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Synopsis

Basic requirement for any manufacturing company is to have effective work output. In the world with ever growing technologies, system becomes obsolete very early. Thus it is very necessary to implement a proper work system to reduce production time and to avoid high cost of not automating. The automation of manufacturing facilities and manufacturing support system increases the shop efficiency. It reduces the scrap and rework, thereby reducing the material and manufacturing cost. Sharda Motor Industries Ltd., are manufacturers of exhaust system for various types of automobiles e.g. Tata Indigo, Xylo, etc. Our project deals with catalytic convertor of exhaust system. In assembly of catalytic convertor we use heat shield for purpose of reduced radiation and proper dissipation of heat. Our project is based on special purpose dedicated system which provides special operative techniques for clinching and pressing operations. They can be designed with a certain amount of process specialization to make machining operations more efficient. Instead of using general purpose machines, the special purpose machines suitable for limited part family. Which Results increase in rate of production of the system, during assembly of catalytic convertor and heat shield, clinching and pressing operations are carried out. These two operations are automated in our special purpose machine. There is always a need of firm and realistic pattern of work output, for which automation is much reliable. Automation can be defined as the technology involved in automated handling between machines and continuous processing at the machines.

Chapter 1

Preamble

1.1 INTRODUCTION

Advancement in pneumatic as well as in hydro pneumatic instrumentation has been a keen part of concern. It has become one of vital aspect in the field of research and development due to its effective output and range of accuracy. Newer and newer effective methods have been carried out to improve the automation and to make it inexpensive. This report illustrates role of automation. Based on our project, Automation is much helpful in cost saving and to increase the productivity of the system. It is totally based on two activities of clinching and pressing. For any industry, it is much important to implement the new techniques and asssociate the methodologies with respect to the high work output with better productivity and maximum efficiency, in order to reduce the production time and save the expenses on the resources. The integration of manufacturing facilities and the support systems increases the shop efficiency. It reduces the rework and rejections, thereby reducing the material and manufacturing cost. Our machine deals with the advancement in work output using automation as integral concept. Basic operations are subjected in a simple manner to provide efficient work using automation technique. It always increases productivity and reduces deviations of a operational path. Our machine is special purpose oriented machine which carries a special purpose operation methodology for clinching and pressing operations.

SPM:

Machine suitable for large quantity production of similar components in this case, special purpose machinery is developed for achieving medium to large scale productions.

Objectives of SPM are:

1) Reduced errors and Reduction in inventory
2) Cost saving
3) Greater productivity and Greater flexibility
4) Reduced labour requirement
5) Increased machine utilization.

1.2 STATEMENT OF THE PROBLEM

Old manufacturing technology have measurable amount of flaws that are overcome using automation. Pressing and clinching operation are integrated using automation which converts it in a special purpose machines. It is been observed that the consumption of the energy is reduced energy alongwith the operational cost with increase in overall production. Previously, operation of clinching was done manually by manual hammering techniques. While In case of pressing of work piece, large capacity press machine was used. Using the concept of automation, we have integrated pressing and clinching operations with assistance of hydro - pneumatic special purpose machine. In which operations were carried out in two cycle i.e. clinching and pressing. In preceding method, the heat shield and catalytic converter which are to be joint together by using clinching and pressing was done manually, first the heat shield is placed below the catalytic converter together on the die, which having its designed shape. After placing the heat shield, its edges are to be bent on the surface of catalytic converter for further hammering it manually. Further hammered heat shield edges were placed over hydraulic press machine. The heat shield is placed over it by workers manually. The hydraulic press machine has 10 tones capacity. The current working capacity was much greater than the required capacity. Current capacity was noticed to be much greater in terms of economy and production rate. Due to constraints in the working and methodology of machine, the clinching/bending process was required to be done manually by operator. It increases the cycle time rate. It has been also observed that process consumes much human efforts and percieving much less accuracy. Continued précised working in also varied as the process is carried out on higher production requirement.

1.3 OBJECTIVE OF THE STUDY

The Objective of the study is:

1. Automation of operation:-

The main aim of project is to automate the operation in order to reduce human error. Also improves the quality of the product alongwith the rate of production.

2. Energy saving:-

Very low air consumption, resulting in energy saving of up to 80% over equivalent pneumatic cylinders and 50 % over equivalent hydraulic systems.

The Speed of Operation is also much higher than an equivalent standard pneumatic or hydraulic system.

3. Compact:-

Compact Cylinder design, which can be mounted in any position. Compact, Lightweight Press Frames, which can be mounted on a light work table.

4. High stroke frequency:-

High stroke frequency because of shorter oil path between the oil reservoir and the output hydraulic cylinder.

5. Cost saving:-

Uses Compressed air as the power source resulting in reliable, inexpensive components and piping. Completely eliminates the use of expensive hydraulic components and a large quantity of expensive hydraulic oil.

6. Improve quality:-

Only one point can be clinching at a time during manual clinching. Clinching force at each point may vary. This is avoided by clinching and pressing machine which improve the quality of operation.

7. Reduces operator fatigue:-

In manual clinching, the efficiency of the operator decreases due to fatigue. This may result in less clinching force at the end of the shift, specifically for the elderly operators, causing reduction in safety.

8. Saves Time :-

Manual clinching requires 70 to 80 seconds per clinching. . For uniform clinching, this time will be still more. This time can be saved by automatic clinching by using pneumatic cylinder.

9. Reduce maintenance :-

As components used such as pneumatic cylinder and hydro-pneumatic cylinder has less maintenance hence overall system gives reduced maintenance.

10. Improve productivity :-

As there is reduction in cycle time and cost saving, it increases the productivity.

1.4 SCOPE OF THE STUDY

We have developed a machine that is beneficial for production system in order to manage its resources like time, money and manpower. The company has the benefit of using two operations on one setup as it reduces the errors caused by the manual operations, which allows greater rate of production which directly results in increase of net income and having less payback period. Our machine is beneficial for company in terms of saving its time and energy. This machine reduces the worker fatigue.

1.5 REVIEW OF LITERATURE

In literature Survey we are going to study previously used methods for clinching and pressing operation for Heat Shield Assembly.

1. Manual Bending
2. Post Hammering Process
3. Cycle Time

1.5.1 Manual Bending

In preceding method, the heat shield and catalytic converter which are to be joint together by using clinching and pressing was done manually, first the heat shield is placed below the catalytic converter together on the die, which having its designed shape .After placing the heat shield, its edges are to be bent on the surface of catalytic converter for further hammering it manually.

1.5.2 Post Hammering Process

Further hammered heat shield edges were placed over hydraulic press machine. The heat shield is placed over it by workers manually. The hydraulic press machine has 10 tones capacity. The current working capacity was much greater than the required capacity. Current capacity was noticed to be much greater in terms of economy and production rate.

1.5.3 Cycle Time

Due to constraints in the working and methodology of machine, the clinching/bending process was required to be done manually by operator. It increases the cycle time rate. The process deals a lot with production, safety and working hours of the worker. Thus, it directly effects the cycle time which is never desirable. These further have a great effect on the working condition of workers. Since, it makes the process hectic and long running. Thus it makes work system less accurate. Hydraulic press used in this method is having 10 tons capacity. Such a capacity is not required in any terms. The process covers a large area on shop floor. The procedure could be able to execute in very less capacity than required one. For this we need only 1.5 to 2 ton capacity with pressing. So in this process energy wastage is at a higher rate. It is been also observed that process consumes much human efforts and preceding much less accuracy. Continued précised working in also varied as the process is carried out on higher production requirement.

1.5.4 Limitations of Previous Used Machine

The Previously used machine has ollowing limitations:

- Higher machine cost.
- Process becomes less accurate due to interference of workers in hammering process.
- Clinching process is carried with less speed.
- Low reliability as it can be overwhelmed by workers.
- Cycle time is more.
- Bulky for even medium clamping floor.
- Requires more space floor area.
- Having less accuracy due to manually hammering on edges of work area.

- This method is more time consuming because of many manual work.
- Manual clamping is requires.
- Less précised work piece are produced.
- Only one point can be clinching at a time during manual clamping.
- Clamping force at each time may be vary thus it reduces the production rate.
- Power supply needed is more for big press.

1.5.5 Conclusion from Literature Survey

From above Literature survey, we found some limitations & drawbacks of previously used system that it does not provide authentication to the company about the accuracy due to interference of workers in hammering process & low reliability as it can be overwhelmed by workers, as clinching process is carried with less speed. Proposed System will eliminate the interference of workers in clinching process which will help the company to manages their resources & manpower & time. Also it provides facility of combination of both the clinching and pressing operations on one setup. It will help to deliver the higher production rate to the company.

1.6 METHODOLOGY

In this section, complete details of the project system development are given. In this, we used the pneumatic circuits for performing both operations on single setup (i.e. clinching and pressing) and hydro-pneumatic cylinder is been used for pressing operations.

In clinching operation, the edges of the shield are bent with the help of the clinching jaws that grasps the edges of the Catalytic Converter. Then the pressure is applied on these edges in pressing operation for fixing the heat shield on the Catalytic Converter. In hydro-pneumatics, a small amount of power supply is needed for compression of air which varies as compared to that of earlier used hydraulic press machine. Thus it also helps in saving electricity, reducing the consumption yearly.

On other hand, safety plays a vital role in developing a technically advanced system. No such provisions were taken in earlier ones. Safety of worker relates to productivity and other manual applications of other machine. The new machine deals a lot with prepared sequence of operation. Thus as per machine cycle when operator's both hand are busy at pressing or clinching switch, operation gets executed. In such case it matters a lot with safety of operator. Precautions are taken with specific modification made with new design. The new machine deals with improvising efficiency, decreases cycle time and developing simple working system. It reduces electric consumption in terms of yearly basis.

1.7 LIMITATIONS OF STUDY

Sometimes the pneumatic system may fail to work, due to mechanical trouble or electrical failure. Mechanical faults may develop from excessive jerks which may loosen the mechanical actuating element such as rollers, springs, cams etc. mechanical faults may include faulty signal or may not transmit signal onward. In case of such damage simply repair of damage part is not sufficient but root cause of the faults should be identified and appropriate action to prevent recurrence of similar type of fault in future.

Chapter 2

PROJECT OVERVIEW

2.1 INTRODUCTION

Necessity is the mother of invention. The drawbacks are overcome with engaging newer and improved technology. From past decades brighter and effective technology is single favoured goal of any working system. The drawbacks must be strictly overcome to enhance the level to higher level. As we observed the old machine, we detected various losses associated with it. It was necessary to develop an alternative for it. We certainly have described the new working system with keeping current technology in system. The system is desired to give precise output with an access to provide full automation in future. Our new concept talks more about automation with a view to provide effective work system and reducing human efforts.

The following "Automated Press Machine" is desired to provide economical results. It is described as following in brief: This is semi-automatic machine. The required provisions are provided to make it completely automated if needed. One of major aspect of any system is related to cycle time because, cycle time directly depends upon time lag, economical conditions, safety of workers and accuracy. We have worked over it as it has less cycle time with making system simple. In old machine it has been observed that the surface area of the work piece which is to be hammered is done manually. It must be understand that every part cannot be hammered with a standard as compared to that done mechanically. Thus, new venture talks about providing an improve accuracy for uniform joints with "Automated Press Machine". Further these parts placed on catalytic converter in various types of automobile. It is namely Catalytic Converter Heat Shield, which is main component of exhaust system. Thus, it was necessary to obtain uniform joints with almost no human efforts. Earlier a 10 ton capacity hydraulic press machine required a large amount of power supply in terms of electricity. We later noticed that, such condition deals not only with (electricity) power supply, but also with capacity of press machine. Because required amount of capacity was rated to be 1.5 to 2 tons only.

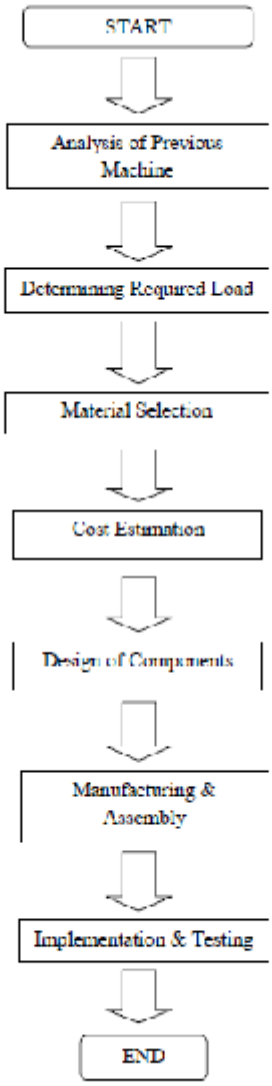

Figure 2.1: Process Flow Chart

2.2 Machine Details

In hydro-pneumatics, a small amount of power supply is needed for compression of air which varies as compared to that of earlier used hydraulic press machine. Thus it also helps in saving electricity, reducing the consumption yearly. Modified and effective body of machine is provided for better manual as well as automatic applications. It is much more economical for high production rate, as system becomes special purpose manufacturing system. The "Automated Press Machine" is more robust as compared to previously used conventional method. It emerges in a very little floor space area resulting in saving the area. It provides uniform joints of Catalytic Converter Heat Shield as compared to old working 10 ton capacity hydraulic pressing machine.

2.2.1 Cavity & Jig and Fixtures

It is heart of the design, as it provides major assistance for the process. Cavity manufactured is required with better surface finish and strength because it further provides perfect shape and size to the work piece. It provides précised output if manufactured as per as requirement and allowable tolerances. Cavity provides effective housing to the work piece, as work piece rests over the cavity for pressing and clinching operations. As output requirement is much accurate, cavity must be able to avoid any kind of flaws associated with the operation.

Material used for cavity is OHNS. OHNS-(oil hardened non-shrinking steel carbon0.9-1.3%, chromium 0.5%, tungsten 0.4-0.8% , it's an alloy steel mainly used for forming dies, its hardened up to 50to 55 HRC OHNS is a kind of material as stated above which is hardened ranging between 50 to 55 HRC. A fixture is a work holding or support device used in the manufacturing industry. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in some cases hold a work piece during either a machining operation or some other industrial process. A jig differs from a fixture in that it guides the tool to its correct position in addition to locating and supporting the work piece.

The primary purposes of jigs and fixtures are to:

- Reduce the cost of production
- Maintain consistent quality
- Maximize efficiency
- Enable a variety of parts to be made to correct specifications

2.2.2 Pneumatic Cylinder for Clinching

Pneumatics is a section of technology that deals with the study and application of pressurized gas to produce mechanical motion. Pneumatic systems are used extensively in industry, and factories are commonly plumbed with compressed air or compressed inert gases. This is because a centrally located and electrically powered compressor that powers cylinders and other pneumatic devices through solenoid valves can often provide motive power in a cheaper, safer, more flexible, and more reliable way than a large number of electric motors and actuators.

Pneumatic cylinder configuration which we used in our machine:-

It's having bore diameter and stroke length (80*60).

Power stroke: 37.5mm

Pressure range: 5 bar 226kg for forward (working) stroke.

Temperature range. : 0 to 85 degree Celsius.

Media: air (40 micron lubricated)

Leakage: bubble tight

Piston rod: carbon steel

End caps: aluminium alloy

Seals: Nitrile rubber, Polyurethanes

2.2.3 Hydro-pneumatic cylinder

Technical specifications and dimensions:

Capacity - the capacity of our hydro pneumatic cylinder is 2.5 ton. But we are working on 2 ton pressure for our pressing operation and 2.5 ton is used for future expansion.

Construction:-

Bore diameter: 40mm

Stroke length: 160mm

Power stroke: 6mm.

Temperature range: 0 to 85 degree Celsius.

Media: air (40 micron lubricated) & oil.

2.2.4 FRL Unit

The air that is sucked by air compressor is evidently not clean because of the presence of various types of the contaminants in the atmosphere. Moreover, the air that is supplied to the system from the compressor is further contaminated by virtue of generation of contaminants downstream. It is also fact that the presence of the air does seldom remain stable due to possibility of line fluctuations. Hence, to enable supply of clean, pure and contamination free compressed air, the air required to be filtered. The system performance and accuracy depends much on pressure stability of the air supply. An airline filter and a pressure regulator therefore, find an important place in the pneumatic system along with a third component – on air lubricator. The main function of lubricator is to provide the air with a lubricating film or oil.

These three units together are called service unit or FRL unit are:

1. Air Filter.
2. Pressure regulator.
3. Lubricator.

Their brief explanation is given below:

2.2.4.1 Air Filter

Air-filters are used in pneumatic system to perform the following main functions:

- To prevent entrance of solid contamination to the system.
- To condense & remove the water vapour that is present in the air passing through it.
- To arrest any submicron particles that may pass a problem in system components.

Table 2.1: Comparison of Pneumatic, Hydraulic, Hydro-Pneumatic System

Criteria	Pneumatic	Hydraulic	Hydro-Pneumatic
Running Cost	Lowest	High	Low
Clamping Cylinder Size	Bulky for even medium force (opt. 5 bar)	Compact (opt. pr 30 to 70bar)	Most compact for heavy forces (op. pr 150 to 200 bar)
Clamping Stroke	Wide Range – Short to very long	Wide Range – Short to very long	Short Stroke – Max 50 mm
Clamping Speed	Very Fast	Fast	Fast
Impact While Clamping	Present	Not Present	Not Present
Reliability	Low	Most Safe	Safe
Sequencing	Possible	Possible	Difficult
Piping & Circuit	Complicated	Complicated	Simple
Oil Heating Prob.	Not Present	Present	Not Present
No. of Clamping Points	No Limit	No Limit	Limited, 3 to 5 per intensifier
Clamping Force	Light – 2 to 3 kN	Medium and Heavy – Above 5 kN	Medium& Heavy – 5 kN to 100 kN
Other Applications	Material Handling, Valve Actuation	Feed Cylinders, Earth Moving Equip.	Pressing Assembly, Riveting

2.2.4.2 Pressure Regulator

The main function of this valve is to regulate the incoming pressure to system so that the desired air pressure is capable of flowing at steady condition.

2.2.4.3 Lubricator

In most pneumatic system the compressed air is first filtered then regulated to the specific pressure and made to pass through a lubricator in order to form mist of soil and air for the sale purposed of providing lubrication to the mating components of valves, cylinders, etc. To form the mist, a lubricator unit is used.

Chapter 3

SYSTEM MODELLING

3.1 INTRODUCTION

CAD Modelling of machine parts is the major part in the system modelling. Unlike other software of Part Modelling, Pro - Engineer focuses on the use of objects design in most convenient way. This uses the objects to design various components as per the requirement and need of the project. System modelling helps the analyst to understand the functionality of the system and these designed models are applied in various fields of the organisation according to their applications. The software Auto-CAD is used for drafting purposes. As the tolerances required for machining of components can be provided easily in this software as tolerance cannot be provided in Pro-E. The system modelling defines different models that represent the system from different perspectives.

3.2 Constructional Details

The machine has numerous components installed with it. Every material has a kind of unique property associated with it. This is required to serve proper functioning and long run of the machine. Every material has a range of properties consequently it is essential for user to opt for pertinent kind of material for construction of machine. Vibration and associated resonant frequencies are most deadly factor for any working system, thus it is quite necessary to avoid it by using isolators and shock absorbing devices, similarly for reliable and efficient functional activities, we must have to select suitable type of material.

The CAD Modelling of Press Machine is mainly divided into five major parts. They are as follows:

1) Clinching jaw
2) Press tool
3) Base plate
4) Pillars
5) Top plate

3.2.1 Clinching Jaws

Clinching operation is major part of the process, where work piece is clinched on either side. The Press Machine is semi automatic, thus it eradicates all human efforts which were been associated with the old machining techniques. For clinching operation, work piece is kept between the jaws or hold between the jaws. Later, work piece is surrounded by two sided jaws to make holding modus operandi more effective. Material selected is based as per as metallurgical aspects and type of operation. It resembles quality of selection and life of the machine. Material used in clinching jaw manufacturing is OHNS. OHNS is a kind of material as stated above which is hardened ranging between 50 to 55 HRC. The value of HRC is kept low for clinching jaw manufacturing as compared to that of cavity manufacturing. Clinching is a process allied with holding and other machining techniques, thus proper adjustments are necessary to execute to operation in accurate time span and precise quality level.

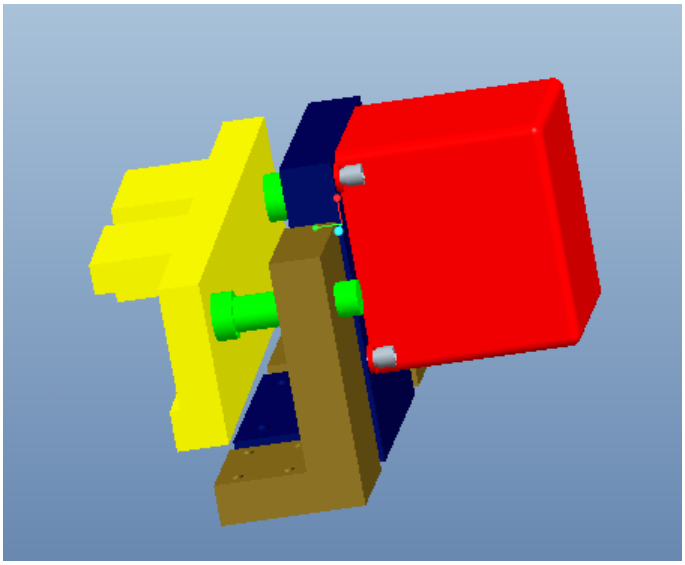

Figure 3.1: Clinching Jaws

3.2.2 Press Tool

Press tools are commonly used in hydraulic and mechanical presses to produce components at a high productivity rate. Generally press tools are categorized by the types of operation performed using the tool, such as blanking, piercing, bending, forming, forging, trimming etc. The press tool will also be specified as blanking tool, piercing tool, bending tool etc. Pressing is operation carried over work piece after clinching. Press tool must have properties required for accomplishment of the process. Press tool must have high reliability in terms of productivity and heat dissipation. Tool is required to provide good strength and wear resistance. Material used for selection of press tool is EN31 [EMERGENCY NO] of

OHNS material. An assortment of manufacturing processes is coupled with the development of press tools. These processes are pooled to endow with the purposeful requirement and specific output. Cavity is six side right angled machined. Further, grinding operation is also carried after press tool is six side right angled machined. Generally, press tools both the operation to replicate it over the output. It is basic serviceable constraint for developing any tool with perfect facade finish and geometrical appearances.

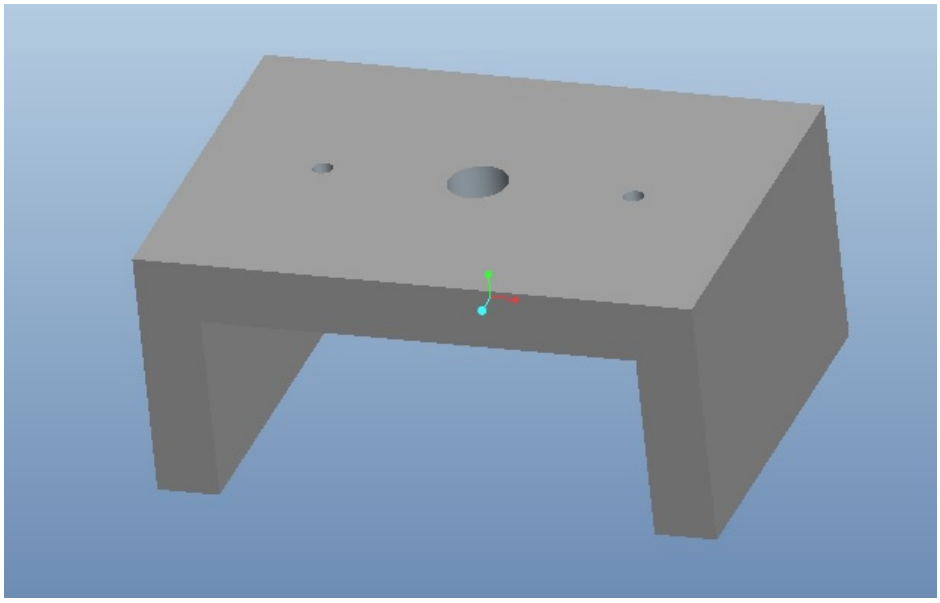

Figure 3.2: Press Tool

3.2.3 Base Plate

Base plate is the basic load carrying component of Press Machine. Base plate acts as an foundation base, it should be able to withstand against critical and normal working conditions. Forces that normally acts over base plate - (compression, tension, bending, shear) Base plate has to be as thick as required because its main objective is to avoid bending. Bending of plates is normally observed due to excessive acting of loads, idealistic constructional specifications, environmental and climatic conditions, excessive work loading etc. In press machine, the required amount of thickness was 30mm having width*length (W*L) equal to (700*700). Constructional requirement was identified using the strength and weight of the product to assemble for which the respective thickness was sufficient. Numerous manufacturing processes are attached with the development of required base plate. These processes are pooled to bestow with the focused necessity and determined strength base plates are six side right angled machined. Later, base plates are subjected to top bottom grinding. Material used for base plates are MS PROFILE.

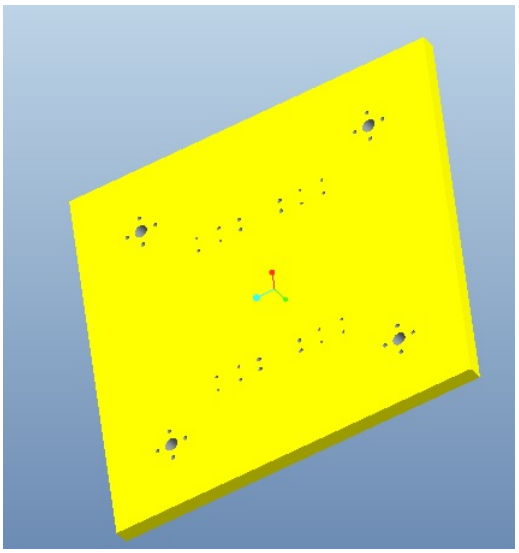

Figure 3.3: Base Plate

3.2.4 Pillars

Pillars acts as a vital component in press machine. It helps to transmit the load of the upper section of the machine to the base plate. It enables to execute the process of clinching and pressing by transmitting unwanted reactive loads and vibrations to the base plate.

Number of pillars used: Four (4) Pillars are of 40 mm diameter and 500 mm length.

Material used in selection of pillars is MS (MILD STEEL)

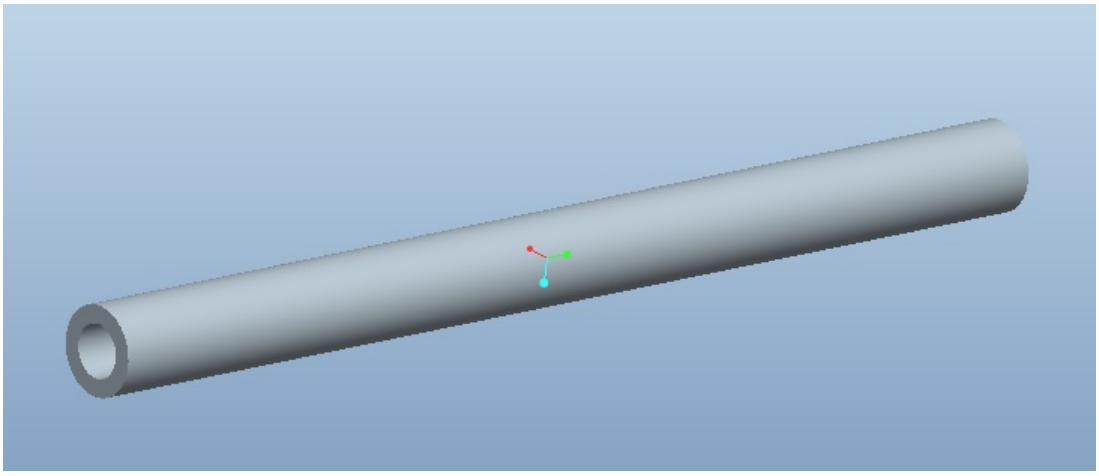

Figure 3.4: Pillars

Functional requirement of pillars-

As it is stated above functional requirement provides firm and rigid structure. It enables to avoid any kind of danger and provides operator's safety. Pillars are manufactured using by length machining techniques where straightness and proportion is considered. It provides a support to the system. As it is shown in the images, pillars are drilled at both

ends to elevate upper and lower sections of the machine. They are bolted on both sides over top and base plate respectively.

3.2.5 Top Plate

Top plate is the basic load carrying component of press machine. Top plate acts as a foundation base, it should be able to withstand against critical and normal working conditions. Forces that normally acts over top plate-(sagging, bending, shearing, tensile, and compressive). Top plate has to be as thick as required because its main objective is to avoid bending. It is generally observed that various types of forces and couples act over the plate which results in sagging action. In this machine, the required amount of thickness was 25mm having length*breadth (L*B) equal to (600*600). Constructional requirement was identified by means of the strength and weight of the product to assemble for which the respective thickness was sufficient. Dimensions of top plate in terms of geometry are kept quite lesser than that of compared to base plate. Numerous manufacturing processes are attached with the development of required base plate.

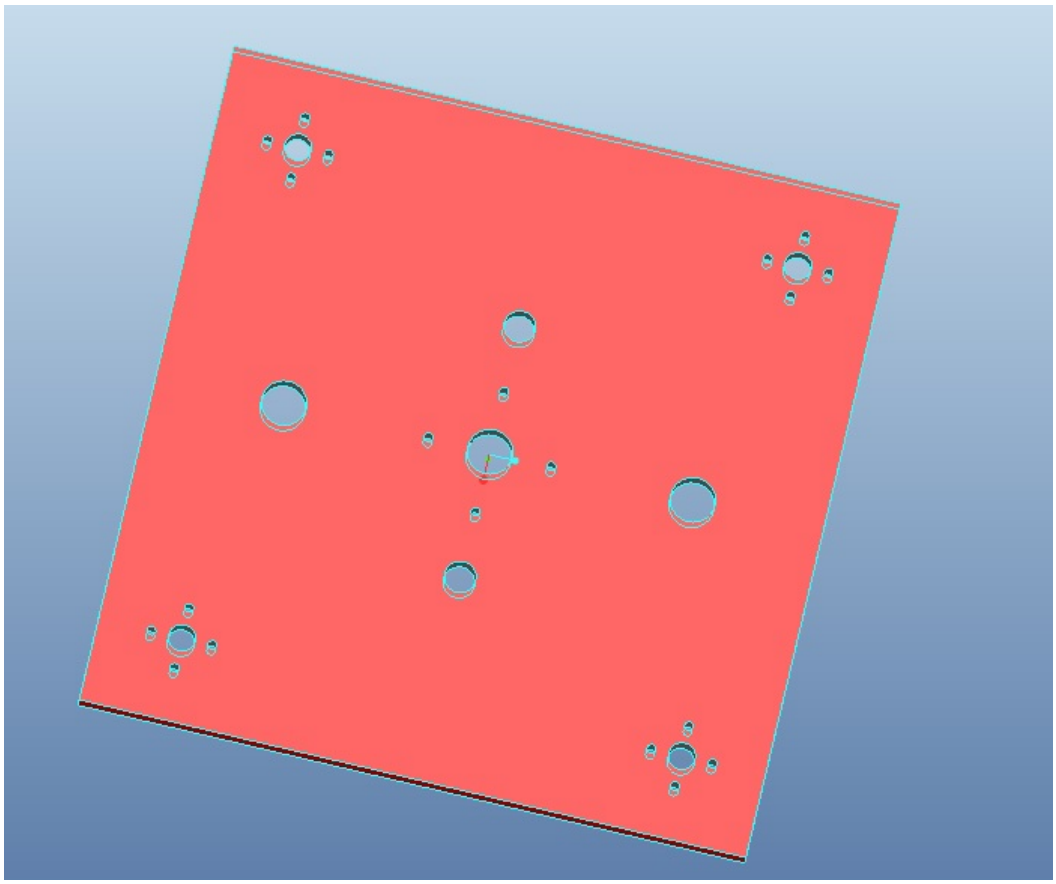

Figure 3.5: Top Plate

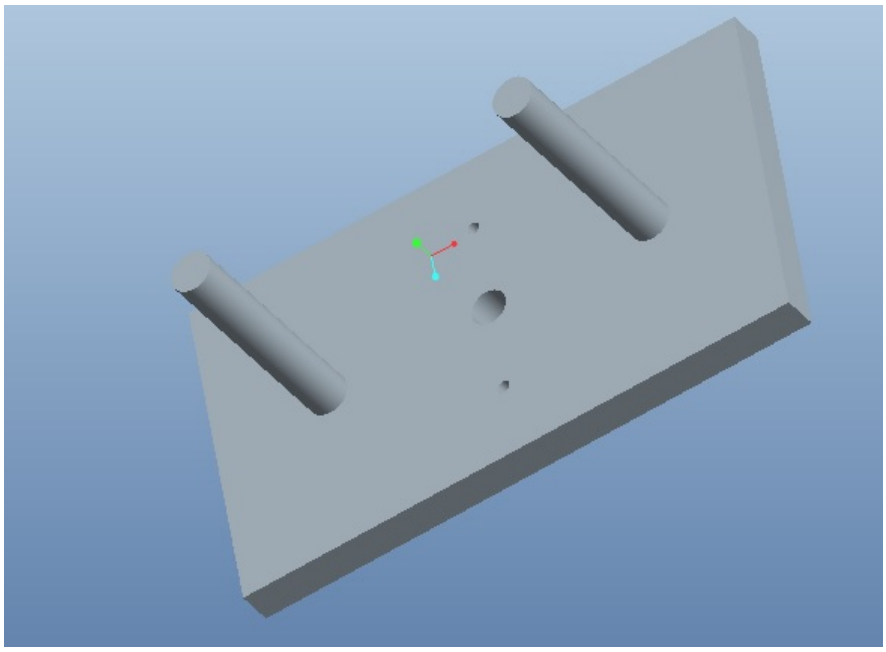

Figure 3.6: Top Guide Plate

These processes are pooled to bestow with the focused necessity and determined strength base plates are six side right angled machined. Later, base plates are subjected to top bottom grinding. Material used for base plates are MSPROFILE.

3.3 Circuit Diagram

The design of the circuit diagram of the automated press machine is totally based on pneumatic circuits. In automated press machine we have used two cylinders that comprise of:

1. Pneumatic Cylinder
2. Hydro – Pneumatic Cylinder

3.3.1 Pneumatic Cylinder

Pneumatic cylinder is used for the clinching operation. The clinching operation consists of bending the edges of the heat shield by an angle of 90 degree so as to grab the edges of the catalytic converter and further press it down by the press to grasp the edges of the catalytic converter and the heat shield. Pneumatic cylinder pushes the clinching jaws on the action of the compressed air towards the edges of the heat shield for clinching operation. The Pneumatic cylinder works on the principle of the compressed air which uses it as a medium where it transfers the pressure energy of the air into the mechanical motion. This is because a centrally located and electrically powered compressor that powers cylinders and other pneumatic devices through solenoid valves can often provide motive power in a cheaper, safer, more flexible, and more reliable way than a large number of electric motors and actuators.

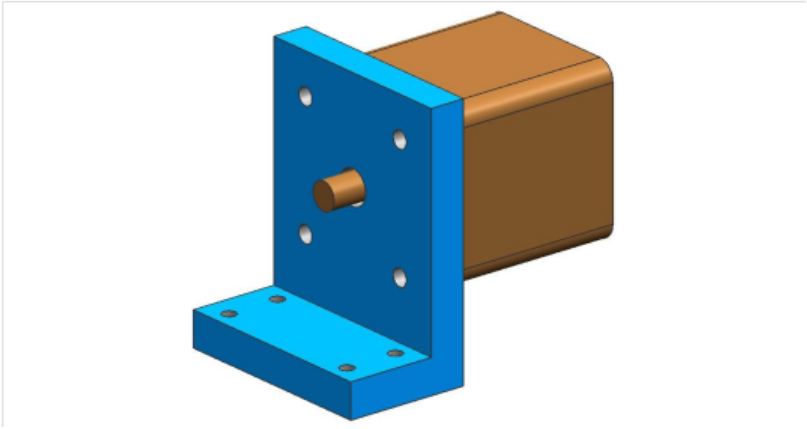

Figure 3.7: Pneumatic Cylinder

3.3.2 Hydro – Pneumatic Cylinder

The Hydro-Pneumatic cylinder is used for the pressing operation. After clinching the edges of the heat shield, the next step is to press those edges to grasp the edges of the catalytic converter. The Hydro-Pneumatic cylinder is used for the pressing operation of the heat shield edges with the application of the intensifier used to operate the hydro-pneumatic cylinder to press the edges. The intensifier used at the machine is also used for the compensation of the pressure acting on the workpiece by the press. The load range used for the pressing operation is between 1.5 to 2.5 ton. The hydro-pneumatics is taken into consideration due to its several advantages such as low running cost, simpler in piping and the circuit, fast operating speed, no oil heating problem and safe in reliability.

The capacity of our hydro pneumatic cylinder is 2.5 ton. But we are working on 2 ton pressure for our pressing operation and 2.5 ton is used for future expansion.

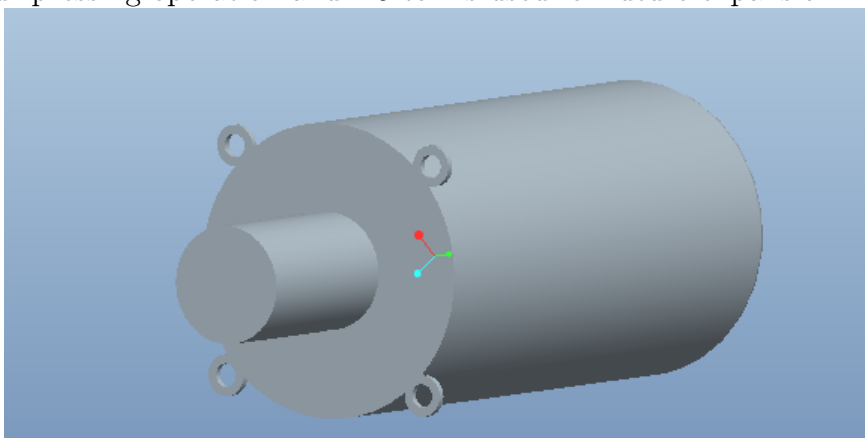

Figure 3.8: Hydro-Pneumatic Cylinder

3.3.3 Circuit diagram explanation

As shown in the circuit diagram, circuit is very simple to understand and easy to operate manually. It provides worker's safety and reduces machine cycle time. Figure illustrates

respective sequence of operations which are performed in the following manner. Initially operate places the part manually in the cavity. Machine have four numbers of press push buttons namely ABCD. If operator presses only "A" button, cylinder will not operate, even if operator presses A and B both, to will not operate. The system is provided with basic constraint in pressing actual buttons to execute the clinching and pressing operation. Purpose is to have such constraint in the system is to provide workers safety. Clinching operation will be executed by pressing buttons "A" and "D" which are situated to extreme positions on switch panel, while pressing will take place if the buttons "B" and "C" are much necessary to avoid a case of accident when worker both hands are in operation. When switch A and D are operated, air from the compressor is supplied to double acting cylinder FRL unit. The push button actuated 5/2 DCV is used for direction control for clinching operation whereas, for pressing operation when push button B and C are pushed 3/2 DCV is used for control over execution of respective operation.

When DCV is in position 1 air enters into the piston end side of the cylinder and the rod end is connected to the exhaust through silencer. The cylinder moves in the forward direction. When DCV is changed to position 2, air enters into the piston rod end side of the cylinder and piston end is connected exhaust. Therefore, the piston returns back to its original position due to high pressure acting on piston its position rod and side of cylinder with provides clinching operation.

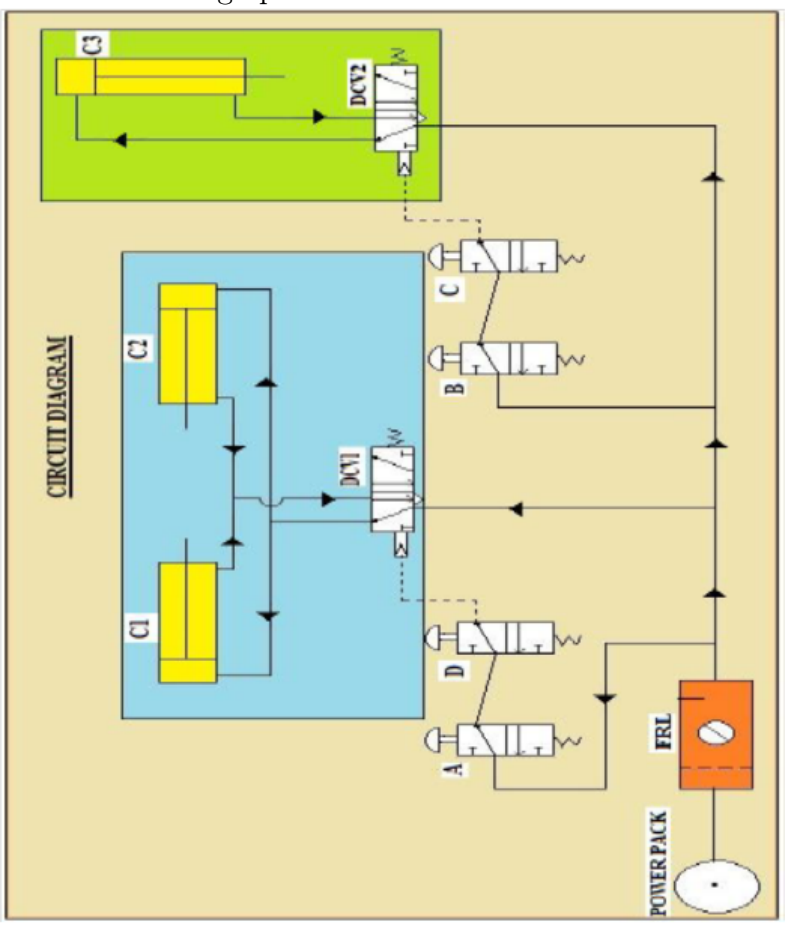

Figure 3.9: Hydro-Pneumatic Circuit

$$pressure \propto force$$

$$\boldsymbol{pressure} = \frac{force}{area}$$

$$\boldsymbol{pressure} = \frac{1.5 \times 10^3 \times 9.81}{\pi r^2}$$

$$\boldsymbol{pressure} = \frac{1.5 \times 10^3 \times 9.81}{\pi \times 20^2}$$

$$\boldsymbol{pressure} = \mathbf{11.709\ N/mm^2}$$

hence as the load increase, input power will increase.

Therefore,

thickness of heat shield assembly
= thickness of heat sheild + thickness of catalatic converter

$$thickness = (0.6 + 8)mm$$

$$\boldsymbol{thickness = 8.6\ mm}$$

Depending upon the thickness of the heat shield, the required load will be 1.5 tonne for pressing the heat shield with catalytic converter.

Density of Mild steel is =7.85gm/cm³

Ultimate tensile strength= 400N/mm²

$$\boldsymbol{\sigma_{all} = \frac{S_{ut}}{3}}$$

$$\boldsymbol{\sigma_{all} = \frac{400}{3}}$$

Allowable tensile strength =133.33N/mm²

$$\text{Thickness of top plate} = \frac{P_{in} \times side}{2.1 \times \sigma_{all}}$$

$$t_{top} = \frac{11.709 \times 600}{2.1 \times 133.33}$$

$$t_{top} = 24.78\ mm \approx 25\ mm$$

$$\text{Weight of top plate} = v * \rho * g$$

$$= (0.6\ m \times 0.6\ m \times 0.025\ m) \times (7.85 \times 10^3) \times 9.81$$

$$= 693.07\ N$$

$$\text{Thickness of base plate} = \frac{Pin \times side}{2.1 \times \sigma_{all}}$$

$$t_{base} = \frac{11.709 \times 700}{2.1 \times 133.33}$$

$$t_{base} = 29.27\ mm \approx 30\ mm$$

$$\text{Volume of Cylinder} = A \times h = \pi r^2 h$$

$$= 628.318\ m^3$$

$$\text{Weight of base plate} = v * \rho * g$$

$$= (0.7\ m \times 0.7\ m \times 0.030\ m) \times (7.85 \times 10^3) \times 9.81$$

$$= 1132.025\ N$$

$$\text{Total Load} = \text{Static Load} + \text{Dynamic Load}$$

$$= (1.5 \times 10^3) + 1132.025$$

$$= 2632.025\ N$$

Weight of Fixture = 122.6 N

Weight of Pillar = 193.54 N (each)

$$\text{Total Weight of Pillars} = \text{Weight of Pillar} \times \text{No. of Pillars}$$

$$= 193.54 \times 4$$

$$= 774.16\ N$$

Chapter 4

IMPLEMENTATION DETAILS

4.1 INTRODUCTION

Every system works on a systematic kind of work pattern. It is very essential for manufacturer to reduce any kind of detectable flaws regarding working and execution of process. Machine cycle talks about present field work and concept of reducing time span and motivating operator's safety. Machine cycle talks about the actual kind of technique to be implanted to reduce rasping phase between operator and machine itself. It provides a dedicated action of system and control given by the operator. Machine is an allied form of components, which must be handy with operator to concise, the work in short span of time. Machine cycle is a selected path pattern designed to work in less time and more efficiently.

The press machine has a machine cycle based on three basic aspects, they are:

1) Total time required
2) Productivity
3) Operator's safety

4.2 Design of Machine Instruction Control Panel

Machine has four number of press push button. Each button is accessed with design of pressing as they operate as per as designed pushing pattern. Figure shows the basic pattern of the four press buttons over the control panel. Each button is named for operator's convenience. Four of the buttons as shown in figure are named A B C D respectively.

4.2.1 Process of Operation

A) Clinching:

CONDITION 1: If the operator presses button "A" no cylinder will operate.

CONDITION 2: if the operator presses button "D", no cylinder will operate.

If the operator presses both "A" and "D" at same time, clinching operation will take place.

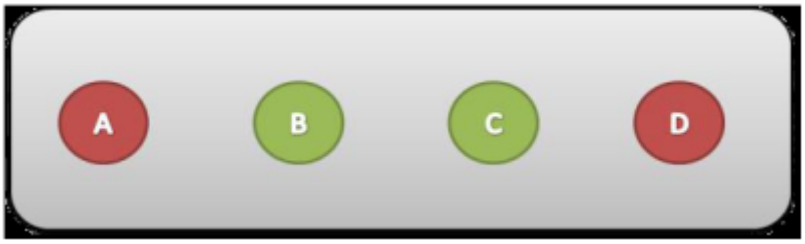

Figure 4.1: Control Switch (Clinching)

B) Pressing:

CONDITION 1: If the operator presses button "B" no cylinder will operate.

CONDITION2: if the operator presses button "C", no cylinder will operate.

If the operator presses both B and C at same time, pressing operation will take place.

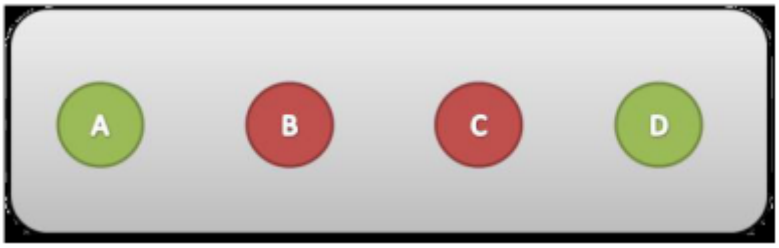

Figure 4.2: Control Switch (Pressing)

4.2.2 Objective

Our major concern is over operator's safety, because it engages operator's both hands in operation. It eliminates any sight of confusion and making the process flawless. It avoids any kind of accidents and makes the process hazard free. Other major concerns are related to time, as it reduce time span and increases productivity. Further if develops a safe working environment for the operator.

Chapter 5

TESTING

5.1 INTRODUCTION

Testing is a critical element of quality assurance and represents the ultimate review of specification, design and generation. Testing is the process of evaluating a system or its components with the intent to find that whether it satisfies the specified requirements or not. This activity results in the actual, expected and difference between their results. In simple words testing is executing a system in order to identify any gaps, errors or missing requirements in contrary to the actual desired requirements.

5.2 Economical Benefit

ECONOMICAL BENEFIT is defined as the difference between the cost of previously used method and present method. It's the amount of money being saved in the method after making some modification in it.

- The cost required for clinching and pressing in previously used method is **Rs. 3.64/-** as mentioned in Sharda Motor Industries manual.
- Also, the cost required for clinching and pressing for one part in present method is given by the ratio of total cost of silencer leakage machine to the number of silencer checked in the life of that machine.
- The Total cost is given by, Manufacturing cost of machine + labour cost for manufacturing = **Rs. 1,30,080/-**
- Maintenance cost of the clinching and pressing machine for its life time = **Rs. 15,000/-**(As mentioned in the product manual of the "SHARDA MOTOR INDUSTRIES LIMITED")
- Labour cost for work piece assembly = **Rs. 4, 60,000/- (approx.)**
- Operating cost for machine = **Rs. 1,38,000 (approx.)**

- Therefore, Total cost = 1,30,080 + 15,000 + 4, 60,000 + 1, 38,000 = **Rs. 7,43,080 /-**

Also, number of parts assembled in the life estimated life of the machine is calculated as,

1. There is a machine for assembling the heat shield on catalytic convertor in "SHARDA MOTOR INDUSTRIES LIMITED".

2. An estimated life of a machine about **5 years.**

3. The total numbers of clinching and pressing operation in the industry are **400** approximately per day.

4. The non-working days in a month are 4.

Therefore, numbers of non-working days in a year are,

= 12 x 4 = **48.**

5. Considering number of holidays in a year equals to 12, the total number of non-working days are,

= 48 + 12 = **60.**

6. Therefore, Total number of working days in a year will be,

Total number of days in year – Total number of non-working days in a year

= 365-60 = **305**

7. In each day, 400 clinching and pressing operation performed by machine.

So, no. of clinching and pressing operation per year will be,

= 400 x 305 = **1, 22,000.**

8. Number of parts assembled during its estimated life,

= 1, 22,000 x 5 = **6,10,000**

Substituting the value, Cost required for clinching and pressing operation in present method = 7,43,080 / 6, 10,000 =**Rs.1.22 / assembly**

Now, we will get the economical benefit, which is,

Economical Benefit = Rs. (3.64 – 1.22) = **Rs. 2.42 /-**

If we calculate the cost save by a "Automated Press Machine" in its per year, it will be, = Rs. 2.42 x 1,22,000 = **Rs. 2,95,240/-**

Thus, total saving in estimated life of machine will be = 5 x 2,95,240 = **Rs. 14,76,200 /-**

Thus, as explained above, present "Automated Press Machine" is not only time saving but it also saves lot of money and is also economically beneficial.

5.3 Maintenance

In comparison to other types of mechanical system pneumatic and hydro-pneumatic systems are found to be less problematic and hence offer more trouble free life. However, the industrial experience shows that even the system fails and hence to avoid these failures, pneumatic system should be subjected to regular and preventive maintenance.

5.3.1 Preventive maintenance

5.3.1.1 Daily

The Daily Maintenance:

1. Keep the machine clean.
2. Switch off the power supply and air supply whenever the press is not use.
3. Observe the oil spray from exhaust silencer.

If the auto lube counter is not set correctly and excess oil is released into the cylinder, the solenoid valves may get chocked and stop working. Excess oil and water is also indicated as a spray from the exhaust silencer. If excess oil is released, then the solenoid armature parts should be cleaned and dried

5.3.1.2 Weekly

Weekly Maintenance Program:

1. Top the cylinder with oil as per manufacturer catalogue.
2. Observe the any leakage of oil from bleed holes.
3. Observe if too much oil is spraying out of the 3 exhaust silencer.

5.3.1.3 Yearly

Yearly Maintenance Program:

1. Clean or replace three silencers.
2. Check the condition of hose pipe and replace if required.

5.3.1.4 Seal change

The normal life of seal is 1 million cycles or 3 years whichever is easier. It is recommended that even though the seals are not leaking after 3 years of 37 installation, they should be replaced as the properties of rubber parts deteriorates with time.

5.3.2 General caution

The general precautions to be taken are:

1. Ensue that the press is not operated above its rated capacity and in no case should it be operated above an input air pressure of 6 bars.
2. Use only recommended spares which should be procured authorized service centre.
3. The press should be serviced by trained and authorized personnel only.
4. Ensure that the press applies force centrally.

The cylinder has not been designed for cantilever loading. In case of eccentric loading, ensure that there is a flexible coupling connecting the cylinder to the tool.

5.3.2.1 Seal failure

Seal failure is indicated:-

1. When excess oil comes out from the silencer, the cylinder will have to be opened and seals will have to be replaced

2. Oil accumulates at the bottom of cylinder and reservoir. Check for source of leakage.

3. If oil is coming out of bleed holes .then cylinder seals need to be change.

4. If the leakage is from oil fill plug or gauge isolator screw, the cylinder need not be opened and the leakage can be stopped by replacing the "o" ring on oil fill plug and gauge isolator screw.

Maintenance periods should be scheduled in accordance with frequency of use and working environment of the cylinder or press. All cylinders and press must be visually inspected for wear and given an “in system” operating performance and leakage test at least once a year. If these visual observations indicate cylinder or press repair is required, the cylinder must be removed, repaired and tested. A major overhaul is recommended at one million cycles. However, where frequency of use is such that it would require more than two years to obtain one million cycles, the cylinder and press must be overhauled at the two year period. When it is determined that the cylinder or press requires a major repair as a result of the one million cycles, one year routine inspection, or the two year service period has elapsed, the device must be disassembled, cleaned, inspected, parts replaced as required, rebuilt and tested for leakage, and proper operation prior to installation.

5.3.3 FRL unit

FRL unit is use to protect the system from undesirable foreign particles, to maintain steady pressure of air supply and to lubricate the compressed air. To maintain overall health of system, the FRL unit should be given proper attention. Following maintenance activities should be carried out at proper interval.

1. Check the operation of the FRL unit monthly to make sure it is in good operating conditions.

2. Increase or decrease frequency depending on the usage.

3. Drain the filter bowl or replace the filter if necessary.

4. Add lubricating oil to the lubricator if necessary

5. Never put synthetic oil or organic solvent into the Filter or Lubricator Bowl – they are not compatible!

6. Make sure that the service pressure does not exceed 150 PSI

5.3.4 Line problem

The major problem in the pipe system is mostly related to the leakage of compressed air through pipeline fitting and glands and other joint is regular and routine problem.

Leakage detection is most important activity in the maintenance. If amount of leakage of compressed air is quite significant, air escape with noise and hence leakage is identified. If leakage is less or minute, leakage is done by applying soap so on the joints and when required.

5.3.5 Circuit

Though a pneumatic system is properly design with best possible care, trouble may occur due to improper circuit diagram of the system.

To avoid this faults following steps are taken:-

1. The circuit diagram of the system should be drawn and understand the functional aspect of total system.

2. Try to ascertain the sequential aspect of cylinder, travels along with the component.

3. Faulty element should be deleted by operating the system element one after the other according to sequence of circuit diagram.

5.4 Results and Discussions

The Results obtained after testing the newly designed machine, the results obtained as compared to previous machine are given in table below:

Table 5.1: Comparison of the Parameters of Previous and Newly Designed Machine

Parameters	Previous Machine	New Machine
Size	Bulky	Compact
No. of Operations	1	2
No. of Parts Produced	255	400
Time Consumption	More	Less
Fatigue to Operator	More	Negligible
Energy Consumption	Maximum	Less
Reliability	Less	More
Efficiency	Poor	High
Capacity of Machine	10 Tons	2.5 Tons
Required Load	4 Tons	1 – 2 Tons
Type	General Purpose	Special Purpose

The results obtained by the current machine are, it is more reliable than the previously used machine. Also, it gives the maximum efficeincy as compared to older machine. It imrpoves the productivity of the company by near about 60% as by producing 400 parts per shift as compared to the figure of 255 parts per shift produced by hte previous machine. The time consumption along with the consumption of energy is less and it gives less fatigue to the operator.

Chapter 6

FUTURE SCOPE

The Catalytic Converter Heat Shield Assembly machine is now been operating between the load range of 1.5 tons to 2.5 tons. The estimated measures of the productivity and the cost on the machine are of 5 years.

For future expansion of the project, the machine can be operated under the load range of 2.5 tons and above according to the workpiece parameters. The integration of the Hydro-Pneumatic Circuit in the setup is beneficial for the saving of the time of production thus, hereby increasing the quantity of the production along with the quality.

The combination of both the circuits in the setup will help the company to conduct any other kind of production of components by changing the fixture on the setup in accordance with the use of the machine for multiple products. Thereby, the machine will be a multipurpose setup for the production

The newly designed machine fulfils all necessary requirements for the assembly and other operations as Clinching and Pressing and increase the productivity of machine and ultimately the productivity of company are successfully.

The modification can be done in the machine in future will be: To provide the ability to change the fixture according to different sizes of workpiece and different applications and purpose of production frequently.

Chapter 7

CONCLUSION

While selecting a project, our main goal was to gain practical knowledge rather than theoretical knowledge. During the grounding of project, we got great experience of work. We come to conclusion that theoretical knowledge from books and practical knowledge when actually working in workshop both are different things. Catalytic Converter heat shield assembly SPM is easy to operate and efficient in working. Mechanization is the need for any respective organization or technically dedicated developing country. It plays role of backbone for manufacturing as well as financial growth. Automation may provide helpful measures to avoid fiscal discrepancy. Our system is more productive providing ease of operation in terms of assembly and manufacturing techniques. Also, this system is more beneficial in plummeting manufacturing lead time and improving shop floor efficiency. We are sure that this valuable experience is useful in our future life in all aspects.

References

References:

[1] O.P. Khanna – A text book of material science and metallurgy, Dhanpat rai and Sons.

[2] Maintenance manual – Rextorth.

[3] Product Manual & Holiday Sheet - Sharda Motor Industries Limited

[4] Maintenance Engineering Handbook – L. R. Higgins – Tata McGraw Hill.

[5] Book on industrial fluid power – Andrew Pearson

[6] www.yogeshwarind.com

[7] www.shardamotorsltd.com

Appendix

Figure 7.1: Catalytic Converter Heat Shield Assembly

Figure 7.2: Catalytic Converter & Heat Shield

Figure 7.3: New Machine

Figure 7.4: Previously Used Machine

Figure 7.5: Heat Shield Before Assembly

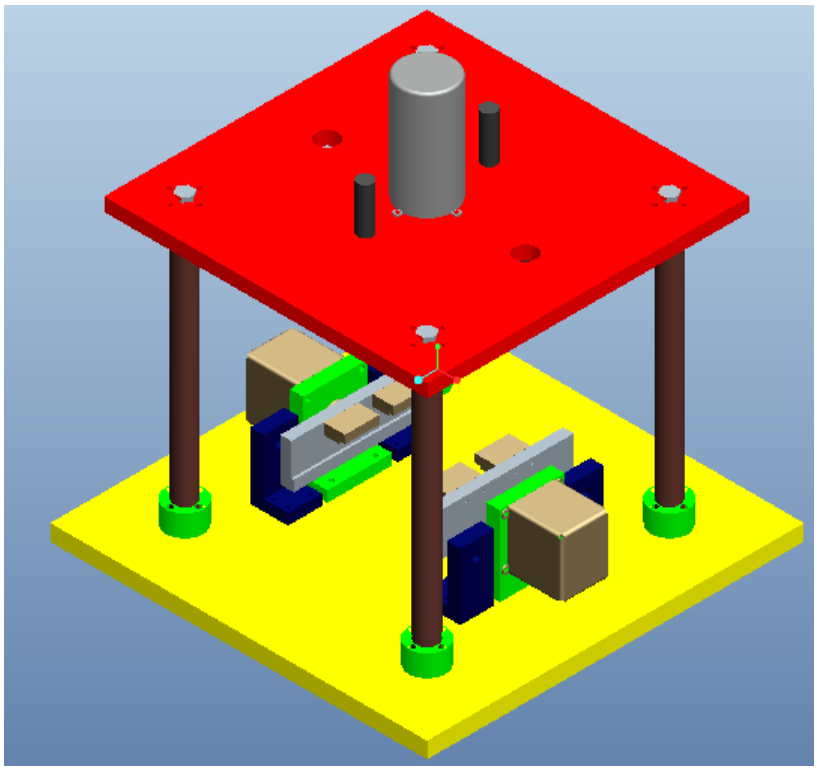

Figure 7.6: Machine Model

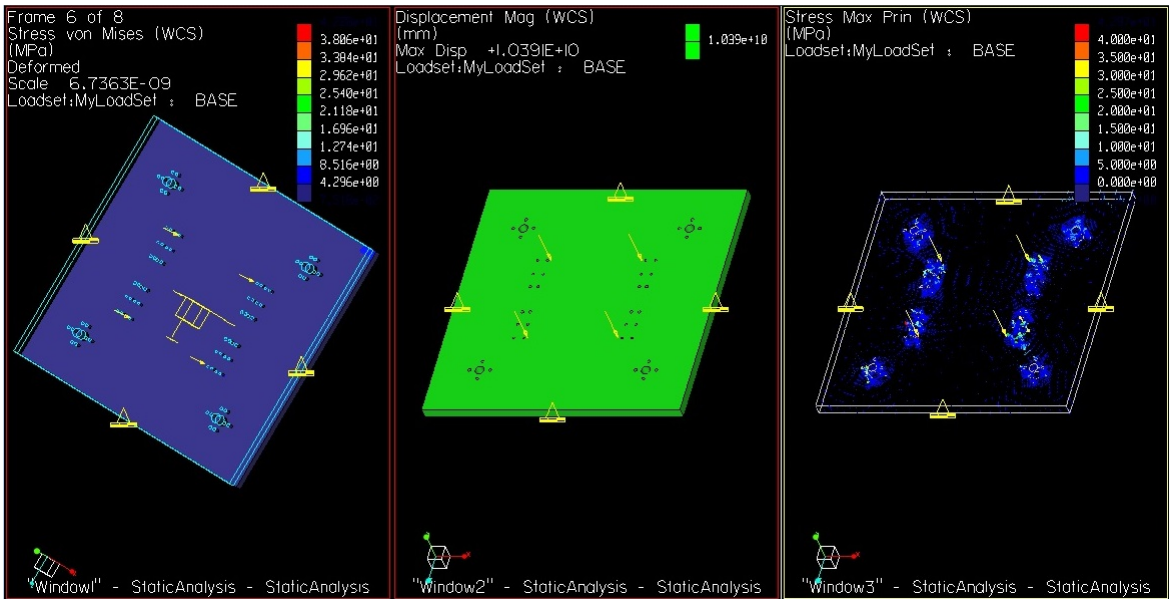

Figure 7.7: Analysis of Base Plate

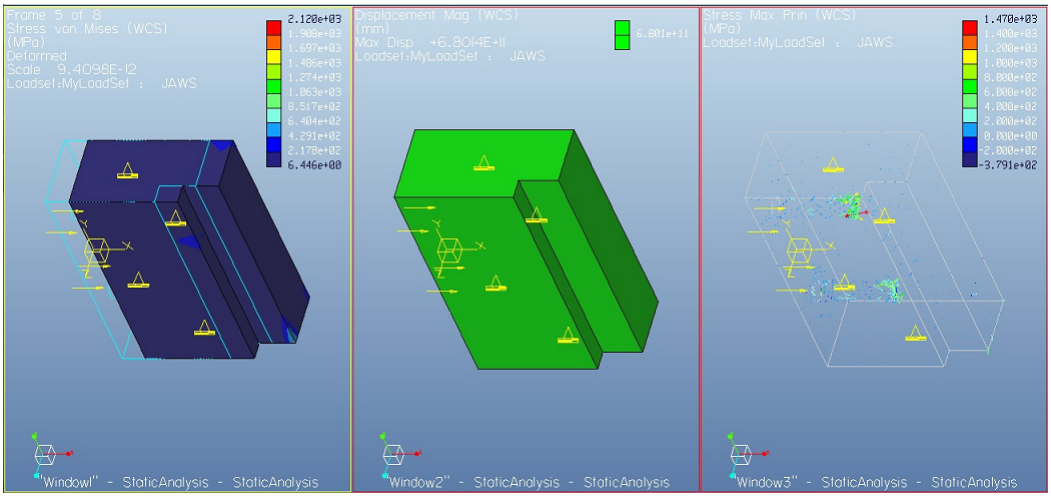

Figure 7.8: Analysis of Jaws

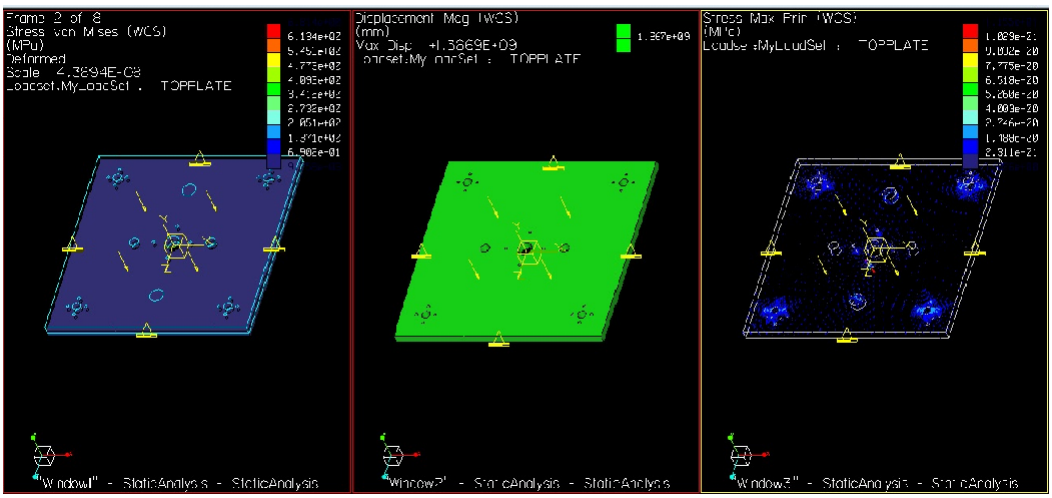

Figure 7.9: Analysisi of Top Plate

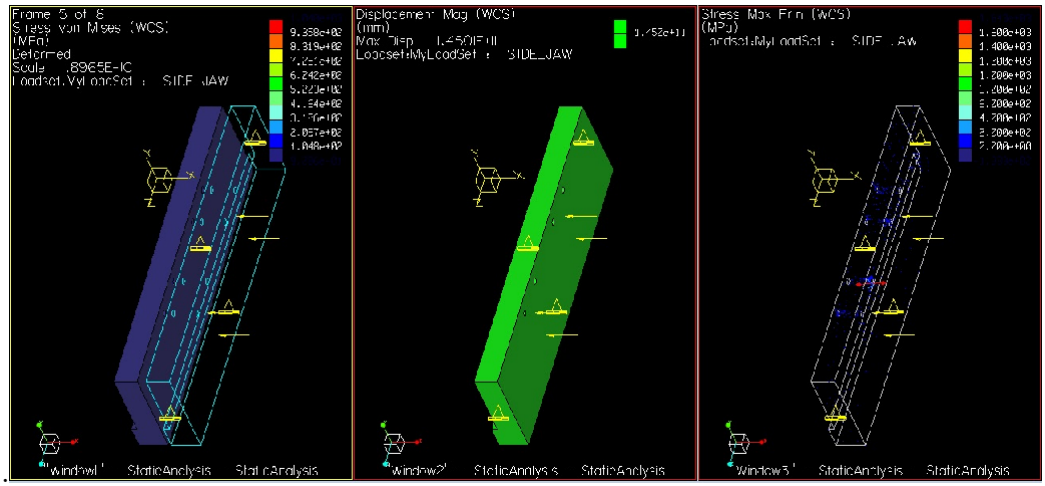

Figure 7.10: Analysis of Side Jaw