

## International Journal of Innovative Research in Science, Engineering and Technology

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# Automatic Dual Line Lubrication of 1400 Litre Excavator Machine using PLC

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**ABSTRACT:** Objective of the paper is the automation in lubrication of the bearings in the crawler of an excavator machine using PLC. The purpose of this paper is to replace the manual lubrication, discrete wiring employed in lubrication system in heavy machines using PLC. Most of the bearing lubrication fail due to the too much or too less grease injected using manual lubrication. Also, the discrete wiring system involves the complication of wiring, which involves too much cost. So, the PLC's can be used to overcome the shortcomings. The physical phenomenon that is going to be monitored is mainly pressure signals. PLC is mainly used to reduce the labor cost, power consumption, complication in circuits. There is a grease container along with the motor, an auto/continuous mode selector, end switch, crawler arrangement and a change over valve. We are going to control the lubrication of the bearings by integrating the above mentioned parts along with the PLC. When the crawler moves for 20 minutes the PLC switches on the grease motor which lubricates the bearings. When the entire crawler is lubricated, the PLC commands the changeover valve to lubricate the next crawler section.

**KEYWORDS:** Automation, lubrication, end switch, change over valve, crawler, Mode selector, discrete wiring, manual lubrication.

## I. INTRODUCTION

Lubrication is the process, or technique employed to reduce wear of one or both surfaces in close proximity, and moving relative to each other, by interposing a substance called lubricant between the surfaces to carry or to help carry the load (pressure generated) between the opposing surfaces. Lubrication can also describe the phenomenon where such reduction of wear occurs without human intervention (hydroplaning on a road). The science of friction, lubrication and wear is called tribology. Adequate lubrication allows smooth continuous operation of equipment, with only mild wear, and without excessive stresses or seizures at bearings. When lubrication breaks down, metal or other components can rub destructively over each other, causing destructive damage, heat, and failure. Automation is the use of various control systems for operating equipment such as machinery, steering of heavy machines. This paper involves the automation in lubrication system of a crawler system deployed in heavy excavator machine. The biggest benefit of the automation is that it saves labour. However, it is also used to save energy and materials and to improve quality, accuracy, precision. Automation has been achieved by various means including mechanical, hydraulic, pneumatic, electrical, electronics in integration with computers. The automation of lubrication here is carried out using a PLC. A PLC is a digital computer used for automation of electromechanical process. PLC is designed for multiple I/O arrangement, immunity to electrical noise, extended temperature ranges, resistance to vibration and impact, memory back-up and PLC is a hard real time system.

## II. SURVEY ON AUTOMATION OF LUBRICATION IN AN EXCAVATOR

Each year millions of dollars are spent for new plant equipment designed to build things better and faster. However, machines continue to break down. Bearing failure is a major cause of equipment downtime in today's industrial environment, most often resulting from improper lubrication. Improper lubrication scenarios include the contamination of the lubricant by replacements and repair, excess lubricant and labour for inefficient manual practice. Some of the

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indirect, lubrication scenario. Conversely, automated lubrication provides lubricant constantly at an appropriate amount that allows the bearing to operate at its optimum. When the bearing is properly lubricated in this manner, it also helps to seal the bearing from contaminants. Maintaining proper lubrication on production equipment reduces the number of breakdowns due to bearing failure. In addition, there is less downtime due to the manual lubrication process, as well as substantially reduced man-hours required for the task. Automated lubrication is more precise and eliminates the cycle of over lubrication and under lubrication that lubrication problems for the first time. The present analysis applies to one-face roughness having striation wavelengths sufficiently long for the applicability of Reynolds equation. Transient effects are included. The final differential equation for support pressure is simple in form. In addition to predicting the effects of striated "Reynolds roughness", this equation can be directly used in grooved-bearing design.

## CONVENTIONAL SYSTEM LUBRICATION

Lubricant film can be a solid, (e.g. graphite,  $\text{MoS}_2$ ) a solid/liquid dispersion, a liquid, a liquid-liquid dispersion (a grease) or, exceptionally, a gas. In the most common case the applied load is carried by pressure generated within the fluid due to the frictional viscous resistance to motion of the lubricating fluid. Lubrication is the process, or technique employed to contacting surfaces three distinct reduce wear of one or both surfaces in situations can be observed with respect to the mode of lubrication, which are called regimes of lubrication.

## FLUID FILM LUBRICATION

Fluid film lubrication is the lubrication regime in which through viscous forces the load is fully supported by the lubricant within the space or gap between the parts in motion relative to one another (the lubricated conjunction) and solid-solid contact is avoided.

Hydrostatic lubrication is when an external pressure is applied to the lubricant in the bearing, to maintain the fluid lubricant film where it would otherwise be squeezed out.

## BOUNDARY LUBRICATION (ALSO CALLED BOUNDARY FILM LUBRICATION)

The bodies come into closer contact at their asperities; the heat developed by the local pressures causes a condition which is called stick-slip and some asperities break off. At the elevated temperature and pressure conditions chemically reactive constituents of the lubricant react with the contact surface forming a highly resistant tenacious layer, or film on the moving solid surfaces (boundary film) which is capable of supporting the load and major wear or breakdown is avoided. Boundary lubrication is also defined as that regime in which the load is carried by the surface asperities rather than by the lubricant.

Besides supporting the load the lubricant may have to perform other functions as well, for instance it may cool the contact areas and remove wear products. While carrying out these

## SIX FUNCTIONS OF LUBRICANT

- Reduce friction
- Reduce wear
- Seal power
- Absorb shock
- Clean
- Cool

## DIFFERENT TYPES OF AUTOMATIC LUBRICATION SYSTEMS

There are several different types of automatic lubrication systems including:

- Single Line Parallel systems
- Dual Line Parallel systems
- Single Point Automatics
- Single Line Progressive systems (or Series Progressive)
- Single Line Resistance
- Oil Mist and Air-Oil systems

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- Oil re-circulating

### III. EXCAVATOR

Excavators are heavy construction equipment consisting of a boom, stick, bucket and cab on a rotating platform (known as the "house"). The house sits atop an undercarriage with tracks or wheels. A cable-operated excavator uses winches and steel ropes to accomplish the movements. They are a natural progression from the steam shovels and often called power shovels. All movement and functions of a hydraulic excavator are accomplished through the use of hydraulic fluid, with hydraulic cylinders and hydraulic motors. Due to the linear actuation of hydraulic cylinders, their mode of operation is fundamentally different from cable-operated excavators.

### IV. PROPOSED SYSTEM

PLC is mainly used to reduce the power consumption due to discrete wiring system, cost effectiveness is achieved. The lubrication system consists of 6 crawlers divided into 3 sections containing 2 crawlers each. When 1 of the crawlers moves for 20 minutes the PLC checks for 25 bar pressure and activates the end switch grease tank empty, pressure release. When there is a continuous current flow in the above mentioned wirings and the pressure in the dual lines increase the end switch is activated. The activated end switch triggers the changeover unit from position 1 to position 2 or vice versa. As the grease moves into the dual lines, the pressure gradually increases this is detected by the end switch. The end switch serves as the pressure sensor which detects the pressure in the dual lines.

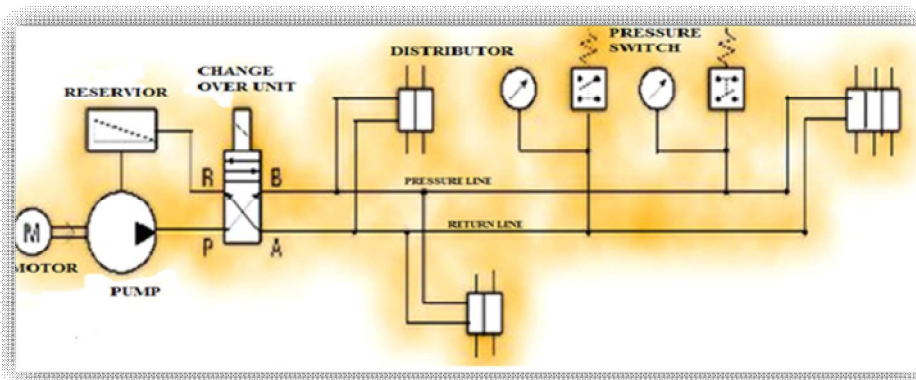


Fig.1 Block Diagram of proposed model

PLC stands for programmable logic control. A PLC is a microprocessor-based control system, designed for automation processes in industrial environments. It uses a programmable memory for the internal storage of user-orientated instructions for implementing specific functions such as arithmetic, counting, logic, sequencing, and timing. A PLC can be programmed to sense, activate, and control industrial equipment and, therefore, incorporates a number of I/O points, which allow electrical signals to be interfaced. Input devices and output devices of the process are connected to the PLC and the control program is entered into the PLC memory. PLC's programming is based on the logic demands of input devices and the programs implemented are predominantly logical rather than numerical computational algorithms.

### V. RESULT SECTION

Ladder diagram is one of the simplest programming languages available for programming in PLC's. **Ladder logic** was originally a written method to document the design and construction of relay racks as used in manufacturing and process control. Each device in the relay rack would be represented by a symbol on the ladder diagram with

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connections between those devices shown. In addition, other items external to the relay rack such as pumps, heaters, and so forth would also be shown on the ladder diagram.

Ladder logic has evolved into a programming language that represents a program by a graphical diagram based on the circuit diagrams of relay logic hardware. Ladder logic is used to develop software for programmable logic controllers (PLCs) used in industrial control applications. The name is based on the observation that programs in this language resemble ladders, with two vertical rails and a series of horizontal rungs between them. While ladder diagrams were once the only available notation for recording programmable controller programs, today The ladder diagram for the above is drawn below.

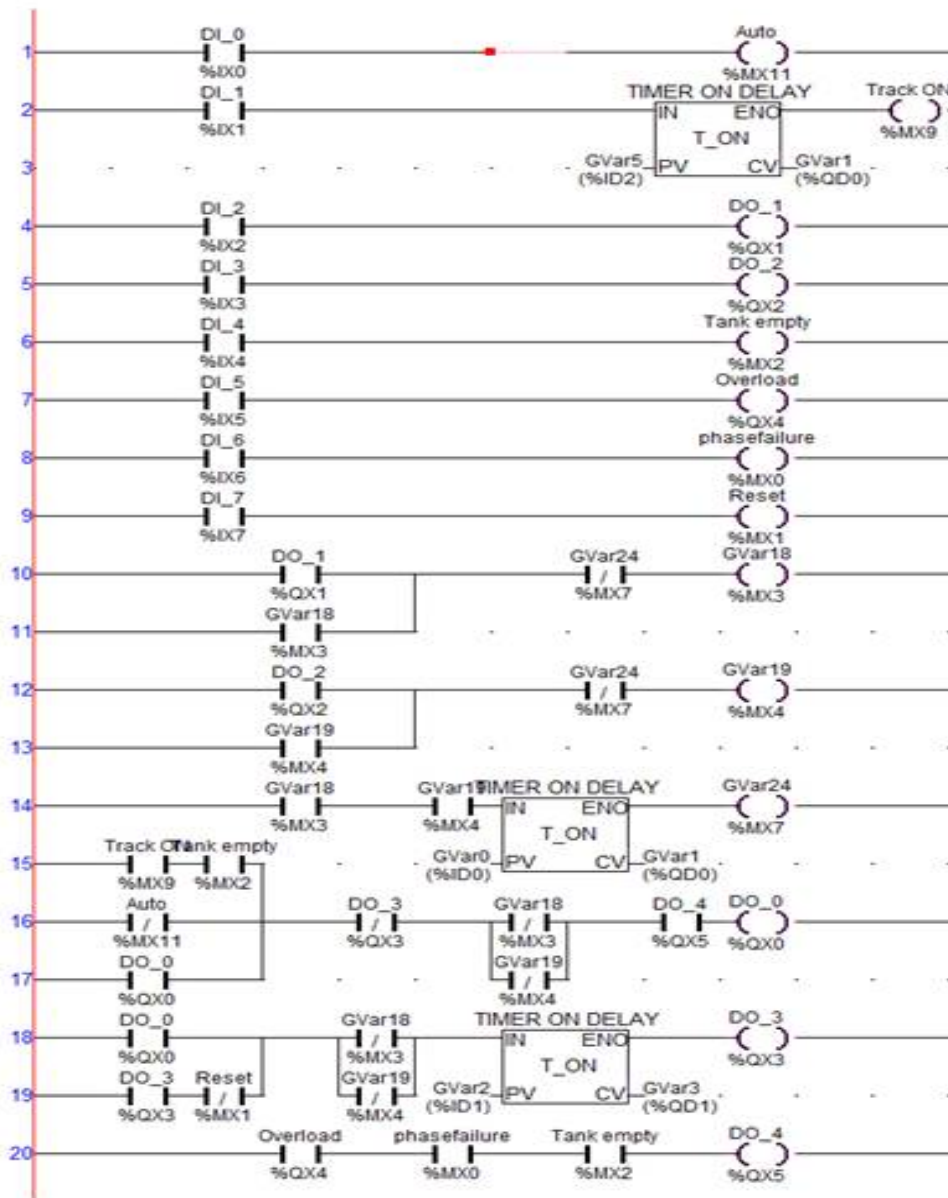


Fig.2 Ladder Logic for proposed system

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## VI. CONCLUSION

The installed control system in the crawler system of the bucket wheel excavator reveals obtaining best performance of lubrication system using PLC. The lubricant consumption will considerably reduced by control system optimization that is right quantity of lubricant at right part. Failure of bearings due to lack of lubrication is considerably reduced. Overall performance of the Bucket wheel machine increases which in turn reduces down time. Identification of the lubrication system breakdown is very easy by fault annunciation system in PLC. Contactor misguidance due to environmental effects can be reduced by employing the PLC. Modification in the circuit according to the technology changes is difficult in the discrete wiring system used earlier and it can be easily carried out through appropriate software.

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