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PLC and servo drive based infeed control system for grinding machine application

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Abstract —*In the mechatronics grinding machine, servo motor, PLC and HMI plays an important role. Due to the use of stepper motor in grinding machine the reliability of machine decreases. To overcome such problem stepper motor is replaced with the servo based infeed control system which increases the reliability of machine as well as productivity.*

Keywords-*PLC, HMI, Grinding Machine etc.*

I. INTRODUCTION

Bharat Forge Limited (BFL), is a Pune-based Indian multinational company involved in automotive, power, oil and gas, construction & mining, locomotive, marine and aerospace industries. At Mundhawa plant there are many divisions like Forge, Heat treatment, Machine Component Division (MCD), Heat Forge Division(HFD), Forge Modernization Division(FMD). Here we are doing a project in MCD-1 division. In Machine Component Division (MCD-1), machining of crank shafts, automotive, locomotive is being done. Machining of front axles, knuckles & various other auto parts is being carried out. Grinding is a finishing process used to improve surface finish, abrade hard materials and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material[2]. A grinding machine, often shortened to grinder, is any of various power tools or machine tools used for grinding, which is a type of machining using an abrasive wheel as the cutting tool. Grinding is an important function in crankshaft machining where it is done on journal (main) and pin bearings. And machine operation is carried out on machine no. 588.

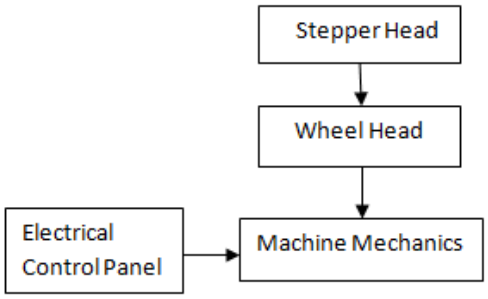


Figure 1. Operation of wheel head on job

Servo control feed drives using DC and or AC servomotors have been known for more than a hundred of years and have many applications in the areas of manufacturing process and machine control.[3] The servo motors are generally used as a high performance alternative to the stepper motor. Also used to improve productivity, reliability of grinding machines. Servo infeed system is no more costly and requires less maintenance

II. LITERATUREREVIEW

1. Automated security system using surveillance AUTHOR: -P.Vigneswari et.al.

The literature review is carried out by highlighting the features of the stepper motor, servo infeed control system and grinding machine. The main objective is the automatic control of the entire working of the electrical equipments and electrical machines. It reduces unwanted faults and tripping of electrical circuit caused by the faulty manual operation. It also provide easy access and control of electrical machines, reduce time of operation, reduce electrical losses in the machine, save electrical power / energy saving , reduce labour cost thus improves overall efficiency of the machine.[4] Machining and process control can be classified according to the level of precision and dynamic response as normal machining, precision, high precision and ultra-high precision machining. It is understood that higher accuracy, finer resolution and fast dynamic response are essential for high precision machining and manufacturing processes[3].

In company previously used a stepper motor which is become a obsolete method hence Stepper motor has limitations like Low efficiency, torque drops rapidly with speed (torque is the inverse of speed), low accuracy, no feedback to low torque to inertia ratio hence cannot accelerate loads very rapidly. And also motor gets very hot in high performance

configurations. The grinding process is characterized with large number of uncertainties. In grinding process the cutting conditions are continuously varying as a result of variations in material hardness, variations in tool sharpness due to wheel wearing, variations in width and depth of cut due to vibrations[1] .
The DC servo motors play a vital role in all the process industries. Development of accurate controllers for such processes becomes a difficult task. Hence to overcome the limitations of stepper motor we have to use servo motor to operate grinding machine with the help of PLC . Servo motor provides following advantages like:
1. High efficiency ,
2. It has high torque to inertia ratio,
3. It can rapidly accelerate loads,
4. Motor stays cool.
Grinding is a finishing process used to improve surface finish, abrade hard materials and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material[1].

III. SYSTEM ARCHITECTURE

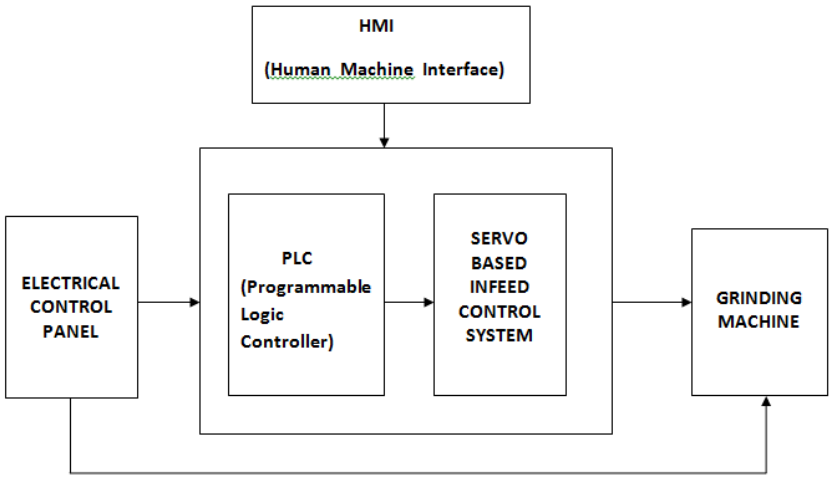


Figure 2. Block diagram of plc and servo based infeed control system

PLC-Programmable Logic Controller
PLC is an industrial computer control system that continuously monitors the state of input devices and makes decision based such as controlling of machinery. .It is a digital computer used for automation of no. of electromechanical processes. Here we are using MESSUNG NEXGEN 2K PLC.

Figure 3. Messung Nexgen 2K PLC

SERVO MOTOR

Servo implies an error sensing feedback control which is utilized to correct the performance of a system. It consists of a DC Motor, a Gear system, a position sensor and a control circuit. A servo motor is controlled by controlling its position using Pulse Width Modulation Technique. The width of the pulse applied to the motor is varied and
send for a fixed amount of time. The pulse width determines the angular position of the servo motor. This servo motor used for movement of grinding wheel in forward and backward direction.

HMI (HUMAN MACHINE INTERFACE)

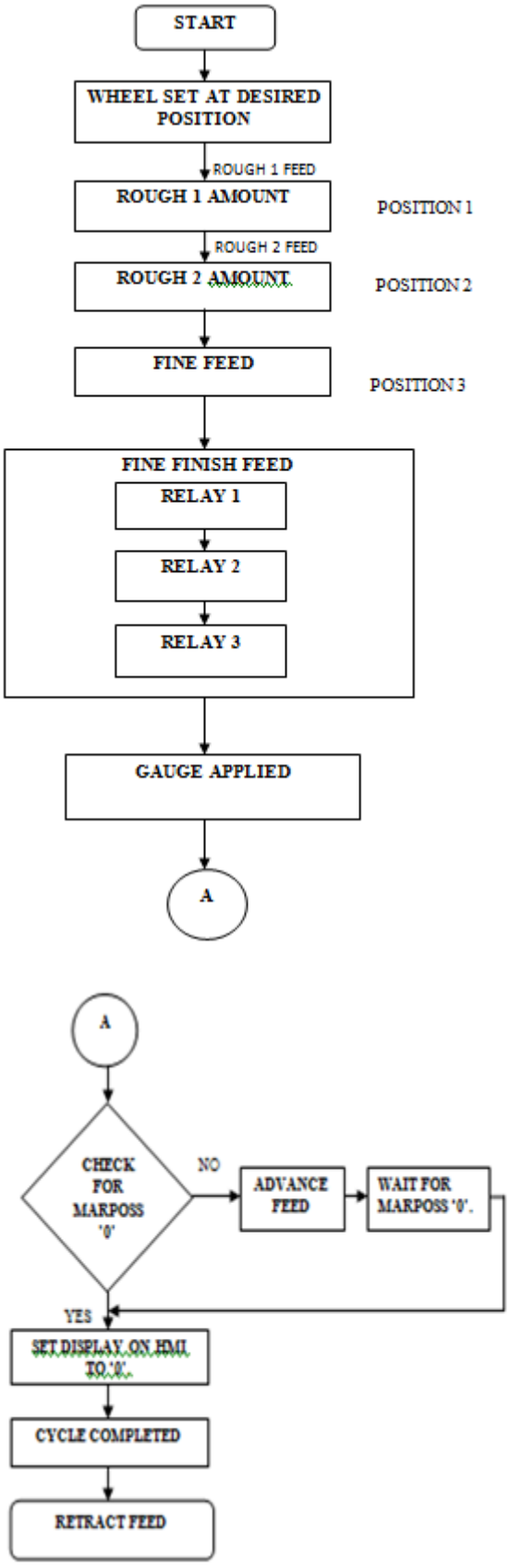
HMI is the acronym for Human Machine Interface, and can be designed as just that; an interface between the user and the machine. An HMI is much more specific to manufacturing and process control systems. An HMI provides a visual representation of a control system and provides real time data acquisition. HMI can increase productivity by having a centralized control center that is extremely user friendly. It can display the status of process parameters by making communication with intelligent controllers like PLC, drive, process controllers, PC. On line monitoring of process parametric values and changing set points of a process is not possible through PLC during its RUN mode, while controlling a process.PLC programming software installed in PC ,does allow this, but it leads to modification of a program and is not a correct approach. HMI provides this facility i.e. Supervision & Control.

Figure 4.Display of HMI

STEPPERMOTOR

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any feedback sensor (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed. Switched reluctance motors are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.

FLOWCHART



SOFTWARE USED-

1. MEI SOFTWARE – Used for developing Ladder digram of PLC.
2. E Designer 7.52 – Used for Programming of HMI.

HIGHLIGTES OF SOFTWARE-

1. Only One Software For Programming And Configuration.
2. Visual Studio® Integration.
3. More Freedom In Selecting Programming Languages.

METHODOLOGY

- To study present grinding cycle.
- Requirements- cycle time, feed rates, change-over points in cycle, easy editing options for parameters, grinding compensation.
- Selection of servo drive and PLC system.
- Project on PLC logic.
- Servo parameters programming.
- Testing logic.
- Testing servo motor and drive externally from outside machine.
- Functional trial.
- Grinding cycle trial.
- Production trial.
- Final testing.
- Documentation.

EXPECTED RESULT

- Reduction in down time.
- Cycle time reduction.
- Smooth production flow.
- Upgradation of machine – for easy back up support for maintenance. \
- Increase in the reliability of machine.

IV. CONCLUSION

The system consist of grinding machine, servo motor and electrical control panel. These are interfaced with the PLC(Programmable Logic Controller). The grinding machine grinds the crank shaft . while grinding feeding is done by the servo motor . The accuracy shown on the MARPOSS amplifier. Hence this is necessary system is being implementing in a company.

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