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Design and Build Pneumatic Trainer for Detecting Ferrous Metal (FE)

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ABSTRACT

Ferrous metal (Fe) detection pneumatic trainers are designed to provide a practical understanding of pneumatic systems used in industry, particularly in automation processes involving metal detection sensors. The main goal of the project is to design and build a trainer that can demonstrate the working principle of a pneumatic system combined with a Fe metal detection sensor. The methods used include mechanical and electrical design, control programming, and system functionality testing. The results of this design show that the trainer can detect Fe metal with high accuracy and provide the appropriate pneumatic response. This trainer can be used as a learning medium to understand the application of sensors in industrial automation, as well as improve the practical skills of students or technicians in the field of mechatronics and control systems.
***Keywords**: Pneumatic Trainer, Metal Sensor, Automation, Control System.*

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Introduction

Along with the rapid development of industrial technology engineering, it requires an increase in efficiency and productivity in producing a product itself. Every production process must pay attention to the level of speed, precision and precision index during production. The use of pneutics in the manufacturing industry is very important and has many benefits that can be used to facilitate the work of its users. One of them is in material handling, for example, clamping the workpiece, moving the workpiece, adjusting the position of the workpiece and arranging. However, not many people know about the use of pneumatic applications because they have not been widely used outside the industrial world because the application of this pneumatic requires the use of air from the compressor as the driving force. Extensive development will have an impact on the relatively short work process and save time.

Therefore, the author tries to make props Pneumatic trainer for ferrous metal detection (Fe) With the hope of being able to make this tool at an affordable cost by also utilizing the components in the automotive laboratory that can be used in the manufacture of this teaching aids and the hope that this research can be developed by future students to make it easier to understand how the control system, especially pneumatic, works.

The things that background the author in choosing the title of the Case Study of the Design and Construction of a Pneumatic Trainer for Iron Metal Detection (Fe) are:

1. Producing a trainer design on the control system, namely pneumatic.
2. As a learning medium for students of the Bogor Academy of Technology through the way the control system works, namely pneumatic.

   Based on the background of the above problems, the main problems that the author can take are:

   a. Lack of understanding of the design and design of the Ferrous Metal (Fe) detection pneumatic trainer.
   b. Lack of understanding of the wiring path of the pneumatic system from the design and construction of the ferrous metal detection (Fe) pneumatic trainer.
   c. How does a pneumatic system work in a trainer design pneumatic ferrous metal (Fe) detector?
   d. How is the wiring diagram of the pneumatic system design and construction of the ferrous metal (Fe) detection pneumatic trainer?

The research objectives to be achieved in the preparation of this final project report are:

a. Producing a metal detection pneumatic trainer design metal (Fe).
b. Gives a simple overview of how pneumatic systems work in control system material.
c. To find out the supporting components in the trainer design

Theoretical Foundations

Pneumatics comes from the Greek word "Pneuma" which means wind or wind. The definition of pneumatics is one of the branches of physics that studies the phenomenon of compressed air so that the pressure that occurs will produce force as the cause of motion or actuation in the actuator, (Totok Heru, 2011: 3).

According to Sudaryono (2013) in his book entitled Pneumatic and Hydraulics, it is explained that pneumatics is a theory or knowledge of moving air, states of air balance and balance conditions. According to Hakim (2009:23) pneumatic is a fluid power system, which is an energy source from air pressure in a compressor engine, where air is stored in a tank. Based on some of the above understandings, it can be concluded that a pneumatic system is a working system that is sourced from compressed air in a storage place (reservo2.1.2.)

Components of pneumatic system

According to Krist and Ginting (1993) component selection is very important for the application of pneumatic systems. The pneumatic components that will be used are as follows:

Energy supply

Compressed air is the source of energy for the pneumatic system, the air is obtained from the compressor. According to Anhar, et al. (2016:39) a compressor is a tool that functions to store and compress air using a special pump. Usually the compressor operates to fill the air tank and serves as an air reserve for a period of time.

Actuator (actuator)

According to Hakim (2009:23) the output part that converts compressed air energy into working energy is the actuator. The output signal is controlled by the control system, and the actuator is responsible for the control signal through the last control element.

How pneumatic systems work

The working system of pneumatic components resembles the working system of electrical control. The electrical control system comes from the electrical voltage that is melted from the PLN mesh (380 Volt for 3 phase and 220 Volt for 1 phase) or from the power supply (24 Volt DC, 13 12 Volt DC etc.), then for the pneumatic system uses compressed air as an energy source, (Hanif Said, 2012: 33). This compressed air is produced by a device called Air Compressor. The use of the embalming system as an automation system is widely applied in daily life which includes arranging, gritting, printing, adjusting the direction of objects, transferring (transferring), sorting to the process of packing goods.

Types of pneumatics used

Pneumatic cylinders, also known as pneumatic actuators, are products used to provide linear or rotary motion and force to automated systems, machines, and processes, for example in industrial applications. Pneumatic cylinders and actuators work when compressed air is forced into the cylinder or the actuator itself to move the pistons placed in it. The work is carried out with a mechanism attached to the piston, converting the energy generated into practical use, for example picking and placing systems in factory automation.

Research Methodology

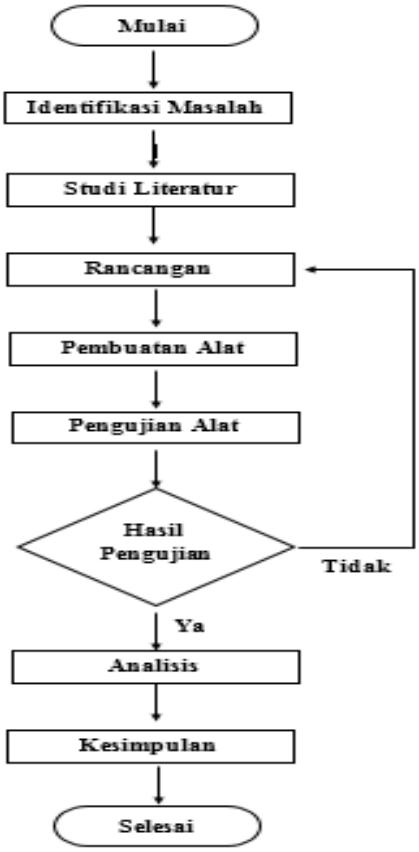

Figure.3.1. Research Flow Diagram

The above research procedure describes the stages that must be passed in the manufacture of a pneumatic trainer for detecting ferrous metal (Fe). Where this research procedure is made to make the research process easier.

The above architecture is designed using the Solidworks application, Solidworks is software used to create product designs from simple to complex such as gears, car engines and so on.

Analysis of Technology Architecture Needs.

In the development of technology architecture with the title Case Study of Design and Build of Metal Detection (Fe) Pneumatic Trainer, the author needed a tool so that this pneumatic trainer system could work properly.

Tool Requirements

The following are the needs of the tools that the author uses in making the Design of the Metal Detection Pneumatic Trainer (Fe):

1. Cut pliers.
   Used to cut wires in the process of electrical installation.
2. Screwdriver (-) and (+).
   Used to tighten bolts of electrical installation processes.
3. L Lock
   Used to tighten the L bolts of conveyor jigs.
4. Scissors.
   To cut the insulation of electrical installations.
5. Test pen.
   To find out whether there is an electrical voltage in an object, and the electrical circuit has electrical power or not.
6. Glove.
   To protect the skin from cuts or injuries.
7. Cutter.
   To peel off the skin of electrical cables.
8. Compressor
   Compressed air source for pneumatic actuation.

Material Requirements

The following are the material requirements in the Design and Construction of Metal Detection (Fe) Pneumatic Trainer:

1. The Power Source serves as the main power source so that the trainer equipment system can work properly.
2. A power supply is a tool that functions to convert a high AC voltage (Reciprocating) voltage into a lower DC (Direct Directional) voltage.
3. The Switch button works to activate and Deactivate the motor.
4. DC Motor Oriental Motor 5GN25K. works for a device that converts DC electrical energy into rotational mechanical energy.

5. The Omron MY2N relay serves as a bridge between the current from the battery directly to the time.
6. SMC SY5220-5DZD-01 selenoid functions to control the airflow/wind that goes to the SMC CM2B20-25Z Cylinder Pneumatic body valve.
7. Pneumatic Cylinder functions as a mechanical force in the form of forward and backward movement on a cylinder.
8. Fotek PL-05P sensor, functions to detect metal and the distance of an object to the sensor.
9. Limit Switch, (limit switch) is a switch or electromechanical device that has an actuator lever as a change in the position of the terminal contacts (from Normally Open/NO to Close or vice versa from Normally Close/NC to Open).
10. Urethane hose. for pneumatic installations.
11. Cables.
12. Insulation, serves to wrap all the wires that have been assembled.

Result and Discussion

3-dimensional design

The following is a 3-dimensional design that the author made in the Design and Build of a Metal Detection (Fe) Pneumatic Trainer:

1. Creating Part 1A: With the initial step, open the Solidworks application, then select the parts menu, select plane top, select sketch and make a sketch according to the predetermined size, which is 180 mm x 60 mm. Next, select the Boss-Extruded menu, select the blind menu and determine the material thickness of 14 mm then press enter.
2. Making Part 1B: With the same steps, select the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 60 mm x 20 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm, then press enter.
3. Making Part 1C: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 120 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm then press enter.
4. Making Part 1D: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 60 mm x 47 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm then press enter.
5. Making Part 1E: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 70 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm, then press enter.
6. Making Part 2A: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 225 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 8 mm then press enter.
7. Making Part 2B: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 165 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 10 mm then press enter.

8. Making Part 2C: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 350 mm x 27 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm, then press enter.
9. Creating 2D Parts: With the step of selecting the part menu, select plane top, select sketch, select the tool line and make a sketch with a size of 5 mm x 10 mm x 5 mm. then select the Revolved menu then press enter.
10. Making Part 2E: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 120 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 10 mm, then press enter.
11. Making Part 2F: By selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 235 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 8 mm then press enter.
12. Making Part 2G: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 80 mm x 40 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 3 mm then press enter.
13. Making Part 2H: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 80 mm x 40 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 3 mm then press enter.
14. Making Part 3A: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 75 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 5 mm then press enter.
15. Making Part 3B: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 70 mm x 60 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 10 mm then press enter.
16. Making Part 3C: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 120 mm x 45 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 10 mm then press enter.
17. Creating 3D Parts: With the step of selecting the part menu, select the plane top, select sketch, select the tool line and make a sketch with a size of 5 mm 10 mm x 5 mm. then select the Revolved menu then press enter.
18. Making Part 4A: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 50 mm x 50 mm. then select the Boss-Extruded menu, select the blind menu, determine the thickness of the material 14 mm then press enter.
19. Making Part 4B: With the step of selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 118 mm x 30 mm. then select the

Boss-Extruded menu, select the blind menu, determine the material thickness of 14 mm then press enter.

20. Making Part 4C: By selecting the part menu, select the plane top, select sketch and make a sketch according to the predetermined size, which is 50 mm x 25 mm. then select the Boss-Extruded menu, select the blind menu, determine the material thickness of 20 mm then press enter.

Proses Assembly/Perakitan Part

In this process part What we have made at the beginning will be assembled according to the concept that has been made before.

On the development of Design and Build Pneumatic Trainer for Iron Metal (Fe) Detection There are several processes that must be carried out so that the pneumatic trainer can work properly and correctly. The following is the process of developing a technological architecture in the Design and Construction of a Ferrous Metal Detection Pneumatic Trainer:

1. Gather all the tools and materials to be made.
2. After everything is collected, the process of making this pneumatic trainer can be done.
3. By starting by cutting iron material using a cutting machine according to the predetermined size, the author continues to tidy up the iron material that has been cut using a hand grinding machine so that it is not sharp.

The material is processed according to 2-dimensional drawings that have been made according to the existing shape and size.

1. After all Machining finished, the author continued by making the inner thread using the Tap.
2. After making the inner thread is completed, it is continued with the process of assembling the material that has been made.
3. After the assembly is completed, the author pairs the Wiring and pneumatic cylinders.

How it works

Here's how the technology object of Design and Build Pneumatic Trainer for Iron Metal (Fe) Detection :

1. How the Pneumatic Trainer works:
   a. The first step is to insert the plug on the terminal to supply electricity to the Power Supply.
   b. Press the switch to start the AC motor and move the conveyor.
   c. Then the Power Supply converts the voltage of 240 AC to 24 VDC.
   d. After the Power Supply outputs the DC voltage, the fotek sensor function standby.
   e. When the test material enters the conveyor and passes through the photoc sensor, if the test device contains metal then the phototech sensor will turn ON and send a signal to the relay.
   f. The relay relays the signal back to the Selenoid Valve.
   g. The Selenoid Valve receives the command or voltage that enters the Coil and opens the valve outlet and instantly the pneumatic ON discards the test device containing the metal out of the conveyor track.
   h. Fotek OFF sensor, sends a signal or voltage to the relay, then the relay turns on the coil solenoid valve OFF which will return the pneumatic position to its original position.

Conclusion

a. When the test material enters the conveyor and passes through the photoc sensor, if the test device contains metal then the phototech sensor will turn ON and send a signal to the relay.
b. Uses of Selenoid Valve receiving commands or voltages that go inside Coil and open the exit Valve and instantaneous pneumatic ON throw away The test equipment containing the metal goes out of the conveyor track.

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