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Automation of Injector Test Stand Machine

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Abstract: This paper explains the control of injector test stand machine. The injector test machine is used to test the injectors in the industry as per requirements. HA290 Harritadge injector test stand was designed for Cummins india Ltd. to test the output of Cummins made injector.This injector test machine is currently controlled by an electronic card and relay system .Since this machine is 36 years old it's service is not available for electronic parts, hence it's maintenance is very difficult also it is very difficult to replace all electronic card with new electronic card. We can replace the electronic card with PLC technology. One can make better use of PLC in the design of Injector Test Stand Machine. This control is based on the input that is received from the operator as well as from the sensors. PLC control system is requiring to control all the functions of the injector test stand machine. The ladder logic programming will be used to simulate the proposed system. Because of use of PLC, systems are getting better, faster, Operator can read the measurements of injector accurately.PLC kit will be used to check parameters which affect injector output. Hence it is decided to design PLC operated injector test stand machine.

Keywords: PLC, solenoid valve, injector, proximity sensor, LVDT, motor.

I.INTRODUCTION

Cummins India Ltd. is a manufacturer of diesel engines. These diesel engines require fuel injectors for combustion purpose. These fuel injectors are manufactured in company and company has to test these injectors for having required operation. For this purpose, injector test machine is required. Company imported specially designed injector test stand machine H A 290 manufactured by Harritage company in United Kingdom(UK) in the year 1981. Now a days this injector test stand machine is facing breakdown problem due to electronic control system. Since this machine is 36 years old hence any type of service is not available from manufacturer. This problem is affecting the manufacturing process. So company decided to bring back the test stand machine in working condition. A few solutions are available for electronic control system out of these PLC is better option to control injector test stand machine efficiently and economically. Hence it is decided to use Mitsubishi PLC to control operations of injector test stand machine.

II. WORKING OF INJECTOR TEST STAND MACHINE

Fuel is injected and extracted from injector for setting and checking purpose Fuel injector contains plunger when plunger is pressed fuel is extracted by injector Fuel injected from nozzle holes in injector through fuel tank of injector test stand machine. Plunger has 50 strokes It moves in forward and backward (reciprocation) motion for 50 times, 50 strokes is standard value for this machine.50 strokes are controlled by rotating arrangement hence reciprocators motion is obtained by rotational motion. This rotator motion is obtaining by motor of 1500 rpm. This motor is connected to pulley and pulley is connected to rotating arrangements. Pulley has 1050 rotations when 1050 rotations are completed in pulley we get 50 strokes The fuel is extracted by main hole (nozzle) of injector and it is stored in container Working of solenoid starts when it receives voltage from electronic card and starts filling the container, with increasing number of strokes container starts filling with fuel hence volume in container increases. Volume of fuel can be measured with the help of LVDT. When container is filled fully i.e. after 50 stokes of plunger, the spring which is connected to lvdt moves upward completely in the container Then volume of fuel in C.C. After 50 strokes, reading fuel volume in C.C. must be 245.

There are two solenoid valves are connected at inlet and outlet of container Proximity sensor arrangements in machine sends the information about the number of strokes of plunger to electronic card Output of proximity sensor

For zero strokes – 0 volt

For 50 stokes - + 12v

When we get 1050 pulses in proximity there are 50 strokes of plunger of injector Proximity sensors are connected to electronic card to sense the number of strokes When 1st pulse is obtained solenoid valve is activated, it is activated till 1050 pulses that is 50 stokes, as we get 50th stroke inlet solenoid valve deactivated immediately. Proximity operation is continue but because container is filled completely with fuel it will not operate after 50th strokes. Electronic card system takes some time delay using timer to get fuel stable, after this delay solenoid outlet valve is activated and oil is drained

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out from container. Hence our main aim is to measure C.C. count that is volume of fuel and displacement of fuel of LVDT.

III. PROPOSED TECHNOLOGY

We can design new electronic based control system but it is highly uneconomical now days. If we try to replace old electronic cards with new electronic cards, then system become more complex and machine will not work as per requirements. So there is another option to replace electronic card with PLC technology. The PLC system is efficient and economical than electronic control system. We can control parameters of injector test stand machine according to our requirements. Hence more importance is given to design of PLC control system**.**

IV. BLOCK DIAGRAM OF AN ELEVATOR

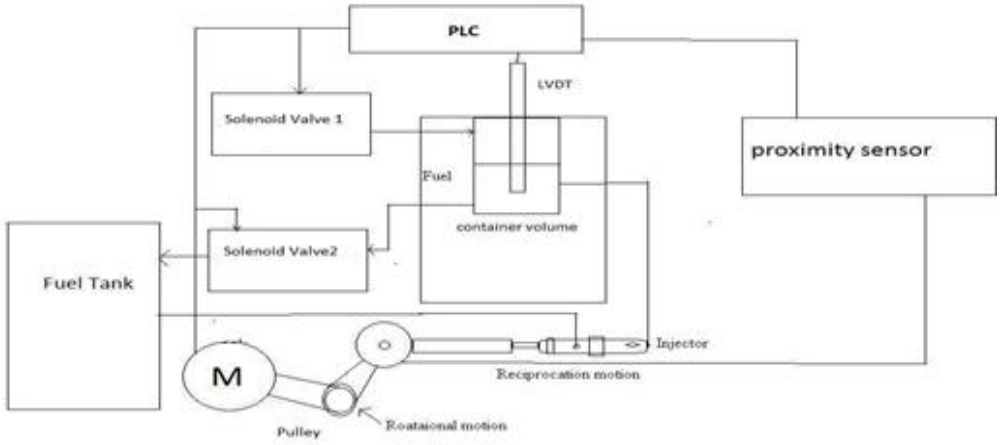

Fig. 1: Block diagram of injector test stand machine

A. PLC

A PLC is user friendly microprocessor based specialized computer that carries out control function of many types and levels of complexity. PLC controller is main element in this system which controls machine functions. PLC receives input signal from operator or various sensors used at different parts of machine for performing many functions.PLC controller produces control signals via output module which controls the machine operation and feedback is given to PLC controller.

B. Fuel Pump

Fuel pump extracts oil from fuel tank and supplies it to injector.

C. Power Supply

Power supply is given to PLC controller as well as motor drive circuit. The power available in most plants is 230 volts AC at 50 HZ. Most PLC operates on +24volts and -24volts DC. Therefore, the PLC CPU must contain circuitry to convert 230 volts AC input to the required 24 volts DC value.

D. Motor

It converts electrical energy to mechanical energy. It converts rotational motion to reciprocatory motion through pulley arrangement which produces strokes in injector.

E. Proximity Sensor

It counts the rotations of motor and produces pules and gives signal to PLC controller. In this machine it produces 1050 pulses for 1500rpm in motor.

F. Solenoid Valve 1 & 2

Solenoid Valve 1 gets opened when it receives signal from PLC and fuel from injector stars filling in fuel container and it gets closed after 50 strokes in injector or 1050 pulses in proximity sensor. Solenoid Valve 2 is initially closed during measurement of fuel in container. When fuel is measured by LVDT sensor it sends signal to PLC then solenoid valve 2 opens and fuel gets extracted in fuel tank.

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G. LVDT

When fuel starts filling in container LVDT starts measuring volume of fuel and after 50 strokes of injector it measures total volume of fuel and sends signal to PLC.

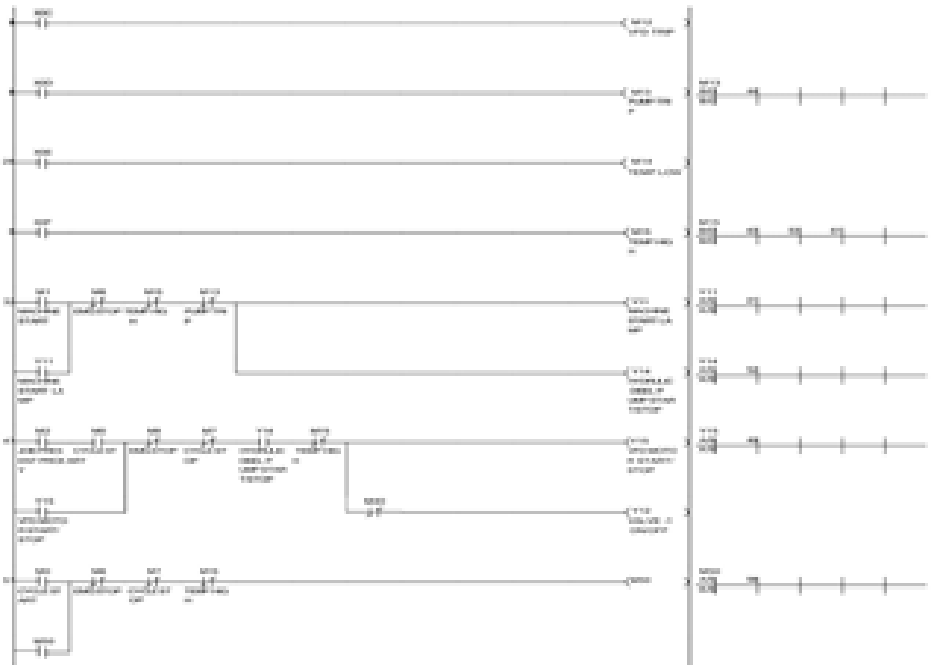
H. Injector

Injector is one of the main component of operation. Fuel extracted from injector is measured in this machine in 50 strokes.Injector is tested by the machine according to requirement.

V.INJECTOR TEST STAND MACHINE

VI. SOFTWARE IMPLEMENTATION

Ladder diagram has commonly used programming languages for the PLC. As it is the simplest method with the basic knowledge of computers and logic circuits one can program the PLC by the use of this method .



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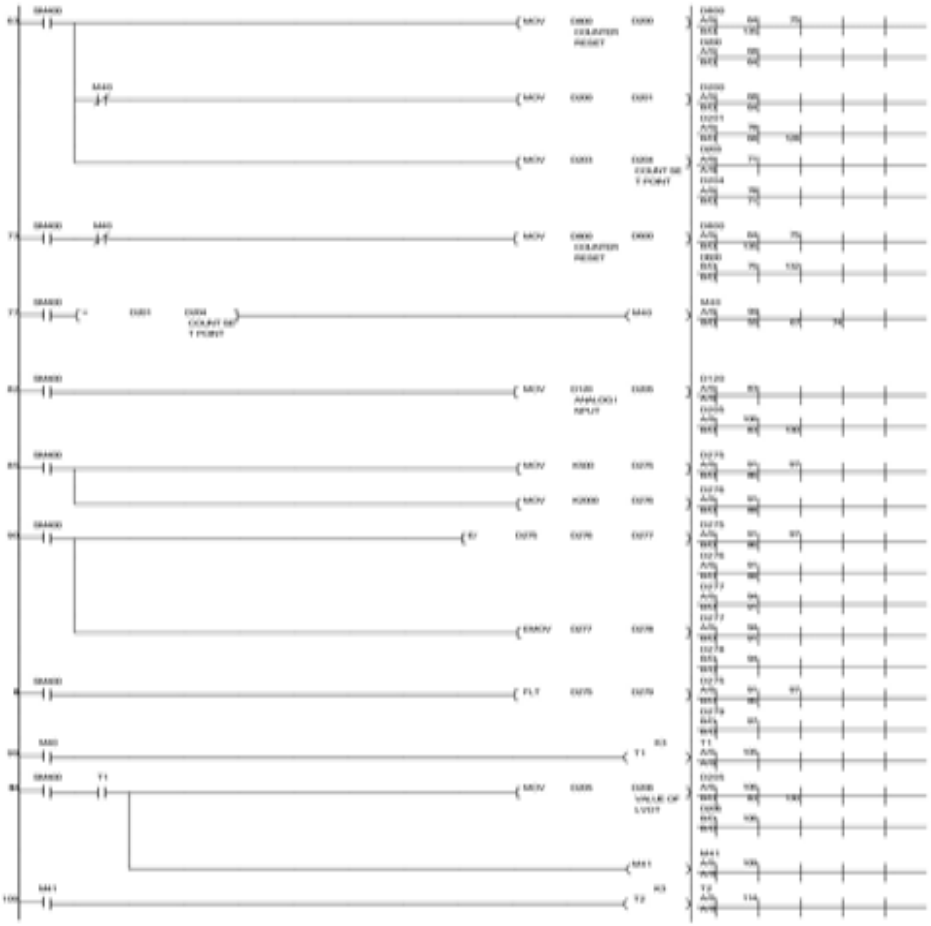

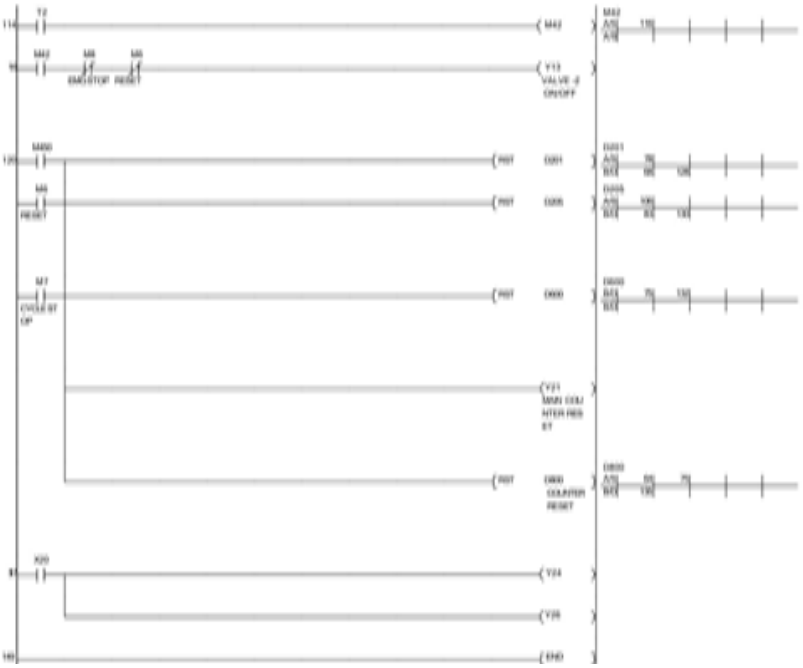

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VII. ADVANTAGES AND DISADVANTAGES

PLC and various sensors are uses to perform various functions, which are advantageous for providing comfort to human being.

A. Advantages

- In PLC, troubleshooting and start-up is very simple. All inputs to the computer system from buttons, switches and outputs from the system to light, relays and motor drive, can be individually monitored with an indication of LED.
- The PLC based system is flexible while the program can be updated quite easily to integrate adaptations and new features.
- In PLC, increased technology makes it possible to condense more functions into smaller size and economical in long term.
- The operational speed for PLC program is very fast as compared to relay time and is determined from scan time, which is a matter of millisecond

B. Disadvantages

- More costly as compared to microcontroller based control.

VIII. CONCLUSION AND FUTURE SCOPE

The PLC based system is flexible while the program can be updated quite easily to integrate adaptations and new features. The operational speed for PLC program is very fast as compared to electronic control system .Hence injector test stand machine works satisfactorily with PLC system. In this machine different types injectors can be tested by changing programming in PLC .If any fault occurs in PLC system it can be detected and resolved easily.

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