Automation of Bush Press Machine using PLC

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*Abstract –***This paper presents a design and implementation in automation of Bush press machine using PLC..Bushpress machine is an essential component for fitting of bushes in the cam-bore assembly that is used in diesel generators. The bushes are cylindrical in shape and can be easily replaced as wear and tear occurs during the continuous movement of shaft. If not fitted properly bush misalignment can occur as every bush has its own alignment. The bushes are of three types and are fitted according to the corresponding oil gallery.**

Keywords:- PLC, BUSHPRESS MACHINE, BUSH MISALIGNMENT.

I. INTRODUCTION

Wear in engines and machines occurring only on areas subject to movement, it is essential to be able to make renewals without replacing major components. Maintenance would otherwise prove expensive, particularly as all parts which move are not subject to the same loading and rubbing speed; and the higher these are, the greater wear is likely to be. Removable bushes are often the means for making renewals. If the bush is a plain parallel type with free access to both ends, as employed in a spring eye or for the small end of a connecting rod. The bushpress machine does the task of fitting the bushes by press fit arrangement. It is connected to an induction motor as well as a hydraulic motor. There is a two hand safety switch which is employed for controlling the forward and reverse operation. The bore and bush diameter has to be very accurately decided so that the bushes fit properly. The bushes have a particular alignment so they correspond with the oil assembly. While fitting this alignment is taken care of by checking each bush.

II. LITERATURE SURVEY

A. DEFINITION OF PLC

A digital electronic device that uses a programmable memory to store instruction and to implement function such as logic, sequencing, timing, counting and arithmetic in order to control machines and processes. The term logic is use primarily concerned with implementing logic and switching operations .Input devices e.g. switches, and output devices e.g. motors, being controlled are connected to the PLC and then the controller monitors the inputs and outputs according t this program stored in the PLC by the operator and so controls the machine or process. Originally they were designed as a replacement for hard-wired relay and timer logic control systems. PLCs have the great advantage that it is possible to modify a control system without having to rewrite the connections to the input and output devices, the only requirement being that an operator has key in a different set of instruction. The result is a flexible system which can be used to control systems which vary quite widely in their nature and complexity.[3]

The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC). The advent of the PLC began in the 1970s, and has become the most common choice for manufacturing controls. The conventional methods need to be modernized and its various functions are required to be automated to achieve reduced cycle time, higher productivity, higher levels of accuracy and more reliability. The age of automation has brought a new meaning to electronics in industries; it means the complete automatic operation of the machines without human brain intervention, implying automatic inspection and electronics integration and control of various machine operations.[4]

B. WHY PLCS ARE PREFERRED?

In a system the number of relays required for a particular operation is more than a PLC used for the same operation

- Cost effective for controlling complex systems.
- Flexible and can be reapplied to control other systems quickly and easily.
- Computational abilities allow more sophisticated control.
- Trouble shooting aids make programming easier and reduce downtime.[1]

C. EXISTING SYSTEM

The existing system is purely manual and operator dependant. Bush misalignment can happen if Proper bush is not pressed with corresponding cam bore; as bush placing & pressing operation is totally operator dependant.

Fig.1. Machine Overview

III. OVERVIEW OF A BUSHPRESS MACHINE

A PLC based panel consists of proximity sensors, photoelectric sensors, bush press machine, induction motor, and hydraulic pump.

Components of PLC panel are as follows:-

A. SMPS

A switched-mode power supply (switching-mode power supply, switch-mode power supply, SMPS, or switcher) is an

electronic power supply that incorporates a switching regulator to convert electric power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

B. MOTOR PROTECTION CIRCUIT BREAKER

Motor Protection Circuit Breakers(MPCB)provide both short circuit and overload protection for individual motor loads and are available for a wide range of motor sizes and installation types. The rating of the current MPCB is 10 A. The circuit breaker safeguards the motor from electrical damage. Features

are such that the mpcb is designed according to the rating of the motor. It provides short circuit as well as overload protection.

C. MINIATURE CIRCUIT BREAKER

The frame of miniature circuit breaker is a molded case. This is a rigid, strong, insulated housing in which the other components are mounted. They are used for household as well as electrical appliances.

Operating Mechanism of Miniature Circuit Breaker

The operating mechanism of miniature circuit breaker provides the means of manual opening and closing operation of miniature circuit breaker. It has two-positions "ON," "OFF,". When the mcb trips it goes in "off" position. When manually switch off the MCB, the switching latch will be in "OFF" position. In close condition of MCB, the switch is positioned at "ON". The mcb gives overload as well as short circuit protection by means of a bimetal and trip coil.

D. PHOTOELECTRIC SENSORS

A photoelectric sensor, or photo eye, is a device used to detect the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. They are used extensively in industrial manufacturing. There are three different functional types: opposed (through beam), retro-reflective, and proximity-sensing (diffused).
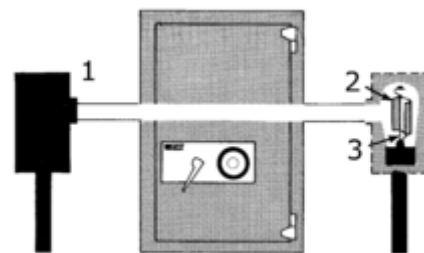

Fig.2. Photoelectric Sensors

An industrial electric sensor is a device composed of light transmitter and light receiver. Light is directed towards the object by transmitter .Receiver is pointed towards same object and detects presence or absence of reflected light originating from transmitter. Detection of output signal for use may be actuator, controller. Output signal can be analog or digital.[5]

A self-contained photoelectric sensor contains the optics along with the electronics. It requires only a power source. The sensor performs its own modulation, demodulation, amplification, and output switching. Some self-contained sensors provide such options as built-in control timers or counters. Because of technological progress, self-contained photoelectric sensors have become increasingly smaller.

Remote photoelectric sensors used for remote sensing contain only the optical components of a sensor. The circuitry for power input, amplification, and output switching are located elsewhere, typically in a control panel. This allows the sensor, itself, to be very small. Also, the controls for the sensor are more accessible, since they may be bigger.

E) PROXIMITY SENSORS

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact.

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiations.(infrared for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target.

The maximum distance that this sensor can detect is defined "nominal range". Some sensors have adjustments of the nominal range or means to report a graduated detection distance.

F) CONTACTOR

A contactor is an electrically controlled switch used for switching a power circuit, similar to a relay except with higher current ratings. A contactor is controlled by a circuit which has a much lower power level than the switched circuit.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 V DC to many kilovolts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side.

Contactors are used to control electric motors, lighting, heating, capacitor banks, thermal evaporators, and other electrical loads.

V. PROTOTYPE MODEL OF BUSHES USED IN PLC

Before implementing the developed logic on the actual machine using ladder programming a small Prototype model of the adapter was developed. It consists of following components.
4 proximity sensors and ladder logic which detected the correct bush and glowed an Light Emitting Diode (LED).
The model would detect the respective bush and glow the LED accordingly. The bush placed was sensed by the sensors which were fitted inside the adapter.

IV. MONITORING OF THE BUSHPRESS MACHINE

The bushes are selected and the alignment is checked. Then they are fitted one by one. If the alignment is not correct then alarm is raised and further operation is stopped.

VI.PLC SPECIFICATIONS

Selection of PLC based on above criteria. The PLC used is 24 MR/DS Mitsubishi FX1N series. There are 24 and 12 I/O's, the Ethernet protocol is used for transferring the program TO PLC.[2] GX developer software used for ladder programming.


Fig.3. PLC Panel

[VII]
A.ALGORITHM

1. Switch on induction motor.
2. Place the type of bush (A,B,C) and indicate the respective bush by glowing LED.
3. This process will continue till bush is fitted in bore no.1 by verifying the type of bush and respective bore.
4. Photo electric sensor will work concurrently by detecting position of shaft corresponding to the respective bore number.
5. The bore will move forward while pressing the bush and move backward while returning.
6. Check the proximity sensors while reverse operation. If fault is detected raise alarm.
7. Switch off induction motor after five minutes of being idle.

*B.*FLOWCHART
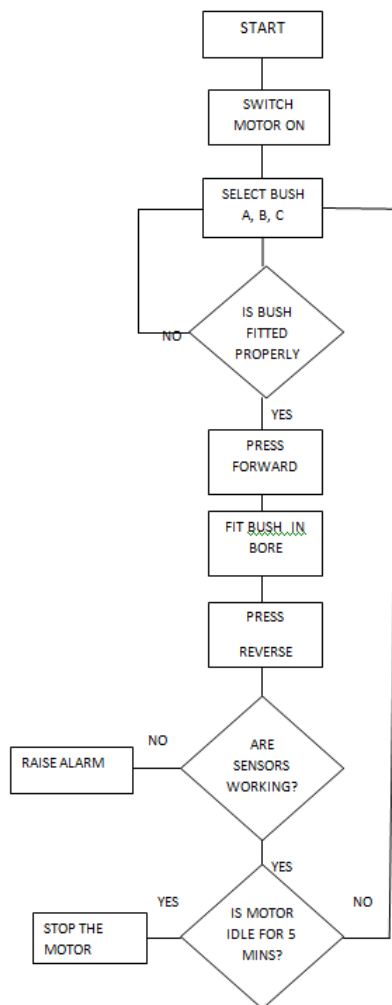
VIII.RESULTS

After developing the logic and making necessary changes in the machine to suit the requirements of plc and ladder logic developed testing was carried out. the bushes were detected and respective led was glowing indicating the type of bush. Thus the cam bore misalignment problem was solved successfully.

VIII.   CONCLUSION

It has been observed that PLC is more convenient and this will eliminate any future hazards or failures that can occur due to the bush misalignment in the bush press machine hence eliminating oil gallery mismatch and ensuring quality and efficiency. By the logic developed in the project the process is being made more reliable, precise and accurate that will help in the improvement of productivity and speed of operation.

VIII.   REFERENCES

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