Bent Hollow Channel Punching Using Hydraulic Compact Press

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Abstract:
In an attempt to alleviate the problem of the dearth of equipment in punching for irregular or non-standard holes, in industries the compact hydraulic punching machine was designed, constructed and tested using locally sourced materials. The principle parameters of the design included of stroke 40 mm on pipe, Hole varies sizes on pipe, its wall thickness 1mm, 1inch square hollow section. The major components of punching machine includes the clamping cylinder, combination die assembly, vertical and horizontal punching stations with dies, and a stripper, punch, collet, mounting stand for assembling all parts. The machine was tested for performance with 1 inch square hollow channel at 40mm stroke, to punch a hole was found to be satisfactory.

Keywords: Design, Terminologies, Cost Estimate, Manufacturing.

1. INTRODUCTION
The advancement of technology over years has been pushing the study of finding ever more efficient and convenient means of punching, ranging from medium to large scale materials

A punching mechanism is designed to cut a hole in some material such as paper, metal or card stock etc. Punching types are Center punch, Prick punch, Pin punch and Drift punch. There are three basic elements of any punching device, a punch, a die, and a stripper. In punching power must be applied to the punch so that it will cut the hole in required material.

The hand provides the driving force in the case of conductor's hand punch. and in some case Punches are also driven automatically, the punch press is fitted with punches and dies of size and shape of the hole required for irregular and non-standard holes, punching action is accomplished by a vertically moving ram that forces the punch through the material and into the die through which the resulting slug is ejected, additionally, a device to hold the material in place as punch is withdrawn, called stripper, is an integral part of punching tool.

The press ram may be activated manually, mechanically, or hydraulically. The manual press, usually a tabletop model, is capable of generating about four tons of force. Mechanical punch press use a system of fly wheel, gears, and eccentrics to stroke the ram. Hydraulic press use oil pressure to perform the punching action. The last two can generate from 8 to 60 tons of force with some larger models creating over 150 tons, the mechanical press can operate faster than hydraulic models but the latter can exert more punching pressure more uniformly on the thicker work piece.

In this hydraulic punching machine, the ram activated by the force generated are achieved using fluid under pressure. The fluid operates in a cycle manner, controlled by valves according to pressure required. Initially the clamping cylinder operates and it holds the hollow channel tightly, then a series of operation carries (i.e.) pressure activate at vertical punch station, forward movement of punch to carry hole operation, and withdraw and then horizontal punch station operates and then the clamping goes to initial position and we remove the hollow channel and required size of holes obtained. The main advantage of compact punching through dies over other types are they are equipped with compact combination die assembly and compact horizontal and vertical station they can be adjusted to which alignment ever shape the material is to be punched (any degree channel), for any kind of irregular holes. Therefore it is intended here to design and manufacture a punching machine, which is low cost and operated with compact dies; this will help in enhance the level of our local technology and decrease level of imports.

2. DESIGN METHODOLOGIES

The primary problem to be solved in designing the system is the stations are adjusted according to requirements of irregular size holes and shapes of channels.
2.1 Component Design:

2.1.1 Combination Dies Assembly:

In this die also, more than one operation may be performed at one station. Due to that it is called combination die. It provides both horizontal and vertical punches. This is equipped with two cylinders, with help of cylinder holders, piston connected to punch through collet at each station and a gusset to a single die. The sequence operates at vertical punching and then horizontal punching. The punch diameter may vary through requirement.

2.1.2 Horizontal Punching Station: In this die the horizontal punching performed, the cylinder is connected with punch and dies with supporter of gusset and stripper is not integral part of station

2.1.3 Vertical punching station: In this die, vertical punching is performed, with single punch tool and single die with stripper as integral part.

2.2 Terminologies Used:

2.2.1 Clearance: The difference in dimensions between the mating members of a die set is called clearance.

2.2.2 Cutting Forces: In cutting operation, as punch in its downward movement enters the material, it need not penetrate the thickness of the stock in the order to offset complete rupture of the part. The distance which the punch enters into the work material to cause rupture to take place is called penetrable and is usually given as the percentage of the stock thickness.

2.2.3 Strippers: After a material has been cut by the punch on its forward stroke, the scrap strip has tendency to expand. On the return stroke of the punch the scrap strip has the tin denied to adhere to the punch and be lift by it. Stationary strippers are utilized in this model.
2.2.4 Selection of Seals:
Seals are used to prevent internal and external leakages in the system under varying operation conditions of pressure.

2.2.5 Frame Design:
The frame provides mounting points and maintains proper relative positions of the units and parts mounted on it over the period of service under all specified working conditions. It also provides general rigidity of the machine.

2.2.6 Cylinder:
Cylinder is defined as the number of cubic units that will exactly fill a cylinder.

\[ V = \pi r^2 h \]

Where:
- \( V \) = volume,
- \( \pi \approx 3.142 \),
- \( r \) = radius of the circular end of the cylinder
- \( h \) = height

2.2.7 Piston:
The required piston rod column size necessary to sustain applied load and which is in alignment with the center line of the cylinder bore is influenced by the strength of the rod material, the force applied to the rod column in compression, the mounting situation of the cylinder itself and the stroke over which the load is to be applied. The procedure for computing piston rod column size and cylinder lengths under end thrust condition was accomplished using the procedure suggested by Sullivan (1975).

2.2.8 Punch:
A punch is a hard metal rod with a shaped tip at one end and a blunt butt end at the other which is struck by a collet.

2.2.9 Gusset:
A piece of material sewn into a garment to strengthen or enlarge a part of it.

2.2.10 Die:
A die is a specialized tool used in manufacturing industries to cut or shape material mostly using a press.

2.2.11 Base Frame:
The frame provides mounting points and maintains proper relative positions of the units and parts mounted on it over the period of the service under all specified working conditions. It also provides general rigidity of the machine.

3. PERFORMANCE TEST RESULT:

It is normal practice to subject engineering products to test after manufacture. This is significant step in the manufacturing process. Under tests the product is checked to see if functional requirements are satisfied, identify manufacturing problems, ascertain economic viability, etc.

Testing is therefore employed to prove the effectiveness of the product. For the punching machine, test of accuracy in hole is significant test. The test commenced with initial clamping, to activating of vertical and horizontal sections with use of hydraulic pressure. This was carried out under no-load condition. The machine was left to stand in this position for few hours.

3.1 Tonnage Calculations:

General:

When pressure per square inch is known, psi * area of work/2000 = 2 tons of ram force is required.

Example: where it is known that 100 psi is needed to do a job on a 5"*8" wide piece.

\[ 100 \times 5 \times 8 / 2000 = 2 \text{tons} \]

Sheet thickness is 1mm, pressure applied approximately 40, is satisfactory here.

Press Fit:

To determine the force required to press fit two round pieces together such as a shaft presses in to a bushing, use the following formula:

\[ F = D \omega L I P / 2 \]

Where \( F \) = force required in tons,
- \( D \) = Diameter of the part to be presses in inches
- \( L \) = Length of the part to be presses in inches
- \( I \) = Inference in inches
- \( P \) = Pressure factor.

Following above procedures, then machine was subjected to bent hollow section of 1inch square section and required holes occur through accurate punching.

3.2 Cost Estimate:

The cost estimate for punching machine was around 1 lakh rupees in Indian rupee at the time of machine manufactured. It cut down the cost operation for half when compared to other punching machine. The cost inclusion labor works.
4. CONCLUSIONS:

A compact punching machine was designed and manufactured. The machine was tested to ensure conformability to design objectives. The machine was found to be satisfactory at test.

5. REFERENCES:


