

PLC based Automation of Rotary Indexing Fixture

Anagha Nampurkar¹ Pallavi Taware² Shahiqua Nasreen³ Prof. Mrs. S. M. Shaikh⁴

^{1,2,3,4}Department of Electrical Engineering
^{1,2,3,4}AISSMS's IOIT, Pune, India

Abstract— This paper mainly discusses automation of rotary indexing fixture using PLC. The different operations of rotary indexing fixtures are been controlled by PLC programming, PLC panel and Control panel. The basic function of Rotary Fixture is for Visual Inspection and Grinding of valve body.

Key words: Programmable logic controller (PLC), Rotary indexing fixture, Hydraulic motor, valve body, Push button (PB), selector switches (SS), proximity sensors

I. INTRODUCTION

Automation is the use of various control system for operating equipment such as machinery, processes in factories, boilers and aircraft etc. and other applications with minimal or reduced human intervention. In today's world Automation is the need and requirement of every industry. The biggest benefit of automation is that it saves labour; however, it is also used to save energy and materials and to improve quality, accuracy and precision. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical and electronic and computers, usually in combination.

In this project we are using PLC based automation for the Rotary Indexing Fixture for valve body.

The 'Rotary Indexing Fixture' is the mechanical structure with a specified set of operations. The project is about, to design the PLC panel and program to control the operation of 'Rotary Indexing Fixture'.

The basic function of Rotary Fixture is for Visual Inspection and Grinding of valve body. The valve body approximately weighs 420kg and the loading -unloading height is about 622±50mm. It is required that the fixture should be capable of working in automatic as well as manual mode. It is also desired that the Fixture should have 360deg rotation possible in both horizontal and vertical axis, so that inspection and grinding can be done on all sides without any restrictions.

II. RELATED WORK

In the exhaustive literature survey we came across the contributions proposed in recent years in automation of material handling systems. These includes conveyors, portable conveyors, roller conveyors, hydraulic pallet truck , Hydraulic and pneumatic parts handling systems, etc. these all material handling systems were automated till now using PLC. It has been observed that the automation of material handling system has improved the productivity, accuracy in work, speed of work, more consistent performance, reduced labour cost, achieving higher productivity and so on. In line with these works, we describe in this paper the description of Automation of Rotary Indexing Fixture using PLC.

III. CONSTRUCTION

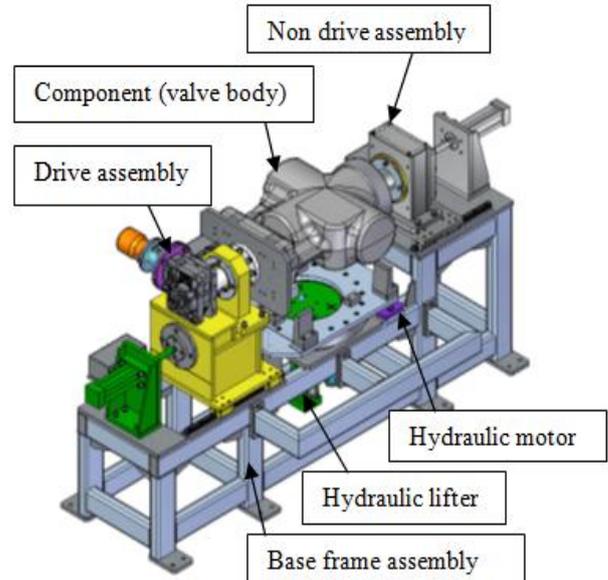


Fig. 1: The full view of rotary indexing fixture
The Rotary indexing fixture consists of 6 parts:

A. Base Frame Assembly:

It is the support on which the whole assembly is mounted. It consists of fabricated structure of rectangular tube. On top of it, rectangular tube LM rail mounting plate and cylinder mounting bracket is placed. At the centre, Fixture mounting arrangement is placed.

B. Drive Clamping Assembly:

It consists of drive shaft, bearings and a retainer. Drive clamping assembly is mounted on LM rail. The rotary motion of fixture plates and the sliding motion of the drive clamping assembly are given with the help of Hydraulic cylinder assembly.

C. Non Drive Clamping Assembly:

It consists of non-drive shaft, bearings and retainer. A locator is mounted on non-drive shaft for job clamping purpose. Non-drive clamping assembly is mounted over LM rail and sliding motion is given with the help of Hydraulic cylinder assembly.

D. Hydraulic Motor Assembly:

Hydraulic motor assembly is mounted on base plate. It consists of pinion, Hydraulic motor and retainer. The pinion is rotated with the help of Hydraulic motor. Retainer is mounted on top side on pinion for locking purpose. The Hydraulic motor has following specification:

Make: EATON
Torque: 47Nm
Speed: 276rpm
Flow: 14.1Lpm

E. Lifting Cylinder Assembly:

Lifting cylinder assembly is used for vertical motion of valve body. It consists of lifter, hydraulic cylinder and guide bar mounted on lifter plate.

F. Valve Body:

It is the job (component) placed on the rotary plate. The visual inspection will be done on the valve body.

IV. PLC SPECIFICATIONS

A. Siemens- CPU S700, CPU 224, 14 I/P- 10 O/P:

Module Dimensions	Height: 80mm Depth: 62 mm Width: 120.5 mm
Program memory	8/12kbytes
Data memory	8kbytes
Digital inputs/outputs/max. number of channels with expansion modules	114/110/224
Storage of dyn. data via high-performance capacitor	typ. 100 h
High-speed counters	6 x 30 kHz, of which 4 x 20 kHz A/B counter usable
Integrated 24-V-DC sensor supply volt.	max. 280 mA

Table 1: Specifications of PLC

V. PANEL SPECIFICATIONS

A. Inputs of PLC Panel:

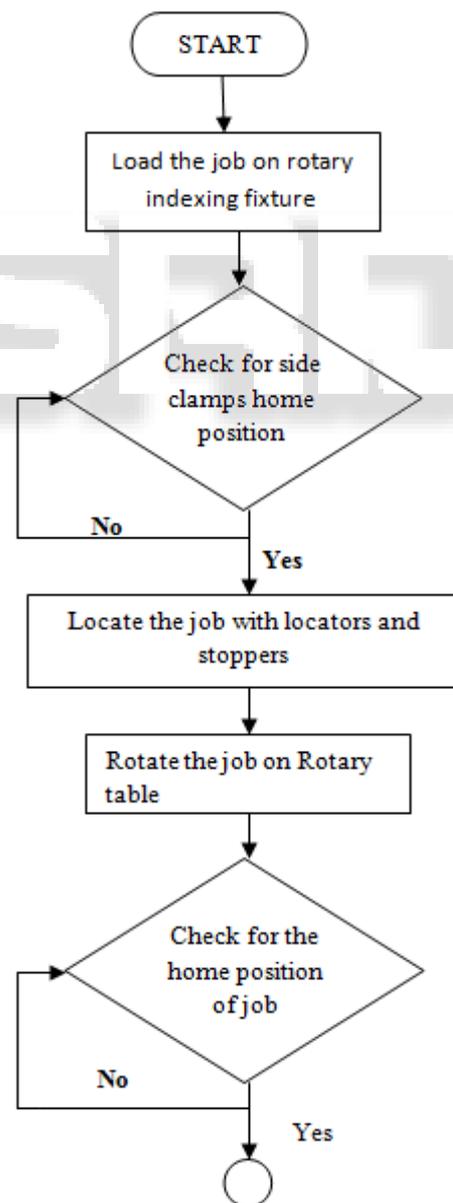
- 1) Auto select: To select automatic mode.
- 2) Cycle start: To start the cycle
- 3) Cycle stop: To stop the cycle
- 4) Emergency stop: If any fault/ emergency occurs emergency stop is used.
- 5) Fault reset: After the fault is cleared, it will reset the operation.
- 6) Power pack motor over load: It is a NC switch. If overload occurs the switch will open and motor is protected.
- 7) Power pack on ILPS: It will indicate green light if the motor is turned on.
- 8) Power pack off ILPS: It will indicate red light if motor is turned off.
- 9) Rotary table forward foot switch: Foot switch is provided so as to control the rotary table manually in forward direction.
- 10) Rotary table reverse foot switch: Foot switch is provided so as to control the rotary table manually in reverse direction.
- 11) Rotary table home: Proximity sensor will sense rotary table if it is in home position or not and then it will give indication
- 12) Rotary table up: It is a switch to move the hydraulic lifter up manually.
- 13) Rotary table down: It is a switch to move the hydraulic lifter down.

- 14) Rotary table up (px): Proximity sensor is used to sense the up position of the rotary table.
- 15) Rotary table down (px): Proximity sensor is used to sense the down position of the rotary table.
- 16) Side clamp reverse (px): Proximity sensor is used to sense the home position of side clamp.
- 17) Side clamp forward (px): Proximity sensor is used to sense the forward position of the side clamp.
- 18) Spare: These inputs are provided for future expansion.

B. Outputs of PLC Panel:

- Tower lamp
- Hooter
- Rotary table
- Hydraulic cylinders
- Side clamps
- Power pack

VI. FLOWCHART OF OPERATION OF ROTARY INDEXING FIXTURE



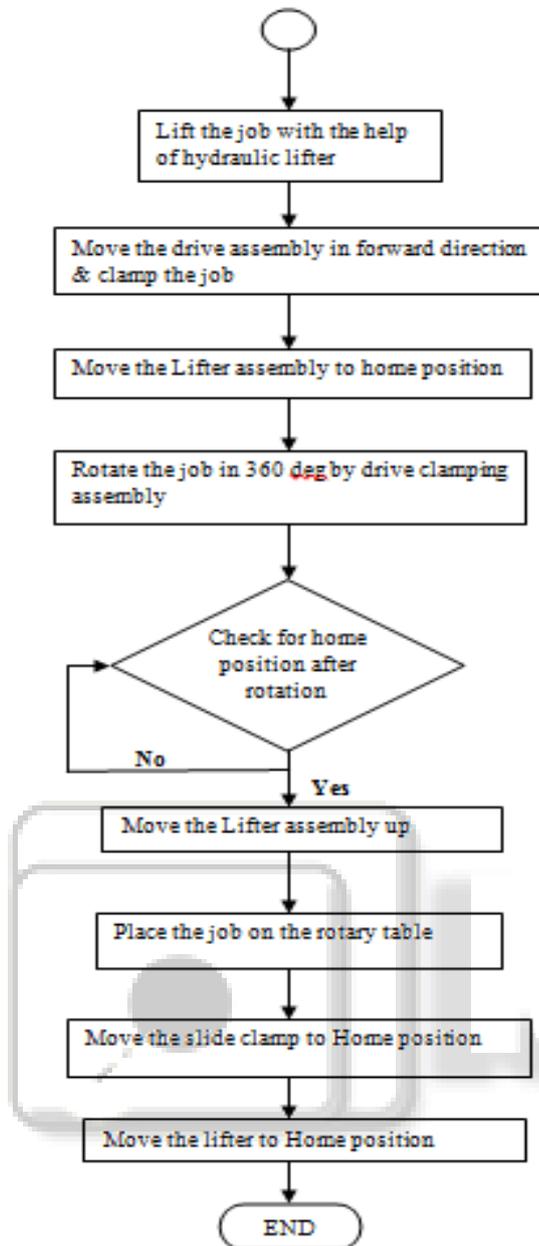


Fig. 2: Flowchart of Operation of Rotary Indexing Fixture

VII. RESULT

The Rotary Indexing Fixture is functioning properly according to the desired operations. In case of any fault the tower lamp will show the red indication and hooter will buzz.

VIII. CONCLUSION

In this paper, a system has been successfully designed that will prove very useful in the field of 'material handling system'. Based on testing and working of the rotary fixture we conclude that the system designed will provide facility for grinding and visual inspection of the job, which otherwise would have been difficult to do manually. We learnt to design PLC based system which is capable of rotating the valve body in 360° in both the axis. The system can be operated automatically as well as manually with the help of foot switch and in case of any fault it will notify the operator by the alarm and indication.

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