

Design and Fabrication of Automated Punching Machine

Mr. Jayant Khade¹

Assistant Professor
Department of Mechanical Engineering
ARMJET, Thane, India

ABSTRACT: In this project we are fabricating Auto roll punching machine. This project is specially designed for automatic punching in work piece. This project is to introduce automation in industries. The major components involved in this project are dc motor, CAM arrangement, conveyor arrangement and punching tool. In this project we are using two rollers, for winding and unwinding the sheet during operation. A DC motor is connected with the winding roller. A chain driver is used to transmit the power from the motor to the punching tool. The sprocket connected with the punching tool has CAM arrangement. The CAM arrangement is to convert the rotary motion of the chain drive to linear motion. The CAM provides the linear movement to the punching tool, the punching tool moves through the guide provided. After placing the work piece in the roller, the motor will be switched ON. As the motor rotates the winding roller connected to it also rotates, providing the required movement for the work piece. The CAM also starts working and the punching operation will be done automatically with equal intervals.

KEYWORDS: punching, CAM arrangement, auto roll.

INTRODUCTION

A press or a machine press is a tool used to work metal (SOAP) by changing its shape and internal structure. A forge press reforms the work piece into a three dimensional object—not only changing its visible shape but also the internal structure of the material. A stronger part results from this process than if the object was machined.

A punch press is a type of machine press used to cut holes in material. It can be small and manually operated and hold one simple die set, or be very large, CNC operated, with a multi-station turret and hold a much larger and complex die set.

Most punch presses are large machines with either a 'C' type frame, or a 'portal' (bridge) type frame. The C type has the hydraulic ram at the top foremost part, whereas the portal frame is much akin to a complete circle with the ram being centered within the frame to stop frame deflection or distortion.

U type presses have a bed plate which is used to lock the die bottom bolster. For locking the die, T bolts are used and so this plate contains 'T' - slots into which t- bolts are slid in. These slots are placed diagonally and with a slot horizontal to the longer side of the plate, is the general practice. These slots run up to a central hole made in the plate, the hole being large enough to accommodate another bush with a hole, the hole being used for dropping the punched part to the bottom of the press. The top of the tool butted against a vertical sliding ram with a clamping system which accommodates only a particular diameter of a threaded cylindrical member called the "shank" of the tool. The bottom portion of the tool is locked to the bottom bed plate and the top portion of the tool is locked to the sliding ram. Top and bottom portions of the tool are generally guided by suitable pillar and bush assemblies, (one or two pairs), which gives safety to the punching elements of the tool.

NEED FOR AUTOMATION:

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics form an attractive medium for low cost automation.

The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production.

Now adays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

- To achieve mass production
- To reduce man power
- To increase the efficiency of the plant
- To reduce the work load
- To reduce the production cost
- To reduce the production time
- To reduce the material handling
- To reduce the fatigue of workers
- To achieve good product quality
- Less maintenance

The pneumatic multipurpose punching machine. It can be widely used in low cost automation in manufacturing industries. Pneumatic power is safe. The manpower requirement is reduced also reducing the machining time.

DESCRIPTION OF EQUIPMENTS

Figure shows the actual dimensions of the part needed to be punched.

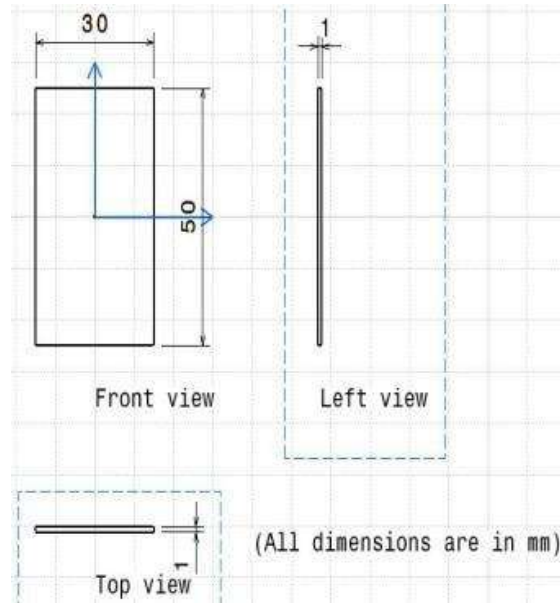


Figure no 1 shows the actual dimensions of the part needed to be punched.

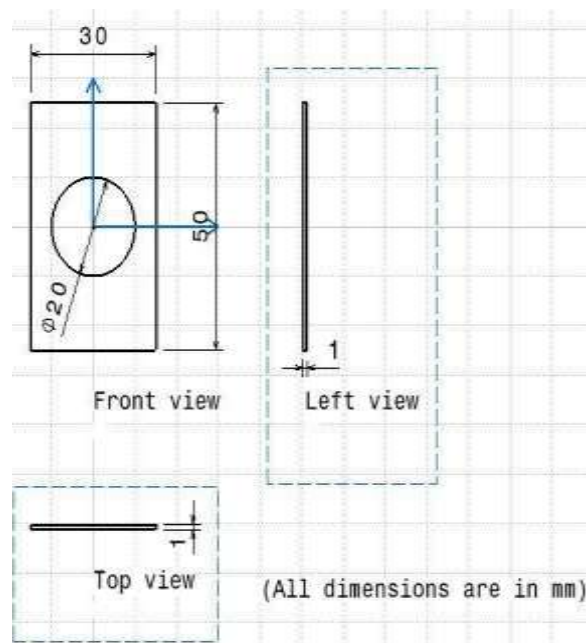


Fig 2 commutator

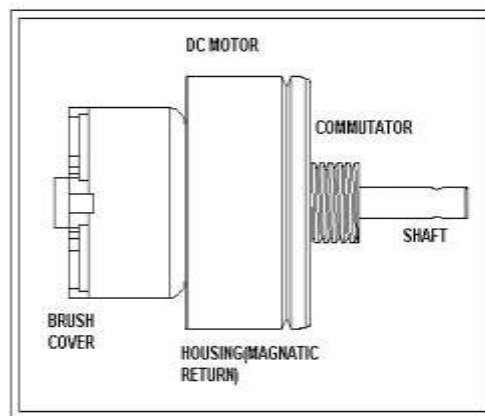
MOTOR:

Fig 3 Motor

As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Let's start by looking at a simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization).

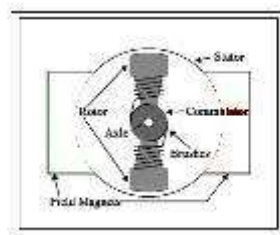


Fig 4 commutator

Every DC motor has six basic parts -- axle, rotor (armature), stator, commutator, field magnet(s), and brushes. In most common DC motors, the external magnetic field is produced by high-strength permanent magnets. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets.

The geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnet(s) are misaligned, and the rotor will rotate until it is almost aligned with the stator's field magnets. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating.

In real life, though, DC motors will always have more than two poles (three is a very common number). In particular, this avoids "dead spots" in the commutator. You can imagine how with our example two-pole motor, if the rotor is exactly at the middle of its rotation (perfectly aligned with the field magnets), it will get "stuck" there. Meanwhile, with a two-pole motor, there is a moment where the commutator shorts out the power supply. This would be bad for the power supply, waste energy, and damage motor components as well. Yet another disadvantage of such a simple motor is that it would exhibit a high amount of torque "ripple" (the amount of torque it could produce is cyclic with the position of the rotor).

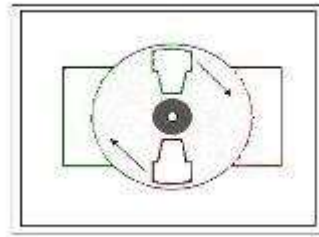


Fig 5 commutator

So since most small DC motors are of a three-pole design, let's tinker with the workings of one via an interactive animation (JavaScript required):

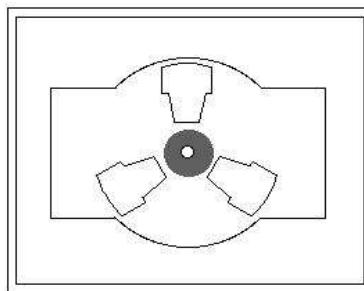


Fig 6 commutator

A few things from this -- namely, one pole is fully energized at a time (but two others are "partially" energized). As each brush transitions from one commutator contact to the next, one coil's field will rapidly collapse, as the next coil's field will rapidly charge up (this occurs within a few microsecond). We'll see more about the effects of this later, but in the meantime you can see that this is a direct result of the coil windings' series wiring:

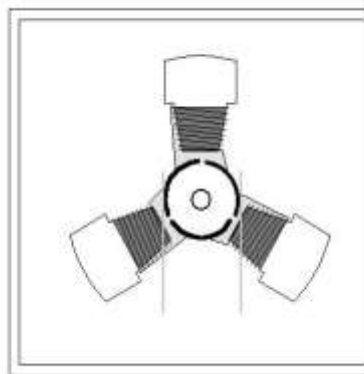


Fig 7 armature

There's probably no better way to see how an average DC motor is put together, than by just opening one up.

Unfortunately this is tedious work, as well as requiring the destruction of a perfectly good motor.

The guts of a disassembled Mabuchi FF-030-PN motor (the same model that Solarbotics sells) are available for (on 10 lines / cm graph paper). This is a basic 3-pole DC motor, with 2 brushes and three commutator contacts.

The use of an iron core armature (as in the Mabuchi, above) is quite common, and has a number of advantages. First off, the iron core provides a strong, rigid support for the windings -- a particularly important consideration for high-torque motors. The core also conducts heat away from the rotor windings, allowing the motor to be driven harder than might otherwise be the case. Iron core construction is also relatively inexpensive compared with other construction types.

But iron core construction also has several disadvantages. The iron armature has a relatively high inertia which limits motor acceleration. This construction also results in high winding inductances which limit brush and commutator life.

In small motors, an alternative design is often used which features a 'coreless' armature winding. This design depends

upon the coil wire itself for structural integrity. As a result, the armature is hollow, and the permanent magnet can be mounted **inside** the rotor coil. Coreless DC motors have much lower armature inductance than iron-core motors of comparable size, extending brush and commutator life.

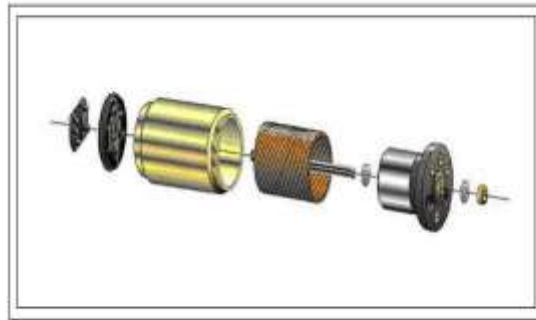


Fig 8 commutator

The coreless design also allows manufacturers to build smaller motors; meanwhile, due to the lack of iron in their rotors, coreless motors are somewhat prone to overheating. As a result, this design is generally used just in small, low-power motors. Beamers will most often see coreless DC motors in the form of pager motors.

Again, disassembling a coreless motor can be instructive -- in this case, my hapless victim was a cheap pager vibrator motor. The guts of this disassembled motor are available (on 10 lines / cm graph paper). This is (or more accurately, was) a 3-pole coreless DC motor.

CHAIN DRIVE:

Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. The power is conveyed by a roller chain, known as the drive chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force.

CAM:

A cam is a projecting part of a rotating wheel or shaft that strikes a lever at one or more points on its circular path. The cam can be a simple tooth, as is used to deliver pulses of power to a steam hammer, for example, or an eccentric disc or other shape that produces a smooth reciprocating (back and forth) motion in the follower which is a lever making contact with the cam.

The reason the cam acts as a lever is because the hole is not directly in the centre, therefore moving the cam rather than just spinning. On the other hand, some cams are made with a hole exactly in the centre and their sides act as cams to move the levers touching them to move up and down or to go back and forth.

PUNCH:

The punching die is made out of mild steel. The movable die or male die has the dimension of the hole, profile required and the female die has the cavity. A Die set consists of a set of (male) punches and (female) dies which, when pressed together, may deform the work piece in some desired manner. The punches and dies are removable with the punch being temporarily attached to the end of a ram during the punching process. The ram moves up and down in a vertically linear motion.

Hoses:

Hoses used in this pneumatic system are made up of polyurethane. These hoses can withstand a maximum pressure level of $10 \times 10^5 \text{ N/m}^2$.

Connectors:

In our system there are two types of connectors used. One is the

Hose connector and the other is the reducer. Hose connectors normally comprise an adaptor hose nipple and cap nut. These types of connectors are made up of brass (or) aluminum (or) hardened pneumatic steel.

CONTROL UNIT:

In pneumatic punching device is an air-operated device used for many small operations. It is a portable one. Compressed air is the source of energy for this device. The compressed air is used for punching operation. Here the compressed air from the compressor firstly enters the Control unit. In the control unit the pressure of the air is controlled and sent to the barrel to move the piston, which in turn moves the punching die. The gate valve controls the pressure volume of air.

PRESSURE GAUGE:

Pressure gauges are usually fitted with the regulators. So the air Pressure adjusted in the regulator is indicated in the pressure Gauge, is the line pressure of the air taken to the cylinder.

Among the several research processes, drilling of composite materials causes several damage modes, such as: de-lamination, fiber-pull out, swelling, edge chipping, uncut fibres, surface roughness and dimensional errors and others. De-lamination is considered as the major concern.

III. DESIGN OF EQUIPMENT AND DRAWING

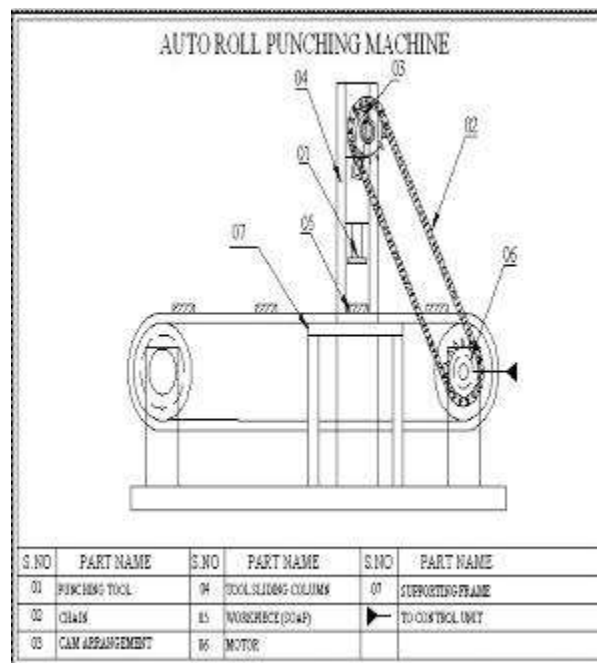


Fig 9 auto roll punching machine

RESULT

WORKING PRESSURE: 8 bar to 10 bars

Operating Force = Pressure x Cylinder area

OPERATING FORCE = 1501.96 N

$$F = (8 \times 100) \times (3.14/4) (D * D)$$

Where, D is the diameter of the cylinder in mm.

$$\text{Operating force} = 6 \times 9.81 \times 104 \times 0.785 \times 0.057 \times 0.057$$

YIELD STRESS OF THE WORK MATERIAL FROM DATA BOOK FOR ASTHETIC FIBRE = 40 N/mm²

Cutting Force = Yield stress x Shearing area

Yield stress = Fy

Shearing area = (3.14 x d x t)

Factor of safety is to be decided based upon the operating force and cutting force.

**CUTTING FORCE FOR
ASTHETIC FIBRE** = 40×117.74
= 1256 N

MECHANICAL ADVANTAGE

$$W \times L_1 = P \times L_2$$

W/p = Mechanical Advantage =
 L_2/L_1 = Leverage, L_2 / L_1 is 2:1

Hence applied force is doubled due to the leverage. Operating force is greater than cutting force,

Hence the design is safe and the material is cut.

In this project we are using two rollers, for winding and unwinding

the sheet during operation. A DC motor is connected with the winding roller. A chain driver is used to transmit the power from the motor to the punching tool. The sprocket connected with the punching tool has CAM arrangement. The CAM arrangement is to convert the rotary motion of the chain drive to linear motion. The CAM provides the linear movement to the punching tool, the punching tool moves through the guide provided. After placing the work piece in the roller, the motor will be switched ON. As the motor rotates the winding roller connected to it also rotates, providing the required movement for the work piece. The CAM also starts working and the punching operation will be done automatically with equal intervals.

PNEUMATIC COMPONENTS AND ITS SPECIFICATION

The pneumatic punching machine consists of the following components to full fill the requirements of complete operation of the machine.

1. Motor
2. Chain drive
3. Cam arrangement
4. Punching tool
5. Tool sliding column

Reliable & flexible
Low maintenance
Automated process

DEMERITS

Separate arrangement has to be done for different work pieces.

CONCLUSION

The project carried out by us will make an impressing mark in the field of small scale industries. It is very usefully for the workers to carry out the operations in a single machine.

This project has also reduced the cost involved in the concern. The project has been designed to perform the required task taking minimum time.

REFERENCES

1. Aditya Polapragada, Sri Varsha, "Pneumatic Auto Feed Punching and Riveting Machine", International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 7, September – 2012, ISSN: 2278-0181.
2. Vijaylaxmi.G.Biradar, Siddharam Patil , R M Lathe, "Automation of Sheet Bending Machine Using Electro Pneumatic Devices" International Journal of Scientific & Engineering Research Volume 3, Issue 9, September-2012 1 ISSN 2229-5518.
3. Handbook of die design, Second Edition, 2006, McGraw-Hill Handbooks, Ivana Suchy.
4. Materials Handbook, Fifteenth Edition, 2008, Mc-Graw-Hill Handbooks, George.S.Brady, Henry.R.Clauser.
5. P.M.Pradhan, "Experimental Investigation and Fabrication of Pneumatic Punch", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 6, June 2013.
6. A.S. Aditya Polapragada & K. Sri Varsha, "Pneumatic Auto Feed Punching and Riveting Machine ", International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 7, September - 2012 ISSN: 2278 - 0181.
7. U.P. Singh, "Design Study of the Geometry of a Punching tool", Journal of Materials Processing Technology, 33 (1992) 331-345 Elsevier.
8. P.C.Sharma, "Methods of reducing Cutting Forces", Pages 63-66, Production Engineering, Ninth edition, 2004, S. Chand & Company Ltd.
9. E. Paul. Degarmo, "Shearing in Metal Cutting", Pages 518-528, Materials and Processes in Manufacturing, Eighth edition, 2003, Prentice Hall of India Pvt Ltd.
10. K. Mahadevan, Design Data Handbook, Third edition, Reprint 2002, CBS Publishers & distributors