Automated Pneumatic Bearing press

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Abstract: ***Through computers, pneumatics, robotics, etc., automation can be achieved. Among these sources, low cost automation can be achieved by pneumatics. Nowadays by using a hand operated device, removing of bearing are carried out and bearings are pressed manually. The proposed system consists of a pneumatic operated bearing press to fix the bearing. By using this system, time consumption is less to press the bearing and easy to operate***

Index Terms: Pneumatics, Bearing Press, Flow-Control, Pressure Control, Automation.

I. INTRODUCTION

To increase the profitability of a modern industries, the operating cost and the cost of the products should be minimum. The pneumatic puller is a device that is generally used in automobile repairs. The efficiency of the manpower in removing the bearing is increased by using Pneumatic puller, because it is a hand operated device. Since the device is very compact, simple and versatile, the operation of removing the cylinder liner from the engine block can be done with this device. Through pneumatic controlled devices, the removing of bearing is carried out. But in this the puller must be removed from the chassis, but it requires more manpower and it is a time-consuming process. The cost of reconditioning the bearing also increases. Economy and simplicity are the main advantages of pneumatic systems. Automation plays a major role in mass production. To perform the punching operation on sheets of less thickness (1 to 2 mm) of diverse materials (e.g. plastic and aluminum) pneumatically controlled small-scale punching machine is used. By modifying the punching tool design, punching force reduction can be obtained [1]. The technique of finite element is used to achieve reduction of stress on tool while punching operation takes place. Models of Punching and blanking tools using 3D finite element was developed for this purpose. The effects of varying the tool geometry is analyzed to assess the performance of the punching tool [2]. In pressing field, pneumatic punching and riveting machine were used. It is obtained by the means of a compressor, piston, cylinder and lever. The worked material was pierced by the punched force towards downward motion [3],

A flexible punching system was designed using an industrial robot. This robot consists of an end effector, which helps in performing the industrial punching operations with "soft approach technique", and "Adaptive Force technique". [4]. The punch designed for this purpose utilizes segmentation for extrusion and a customized design to reduce the pressure between the work piece and the tool. It was obtained by establishing the elastic pressure field at the nose of the punch and based on finite element analysis on the elastic punch, the effects of possible parameters on the stress acting on the punch was carried out. [5].

II. RESEARCH OBJECTIVES

A. A pneumatic operated bearing press is a device which enables to fix the bearing.

B. Nowadays bearings are pressed manually it is a time-consuming process and also damages the bearing.

C. The proposed system is easy to operate with the help of pneumatic sources and time consumed is very less.

III. DESIGN OF SYSTEM

Double acting and Single acting are the two main kinds of pneumatic cylinders. They are manufactured in a wide range of capacity and types in order to suit operations including stamping. To push in both directions, double acting cylinders is used and to push in only one direction single acting cylinders are used. The three main values measured by air cylinders are "pressure rating", the "bore" and "stroke". For power measurements, air pressure and the bore are primarily taken into the account. The pneumatic cylinders are always specified with power rating at maximum permissible pressure for the same cylinder. For example, if a cylinder offers 200 N of push, it does it at its maximum pressure. The basic parts of a double acting air cylinders are a cylinder, a plunger and a rod. A cylinder is used to contain the pressurized air and offer support to other components, a plunger controls the inlet and outlet of the air and rod exhibits linear actuation which is used in various applications. A directional control valve (DCV), controls the direction of airflow by changing the position of the internal moving parts. For automating the machine, 5/2 solenoid valve is selected to ensure effective operation of the pneumatic system. The figure 4.1 shows the assembly diagram of the pneumatic press is done by using modeling software [6], [7].

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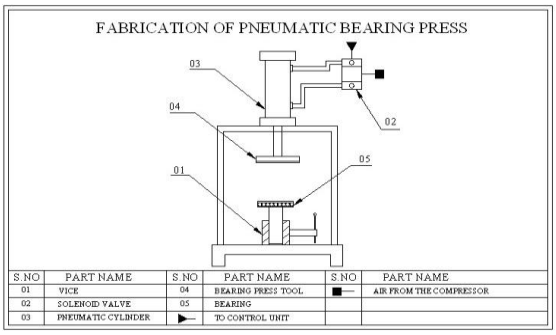

Fig. 1 Assembly diagram of the pneumatic press

IV. HARDWARE SPECIFICATIONS

The pneumatic bearing puller machine consists of, 1. Double acting pneumatic cylinder 2. Solenoid vale 3. Flow control valve 4. Connectors and Hoses 5. Deep-groove Ball Bearing 6. Compressor

A. Double Acting Cylinder

The basic parts of a double acting air cylinders are a cylinder, a plunger and a rod. A cylinder is used to contain the pressurized air and to offer mechanical support to the other components, a plunger controls the passage of air in and out of the system, and a rod provides linear actuation. The rod goes out and pushes against the plunger if the air enters into the connection in the left. Sending air to the connection in the right reverses this action. Among different ways in which an air cylinder could be mounted, Clevis mounts are preferable in terms of movement, mounting and flexibility.

B. 5/2 DCV Solenoid Valve

Electrical energy is converted into straight line motion and force by using a solenoid. Energizing the plunger results in the plunger being pulled. One of the important parts of a pneumatic system is a directional valve, which is also known as DCV. It controls the air flow direction in the system by changing the position of internal movable parts. For the modification of the machine into automatic machine, 5/2 solenoid valve is selected for ensuring quick operation of the system.

C. Flow and pressure Control Valve

The speed of the actuator is controlled by using a flow control valve. The flow control can be achieved by varying the area of flow through which the air is passing. The actuator receives more quantity of air, when area is increased as a result of which speed will increase. The speed of the actuator is reduced when the amount of air entering into the actuator is reduced.The main function of a pressure control valve is to control the pressure in a pneumatic circuit. Depending upon the control of pressure in pneumatic circuit it is classified into, Pressure relief valve and Pressure reducing valve.

D. Connectors and Hoses

The Polyurethane hoses of the Pneumatic system play a pivotal role in the working of the system. They have a maximum pressure of 10 $x10^5 N/m^2$. The two types of connectors used in this system are Hose connector and reducer. They are made of brass, aluminum, or steel.

E. Deep groove Ball Bearing and Compressors

A bearing is a load-carrying device that permits smooth relative motion between two parts. Based upon the principle of operation and according to motions bearings are classified. Low friction bearings offer less wear, and high-speed operation. Bearing friction can be reduced by proper design, selection of suitable material, or by using a good lubricating oil. Of many bearing types available, single row deep groove ball bearings are preferred for this application owing to their quality and performance. Air compressors help to obtain pressurized air for numerous applications. They are manufactured in a wide range of rate of air flow and pressures.

V. FABRICATION AND WORKING METHODOLOGY

Compressed air is adopted as a working medium. It is used to obtain reciprocating motion using a double acting pneumatic cylinder. For pressing the bearing into the shaft, the reciprocating motion is used. Using a suitable clamping device, the work piece is fixed to the work table. Pneumatic cylinder receives the power, from the compressed air. The pressing die is mounted at the end of the piston rod. Thus, the bearing is pressed into the shaft without any damage with the help of dies and pneumatic cylinder.

Calculations:

Force exerted by the piston (F) = Applied pressure x area of the cylinder

Force = $(2 \times 10^5 \text{ n}/m^2)(8.0384 \times 10^{-4} m^2)$

= 160.768 N

Force required for lifting 1 kg of weight is given by,

Force = mass x acceleration = 9.81 N

Pressure, P =Force/ Area =0.1220392 bar

Maximum pressure load in the cylinder = Pressure*area

= 160.768 N

Total load in the cylinder = m x a

= 160.768 x9.81

= 1577.13 kg

VI. CONCLUSION

This paper proposed to automate the working of a pneumatic bearing press using basic electronics and microcontroller programming. By using a pressure valve, actuation of a double acting cylinder is controlled and monitored in which on/off process of a pressure valve is controlled by the microcontroller switches.

The cylinder is actuated using a minimum, optimum pressure value, which is calculated by the design calculation of the cylinder and pressure required to actuate the cylinder. The working model was capable of creating an impressive impact in small-scale industries and automobile maintenance shops. It is very useful for the workers in the case of removing the bearings from the shaft. It would reduce the time and effort and more importantly, it won't damage the bearing. The system was designed to perform the punching operation in a short time with minimum wear and maximum accuracy

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