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Implementation of Proximity Sensor in CNC Machine for Mass Production

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ABSTRACT:

In the recent times, each and every manufacturing company has upgraded its machines to automated ways to increase the productivity and quality of products. As a development, the lathe machines are replaced by CNC machines, which uses the computer numerical codes to perform the desired operation. In those CNC machines, particularly the machine that performs drilling operation must be upgraded to next level to ensure the safety and increase the product's standard. This project deals with such an aim to upgrade the CNC machine with hydraulic clamping that has been in practice in the renowned industry. The various problems arising in the drilling operations such as part rejection, tool breakage and part holding mechanisms are examined accurately with the proximity sensors, which is connected to a PLC circuit, which helps to make the operation automated. That this project deals with every problems in drilling operation and helps to neglect them and also to ensure the safety of the tool and the labour.

Keywords—Clamping system, controller, hydraulic actuator, Proximity sensor, Drilling operation.

I INTRODUCTION

A. Introduction to company

This company performs, contributes and touches the lives of many with operation in the field of Sugar, Alcohol, Tea, Soft Drinks, Soya Foods, Synthesis, Gems, Textiles, Transport, Retreading, Finance And Foundry. The company has strategically invested in the most modern foundry facility and looks forward to set the pace for the industry in the years to follow.. The company is a major supplier of critical components to passenger car manufactures. The components are Steering Knuckles, Brake Drum, Brake Discs, Hubs, Brake Caliper, Carriers, Differential Cases, and Manifolds etc... Presently the supplies of these components are made to MarutiUdyog Ltd., Hyundai, Ind Auto Ltd., Ford,

Honda Siel Cars and Tractors and farm Equipment Ltd, etc... Castings meant for trucks and refineries are exported to USA. The quantum of exports per month ranges between 250MT to 500MT. it is likely to go up to 1000MT in near future. The company has been awarded the industrial safety awards for three consecutive years. It has also been recognized by

MarutiUdyog Limited as a first class critical component vendor.

B. Introduction to Project,

As a development, the lathe machines are replaced by the CNC machines. which uses the computer numerical code to perfume the desired operation. The proximity sensor is used to sense the ferrous and non-ferrous metal objects and capacitive inductance to detect non-metal objects. Proximity sensors are to sense the range or distance between the two objects. As a part of this, proximity sensor used in CNC machine to detect the work piece presence, while clamping the component over the fixture to enhance the accurate clamping. Here, OMRAN is a type of sensor used to detect the work piece presence with the help of c-washer as a non-metal.

II. LITERATURE SURVEY

[1] W.KIM;K.MECHITOV; J.YCHOI;S.HAN:

This paper deals about proximity sensor, that we consider the use of binary proximity sensor for tracking target. In this the sensor sense whether the object is place near by the sensor, and gives the position of the component placed near.

[2]Thomas F Bailey John E Campbell:

In this paper presents a review of clamping assembly is hydraulically controlled to permit remote operations and access to the drive bearings. An angular piston is used to lock and unlock the clamp assembly.

[3] R Singla; Suchil Kumar:

This paper discuss the intelligent clamping system have ability to clamp the work piece without any deformation. Here the sensor is used to detect the presence and clamping/unclamping of the work piece.

[4]Joukokivio, paul H. Andresson:

This paper describes about tool breakage monitoring during drilling operation. Using Acoustic Emission (AE) signals. The measurement taken from real industrial environment with drilling machine. The measurement have been analyzed both time and frequency. The location of sensor play important role because the high frequency and sensor will indicate the work piece and cutting tool.

III. PROBLEM IDENTIFICATION

We obtained a large amount of information when conducting our initial research within the factory. Operation managers as mentioned before provided us with such information as production and quality data. The operation managers of production line also answered many important questions we had concerning the production and flow of operations. We also obtained information when we visited the factory ourselves. The operation managers inspected as to view the plant to study about the flow of operations for various components. The operators also answered the questions as well as walked us through the presumed plant. When visiting the plating factory, we were able to see how the machines operate and we were able to acquire details about CNC machine. The factory persons gave the data about the tool breakage and work piece rejection. while placing the component with varied dimensions, and also explains how the pieces are getting rejected on the regular basis and gave us many ideas for finding areas fit for improvement.

For many failures, the main cause is manual errors. So this error can be solved only with the help of automating the system i.e., proximity sensors.

TABLE I Accident occurred before implementing proximity sensor

Accident on CNC machine	Total accident/year	Accepted Work Piece	Rejection of work piece
	10	2	8

Piece rejection before implementing proximity sensor

TABLE II Piece rejection in percentage

Year	Total piece/ Shift	Rejection piece/ shift	Rejection in percentage
2015	350	50	15%
2016		30	8%

The above table mention that in the year of 2015, 350 set of component should be produced per Shift. In that, 50 set of piece had been rejected. In the year of 2016, 350set of component should be produced per shift. In that, 30 set of piece had been rejected.

In 2015the inspection of work piece is done after finishing all the operations in the CNC machine, but in 2016 the inspection of the work piece is done after finishing each single operation in CNC machine. So the work piece rejection is reduced due to the inspection of each single operation in CNC machine.

IV. PROPOSED DESIGN

The design of clamping system consists of work piece detection and clamping/ unclamping of work piece without deformation. The proximity sensor sense whether the work piece have any sort of damages and size variations in the work piece dimensions. Work piece detection can be done by the use of proximity sensors and clamping/ unclamping can be achieved by using hydraulic double acting cylinder.

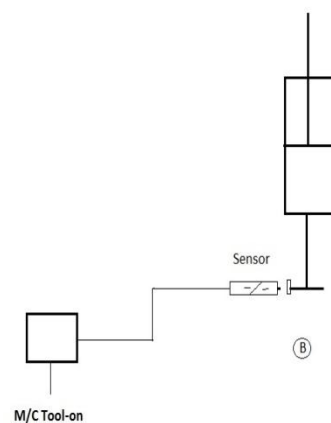


Fig.1

A. Work holding mechanism

The Work Piece Detection and Clamping Mechanism have two jaws, one is fixed and other is moving. The moving jaw is connected to the double acting hydraulic cylinder whose movement can be done by extension and retraction. A proximity sensor is used at the fixed jaw to detect the presence of work piece.

receiving the signal from sensor. OMRAN proximity sensor is used in this project. Selection of sensor depends upon the material of work piece and range required. Inductive sensor can be used for metallic work pieces and capacitive sensor for non-metallic work pieces. Sensor detects the work piece presence with the help of c-washer, while it is placed at the bottom of the hydraulic cylinder.

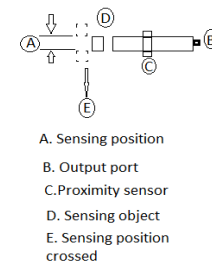


Fig.3

B. Process flow

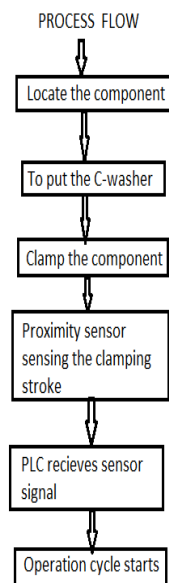


Fig.2

First step of this project is, the work piece is placed in the jaw of the CNC machine. The CNC machine has two jaws, one is fixed and another one is moving, the work piece is placed in the fixed jaw of the CNC machine. Next step is to put the C-washer, and the work piece is clamped in CNC machine. The clamping stroke is sensed by using proximity sensor, and the programmable logic controller receives the electrical signal from proximity sensor. After getting signal from sensor the PLC starts the operation cycle in CNC machine.

C. Sensor

The proximity sensor is used to detect the presence of work piece so that clamping can be done after

D. Actuator

The hydraulic actuator is preferred over the pneumatic actuator for mass production. A hydraulic cylinder is the actuator or “motor” side of the system. The “generator” side of the hydraulic pump which brings in a fixed or regulated flow of the oil to the bottom side of the hydraulic cylinder to move the piston rod upwards. The piston pushes the oil in the other chamber back to the reservoir.

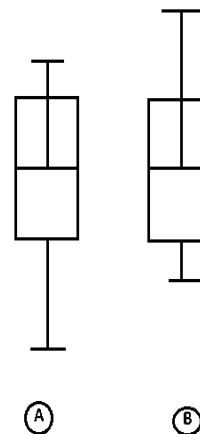
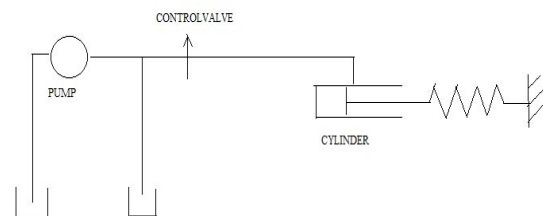


Fig.4

A-Max de-clamp stroke (Retraction)

B-Full clamp stroke (Extension)

E. C-WASHER

Washer is a thin plate with a hole, i.e., normally used to load of threaded fastener such as screw or nut. Other uses are as spacer, spring, wear pad per load indicating device, locking device and to reduce the vibrations. Washers are metal or plastic. High quality belted joints require hardened steel washers to prevent the loss of pre-load after the torque is applied. C-washers are knurled outside diameter for easy gripping while quick insertion or removal.

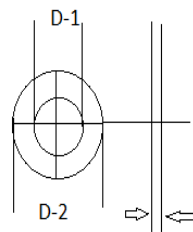


Fig.5

E.PROGRAMMABLE LOGIC CONTROLLER

Programmable logic controller can be used for this purpose as it can be programmed easily and contains various input and output ports. The programmable logic controller after getting positive response from the proximity sensor starts the next operation in CNC machine, sensors are connected to input port of PLC whereas solenoids of dc valve are connected to output ports.

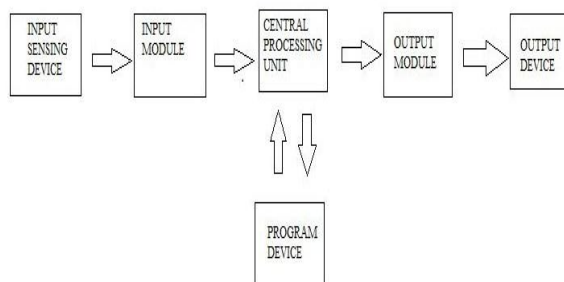


Fig.6

V. CONCLUSION

Based on the design, this system can be used in all CNC machines with hydraulic clamping mechanism. This design can detect the exact defect in the work piece with use of proximity sensor. So that, this design can help to save the product's lead time and also stop the piece from rejection due to various defects that arise after the CNC operation.

From the above mention data, it is evident that this design can serve as the upgraded version of the existing CNC machine with an automated working with the help of PLC circuit

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