Automatic Component Feeding System for Centerless Grinding Machine

Gaurav Laxman Deore[1] Dr. A. R. Sahu[2]
[1]PG Student [2]Professor
[1,2]Department of Mechanical Engineering
[1,2]GHRCEM, Pune, India – 412207

Abstract— In the present work external centerless grinding machine, the manual feeding of work pieces can be replaced by designing and development of automatic feeding system which helps to feed the work pieces automatically into the centerless grinding machine. It comprises hydraulic system and controlling mechanism, as per the grinding machine specifications with particular reference to the grinding of various drills as per manufacturing capability. This system eliminates fatigue to operator due to repetitive work. The objective of switching over to automation is to minimize the errors incorporated due to conventional operations. This further led to cycle time reduction with increase in the productivity accuracy. All the parts and assembly modeling of automatic loading and unloading system using CATIA V5R19. The cycle time analysis result shows to find the number of work pieces grind per minute and also show how the process takes place with respect to the time.

Keywords: Grinding Machine, Centerless Grinding, Regulating Wheel, Hydraulic Power Pack

I. Introduction

External centerless grinding is a grinding process to machine outer diameter of the work piece. In contrast to other cylindrical processes, where the work piece is held in the grinding machine, while grinding between centers, the work piece is not mechanically constrained. Therefore the parts to be ground on a center less grinder do not need center holes, drivers or work head fixtures at the ends. The work piece is supported in the grinding machine on its own outer diameter by a work blade and by the regulating wheel. The work piece is rotating between a high speed grinding wheel and a slower speed regulating wheel with a smaller diameter. The blade of the grinding machine is usually positioned in a way such that the center of the work piece is higher than the virtual line between the centers of the regulating wheel and the grinding wheel. Also the blade is designed with an angle in order to ensure that the work piece is fixed between the blade and the regulating wheel. The regulating wheel consists of soft material like rubber and can contain some hard grain material to achieve good traction between work piece and regulating wheel. For grinding, initially the work piece is loaded manually which leads to increase in loading time.

II. Literature review

In 2009 Hashimoto and oliveira presented a CIRP keynote on Industrial challenges in centerless grinding [1]. That survey focused to understand what are the challenges are in industrial use of grinding process. They have analyzed main problems in more efficient engines and changes in their components that will affect the grinding performance. By their industrial experience in grinding they selected some challenges and tried to solve these. They have explained different sources of information on industrial challenges in grinding. W Xu and Y Wu in 2010 studied and much of work is devoted to the in feed centerless grinding techniques but that was by using surface grinder and ultrasonic shoe [2]. But in feed centerless grinding by using surface grinder limits the size of job and also it require more cost. In this the workpiece is held by shoe and blade. The rotational speed of the workpiece is controlled by shoe which is connected to piezoelectric ceramic device on a metal elastic body. Workpiece rounding process is investigated by simulation. They achieved higher machining accuracy at lower speed rate and lager material removal at faster workpiece rotational speed. Krajnik and Drazumeric studied only the modelling and simulation in the centerless grinding operation [3].

In 2009 in the APEM journal they have developed and implemented different simulation model that assist in efficient system set-up. In 2014 Barrenetxea et al [4]. Three Dimensional grinding Model is described by analytical methods. The model includes a parametrical description of all grinding gap elements and their kinematics and enables the determination of optimal regulating wheel form. Moreover, the model can be used in a simulation tool that creates an interactive virtual environment, places all grinding gap elements in the defined set-up and visualizes the process [5]. Thermal variation in machine tools greatly affects the dimensional tolerances of work pieces and causes various defects in manufacturing process. For preventing thermal distortion that makes to substantial improvement in quality, manufacturing efficiency and energy saving [6]. During operation there is chance of overlapping of rods that damages the grinding wheel or stops the operation, for that purpose pneumatic proximity sensor is attached. Output of sensor placed nearer to the grinding machine, input attached to the cylinder. Mainly pneumatic proximity sensors involve the use of compressed air, displacement or the proximity of an object being transformed into a change in air pressure. Low pressure air is allowed to escape through a port in front of the sensor. This escaping air, in the absence of any close-by object, escapes and in doing so also reduces the pressure in the nearby sensor output port. However, if there is close-by object, the air cannot so readily escape and result is that the pressure increase in the sensor output port. The output pressure from the sensor thus depends on the proximity of objects. Here, in this case inductive proximity sensor is used. It can be used for the detection of metal objects and is best with ferrous metals [7].

III. Analytical section & Development of mechanism

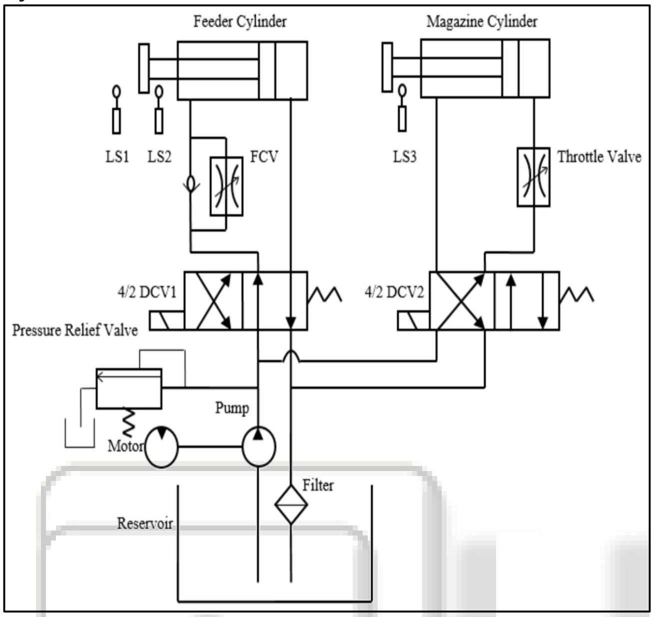
A. *Calculations:*

System requirement and initial available data are as below,

Cycle time	Pressure	Stroke length	Load to be moved
0-1 sec	0.4 bar	20 mm	10 kg
1-5 sec	0.4 bar	140	1kg

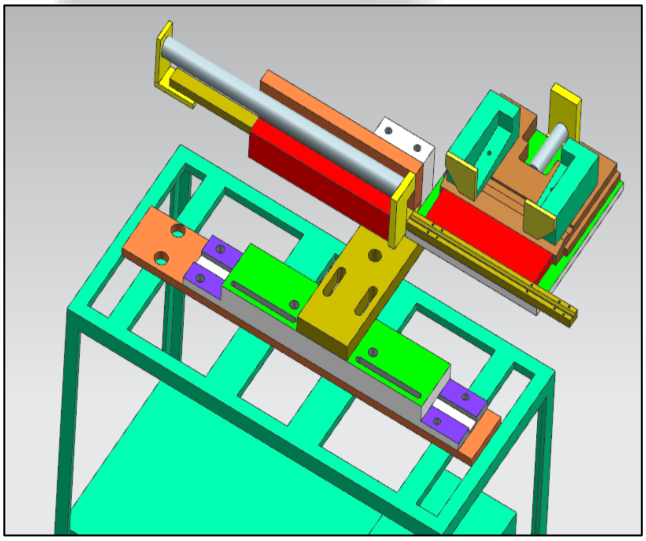
B. *Hydraulic Circuit:*

Sequence of Operations are as follow:
Pump starts, Feeder cylinder extends, Pusher touches LS2, LS 2 sends signal to solenoid x, Direction of DCV 1 changes, Feeder cylinder retracts, Pusher touches LS1, LS 1 sends signal to timer, Timer starts and spring operated DCV changes its direction, Magazine cylinder extends, After a set time interval DCV 2 changes its direction, Magazine cylinder retracts and touches LS3, LS3 sends signal to solenoid-y an Cycle continued.



C. *Solid Modeling:*

The mechanical structure is basically a fixture which is attached directly to the grinding machine. It is made in order to match the center height. It acts as the man feeding the jobs into the machine.



D. *Discussion:*

From result point of view two objectives are very necessary to be analyzed: No. of rejection per shift & No. of parts grind per shift There are three sizes of drill bits: 8 mm, 6 mm & 4 mm diameter drill Percentage reduction in rejection and increase in production are shown in below table,

Drill diameter	No. of parts grind per shift		% increase in production
	Manual system	Auto feeding system	
8	3500	5000	42.87
6	4000	5500	37.5
4	4800	6200	29.16

IV. CONCLUSIONS

1) After installation of automatic feeding system, there is increase in production as well as reduction in rejection.
2) After analyzing the performance of an automatic feeding system, requirement of a skilled labor to feed the work-piece is totally eliminated.
3) It is concluded that, percentage increase in production is different for different diameter of work pieces and percentage decrease in reduction is also different.

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