



Design and Fabrication of Computerized Numerical Control Based Pneumatic Punching Machine

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Abstract— Punching has a wide usage in industries. Holes need to be punched in sheets; pipes of a various materials for assembly purpose are demanded. Here, the promotion of holes in various materials is carried by applying pneumatic force which was fully automated by computerized numerical control. The pressure is required up to 10bar to punch the sheet metal. Punching movement is controlled by G-codes & M-codes through Master Cam software for various position of pneumatic cylinder. The circuit is designed and analysed through Multisim software. The movement of chain & sprocket and pneumatic cylinder were gets time delayed its working by Arduino circuit board. The coding for time delay is coded by Arduino software. The total punching force required for punch the different material is analyzed and evaluated. Then, conclude which one is suitable for punching the material in easily and non-broke able condition.

Keywords— CNC, Pneumatic, Master Cam & Multisim Software, Arduino Circuit Board.

I. INTRODUCTION

In modern world, the people expected speed, speed and speed only. So we need advanced method and digitalized one for any works. They expected automation in all works. In our project, the punching operation is carried by pneumatic force. The pneumatic force is used many applications due to easy to handle. Air is one of unlimited resource and easily available in the world. This project no need of man power to operate it. Just set the programming code for operation. The program is control in where the punches are punched and which distance required for each punching in work piece. Finally, the forces are analyzed in various work piece materials by ANSYS.

II. LITERATURE SURVEY

Manish kale, 2015-In a scientific world, the automation is required for every industries to challenge our competitors. In this paper, conventional drilling and riveting machines are replayed by special purpose machine (SPM) by means of time consuming. In this SPM, the drilling and riveting are performed in same machine by using different spindles. The efficiency of the SPM is compared with conventional drilling and riveting machines. The SPM was design in CAD software and the stresses are analyzed in Finite Element Analysis (FEA) software. In this paper, the sheet metal is used as a work piece to prepare drilling and riveting by using SPM.

Girish Gharat, 2015- In the current scenario, the pneumatic system has developed to their availability and expansive due to lack age of fossil fuel. The operating skills for pneumatic based machine are less compare to other machine. So, this product is prepared by pneumatic system. The pneumatic press tool is operating at low pressure even 6bar enough to operate it. In this project, changing the die for required shapes on the work piece. The design is created in PRO-E software and analyzed in FEA software. The different materials are used as work piece and check it.

P. Goyal, 2015- In this project, deals with reduction of punching required for tool to punch the thin sheet by pneumatic punching machines. The reduction of punching force is achieved by provision of shear on punch tool faces. The reduction force is analyzed by the calculation of punching force and compare with standard force for particular material. The project is designed in the CATIA software. The stresses and forces are analyzed in FEA software. The material taken as a work pieces are Aluminum and Plastic.

Amit M. Gedam, 2014-In today, the modern world run by the advance technology and automation for time consumption. In every product, the label plate is essential to express company details, product details, composition (must for medicine), Expiry date, manufacturing date etc. Most of industries are produced the label by embossing machines. In this project, the machine designed for producing logo and label plate for various products. The different materials are used to produce label plate of various companies.

Yunxi SHI, 2005-In the world, the air is essential for all beings. In this paper, the polluted exhaust gas has been reused as an input source by reclaiming device. Before re-usage of exhaust gas, majorly consider the velocity of exhaust gas. These physical and chemical properties are maintained by this device especially pressure of air in exhaust and inlet condition. Finally, the efficiency of reused air is calculated in this paper.

III. PROBLEM IDENTIFICATION

Hand operated punching has many advantage and disadvantages, like hand punching has accuracy and job availability but due to late work complete, accident and high cost, alternate source of operation started. Pneumatic punching machine give us high accuracy with before time completion and second most important, it is not dangerous and second does not worried about slot of job.

IV. DESIGNING PROCESS

In the project, designing is required for pneumatic punching machine. Design is the preliminary function for the machine product to particular dimension and tolerance range. The design software is the creation of part and assembly view of the project design. The design is achieved in this project by Computer Aided Design (CAD) software. This software is used to design the dimension and tolerance whereas required for this project.



Figure1 Front and Side View of Pneumatic Punching Machine

In the Arduino board, two outputs gets from pin 12 and pin 13 and it gives 5V output to the relay. The relay converts a 5V to any voltage range (AC or DC) for our requirement. From relay two outputs gets and one is given to viper motor through the drive. Another output is connected to the solenoid valve. Then, the motor is connected to the DC battery and the solenoid valve is connected to the compressor and pneumatic cylinder. Finally, the circuit is analyzed whether is right are wrong by MULTISIM software.

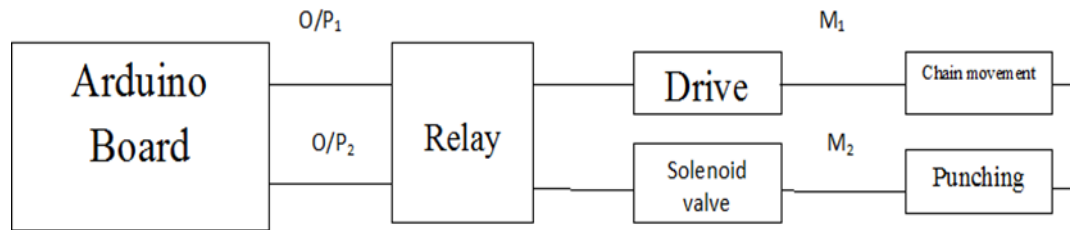


Figure 2 Circuit Layout

The Arduino board is assembly of lot of microprocessors and controllers by soldering. In the Arduino board the analog and digital outputs are taken as per requirement. The output takes to the Arduino from PC by using Universal Serial Bus (USB). There are lot of Arduino boards used. In this project UNO type board is used.



Figure 3 Arduino board and Arduino software

In Arduino software, the coding is coded based on operation required. In this project, time delay coding is coded. The time delay is given to the pneumatic cylinder through the wires from Arduino board.

V. WORKING METHODOLOGY

In this project, the punching operation is carried by pneumatic force. This project no need of man power to operate it. Just set the programming code for operation. The program is control in where the punches are punched and which distance required for each punching in work piece. Finally, the forces are analyzed in various work piece materials. The Arduino coding is inputted by computer to the Arduino board through an Arduino cable. The compressor gets air from atmosphere and gives that air at high pressure to solenoid valve. Two outputs get from Arduino board and give it to relay for changing an output voltage with required range (AC or DC). The output from the relay is gives to a solenoid valve and viper motor. Output from viper motor run by DC battery and it's rotating the chain sprocket and shaft arrangement in our project. Output from solenoid valve is control the reciprocating movement of the pneumatic cylinder. Finally, we get punches to the work piece automatically.

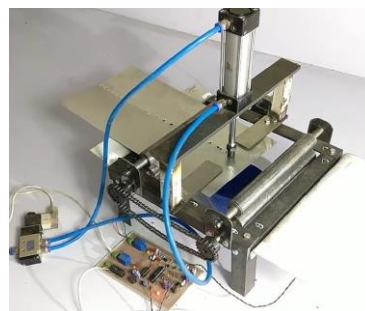


Figure 4 Working Methodology of Pneumatic Punching Machine

VI. ARDUINO CODING

```
// the setup function runs once when you press reset or power the board
void setup() {
// initialize digital pin LED_BUILTIN as an output.
pinMode(13, OUTPUT);
pinMode(12, OUTPUT);
}
// the loop function runs over and over again forever
void loop() {
digitalWrite(13, HIGH);
delay(3000);
digitalWrite(13, LOW);
delay(1000);
digitalWrite(12, HIGH);
delay(3000);
digitalWrite(12, LOW);
delay(1000);
}
```

VII. COMPUTER NUMERICAL CONTROL (CNC)

The CNC means the tools and machines are controlled by computer automatically. The computer is commanded the operation to be performed. In CNC, machine the tool movement are controlled by G-codes and M-codes coded in CNC software for programming. Compare to conventional machine, the CNC machine has high dimensional accuracy and closed tolerance.

CNC Software-Mastercam - MASTERCAM is the one of the CNC programming software. In this project, CNC program is created for tool movement and axis changing along X and Y direction. The program is also control the basic machine operation such as coolant on/off, spindle on/off, tool change etc. The main function of this software is to code the tool movement from one position to another position such as linear, circular etc. In this software, ease to code the large programs by using cycle codes.

VIII. CNC PROGRAM

```
G21 G94
G91 G28 Z0
G28 X0 Y0
M06 T01
M03 S1500
G90
G00 X95 Y25
G01 Z0
G01 Z-.8 F50
G01 Z+1
G01 X90 Y25
G01 Z-1.8 F50
G01 Z+2
G01 X85 Y25
G01 Z-2.8 F50
G01 Z+3
G01 X80 Y25
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G01 Z-3.8 F50
G01 Z+4
G01 X75 Y25
G01 Z-4.8 F50
G01 Z+5
G01 X70 Y25
G01 Z-5.8 F50
G01 Z+6
G01 X65 Y25
G01 Z-6.8 F50
G01 Z+7
G91
G28 Z0
G28 X0 Y0
M05
M30

IX. PRINCIPLE OF WORKING

When, the DC power supply is given to the machine; that would be run. The atmosphere air is sucked by compressor and give to solenoid valve through the hose. At a same time the computer run the ARDUINO and CNC programming. The Arduino coding is supply to Arduino board and its gives to the solenoid valve through the relay. The solenoid valve outputs are given to the inlet and outlet valve of pneumatic cylinder. The working table is moved along X and Y direction at a same time the cylinder tends to punching by pneumatic force. The table movement is achieved by CNC programming through chain and sprocket. Finally, the pneumatic punching machine is run better accuracy compare to conventional machines.

X. CONCLUSION

After analyzing the force, which material is easily punched, the minimum force is enough for punching the aluminium work piece compare to other. But the aluminium may be broken maximum force applied on it. The maximum force is required for punching the stainless steel compare to other and withstand large amount of force applied on it.

Pneumatically operated punching machine is suitable for small scale and medium size industries. Based on, shear provided on the punch face the punching force reduction of 25% to 60% thereby increasing tool life and reducing tool machining cost.

Therefore with this force reduction we are able to easily punch sheets of thickness up to 2.25 mm for plastic sheet having tensile strength 90 N/mm² and up to 1.5 mm of aluminium sheet having tensile strength 180 N/mm².

Using of Arduino board is reduces circuit designing complexity and short circuit problems during test our project. Using CNC coding, tool movement can control ease and efficiently.

Thus, the CNC and Arduino coding is used to control the various operation and various position of tool in ease manner

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