REDUCTION OF DENTS THROUGH INSTALLATION OF EJECTOR PINS ON COMPOUND DIE

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ABSTRACT

Dents are common defects in sheet metal manufacturing. A dent in sheet metal is the result of the metal being stretched by something impacting with it. Dents can occur in objects made of various metal materials: sheet metal, aluminum, steel. There are many kinds of dents in sheet metal. It comes in large and small sizes. They can be a crease, a shallow egg-shaped depression or just a little ding. What they all have in common is that they are distortions in the shape of the metal. A dent, no matter what its shape, is a place where the metal has been stretched. When scrap which should be removed from the mold affixes to the punch, clogging and floating scrap will be the cause of defects such as dents on the material surface and it may also result to broken die.

This paper focuses on the reduction of dents particularly in item Sensor Fixing Plate LB33L633PZ11, through installation of ejector pins. Occurrence of dents drastically decreases by 99% during monitoring of effectiveness upon implementation of the improvement.

1. 0 INTRODUCTION

A die is a specialized tool used in manufacturing industries to cut or shape material using a press. Die stamping is a method for cutting and forming metal into a specified shape. Like molds, dies are generally customized to the item they are used to create. Products made with dies range from simple paper clips to complex pieces used in advanced technology. Piercing dies are typically made by tool and die makers and put into production after mounting into a press. The die is a metal block that is used for forming materials like sheet metal and plastic. For the forming of sheet metal, such as automobile body parts, two parts may be used, one, called the punch, performs the piercing, stretching, bending and blanking operation.

There are several methods used for cutting metal parts. Compound die stamping is an efficient and cost-effective option for shorter runs and where parts can be produced using a single station, as opposed to the multiple stations used for progressive die stamping. Using a single station also improves mechanical accuracy and makes it easier to maintain part flatness and achieve close dimensional tolerances. Compound dies produce a complete blank in one station at every stroke of the press. Basically, these dies perform one or more operations at the same time. For instance, they can blank (cut the outer form) and pierce (cut the inner form) of a shape simultaneously. Compound die stamping is also an excellent choice for medium to high volume production runs because it efficiently and accurately cuts multiple features in a single stroke.

A blanking die produces a flat piece of material by cutting the desired shape in one operation. The finished part is referred to as a blank. Generally, a blanking die may only cut the outside contour of a part, often used for parts with no internal features. Piercing is a shearing process where a punch and die are used to create a hole in sheet metal or a plate. The process and machinery are usually the same as that used in blanking, except that the piece being punched out is scrap in the piercing process. A die, as mounted in the press, is a complex action mechanism, producing parts in predetermined sequence. The lower half of the die, press bed, while the upper portion is bolted to the ram, sliding up and down along with it. The die block contains all bushings,
Compound die forming dies, or cutting inserts. Compound die-cutting ensures superior accuracy, especially when it comes to the spacing between holes or between the edge of a blank and the edge of a hole. This, in turn, ensures the perfect stock thickness and ultimately prevents distortion. Compound die-cuts can guarantee good flatness because the materials are pressed by knockouts and punches. As a result, the accuracy of the final product is of high quality.

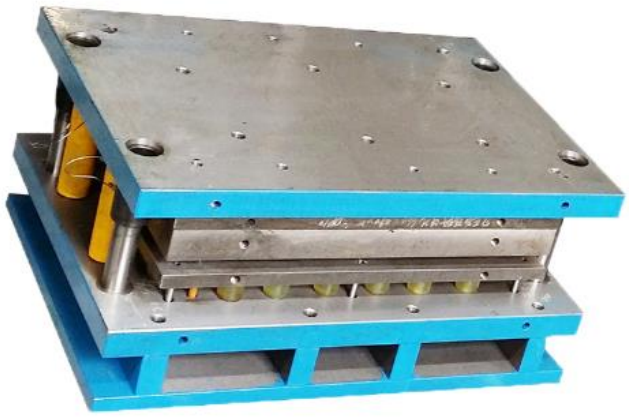

Figure 1: Die Illustration

1.1 Understanding Press Machine Operation

The design principle of the mechanical power press is to convert the circular motion into a linear motion, and the main motor outputs the force to drive the flywheel. The clutch drives the gear, the crankshaft (or the eccentric gear), the connecting rod, etc. to achieve the linear motion of the slider. The motion of the motor to the connecting rod is a circular motion. There is a need for a circular motion and a linear motion transfer point between the connecting rod and the slider. The design has roughly two mechanisms, one is a spherical type and the other is a pin type (cylindrical type), and the circular motion is performed via this mechanism to a linear motion of the slider. The presses release the force on the material to plastically deform it to obtain the required shape and precision. Therefore, it is necessary to match a set of molds (dividing the upper mold and the lower mold), placing the material between them, and applying pressure by the machine to make it deformed, the reaction force cause by the force applied to the material during processing is absorbed by the mechanical body of press.

Figure 2: Press Machine Set-up

A machine press is a tool used in the manufacturing industry to deform a workpiece under high pressure. There are different types of machines presses, including press brakes, punch presses, shop presses and more. The defining characteristic of all machine presses, however, is that they press a workpiece using high pressure to change the shape of a workpiece.

1.2 Understanding Compound Process.

Compound die stamping is a metal forming process that involves cutting parts from strips of steel. The system feeds a strip of steel through the compound die, which cuts or punches out a part in a single stroke. A knock-out tool ejects the metal parts from the material and the steel strip continues feeding through the die until all the metal parts have been punched out. Scrap steel is either cut off or ejected in full strips and is collected for disposal or recycle.

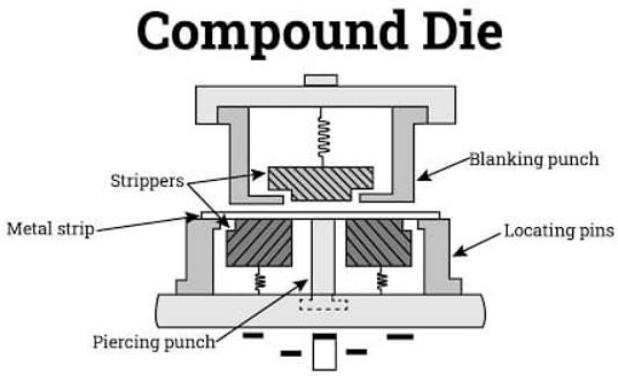

Figure 3: Compound Die Illustration

Compound dies perform more than one cutting operation per stroke, such as simultaneous blanking and piercing that is usually combined. They are used to produce parts with multiple cuts and complex designs, which perform the task faster. However, they are not suitable for forming operations as these processes require more force. A typical application of compound dies is in the production of flat washers. metal as well. compound dies are created by combining steel rule components with matched metal components common in metal stamping. The steel rule component is used to cut the less detailed part of the shape the outer perimeter for example and the matched metal components are used to cut the inner, more detailed shapes. Once tooled and assembled, the compound die is placed inside a press and will be used for long run, high output programs. Die-cutting is more efficient than most cutting methods, especially since it mass-produces shapes with exactly the same dimensions regardless of the type of flexible material used. Unlike stamped die cuts, compound die cutting performs two or more cutting operations in one stroke at one station.

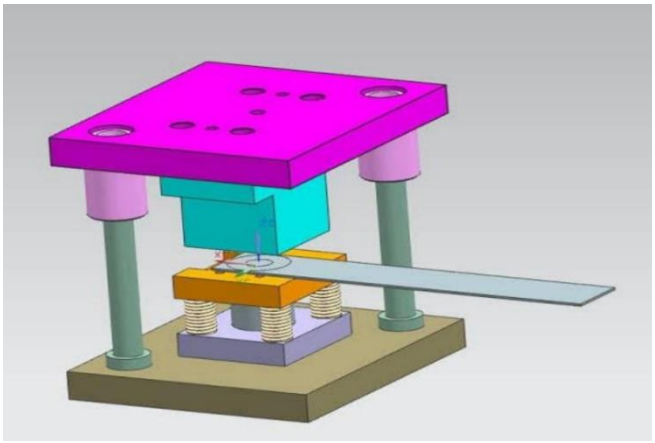

Figure 4: Compound Die with Metal Sheet Illustration

Advantages of Compound Die Stamping

- Speed: Compound die stamping can produce a part every 3 seconds, or 1200 parts per hour. This reduces labor costs and can significantly shorten project lead times.
- Efficiency: Compound dies can cut complex parts all in one stroke, eliminating the need for multiple dies and reducing tooling costs and cycle times.
- Repeatability: By creating parts with one die, we're able to ensure consistency and accuracy, and achieve flatness and good dimensional stability.
- Cost-effectiveness: Because compound dies can produce your part quickly and effortlessly, you can expect to save money.
- Reduced waste: The high mechanical accuracy of compound die stamping produces less material waste, resulting in cost savings.

As P.IMES Metal Press strives for higher productivity and better quality, this is a need to improve the compound process as well as the compound die through installation of ejector pins which can reduce or eliminate the above-mentioned problems for better quality and improvement in productivity and economy.

2. 0 REVIEW OF RELATED LITERATURE

Metal stampings play an important part in modern day life. Together with plastic molds, they form the most important structural components of all electronic and electrical equipment.

Glory Phils and Mikuni Terminal Mechatronics Phils., Our main customers for production of ATM machines often encountered dents particularly in item Sensor Fixing Plate LB33L633PZ11. This triggers PIMES metal press to conduct investigation and study the major problem encountered at our customer sides. Metal Press team consists of multi-disciplinary members finds ways to improve the major problem being encountered in our customers.

3.0 EXPERIMENTAL SECTION

3.1 Materials

To start the compound process, the operator needs Press Machine, Work Process, Monitoring Sheet, Improved die (with installed ejector pins) and Workpiece/item.

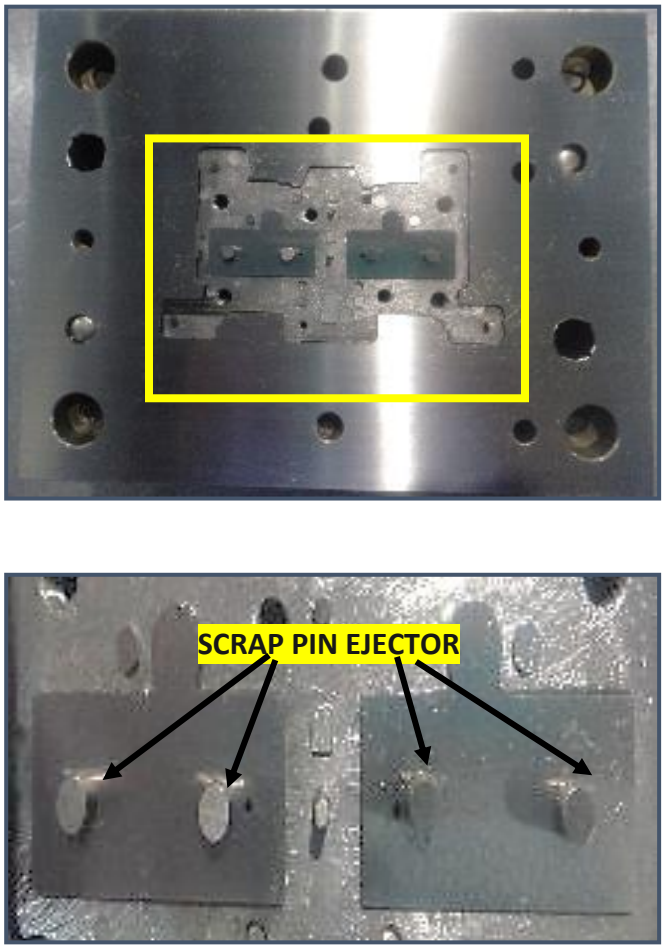

Figure 5: Installed Ejector Pins on Compound Die

3.2 Procedure

Installation of Ejector Pin on Sensor Fixing Plate LB33L633PZ11 compound die was performed to improve the process.

For the month of May 2022, Installation of Ejector Pins for item Sensor Fixing Plate LB33L633PZ11 compound die was

implemented. Monitoring of effectiveness in terms of dent defect was performed to distinguish the effectivity of die improvement.

Figure 6: Actual Compound Process

4.0 RESULTS AND DISCUSSION

4.1 Result of Monitoring

Data gathering have been completed; effectiveness has been monitored for the past 4 months started October 2022-January 2023.

Table 1 shows data comparison before and after compound die improvement. Defect rate prior to improvement of compound die. 4 months prior to improvement dated May 2022 – August 2022 shows high rate of dents rejection and is drastically decreases on the succeeding months upon implementation of compound die with installed ejector pins.

Compound Die	Input Qty.	NG Qty.	NG Rate
No Ejector Pins Installed	10,080	286	**2.84%**
With Installed Ejector Pins	10,204	2	**0.02%**

Table 1: Data Comparison Before and After Compound Die Improvement

4.1 Graphical Representation

Figure 7 and 8 shows the graphical representation before and after implementation of compound die improvement.

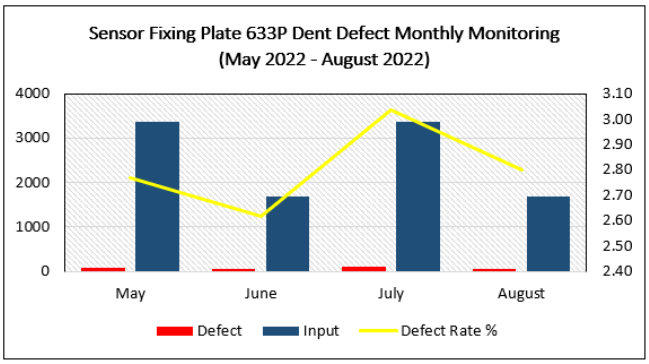

Figure 7: Dents Defect Monthly Monitoring (May'22-August'22)

The result on defect rate of dents decreased from the month of October 2022 that the improved compound die started to used. (See figure 8).

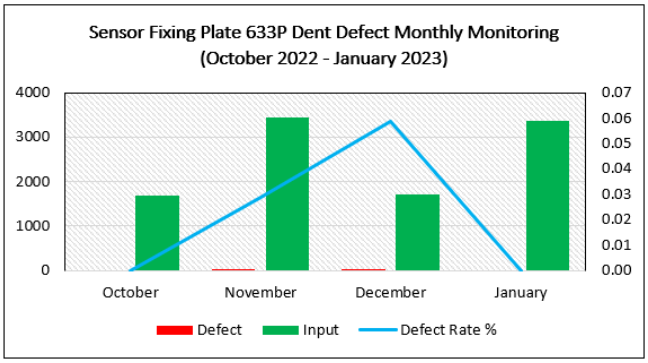

Figure 8: Dents Defect Monthly Monitoring (Oct'22- Jan'23)

5.0 CONCLUSION

Based on the result of Evaluation, occurrence of dents drastically decreases by 99% during monitoring of effectiveness upon implementation of the improvement. Resulting to increase in production efficiency and decrease on loss cost from scrapping of rejected parts since defect is not reworkable.

6.0 RECOMMENDATIONS

It is highly recommended to implement installation of ejector pins on compound die for manual items and for dies that needs ejector pins to reduce high defect rate related to

dents as well as it improves the tool life expectancy of compound die since it lessens die damage/broken die due to clogging and floating scrap result.s

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8.0 REFERENCES

1. http://www.wikipedia.org
2. http;//www.engineering.blogspot.com
3. http;//www.moroeengineering.com

9.0 ABOUT THE AUTHORS

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