

Design and Fabrication of Hydraulic Zigzag Bending Machine

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Abstract--The main aim of our Project is to develop a model of hydraulic Zigzag bending machine which is a developed one that of the conventional one. It is more advantageous for making Zigzag bending in work piece, such that it can form Zigzag profile using normal hydraulic press. It can be placed in all machine shop and all sheet metal bending workshops to replace the conventional thing with less cost and low maintenance.

A work piece can be bent in multiple directions and angles. Common simple bends consists of forming elbows which are bends that are range from 2 to 90°, and zigzag bends which are 180° bends.

1. INTRODUCTION

This machine is used to bend steel into curve or curvature shape. The size of machine is very convenient for portable work. It is fully made by steel. Moreover it is easy to carried and used at any time and any place.

To build this machine many equipment or machine is used. By using all this equipment, process for making the project is faster and easier. We had also learned a proper method for operating all this machine and equipment. Choosing component material is very important, because it will affect the overall cost of the machine and the product quality. With this consideration, we had design this machine with the maximum quality and low cost

A Hydraulic cylinder is a mechanical actuator that is used to give a unidirectional force through a unidirectional stroke. It has many applications, notably in engineering vehicles, industrial application, and civil applications.

Hydraulic cylinders get their power from pressurized hydraulic fluid, which is typically oil or air. The hydraulic cylinder consists of a cylinder barrel, in which a piston connected to a piston rod moves back and forth. The barrel is closed on one end by the cylinder bottom (also called the cap) and the other end by the cylinder head (also called the gland) where the piston rod comes out of the cylinder. The piston has sliding rings and seals. The piston divides the inside of the cylinder into two chambers, the bottom chamber and the piston rod side chamber.

2. BENDING

Bending is usually defined as "the plastic deformation of a sheet metal along a straight line".

Bending is defined as the straining of metal around a straight axis. During this process, the metal on the inside of the neutral axis is compressed, while the metal on the outside of the neutral axis is stretched.

Bending implies the deformation of a work piece produced by loads perpendicular to its axis as well as force couple acting in a plane passing through the axis of the bar. Bending is only occurred when the load is acting perpendicular to the neutral axes of pipe.

Work piece bending as a process starts with loading a work piece into a work piece bender and clamping it into place between two dies, clamping block and forming die. The work piece is also loosely held by two other dies, the wiper die and the pressure die.

2.2: Bending terminology

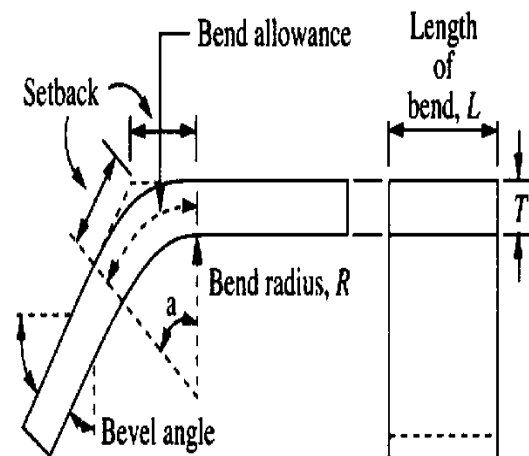


Fig. 2.1: Bending terminology

2.3: Types of bending

Bending is a manufacturing process that produces V-shape, U-shape, channel shape, zigzag shape along a straight axis in ductile materials, most commonly sheet metal. Equipment includes box and pan brakes, brake presses and other specialized machine presses. Typical products that are made like this are boxes such as electrical enclosures and rectangular ductwork.

- Air Bending
- Rotary Bending
- Roll Bending
- Wiping
- Coining
- Folding

2.4: Zigzag Bending

A zigzag is a pattern made up of small corners at variable angles, though constant within the zigzag, tracing a path between two parallel lines.

From the point of view of symmetry, a regular zigzag can be generated from a simple motif like a line segment by a repeated application of a glide reflection.

This study presents methods for suppression of defects observed in zigzag bending of sheet-metal or plate. This type of bending is widely used in industry for manufacturing structural parts in automobiles. Although it is easily conducted by press forming using upper and lower dies which have zigzag shape, it often has defects, such as spring-back and dents. A series of finite element analyses and experiments were conducted for suppression of the defects in two-place bending, which has three segments. As a result, it is revealed that the distance between two bending positions is dominant for occurrence of the dents and that the dent area was able to be reduced by selecting the optimum moving direction of the upper die. It is also revealed that the cause of spring-back is elastic recovery of the straight segments instead of the bent parts against engineers' and technicians' intuition, and that there is an optimum moving direction of the upper die for the least spring-back. Furthermore, another realistic method for suppression of spring-back was suggested for four-place bending.

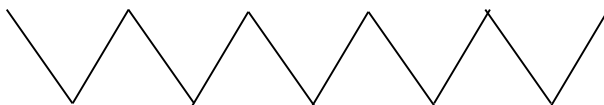


Fig.3.1: zigzag bending

3: WORKING AND COMPONENTS

3.1: Working Principle

When bending force is applied to work piece under free bending conditions, the initial bending is elastic in character. This is because the stresses that are developed in the opposites faces of the material are not sufficiently high to exceed the yield strength of the material. The stresses developed on the inside of the bend tend to shorten the metal and are, therefore, compressive stresses. The movement or strain which takes place in the work piece as a result of the initial bending force is elastic only and, upon removal of the force, the work piece springs back to its original shape.

3.2: Working

Here our project consists of a hydraulic bottle jack which is placed vertically. The bottom portion of the jack is welded to a beam which slides on two pillars which are placed parallel to each other. The bending tool is welded to the beam which is attached to the lower end of the hydraulic cylinder. The bending tool is also welded to the bottom beam of the frame in a relative position, which results in forming Zigzag profile. There will be a gap provided between the bending tools to form the bending accordingly. The piston from the cylinder is connected to the top beam of the frame. The sheet metal to be bended is placed in between the bending tools, and then the operation is carried

out by means of actuating rod which is provided with the bottle jack. After the bending operation is done, the hydraulic jack is made to come to the original position by opening a relief valve which is placed in the hydraulic jack. The returning stroke of the cylinder is done with the help of the spring attached between the sliding arrangement and the top beam.

3.3: Components

1. Hydraulic system.
2. Pumping rod/ Sucker rod.
3. Spring.
4. Sliding block.
5. Bending tool.
6. Work piece.
7. Frame .

3.3.1: Hydraulic System

i. Principles of hydraulic drive

Pascal's law is the basis of hydraulic drive system. As the pressure in the system is the same, the force that the fluid gives to the surroundings is therefore equal to pressure x area. In such a way, a small piston feels a small force and a large piston feels a large force.

ii. Hydraulic jack

Use of jacks not designed for a specific vehicle requires more than the usual care in selecting ground conditions, the jacking point on a vehicle, and to ensure stability when the jack is extended.

3.3.2: Pumping Rod

A pumping rod/sucker rod is a steel rod, typically between 12 and 15 centimeter (7 to 9 inches) in length, and threaded at both ends, used in the oil industry to join together the surface and down hole components of a reciprocating piston pump installed in an oil well.

3.3.3: Sliding block

Sliding block may refer to:

1. sliding-block action
2. sliding-block puzzle

3.3.4: Bending Tools

Its purpose is to assemble a bend on a work piece. A bend is manufactured by using a bending tool during a linear or rotating move.

3.3.5: Spring

A spring is an elastic object used to store mechanical energy. Springs are usually made out of spring steel. There are a large number of spring designs; in everyday usage the term often refers to coil springs.

When a spring is compressed or stretched from its resting position, it exerts an opposing force approximately proportional to its change in length (this approximation breaks down for larger deflections). The rate or spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring. That is, it is the gradient of the force versus deflection curve. An extension or compression spring's rate is expressed in units of force divided by distance, for example lbf/in or

N/m. A torsion spring is a spring that works by twisting; when it is twisted about its axis by an angle, it produces a torque proportional to the angle. A torsion spring's rate is in units of torque divided by angle, such as N-m/rad or ft-lbf/degree. The inverse of spring rate is compliance, that is: if a spring has a rate of 10 N/mm, it has a compliance of 0.1 mm/N. The stiffness (or rate) of springs in parallel is additive, as is the compliance of springs in series.

4: DESIGNING

4.1: Hydraulic Bottle Jack

➤ Product description

Hydraulic Bottle Jacks are designed to lift, but not sustain, loads ranging from 1.385tons thru 2 tons depending on the rated capacity of the bending needed. They are designed to be used vertically. Each model is suitable for use in an appropriately rated and designed vertical or bench press structure. These jacks are not appropriate to use for lifting or positioning construction trailers, houses and/or other building structures.

➤ Product Specification

- ★ Capacity: 2ton
- ★ Min. height: 7”
- ★ Max. height : 135/8”
- ★ Extension screw: 2”

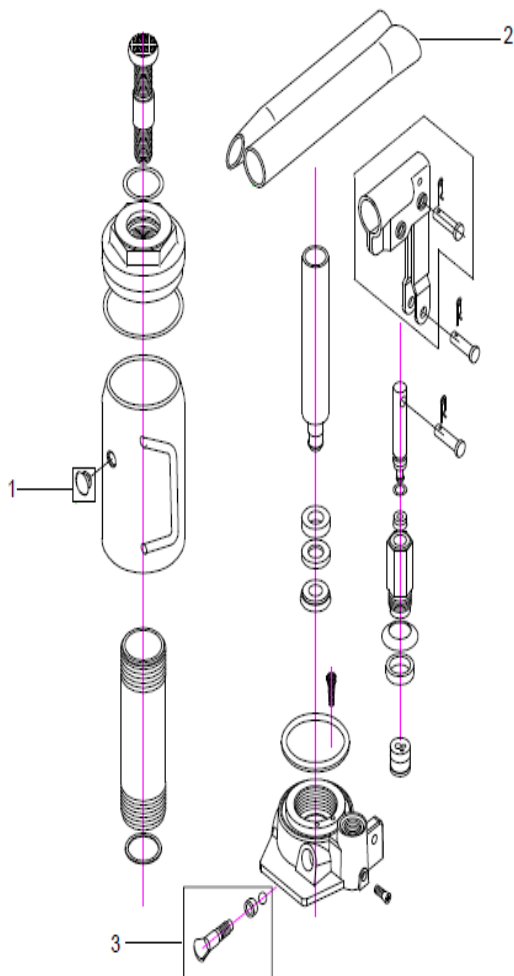
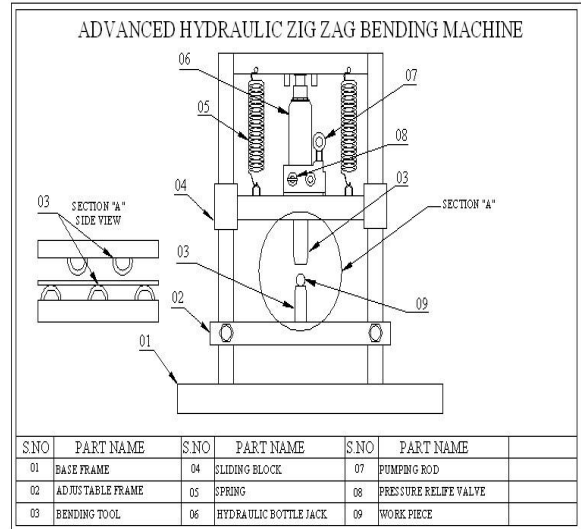


Fig. 4.1: Bottle jack construction

1. Oil Filler Plig
2. Handle Assembly
3. Release Valve Assembly

4.2: Design



4.3: Fabricated Work



Fig.4.2: Fabricated piece

5: CONCLUSION

Thus the hydraulic zigzag bending press is one of the most flexible machines on the market, allowing the fabricator or iron worker to shear, punch, and bend. When considering industrial machinery, the hydraulic bending press is perfect machine shop tool for metal fabricator. The hydraulic zigzag bending press fits any small to medium-sized industry when machinery for large-scale production must necessarily make way for machinery with distinctly lower production costs.

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