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Design and Fabrication of Arduino Controller Based Hydro Pneumatic Feed Control Drilling Machine

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ABSTRACT

This work "Design and fabrication of Arduino controller based hydro pneumatic feed control drilling machine", the Arduino controller is used to automatically control the hydro-pneumatic cylinder that feeds the portable hand-operated electric drilling machine. Here, the workpiece to be drilled is manually clamped in a vice. Here, a portable electric drilling tool is supported longitudinally on a pivoting platform coupled to the hydro-pneumatic cylinders' piston rods. One cylinder in a hydro-pneumatic cylinder comprises oil on both sides of the piston, and the ports are connected by a polyurethane tube with a diameter of 4 millimetres. The linear scale and limit switch arrangement, which is put next to the drill spindle, can be used to set the drilling depth. The workpiece that will be drilled is secured in a vise before beginning by manually tightening the bolt. This spindle begins revolving and slips through the hydro-pneumatic cylinder when the switch is depressed. When the drill spindle reaches the drilling depth, the limit switch causes it to automatically return to the home position. The output of the Arduino controller is connected to the drilling machine on/off control and the solenoid values. The Arduino controller input receives the switches' signals. The drilling machine feed is automatically regulated with the hydro-pneumatic cylinder in our project, here, a portable hand drill is supported horizontally on a platform by a clamping attachment that is attached to the hydro-pneumatic cylinders piston rods. One cylinder of a hydro-pneumatic cylinder has oil on both sides of the piston. The PVC pipeline connects the ports on the oil cylinders. Limit switches that are located close to the drill spindle allow the drilling depth to be adjusted. This spindle begins revolving and slips through the hydro-pneumatic cylinder when the switch is depressed. When the drill spindle reaches the drilling depth, the limit switch causes it to automatically return to the home position. The solenoid valve is controlled by the Arduino, which causes the cylinder to move forward and backward. The controllers are connected to the push buttons and limit switch signals.

Keywords : Drilling Machine, Hydraulic Cylinder, Pneumatic Cylinder.

I. INTRODUCTION

Drilling is a cutting technique that creates circular holes in solid objects by using a drill bit. The drill bit is often a multi-point cutting edge instrument. Drilling that is controlled automatically is referred to as automated process and also it aims to use as little human involvement as possible. Automated drilling is carried out using a combination of control systems and data technologies. The devices used to hit a force in a linear motion by the piston for instance in industrial applications, are known as pneumatic cylinders or pneumatic actuators. Pneumatic cylinders and actuators are the of a pneumatics system, moving a piston inside them when compressed air is delivered into the cylinder or actuator. Pneumatic cylinders and actuators are an easy approach to generate precise linear and rotary motion in difficult situations, such as extremely high or low temperatures. Pressurized, incompressible hydraulic fluid is what powers hydraulic cylinders. Typically, hydraulic fluid is made of oil. A piston and piston rod coupled to a cylinder barrel make up the hydraulic cylinder, which oscillates back and forth. The barrel is sealed at both ends by the cylinder bottom, also known as the cap, and the cylinder head, also known as the gland, from which the piston rod emerges. Seals and sliding rings are on the piston. The piston creates two chambers inside the cylinder: the bottom chamber (cap end) and the chamber on the side of the piston rod (rod end/head end). Cylinder mounting solutions frequently used include flanges, trunnions, clevises, and lugs. In order to link the cylinder to the object or machine part that it is pushing or pulling, the piston rod also has mounting attachments. The actuator, or "motor," side of this system is a hydraulic cylinder. The hydraulic pump, which provides a fixed or controlled flow of oil to the hydraulic cylinder in order to drive the piston, is the "generator" side of the hydraulic system. Hydraulic hand pumps, hydraulic air pumps, and hydraulic electric pumps are the three most popular types of pumps. The oil in the opposite chamber is pushed back to the reservoir by the piston.

II. COMPONENTS

1) Portable drilling machine.
2) Hydraulic cylinder.
3) Pneumatic cylinder.
4) Soleniod value.
5) Limit switch.
6) Relay.
7) Arduino uno R3.

III. CALCULATION AND ARDUINO CODING

For pneumatic cylinder

Applied power, Po = F/A
= 3000/(π/4) d2
= 3000 / 0.0254469
= 471.698 Kpa
Volume, V = πr2h
= π × (0.045)2 × 0.007

=4.45 × 10-5 m3

1) Mass, m = d × v = 8000 × 4.45 ×10-5
2) = 0.35625 kg
3) Now area of piston, Ap = 2πrh
4) = 2 × π × 0.045 × 0.205
5) = 0.05796 m2
6) Now pressure of N2 inside the cylinder to sustain the load
7) = Po+ [mass of piston × g] / Area of piston
8) = 471.698 + [0.35625 × 9.81] / 0.0579
9) = 531.91 Kpa
= 5.319 bar (or) 0.531 N/mm2

For hydraulic cylinder
Applied power, Po = F/A= 3000 / [π / 4] × d2
= 3000 / 3.8 × 10-3
= 779534.6 N / mm2 (or) 779.4 Kpa
Volume, V = πr2h
= π × 0.0352 × 0.007
= 2.6939 × 10 -5

= 0.2155 kg
Now area of piston, Ap = 2πrh
= 2 × π × 0.035 × 0.138
= 0.0303 m2

Now pressure of oil inside the cylinder to sustain the load,
= Po + [mass of piston × g] / Area of piston
= 779.4 + [0.2155 × 9.81] / 0.0303
= 849.3 Kpa
= 8.493 bar
(or)
= 0.849 N / mm2FABRICATION

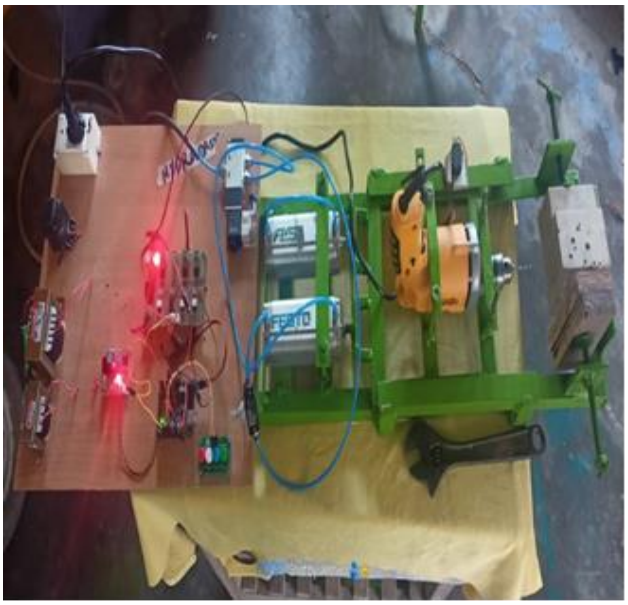

FIG. 1 Fabricated Model

The knowledge of working of pneumatic system and how automation can be effectively done with the help of hydropneumatic system are studied. The working principle and uses of various valves switches relays etc., are also studied. It is concluded that drilling can be done with the help of hydropneumatic system. It is imperative to generate Arduino controller based hydropneumatic speed control drilling machine that can satisfy the demands of a case study by adhering to the concepts of system engineering and innovation management. Utilizing pressurized air causes a faster approach and retraction, which speeds up the response. Because they are portable and lightweight, hydropneumatic presses are simple to put on a table. Additionally, you can save a lot of floor area by not having to install a hydraulic power pack. Hydro-Pneumatic system components, as opposed to electromotive ones, do not overheat when overloaded and pose less of a fire risk. Economical - The initial investment in pneumatic systems is particularly cost-effective due to the low cost of the system's components.

IV. BENEFITS

- ✓ High accuracy and finish:
  Drilling that is automated can perform activities that humans find laborious and time-consuming with great levels of accuracy.
- ✓ Flexibility:
  This will depend on how the equipment is configured specifically. You can have automation that is versatile or customized to one single activity depending on the tasks necessary. Additionally, major improvements can be made without replacing hardware by simply updating software, albeit this may be necessary depending on the functionality needed.
- ✓ Repeatability & Consistency:
  Automated drilling enables unlimited number of consistent repetitions of the same operation. The consistency levels are higher than what is possible for humans.
- ✓ Production benefits:
  Automation is expensive, but because of its reproducibility, consistency, faster production, and need for less manpower, later manufacturing costs are lower. The increased safety offered by automated drilling is due to the little need for human interaction when working on the surface.

V. RESULTS AND DISCUSSION

Drilling machine with hydro pneumatic feed control has been created using an Arduino controller. Automation of the drilling process is accomplished with the Arduino Uno R3. The constructed hydro

pneumatic feed control drilling machine with an Arduino controller is completely operational and equipped for any industrial use. The cylinders are chosen for that in accordance with the load estimates that have been performed. Therefore, overloading won't be an issue for those cylinders. The Arduino coding is finished. Additionally, it has been confirmed by using Tinker CAD software to perform the exact identical programme. According to the design and specifications, the circuits are connected. In addition, a bridge rectifier has also been added to the circuit to regulate the drilling machine's power supply.

VI. FUTURE SCOPE

By using app control, we can able to improve the technical formation in board cleaning system.

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