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Design and Implementation of Sealing Unit based on PLC

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***Abstract*— this paper presents machine vision approach to put and inspect the integrity of LPG cylinder seals. Programmable Logic Controllers (PLC) are used in industries over a decade because of its robust nature, computational power and applications beyond automation and control. Due to its advance features and high speed computations it can be easily used in designing a new sealing unit for sealing LPG cylinders. This paper focuses on Allen Bradley microtransistor 800 model which is widely used in the industries. PLC will be used to monitor the temperature, control the movement of LPG cylinders and seal them once they enter the unit. The whole sealing process should take place only if the temperature of hot air is above 250°C. This hot air will be passed onto the blue color plastic cover so that it seals it. SCADA will be used to monitor sealing unit from distance.**

***Index Terms*—Allen Bradley PLC, Baliga Heater, Inductive Sensor, SCADA, Sealing Unit.**

I. INTRODUCTION

LPG cylinders are the necessity of each and every one this days. Almost everyone uses LPG cylinders to cook at home, restaurants. As the demand for LPG increased, this has caused industry to rethink about the method of sealing. The present system was pneumatic based sealing system which was not entirely leaving up to the demand of LPG cylinders. There was a need for rethinking of that sealing process. The new system will be based upon Allen Bradley micro transistor 800 PLC. Before sealing, PLC will check for the temperature and if it is above 250ºC the sealing will take place. The main advantage of using PLC is that it can withstand in harsh temperature and conditions [1]. PLC can protect your work as you can put password for your work thus protecting it from alterations. It is easy to download code from PLC to any system if at all someone wants to make a change in the program. PLC is designed for an industrial environment and was manufactured to deal with the harsh conditions which could be electrical noise, electromechanical interferences, mechanical vibrations, extreme temperatures and non-condensing humidity of 95% [2].

II. DESIGNING

Conveyor belt will be continuously carrying the LPG cylinders from unloading section to loading section. Once the LPG cylinders are filled, they enter the sealing unit so that the seals can be applied. Three inductive sensors will be placed inside the sealing unit at a distance 14 inches from each other as shown in the schematic block diagram in Fig. 1. This will be detecting the movement of cylinder inside the unit. Stoppers will be placed right at the start and end of sealing unit. This stoppers are nothing but a pneumatic cylinders which will have a piston inside it and they can be controlled by solenoid valve which will be controlling the flow of air towards the pneumatic cylinder. Once three LPG cylinders enter the unit, PLC will sense this through the inductive sensor and will turn on the 2 by 2 Festo solenoid valve. This solenoid valve will turn on the outlet 1 so that the air goes from inlet to outlet 1 and it gets to the piston of pneumatic cylinder. Due to this air supply the piston will move outwards thus halting the conveyor belt.

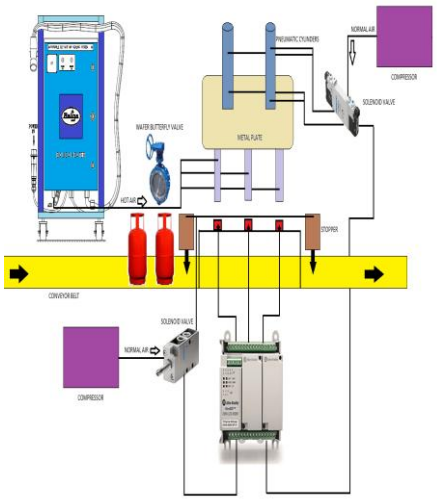

Fig. 1 Schematic block diagram of the proposed system

Once the conveyor belt is stopped, PLC will turn on the 5 by 2 solenoid valve which will be controlling the

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pneumatic cylinders mounted on top of the metal plate. This solenoid valve will turn on the outlet 1 so that the air supply entering through inlet gets to the pneumatic cylinders. This will force the piston to move down, because of this downward movement the metal plate will come downwards so that gun touches the LPG cylinders. The hot air coming out of the Baliga heater will be controlled by the air cut off valve which will only open when the gun touches the cylinder. There will be three cut off valves controlling the hot air supply to each gun. Once the gun touches the LPG cylinders, hot air will come though the opening inside the gun and will be passed onto the seals.

Once the 3 cylinders are sealed PLC will turn off the 2 by 2 solenoid valve which will turn off the stopper. The sealed LPG cylinders can move ahead and the new set of LPG cylinders will enter the unit. Also it will turn off the 5 by 2 solenoid valve so that the metal plate move upwards due to movement of piston inside the pneumatic cylinders. There could be cases where in there is a large time gap between the two incoming LPG cylinders. At that time the unit must not wait for all 3 LPG cylinders instead it should seal the LPG cylinder which has entered inside the unit. This was the major advantage of the new system as it was not waiting for all cylinders. It saved crucial time and the number of LPG cylinders sealed per hour increased drastically. PLC and SMPS will be placed in a flame proof box. Control panel will have start and stop buttons.

III. ALGORITHM

1. When start button is pressed, the first thing it should do is to check the temperature. The temperature should be above 250ºC.
2. When sensor 3 detects the LPG cylinder stopper 2 will be high.
3. If sensor 2 and sensor 1 are high along with sensor 3 PLC will turn on the five by two solenoid valve.
4. Five by two solenoid valve will force the metal plate to come down. Once the seal is applied the same valve will force it to go up.
5. Once the seal is applied stopper 2 will go low. Exceptional Cases:-
6. If sensor 3 is high and sensor 2 and sensor 1 don't get any signal for 3 seconds, stopper 1 will be high along with stopper 2 and then the seal will be applied.
7. If sensor 3 and sensor 2 are high but sensor 1 is low and doesn't get any signal for 3 seconds, stopper 2 and stopper 1 will be high and sealing will take place.
8. There will be emergency stop button which will halt the operation.

IV. SCADA SIMULATION

The SCADA (Supervisory Control and Date Acquisition) is mainly designed to visualize and control processes, production sequences and machines and troubleshooting. SCADA implementation in automation systems improves the planning ability and also enables the operation, control and visualization of the automation system from one outdoor [3]. In order to observe and control the sealing process we will be using Wonderware InTouch 10.0 SCADA software. This software is widely used in the automation industries. When the InTouch software is start up, Application Manager Page will show all the existing projects and will give us the opportunity to make a new one. In Application Manager Page projects, modes, screen resolutions and versions can be checked [4].

InTouch SCADA software is run in Window Viewer mode. In Window Maker Page, there will be a Runtime icon, by clicking that the simulation can be carried out. InTouch SCADA software will have a window script option where in you have to write the script. After selecting the wizards required for the project, you have to name them in a specific order [5].There will be two screens, 'On Show' and 'While Showing'. Under 'On Show' screen you have to define the initial conditions whereas in 'While Showing' you have to write the actual script.

Three LPG cylinders are entering the sealing unit as shown in Fig. 2. Once they enter the unit, seals will be applied onto the LPG cylinders as shown in Fig. 3. Once the seals are applied, new cylinders will enter the sealing unit.

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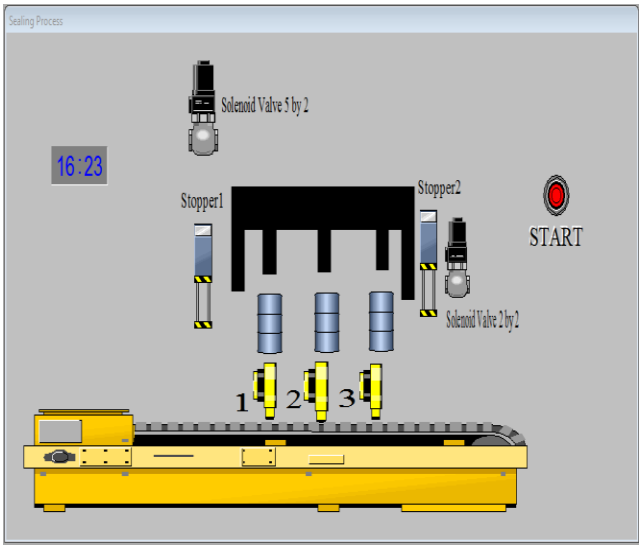

Fig. 2 Three LPG cylinders entering the sealing unit

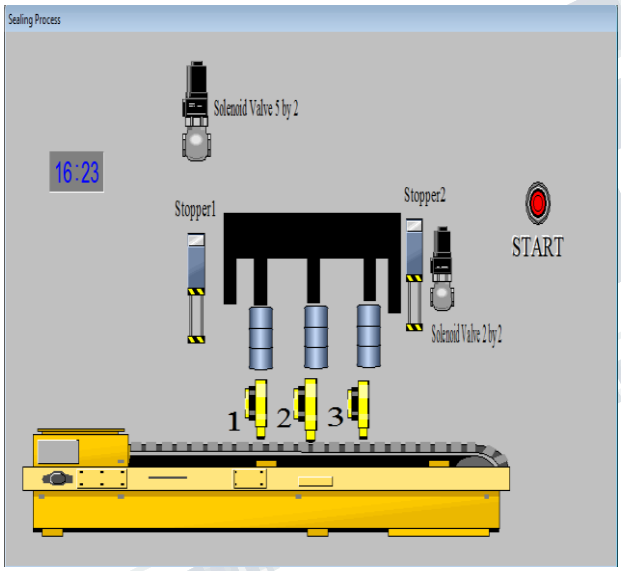

Fig. 3 Sealing of LPG cylinders

V. CONCLUSION

The main ideas of this study are designing and implementation of PLC based seal packing process by using the industrial production equipment and visualization and controlling the system via SCADA System. This SCADA System enables us to control and manage the sealing unit from a distance.

Using the pneumatic system the sealing unit could seal around 1600 LPG cylinders per hour, but because of this PLC based system, the unit could seal around 1800 LPG cylinders per hour thus meeting the demand.

VI. ACKNOWLEDGMENT

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