Multipurpose Application of Soft Starter by Plc in Conveyor Motors

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ABSTRACT: *In recent days industries have started shifting the operation from manual to automation. Normally, when the conveyor motor is started it experiences some shock or jerk over the motor, which results in change in position of the conveyor where it should actually be positioned. Where PLC is used as soft starter. In this paper, GXWORKS 2 software is used to program PLC. Each output terminal is connected to the terminals of the regulator which in turn connected to the conveyor motor. PLC is programmed in such a way that the output terminals energizes consequently one by other while start and de-energizes one by other consequently. This operation enables the conveyor motor to start smoothly and run without jerk and stop at the exact position that is required to attain. Thus the PLC which is already in use in the industry for other operations is used as soft starter and remains economical.*

KEYWORDS:
Soft starter, PLC, regulator, conveyor motor, GXWORKS 2, Ladder diagram

I. INTRODUCTON

In industries conveyors are employed to do many automated operations, thus conveyor motors have to be driven accurately for proper functioning of the industry. Normally conveyor motors are started by DOL starter which leads to jerk or shock over the motor which leads to miss positioning of the conveyor to avoid this PLC is used as soft starter and ensure the proper functioning of the conveyor.

This paper is about the multipurpose application of soft starter by PLC in conveyor motors. Normally, when the conveyor motor is started it experiences some shock or jerk over the motor, which results in change in position of the conveyor where it should actually be positioned. The soft starter can be constructed by IGBT devices but when we consider cost its uneconomical thus we have an alternative method, Where PLC is used as soft starter. In this project, GXWORKS 2 software is used to program PLC.

In this software we use ladder logic to write programs. PLC has six inputs and four outputs which are used to start and stop the motor in smooth way. Here a regulator is connected to the PLC output terminals, where the terminals energizes according to the program we have feed. Each output terminal is connected to the terminals of the regulator which in turn connected to the conveyor motor. PLC is programmed in such a way that the output terminals energizes consequently one by other while start and de-energizes one by other consequently. This operation enables the conveyor motor to start smoothly and run without jerk and stop at the exact position that is required to attain. Thus the PLC which is already in use in the industry for other operations is used as soft starter and remains economical.

II. LITERAURE REVIEW

The paper describes the overall automation in the starting of conveyor motor and control using the PLC technology. The first existing method is carried out by DOL starter. Due to which the occurs jerk or mechanical shock over the motor. It results in improper positioning of the conveyor and the entire production gets collapsed. Due to the continuous operation of motor with jerk the lifetime of the motor reduces. These are the disadvantages of existing control technology.

Second existing system consists of IGBT based Induction Motor Soft Starter. Three-phase induction motor of ratings beyond 50 KW take very large currents and low power factor while being started directly from a 3-phase supply. In order to mitigate the adverse effects of starting torque transients and high inrush currents in induction motors, a popular method is to use electronically controlled soft-starting voltages utilizing IGBT's. Normally soft-starters are used for avoiding this problem and to achieve smooth starting of large capacity induction motors. Soft starters use ac voltage controllers to start the induction motor and to adjust its speed. The performance of a voltage-controlled large induction motor soft starter has been improved, resulting in nearly perfect current and torque profiles. Soft starters are used as induction motor controllers in compressors, blowers, fans, pumps, mixers, crushers and grinders, and many other applications. Starting torque pulsations are eliminated by triggering back-to-back-connected IGBT at proper points on the first supply voltage cycle. The soft starter is connected in motor drive during the starting condition only and once the motor get its rated speed then the soft starter is disconnected from the main motor system so that the motor get protected. For analysis of the various

waveforms Digital Storage Oscilloscope Textronix TDS2024B is used.

Third existing system consists of starting of three phase asynchronous motor. This is an effective starting system for starting and stopping a motor smoothly (see the section on electronic speed controllers for more details).It can be used for: current limitation, torque adjustment. Control by current limitation sets a maximum current (3 to 4 x RC) during the starting stage and lowers torque performance. This control is especially suitable for "turbo machines" (centrifugal pumps, fans). Control by torque adjustment optimizes torque performance in the starting process and lowers mains inrush current. This is suited to constant torque machines. This type of starter can have many different diagrams: one-way operation, two-way operation, device shunting at the end of the starting process, starting and slackening several motors in cascade.

III.COMPONENTS OF PROPOSED SYSTEM

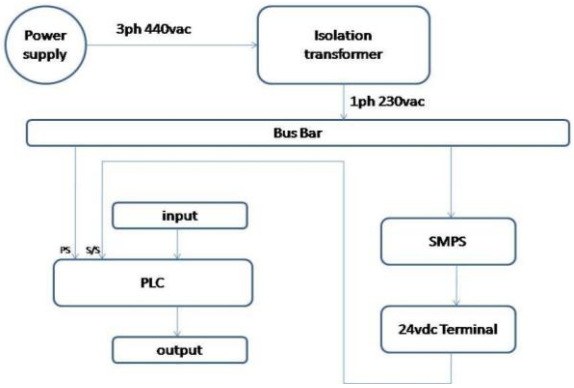

Fig. 1 Main Block Diagram of Proposed system

The fig. 1 shows the main block diagram of this project. The three phase 440V AC supply is taken and is fed to the isolation transformer which in turn converts to single phase 230V AC supply and it is used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source, usually for safety reasons. Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected and fed to the bus bar. Bus bar is connected to SMPS transfers power from a AC source to DC loads. Then the 24V dc supply is fed to PLC which is driven at 24V dc. Where the input is given to it through the computer and the output is taken from the output terminals. This is connected to the regulator to regulate the conveyor motor.

III.A.Power Circuit

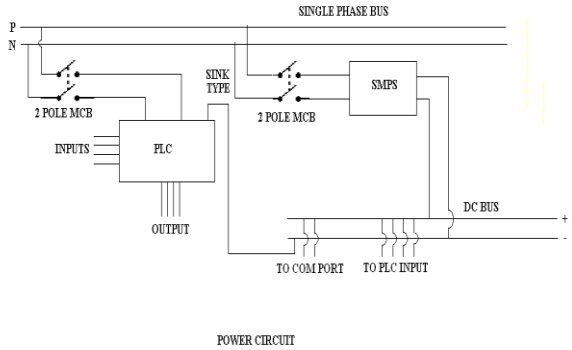

Fig. 2 Block Diagram representation of power circuit

The fig. 2 shows the power circuit diagram for PLC. In this the power circuit that feeds PLC from the bus bar is shown. The single phase 230V ac supply that is available in the bus bar is tapped by the SMPS which transfers power from a DC or AC source (often mains power), to DC loads, 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. SMPS taps through the 2pole MCB and the SMPS converts the single phase ac supply to 24V dc supply. The 24V dc supply is provided to the dc bus. From the bus bar the dc supply is fed to the COM port of the PLC and the input terminal of the PLC. On the other side a single phase 230V ac supply is fed to the PLC through a 2 pole MCB. This is the complete power circuit which supplies power to the PLC.

III.B. Control Circuit

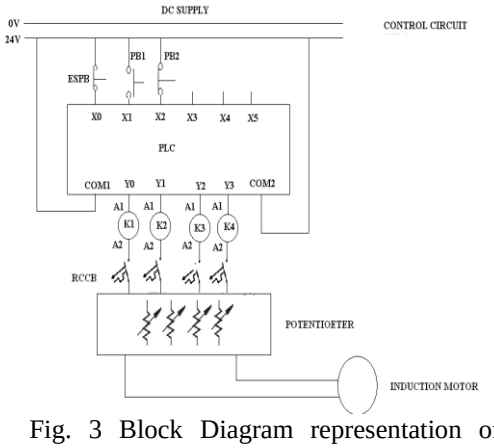

Fig. 3 Block Diagram representation of control circuit

The fig. 3 shows the control circuit of the soft starter. In this circuit the 24V power supply is given to the PLC inputs X0, X1, X2 and the common ports 1 and 2. PLC has six input terminals and 4 output terminals. The power supplies to the input terminals are fed through push buttons ESPB,

PB1, PB2. The output terminals are connected to the regulator where each output terminals are connected to a relay K1, K2, K3, K4 respectively. A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The relays are connected to the residual current circuit breakers which ensure the safety of the PLC by isolating the PLC from the fault current. Residual Current Circuit Breakers is another different class of Circuit Breakers. A Residual Current Circuit Breaker (RCCB) is essentially a current sensing device used to protect a low voltage circuit in case of a fault. It contains a switch device that switches off whenever a fault occurs in the connected circuit.

As PLC is a sensitive device relays and circuit breakers must be employed. PLC is programmed in such a way that the output terminal Y0 energizes when the start push button is pressed and after the given time delay Y1 energizes, this process continues for four output terminals. By the way the conveyor motor starts running smoothly without any jerk. When the stop push button is pressed the output terminals Y3, Y2, Y1, and Y0 consequently de-energizes which results in smooth operation and the conveyor positions at the right position.

IV.SOFTWARE AND HARDWARE IMPLEMENTATION

IV (A). Software Implementation

A PLC has many "input" terminals, through which it interprets "high" and "low" logical states from sensors and switches. It also has many output terminals, through which it outputs "high" and "low" signals to power lights, solenoids, contactors, small motors, and other devices lending themselves to on/off control. In an effort to make PLCs easy to program, their programming language was designed to resemble ladder logic diagrams. Thus, an industrial electrician or electrical engineer accustomed to reading ladder logic schematics would feel comfortable programming a PLC to perform the same control functions.

PLCs are industrial computers, and as such their input and output signals are typically 120 volts AC, just like the electromechanical control relays they were designed to replace. Although some PLCs have the ability to input and output low-level DC voltage signals of the magnitude used in logic gate circuits, this is the exception and not the rule. Signal connection and programming standards vary somewhat between different models of PLC, but they are similar enough to allow a "generic" introduction to PLC programming here. The following illustration shows a simple PLC, as it might appear from a front view. Two screw terminals provide connection to 120 volts AC for powering the PLC's internal circuitry, labeled L1 and L2. Six screw terminals on the left-hand side provide connection to input devices, each terminal representing a different input "channel" with its own "X" label. The lower-left screw terminal is a "Common" connection, which is generally connected to L2 (neutral) of the 120 VAC power source.

IV (B). Ladder Diagram

A ladder logic diagram is a graphic programming language developed from the relay ladder diagram and is useful in programming a PLC. Programming controller is generally programmed in ladder diagram rather than relay diagram, which is nothing but a symbolic representation of electric circuits. Symbols were selected that actually looked similar to schematic symbols of electrical devices and this has made it much easier for electricians to switch to PLCs. An electrician who has never seen a PLC can easily understand a ladder diagram.

The main function of the logic ladder diagram is to control outputs based on input conditions. This is accomplished with a ladder ring. A ring consists of a set of input conditions represented by contact instructions and an output instruction at the end of the ring represented by the coil symbol. Each contact or coil symbol is referenced with an added numbers that identifies what is being evaluated and what is being controlled. For an output to be activated at one left-to-right path of contacts must be close. A completely closed path is referred to as having logic continuity and is at least one path has continuity.

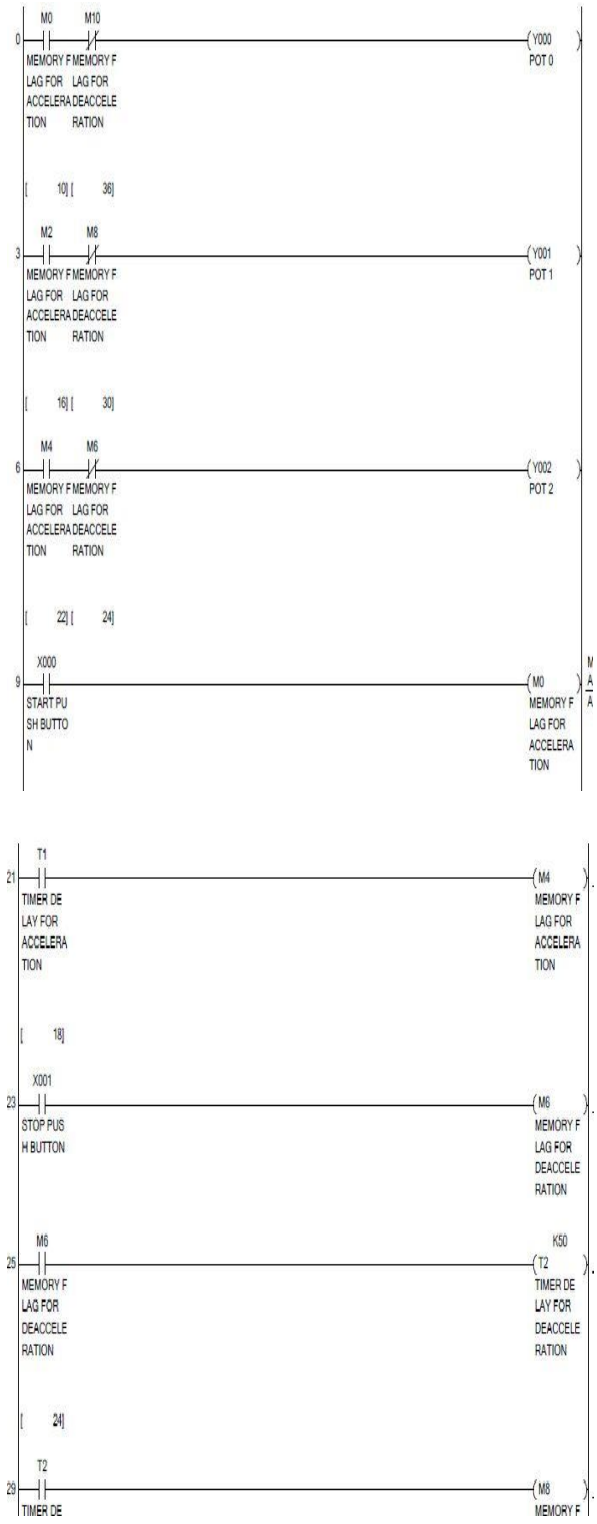

Fig.4 Ladder Logic

IV (C).Hardware Implementation

The three phase 440V AC supply is taken and is fed to the isolation transformer which in turn converts to single phase 230V AC supply and it is used to transfer electrical power from a source of alternating current (AC) power to some equipment or device while isolating the powered device from the power source, usually for safety reasons. Isolation transformers provide galvanic isolation and are used to protect against electric shock, to suppress electrical noise in sensitive devices, or to transfer power between two circuits which must not be connected and fed to the bus bar. Bus bar is connected to SMPS transfers power from a AC source to DC loads. Then the 24V dc supply is fed to PLC which is driven at 24V dc. Where the input is given to it through the computer and the output is taken from the output terminals. This is connected to the regulator to regulate the conveyor motor.

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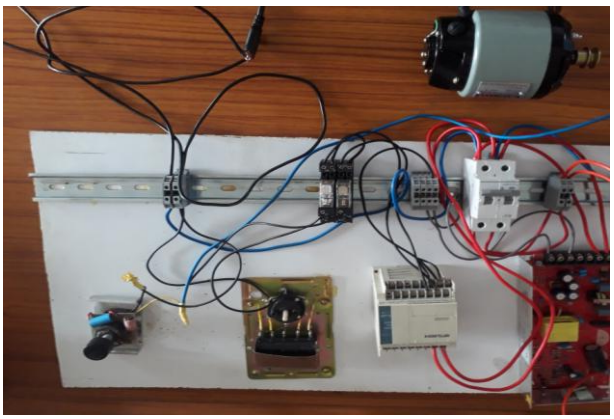

Fig.5 Hardware Setup of Proposed System

V.CONCLUSION

The paper describes the overall automation in the starting of conveyor motor and control using the PLC technology. The existing method is carried out by DOL starter. Due to which the occurs jerk or mechanical shock over the motor. It results in improper positioning of the conveyor and the entire production gets collapsed. Due to the continuous operation of motor with jerk the lifetime of the motor reduces. These are the disadvantages of existing control technology.

In order to overcome the disadvantages of the existing control scheme, a Programmable Logic Controller (PLC) can be used. PLC is user-friendly software whose operation mainly depends on the program written in its memory. One of the common programming methods used in PLC is the Ladder Program (LAD logic). Our system uses the regulator for regulating the speed of the motor. The regulator is connected to the output terminals of the PLC. Usage of PLC that exists earlier makes the soft starting economical. Thus, the project eliminates the jerk over the motor, increases the lifetime and cost effective too.

VI. FUTURE SCOPE

The advancement in this project can made by implementing the SCADA system in monitoring the soft starting and operation in the conveyor motors. This increases the accuracy of the system to the maximum level. SCADA system completely avoid the man power, since it is a fully automatic system. The SCADA system of control costs higher than the PLC system of control. Hence, PLC becomes cost effective and perfect for the industry

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