

DESIGN AND FABRICATION OF AUTOFEED PNEUMATIC PUNCHING AND RIVETING MACHINE

Submitted in partial fulfilment of the requirements
for the award of
Bachelor of Engineering degree in Mechanical Engineering
by

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DEPARTMENT OF MECHANICAL ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE

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DEPARTMENT OF MECHANICAL ENGINEERING BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Velayutham.pon (37150221), TisonAntonio.J (37150196)** who carried out the project entitled **“DESIGN AND FABRICATION OF AUTOFEED PNEUMATIC PUNCHING AND RIVETING MACHINE”**, under our supervision from November 2020 to April 2021

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DECLARATION

We **Velaythum.pon (37150221)** , **TisonAntonio (37150196)** hereby declare that the project Retort entitled “**DESIGN AND FABRICATION OF AUTOFEED PNEUMATIC PUNCHING AND RIVETING MACHINE**” done by me under the guidance of **Dr.G.Arunkumar, M.E., Ph.D.**, is submitted in partial fulfilment of requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

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ABSTRACT

Metal in the form of sheets is more important. But metal in the form of sheets cannot be directly used, operations like punching, blanking, bending, riveting, etc. are need to be carried out on the metal sheets. For these operations, most large-scale manufacturing industries use hydraulically operated machines which are not cost-effective, most small and medium scale industries use hand-operated machines for carrying out sheet metal operation which are slow. The pneumatic punching and riveting machine are capable of working in low pressure that is even a pressure of 6 bar is enough. The pressurized air is passing through the tubes to the cylinder forces the piston out which in turn actuates the piston down which in turn does the process of punching or rivet. This enables us to use different types of tool to perform different operations. After the completion of punch or rivet in the sheet metal the pressurized air flows to the bottom of the cylinder which actuates the piston upwards so the metal is freed from the tool and the next punch or rivet process is made available. According to the working material the working pressure can be changed. This enables us to use different types of punch or rivet tool dies resulting in a wide range of products

TABLE OF CONTENT

CHAPTER	TITLE	PAGENO.
	ABSTRACT	V
	LIST OF FIGURES	VIII
	LIST OF TABLES	IX
1	INTRODUCTION	1
	1.1 PUNCHING AND RIVETING	1
	1.2 NEED FOR AUTOMATION	3
	1.3 SELECTION OF PNEUMATICS	5
	1.4 COMPRESSED AIR	7
2	LITERATURE SURVEY	8
3	AIM AND SCOPE	13
4	MATERIALS AND WORKING PRINCIPLE	14
	4.1 PNEUMATIC CYLINDER	14
	4.1.1 Single-acting Cylinder	14
	4.1.2 Double-acting Cylinder	15
	4.1.3 Advantages of Double-acting Cylinder	15
	4.2 COMPRESSOR	18
	4.3 5/2 DIRECTIONAL FLOW CONTROL VALVE	21
	4.3.1 Parts of 5/2 Solenoid Valve	23
	4.4 DC Motor	25
	4.4.1 Advantages of DC Motor	27
	4.5 Pneumatic Hose Pipes	28
	4.6 MICRO CONTROLLER	32
	4.6.1 Elements Of Microcontroller	33
	4.6.2 Working Of Microcontroller	35
	4.6.3 Features Of Microcontroller	35

	4.6.4 Types Of Microcontroller	36
	4.7 RELAY	37
	4.7.1 Components Of Relays	38
	4.7.2 Working of Relays	39
	4.7.3 Types Of Relays	40
	4.8 TIMER	42
	4.8.1 Types of Timer Function	43
	4.9 PUNCHING TOOL	44
	4.10 RIVETING TOOL	44
	4.11 WORKING PRINCIPLE	45
	4.11.1 Working	46
	4.11.3 Design Calculation	48
5	RESULTS AND DISCUSSIONS	50
6	SUMMARY AND CONCLUSION	54
	REFERENCES	55
	APENDIX	57

LIST OF FIGURES

FIGURE NO	FIGURE NAME	PAGE NO
4.1	Pneumatic Cylinder	18
4.2	Compressor	21
4.3	5/2 Dirctional Control Valve	25
4.4	DC Motor	28
4.5	Hose Pipes	31
4.6	Microcontroller	32
4.7	Relay	37
4.9	Punching Tool	44
4.10	Riveting Tool	45
4.11	Schematic Diagram	47
5.1	3D Model	50
5.2	Full View	52

LIST OF TABLES

TABLE NO	TABLE NAME	PAGE NO
4.1	End Cover Materials	16
4.2	Piston Materials	16
4.3	Piston Rod Materials	17
4.4	Specifications	17
4.5	Specifications of Compressor	20
4.6	Specifications of Solenoid Valve	24
4.7	Specifications of DC motor	27
4.8	Specifications of Hose Pipes	30
5.1	Cost Estimation	51

CHAPTER-1

INTRODUCTION

In manufacturing industry, the punch or rivet is done by using press. The press are traditional machine which is used to perform the punch or rivet in the metal sheets. Using the presses required dimensions of the punch or rivet is done. And presses are used for mass production, this the efficient and fastest way by which the finished punched or riveted product is obtained. Press tools are used and changed according to the user's requirement. The press tool is simplified by using the die at the bottom, by using die the punch or rivet is done without any deformation in the metal sheets.

There are various types of presses used in the industry for performing punching or riveting based on the requirements. We are interested to use pneumatic in the presses to increase the efficiency and decrease the work load. By using pneumatics, the press tool can be actuated even at low pressure of 8 bar.

1.1 PUNCHING AND RIVETING

Pneumatic punching and riveting machine use the compressed air to generate high pressure to be applied on the piston. Compressed air is produced with the help of compressor. The compressor is the mechanical device that increases the pressure of the air by reducing the volume of air. Compressors are very similar to the pumps both increases the pressure of the air and fluid respectively. Since the air is compressible, using the compressor the pressure of atmospheric air increased by decreasing the volume of the air. Fluids are incompressible so they cannot be compressed directly, by reducing the circumference of the pumps based on the requirement we increase the pressure of the fluid. Now the compressed air at the pressure of 8 bar is supplied to the directional control valve through pneumatic hose pipes. The pneumatic hose pipes are used since they do not leak the compressed air out of them. If the compressed air leaks from the pneumatic hose pipes then the required pressure is not reached and due to this the applied pressure of the compressed air not sufficient to actuate the piston in the pneumatic cylinder.

The compressed air is supplied to the 5/2 directional control valve. This is also called solenoid valve, which has 5 ports and 2 outlet ports. Among that 5 ports, 1 port are used for the inlet of compressed air from the compressor, 2 ports are for outlet of the

compressed air to the pneumatic cylinder, and 2 ports is for the exhaust to release the compressed air once the punching or riveting is done. The solenoid valve is parallelly connected with the microcontroller and also with the timer and the relay. The microcontroller is mainly used to feed the sheet metal without the human work. By doing this, safety of the worker is increased and the percentage of error to occur is also reduced. Microcontroller in this system is electrically operated and according to our requirements the appropriate programme is done in that way. The microcontroller is parallelly connected to the timer and the relay. The purpose of the timer in this pneumatic punching and riveting system, is to count the number of seconds at which the sheet metal should be feed and also the time(sec) at which the punch or rivet should be done. And this input from the timer is passed to the microcontroller at every cycle. The purpose of the relay in this pneumatic punching and riveting machine is to feed the sheet metal according to the duration sent by the timer.

The input from the relay and the timer is send to the microcontroller at the same time. According to the inputs from the timer and the relay the microcontroller will actuate the solenoid valve. Now the solenoid valve is actuated and the compressed air is supplied to the pneumatic cylinder using hose pipes. Basically, pneumatic cylinder is the mechanical device which converts the high pressure of the compressed air into the force using the reciprocating piston. The pneumatic cylinder is of two types single acting cylinder and double acting cylinder. In this pneumatic punching and riveting machine double acting pneumatic cylinder is used. The double acting cylinder uses the force of the compressed air to move in both the extend and the retract strokes. They have two ports; one is at the top and another one at the bottom of the cylinder. Once the compressed air is passed at the top pf the cylinder due to the high pressure the piston moves from top dead centre to the bottom dead centre. When the piston head reaches the maximum stroke length, the compressed air is supplied to the bottom of the cylinder and due to the high pressure of the compressed air the piston moves from the bottom dead centre to the top dead centre. The stroke length of the double acting pneumatic cylinder varies, according to our requirement we need to select our cylinder.

In this pneumatic punching and riveting machine, the sheet metal is feed automatically. To feed the sheet metal the microcontroller is connected with the DC motor. The DC motor is a electrical device that convert the electrical energy into the mechanical energy. Once the input from the timer and the relay is obtained by the microcontroller, the DC motor is actuated accordingly by the microcontroller. The rotational speed of the DC motor will be high so that we should some gears to reduce the speed according to our requirements. The driver gear is attached with the set of rollers at the same time the driven is also attached with the set of rollers. These roller plays a major role in the auto-feed of the sheet metal for punching and the riveting machine to punch or rivet.

The tool used for punching and riveting is high speed steel, commonly used as cutting tool materials. It is superior to the older high carbon steels used extensively through the 1940s in that it can withstand higher temperature without losing its hardness. Due to this property, high speed steel can cut faster than high carbon steel. The name itself indicates that it cuts faster than the high carbon steel. High speed are the alloys the alloys that gain their properties from variety of the alloying metals added to the carbon steel. Most commonly tungsten and molybdenum, or the combination of both are used. The addition of 10% of tungsten and molybdenum in total will maximise the hardness and toughness of the high-speed steel. And this combination is also maintaining the high temperature during the cutting materials.

Metal sheets are the basic requirement in manufacturing industry. Metal sheets cannot be directly used for the production in the industry. Before that metal sheets should be subjected to some manufacturing process like punching, blanking, bending, riveting, etc. To perform this process, large-scale industries use hydraulic systems and small-scale industries use man power. Instead of this we can use pneumatics, because they are very economical when compared to hydraulic systems and easy to understand and execute. Pneumatic system uses compressed air to perform the processes. In pneumatic punching and riveting machine, the compressed air generates the high pressure to be applied on the cylinder. The direction where the pressure needs to be applied in the pneumatic cylinder is controlled by solenoid valve. The compressed air is supplied to the solenoid valve through pneumatic hose pipes. Once the high pressure is applied on the piston.

1.2 NEED FOR AUTOMATION

In early days, industries use thousands of people for the production because those days no machines were invented. Thousands of people are working in every department, they spend their lot of energy to finish the work which is given to them. In industry lots of departments are available namely design, material selection, assembling section, testing section, delivery, etc. Due to these lot of sections more amount is needed in the industry to finish the work in right way and also in particular period of time. While using these much of people in the industry, they should schedule that at particular time certain amount of people should work. After that next batch people should come to the industry and they should resume the work where the previous batch workers left and do it in right manner. By doing lot of things the industry will face many problems in scheduling the workers. Some of the workers may not come to the work at time, some of them will ask certain time period of working time. Even though all the workers came to industry for working, unfortunately workers may commit

mistake and this cannot be preventable. When previous department workers are doing mistakes then automatically the next department workers will be affected. For example, in material selection department if the material is not collected in particular date then the production will get affected. Because they might have planned to start the work in that date.

Automation plays a major role in the manufacturing industries, world economy and daily experience. The automation is the combination of both control systems and information technologies. In this automation most of the work is done by the machine itself so no human power is involved. In industry while using automation, most of the work is automatically done by the machines human should watch whether it is doing correctly. In the scope of industrialization, automation is very important part of the manufacturing department. When industries are converted to automation it will be beyond mechanization. In mechanization, lots of humans and their muscular power is needed to do the certain work. And the work should be completed within the particular date and the finished product should be satisfying the customer's requirements and also profitable to the industry. And using automation in the industry the percentage of error while manufacturing is greatly decreased, or else the production will be affected. While using automation the error in the particular department is found when it occurs. If automation is not available the error is not found and also carried to the next department this the time waste and also the cost is wasted.

The error in the product is found at the same time and the steps to rectify the error is also started. In manufacturing industry, thousands and lakhs of products are produced in the production department for every single day. And main aim of the industry is not only to manufacture the product, the manufactured product should satisfy the customers' requirements. In older days thousands of workers are worked in the industry to finish the large number of products at a particular date and time since lot of errors will occur. To prevent this most of the manufacturing industry developed their industry with automation and due to automation industry would manufacture the finished product without any errors or any damages and also, they can satisfy the customer need. The most important advantage of using automation is that the industries are able to manufacture their products within the given time.

Nowadays most of the manufacturing industries are preferring automation in their every department of manufacturing. By using automation in the industries, 90% of the work will be completed by the machines itself and rest 10% work will be completed by the workers. Due to this automation workers need is reduced and the work is done perfectly. If the industry is without automation then the management should search for lot of people for working and also the workers should accept for the salary given by the

industry. Most of the people attitude will be changing day by day and they will take leave often. If the workers are not available then automatically production will not be able to complete within the given date and time. If the company chooses automation they will invest their money only on the machines which is good when compared to conventional type manufacturing. The single automated machine will complete the entire work which need to be completed by the thousands of workers. The industry will be able to control the single machine which is easy and profitable when compared to manual manufacturing. In conventional manufacturing every thousands of workers need to be satisfied by the company in terms of salary and safety precautions. So in modern days most of the manufacturing industries are using automation in their company.

While using fully automated machines in the manufacturing industries the need of the workers is completely decreased and the work is done perfectly. The company should hire the workers by knowing about these automated machines and how to operate them and also they should be aware of repairing these machine when they are repaired. Most of the cases machines are automated using this computer programming and programming is the heart of the machines. Each and every information is feed by the computer programme to the machine automatically and the machine will do the rest of the operations. By using this automated machine in the manufacturing large amount of errors is identified and rectified at the same time.

1.3 SELECTION OF PNEUMATICS

The origin of pneumatics is initially traced back to the 1st century when ancient Greek mathematician Hero of Alexandra wrote the inventions powered by steam or wind in his book. The German physicist Otto von Guericke (1602 to 1686) researched it little deeper. He invented a vacuum pump which can draw the air or gas from the connected vessel or container. He invented a machine that separate two copper hemispheres using pressurized air. With this basic principle the machines had evolved from smaller to larger over the years. And different machines are used for the different purposes with multiple parts that serve different functions.

Pneumatics is derived from the Greek word “pneuma” which means wind or breath. Pneumatics is the branch of manufacturing engineering that uses compressed gas or pressurised air in it. Pneumatic systems available in the manufacturing industries are compressed air or pressurised inert gases. To produce these compressed or pressurised gases some of the machines are used. An electrically powered compressor power cylinders, air motors, pneumatic actuators, and other pneumatic

devices are used. In factories pneumatic systems used for manufacturing make use of the atmospheric air because they are readily available. The atmospheric air is free of moisture content in it so some oil or any other lubricant is used in the compressor to prevent corrosion and lubricate mechanical components. Since we are using atmospheric air for the manufacturing it is free of poisonous leakage. Some of the manufacturing companies are using asphyxiation including nitrogen, makes up (78% of air) which is harmful to the workers. And the oxygen which contains (21% of air) cannot be used for compression because it is a fire hazard, more expensive and performance is low when compared to other gases.

Both pneumatics and hydraulics can be used for the compression of the air and increase the pressure of the air by reducing the volume of the air. When compared to hydraulics the pneumatics has the advantage of working even at the low pressure and also the air which is needed for the actuation is readily available. But in hydraulics system of compression separate oils should be bought and we must use it for the lubrication purpose. The cost of the hydraulic fluids is high and also the construction of the hydraulic system is a little bit complicated when compared to pneumatics systems. And the workers are finding difficulties in understanding the hydraulic system but pneumatics is slightly easier to understand and working.

- **Simplicity of design and control:** Pneumatic machines are easily designed and the components which we are using is very easy to handle such as pneumatic cylinders, solenoid valve, hose pipes, etc. They can be operated using the on/off switch control which is easy to control
- **Reliability:** Pneumatic systems basically have long operating lives and require less maintenance when compared to hydraulics systems. The components we are using for the pneumatics are easy to handle and have long lives. Since we are using atmospheric air for compression it is easy to compress so the pneumatic system is subjected to less shock damage atmospheric gas absorbs the maximum force. Whereas in hydraulics the fluids exert the excessive forces. In pneumatics the compressed air can be stored separately for the future use whether the power is available we can make use of the stored compressed air.
- **Safety:** When compared to hydraulics, in pneumatics system there is very low chance of fire hazard because the air does not exert the maximum force directly. And in pneumatic systems the components used are not very dangerous to the workers. Since pneumatic system runs on the compressed air it is very free of fire hazard and also free of hazardous gases leakage because we are using atmospheric air for compression.

1.4 COMPRESSED AIR

Pneumatic system operates on the supply of compressed air to the machine and the components. And mainly the compressed or pressurized air should be at a certain quantity and also at particular pressure which is based on the capacity of the system. Based on the capacity of the pneumatic system compressed air should be supplied and for the compression of air compressor is needed. A compressor is the mechanical device used to increase the pressure of the air by decreasing the volume of the air. The capacity of the compressor also varies it is different based on the amount of air that can be compressed at a unit time. Compressor capacity depends on the amount and also the volume of the air that is to intake. The condition of the air to be intake is also important because when the air is free from moisture is easy to compress. But when the air warm and moist the compressed air is condensed and not up to the mark. Compressor is of two types,

- Positive displacement compressor
- Turbo compressor

Positive displacement compressor are frequently used in the manufacturing industries or factories and has proved the efficient type of compressor to supply the compressed air. Positive displacement compressor is of two types,

- Reciprocating type compressor
- Rotatory type compressor

Reciprocating compressor is the basic type of compressor used all over the manufacturing industries and companies. Reciprocating compressor is also called as piston compressor. As the name indicates the compressor uses the piston which is driven with the help of crankshaft to compress the air and deliver it. When the crankshaft rotates the piston connected to the crankshaft starts reciprocating and due to this the piston moves down since the atmospheric air is entered and the next stroke the piston moves upwards and the air compressed by reducing the volume of the air which entered the cylinder. And the compressed air supplied to the rest of the pneumatic systems.

Turbo compressor works on the principle when the atmospheric air is sucked in then the turbine rotates due to the flow of air. When the turbine rotates the air is compressed by reducing the volume of the air. But the main disadvantage is that the turbo compressor is not able to supply large amount of compressed air at particular pressure. Turbo compressor is able to supply only small amount of compressed of low pressure at a unit time.

CHAPTER – 2

LITERATURE SURVEY

Shubhangi.S. Shetake et al. (2020) this paper describes about automatic punching machine which uses an 8-bit micro controller chip which is used for automation. The microcontroller controls the punch time between each consecutive strokes. The cylinder used here is a double acting cylinder of bore diameter -25mm and stroke length- 40mm and the roller is directly connected to the motor and the other side of the roller is driven which is connected to the drive roller with the help of chains. In these sensors are being used to detect the feed of metal sheets, based on the length of the feed which passes signal to the relays which in turn passes electricity to the solenoid valve to actuate the pneumatic cylinder. When the feed of sheet metal is finished the proximity, switch used in this device will detects it and will stop the process. The proximity sensor is being controlled by the microprocessor chip which is connected to the relay to perform the operation of ON/OFF based on sheet metal feed.

Madhanmohan.K et al. (2019) this paper describes about sensor based auto punching Conveyor machine .program instruction controller is used and a Geneva conveyor is also connected to the controller in addition to this a object sensor is used to monitor the presence of workpiece so that the object sensor sent signal to the proximity sensor which detects the number of rolls to decide the distance between each punch the sensors play an important role in maintaining the automation process .it's like the object sensor detects the stoppage of the pneumatic cylinder after each punch so that the proximity sensor can do the process of feed with the help of the Geneva conveyer .The signal that is being transmitted by the object sensor , proximity sensor and the PI controller is being detected by a separate signal conditional unit where its modifies each signal before transmission. These types of conveyer belt can be damaged during the punching process so good quality belts are being used and a stand is also placed below the conveyer belt at the axis of the punch tool.

Romit Singh et al. (2020) This paper describes about the analysis of punching tool made up of high-speed steel design of the punch tool is flat with an opening in the middle with outside shear model. So, the stress distribution in the punch tool starts from the middle to the radial side of the tool. This double shear punching tool is also used or reduced force due to symmetrical distribution of force while the single shear tool in which the force distribution is higher in the higher degree and may cause bending due to non-even symmetry. So, the deformation of this tool is so high when compared to other punch tool materials.

Kundan Kumar et al. (2016) this paper describes about auto roller punching machine which uses a conveyer arrangement to perform the feeding operation. In this the sheet metal will be feed through the conveyer which enables the process of auto feed through a conventional process. The punch tool passes through the guide provided in the conveyer the motor is connected to a roller in which a conveyer is connected. While the drive motor rotates the driven motor also rotates to provide the auto feed mechanism. So, these sensors play an important role in automation process which is essential for cost reduction. In this model metal sheets of small length can only be punched. This system uses three pneumatic cylinders to perform the operation like one for punching and the other cylinder has two process a half actuation to place the sheet metal to the die. The efficiency of the punch depends upon the guides provided in the conveyer and the finish of punch hole depends on the thickness of the sheet. In addition to this cam is also provided to change the rotational power to linear power to change the position of each punch based on requirements.

Enrico Armentani et al. (2020) this research paper describes about the fatigue behavior of rivet joints. Tests were done on multiple rivet joint specimens in metal joining process three different tests were performed to check the fatigue of the rivet joints like three levels of stress ratio were tested the fatigue life and crack size for all specimen of rivet joints were analyzed. The analysis consists of two types like the width and the depth of the crack is analyzed the higher the stress the deeper the crack goes. Under a specific stress level only 35% of the rivet joint showed small amount of fatigue crack as the stress level increase the most of the rivet joints showed fatigue crack while some had deep cracks while some had small cracks this is due to the life time of the rivet joints the older the joint it gets cracked deeper and easier while the newer ones can resist some amount of stress before getting damaged.

A.S. Aditya Polapragada et al. (2012) this paper describes about the process of pneumatic punching with manual feed process in which the actuation of the cylinder is performed manually by a switch in the solenoid valve. When the sheet metal is fed the pneumatic cylinder is actuated which in turn guides the punching tool to the sheet metal and the bottom die to perform the process of punching and after that when the punching process is over the switch in the solenoid valve is again used so that the pneumatic cylinder actuates upward which in turn guide the punching tool from the bottom die and the sheet metal is freed from the die and the next punch is also being readied manually.

Sudeep Kelaginamane et al. (2015) this paper describes the process of automation of pneumatic punching using a programmable logic controller. This is an auto feed

system designed for the feed of sheet metal in which the whole process can be controlled by a single programmable logic controller system. The accuracy of the punch hole is so precise due to automation and the number punch can also be increased in automation process for mass production with less cost and more accuracy. In most of the sheet metal the main process are punching, pressing, blanking etc. These systems can replace the old manual punching machines which are not precise and not easy to maintain. This system uses three pneumatic cylinders to perform the operation like one for punching and the other cylinder has two process a half actuation to place the sheet metal to the die and a full actuation to the next phase where another pneumatic cylinder is used to push the finished metal sheet to the storage container and This programmable logic controller is user friendly in which less experienced workers are enough to do the process.

Utkarh Sharma et al. (2014) this paper describes the use of sheet metal like aluminum, brass, copper, stainless steel has so many uses now a days in manufacturing industries. The reason behind is that sheet metal is easy to manufacture and easy to handle and easy to maintain. This paper deals with the design and idea of using pneumatics to perform operations on sheet metal which was done in solid works software. Finally, several ideas were made for the improvement of this design like to automate the whole process of punching and to improve the finish of each punch. Since these metal sheets are cheap and lesser in weight every manufacturing industries uses these sheets for manufacturing purposes so a punching machine which works on pneumatic is of great use.

Kyoung-Yun Kim et al. (2019) this paper describes challenges in riveting process in improving the efficiency of the riveting process. In this the research is done on different methods of riveting with special interest to self-piercing rivet. The analysis of riveting quality and the methods for riveting is also studied using data mining process from various indexes at engineering village database. Currently industries want to minimize the weight while joining metal sheet and in turn they want to increase the overall strength of the joint using riveting process. This process will be helpful in automobile and aircraft body to decrease the over all weight to reduce the fuel consumptions. Riveting has an advantage of joining light weight material and it is also used to join different materials of different thickness without any heating, welding or superior fatigue resistance. Most of the manufacturing industries use rivet due to these advantages. This paper also involves in the research of improving the riveting methods quality to do these process different types of rivet requires physical riveting tests to find the riveting design, type of material used, riveting parameters and selection of rivet.

P.Goyal et al. (2015) this paper describes about the modification of punch tool to reduce the punch force requirement which deals with the design of small scale punching machine which is operated pneumatically to punch aluminum and plastics the main aim in this paper is to reduce the punch force requirements which is done by modifying the punch tool design by providing shear on the punch face which results in reduction of force required to punch the sheet metal .calculations for different types of shear tool were given and the force required for aluminum and plastics sheets were given. In this stripping force plays a major role as it is necessary for shear tool. Single shear and double shear tools were tested for both aluminum sheets and plastics sheets. If the face of the punch is flat to the sheet metal the entire area is being punched but tilting the face at a specific angle to get a shear the force can be reduced considerably.

Sree Rajendran et al. (2014) this paper describes about automatic punching machine in a low-cost approach in which programmable logic controller is being used and shredding light system. In this sensors are being used to find whether the punch or blank process is finished in this when the process of shredding happens in the sheet metal additional actuation of the piston won't happen due to the sensors. So, these sensors play an important role in automation process which is essential for cost reduction. In this model metal sheets of small length can only be punched. This system uses three pneumatic cylinders to perform the operation like one for punching and the other cylinder has two process a half actuation to place the sheet metal to the die and a full actuation to the next phase where another pneumatic cylinder is used to push the finished metal sheet to the storage container in this all the process is automatic and these process is carries out by capacitive sensor, inductive sensor and magnetic sensor.

Mohamed Ben Bettaieb et al. (2017) this paper describes about the impact of stress on sheet metal formability. Now a day's single point sheet metal forming, sheet metals are subjected to stresses in addition to this other stress most of the time this may lead to deformation on specific area of the sheet metal. In this paper many deformation theories are taken into account like bifurcation theory and perturbation approach. Most of these theories are based on the stress plane assumption where the critical place on the sheet metal are not being taken into account so the application of these theories should be minimized in the process of sheet metal formability. So for sheet metal forming like punching, blanking the over all properties of the sheet metal should be taken into account for the process of sheet metal forming processes.

Butterworth et al. (2002) Mechanics of sheet metal based on this book the deformation of sheet metal can occur as the force which passes through the sheet the

force per unit width of the sheet is the multiple of stress and thickness. Strain is also a cause for deformation of sheet metal strain path is linear in sheet metal but some time strain in sheet metal may deviate from the linear path. And tension is also a cause for deformation in sheet metal

CHAPTER-3

AIM AND SCOPE

In manufacturing industries use of sheet metal is necessary to make a finished product. Sheet metals in turn cannot be directly used basic operations like punching, blanking, bending, etc. have to be done to make these sheets industry ready. To carry out this process most industries use hydraulic machines to perform this process which are not cost efficient and the maintenance is also high in this type of machines. Due to these reasons most of the small-scale industries uses hand operated machine which are very slow to operate and not accurate. This is where the use of pneumatics to perform these operations will have its advantage.

The usage of conventional punching machine has some of the following problems

1. Maximum effort is needed while using hand held punching machines
2. Only sheet metal of specific thickness can be punched using hand held device
3. Maintenance of conventional punching machine is also high

With the design and development of auto feed pneumatic punching and riveting machine, the above problems will be eliminated.

CHAPTER-4

MATERIALS AND WORKING PRINCIPLE

4.1 PNEUMATIC CYLINDER

Pneumatic cylinders are the mechanical devices which use the power of the compressed air to produce a force which is needed by reciprocating linear motion. When the compressed air at high pressure is supplied to the cylinder due to this high pressure the piston inside the cylinder moves downwards and the force needed is obtained. While comparing pneumatics over hydraulics, engineers prefer to use pneumatics because they are cost effective, easy to understand and work, do not require large amount of space for the storage purpose. The main advantage of pneumatics is that operating fluid is the gas so no leakage will happen and maintenance is also less. But in hydraulics, the operating fluid is liquid and thus the workers should be aware of no leakage from the system and also the maintenance of the system is quite higher when compared to pneumatics. Although pneumatic cylinders are of various types based on the size, appearance and function they all come under a particular category. However, there are various types of pneumatic cylinders available in the market, they all are designed to fulfil the specific and desired functions. There are various types of pneumatic cylinders,

- Single-acting cylinders
- Double-acting cylinders

4.1.1 Single-acting Cylinder

In this type of pneumatic cylinder uses the compressed air to produce the force needed to punch or rivet the sheet metal. When the compressed air is allowed into the cylinder due to the high pressure of air the piston moves downwards and the force is produced due to the reciprocating motion of the piston. The piston tail is attached with the spring to the other end or bottom dead centre of the cylinder. Once the piston head reaches the maximum stroke length the attached spring will move the piston upwards that is from bottom dead centre to the top dead centre. Both the single acting and the double acting cylinders are using compressed air as the source. But they differ in the port design which allows the compressed air into the cylinder. Single acting cylinders are used in the factories where force is needed in one direction. For example, ejecting the parts/items from the belt or conveyor. In single acting cylinder frequently some problems may occur because the spring is used for the retraction stroke. The spring should be maintained constantly and lubricated with some oils, liquids, etc. If not then

retraction of the spring is not perfect and due to this the retraction stroke of the cylinder is also affected.

4.1.2 Double-acting Cylinder

This type of pneumatic cylinder have two ports to allow the compressed air into the cylinder. Double acting pneumatic cylinder (shown in fig 4.1) uses the compressed air to actuate the piston inside the pneumatic cylinder. The compressed air allowed into the pneumatic cylinder through one port at the top of the cylinder. Once the compressed air enters the cylinder due to the high pressure the piston moves from top dead centre to the bottom dead centre and the force required for the punch and rivet is obtained. When the piston head reaches the maximum stroke length, the compressed air is passed into the cylinder through the second port at the bottom of the piston. When the compressed air is passed to the bottom of the cylinder due to the high pressure the piston moves from the bottom dead centre to the top dead centre. The double acting pneumatic has two strokes namely compression stroke and expansion stroke. During the compression the force required to punch or rivet the sheet metal is obtained by means of reciprocating motion of the piston. During the expansion stroke once the punch is finished the piston is settled to its original position with the help of the compressed air. Both the single acting and the double acting cylinders are using compressed air as the source. But they differ in the port design which allows the compressed air into the cylinder. Single acting cylinders are used in the factories where force is needed in one direction. For example, ejecting the parts/items from the belt or conveyor. Double acting cylinders are used in the industries for faster, stronger and most effective applications. For example, when the work need to be done is of high speed and force industries prefer double acting cylinder. Since compressed air is used for both compression stroke and the expansion stroke the work done is accurate and reliable, most importantly the maintenance is low.

4.1.3 Advantages of Double-acting Cylinder

- The control over the movement in double acting cylinder is high because the compressed air is used to move the piston in both ways.
- Faster, stronger and uses less energy.
- While using double acting cylinder in the manufacturing industries more bore sizes and stroke lengths are available, we can use it according to the requirements.
- Since compressed air is used for actuating both the strokes maintenance is low compared to single acting cylinder.

Table 4.1 End Cover Materials

Light duty	Medium duty	Heavy duty
Aluminium stock (fabricated)	Aluminium stock (fabricated)	High carbon steel castings
Brass stock (fabricated)	Brass stock (fabricated)	High speed steel castings
Aluminium castings	Aluminium, brass, iron castings	High speed steel castings

Table 4.2 Piston Materials

Light duty	Medium duty	Heavy duty
Aluminium castings	Aluminium casting Brass(fabricated)	Aluminium forging, Aluminium castings.
Aluminium forging	Bronze (fabricated)	Bronze (fabricated)
Brass castings	Iron and steel castings	Brass, bronze or iron and steel castings

Table 4.3 Piston Rod Materials

Light duty	Medium duty	Heavy duty
Mild steel	Ground and polished, ground, hardened, and polished.	Generally preferred chrome plated
Stainless steel	Ground and polished	Less scratch resistant than chrome plated piston rod

Table 4.4 Specifications

Cylinder type	Bore diameter	Stroke length
Double-acting cylinder	65 mm	85 mm



Figure 4.1 Pneumatic Cylinder

4.2 COMPRESSOR

Pneumatics is derived from the Greek word “pneuma” which means wind or breath. Pneumatics is the branch of manufacturing engineering that uses compressed gas or pressurised air in it. Pneumatic systems available in the manufacturing industries are compressed air or pressurised inert gases. To produce these compressed or pressurised gases some of the machines are used. An electrically powered compressor (shown in fig 4.2) power cylinders, air motors, pneumatic actuators, and other pneumatic devices are used. In factories pneumatic systems used for manufacturing make use of the atmospheric air because they are readily available. The atmospheric air is free of moisture content in it so some oil or any other lubricant is used in the compressor to prevent corrosion and lubricate mechanical components. Since we are using atmospheric air for the manufacturing it is free of poisonous leakage. Some of the manufacturing companies are using asphyxiation including nitrogen, makes up (78% of air) which is harmful to the workers. And the oxygen which contains (28% of air) cannot used for compression because it is fire hazard, more expensive and performance is low when compares to other gases.

Both pneumatics and hydraulics can be used for the compression of the air and increase the pressure of the air by reducing the volume of the air. When compared to hydraulics the pneumatics has the advantage of working even at the low pressure and also the air which is needed for the actuation is readily available. But in hydraulics system of compression separate oils should be bought and we must use it for the lubrication purpose. The cost of the hydraulic fluids is high and also the construction of the hydraulic system is little bit complicated when compared to pneumatics systems. And the workers are finding difficulties in understanding the hydraulic system but pneumatics is slight easier to understand and working.

Pneumatic system operates on the supply of compressed air to the machine and the components. And mainly the compressed or pressurized air should be at a certain quantity and also at particular pressure which is based on the capacity of the system. Based on the capacity of the pneumatic system compressed air should be supplied and for the compression of air compressor is needed. A compressor is the mechanical device used to increase the pressure of the air by decreasing the volume of the air. The capacity of the compressor also varies it is different based on the amount of air that can be compressed at a unit time. Compressor capacity depends on the amount and also the volume of the air that is to intake. The condition of the air to be intake is also important because when the air is free from moisture is easy to compress. But when the air warm and moist the compressed air is condensed and not up to the mark. Compressor is of two types,

- Positive displacement compressor
- Turbo compressor

Positive displacement compressor are frequently used in the manufacturing industries or factories and has proved the efficient type of compressor to supply the compressed air. Positive displacement compressor is of two types,

- Reciprocating type compressor
- Rotatory type compressor

Reciprocating compressor is the basic type of compressor used all over the manufacturing industries and companies. Reciprocating compressor is also called as piston compressor. As the name indicates the compressor uses the piston which is driven with the help of crankshaft to compress the air and deliver it. When the crankshaft rotates the piston connected to the crankshaft starts reciprocating and due to this the piston moves down since the atmospheric air is entered and the next stroke the piston moves upwards and the air compressed by reducing the volume of the air

which entered the cylinder. And the compressed air supplied to the rest of the pneumatic systems.

Turbo compressor works on the principle when the atmospheric air is sucked in then the turbine rotates due to the flow of air. When the turbine rotates the air is compressed by reducing the volume of the air. But the main disadvantage is that the turbo compressor is not able to supply large amount of compressed air at particular pressure. Turbo compressor is able to supply only small amount of compressed air of low pressure at a unit time.

The compressed air is supplied to the 5/2 directional control valve. This is also called solenoid valve, which has 5 ports and 2 outlet ports. Among that 5 ports, 1 port is used for the inlet of compressed air from the compressor, 2 ports are for outlet of the compressed air to the pneumatic cylinder, and 2 ports are for the exhaust to release the compressed air once the punching or riveting is done. The solenoid valve is parallel connected with the microcontroller and also with the timer and the relay. The microcontroller is mainly used to feed the sheet metal without the human work. By doing this, safety of the worker is increased and the percentage of error to occur is also reduced. Microcontroller in this system is electrically operated and according to our requirements the appropriate programme is done in that way. The microcontroller is parallel connected to the timer and the relay. The purpose of the timer in this pneumatic punching and riveting system, is to count the number of seconds at which the sheet metal should be fed and also the time(sec) at which the punch or rivet should be done. And this input from the timer is passed to the microcontroller at every cycle. The purpose of the relay in this pneumatic punching and riveting machine is to feed the sheet metal according to the duration sent by the timer.

Table 4.5 Specifications of Compressor

Compressor type	Horse power	Max. pressure	Tank capacity
Reciprocating compressor	7.0 HP	10 bar	70 Litres



Figure 4.2 Compressor

4.3 5/2 DIRECTIONAL FLOW CONTROL VALVE

Directional control valves are the most basic and fundamental parts of the pneumatic and hydraulic systems. Directional control valves are mainly used for guiding the fluids or air to the corresponding parts respectively. It may vary depending on the workers or the customers need. Every directional control valve will have a spool inside it which can be actuated mechanically or electrically based on the requirements and the need. The spool inside the directional control valve will decide the direction of the fluid or air to be supplied based on the requirements respectively. The spool inside the cylinder of the directional control valve consists of lands and grooves. This lands and grooves will decide the flow of the air or fluid. The lands will block the flow of the air or fluid where it should not flow. The grooves will allow the fluid or air along the ports and the entire spool where it should be supplied. In directional control valve there are two positions normal and working positions. In normal position, the valve returns on removal of the

actuating force. In the working position the valve won't return when the actuating force is applied.

This directional control valve is selected rapid operation and also to reduce the manual operation need to be done by the workers. Directional control valve is also used for converting the pneumatic punching and riveting machine into automatic pneumatic punching and riveting machine. Nowadays most of the manufacturing industries are preferring automation in their every department of manufacturing. By using automation in the industries, 90% of the work will be completed by the machines itself and rest 10% work will be completed by the workers. Due to this automation workers need is reduced and the work is done perfectly. If the industry is without automation then the management should search for lot of people for working and also the workers should accept for the salary given by the industry. Most of the people attitude will be changing day by day and they will take leave often. If the workers are not available then automatically production will not be able to complete within the given date and time. If the company chooses automation, they will invest their money only on the machines which is good when compared to conventional type manufacturing. The single automated machine will complete the entire work which need to be completed by the thousands of workers. The industry will able to control the single machine which is easy and profitable when compared to manual manufacturing. In conventional manufacturing every thousands of workers need to be satisfied by the company in terms of salary and safety precautions. So, in modern days most of the manufacturing industries are using automation in their company.

Solenoid valve is the electrical device used for the converting the electrical energy into the straight or linear force. Solenoid valve is also used for the conversion of the mechanical work into automatic work. That is the work which is to be done by the workers can be automatically done by the solenoid valve without any error and accurate manner. Solenoid valve are of two types namely push type and pull type. In push type solenoid valve, the plunger is pushed when the solenoid valve is actuated electrically. And in the pull type solenoid valve, the plunger is pulled when the solenoid valve is actuated electrically. The workers should be well known about the parts and the working of the solenoid valve because if the solenoid valve repairs workers should be able to rectify it and continue their process. The compressed air is supplied to the 5/2 directional control valve (shown in fig 4.3). This is also called solenoid valve, which has 5 ports and 2 outlet ports. Among that 5 ports, 1 port are used for the inlet of compressed air from the compressor, 2 ports are for outlet of the compressed air to the pneumatic cylinder, and 2 ports is for the exhaust to release the compressed air once the punching or riveting is done.

4.3.1 Parts of 5/2 Solenoid Valve

Solenoid valve is the easiest valve to understand and work with it. There are some parts in the solenoid valve we need to see. Because the workers should be aware of the parts and the function of the solenoid valve. If it gets stopped or repaired then the workers should be able to rectify the problem. These are the three main parts of solenoid valve,

- Coil
- Frame
- Solenoid plunger

Coil

The solenoid valve consists of coil inside it which is the core of the valve. The coil which is present inside the solenoid valve is made up of copper wires. The coil will consist of thousands of wires for the specific purpose. And these copper wires are separated from one another with the help of the insulating layer. The whole solenoid valve is covered with the help of varnish and due to this the solenoid valve is protected from the external disturbance. The disturbance may be by solvents, moisture, cutting oils, or other fluids. The coils present inside the cylinder may vary according to the operating voltage. The operating voltage available till date are 115 volts AC, 230 volts AC, 460 volts AC, 575 volts AC, 6 volts DC, 12 volts DC, 24 volts DC, 115 volts DC. The frequency of the actuation of the solenoid valve is 50 Hz to 60 Hz.

Frame

The solenoid valve is designed in such a way that the valve is applicable for all purposes. The frame which is used for the construction of the solenoid valve is also for several purposes. The frame of the solenoid valve is made of laminated sheets, the laminated sheets have the advantage of auto magnetize itself when the solenoid valve is electrically connected. The main purpose of using the laminated sheets is that the plunger is pushed or pulled using the magnetising effect in the frame. The frame consists of the provisions for the attachment to the external parts. They can be bolted or welded along the frame to actuate the solenoid valve. The wear strips are connected to the frame and they are made of materials such as metal or impregnated glass fibre clothes.

Solenoid plunger

The solenoid plunger is the most important part of the solenoid valve. Through which the workers will feed the input to the solenoid valve. Solenoid plunger is the movable

part which can be pushed or pulled according to the requirement. The solenoid plunger is made of thousands of laminated steel which is connected by riveting it along one another through applying high pressure. It is connected by riveting the each and every layer so that there will be no movement between the layers. The solenoid plunger can be operated in two ways, either by applying input in manual method or by connecting it to the electrical devices. At the top of the solenoid plunger a pin hole is present through which the solenoid plunger is connected to the other devices for actuation. When the solenoid plunger is operated electrically the plunger will move initially by means of magnetic force and then the plunger will return to the original position by means of spring action.

The valves which are operated by the solenoid valve are generally provided with the cover. This is mainly to prevent the ports and the solenoid valve from the dust and other foreign matters and to protect the actuator. Most of the manufacturing industries are using explosion proofs solenoid valve for the manufacturing purpose.

Table 4.6 Specifications of Solenoid Valve

Type	Operating pressure range	Ports
5/2 directional control valve	2 to 10 bar	1,2,4-G 1/4,5-G 1/8



Figure 4.3 5/2 Dirctional Control Valve

4.4 DC Motor

The DC motor (shown in fig 4.4) is one of the types of rotary electrical motors. DC motor is the electrical device that converts the electrical energy into mechanical energy. The main thing in DC motor is that the input electrical energy should be in direct current. All the DC motor will have internal mechanism in it which is used to convert the electrical energy into the mechanical energy. It may be electrochemical or electronic to constantly change the direction of the current in the motor. It is the first and the foremost form of motor used all over the world. This DC motor can be powered using the direct current electrical systems. The DC motor speed can be changed according to the need by either changing the supply voltage or by changing the strength of the current in the windings. We can see wide range of DC motors are used for example small DC motors are used in toys, tools, and appliances. This universal motor can be operated using direct current anywhere needed. Brushed DC motors are widely used because it has an advantage of portable power tools and appliances. Larger DC motors are rarely used in propulsion in vehicles, elevator and hoists, and in drives for steel rolling mills.

The brushed DC motor will generate torque directly from DC power supplied to the motor with the help of internal commutation, stationary magnets that is permanent or electromagnet and rotating magnets. The brushed DC motor has the advantage of low initial cost, very high reliability and easy control of motor speed. But at the same time brushed DC motor has equal number of disadvantages like high maintenance costs and low life span for high intensity of current usage. The maintenance involves regular replacement of the carbon brushes which carries the current and springs used for the conduction of current. And also the commutator should be cleaned regularly or else the dust will affect the efficiency of the motor. These components are necessary for conduction of the direct current from the outside of the motor to the spinning windings inside the motor.

In the brushed DC motor the brushes are commonly made up of graphite or carbon, and in some cases the brushes are dispersed with the copper to increase the current conduction due to this the efficiency of the DC motor is also increased. The brushes which make contact with the commutator is replaced with some soft brushes, so the brushes fit to the diameter of the commutator and the wear and tear is reduced. The brush holder has a spring to maintain pressure on the brushes to prevent the efficiency decrease while the current is not supplied at constant manner. The brushes which carries one ampere or more than one ampere, the brushes are moulded with a flying led to the motor terminals. Very small brushes may experience the contact with the metal brushes holder for carrying current into the brush. The DC motor which are used in toys and other small tools are made up of folded strip of metal that connects the commutator.

In brushless DC motor, one or more permanent magnets in the rotor and electromagnets on the motor and for the stator. In the brushless DC motor, a motor controller is used for the conversion of DC current into ac current. The design of the brushless DC motor is simple when compared to brushed DC motor. The brushed DC motor will have some conduction of the direct current from the outside of the motor to the spinning motor inside the DC motor. The motor controller can sense the rotor position through hall effect sensors and similarly control the timing, phase, etc of the current rotor coils to optimise torque, conserve, power, regulate speed, and even applying some braking when needed. The advantages if the brushless DC motor long life span, little or no maintenance and high efficiency. The disadvantages of brushless DC motor is that the initial installing cost is high and mor complicated motor speed controllers. The brushless DC motor is also known as synchronous motors they have no external power supply to synchronize. In this pneumatic punching and riveting machine, the sheet metal is feed automatically. To feed the sheet metal the microcontroller is connected with the DC motor. The DC motor is a electrical device that convert the electrical energy into the mechanical energy. Once the input from the

timer and the relay is obtained by the microcontroller, the DC motor is actuated accordingly by the microcontroller. The rotational speed of the DC motor will be high so that we should use some gears to reduce the speed according to our requirements. The driver gear is attached with the set of rollers at the same time the driven is also attached with the set of rollers. These rollers play a major role in the auto-feed of the sheet metal for punching and the riveting machine to punch or rivet. And this input from the timer is passed to the microcontroller at every cycle. The purpose of the relay in this pneumatic punching and riveting machine is to feed the sheet metal according to the duration sent by the timer

4.4.1 Advantages of DC Motor

- Drive circuit is not needed when the DC motor is running at a constant speed.
- The design of the brushed DC motor is done in such a way that it has high efficiency.
- Brushed DC motor can be operated at high speed and high current.
- When the DC motor is starting the current can be high and also the torque produced due to this can also be high.
- By using brushed type of DC motor the speed and torque can be controlled and responsive by controlling the voltage.

Table 4.7 Specifications of DC Motor

Type	Supply voltage range	RPM	Gear assembly
Brush type DC motor	4 to 12 Volts	30 RPM at 12 V	Heavy duty metal gears

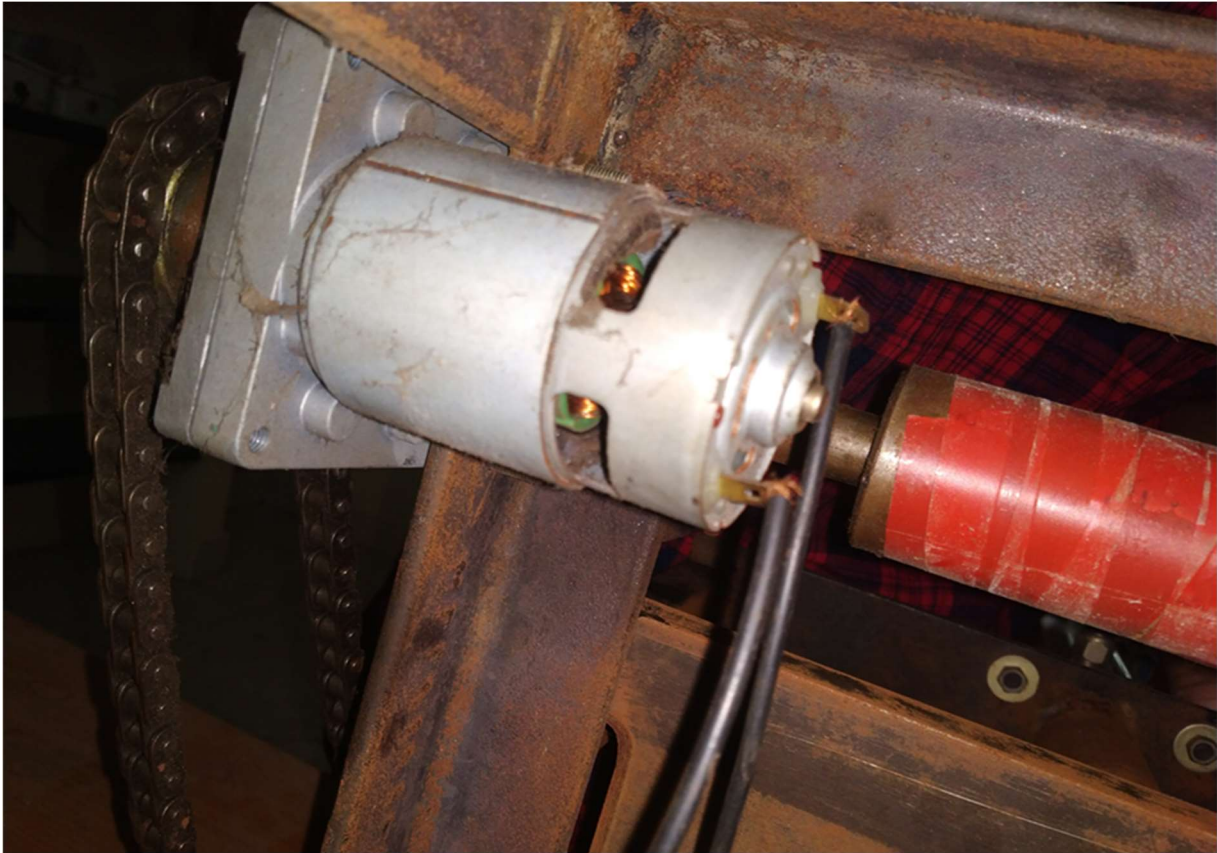


Figure 4.4 DC Motor

4.5 PNEUMATIC HOSE PIPE

The basic function of pneumatic hose pipes (shown in fig 4.5) is to transfer the compressed air from the compressor or from one part to another part where the air is needed without losing the pressure of the air. In the market, there are several types of pneumatic hose pipes available for sale. Engineers in the manufacturing industries will select the pneumatic hose pipes according to the requirements. Engineers will mainly consider the construction of the pneumatic hose pipes. The tubing of the hose pipes may be extruded with a single material, or the outer layer is done with one material and the inner layer is finished with the help of another material. Most of the pneumatic hose pipes are made up of textile fibres for higher strength. Pneumatic hose pipes are of two layers; the inner tube layer is made up of one or more layers of reinforcing braided or spiral wound fibre. The outer layer of the pneumatic hose pipe is made up of a protective cover to prevent external damage.

The next main criteria of selecting the pneumatic hose pipes are the air supply and the flow requirements. Once the design and the construction are done by the engineers in the manufacturing industries. Then the engineers will consider the capacity how much the hose pipe will supply or pass the air through it. Generally tubing of the hose pipe is done by considering the outer diameter, inner diameter and wall thickness. When the hose pipes are with less inner diameter will leads to loss in the pressure of the compressed air, low efficiency, and low life span. At the same time when hose pipes are constructed with high inner diameter then the weight of the hose pipe, size and also the cost of the hose pipe will increase which results in loss to the industry. Manufacturers basically fix the tubing measures using the burst pressure of 75 F, then they divide it by safety factor to calculate the maximum working pressure. While buying a pneumatic hose pipes from market the maximum working pressure will be mentioned in that and the manufacturers should not operate the hose pipes beyond that pressure for their safety measures. Since we are using atmospheric air for the manufacturing it is free of poisonous leakage. Some of the manufacturing companies are using asphyxiation including nitrogen, makes up (78% of air) which is harmful to the workers. And the oxygen which contains (28% of air) cannot used for compression because it is fire hazard, more expensive and performance is low when compares to other gases.

Normally the tubing of the pneumatic hose pipes is done with the help of thermoplastic tubing. But the engineers from the manufacturing industries are choosing it in various countless materials for the production based on the requirements. But typical tubing material used for the pneumatic hose pipe is polyurethane tubing. The polyurethane tubing is very strong, flexible according to the customer need, abrasion resistant it also with stand the contact with fuels and oils. Polyurethane tubing is most commonly sued in robotics, pneumatic actuation, logic systems and vacuum equipment. And also, the polyurethane tubing is widely used for the semiconductor manufacturing, medical and laboratory applications. Nylon tubing is also used in the tubing of pneumatic hose pipes but it is not much effective as polyurethane tubing. Nylon tubing are used in low pressure it is tough, light, and dimensionally stable. Nylon tubing are used mainly for high pressure pneumatics, flexibility for routing in tight spaces, low water absorption can be used in the water applications.

Polyethylene tubing is used only for the low- pressure pneumatics. But polyethylene tubing has an advantage of chemical resistant and solvents resistant. Polyethylene tubing have good flexibility and available at low cost. High graded polyethylene tubes are having the major advantage of resistance to the cuts and external damage which leads to the pressure loss. The polyethylene tubes are having high burst pressure when compared to the polyurethane tubing.

Polyvinyl chloride tubing is very light and more flexible when compared to the polyethylene and nylon tubing. It also offers good chemical resistance and can be frequently stabilized. Polyvinyl tubing is suitable for the low-pressure medical applications and can be used for the FDA specifications for the direct contact with the food and drugs. Polyvinyl chloride tubing is clear to the human eyes and suitable for the visible indication of the flow is necessary. Polypropylene tubing is suitable for the direct food contact applications and also the polypropylene tubing is good chemical resistant and withstand the ultraviolet radiation in outdoor applications.

There are basically two common physical characteristics we need to consider while choosing pneumatic hose pipes. They are flexibility and kink resistance of the tubing done for the hose pipes. This the best characteristics among all when selecting pneumatic hose pipes rather than looking at the manufacturer need. The another selecting criteria is colour, tubing comes in wide range of colours as well as clear depending upon the material used for the tubing of pneumatic hose pipes. Finally, the tubing of the hose pipes should meet the rules and regulations of the ISO and FDM. The compressed air is supplied to the 5/2 directional control valve. This is also called solenoid valve, which has 5 ports and 2 outlet ports. Among that 5 ports, 1 port are used for the inlet of compressed air from the compressor, 2 ports are for outlet of the compressed air to the pneumatic cylinder, and 2 ports is for the exhaust to release the compressed air once the punching or riveting is done. Both pneumatics and hydraulics can be used for the compression of the air and increase the pressure of the air by reducing the volume of the air. When compared to hydraulics the pneumatics has the advantage of working even at the low pressure and also the air which is needed for the actuation is readily available. But in hydraulics system of compression separate oils should be bought and we must use it for the lubrication purpose. The cost of the hydraulic fluids is high and also the construction of the hydraulic system is little bit complicated when compared to pneumatics systems. And the workers are finding difficulties in understanding the hydraulic system but pneumatics is slight easier to understand and working.

Table 4.8 Specifications of Hose Pipes

Pipe made by the material	Diameter in (mm)	Wall thickness in (mm)	Length used in (mm)

Polyurethane hose pipes	15 mm	4.1 mm	100 mm (2 sets are used)
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Figure 4.5 Hose Pipes

4.6 MICRO CONTROLLER

A microcontroller (shown in fig 4.6) is integrated compact circuit designed to govern a specific operation in an automated system. The important components of a micro controller include a processor, memory, input connections, output connections in a single chip sometimes these micro controllers are referred as microcontroller unit and it is also called as embedded controller these micro controllers are found in vehicles, mobiles, radios, vending machine, and these micro controllers are also found in home appliances and in another daily device that we use.

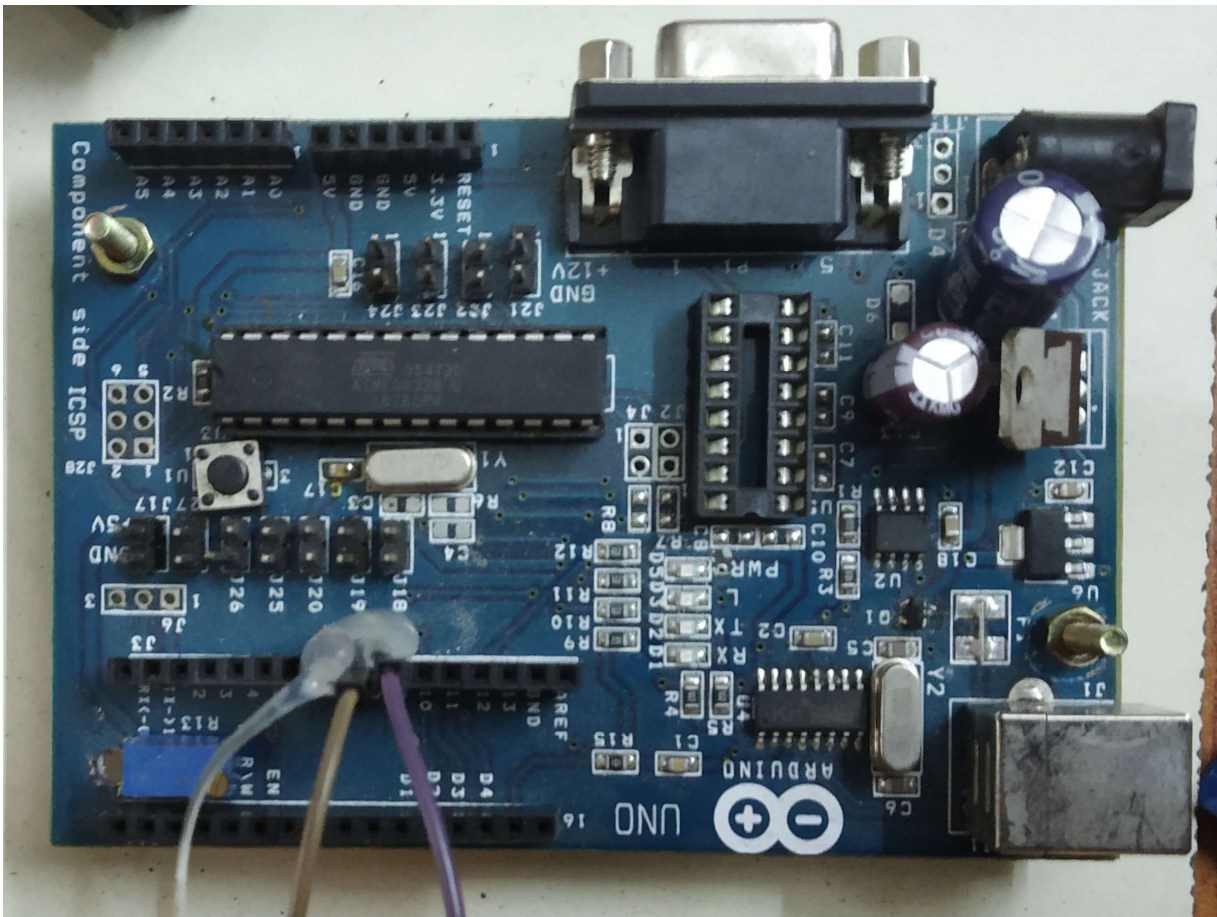


Figure 4.6 Microcontroller

These micro controllers are miniature personal computers which are essential to carry out certain processes which involves in automation or controlling of large components small features without a complex algorithmic process or a complex operating system. Most of the automated devices will contain a microcontroller these micro controllers are low in cost and also low in weight when compared to the old programmable logic controller which are twice its size and the algorithm used in this is so complex when compared to the modern micro controller that are being used now a days. In which mixed signal micro controller are being used common now a days due to its capacity to work with different out signals like the microcontroller get signal from different sensors in different signal format like light, sound, movement all these signals are of different types so the micro controller converts all these different signals into one signal to perform the desired operations the input signal may be analog signal or digital signal. Micro controllers are cheap data collecting tool which uses the information that it gathered from the sensors and use these data to perform action like actuation and other sensing operations. Some micro controllers use 4-bit and operation frequency of these microcontrollers are 4 kHz for low power consumption most of the micro controller acts as the digital signal processor. In addition to this there are 8-bit micro controller which uses 16 kHz of power consumption the difference between the 4-bit and the 8-bit micro controller is the amount of data which is being controlled or sensed or collected or displayed the higher the bit the amount of data and signal which are being controlled need more power to do the process. When lower control is required 4-bit micro controller is used so that the power consumption will be reduced in turn reducing the overall cost and overall weight of the final product.

4.6.1 Elements of Microcontroller

1. THE CENTRAL PROCESSING UNIT

The central processing unit (CPU) which is responsible for Arithmetic operation's, control signals, manages data flow in relation with the code given by the programmer. The programmer doesn't have any problem with the functionality of the device which is the responsibilities of the integrated development environments and complex language like C which is use to program the controller

2. MEMORY

A read only memory (ROM) is used in a microcontroller this memory is also called nonvolatile memory which refers to the memory in which data can retain itself after a shutdown. This memory is the place where the program is being stored and the program is machine language that instructs the CPU exactly what process has to be done. The word "Flash" is used in the microcontroller which indirectly denotes nonvolatile data storage. Temporary memory also known as

volatile data storage or also called random access memory (RAM). The data which is being stored in this is lost when the power to the controller is turned off. process which are being done by volatile data is faster when compared to nonvolatile storage.

3. PERIPHERALS

The word peripherals mean the other modules that are being used or that helps a microcontroller to communicate with the external system to perform the required operations the following are the categories of the peripherals

- **DATA CONVERTERS:** Data converters convert analog signal to digital signal and vice versa like digital signal to analog signal references and also reference voltage generator.
- **CLOCK GERERATION:** This component deals with the internal oscillator, phase locked loop and drive circuit.
- **TIMING:** The general purpose of timer is to manage the time difference by the use of real time clock timer and event counter
- **ANALOG SIGNAL PROCESSING:** Analog comparator which helps in the process of conversion or generation of analog signal
- **INPUT:** The input of the microcontroller includes the connections of ethernet or any external USB drives to perform the operations of giving input data to the microcontroller
- **OUTPUT:** The output connection is made by the bread board to various components to perform various tasks like connecting the sensors so that the input data can be transferred to various sensors for output generation
- **SERIAL COMMUNICATION:** USB, I2C

4. SUPPORT CIRCUIT

The micro controller has a variety of functional block which cannot be classified or comes under the periphery. The support circuit does not have any primary job like control, monitor or communication with external components. The use of support circuit is that they support the internal operations like implementation and development process. These processes are carried out by different components like

- **Debug circuitry:** This allows the programmer to monitor the microcontroller as the instructions are being executed. This is an important process to take down bugs for improving the performance
- **Interrupts:** This is a most important component of a microcontroller functionality this component is an external hardware component this cause the component for specific instructions.

- **Clock generation module:** This module can be determined as a peripheral if it was to send signal but instead this module is used to provide internal oscillation signals to the CPU. These modules have low precision but this is capable to tolerate the low precision signals this module is used to save space in the microcontroller board and for a simple design.
- **Power supply circuit:** Integrated voltage regulators allow the generation of required voltage and power management properties can be used to reduce the devices power consumption during in active state and can place the processor in a stable voltage supply for volatile data storage system.

4.6.2 Working of Microcontroller

The microcontroller is embedded inside a system as a singular functional device. The micro controller does this by compiling the data it gets from the input sensors or the output sensors or the peripherals using its central processing unit. The information which are required temporarily are stored in the volatile data store (RAM), the processor access it use the program I in it to carry out the process and apply the data in it to get the necessary data and it uses the input and output peripherals to communicate with the other components of the sensors to get the required data or to perform the required actions. These microcontrollers are used in wide variety of systems and devices. In some case some devices use multiple microcontrollers to perform multiple tasks in which the microcontroller works together to perform their respective tasks. Like a device may contain multiple microcontrollers like one to perform one specific operation and a another to perform another operation the two microcontroller has to work together so that their individual work can be done easily. The micro controller has a specific complex instruction set computing and reduced instruction set computing. The complex instruction set computing has around 80 instructions that can de done at one in a device to make it more useable. While the reduced instruction set computing has a instruction limit of 30 so the data storage used in this is low when compared to the CISC controller but the CISC controller is more efficient and compactable in automating process.

4.6.3 Features of Microcontroller

The microcontroller is subjected to change based on the application it is being used. The processor varies from 4-bit, 8-bit, 16-bit to more high-power processors like 32-bit

and 64-bit processors. Microcontroller can even vary based on the type of data they handle like volatile data storage and nonvolatile data storage which means Random Access Memory (RAM) or permanent memory and Read Only Memory (ROM) or permanent memory and Electrically erasable programmable read only memory (EEPROM). Generally micro controllers are used as a device which is readily available without any additional components because while designing readily memory is already available to use instead of expanding and in addition to this the microcontroller board has pins for input and output operations so they can be used directly with the sensors without any interference of other components.

The architecture of microcontroller is based on the Harvard architecture which offers exchange of data from one version or model to another version or model of microcontrollers the data bus and instructions are separate in this architecture so the transfer of data is easy when compared to other architecture. The microcontroller processor the micro controller has a specific complex instruction set computing (CISC) and reduced instruction set computing (RISC). The complex instruction set computing has around 80 instructions that can be done at one in a device to make it more useable. The CISC's is easy to implement and work on due to the vast memory it provides and has performance at its best due to the higher number of clock cycles need to execute a program. While RISC which rely more on the software for performance when compared to CISC type. While the CISC type microcontroller rely more on the hardware part of the microcontroller, and it has a compact design due to the complex hardware parts. While the RISC having a simple design due to simple hardware parts and complex software. During the initial stages of the micro controller, they mainly depend upon assembly language for their operations, but now days other languages like python, C, C++ can be used to program a microcontroller. The microcontroller units use pins to implement the input and output operations from the peripherals to the sensors. Even the sensors are connected to the microcontroller through the pins. The function also includes the conversion of signals and liquid crystal display can be connected to the controller for monitoring purpose and real time clock can also be attached to the controller with the help of pins. Universal synchronous or asynchronous receiver is also provided with most of the controller for wireless transmission and universal serial bus (USB) connectivity is also used in microcontroller. The sensors collect data from different source and convert the signal using these features to get the end result or to perform an automation process.

4.6.4. Types of Microcontroller

1. Intel MCS-51

2. AVR microcontroller
3. Programmable interface controller (PIC)
4. Advanced RISC Machine (ARM)

4.7 RELAY



Figure 4.7 Relay

Relay(shown in fig 4.7) can be defined as a switch. Which is generally used to open and close the circuit manually relay is also a switch that is used to connect two circuit or close two circuits but instead of manual operation relay uses electrical signal to perform the operation of connections and disconnections. And relay is used to control a circuit of higher voltage than the input voltage it can also be called as an electrical amplifier. The relay is also used to refresh the signal from one circuit to another circuit. Relay uses an electromagnet to connect to a circuit or disconnect that circuit. Besides this there are other types like solid state relay which uses the properties of semiconductor for the process of connections to the circuit or disconnection of the circuit by zero moving parts. Relays multiple coils to prevent from overloading to protect the electrical circuit. In modern systems these functions are performed by digital relays called protective relays.

Some relays only require only single pulse of control power to connect the switch. When a negative pulse if given to the relay it will discount the circuit repeated pulses of same kind will have no effect

4.7.1 Components of Relays

1. RELAY CONTACTS

A relay has two fixed contacts which is denoted by “NC” normally closed and “NO” normally open. These two contacts have a common movable contact called “COM” or common under normal conditions in which a relay can be either open or closed. These contacts are conductors made up of electricity conducting material's and they have a contact strap on it these contact straps also has high conductivity and this strap is resistance to electric spark. This property provides protection when sudden high voltage passes through it. These metals are used to close the circuit allowing electricity to flow through it. These contacts should be monitored that if the resistance and conductivity are constant.

2. ELECTOMAGNET

When current passes through the conductor magnetic field is produced similarly when is being passed through a coil wounded in a soft iron a magnetic field is created perpendicular to the direction of the current. This magnetic field is converted into an electromagnet when it passe through the iron core, magnetic properties will be present in the electro magnet until the current is disconnected. So, this electro magnet has an important role in the relays working principle even in most cases the magnetic field is retained by the magnet even after the current is disconnected. This is done by the magnetic lag which is created by hysteresis. To nullify the magnetic property in the iron core a small magnetic force can be applied.

3. MOVABLE ARMATURE

The armature is a moving conductor in the relay which is used to connect or disconnect the contact based on the amount of magnetic flux in the iron core. When electricity passes through the armature it will be pulled against the spring due to tension to connect or disconnect the contact based on the relay type (normally closed or normally open). Due to some fault in the current it may cause unintentional triggers in maintain the spring tension. An armature can be unbalanced by the addition of regular plastic covers. The disadvantages of these type of armature are that these types are easily affected by external factors. Relays having balanced armature can counter external force or any sudden increase in voltage. Two types of armature can be used for both direct current and alternative current but alternative current can cause increasing pulsating magnetic field this will cause the armature to connect and disconnect the contact for each half-cycle. Shader ring can be placed in the iron core in the armature to prevent the pulsating magnetic field.

4. YOKE

The yoke is attached to the soft iron core which is an electrochemical metal piece. Which is used for attracting and holding the armature. The yoke is attached to the top of the of the iron core element in most of the relay the armature is connected to the yoke with the help of a conducting wire which is used as a connectivity or the continuity of electricity between the armature and the contact. The yoke also provides low reluctance path to the magnetic flux that passes through the armature and the contacts. The primary circuit has the movable armature and the spring the yoke is the small material which connects them to make the primary circuit. Due to magnetic field the is responsible for the pull of armature coil to the contact for the process of connection and disconnection.

5. SPRING

Springs are attached to the armature coil for its easier movement. When magnetic field is generated the for the process of connection and disconnection the contacts during this process the spring allows the armature to move freely. These springs are usually made up of sheet metal. In some high-performance relay, the spring will be made up of nickel silver. A relay will be useless when there is reduction in spring tension. Thus the spring should be in a good condition to use the relay.

4.7.2 Working of Relays

A simple electromagnetic relay has a coil of wire wrapped around a soft iron core also called a solenoid a low reluctance path for magnetic flux is provided by an iron yoke and a movable iron armature and two set of contacts. The armature is connected to the yoke and mechanically to one or more sets of moving contacts. A spring is used to hold the armature in place so when the coil is de-energized a gap is formed in the magnetic circuit so in this condition one of the contacts is will be closed and the other set of contact will be open. Depending on the functions of the relay one or many contacts will be used a wire will be connected between the yoke and the armature this for the continuity of the circuit the yoke is attached to the board by using a soldered mechanism. Magnetic field is generated when the electric current is passing through it which activates the armature. The consequent moment of the armature makes the movable contacts either to break or make a connection with a fixed contact. If the connections were closed during the de-energization of the relay the contact breaks the connection by opening the movement and if the contacts were open during the de-energization of the relay the contact makes the connections by closing the movement. The armature will return the force half as strong as that of the magnetic force when

switched off. Spring is responsible for providing this force but in industries the starter force is provided by gravity. Relays can even operate on low voltage. Noise is reduced in low voltage and during high voltage the electrical arcing is reduced.

There will be surge currents in the relay output if the relay is driving a large or high load. So, a snubber is used in between the contacts to reduce the surge between each contact when high load is being passed through the relay. While using alternative currents the flux produced should be split into two out of space components which increase the pull during the usage of alternative current. Usually this is done by using a copper ring around the core which creates a delayed out of phase component which controls the voltage during the initial contact of the contacts with movement. Contact materials for relay vary by applications low resistance materials which are oxidized by the air should be used for low resistance and the material should have high heat resistance since this material will be active through the process when electricity passes through it the conduction should be also high.

4.7.3 Types Of Relays

1. LATCHING RELAY

Latching relay are also called keep relay which has two relaxed states. The relay will remain in disconnected state when the current is switched off a cam mechanism and a ratchet operating solenoid are responsible for this process or by having a positive and a negative coil which are opposing each other with a permanent magnet at center to hold the armature and the position of contacts in the coil are relaxed or with a remnant core. The first pulse of the coil turns it on and the second pulse turns it off.

If the pulse to one of the coils connects the relay and turn it on and a pulse to the opposite coil will disconnect the circuit and turn off the relay. The relay only consumes current for an instant while turning it on. Latching type relay has a remanent core that is used to mark the position of the contact. This is used to retain the contact by magnetism which will be present in the core during energizing process. A permanent magnet will be used to produce a variation in the force required to close the contact. The is responsible for providing the necessary force required to connect and disconnect the contact from the core which is done by opposing the magnetic field or adding up of the field of the permanent magnet. The latching relay can only be controlled by a switch which is connected to the circuit. The latching relay is less expensive when compared to other types of relay but its cost may increase based on the use of an external circuits.

In another type latching relay has a ratchet mechanism in which the coil will be momentarily energized when the contacts are being closed. This is done by the first impulse while the second impulse is responsible of the release of the second contact which will produce the same energy which is similar to the first impulse.

2. REED RELAY

Reed relay has contacts which are placed inside vacuum or a glass tube filled with inert gas which is used to protect the contact from corrosion. When current passes through the circuit magnetic field is formed around the contact. Reed relays are capable for the fast switching between open and close circuit and requires low voltage for operation when compared to other types of relays. Reed relay can switch to different connection faster than larger relays and the power required is very low when compared to other relay of this size. On some rare occasions these types of reed relay can be magnetized over time which make them attractive in nature like to stick on to the opposite poles even when the current to it is turned off. These types of relays have more operating lives when compared to other relays. These types of relay has relative low voltage when the switching of the contacts happen.

3. MERCURY WETTED RELAY

These relays are used as high current connecting switches or contactors, where erosion of contact is a problem in most of the conventional relays contact. Mercury relays are not mostly used in modern applications these mercury wetted relays are being replaced by solid state relays. As the name denotes this relay has a mercury tube in a vertical position. The bottom of the tube is isolated and in a side up arm of the glass. The working of the relay is based on a slug which is placed inside the mercury tube will sink due to gravity due to this displacement of mercury takes place this displacement is responsible of the rise of mercury in the tube so that the circuit will be complete now due to the contact of mercury and the other parts of the relay. The coil is placed at the top of the tube this coil is responsible for the attraction of the slug. So, when the coil is subjected to electricity the coil will attract the slug and thus in turn the mercury will be displaced by the slug. The glass tube of mercury should be mounted vertically the sensitivity of the relay can be adjusted by the angle relative to a vertical position. The high-speed switching action of the mercury relay is one of the best advantages that it can get.

4. POLARIZED RELAY

A Polarized Relay contains a permanent magnet that inducts magnetic flux to the coil. The permanent magnet is also responsible for the transfer of flux to the two contacts that are placed at the centre of the coil. The contacts are associated with the other components to transfer the armature current through the electromagnetic coil using the correct polarity of positive or negative. The current pulse will energize the coil of proper current of one flux while the other flux is reversed in the armature. Polarized relays are usually small in size and have faster operation speed and have higher resistance to shock and vibration.

5. FORCE GUIDED CONTACTS RELAY

In this type of relay, the contacts are connected together using mechanical linkages. When electricity is being passed to the core, all the contacts will move together as one since all the contacts are linked mechanically. If one of the contacts is immobilized, not even a single contact will move due to the mechanical linkage. This process is used to maintain the safety of the relay. These relays are also known as positive guided contacts or captive contacts or safety relays. These safety relays follow a certain design rule since this relay depends upon mechanical linkage. Most of the time the contacts should be checked since there is no guarantee that all the contacts are in the same state as the other contacts.

4.8 TIMER

The timer is a combination of an electromagnetically output relay and a control unit. In this, the contact will open after a predetermined time or after some time interval. The timer is initiated or triggered by different methods like by the application of input voltage. Supply will connect or disconnects the trigger. The trigger signal can also be a control switch or a power voltage trigger.

4.8.1 Types Of Timer Function

1. DELAY ON

During the start of the timer there is a delay on the pull-in which acts as the delay of signals.

2. ONE-SHOT (FALLING EDGE)

When an input voltage is applied the timer will be ready to accept the trigger. So, the trigger will be triggered which will leave the output de-energized. When the trigger is removed the output will be energized so at the end of the time delay the output will again be de-energized.

3. DELAY ON AND DELAY OFF

The timer needs a voltage supply so that it can be activated and deactivated with an external contact or with a DC voltage. When activated there will be a pull in and which will de-energize the timer on the drop out of the delay

4. DELAY OFF

When no voltage is given to the timer there will be a delay on dropout without any power supply

5. TWO-SHORTS (RISING EDGE AND FALLING EDGE)

When input voltage is given to the timer the trigger will be triggered upon the signal based on the time interval set the other process will be executed.

6. FLASHING

During the application of input current, the time delay will begin the output will be energized at the end of the time delay it will remain the same for some time. The output will be de-energized at this time and it will remain like

this until the end of the time delay. After the end of the time delay the output will be energized and this will be repeated until the next sequence.

4.9 PUNCHING TOOL

The punch tool(as shown in the fig 4.9) used here is made up of high-speed steel and has a double shear which is used to Pierce the metal sheet with minimal effort and the design of the punch tool is flat with an opening in the middle with outside shear model. So, the stress distribution in the punch tool starts from the middle to the radial side of the tool. This double shear punching tool is also used or reduced force due to symmetrical distribution of force while the single shear tool in which the force distribution is higher in the higher degree and may cause bending due to non-even symmetry.



Figure 4.9 Punching Tool

4.10 RIVETING TOOL

The Rivet tool (as shown in the fig 4.10) used here is made up of mild steel the bottom of the tool is like old punching tool of full metal in a cylindrical shape which is used to

ram the nut rivet in the sheet metal this type of rivet is used for blocking the punch hole and also used to join two material the main advantage of this riveting process is that the hardness of the nut rivet after the process of riveting is high due to the ramming process done here.



Figure 4.10 Riveting Tool

4.11 WORKING PRINCIPLE

The compressed air from the compressor is used to punch or rivet the sheet metal with the help of cylinder, piston and piston rod. The pneumatic cylinder converts the pressure of the compressed air into the mechanical force needed to punch or rivet the sheet metal. The pressure of the compressed air is converted into the mechanical force by reciprocating motion of the piston and the piston rod. When the compressed air is

supplied to the top of the cylinder the piston moves from top dead centre to the bottom dead centre, and the punch or rivet is done. When the compressed air supplied to the bottom end of the cylinder the piston moves from bottom dead centre to the top dead centre.

4.11.1 Working

The atmospheric air is collected by the compressor and with the help of the compressor parts the atmospheric air filtered and cleaned in order get good efficiency. The atmospheric air is compressed, the pressure of the atmospheric air is increased by decreasing the volume of the atmospheric air. The compressed air can be regulated at particular pressure rate with help of pressure gauge according to the requirements. The compressed air at the pressure of 8 to 10 bar is supplied to the solenoid valve with the help of pneumatic hose pipes. The pneumatic hose pipes are used since they do not lose the pressure of the compressed air need to be supplied. The solenoid valve is used to supply the compressed air to the pneumatic cylinder. The solenoid valve can be actuated in both either automatic or manual. The solenoid valve is connected to the microcontroller for the auto feed mechanism. The microcontroller is connected with the timer and the relay, because the timer is used to count the number of seconds the feed needs to be done and the relay is used to actuate the DC motor for the auto feed for the required timing. The DC motor is the electrical used to convert the supplied electrical energy into the rotational energy. And the rotational energy obtained by the DC motor is supplied to the rollers by adjusting the speed of the motor using mechanical gears. The solenoid valve used in this is 5/3 directional control valve which has one input and two outputs and two exhausts. The inlet port is used to receive the compressed air from the compressor, and the two output ports are used to supply the received compressed air to the pneumatic cylinder based on the requirements. The two exhaust ports are used to supply the compressed air to the atmosphere after the work is done. When the compressed air at the pressure of 10 bar is supplied to the one end of the pneumatic cylinder the pressure below the piston is lower than above the piston so the piston will move from the top dead centre to the bottom dead centre and the punch or rivet is done. The punch or the rivet tool is attached to the piston end with the help of the three jaw chuck. The advantage of three jaw chuck is once the punching is finished then the rivet tool is attached to it for riveting. The punch or rivet tool is guided to the sheet metal using a die at the bottom. The die is also used to prevent the bending of the sheet metal and also to prevent the deformation of the sheet metal. When the piston head reaches the maximum stroke length the compressed air is supplied to another end of the pneumatic cylinder, due to this the pressure above the piston is less when compared to the below. This high pressure of the compressed air moves the piston from bottom dead centre to the top dead centre and the punch or rivet tool is now free from the sheet metal. And the pneumatic cylinder is ready for the

next corresponding punch or rivet. Once the punch or rivet is finished then the microcontroller, timer and relay will get ready for the feed of the sheet metal for next punch or rivet through automation. The time duration of the consecutive punch or rivet can be adjusted with the help of microcontroller, timer and relay.

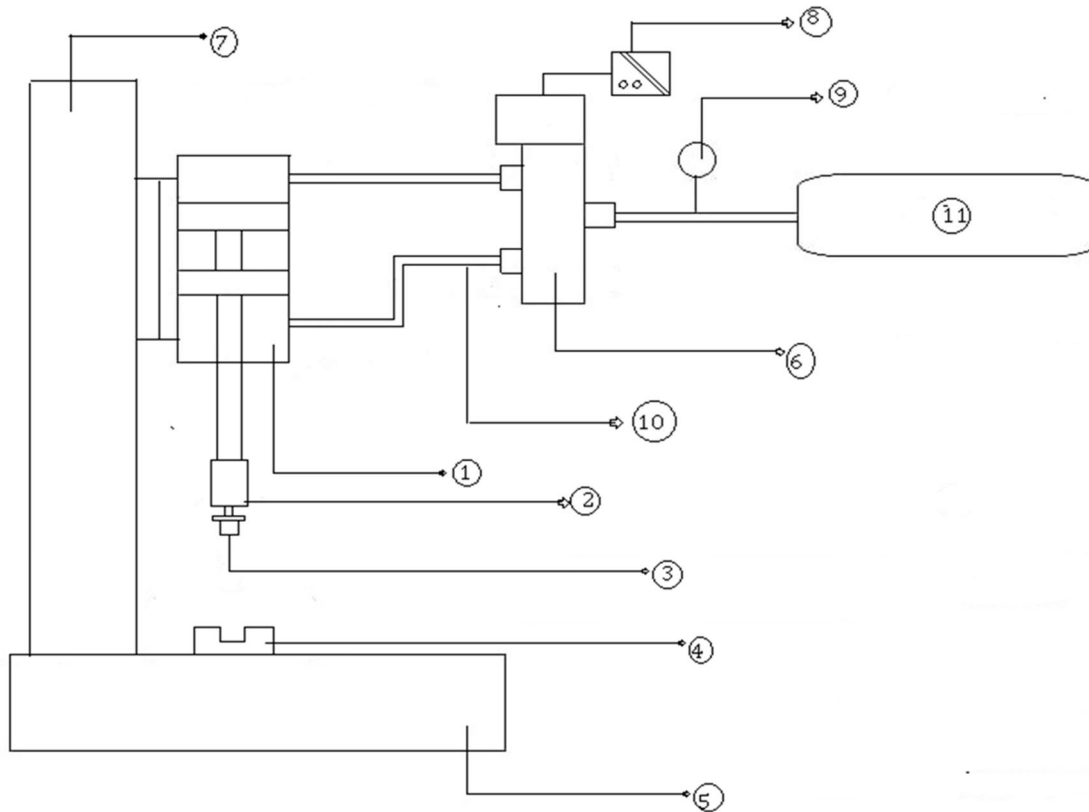


Figure 4.11 Schematic Diagram

1. Pneumatic Cylinder
2. Tool Holder
3. Tool(Punch or Rivet)
4. Bottom die
5. Base Frame
6. Directional Control Valve
7. Frame
8. Control Circuit

9. Pressure Gauge
10. Polyurethane Tube
11. Compressor

4.11.3 Design Calculation

$$\text{Cutting Force} = L * t * T_{\text{max}}$$

L - perimeter of the punch hole.

t - thickness of the sheet.

T_{max} – max tensile strength.

$$L = 2\pi r \text{ (D=10mm)} = 2 * 3.14 * 5 = 31.41 \text{ mm}$$

$$t = 0.5 \text{ mm}$$

$$T_{\text{max}} = 180 \text{ N/mm}^2$$

$$\text{Cutting force} = 31.41 * 0.5 * 180 = 5654.86678 \text{ N.}$$

Stripping Force = 10 % - 20 % of cutting force.

$$15 \% \text{ of cutting force} = (15/100) * 5654.86678 = 848.2300 \text{ N}$$

$$\begin{aligned} \text{Press force} &= \text{Cutting force} + \text{stripping force} \\ &= 5654.86678 \text{ N} + 848.23 \text{ N} \\ &= 6503.097 \text{ N} \end{aligned}$$

$$\begin{aligned} \text{Reduced force} &= 0.37 * \text{press force} \\ &= 0.37 * 6503.097 \text{ N} \\ &= 2438.66137 \text{ N} \end{aligned}$$

For selecting cylinder bore diameter

$$F = P * A$$

$$P = \text{working pressure} = 8 \text{ bar}$$

$$A = \text{area of the cylinder} = (\pi/4) * d^2$$

$$2438.66137 = 0.8 \cdot (3.14/4) \cdot d^2$$

$$d = 62.99 \text{ mm} = 63 \text{ mm (Standard size)}$$

Force realised by the cylinder at 8 bar $F = P \cdot A$

$$F = 0.8 \cdot (3.14/4) \cdot 63 \cdot 63$$

$$F = 2492.532 \text{ N.}$$

CHAPTER 5

RESULTS AND DISCUSSIONS

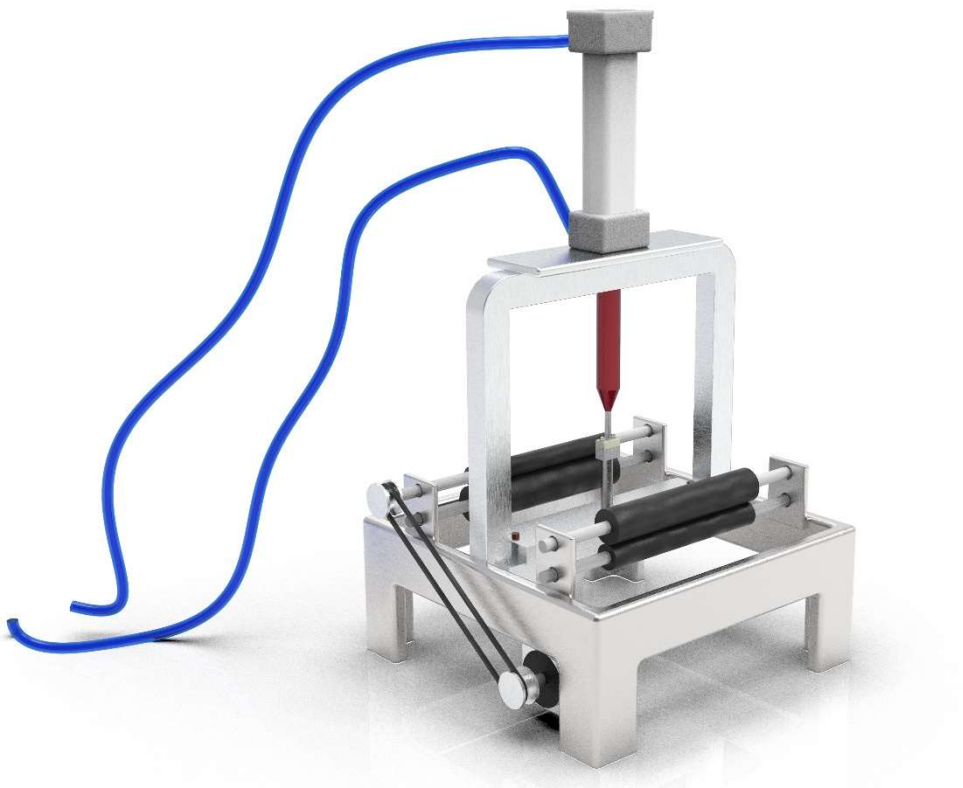


Figure 5.1 3D Model

Based on the design calculation, the 3D model (as shown in the figure) of the auto feed pneumatic punching and riveting machine is done in solid works software. With this 3D model, the fabrication of the auto feed pneumatic punching and riveting machine is done. The project work has provided a great opportunity and experience to use our limited knowledge. Gained lot of knowledge while doing 3D model in solid works software.

Table 5.1 Cost Estimation

S.NO	Parts	Quantity	Material	Amount (Rs)
1.	Pneumatic Double -acting Cylinder	1	Mild Steel	1,428
2.	5/2 Directional Control Valve	1	Aluminium	1356
3.	Pneumatic Hose Pipes	4	Polyurethane	405
4.	Frame (Stand)	1	Mild Steel	499
5.	Microcontroller	1	Arduino	2510
6.	Rollers	4	Mild Steel	875
7.	Punching Tool	1	High Speed Steel	580
8.	Riveting Tool	1	High Speed Steel	575

Total: Rs 9,228

The auto feed pneumatic punching and riveting machine is successfully fabricated within the short period of time. By doing this project lots of knowledge has been gained based on the planning, purchasing, assembling and machining. The auto feed pneumatic punching and riveting machine is working successfully and this will be the example for developing a punching machine at very low cost. This pneumatic punching machine is easy to understand and work even a beginner will work comfortably in this. This machine will clear all the problems based on the automation and the errors happened during the manufacturing in the industries. The changes in the parts can be made easily based on the customer need and also the manufacturer requirements.

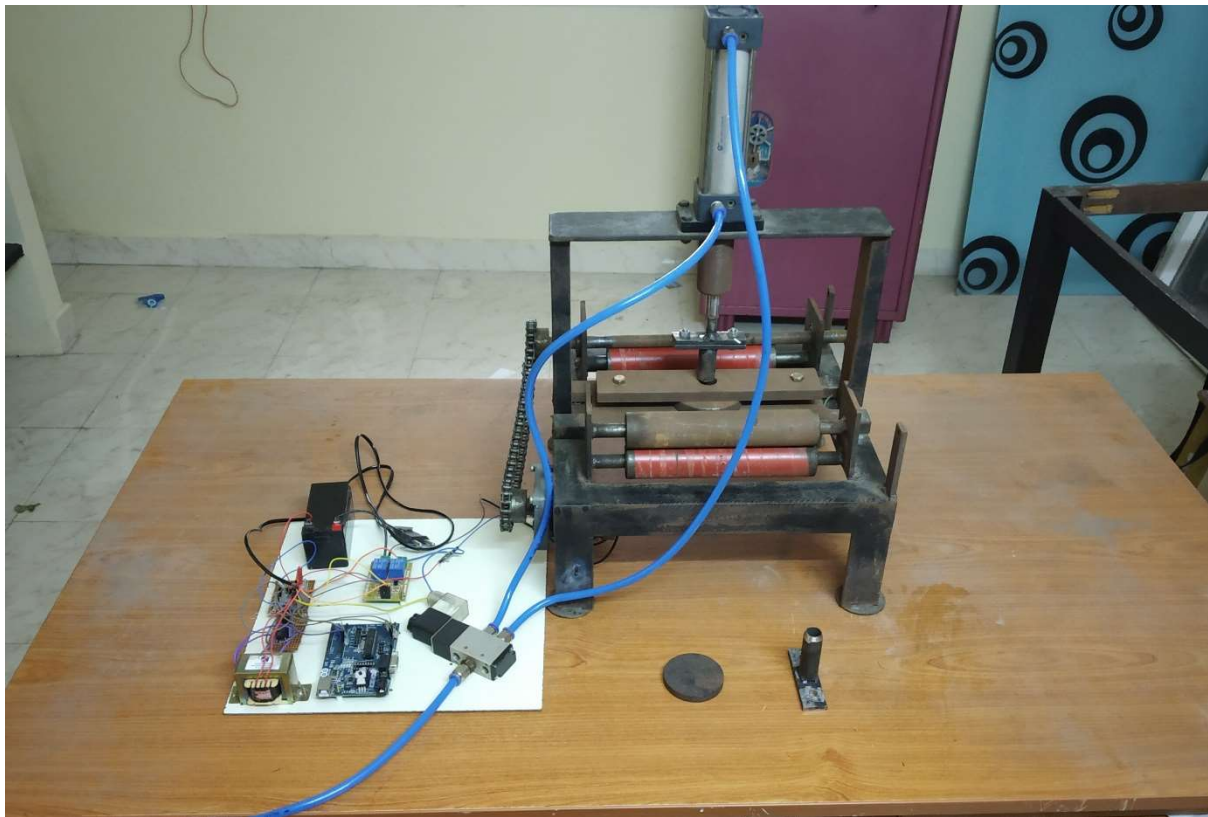


Figure 5.2 Full View

The figure 5.2 shows the full view of the pneumatic punching and riveting machine. When the compressed air at the pressure of 10 bar is supplied to the one end of the pneumatic cylinder the pressure below the piston is lower than above the piston so the piston will move from the top dead centre to the bottom dead centre and the punch or

rivet is done. The punch or the rivet tool is attached to the piston end with the help of the three jaw chuck. The advantage of three jaw chuck is once the punching is finished then the rivet tool is attached to it for riveting. The punch or rivet tool is guided to the sheet metal using a die at the bottom. The die is also used to prevent the bending of the sheet metal and also to prevent the deformation of the sheet metal. When the piston head reaches the maximum stroke length the compressed air is supplied to another end of the pneumatic cylinder, due to this the pressure above the piston is less when compared to the below. This high pressure of the compressed air moves the piston from bottom dead centre to the top dead centre and the punch or rivet tool is now free from the sheet metal. And the pneumatic cylinder is ready for the next corresponding punch or rivet. Once the punch or rivet is finished then the microcontroller, timer and relay will get ready for the feed of the sheet metal for next punch or rivet through automation. The time duration of the consecutive punch or rivet can be adjusted with the help of microcontroller, timer and relay.

CHAPTER 6

SUMMARY AND CONCLUSION

The Auto Feed Pneumatic Punching and Riveting Machine can be used as a replacement for convectional Punching machines like handheld ones which are not precise and Hydraulic machines which are not cost-efficient and the maintenance cost will also be high. But the pneumatic auto feed punching and the riveting machine is low in cost and have less maintenance. Thus, the fabrication of this model helps to achieve low-cost automation. The operating procedure of this machine is very simple when compared to other machines, so any person can operate it. By using more technique this model can be modified and developed based on our requirements. In addition to this the model can be improved to further extend like

- It can be modified based on the requirements.
- Multiple cylinder systems can be put into action according to the need of pressing effort.

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APENDIX

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Velayutham.pon (37150221), TisonAntonio.J

(37150196) who carried out the project entitled **DESIGN AND FABRICATION OF AUTOFEED PNEUMATIC
PUNCHING AND RIVETING MACHINE**, under our supervision from November 2020 to April 2021 Internal
Guide Dr.G.Arunkumar, M.E., Ph.D Head of the department Dr.G.Arunkumar, M.E., Ph.D / Submitted for
Viva voce Examination held on APRIL 2021 Internal Examiner External Examiner DECLARATION We
TisonAntonio (37150196), Velayutham.pon (37150221) hereby declare that the project Retort entitled
DESIGN AND FABRICATION OF AUTOFEED PNEUMATIC PUNCHING AND RIVETING MACHINE
done by me under the guidance of Dr.G.Arunkumar, M.E., Ph.D., is submitted in partial fulfillment of
requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

Sources found:

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