Electronic Retrofitting of IR Face DG300 Grinding Machine

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Abstract— Key The demand for higher quality, greater efficiency and lesser downtime has lead to the need of automation in industries. Due to automation, the downtime in the industry has reduced significantly and the productivity of industries have increased to a large scale. The previously used MTC(Machine Tool Controller) on IR(Inner Ring) face DG300 grinding machine is replaced by a PLC(Programmable Logic Controller) so that it has more enhanced capabilities when it comes to speed, storage, programming and power consumption. The retrofitting of DG300 grinding machine is done by installing a Mitsubishi Q03 PLC.

Key words: PLC, MTC, DG300 Grinding Machine, Grinding Machine, Downtime

I. INTRODUCTION

Roller bearings have 4 parts, the cup, cone, cage and rollers. The cup is also known as inner ring. The MTC is used as a controller to grind the 2 faces of this inner ring. The machine that is used for this purpose is the DG300 grinding machine. The MTC is a controller which uses different types of cards(power, cpu, i/o, ad, da) to perform control and I/O operations. There are some drawbacks present in MTC which is why it is to be replaced with a Mitsubishi PLC. Mitsubishi Q03 PLC along with MRJ3 series servo and GOT HMI interface has been integrated with the grinding machine to eliminate these drawbacks.

Machine Tool Controller Mitsubishi PLC

II. LITERATURE SURVEY

The MTC was used as the controller for DG300 grinding machine. It needs extra components like hex converter to program the controller. The program cannot be changed online. Hence it posed a problem as the machine needs to be stopped when a program is to be dumped into a controller. It also increased manual labour as there was a need to remember the parameter variables to feed input and check the status. Thus there was a need for an operator who could manage the machine and remember the parameters.The Mitsubishi PLC used in this case could eliminate these problems to a certain extent.

III. MACHINE WORK FLOW

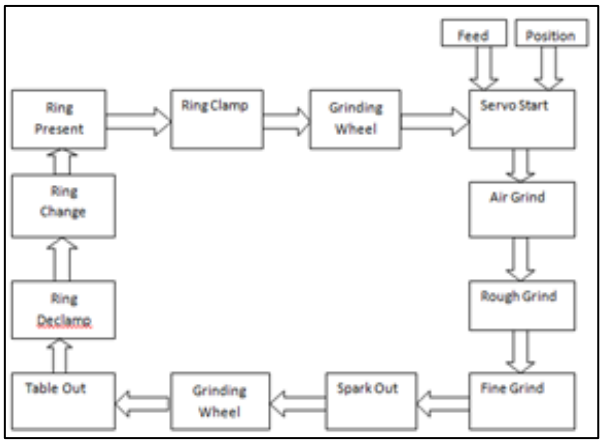

Fig. 1: Work sequence of DG300 Grinding Machine

The magnetic sensor is used to detect the presence of a ring. If a ring is present then the ring is clamped on the indexed wheel. The indexed wheel is rotated with the help of a servo motor to the feed position. The servo motors in the left and right are used to bring the induction motor from the home position to the grinding position. The process begins with air grinding where the debris and dust on the ring is removed. Rough grinding is performed later which does most of the grinding operation. The ring then eventually undergoes fine grinding. There is a sparkout after this operation and index wheel moves to the ring declamp position after which the ring is changed .Dressing is done after grinding of every 15 rings with the help of a diamond.

IV. BLOCK DIAGRAM

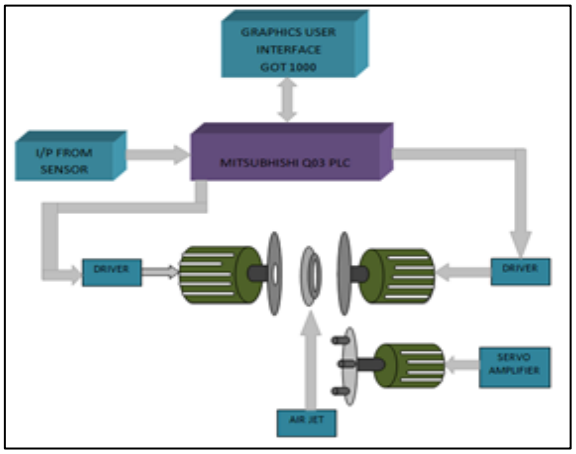

Fig. 2: Block Diagram of the integrated PLC

V. BLOCK DIAGRAM DESCRIPTION

A. GOT 1000 Series:

Human Machine Interfaces are panel mounted devices that provide effective dialogue between the operator and machine .Equipped with programmable display and keys,

HMI allows easy operation and monitoring in the production area. HMIs display operational and fault messages, enables machine specific parameters to be monitored and modified in suitable formats. HMI keeps the operator fully informed of the current status of operations. GOT1000 HMI can be directly connected to the Mitsubishi PLC via serial interface resulting in easy and quick installation. It also replaces the conventional push button panel and related wiring. Mitsubishi has introduced this series of touch screen terminals for effective communication between operator and machine.

B. Digital Inputs:

There are various digital inputs like proximity sensors, push buttons switches, pressure sensors, and flow sensors

C. Digital Outputs:

Digital outputs are given to servo motors, induction motors, lamps and pneumatic switches

D. Mitsubishi Q03 PLC:

It is the heart of the system. It controls the overall operations of the system. Mitsubishi is a manufacturer of world class PLCs indigenously. Use of PLCs is stressed for the following reasons:

- Service availability is excellent
- Maintenance required is less.
- Spare part cost is less and readily available.

E. Servo System:

A servo amplifier reads position data directly to perform operation. Data from a command unit (like a positioning module) is given to the servo amplifier which then controls the speed and rotation direction of servo motor and executes precision positioning. It also conveys the data back from the motor to the corresponding module.MR- J3-70B is a general purpose servo amplifier with analog input and pulse train interface as a standard. The output stage of all servo amplifiers is an analog circuit. The analog circuit provides a means to allow the voltage and current for the motor to be adjusted to control position, velocity and torque. Here 3 servo motors have been used to control the left and right grinding position and the index wheel position.

VI. SIMULATION

The simulation of the ladder diagram has been implemented using GX developer and the HMI has been programmed using GT developer.

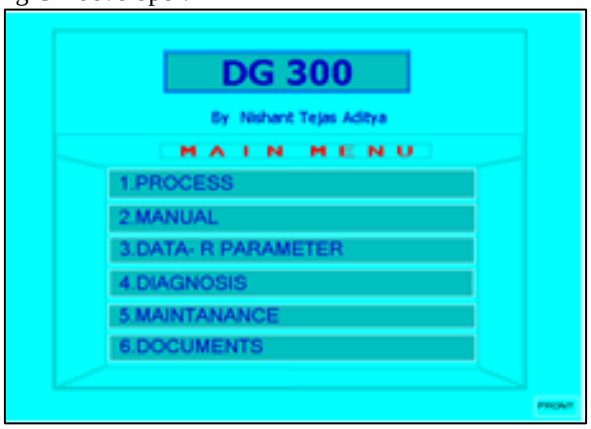

Fig. 3: Main screen of HMI

Fig. 4: Process Auto Mode

VII. APPLICATIONS

1) The purpose of the PLC is to control and implement grinding of the face of inner ring which is further used as a part in bearings.
2) The facility of LAN connection to control other PLC s from the Remote Controlling Station using LAN Technology like Ethernet is available. Same remote control station can be used to operate distributed machines.

VIII. CONCLUSION

The Mitsubishi PLC offers high performance, flexibility and advanced features. Scanning time and maintenance time of the system is thus reduced by using PLC. Thus leading to increase in production of bearings. The compactness required in system is achieved by upgrading the present MTC by Mitsubishi PLC. Thus, the cycle time is reduced from mini second to nano second thereby reducing the down time. There is more ease in operation and the manual labour has also been reduced with its introduction.

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