PLC Based Automatic Bottle Filling Machine

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***Abstract*—** Automation is the use of control system and information technologies to reduce the need for human work in the production of goods and services. Traditionally in bottle filling process we have to put bottles onto a conveyor belt and this method is time consuming and expensive, It fills only one bottle at a time. Our project aims filling and capping machine simultaneously. It also includes a user defined volume selection menu through which the user can input the desired volume to be filled in the bottles.In this project filling operation are controlled using programmable logic controller(PLC) .This is because PLC are reduce complexibility ,human efforts, space efficient ,very flexible.

Keywords*—PLC-Programmable Logic Controller, MCB-Miniature Circuit Breaker, RTD-Resistance Temperature Detector, SMPS, PID controller*

I. INTRODUCTION

The Field of automation has had a notable impact in a wide range of industries beyond manufacturing. Automation use control system and technologies to reduce human work. main important application of automation is in soft drink and other liquid industries, Where a particular liquid has to be filled continuously. In this project we develop bottle filling system using automation and various processes are controlled through automation .By using PLC in bottle filling system we can filled bottle as per user requirment without wastage of liquid.PLC sequance are controlled through ladder logic. Totally Integrated Automation covers the complete production line, from receipt of goods, the production process, filling and packaging, to shipment of goods. This project is an application of automation where we have developed a bottle filling system.The PLC controlled all the system,which is operated on 24V Dc supply.

II. PROBLEM FORMULATION

In our project existing system is totally based on relay. and it causes a large number of errors and also required continuous maintenanace ,made a system complex one. Relay control system may cause short circuit or such a faulty situation which is lesser in chance in PLC.So to overcome these we have used a PLC based system for the plant.This reduces the overall cost increses accuracy and efficiency and also benificial for similar type of small scale industry.

Components Used

Sr no	Components used
1	**Programmable logic controller** (PLC) Schneider PLC Zelio LogicSR2D101BD
2	**Temperature indicator** Selec PIC 101A
3	**Indication Lamps** Round pilot light Ø 22 – red,green,yellow - integral LED - 230..240 V - screw clamp terminals
4	**PID temperature controller** Selec PID 500
5	**Miniature circuit breaker (MCB)** Schneider A9N2P02CxC60 - 2 poles - 2 A – C curve SchneiderA9N3P16CxC60 - 3 poles - 16 A -C curve
6	**Contactors** SchneiderLC1D09M7 D contactor - 3P(3 NO) - AC-3 -440V 9 A - 220 V AC coil
7	**Switched Mode power Supply** (SMPS) 120W Single Output
8	**Selector Switches** Black selector switch Ø22 2-position stay put 1NO 600V
9	**Thermal Overload Relay**

Table No .1 Components

III. WORKING AND OPERATION

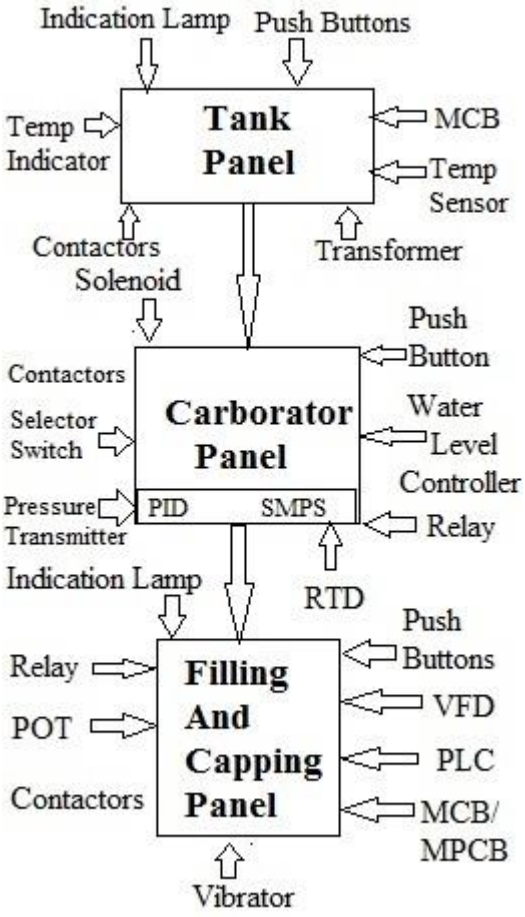


Fig.1 Block Diagram

1. Tank Panel- Tank panel is the combination of three tanks water tank, solution tank and mixture tank. In which the Temperature of all tanks are controlled by PID The indication lamps are used to indicate the on/off condition of motor. Temperature sensor is senses the inner and outer temperature of the tank

2. Carborator Panel- The solution of mixture tank is send to the carbonator tank using motor. In this tank the co2 is mixed with liquid solution under a certain temperature. This panel consist of Pressure sensor, Temperature sensor, PID controller, SMPS, The pressure and temperature measurement is important because of high pressure co2 mixing with liquid solution. The temperature is measured by the RTD and water level controller is indicate the level of liquid.

3. Tapping And Filling Panel- This panel consist of relay, contactors, push buttons, VFD,MCB/MPCB, PLC, vibrator In this the VFD is used for operation of conveyor belt, PLC is programmed for the tapping and filling purpose. Vibrator is used to insert the cap on the bottle thread.

IV. POWER SUPPLY OF TAPPING AND FILLING PANEL

The main supply is given to the SMPS and the MCB is used for the protection purpose. The SMPS converts the 230V AC into the 24V DC Supply. This 24V DC Supply is given to the PLC input terminal. In between the SMPS and PLC the MCB are connected.

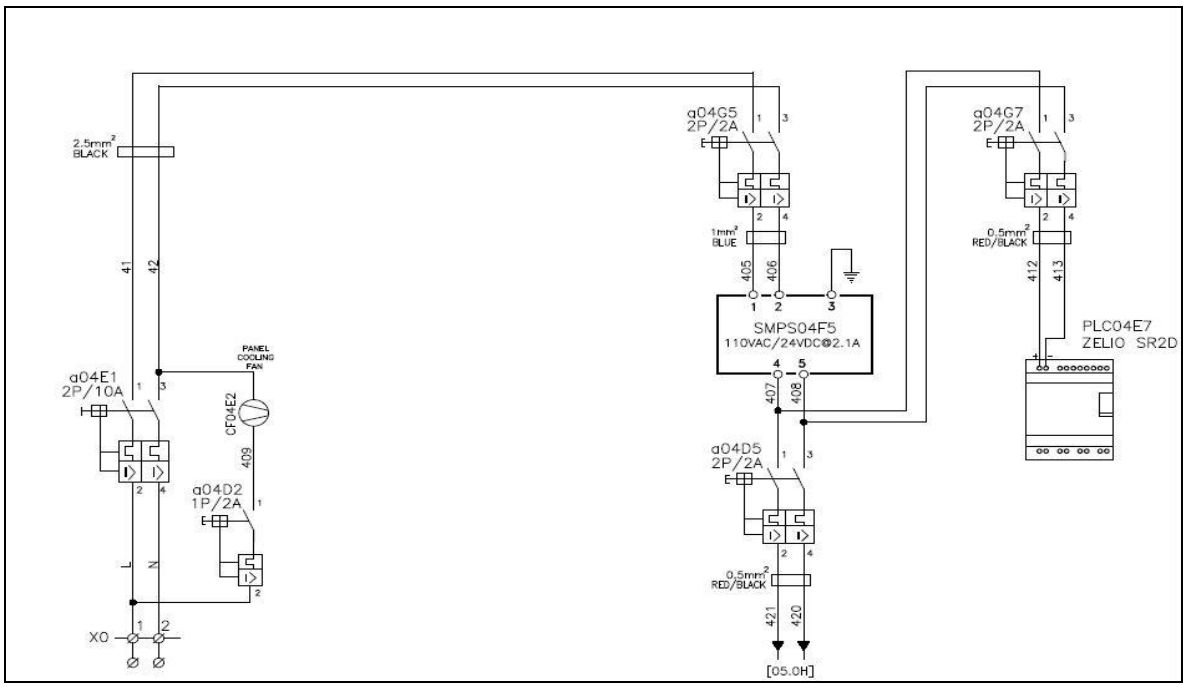


Fig.2 Power Supply Diagram

V. CIRCUIT DIAGRAM

The input 24V DC supply is given to the PLC .The PLC has 5 inputs and 4 outputs. In this the 5 push buttons are used for cycle start and stop operation. Two Push buttons are used for cripping and crowning and one is used for emergency stop operation. The output four terminal supply is given to the relay contacts

This relays are give the signals to the push buttons the operation of this relay is programmed using PLC Ladder logic The circuit Diagram Of this panel is shown in below figure.

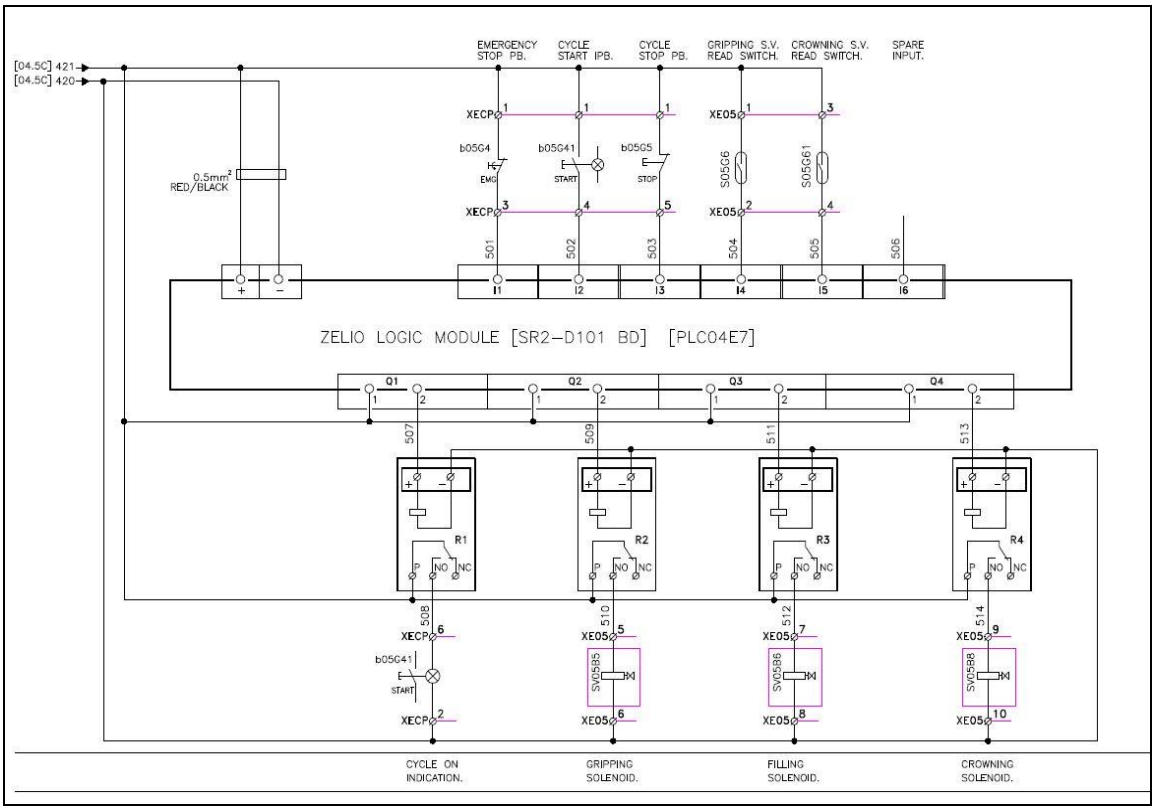


Fig.3 Circuit Diagram

VI. PERFORMANCE ANALYSIS

In The previous system Analog and Digital Timer relays are available. but they are expensive and require several manual operations to ensure that the time sequence operates correctly. It is also a time consuming process so to overcome this the PLC based system is used in the plant

1. Various machine data can be stored in PLC system which is not possible in relay control system.
2. Wiring cost is also reduced in the PLC system.
3. Analog signals like a pressure, temperature cannot be read by relay logic which is possible using the PLC.
4. They can be integrated with computer data logging and other digital control system like VFD.
5. PLC program can be easily modified or to make changes in system is easier which is difficult in the relay system.

VII. OBSERVATION AND RESULTS

Three systems are compared with each other and observations are taken.

Manual control

In this method the bottle filling operation will take place manually and the time required for filling bottle is observed.

Relay Control

In the relay based system the system is little bit faster than the the previous system and time also reduces but some manual operation required.

PLC controlled System

In this system the water fills in the six bottles by one after another in sequence automatically. and actual time required was noted down for compensation.

Manual Control

Loading time-6 sec

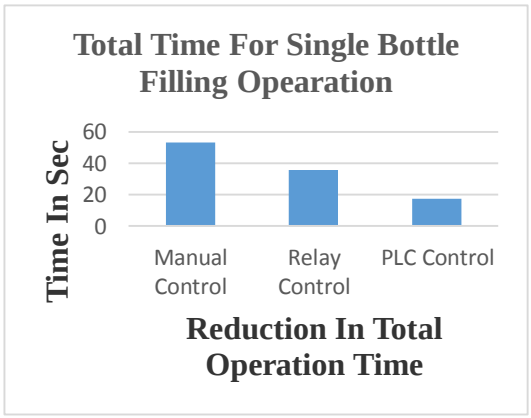
Operational time-36 sec
Unloading time-6 sec
Allowance-10% =5.4 sec
Cycle time for 1 bottle=LT+OT+UT+A
= 6+36+6+5.4
= 53.4 sec
Cycle time for 6 bottles= 320.4 sec

Relay Control

Loading time-4 sec
Operational time-24 sec
Unloading time-4 sec
Allowance-10% =3.6 sec
Cycle time for 1 bottle=LT+OT+UT+A
= 4+24+4+3.6
= 35.6 sec
Cycle time for 6 bottles= 213.6 sec

PLC Control

Loading time-2 sec
Operational time-12 sec
Unloading time-2 sec
Allowance-10% =1.2 sec
Cycle time for 1 bottle=LT+OT+UT+A
= 2+12+2+1.2
= 17.2 sec
Cycle time for 6 bottles= 103.2 sec



Graph No.1 Operation Analysis

VIII. CONCLUSION

The use of PLCs In Bottle filling and tapping application has grown in recent years. Many Technical issues affect the cost benefit analysis of implementing different type relay and microcontroller automation system however this technology for meeting those equipment have key challenge to implementing automation. Time required to operate is 50% less than existing Relay system, life span of this system is more than Previous system, as this system is less complex so Maintenance cost is very less than existing Relay system. And the time required for the bottle filling is reduced as the system is approaching towards PLC automation

IX. REFERENCE

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