IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 3, March 2016

Honing Machine Stone Feeding System

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Abstract: Honing is to sharpen. It is a finishing process. In this process we use a stone that we call a hone to sharpen the workpiece. The process is slow and requires time. It also requires constant supervision. The paper focuses on the increase in precision of the finished job and reduction in need for constant supervision. This system uses a stepper motor to push the hone forward. It also uses sensors to analyze the hone position. The system is easy to install and attach to the honing machine. It is also cost effective as it only has a onetime installation cost and will reduce the possibility of hone breakage or unfinished workpieces.

Keywords: Honing machine, PLC, Stepper motor, Stone feeding system.

I. INTRODUCTION

The process of Honing is a slow process. Manual stone feeding requires more time and has less precision as the stone is usually pushed by hand using approximate measurement and without any precise measurements. Due to this there is variation in quality of each product. Also if the stone is clamped too tight then it may result in breakage of the stone.

Honing process is a finishing process, in which a tool also called a hone is used. It carries out 2 motions simultaneously, rotary and reciprocating. The workpiece meanwhile stays still [1]. This is most common method of honing. However, in our project, the machine we are working on has a rotating workpiece while the hone is still. Most of the times honing is done on internal cylindrical surfaces. The honing stones are held against the workpiece and exert a controlled light pressure. In this process there are two conditions, the hone should not leave the workpiece and the stroke length should cover the entire length of the workpiece.

There are two types of honing machines, feed controlled and force controlled. The machine we are working on is a feed controlled honing machine. Here the length by which the hone is pushed forward stays the same, while the force required keeps increasing as the stone length decreases [2]. Our system is PLC based. So the stone feeding system will be PLC programmed. The project is to automate the stone feeding process using a motor to push the hone forward and proximity sensor to keep track of hone position.

II. WORKING OF EXISTING SYSTEM

In the existing system we use touch pad as primary input source. It allows us to decide when to start execution of the process and when to stop it in case of emergency. It also has different parameters we can manipulate like the speed and time of the job processing. On pressing the start button, the complete body of the machine moves from rest (home) position to the first position. Simultaneously, a ring is inserted automatically in the holder and starts rotating. The hone pushes towards the ring and the process of honing starts as the ring rotates. After a while (according to set time by operator), the ring stops rotating and hone is bought back to home position. Another ring is then inserted in the holder while this one is removed. The Whole process is then repeated. This process is an automatic one and does not have to be supervised by the operator. We use pressure switch to sense how much pressure the hone puts on the ring (job). If the pressure being applied is less than the provided range then the hone is pushed ahead in angular way. The pressure applied should be of given range. Once that much pressure is sensed the hone is kept as it is as the ring rotates. Again this happens till the pressure sensed becomes less than the range. Once this condition is detected the process is repeated again [4].

A Proximity sensor is used to sense whether hone is touching the job or not. If it is not touching the job, then the hone is bought back to home position. If even on tilting the hone it doesn't touch the job. This tells us that the hone has to be pushed forward. This is detected by the proximity sensor. Once the proximity sensor detects that the hone is not touching the job and is bought back to rest position, then the operator has to come and manually unclamp the stone push it forward by 2mm and then clamp it back and restart the process.

III. DRAWBACKS OF EXISTING SYSTEM

The drawbacks seen due to manual hone pushing in the system are as follows:

- Manual Error while pushing hone.
- Worker inconvenience caused due to constant need of supervision.
- Excess time requirement.
- Stone breakage probability due to excess clamping pressure.

To avoid the above drawbacks we have decided to automate the above process of stone feeding in the honing machine.

IV. IDEA PROPOSED

Automation of existing (stone feeding) system:
We have decided to use a stepper motor to push the hone forward instead of the traditional method of it being

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pushed forward manually. Thus whenever the proximity sensor will detect a loss in contact the hone will be bought back to home position. Once at home, the clamps will be loosened by a hydraulic valve. The hone is then automatically pushed 2mm forward by the cylinder. Once the hone is pushed forward, the cylinder will go back to hone position. This will be sensed by a magnetic sensor. The clamps will then be fitted back by the hydraulic valve. This process will keep going on whenever the hone comes back to rest position.

However, at a particular stage the hone end will touch the clamp. Pushing the hone any further at this stage is not possible. If pushed it will break and may also fall. Thus to avoid this we use magnetic sensor to sense this position. It will sense the position of cylinder when the hone can be pushed no further. This is when the hone has to be changed and then only will the process be resumed.

In the project we use force to sense the position of the hone. This is done using time and is placement parameters, and thus calculating applied force. For this purpose we use components of Festo which use force calculations to sense position.

Usually a hone lasts for almost a day and is thus changed only the next day before starting the process all over again.

The critical Process Parameters to be considered here are:

1) Rotation speed and time for each ring
2) Honing stick feed pressure
3) Clamping Pressure
4) Length by which hone is to be pushed

V. PROPOSED SYSTEM BLOCK DIAGRAM

Below figure shows block diagram of PLC based honing machine stone feeding system.

It consists of:

A. PLC
B. Motor Control
C. Stepper motor
D. Cylinder
E. Magnetic Sensors
F. Hydraulic valve and hone clamp

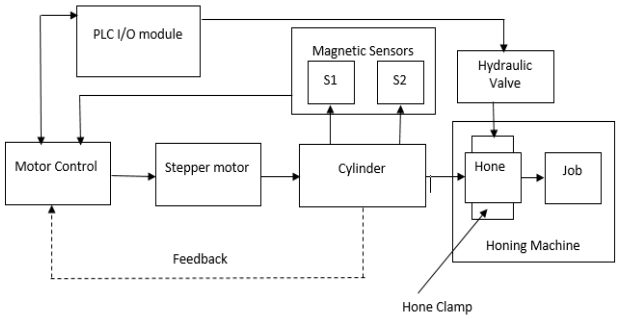

Fig. 1. Block Diagram of Honing Machine Stone Feeding System

Function of each block:

A. PLC

The existing honing machine is PLC based. So to modify the system we use PLC. PLC will provide user required command to the motor control and vice versa. PLC functions as the medium of communication between the honing machine and stone feeding system. It signals the stone feeding system when to start working and can also give commands to stop if operator interrupts manually. It also controls the hydraulic valve as and when required.

B. Motor Control

The motor control works as interface between PLC and Stepper motor. It works according to the PLC commands and sends feedbacks to the PLC according to the work status. It is programmed according to user requirement to push the cylinder by a specified distance (2mm in our case). We program the motor control to the cylinder forward by 2mm every time until it reaches worn out position. Once it does, the motor control signals the PLC to stop the machine completely and indicate the operator that a hone change is required.

C. Stepper Motor

Stepper motor will physically push the cylinder. It converts rotational motion to linear motion. The stepper motor angle of rotation depends on the pulse provided as input. This pulse is provided by the motor controller. The motor controller will provide pulses as required to push the hone forward by 2mm.

D. Cylinder

The cylinder physically pushes the hone forward. Motor controls the cylinder position according to the position the sensors sense and send to motor controller.

E. Magnetic Sensors

These sensors are required to sense the position of cylinder. The sensors send these readings to the motor control. We have two sensors. The fist sensor is used to tell us when the cylinder has reached home position. This is used every time the cylinder pushes the hone forward by 2mm. Once the motor control senses that the cylinder has pushed forward by required amount, it sets the cylinder back to home position. The second sensor is worn out sensor. This sensor indicates that the hone has reached the worn out position and has to be changed.

F. Hydraulic Valve and hone clamp

Hone clamp is used to clamp the hone and declamp it so that it stays in position and moves as and when required. The hydraulic vave is used to loosen and tighten the clamp when required.

VI. FESTO CONFIGURATION TOOL (FCT) SOFTWARE

FCT software is used to control the motor controller. We can program the controller using this software. Depending on the motor and controller used the software decides the working of the motor controller. Fig. 2 and fig. 3 show the program of the controller.

As seen in fig. 2 , the comparators we use in the record table are force and position of cylinder. Force is specified in percentage while position is in mm. Here the controller uses force to find the position of hone.

In fig.3, the sequemce of operations is given in the form of a record table.

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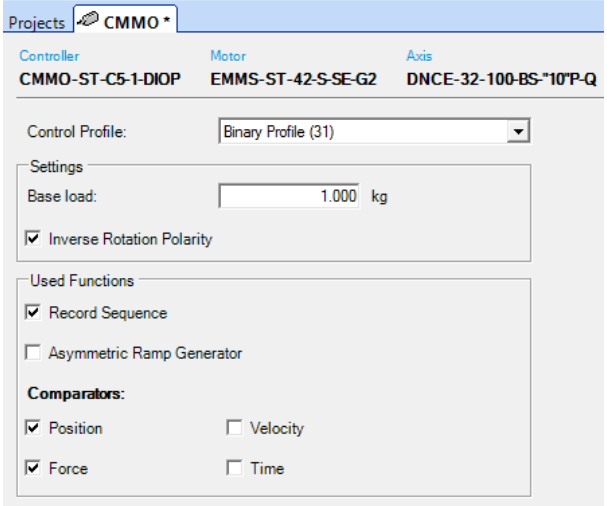

Fig. 2. Comaprator Parameters used in controller

	Type	Target	Start Condition	Velocity	Acceleration	Extra Load	Torque Feed Forward
1	PA	20.00 mm	Ignore	100.00 mm/s	1.000 m/s²	0.000 kg	100 %
2	FSL	10.0 %	Delay	20.00 mm/s	1.000 m/s²	0.000 kg	100 %
3	PRA	0.00 mm	Delay	6.00 mm/s	0.100 m/s²	0.000 kg	100 %
4	PRN	2.00 mm	Ignore	10.00 mm/s	0.100 m/s²	0.000 kg	100 %
5	PA	0.00 mm	Delay	100.00 mm/s	0.100 m/s²	0.000 kg	100 %

Fig. 3. Record table for cylinder working

The 1st operation performed by the controller is to push the cylinder forward by 20 mm from absolute position at a speed of 100mm per second. This operation starts as soon as the PLC signals the controller that the hone is at home position.

The 2nd operation performed by controller is to push the cylinder with a with a velocity of 20 mm per second till a force of 10% of the load is sensed. This tells us that the the cylinder is touching the hone.

The 3rd operation is to apply a force enough to keep the cylinder in same relative positon. The controller signals the PLC at the start of this operation. The PLC then opens the hydraulic valve, thus releasing the pressure on the clamp. It then signals the conroller to go to next operation. This operation is not performed if the position of cylinder is from 91mm to 95mm from absolute position. Else the operation is stopped completely and controller signals PLC that there is need of hone change.

The 4th operation is to push the hone forward by 2mm from relative position at velocity of 10mm per second.

The 5th and last operation is to bring the cylinder back to its absolute home position at a velocity of 100 mm per second. Once the cylinder reaches home position the contoller signals the PLC. The PLC then closes the valve thus, applying the pressure to hone clamp again and fixing the hone in place. After this the honing process continues.

VII. ADVANTAGES

- Less inconvenience to workers
- Less hone breakage
- More time optimization
- Less errors in job
- Lesser supervision required.

VIII. APPLICATIONS

- Produce high finished products.
- To correct out of orderliness, taper, axial distortion.
- Employed very frequently for finishing of bores, gear teeth, roller bearings.
- Reduce inconvenience to workers

IX. CONCLUSION

We have observed that it is easy to modify the logic in PLC. Also use of PLC makes the system more compact, which is a high necessity nowadays.

Hence, it can be concluded that the system designed and developed can be used for demonstrating an application of PLC. It reduces human effort and will also improve finishing of the job.

REFERENCES

[1] George Schneider , Jr. CMfgE , 'Cutting Tool Applications, a handbook to machine tool materials, principles, and designs'
[2] Christina Schmitt, Uwe Moos and Dirk Bähre, 'Comparison of different approaches to force controlled precision honing of bores' Journal of Mechanics Engineering and Automation 3 (2013) 764-771
[3] Pimpalgaonkar M. H., Ghuge R.L, Ade S.L.,'A review on optimization process parameters on honing machine' International Journal of Mechanical and Production Engineering, Volume- 1, Issue- 5, Nov-2013,
[4] Article: Vertical honing machine offers automatic feed system. Modern machine shop magazine. July 2009 edition.
[5] FCT Software manual.

DOI 10.17148/IJIREEICE.2016.4322