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Cost saving of clinching operation by using hydraulic and pneumatic actuators

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Abstract
Clinching is also known as press joining. It is high speed mechanical fastening technique for point joining of sheet metal component. The heat shield and catalytic converter are to be joint together by using clinching operation. Previous process had problem regarding more cycle time, accuracy, rejection and manufacturing cost. In this paper we have implemented new method of clinching by using hydraulic and pneumatic actuator.

Keywords: Clinching, catalytic convertor, heat shield

1. Introduction
Automation is much helpful in cost saving and to increase the productivity of the system. It is totally based on clinching. For any industry, it is much important to implement the new techniques and associate 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. It reduces the rework and rejections, thereby reducing the material and manufacturing cost. The machine 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. It is special purpose oriented machine which carries a special purpose operation methodology for clinching operations.

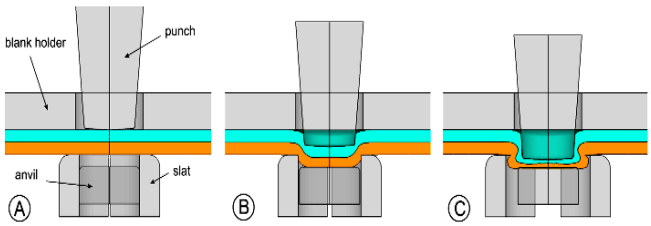

Fig 1: Clinching process.

1.2 Review of Previous Process
1. Manual Bending
2. Post Hammering Process
3. Cycle Time.

1.2.1 Manual Bending
In this method, the heat shield and catalytic converter which are to be joint together by using clinching operation 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.

1.2.2 Post Hammering Process
It is 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.

1.2.3 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. 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.

Fig 2: Cat-con and Heat Shield

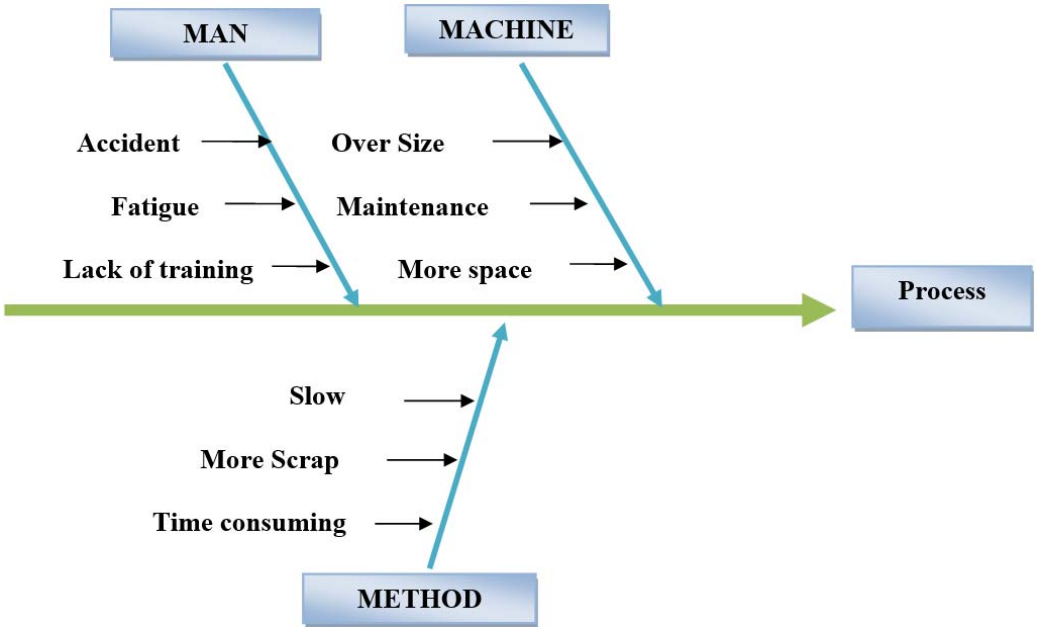

Fig 3: Cause and defect diagram

1.3 Overcoming the effects of cause-effect diagram:

1.3.1 Man

The new process the operator to engage his both hands to operate the machine therefore it results in minimising the accidents as hands are busy in operating the machine. The process of clinching got simple and time saving so fatigue to worker is also got reduced as well an untrained worker can use it as effective as a trained worker.

1.3.2 Machine

Size of the machine reduced in a very considerable manner but there's no effect of it on its efficiency. This reduction in size results in a more proper utilization of floor space area. Maintenance of new machine is become very simple as all the operation is done with hydraulic and pneumatic means.

1.3.3 Method

Use of hydraulic and pneumatic system results in a fast operation of the process which in turn gave less time consumption. This automation also gave less scrap production as compared to the previous machine.

2. Methodology

In this, we are 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. 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 previous used press machine.

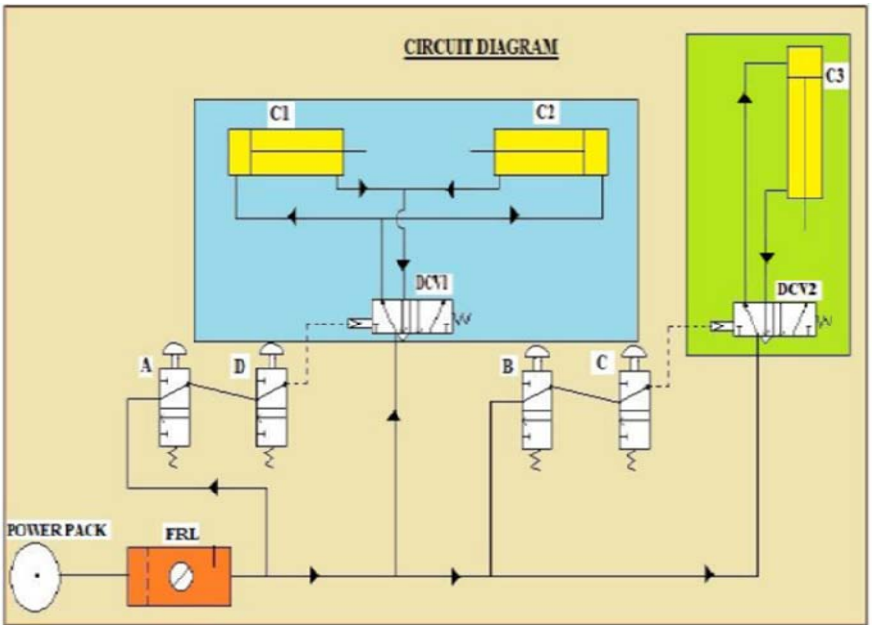

Fig 4: Hydro-Pneumatic circuit

3. Circuit diagram explanation

It provides worker's safety, reduces machine cycle time and save cost. 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.

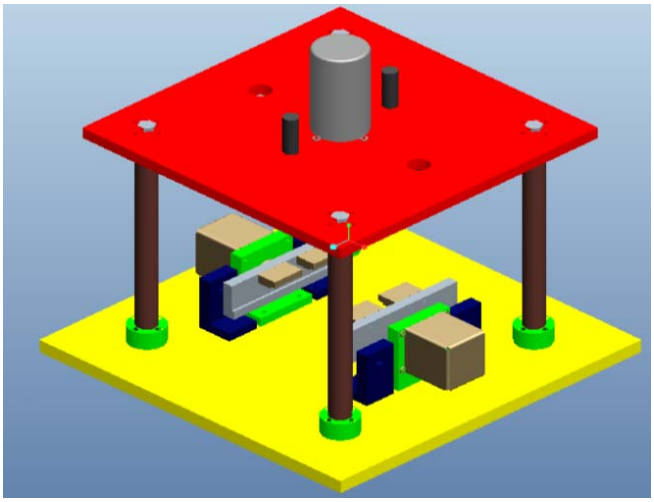

Fig 5: Assembly Model

Fig 6: Previous machine

Fig 7: New machine

4. Economic Benefit

Economic 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.

Table 1: Saved Cost Comparison.

S. No.	Cost/unit (using Previous method)	Cost/unit (using Proposed method)	% saving in Cost/unit
1	Rs.3.64	Rs.122	66.5%

Table 2: cost /unit in Rs. for previously used method

S. No.	Cost/unit (using Previous method)
1	Rs. 3.64/unit

Table 3: Cost/unit by using new machine.

S. No.	Particulars	Cost (Rs)
1	Manufacturing cost of machine + labour cost for manufacturing the machine	26016
2	Maintenance cost/year	3000
3	Labour cost for w/p assembly/year	92000
4	Machine operating cost	27600
5	Total cost	148616
6	Total no working days	305 days
7	Production/ day	400 units
8	No of parts assembled /year	122000 units
9	Cost required for production by new machine	(148616/122000) =1.22/ unit

5. Extra benefits

- **Energy saving:** Very low air consumption, resulting in energy saving of up to 80% over equivalent pneumatic cylinders and 50 % over equivalent hydraulic systems.
- **Saves Time:** This time can be saved by automatic clinching by using pneumatic cylinder.
- **Reduce maintenance:** As components used such as pneumatic cylinder and hydro-pneumatic cylinder has less maintenance hence overall system gives reduced maintenance
- **Improve productivity:** As there is reduction in cycle time and cost saving, it increases the productivity

6. Results

The results obtained as compared to previous machine are given in table below: Comparison of the Parameters of Previous and Newly Designed Machine.

Table 4: Comparison Previous and Proposed machine

Parameter	Previous Machine	Present Machine
Size	Bulky	Compact
No. Of operations	1	2
Time consumptions	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

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