PLC BASED RECIPROCATING
COMPRESSOR CAPACITY
REGULATION SYSTEM

R.Poornima\textsuperscript{1}, V.Sivachidambaranathan \textsuperscript{2}, P.S.Mayurappriyan\textsuperscript{3}
\textsuperscript{1}M.E. KCG College of Technology, Chennai.
\textsuperscript{2}Professor Head of EEE Dept,
Sathyabama Institute of Science and Technology, Chennai.
\textsuperscript{3}Professor Department of EEE,
KCG College of Technology, Chennai.

January 22, 2018

Abstract

The Reciprocating Compressors are widely used for compressing air and it is satisfactory for all ranges of pressures. In this study, an attempt has been made to regulate the capacity of reciprocating compressor, by controlling the speed of the AC motor and also to reduce the heat produced by the motor, to save the energy conservation. The proposed regulation system has been realized employing a proximity sensor. The Programmable Logic Controller (PLC) is mainly used in designing the ladder logic and it controls the regulation system. Omron platform is used for analyzing the PLC and display the ladder logic.

\textbf{Key Words}: Proximity sensor, Pressure sensor, Compressor (model), Programmable Logic Controller.

1 Introduction

The reciprocating compressor that consumes large amount of energy. Suitable methods should be developed to regulate the ca-
pacity of the reciprocating compressor within a certain scope. This will meet the requirements of production process and satisfy energy savings.

The number of cylinders used in reciprocating compressors may be more than one. In single stage reciprocating compressor pressure ratio is kept 5 to 8, and the speed varies from 100 to 1500 rpm.

Reciprocating compressors are driven by electric motors, or I.C. engine. It is not driven by gas turbines because turbines have high rotational speed. The air/gas coming from reciprocating compressor is not continuous but intermittent. So the air/gas is stored in receiver from where continuous flow of gas can be supplied. It is generally seen where there is requirement of high pressure and low flow. Mostly where the air is used for hand-tools, cleaning dust, small paint jobs, commercial uses, etc.

Dacheng Li et al have presented design of capacity regulation system for reciprocating compressor based on programmable logic controller. The advantage of this method is that achieves continuous step less capacity regulation and decreases unnecessary energy losses [1]. Hong et al presented theoretical analysis on realization of step-less capacity regulation for reciprocating compressor. It has to reduce energy consumption [2]. Zhi et al presented an analysis on capacity regulation method of reciprocating compressor. It consumes low power and cheap to manufacture [3]. Yu et al presented an analysis on reciprocating compressor. It reduces the power consumption by using novel rotary valve. [4]. High frequency is suitable for low values of filter components [5].

In this work, an attempt has been made to develop the regulation system by using silicon pressure sensor, window comparator and programmable logic controller (PLC). The small plastic tube transmits the pressure difference to the pressure sensor, where a sensor converts the pressure signal into a changing voltage that is compared with reference voltage by window comparator and variation of speed of ac motor that is indicated by incandescent lamp.

2 METHODOLOGY

The block diagram of the proposed system is shown in Figure 2.1. The system consists of power supply unit, programmable logic con-
controller, pressure sensor, A.C. Motor, proximity sensor and signal conditioning unit.

Fig. 2.1. Block diagram of proposed system

In this study, an attempt has been made to regulate the capacity of reciprocating compressor, by controlling the on-off time of actuator and also to reduce the heat produced by compressor to save the energy conservation. The proposed regulation system has been realized employing a proximity sensor. It senses a metal object and provides necessary electrical signal to the window comparator then it controls the speed of ac motor. The Programmable Logic Controller (PLC) is mainly used in designing the ladder logic and it controls the speed of the ac motor.

Figure 2.2 shows the snapshot of the inductive proximity sensor. In this work, an inductive proximity sensor used to senses the metallic object nearer the sensor and provides an impedance changes due to presence of eddy current induced by coil. The characteristics of this sensor are to detect objects with the objects a short distance, ranging from 1 mm to several centimetres meters according to type of sensors used. Proximity sensor has a working voltage of 10-30 Vdc and there is also a voltage 100-200VAC.

Fig. 2.2. Snapshot of the proximity sensor
The speed of AC motor can be controlled by programmable logic controller, where a sensor converts the pressure signal into a changing voltage that is compared with reference voltage by window comparator. Omron platform is used for analysing the PLC and displays the ladder logic. Figure 2.3 shows the complete view of developed hardware.

![Fig. 2.3 Developed PLC based reciprocating compressor capacity regulation system](image)

3 RESULT AND DISCUSSION

The completely developed regulation system assembly together with actuator, proximity sensor, pressure sensor, plc and ac motor and Omron software are tested with ladder logic. The ladder logic is designed to displays connection of proposed system and output is displayed as shown in Figure 3.1
Testing of PLC based regulation system:

Condition 1:
When the air pressure in the blower becomes very high then the window comparator provides high resistance which makes the motor to run slowly or lamp glows very dim as shown in figure 3.2

Condition 2:
When the air pressure in the blower becomes very low then the window comparator provides less resistance which makes the motor to run fastly or lamp glows very brightly.
4 CONCLUSION

Monitoring reciprocating compressor is an important task when using programmable logic controller (PLC). In this work, an attempt has been made to plc based reciprocating compressor capacity regulation system. The regulation system can be designed by using silicon based inductive proximity sensor, compressor, actuator and low cost programmable logic controller. The Omron software has been developed with a view to display significant motor speed in real-time. The results shown that the various parameters like pressure, volume and speed are measured.

In future, such systems are implemented in multi-cylinder capacity regulation system instead of single cylinder capacity system. Extensive trials need to be performed by using PLC to gather statistical data for further analysis.

References


