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DESIGN OF PNEUMATIC PICK AND PLACE AUTOMATION FOR GROOVE GRINDING MACHINE

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ABSTRACT

Robotics has been introduced in the industry to replace humans in repetitive tasks, to reduce labour costs and to ensure consistent quality control of the process. Nowadays automobile industries are widely developed in all sectors. Automation is used to make work with greater accuracy and reliability is possible to use mechanical and electronic component arrangement. In the presentsituation, the industrial manufacturing has brought new trends in the pneumatic application in an industrial area because due to the continuous availability of compressed air.

Key Words: Accuracy, Reduce Human Effort, Automobile Industries, Automation.

1. INTRODUCTION

Automation is the science of designing, building and mechanism suitable for real life application in automation manufacturing and other non-manufacturing environments. As per international standard organisation (ISO), it can also be defined as; -An industrial robot is an automation, servo-controlled, and freely programmable, multipurpose manipulator, with several areas for the handling of the work pieces, tools or special devices. The variable programmed operation makes the execution of a multiplicity of tasks possible. Here we are designing a pick and place mechanism that is completely in functional by pneumatic principles and reducing the complexity in designing, manufacturing and machining. This help in reducing the overall cost of the robot right from designing to manufacturing since expensive electronic circuits are not used. When compared to electronic robot these pneumatic automation with simultaneous and sequential pneumatic circuits are capable for performing the same task automatically with assistance of even an unskilled labour which is turn reduce the running cost of machine these type of pneumatic automation can be used

where repetitive action is required such as the assembly line, and also where remote operation is required. The recognition using flex sensors for disabled persons. The vision sensor is more stable and accurate for tracking slow movements. Success and advancement of this type of automation depend mainly upon the complexity of the pneumatic circuit. The effective design increases the efficiency and application of this automation. In industrial applications, there are some conditions where a humancannot involve such as hazardous environmental conditions, in a repetitive task to be done many times and where accuracy should be maintained every time in a single task. The cost also will be an important concern based on the requirement. In the proposed system of pneumatic pick and place automation, the cost of the system will vary according to the size of component used in the pneumatic circuit.

Literature Review

Santosh C, Manoj C S, et al has Design and fabrication of pneumatic arm for pick and place of cylindrical objects. The handling of materials and mechanisms to pick and place of objects from lower place to higher place and widely found in factories and industrial manufacturing. There are number of pneumatic arms are available which consists of so many mechanisms hence becomes expensive. The designed pneumatic arm consist of two cylinders, a shaft works with lead screw mechanism capable of converting motion of piston to rotational motion of arm with help of using compressed air. The designed process are carried out based on integrated information of kinematics dynamics and structural analysis of the desired robot configuration as whole.

2. Hardik A. Modi, et al has design the system for pick and place of machine components of CNC-Lathe. Automation is termed as the use of different control systems such as numerical control, programmable logic control or another industrial control system in concern with computer applications or information technology to manipulate all the industrial machinery and processes, thus reducing the need for human intervention. Automation plays a dominant role in the world economy these days and in daily application in industries.

3. Yea-Da Chuah, et al has design the Pick and place machine with vision module. Vision inspection system is one of the commonly used tool in industry. It consists of a camera, light, frame grabber, computer and the image processing algorithm. Vision systems require high reliability in order to find out the defect of inspected units. In the actual application, the vision system is a sub-module mounted on the IC test handler.

4. Rizwanullah Siddiqui, et al has developed the Flex sensors based robotics arm for disable persons. It is used for accurate human hand gesture recognition and tracking. Since a flex sensor is better at tracking rapid movements, while a vision sensor is more stable and accurate for tracking slow movements, a novel adaptive algorithm provides accurate measurement of the robotic arm which is helpful for disabled persons or depending on human needs.

5. N. Firthous Begum, et al has design and implementation of pick and place robot with wireless charging application. The industry is moving from current state of automation to robotization, to increase productivity and to deliver uniform quality. One type of robot commonly used in industry is a robotic manipulator or simply a robotic arm knows as pick and place robot. It is an open or close kinematic chain of rigid links interconnected by movable joints. The robot perform its operation by using android via object detection application and PlC microcontroller. This application is been programmed in java language

3. PROBLEM STATEMENT

Breakdown Maintenance occurs in existing system is-130 Hrs. /5 month.

Breakdown Maintenance Occur Because Of Following Reasons-

- In the existing system, pick and place automation is consist of two cylinders, one support plate, and guide rod. In that horizontal cylinder with valve clamp gripper is mounted on a support plate which is moving up and down, the support plate is movable and guides rod is stationary. The whole assembly is movedcontinuously to perform their function. Due to unequal pressure distribution failure of the gripper is occur.
- Another reason is at time of upward moving gravitational force act downward and help to resist the movement of the vertical cylinder it cause failure in vertical cylinder working.
- Due to unequal distribution of pressure and valve grip position, the stroke length is varying and it causes chuck damping issue.
- Clamping gripper is heavy in weight, due to which deflection from axis develops n horizontal cylinder.

- The overall weight of the system is more because of that compressive stresses induce in guide rod and guide rod failure occurs.
- Maintenance Cost At One Time-18,000-20,000 INR

4. OBJECTIVES

1. The whole mechanism should be based on low cost automation.
2. To increase the productivity of the machine.
3. Minimize the maintenance time of the overall machine.
4. To decrease the worker's fatigue occurs because of repeated maintenance.
5. Distribute the weight of automation for overcome the guide rod failure problem.
6. To reduce scrap valve quantity.
7. Save tooling cost by overcoming the chuck damping problem.
8. Effective utilization of the resources.
9. To increase the quality of finish product.

CONSTRUCTION

In this mechanism, the objective of the mechanism is to reduce the overall weight of the assembly. For reduction of weight, we distribute the total load into two separate assemblies hence weight is also reduced. In that whole assembly is sub-divided into two parts, one is horizontal assembly and another is vertical assembly. Construction of assembly is explained as below:

Horizontal assembly-This assembly is made up of a component such as L-Bracket, T-Plate, L-Plate, Rectangular Plate, horizontal cylinder, bush rod, bush, a support plate, support rod etc. In that L-Bracket is fixed support for horizontal assembly. At the free end of L-Bracket, T-plate is mounted with help of nut and bolt. On T-plate, L-pate is mounted and stock length is adjusting using T-slots. Cylinder is attached to L-pate using the tap. Rectangular plate in present in between horizontal cylinder and L-plate. At the upper side of the L-plate bush is mounted with help of nut and bolt. Bush is provide smooth support for free movement of the bush rod. Bush rod and cylinder rod are a move in a parallel direction. support block is connected to both bush rod and cylinder rod. At right end of the Support block, the support plate is attached in perpendicular position. Support plate is provide for balancing reaction on support block and also pass movement signal to the sensor. At front face of support block, support rod is present both support rod and cylinder rod is at same axis. Support rod is sucking air from Pneumatic circuit

Arrangement and pass to vacuum gripper attached at end of support rod. Gripper is used for pick valve from V-block and place into chuck centre.

Vertical assembly-In that assembly l-bracket is used. One end of I-bracket is attached to back dead support for provide fixed support to complete vertical assembly. At another end of I-bracket, V-block is mounted to locate valve at correct position.

Fig:1 Constructional Details of Pneumatic Pick and place Automation

6. WORKING

The horizontal assembly-Horizontal cylinder is used for forwarding and backward movement. The pneumatic cylinder is sucking air from the pneumatic circuit, at a suctionstroke, the support rod is moved forward in direction. After completion of stroke using vacuum gripper pick valve from V-block. Then return to backward movement. After completion of a primary stroke, secondary forward stroke is started. In that, supper rod moves forward and place the valve in chuck centre to perform the further operation.

The vertical assembly-Vertical cylinder is used for up and down movement of V-block. Valve coming from conveyor is collect in V-block one by one. At the start of the suctionstroke, cylinder rod moves downward up to chuck centre position. After completion of suction stroke valve is pick by the horizontal cylinder and the vertical cylinder is a return to initial position.

Combine assembly working-Firstly valve is coming from conveyor with U-plate attachment U-plate is used for pass one valve at one time from the conveyor to V-Block. Then the valve is located on V-Block and Vertical cylinder move downward direction up to chuck centre axis. After completion of a stroke,the vertical cylinder stops and horizontal cylinder move forward for pick the valve using vacuum gripper. Then move backward same time vertical cylinder move upward direction after Completion of the returnstroke. Horizontal cylinder

moves forward and places valve into chuck centre, a furtherprocess is similarly repeated again and again.

7. COMPONENTS AND DESCRIPTION

7.1 PNEUMATIC CYLINDER

Pneumatic cylinder sometime known as air cylinder are mechanical devises which use the power of compressed gas to produce a force in a reciprocating linear motion

Like hydraulic cylinder, something forces a position to move in the desired direction. The piston is disk or cylinder, and the positioning rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatic because they are quitter, clearance, and do not require a large amount of space for fluid storage

Because operating fluids is a gas. Leakage from a pneumatic cylinder will do not drip out and contaminations the surrounding, making pneumatics more desirable where the clean line is a requirement. For example, in the mechanical puppets of the Disney tick room. Pneumatics are used to prevent fluid from dripping onto people below the puppets.

Figure 2 Double acting cylinder

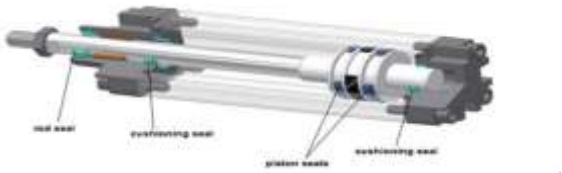

Figure 3 Sectional view of Double Acting Cylinder

7.2 FLOW CONTROL VALVE

A pneumatic system, the energy that will be used by the system and transmitted through the system is stored as potential energy in an air receiver tank in the form of compressed air. A pressure regulator is positioned after a receiver tank and is used to position out this stored energy to each leg of the circuit. A pressure regulator is a normally open valve. With a regulator positioned after a receiver tank, air from the receiver can expand through the valve to a point downstream. As pressure after the regulator rises, it is sensed in an internal pilot passage leading to the underside of the piston. This piston has a large surface area exposed to downstream pressure and for this reason is quite sensitive to downstream pressure fluctuations.

When downstream pressures near the present level, the piston moves upward pulling the poppet towards its seat. The poppet, once it seats, does not allow pressure to continue building downstream.

Figure 4 Flow control valve

7.3 DIRECTION CONTROL VALVE

A solenoid valve is commonly used, a lever can be manually twisted or pinch to actuate the valve, an internal or external hydraulic or pneumatic pilot to move the shaft inside, sometimes with a spring return on the other end so it will go back to its original positions when pressure is gone, or a combination of any of mention above.

Figure 5 Direction Control Valve

7.4 FRL UNIT

A Combination FRL box set does everything that is necessary when preparing compressed air to control a pneumatic system. This is only achievable by ensuring it is clean, regulating optimum pressure for the system, and lubricating it with a small amount of oil to ensure a safe and reliable operation of system components.

Figure 6 FRL Unit

7.5 POSITION SENSORS

Position sensors specify reliable solid state position sensors are used to close the loop with the main controller. For pneumatic systems, discrete sensors send electrical signals to the controller to report the position of the piston. In today's high speed production system, it's often important to identify the end of stock position feedback from cylinders sense air system pressure and flow fluctuation may cause changes in stroke speed. There is a variety of sensors to meet different requirements. One kind of sensors uses external electromechanical limit switches or inductive proximity switches to detect metal flags of the moving part of the machine. However, installation can be complicated, requiring brackets and hardware that also increase the size of the system. Using magnetically actuated switches or sensors mounted on the size of a cylinder or in stroke length out on the cylinder body is the more common approach. The sensor detects the magnetic field of an internal magnet on the moving piston through the wall of the pneumatic cylinder. The sensors typically detect the end of stroke in either direction. Multiple sensors can be used to detect several discrete positions along the length.

Figure 7 Position Sensors

8. DESIGN CALCULATIONS

8.1 Design of T-plate

M= 40.96 Kg

W= 401.87 N

T-Plate is used for supporting the horizontal assembly which is mounted on rectangular plate.

T-Plate is used for height adjustment.

8.2 Design of L-plate

L-Plate design calculation for bending stress-

$\frac{M}{I} = \frac{\sigma b}{Y}$

Y=65.27 mm

I=I0-(I1+I2+I3+I4+I5+I6+I7+I8+I9+I10)

I=17.77 X 106 mm4

F1=3078.76 N

F2=4.92 N

Mmax =151.50 X 106 N/mm2

151.50 X 106 = σb

17.77 X 106 65.27

σb =556.46 Mpa

σb(allowable)= Sut/FOS Assuming FOS=1.25

σb(allowable)= 624.8 Mpa

σb(allowable) ≥ σb, Hence Design is safe.

8.3 Design of L-bracket

$\frac{M}{I} = \frac{\sigma b}{Y}$

M=7728000 N-mm

I=97200 mm^4

Y=9 mm

σb = 715.55 N/mm2

σb (allowable) = Sut/FOS …. Assuming FOS=1.15

σb (allowable)= 731 Mpa

σb(allowable) ≥ σb, Hence Design is safe.

8.4 Specification

Cylinder specification-DNC-40-320-PPV-A		Cylinder specification-DNC-60-320-PPV-A	
Bore Size	40 mm	Bore Size	60 mm
Stroke	320 mm	Stroke	320 mm
Operating Temperature Range	10-40°C	Operating Temperature Range	10-40°C
Working Medium	Compressed Air	Working Medium	Compressed Air
High Temperature	42°C	High Temperature	42°C

9. ADVANTAGES

1 Pneumatics system is very fast in operation. This is because of the very low viscosity of compressed air.

2 Pneumatics system works well even in the hot surrounding. The pneumatic system is cool on duty even in the very hot surrounding of about 398k.

3 Pneumatic system is very clean, absolutely dust free surrounding.

4 Automatic and safety circuit are possible.

5 Pneumatics system is better in mines. Because they do not generate any spark and hence no change of explosion and fire hazard.

6 Less pressure loss.

7 Cycle time reduction.

8 Productivity increase.

9 Less frictional loss.

10 Simple and light weight mechanism.

10. CONCLUSION

1. In previous system total weight of system was high due to this high weight stresses are inducing in the guide rod and finally guide rod failure was occurring. To overcome this problem we have divide whole assembly in two parts such as horizontal assembly and vertical assembly. Also provide fixed support to the both assembly for avoiding bending stress.

2. In previous system because of unequal distribution of pressure inside the pneumatic cylinder gripper failure was occurring. To overcome this problem we have replaced clamp gripper by vacuum operated gripper. Overall system is mounted on fixed support so there is no continuous moment of whole assembly is done. Due to which gripper is move freely

3. In previous system whole assembly is move up and down due to which weight is act as downward force and resist moment at time of upward movement. To overcome this problem we attached only V-block to vertical cylinder having minimum load. Due to which vertical cylinder is capable to move freely without failure.

4. In previous system for gripping the valve from conveyor to chuck centre clamp gripper is used. Clamp gripper is heavy in weight and it produce downward reaction force at end of support rod. Due to action of downward force chuck damping problem is occur. This problem is overcome using vacuum gripper it helps to increase chuck life.

5. Using this new system overall performance of machine is increase and maintenance is reduce at minimum level.

6. We have selected pneumatic system for working of the pick and place mechanism to solve the industrial problem. We select the "Mild Steel" material in our mechanism due to its following properties such as more reliability, availability, greater elastic strength, etc.

7. In Previous system limit switch was used now is replace by red switch.

8. In previous system machine is working for only one shift to reduce maintenance problem. After implementation of new automation system Chances of maintenance reduce up to minimum level so now machine working for three shifts.

9. In the previous system maintenance cost was 20000 per time this can be reduce at minimum level.

10. Maintenance 130 hours/ 5 month was required for pervious automation, after implementation of the modified mechanism we conclude that no maintenance required in monthly basis.

11. Productivity of machine was previously 1200 valve per shift is increase up to 1400 per shift.

	Before	After	Cost	Cost saving
Limit switch	2	0	164	328
Red switch	10	4	154	924
Cylinder	4	3	3000	3000
Guide rod	4	2	875	1750

Stopper	6	4	1100	2200
Direction Control Valve	5	4	465	465

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