

## Plc Based Scrap Management System

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### ABSTRACT

In this paper we have implemented an automated scrap management system for Maintenance Department of Bharat Forge Ltd. Hadapsar, Pune. Bharat Forge is a well known industry for manufacturing of Crank Shaft and various kinds of axels. To manage the scrap & wastage during mass production is a tedious and time consuming job. Scrap Management System is used for storing the scrap & garbage. This Scrap Management System had several problem like huge manpower requirement, time due to which there may be chances of misoperation due to unawareness of handling the system. When any fault is generated due to locking or mechanical operating problem of limit switches, the whole operation can be halt. These flaws lead to increasing concern regarding safety operations and constant maintenance. The conventional system which is in use was developed with a relay logic to control all its operations. But due to bulkiness of the relay logic and number of wiring there are lot of problems during maintenance of the system. This leads to develop some efficient system which find a solution to the painstaking maintenance problems of relay logic, ease of handling, reduction of manpower, & nullify the storing problem of scrap. This can be satisfactorily achieved by replacing the old relay logic by a newly designed PLC system by us.

**Keywords:** Programmable Logic Control (PLC), Scrap Management.

### I. INTRODUCTION

Bharat Forge Ltd (BFL), is the Pune based Indian multinational, a technology-driven global leader in metal forming, having trans-continental presence across a dozen manufacturing locations, serving several sectors including automobile, power, oil and gas, rail, marine, aerospace, construction & mining, etc. The company has their manufacturing facilities spread across India, Europe, US & China. They manufacture a wide range of safety and critical components for the automotive & non-automotive sector. It is the country's largest manufacturing and exporter of automotive components and leading chassis component manufacturer [6]. The project is based on conversion of old relay logic to PLC logic. The conversion from old relay logic to PLC needs to have a list of all inputs and outputs present on the system. The electrical components such as limit switches provide the input. While on the other hand, the component like contactors consist the output part. Before designing the PLC we need to map the inputs to the output.

When the mapping of inputs and outputs has been done, interfacing of the PLC is to be performed. The ladder diagram has to be designed according to the logic based on the operation of the system. Once the ladder diagram is ready, we need to select a proper PLC which satisfies all the requirements for the system operation.

PLC selection is based on various terms like

- a.) The number of inputs.
- b.) The number of outputs.
- c.) Memory Capacity.
- d.) Speed of processing.
- e.) The number of add-on cards the PLC can support.
- f.) Future expansion.

Based on these parameters and requirement of the system we have selected Sheinder make SR3B261B PLC. Before programming PLC with the ladder diagram, we have prepared simulation. The simulation prepared on Zeilo software platform which supports the selected PLC. During simulating the ladder diagram was tested for desired work and find the faults if any.

Once the simulation is over, we implemented the design on the PLC with necessary hardware like power supply, operator consol, input & output.

After the final setup of the PLC is completed on the system, it is necessary to monitor the working of the system to ensure the proper functioning of the system. And if any fault exists we will rectify it.

### II. EXISTING SYSTEM

A scrap management system is a mechanism for scrap storage. The products of forging industries

are crank shaft, knuckles, front axel beam, etc. There are different processes which are carried out for the manufacturing of components. During these processes scrap is formed. There are generally 3 types of scraps like alluminium bur, copper chips & garbage. This scrap is then stored in the scrap yard & then it transport by trucks to refinery plant. In refinery plant the scrap is then converted to the raw material that is recycling is done.

First of all the scrap is collected in scrap yard from machine shop. The scrap is transported with the help of trolleys. The scrap from the trolley is then poured into the bucket. There are following operations required for completion of all process- up travel, down travel, cross travel to east direction, cross travel to west direction, long travel to south direction, long travel to north direction, hoist up and hoist down operation.

For these operations 4 three phase induction motors are used with their reverse action for reverse travel purpose. The names given for that motors are- Hoist motor, Tilt motor, Long motor, Cross motor. Among them hoist motor and tilt motor are located on axial beam and the long travel motor is mounted on cross beam.

The hoist up and tilt up motor gets on and continues till hoist up motor and tilt motor up limit switches gets operated. Then depending upon the scrap type respective bin is selected. After that long travel starts and then cross travel starts. The cross travel is continues till timer given for the cross travel is on. After that the pouring operation is getting started. For that hoist and tilt motor gets down depend on timer given for that and then hoist motor travels to upward direction till the timer 3 gets on then the all process will halted for some time to empty the bucket. After that time the bucket travels to its original position for that the cross travel to east position, then long travel to the south direction till the limit switches of home positions gets operated.

### III. PROPOSED SYSTEM

PLC caused the success in dealing with the problem. As there were 24 inputs in existing system we deduct it to 16 inputs. During this deduction process selector switch which is used for selecting bin is of three positions so we use only two inputs out of three. The third input for third bin is selected automatically when both input for other bins are in normally closed position. Here there is saving in one input.

As there are four motors used for travelling purpose. In control circuit for each contactor MCB is used hence there is requirement of eight MCB's, instead of that we use only one MCB and its connection is given in series of each contactor hence

we deduct here seven inputs. So eight inputs are reduced causes deduction in size of PLC module.

In proposed system we provide the provision of hooter for error indication and acknowledgement of operator. In addition of that we also provide extension to existing system by providing both the auto cycle and the manual cycle in parallel running. It will give flexibility for system in case of maintenance or any fault condition. For this the PLC output is connected in parallel with push button.

During manual operation, the bucket pours the scrap material in bin at specific spot hence it does not get fully filled hence timer provision is done so that the bucket will pours the material equally in bin that is in first time it will pour it at rightmost part, during second time it will pour it at middle position and at third time same procedure will repeat for leftmost position. For fourth operation it will continued from rightmost side.

The automation of many different processes, such as controlling machines or factory assembly lines, is done through the use of small computers called programmable logic controllers (PLCs). This is actually a control device that consists of a programmable microprocessor, and is programmed using a specialized computer language [1]. A modern programmable logic controller is usually programmed in any one of several languages, ranging from ladder logic to Basic or C. Typically, the program is written in a development environment on a computer, and then is downloaded onto the programmable logic controller directly through a cable connection. The program is stored in the programmable logic controller in non-volatile memory [2].

### IV. ELECTRICAL DIAGRAM

The electrical diagram of the power supply provisions made for the control logic in which the PLC is present. The main power source is a three phase 440 V AC supply, which has to step down and rectified accordingly [3].

#### 4.1 POWER DIAGRAM

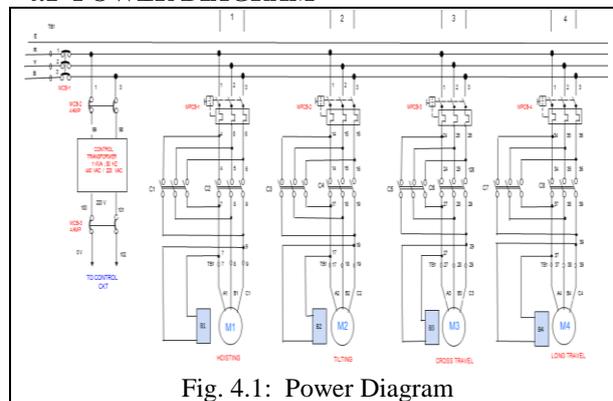


Fig. 4.1: Power Diagram

The above power diagram shows the electrical connection of motors. It shows the four motors M1, M2, M3 and M4. Among them M1 motor is for hoisting, M2 motor is for tilting, M3 motor is for cross travelling while M4 motor is used for long travel operation.

Three phase supply is given for each motor. For protection of motor, Motor Protection Circuit Breaker (MPCB) is used. Thermal overload relay is used for overload protection of motor. Two contactors are used for each motor for reversal rotation of motor so that forward and reverse travel action is possible [4].

The mechanical break is provided for each motor for pause the rotation.

#### 4.2 CONTROL DIAGRAM

Fig. 4.2 shows the control wiring. There are eight contactors used for which control system is designed. The control of circuit is achieved by operation of limit switches and different interlocking operations.

The 3 phase 440V AC supply is stepped down using a 3 phase step down transformer to 220V output. This 220V is used to actuate the solenoid valves which are placed in the system on field. The SMPS is used to power the PLC and its add-on cards, and the SMPS is powered directly using the 3 phase 440V AC supply. The SMPS rectifies and regulates this 440V to 24V DC so as to power the PLC.

The PLC triggers the relays by sourcing 24V through its output ports. The relays in turn switch the 220V supply which is given to the solenoid valves to control the action of the system. To protect the overall circuitry a MCB is installed in series with the main supply, so that in case of any excess draw of current or voltage, the MCB will trip and the control circuitry is protected from any damage. A thermal release consisting of bimetallic elements having inverse time current tripping characteristic trips the circuit breaker on sustained overload. The breaker is open by an electromagnetic release in case of short circuit faults [5].

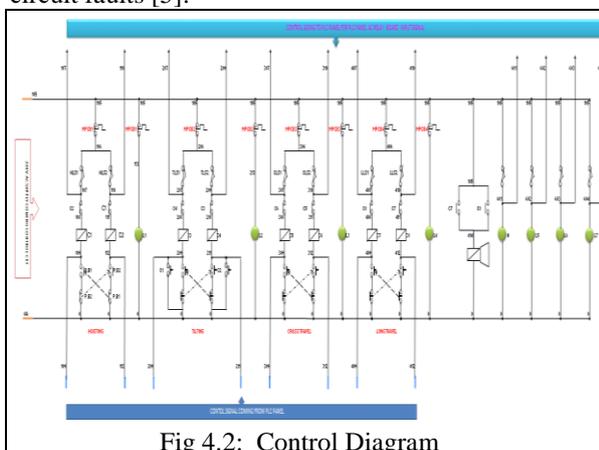


Fig 4.2: Control Diagram

#### 4.3 WIRING DIAGRAM

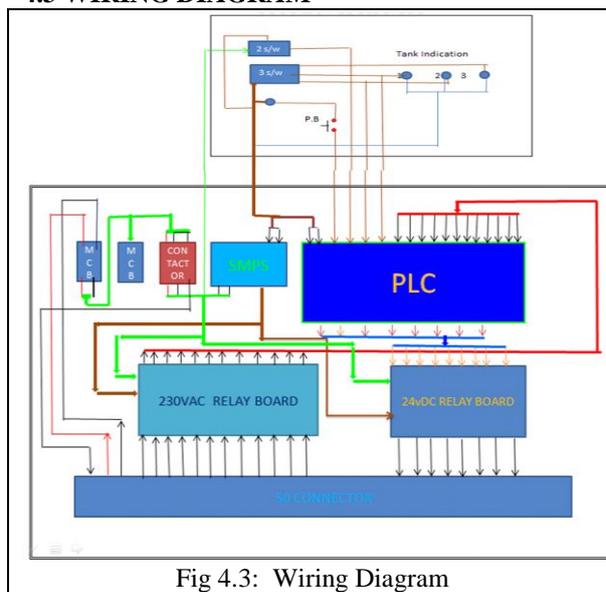


Fig 4.3: Wiring Diagram

#### V. ADVANTAGES

This newly developed system reduces manpower requirement and running cost. It will take less time for completion of process cycle. It will eliminate extra operation required. It reduced idle time. This system is safer than earlier system in all respect. Once the PLC based system is functional, the industry will get lot of benefits in terms of quality, safety, less number of manpower, reduction in processing time, & will have lower impact on environment & working conditions.

#### VI. CONCLUSION

In this way we have successfully design the automated system for scrap management and it is effectively implemented in Bharat Forge limited at Pune location.

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