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Improving Productivity Using Feasible Automation Technique

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***Abstract*: Due to industrialization there has been a rapid development as well as economic growth in countries. Industries provide employment to people as per their abilities and skill of doing work. People often migrate to cities in search of jobs, which in turn improve their standard of living. But on the other hand industries also require consistent improvement by applying new techniques to increase production and to minimize energy consumption along with reducing production time. Our topic is based on similar concept of improving productivity using feasible automation techniques. It can be achieved by using low cost automation to increase strokes per minute (SPM) of mechanical presses used for manufacturing components.**
***Keywords:* Productivity, SPM, Pneumatic, Industrialization, Automation.**

I. INTRODUCTION

Nowadays, ample of production in least utilization of time is of major concern to industries. This paper presents three devices which can be used to reduce cycle time in press operations on sheet metals. Out of these three devices mentioned in this paper, one which is practically possible, economically feasible and easy to operate has been selected. It has been successfully used in JBM auto Ltd., Nashik an automotive industry engaged in Sheet metal Press Components, Robotic Assembly, and Axle Assembly. The Company operates in three segments: Sheet Metal Division (for manufacturing sheet metal components on mechanical and Heavy and Light Press shops H.P.S/L.P.S, Weld shop), Tool Room Division (for maintenance/manufacturing tools, Jigs and Fixtures dies) and assembly division (for development and assembly of SPV, Front and Rear Axle line, Welding Assembly line, Robotic welding assembly line).

The modern world is more practical and cost-conscious, so the punching process for sheet-metal has to be done in an accurate and more precise way with the relative economy of operation, easier implementation for mass production, as well as greater control on the technical parameters. In most of the sheet metal operations punching or pressing operation is the main or initial operation in the process sequence. Automating this operation results in reduced lead time and also can reduce human effort. Automation is a process in which technology concerned with application of mechanical, electronic and computer-based systems to operate and control production. The reason for automating this process may be to reduce manufacturing lead time, to increase and improve Operator productivity or Operator safety, etc [1]

II. PROBLEM STATEMENT

In the process of sheet metal as on raw material shearing is done after that the loading of raw material on press machine, with press tonnage and cushioning pressure draw part is produced. This part at time of unloading from tool, operators offer non value efforts on it as to grab part from press this process is time consuming further process are also delayed. So the impact on SPM was also low. So Draw operation is selected for the process of Automation.

III. METHODOLOGY

Use of proper method is a fruitful source for achieving desired results. Proper research has to be done as per implementation of new techniques to enhance production with minimum utilization of time. Adopted devices should not affect the quality of products. Collection of data is relevant and it includes design data and total plan .The source of data collection classified as primary sources and secondary sources.

A. Primary Sources

1) *Observation Method:* This is one of the simplest techniques used to determine problems in ongoing production line. Production line was observed and then problems were identified. We have visited all concern people from casual worker to manager which are directly or indirectly relate with production parts.

2) *Discussion Method:* Discussion method is the most prominent method as it provide platform for clearance of doubts with the professionals. Here we have discussed topics with operators regarding ongoing processes, manufacturing time, daily loss of time etc.

B. Secondary Sources

1) Data on cycle time of each work center and its output.
2) Datasheet of past year.
3) Layout of shop floor.
4) Work center wise list of material required to make product cell.
5) Internet website.
6) Company website.
7) Cycle time analysis.
8) Strokes per minute (SPM).
9) Standard operating procedure-SOP.
10) Control plan.

IV. OBSERVATIONS

The table below shows Strokes per Minute (SPM) for 1000 ton capacity mechanical press. As this is the first press used for draw operations on sheet metals. Components formed are followed by adjacent presses for further operations. As improving SPM of first press will automatically improve SPM of other presses.so readings of first press without device are stated below.

Table i parts produced without automation.

Press (mechanical)	Capacity (tons)	Time (min)	Parts produced (SPM)
Press I	1000T	5	30
		10	63
		15	96

V. DEVICES USED FOR IMPROVING PRODUCTIVITY

In many industries the task of loading and unloading of workpiece is done manually. Manual loading increases process time hence there is delay in production and due to this company would not able to achieve their targets in desired time. Hence to overcome this problem, some of the methods that are used alone or in combination to eject piece parts from the die to increase SPM are:

A. Robotic Arm

A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm.

The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain.

The business end of the kinematic chain of the manipulator is called the end effectors and it is analogous to the human hand. The end effectors can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy.

The robotic arm can be fixed or mobile (i.e. wheeled) and can be designed for industrial or home applications. [1]

Fig.1 Robotic Arm[4]

B. Conveyor (Stripping Method)

In the process or manufacturing industry, raw materials and products need to be transported from one manufacturing stage to another. Material handling equipment are designed such that they facilitate easy, cheap, fast and safe loading and unloading with least human interference. For instance, belt conveyor system can be employed for easy handling of materials beyond human capacity in terms of weight and height. It is aimed to reduce human effort and at the same time increase the productivity & accuracy levels that cannot be achieved with manual operations. Usually working of this system is a two stage process, firstly stripping of component from die and secondly conveying the same from press.

Fig.2 Conveyor[5]

C. Hydraulic and pneumatic Ejection Systems

The rapid development of electronic interfacing technology had seen the proliferation of electro-hydraulics and electro-pneumatic devices. Fluid, electric and solar powers are some of the energy technologies used for driving modern automated systems. Of these technologies fluid power is mainly reserved for traditional utilization. Hydraulic power is normally used in mechanisms and pneumatic power for sequential automated process. Various combinations of hydraulic and pneumatic attachments can be used to bring the automation in industries like pneumatic or hydraulic clamping devices, hydraulic pallet trucks for material handling, rotary indexing table etc. Industries can implement these types of hydraulic and pneumatic attachments devices to either existing machines or in completely new setup. Pneumatic cylinder operating sweeps, lifters, or kick-out pins, timed with the upstroke of the press, are more effective than air jets for removal of large and heavy pieces. Such pneumatic equipment should include a valve arrangement to shut off the air and exhaust any residual air pressure between valve and cylinders to prevent unintended motion.

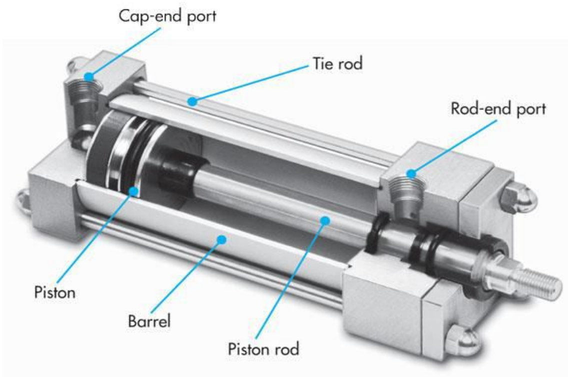

Fig.3 Hydraulic and pneumatic ejection Cylinder[6]

VI. SELECTION OF DEVICE

Among the three devices mentioned above, one which is economically feasible with minimum utilization of energy and does not degrade quality of components manufactured is selected. Here in this scenario pneumatic and hydraulic ejection system is considered. Pneumatic cylinder is used which is mounted on draw die to push the manufactured components directly to the hand of operator. This reduces the time required to grab component from press and to transfer to adjacent press for further operations. This pneumatic cylinder used is of double acting type it is comparatively cost effective and utilizes minimum amount of energy for operation. Maintenance cost is also low as compared to other two. Procedure involved in improving productivity has series of steps discussed below:

A. Selection of Press

As in industry, production line consists of five presses, among these presses first press having 1000 Ton capacity is selected. At initial stage drawing is the first operation performed on sheet metals. After drawing these parts are then transferred to adjacent press for further operations such as blanking, piercing, trimming, flanging etc. Specifications of this press are as follows.

TABLE II SPECIFICATIONS of 1000 T PRESS

Press (T)	1000T
Model	S4-6000-2800 x 2000/LD
SL.NO	HM 2226
Force capacity (13 mm FBDS)	6000 KN
Stroke	800 mm
Shut Height (DU.AU)	1150 mm
Slide Adjustment	400 mm
Bolster Size (LR x FB)	2800 x 2000 mm
Slide Size (LR x FB)	2800 x 2000 mm
Speed (Stroke /min)	10-20 SPM
Power	85 KW
Cushion Force	1100 KN
Cushion Stroke	30-200 mm

B. Selection of Die

The draw dies are designed to force the flat blank through an opening or into a cavity of the required shape, and at the same time so confine the metal between the drawing surfaces that the change in form from a flat blank to the desired shape, it is accomplished without excessive wrinkling or other defects. The Draw die process is to force the flat blank into a cavity of the required shape, and at the same time so confine the metal between the drawing surface that change in form from a flat blank to the desired shape.[2]

In JBM auto Ltd Nashik, production on lower arm die is most as compared to other dies. Lower arm die has cavity at the top with blank holder and lower tool at bottom. So this die is selected for the process of auto-ejection.

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C. Components of Machine Assembly

1) Double acting cylinder
2) Pneumatic pipe fittings and connections
3) Pneumatic hose pipe
4) Solenoid direction control valve 5/2 DCV
5) Washer
6) Nut and Bolt
7) Compressor
8) Limit switch
9) PUV Rubber (Polyurethane)

D. Design of Pneumatic cylinder

1) Specifications of pneumatic cylinder

Piston Diameter (mm)	32, 40, 50, 63, 80, 100
Standard stroke (mm)	25, 50, 80, 100, 125 ,160, 200, 250 ,300
Medium	Compressed Air filtered-Lubricated
Medium Temperature	5^0 - 60^0
Working Pressure	0.5 - 10 Bar

2) Design of pneumatic Cylinder. [3]

Piston Diameter (D) = 63 mm
Stroke Length (L) = 300 mm
Diameter of Rod (d) = 20 mm

A= Area of cross-section of piston.

$A = \frac{\pi}{4}(D^2)\ mm^2$

$A = \frac{\pi}{4}(63^2)\ mm^2$

A= 3117.24 mm^2

A_{PR} = Area of cross-section of piston rod

$A_{PR} = \frac{\pi}{4}(D^2 - d^2)\ mm^2$

$A_{PR} = \frac{\pi}{4}(63^2 - 20^2)\ mm^2$

A_{PR} = 2803.086 mm^2

F_f = Force during forward stroke.

$F_f = P \times \frac{\pi}{4}(D^2)\ mm^2$

$F_f = 0.2 \times \frac{\pi}{4}(63^2)$ (assume P = 2bar = 0.2 N/mm^2)

F_f = 623.44 N

F_{fr} = Force during return stroke.

$F_{fr} = P \times \frac{\pi}{4}(D^2 - d^2)\ mm^2$

$F_{fr} = 0.2 \times \frac{\pi}{4}(63^2 - 20^2)\ mm^2$

F_{fr} = 560.61 N

Time required to complete stroke is 2 sec.

V = Linear velocity of piston.

$V = \frac{L}{t}$ mm/sec

$V = \frac{300}{2}$ mmsec

V= 150 mm/sec

E. Working

A central compressor is the main body for ejection system as it supplies compressed air to pneumatic cylinder. Compressor is kept adjacent to press and assembly of pneumatic cylinder and ejection parts are supported by frame mounted on die of the press. Air is supplied by means of hose pipes and 5/2 solenoid operated direction control valve. Job ejection tool is attached at the end of cylinder rod. High compressed air supplied leads to movement of piston in forward direction eventually ejection of job from press after forming operation is done. Movement of piston is subsequently in forward and reverse direction as cylinder Of double acting along with the use of cam mechanism and limit switch operated solenoid direction control valve to control motion of piston rod.

VII. RESULT

Table iii parts produced with automation

Press (mechanical)	Capacity (tons)	Time (min)	Parts produced (SPM)
Press I	1000T	5	33
		10	74
		15	115

Table above shows number of parts produced with the use of ejector on press of 1000 T. Result is plotted by considering same time for ejector, as earlier considered for production without ejector. It can be seen that number of parts has produced has increased substantially**.**

A. Comparative Study

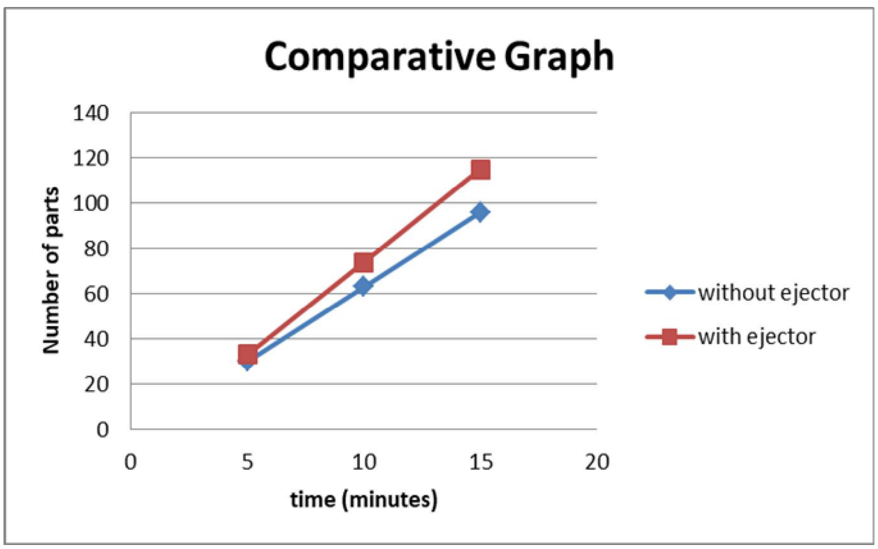

Fig.4 Comparative Graph

The graph shown above is a comparative graph plotted between time and number of parts produced. Parts produced without ejector are marked with blue and with ejector as red. It can be clearly seen that by using pneumatic ejector in press operations, production considerably increases. More number of parts can be produced by minimum utilization of time. This in turn tends to increase productivity.

VII. CONCLUSION

The purpose of this project was to ensure that high cost automation may not always enhance production, but by utilizing certain low cost automation techniques production can be increased. Pneumatic system is cost effective and can be mounted on number of presses to increase production. Pneumatic system used is simple to understand and also operates with minimum noise level as compared to other noise level in industry. If not in use then pneumatic system can also be disassembled easily and with least utilization of time. Safety of workers is first priority and this project takes care about the safety of the workers, as accidents are reduced considerably and efforts required by labour to transfer job to subsequent press is also less. Operating and installation cost is comparatively less as compared to other systems. On implementation of this low cost automation technique on production line, productivity can be increased this intentionally increase the margin of profit for industry.

VIII. ACKNOWLEDGEMENT

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