**Reverse Engineering in Punching Machine – Case Study**

Subject: Product Design and Development (PDAD)

Assignment: 3 Division: I Group: 6

Roll no.: 30, 31, 32, 33, 34, 35

**Introduction to Reverse Engineering**

Reverse engineering is ­a process or a method through which one attempts to understand through deductive reasoning how a previously made device, process, system, or piece of software accomplishes a task with very little insight into exactly how it does so.

It’s used for the following purposes:

1. Design of a new part.
2. Recovery of damaged or broken parts.
3. Copy of an existing part

Reverse engineering is the vital importance in the production of a new product. Since, in most of the cases, it does not feasible to start the production of a product from the ground up because it consumes a lot of time as well as money. This process also helps in understanding how a product works, thus enabling the development team to produce spare parts and repair broken parts locally. The process of development becomes much more affordable and streamlined if we reverse engineer an already existing product while improving existing features and adding new features. Hence, reverse engineering is an efficient approach to streamline the development process.

**Prototyping:**

Rapid prototyping is the fast fabrication of a physical part, model or assembly using 3D CAD. Integration of reverse engineering and rapid prototyping is used for getting the product to the market quickly by resolving a long-standing conflict between design and manufacturing.

Rapid prototyping includes a variety of manufacturing technologies. This also includes technologies like high-speed machining, casting, moulding and extruding.

**Advantages of reverse engineering:**

1. It gives a base to build and improve upon. Hence, the development team doesn’t have to *reinvent the wheel* every time.
2. CAD models can be used for manufacturing or rapid prototyping, which leads to lesser development and manufacturing costs.
3. Reverse engineering enables us to work on a product without having prior knowledge of it, hence it reduces the *to-market time* of the product.
4. It helps in the thorough analysis of a product, which helps the development team discover vulnerabilities and redundancies in the product.

**Steps of product development:**

1. Digitization of the product.
2. Processing the data.
3. Create the cad model.
4. Prototype.
5. Testing.

**Applications of Reverse Engineering:**

*1. Software Industry:*

Software reverse engineering is a process of recovering the design, requirement specification and function of a product from an analysis of its code. It builds a programme database and generates information from this.

Software is used basically in the manufacturing of the punching machine.

Following are the applications of reverse engineering in the software industry:

* To extract design and implementation information. For example, understanding how an API works, etc.
* To detect and neutralize viruses and malware.
* Finding vulnerabilities and bugs in existing software

*2. Manufacturing Engineering:*

Reverse engineering makes the process of manufacturing a physical product much simpler and streamlined as compared to building the product from the ground up.

Following are the application of reverse engineering in the software:

* To analyse the working of a product.
* To create a 3D virtual model of an existing physical part for use in 3D CAD. These files are stored for future reference as well.
* To make a digital 3D record of own products. This helps in case the firm.

**-----------Reverse Engineering of a Punching Machine---------**

**Materials:**

1. Aluminium
2. Stainless steel
3. Perspex

**Required Machinery:**

1. Injection Moulding Machine
2. Assembly Machine
3. CNC Machine
4. Milling Machine
5. Spring Coiler

**Manufacturing & Working:**

1. *Base Plate*

* The base plate is part of the machine on which all other components are attached.
* It serves as the platform for the whole mechanism.

1. *Lever handle*
   * + Lever handle is the trigger for the activation of the punching mechanism.
     + It’s made from Aluminium too.
2. *Punchers*

* Punchers are the vertical rod-like components which make holes in paper.
* These punchers are placed on opposite sides of the base plate, passing through the U-shaped brackets.
* punchers down.
* The punchers have sharp edges at their base, which exert pressure and make the hole.
* Punchers are manufactured using a CNC machine and milling.

1. *Springs*
   * The springs are attached to a shaft, which acts as a hinge.
   * This shaft passes through the U-shaped brackets and the extreme end of the lever handle.
   * This prepares the machine for its next punch.
   * Springs are manufactured spring coilers.

**Manufacturing processes For Important components:**

**Frame:**

The frame is usually made of metal, such as steel or aluminium. The manufacturing process involves cutting the metal to the required size and shape, then welding or bolting the pieces together to form the frame.

**Punching mechanism:**

The punching mechanism consists of a punch and a die that work together to make a hole in the paper. The punch is usually made of high-strength steel and is shaped to match the desired hole size and shape. The die is also made of steel and has a cavity that matches the punch. The manufacturing process involves using a CNC machine to cut and shape the punch and die to the required specifications.

**Handle:**

The handle is used to operate the punching mechanism. It is usually made of plastic or metal and is designed to fit comfortably in the user's hand. The manufacturing process involves moulding or casting the handle to the required shape and size.

**Guide bar:**

The guide bar is used to hold the paper in place while it is being punched. It is usually made of metal or plastic and is designed to slide smoothly along the frame. The manufacturing process involves cutting and shaping the bar to the required size and shape, then attaching it to the frame.

**Spring:**

The spring is used to provide the force needed to operate the punching mechanism. It is usually made of steel and is designed to compress and expand as the handle is pressed and released. The manufacturing process involves coiling the steel wire to the required size and shape.

**Collection tray:**

The collection tray is used to catch the punched paper. It is usually made of plastic or metal and is designed to fit securely onto the frame. The manufacturing process involves moulding or cutting the tray to the required shape and size.

**Rubber feet:**

The rubber feet are used to prevent the punching machine from slipping or scratching the surface it is placed on. They are usually made of soft rubber and are designed to fit onto the bottom of the frame. The manufacturing process involves moulding the rubber to the required shape and size

**Dimensions:**

For our reverse engineering study, we considered the Kangaroo two-hole paper punching machine (student use). We estimate that the product would weigh about 130 – 150g.

**Cost and Weight:**

We estimate that assuming mass production, the product would be priced at Rs. 60 – 150.

**Conclusion:**

Firstly, we design a punching machine using reverse engineering. and we analyse all small components and separately Design them. punching machine was Its mechanism was studied deeply, and conceptual drawings were prepared. Materials and manufacturing processes as well as machinery detail analysis.