it comes to the bottom of pump outlet then it gets filled. This process is continued as the wheel is rotating . This process can be stopped manually with the help of switches . As the whole process is powered by a dc power supply the working of pump and the dc motor can be controlled by use of switches , we can construct a switch board to operate both pump and the wheel accordingly.

II. **Objective**:

The main objective of the project is to Design and Develop an 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.

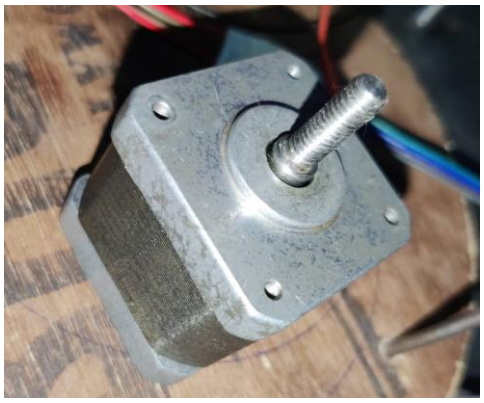
III. Components:

A. Geneva wheel:



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.

B. Stepper motor:



A Stepper motor is any of the class of electrical machine that convert direct current electrical power into the mechanical power. All types of Stepper motor have some internal mechanism either electromechanical and electronic to periodically change the direction of current flow in the part of the motor. Most types produce rotary motion a linear motor directly produces force and motion in the straight line. Stepper motors was the first type widely used since they could be powered from existing direct current lighting power distribution system.

C. Water pump:

A water pump is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid. A two-port valve is switched on or off. It is timer operated and is used to control the amount of liquid to be filled. Its switching is controlled by the microcontroller. It can be operated at the maximum pressure of 10 bar. Material used for the solenoid valve is brass. The following figure shows the solenoid valve.

D. Controller(Arduino UNO): -

Arduino is an open-source microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world. The Nano is a microcontroller board based on the at mega 328p. It has 14 digital input/output pins (of which 6 can be used as PWM outputs),6 analogue inputs, a 16 MHz quartz crystal, a USB connection, a power jack and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. For programming the microcontrollers, the Arduino platform provides an integrated development environment(IDE) based on the Processing project, which includes support for C, C++ and Java10 programming languages.

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 a greater number of teeth. These gears work 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

V. CONCLUSION:

The thesis presents an 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 provide 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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