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Design and Fabrication of Cam Operated Punch Press Machine

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Abstract - Punching operations are commonly used for making the holes in the sheet metals. A literature survey was done in order to study the different punching presses methods used in industries. Based on the survey, the most of the industries used crank lever mechanical press and hydraulic & pneumatic presses for punching operations. By operating of pneumatic systems required compressed air and running cost is not economical. If go for hydraulic system, it is occupied more space and also operating speed is very low. The proposed mechanical cam operated design is very suitable for punching operation. Mechanical system is more economical and more reliable. This proposed Designed two pillar sliding mechanism with cam operation for converting the rotary motion to liner motion instead of cranks & lever mechanism. In this method the force applied based on the compression spring force & high torque transmitted from the helical gear box. This method, as we hope that it can be operated easily with semi-skilled operators and run at high speed. Hence this concept mechanism is very suitable for making mass production of the sheet metal punching, blanking & stamping operation in automotive industries

1. INTRODUCTION

The press is the punching machine tool designed to punch Hole by applying spring load ram force by motor energy. The required metal is punched for desired requirements. The presses are especially intended for mass productions and represent the fastest and more efficient way to form metal into a finished punched product. Press tools are used for form and cut the thin metals. Press tools operation can be simplified to a few simple operations involving a punch a die

There are Nemours types of presses in engineering field, which are used to fulfill the requirements. We are interested to introduce Eccentric cam drive system in presses. The main function of machine is to punching or stamping thin sheet metals or non metals using mechanical power. In this project we have used to punching process for simple application.

2. METHODOLOGY

In achieving the aim of this work, parts of the machines were designed for using various design equations. The design results used to select materials for the various components. The detailed drawings of the developed locally sourced material. The use of mild steels due to the fact that strength, rigidity in the design specification. It is available & cost effective. The Assembly phase of all compounds is assembled in design and Testing Phase as we testing the prototype functions.

3. DESIGN PHASE

At first the All machine elements draw the manual sketch then convert in cad drawings with the help of AutoCAD software next step prototype 3D model is done in the system using PRO E software. The component that is used in this project is separately designed at first with the dimension altered as per the requirement to fit with one another. Then finally all are assembled together and then the design is finalized with the required dimensions which is to be machined (Fabricated) and assembled for building the project prototype

SPM Calculations:

Motor speed-1440rpm

Gear box Output Speed -130rpm N2

Drive pulley Diameter: 50.8mm Perimeter - $\pi d = 50.8 \times \pi = 159.12\text{mm}$

Driven Pulley Diameter : 254mm perimeter- $\pi D = 254 \times \pi = 797.56\text{mm}$

Speed of the Driven shaft: $N1 = D \times N2 / d = 159.12 \times 130 / 797.56 = 26\text{rpm}$

Strokes per Min SPM= 26

Punching Force Calculation:

Coil Material -Mild steel

Plate Thickness-0.5mm to 1mm

Perimeter- πd or $2 \pi r$

If punching one circle hole in the 0.5mm thickness low carbon steel hole Dia 6mm

Perimeter= $3.14 \times 6 = 18.84\text{mm}$

Thickness =0.5mm

Shear strength=0.3447kn/mm

Punching Force (KN)= $18.84 \times 0.5 \times 0.3447 = 3.24\text{KN}$

Result: Covert to Ton: 3.24/9.81=0.33Ton

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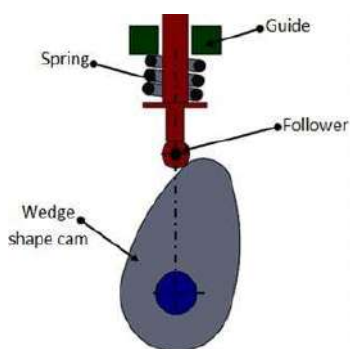
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4.CONSTRUCTIONAL FEATURED

4.4 MAIN FRAME

4.1 CAM FOLLOWER MECHANISM



This cam follower feeder mechanism converts rotary motion into linear motion.

4.2 HELICAL GEAR BOX



power grid, inverters or electrical generators
Helical gears have teeth that are oriented at an angle to the shaft. This leads to more than one tooth to be in contact during the operation, which makes the gear capable of carrying more load. Due to the load sharing between teeth, this arrangement also allows helical gears to operate smoother and quieter than spur gear

4.3 SUPPORT GUIDE SHAFT



Guide shaft is purchased of 25mm dia hard chrome plated rod material which is fixed in the top of frame through guide bearing housing with LM Bearings which moves sliding vertical direction of the machine with help of bearings one end connected with ram block & another end connect to bottom arm. its also maintained accuracy of the machine



Springs The base and Frame is made up of 8mm and 10mm thick Mild steel plates in which holes are drilled for mounting Guide & Main shaft bearing housings and bore is made to fix the bearing in which cam shaft is mounted. Four number ms square tube connected for top & base plate with help of co2 welding centre of the frame fitted 100mm mild steel paa channel welded both the ends and the centre of channel bore machined for fitted in drive shaft assembly This Holds the whole components in our Project proto type

4.5 RAM BLOCK



Punch Ram block is made up of 50mm Thick & 300mm length Mild steel bar in which drilling is done in centre of ram M16x1.5 Size its used to adjust stroke length of punch Ram block its connected to two guide shaft with fitted high tension Hex nuts. weight of the ram block its measure maximum 2.5kgs

4.6 BOTTOM ARM



Punch Bottom arm is made up of 12mmx50mm Mild steel material which is fixed in two support guide bushes through all joints welded. Here a roller follower (NURT25 IR) is used. This roller Follower acts as the friction point which rotates when connected with eccentric cam which converts rotation motion to linear motion of the ram block



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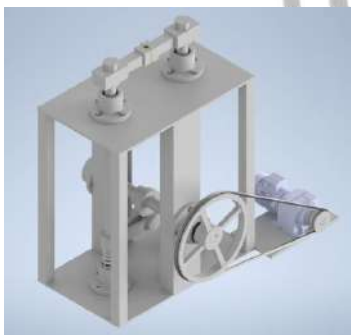


4.7 TOOL & DIE

Tool & dies manufactured special process its involve and maintain accuracy of the product so we select for grade material and heat treatment process at first the make Tool pillar set base & top plate in Mild steel material cut in required size and machined in milling machine then will made pillar shaft in OHNS Material with 52 HRC hardness maintained in HT Process after make in punch and Die HCHCR Material with hardness 58 HRC Then die & punch clearance dimension maintained as per requires thickness of sheet in punching process



5.EXTERNAL SETUP



6.2 Sample Material used for Testing

Testing of this Cam operated machine Prototype is done with the help of Load cell instrument generated mili Voltage (mv) convert to Load indicator tonnage when the punching force is applied.



6.3 TESTING OF THE PROTOTYPE:

Testing is done on the assembled punching press with Tool pillar assembly by using a mild steel plate tested different coil thickness and various punch hole size . first we checking alignment and clearance of the tool & die then run the electrical motor drive cam shaft rotate the speed of 26 strokes per minute then will adjust Ram block locking bolt slowly applying force in the tool suspension spring after insert the mild steel raw material coil spring maximum load can be applied on the machine in punching process tested required hole size cut as per dimension same test conduct with different holes dimension measured & verified

6. PROTOTYPE WORKING & TESTING

6.1 WORKING PRINCIPLE OF PUNCH MACHINE

The punching press works on the principal conversion mechanism that converts the rotary motion to linear motion. The main motor provides the power to drive the flywheel. With a clutch and connecting rods, the flywheel drives the crankshaft or the eccentric gear. To convert the circular motion to the linear motion. There is the need for a transfer point between the slider and the connecting rods. There are two types of designs to convert circular motion into linear motion one is the spherical type. And another is a pin or cylindrical type. During the operation, the drive mechanism powers the rams up and down movement. This action opens and closes the upper die & lower die shoes. During the operation, a sheet metal strip passes between the die shoes. And finally, when the punch (ram attached with the die) moves down, applies pressure on the metal sheet and cuts a hole.

7.WORKING SETUP





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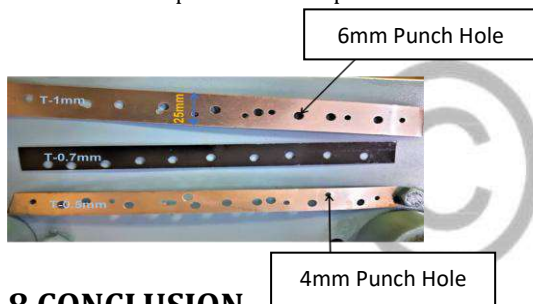
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7.RESULT

The load necessary for punching the material as established by carrying out extensive calculations was 1 ton capacity. The mechanical press is designed for 1.5Ton. The costs encountered in this project are material cost, labour cost, Power cost, and designing cost, manufacturing cost, administrative expenses and cost of indirect expenses. Considering all these parameter. The price of machine calculated compare hydraulic and pneumatic method its very low investment and less power energy consumption. It is observed that utilizing the proposed mechanical press machine will substantially reduce the cost and space required. The new drive for the sheet metal presses with camshaft allows us to optimize the kinematics of simple mechanical presses.



8.CONCLUSION

Punching process is an important element of manufacturing that helps the manufacturing process industries in metal producing processes. There are different types of punching presses like hydraulic, pneumatic, power press. Hence this project has helped to get innovate view of punching press in low cost and working and applications in small scale industry's continues cycle mass production while concluding this report we feel quite fulfill in completed the project assignment well on time we had good practical experience on fulfillment of the schedule of working project model. The selection of choices, raw materials helped us in machining of the various components to very close tolerance. Fabrication and assembly work of this project model is our entire satisfaction

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BIOGRAPHIES



Jayaraman N received Diploma & Bachelor's degree in mechanical engineering in 2010& 2021respectively. And has experienced in mechanical heavy machineries industrial Maintenance related terms & techniques while working in industries



Balaji M received Diploma & Bachelor's degree in mechanical engineering in 2014 & 2021 respectively. And has experienced in production, supply chain, research & development related terms & techniques while working in industries