Sheet Metal Stamping Presses

Training Objectives

After watching the program and reviewing this printed material, the viewer will gain a knowledge and understanding of the various types of stamping presses used, as well as their ancillary systems.

- The mechanical aspect of stamping is explained
- The two basic press types are defined
- Aspects of press drive systems are detailed
- Factors in press selection are provided
- Press control and feed systems are addressed

Stamping Presses

Stamping presses utilize the force of a moving ram, or slide, to transmit force, or an amount of tonnage, to specific tooling in order to achieve a product's final shape, often with little or no scrap and, whenever possible, with minimal operator intervention.

A wide variety of parts are formed in a similarly wide variety of press sizes and types. The moving forces of the press are generated by either mechanical or hydraulic mechanisms.

Simple, single dimension stampings can be accomplished with small bench top presses generating as little as five tons. Larger, more geometric shapes are formed with very large presses rated in thousands of tons. Press speed may also vary from 10 to 18 strokes per minute to as fast as 1800 strokes per minute.

Both the hydraulic and the mechanical press are classified by the type of frame upon which the moving elements of the press are mounted. The two most common frame types are the gap-frame, or "C" frame, and the straightside press. Each have their own advantages and disadvantages.

The "C" type press allows easy access to three sides of the die area. They require less floor space, and in ranges from 35 to 60 tons they may cost half as much as a similar sized straightside press. However, the "C" press, by its design, is prone to angular misalignment as the open frame deflects as force is brought to bear on the die or tooling. Although such misalignment is not always a problem, it is overcome by using heavier and thus more expensive presses.

A popular variation of the gap frame press is the open back inclinable or "OBI" press. By pivoting the frame, usually backwards, on its base, finished part or scrap discharge is more easily facilitated. However, it's the open back stationary (OBS) which is the more popular of the two. OBS presses use timed blasts of air, mechanical devices, or conveyor system to discharge parts or scrap.

Straightside presses are so named because of the vertical columns or uprights on either side of the machine. This design eliminates the problem of angular deflection. Also, die life and part accuracy are enhanced. The four principle components of the straightside press are:

- The crown which supports the motor, flywheel, and other driving mechanisms.
- The columns which support the crown and are fitted with adjustable guides called gibs which insure parallelism, squareness, and proper movement of press components.
- The bed or foundation of the press.
- The bolster which mounts on the press bed and accommodates the die while strengthening the bed.

Mechanical presses have an electric motor that turns a flywheel. The flywheel revolves around a crankshaft until engaged by a clutch device. Then, through a series of drive train components, the energy of the rotating flywheel is transmitted to the vertical movement of the slide or ram.

There are three basic drive train variations. In the direct drive arrangement, the drive motor, through a belt arrangement, rotates the flywheel. This method provides the highest speeds, are more easily maintained while losing less mechanical energy. However, to gain their maximum force, which only occurs near the bottom of the ram stroke, the press must always be operated at its maximum speed. There is also some angular misalignment as torque is applied to only one end of the crankshaft. In other drive arrangements using single and double gear reductions along with eccentric gear drives, the misalignment problems are eliminated and more power for the forming and the deep drawing of larger parts is possible. Other important components of the mechanical press are the clutch and braking systems. While the clutch allows the energy of the revolving flywheel to be transmitted to the crankshaft, the braking system holds the ram in position when the clutch is disengaged.

The major consideration in the selection of a mechanical press is the force capacity or force that can be exerted at a specified distance above the bottom of the stroke. This is expressed in tons or metrically in kilo-newtons. Force capacity is determined by flywheel energy (speed) and torque capacity which is the press' ability to transmit energy through the drive train and ram into the die. Geared presses do not increase force capacity. The gear ratio that is present is primarily a means to obtain the most efficient flywheel speed, and thereby enhancing torque capacity.

The definition of a "high speed mechanical press" is generally accepted as being one capable of 300 strokes per minute and higher. The press speed for small high volume parts can be as fast as 1400 strokes per minute.

While the mechanical press remains the most common, the hydraulic press is gaining popularity, having some distinct advantage. The full force of the press can be delivered at any point of the stroke. Deep drawing and forming require strong forces high in the stroke. Also, the stroke of the hydraulic press can be adjusted to facilitate part clearance between cycles. The ability to pre-set the working hydraulic pressure allows the use of many different tool and die heights and the forming of varying work thickness'.

Press Selection

There is no single universal press that can provide productive and cost efficient operation. Compromises must be made in order to use the press for more than just one type of stamping. Such compromises include consideration of the following primary factors:

- Press size
- Force available
- Energy
- Speed

Other considerations can include:

- Size and geometry of the work
- Number of operations to be performed
- Quantities and production rates
- Accuracy
- Finish requirements
- Equipment costs

Such costs would also include the control systems for the press. As stamping becomes more automated, the use of CNC systems and various electro-mechanical and solid state control devices become necessary. Additionally, devices and systems to feed material to the press must also be factored in. There are mechanical blank handling systems where manual handling is not practical due to speed and size. High volume feeding is done with coil stock which also requires an investment in coil feeding equipment.

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Press Feeding

Coil processing significantly improves the efficiency of sheet metal stamping operations. Because the coil is fed continuously through the system, production is uninterrupted. In addition, coil processing lines can eliminate the need for separate blanking presses and reduce storage and handling requirements.

The basic functions of most coil-processing lines include:

- Uncoiling
- Straightening or leveling the coil stock
- Feeding the coil stock
- Scrap processing

Pay-off reel spindles are used to support and uncoil the sheet metal coil stock. For coils of thicker material and where surface finish is not critical, coil cradles may be used.

Sheet metal stock, as it is uncoiled, has a set, or curvature, which the straightener or leveler removes by flexing the material between opposing, adjustable rollers as it moves toward the press. This provides flat material for feeding into the stamping die.

Automatic feed mechanisms using slide, roll, or gripper feed systems move the coil stock to the die. Slide feeds have grippers which move the coil material a predetermined distance, release, and return for the next cycle. Roll feeds are the most common with intermittently driven, opposed rollers which allow the coil stock to dwell during the working stage of the press stroke. These feed systems are usually press driven using air or hydraulic power.

Independently powered feed rolls driven by digitally controlled servomotors are also used, providing various feeding modes such as joggle, zig-zag, oscillating, and shuttle feeds. Computer programming for the servo system results in higher production per press stroke and less scrap generation.

All coil production will generate an amount of scrap. In some cases scrap processing can be a function of the stamping die itself. Most often scrap is processed by separate mechanisms which may be press actuated or independently powered.

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Review Questions

1. The principle moving component of a press is the:
   a. crankshaft
   b. flywheel
   c. ram or slide
   d. drive motor

2. Press speeds can range from:
   a. 10-1800 spm
   b. 100-2000 spm
   c. 5-50 spm
   d. 50-100 spm

3. A “C” frame press is also known as:
   a. a gap frame press
   b. an incline press
   c. a high speed press
   d. a slide press

4. An inclined “C” frame press offers improved:
   a. die handling
   b. depth of stroke
   c. die lubrication
   d. part and scrap removal

5. A straightside press can more positively affect:
   a. production speed
   b. part accuracy
   c. operation fatigue
   d. scrap discharge

6. The main advantage of a direct drive system in a mechanical press is:
   a. power
   b. safety
   c. speed
   d. cost

7. The principle advantage of a hydraulic press is:
   a. speed
   b. safety
   c. lower costs
   d. full force available through the strokes

8. High volume press feeding is accomplished with:
   a. magnetic feeders
   b. conveyor systems
   c. coil processing
   d. palletizing

9. Coil stock feed mechanisms can employ
   a. slides
   b. grippers
   c. rolls
   d. all of the above

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Answer Key

1. c
2. a
3. a
4. d
5. b
6. c
7. d
8. c
9. d