

# Loading and unloading automation of center less grinding machine

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## ABSTRACT

Centerless grinding machine has been extensively used to produce high surface finish of cylindrical components. In the existing centerless grinding machine, the loading and unloading operations are done manually which increases material handling time, production inconsistency, machine lead time, monotonous to operator and chance for operator to be injured due to continuous rotation of the wheels at high speed. In this project, the automation is implemented for loading and unloading operation with the help of pneumatic control. The methodology for design, development and simulation of the centerless grinding machine is done based on collection of data from the existing machine. A 3D model of the machine is created using Pro-E software. Also, the pneumatic circuit is simulated for loading and unloading operation using FLUID SIM software. A production of 2520 cylindrical engine valves per shift was improved to 4200 component by implementing automation in the conventional machine.

## Keywords:

### 1. INTRODUCTION

**Centreless grinding:** Centerless grinding is defined as the dimensioning and /or finishing of the outside diameter (OD) of a cylindrical part. Centerless grinding is a form of grinding where there are no collets or pair of centers holding the object in place. A center less grinder has three main components: Grinding wheel, Regulating wheel, Work support blade.

There are two types of centerless grinding-

1. Through feed
2. In feed grinding.

**Through Feed:** A metal cutting process by which the external surface of a cylindrical work piece of uniform diameter is ground by passing the work piece between a grinding and regulating wheel.

**In feed Grinding:** Center less grinding in which the piece is fed through grinding and regulating wheels to an end stop. valves are manufacturing by using the infeed grinding. this project is implemented for the infeed grinding machine.

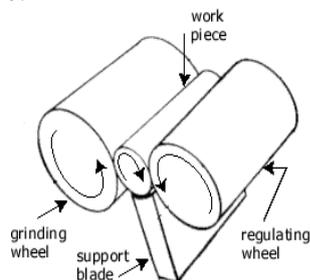


Fig.1. Main Components of Centreless Grinding Machine

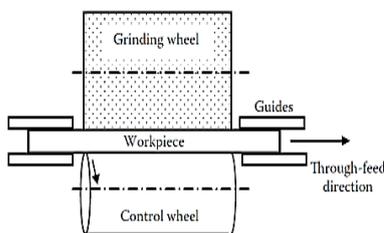


Fig.2. Layout of Through Feed Grinding

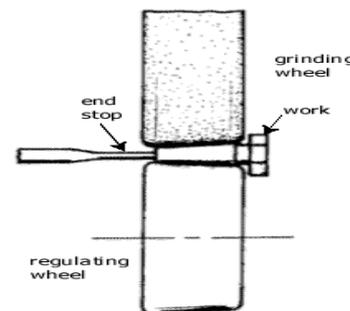


Fig.3. Layout of Infeed Grinding

**Importance of Center less Grinding:** Center less grinding is used for fast production and high accuracy.

- Small rollers, engine valves and needles, for example, are machined to close tolerances in quantities of millions by in feed center less grinding.
- An advantage of center less grinding is that center holes are not required for the purpose of location.
- This saves time, and accuracy is improved since driving devices are a source of errors.
- Grinding processes are also used for high removal.

### 2. PROBLEMS IN THE EXISTING CENTRELESS GRINDING MACHINE

- Individual operator is required for individual grinding machine for initial setting and operating the machine, which leads to increase of man power cost for existing two machines in one lane.
- Presently there are six lanes with 12 grinding machines and having 12 operators to perform the task.
- The possibility of human error like alignment of work piece, in setting up the job in the machine.
- Safety is also a primary concern with center less grinding, as it involves placing a part between two rotating wheels by hand is a dangerous task, and monotonous for the operator

### 3. AUTOMATION

Automation is the use of control systems such as Pneumatics, hydraulics, electrical, electronics and computers to control industrial machinery and processes', reducing the need for human intervention Automation play a vital role in material handling by doing the sequence of operation automatically and helps in mass production

Many automation systems are based on air-operated devices. Most of the manufacturing shops will have pressurized air supply for clamping, cleaning etc. This could also be used as an energy source for automation purposes

**Types of Automation Systems:** Automation systems can be classified into three major types:

- Pneumatic automation
- Hydraulic automation
- Automation using programmable logic controllers, which involve combinations of the above.

#### 4. COMPONENTS OF AUTOMATION

In this project following main components are used for automating the centreless grinding machine.

- 1) Chute
- 2) V-block
- 3) Transfer
- 4) Gripper
- 5) Loader
- 6) Ejector

**Chute:** Chute is nothing but manually material conveying systems. This is fitted in machine at an angle. So part is moving down through gravitational forces. This chute door operated by pneumatic cylinder.

**V-Block:** It helps to carry the parts (engine valves) coming from the chute. Double acting cylinder is connected with v block to move forward and reverse. When the cylinder is extend the v block will reach the same line of pickup axis.

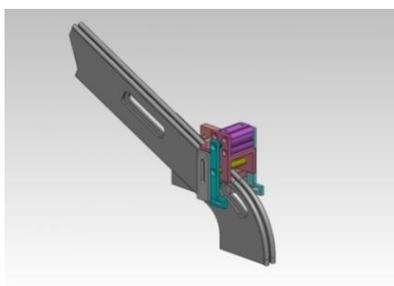


Fig.4.3D model of CHUTE

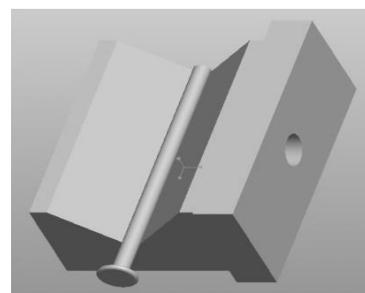


Fig.5.3D Model of V-Block

**Transfer:** This helps to carry the components from the v block. Transfer moves up and down to collect the work piece. This is of U shaped. Transfer cylinder extends to collect the components (engine valve head).

**Gripper:** It is used to grip the component which the pickup is picking. Pickup cylinder moves forward to grip the valve head and retract to ungrasp the components.

**Loader:** It is used to load the components in between the two rotating wheel.

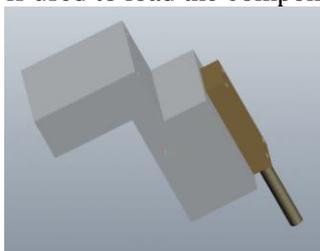


Fig.6.3D Model of Transfer Arrangement

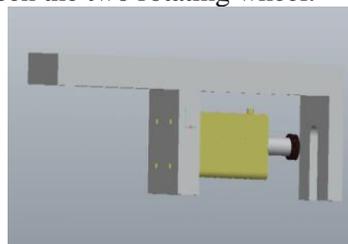


Fig.7.3D model Gripper Block

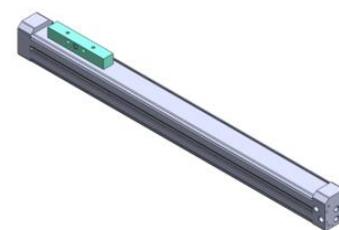


Fig.8.loader Cylinder

**Ejector:** After the required machining process, ejector cylinder extends to remove the workpiece from the rotating wheels.

#### 5. CIRCUIT DESIGN AND SIMULATIONS

**Sequence Of Operation: B-A+A-B+C+D+C-E+C+D-C-E-F+F-**

**A-CHUTE CYLINDER**

**B-VBLOCK CYLINDER**

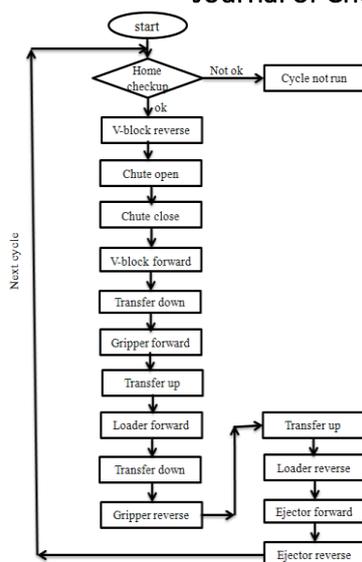
**C-PICKUP CYLINDER**

**D-GRIPPER CYLINDER**

**E-LOADER CYLINDER**

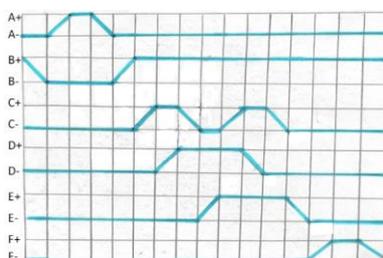
**F-EJECTOR CYLINDER**

**Flowchart for Sequence of operation:**



**Fig.9.Flowchart of Sequence**

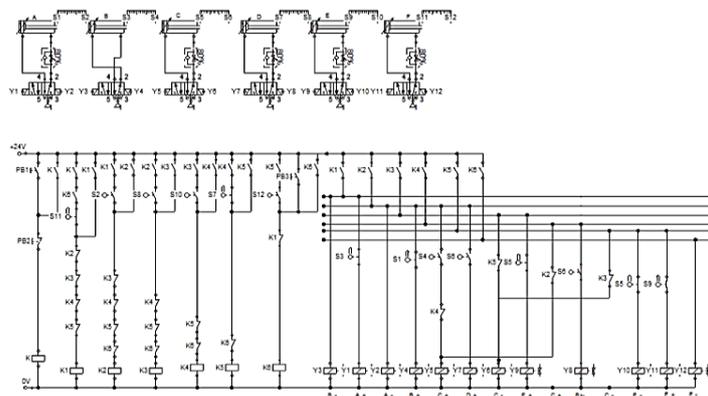
**Position Step Diagram:** Above this figure shows first sequence of operation of vblock cylinder. B- is the retraction of cylinder B.



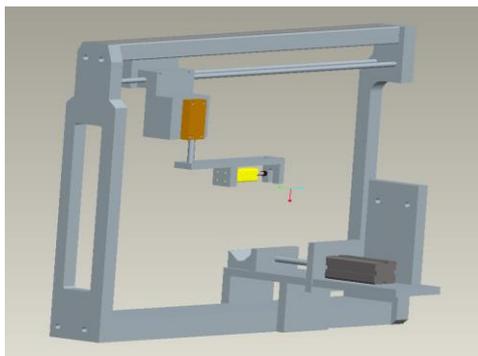
**Fig.10.Position Step Diagram**

When cylinder B retracts the v block will come in position to collect the component (engine valve) which is coming out of chute. Then A+ is the extension of cylinder A. When A cylinder extends chute door will open to allow one valve to flow into the v block. After that chute door will be closed (A-) to arrest the flow of component. B cylinder extends (B+) to move the v-block forward. Then transfer cylinder(C+) will come down to reach the valve head. Once the transfer reach the valve head gripper cylinder extends (D+) to grip the valve head with the U shaped surface. After that cylinder C retracts(C-) to move the gripped valve upward. Transfer is attached with loader cylinder, gripper is attached with transfer. Then loader cylinder extends to move the component just above the two rotating wheel. Then cylinder C extends(C+) to down the transfer to reach the rotating wheels of the centreless grinding machine. Then cylinder D retracts and ungrips to drop the component to the work rest. Next cylinder C retract to reach home position(C-).Then loader cylinder will reach its home position(E-).After the completion of machining ejector cylinder extends(F+) unload the component from the centreless grinding machine. At last ejector cylinder will reach its home position (F-).This cycle continues till the supply is stopped

**Electro pneumatic Circuit**



**Fig.11.Electro pneumatic circuit design**

**3D Model of the Automation Unit****Fig.12.3D Model Of The Automation Unit****6. CALCULATIONS FOR AUTOMATION****Table.1.Shift time calculation**

Shift time	28800sec(8hrs)
Machine idle times	
Refreshments(900s*2)	1800sec
Lunch time	1800sec
TotalMachine running time (-)	25200sec(7hrs)

**Cycle time:**

**Manual:** It take 10 sec to complete one component

$$\text{No of parts per shift} = \frac{\text{Machine running time}}{\text{Time taken to complete one part}} = \frac{25200}{10} = 2520 \text{ components}$$

**If The Machine Is Automated:**It take 6seconds to complete one components

$$\text{No of parts per shift} = \frac{\text{Machine running time}}{\text{Time taken to complete time}} = \frac{25200}{6} = 4200 \text{ components}$$

$$\text{Production improvements} = \text{manual} - \text{automated} = 4200 - 2520 = 1680/\text{shift}$$

**Payback Period:** Time period of return, of implementation cost in automation

**Cost of automation** = Rs 1, 10,000

Operator salary = Rs 20,000/month

$$\text{Multi machine manning} = 20000 \times 2 = 40000/\text{month}$$

**Payback period** = 1, 10,000/40,000 = 3 months (approx.)

**6. CONCLUSION**

Industrial Automation is undeniably a resource which can make industries to increase their productivity through automating the conventional machine, thereby reducing the manpower in operating the machines. The pneumatic automation techniques were introduced in the conventional machine to reduce the lead time in loading and unloading operations of center less grinding machine. The electro-pneumatic circuits with cascading methods were designed for this sequence of operation to load, unload and machine the engine valves automatically. The simulation of electro-pneumatic circuits was verified using FLUID SIM software and the concept was implemented in the existing center less grinding machine. The 3D assembly model was designed and developed the specification for the pneumatic cylinders, and incorporated in the center less grinding machine for sequence of operations. A production of 2520 cylindrical engine valves per shift was improved to 4200 component by implementing automation in the conventional machine. Thus it is easier to worker for loading and unloading the components from the center less grinding machine and providing safety during machining operation, thereby reducing the fatigue of the workers and increased the productivity.

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