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Project Design: MECHANICAL ENGINEERING

Advancement in Clicker Machine and Die

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Abstract- In the case of production process time consumption is an important factor. While using the clicker machine the article material has to be removed manually from the die. Only one die is used at a time, this will increase the production time. To overcome this piston can be changed as a magnetic one so that multiple dies can be attached to the piston and for the removal of the article material from the die; shape of the die can be changed as a one side closed structure and springs attached inside of it. The purpose of this project is to make a development in shoe manufacturing industries. The major component in this manufacturing process is "clicker machine". Clicking is the primary process of the article making in which the upper components and insole are produced. It is a tedious process. To decrease the man power a little advancement can be done in piston and die of the clicker machine.

Keywords: *production, clicker machine, article material, manufacturing, die, insole.*

1. INTRODUCTION

Clicking is the primary process of the article making. In this process the upper components and insole are produced using this method. Synthetic leather, Eva sheet and Lacra are used as raw materials for shoe manufacturing process. Using roll setting process the material can be arranged layer by layer according to its thickness. For example if the material have thickness between 0.6 to 1mm it will be arranged as 16 layers, if it have thickness in between 1 to 2mm then the number of layers will be 8. A semi-automated clicker machine will have three motors in which the primary motor is used for the pumping of oil from the reservoir to the cylinder (the reservoir contains 48kg of oil in it). The other two motors are used for the horizontal movement and for the feeding of the material respectively. LC1D09 PLC unit is used for counting of the parts produced.

The pressure applied and the height of the cylinder can be adjusted according to the material used for the production of different parts of the article different dies are used which is made using high steels. For the size identification notches are provided on the die, the internal notches are used for the size identification while the external notches are provided to identify whether it is left side or right side part.

2. DIE CUTTING

Die cutting is the process of using a die to shear webs of low-strength materials, such as rubber, fibre, foil, cloth, paper, corrugated fibreboard, paperboard, plastics, pressure-sensitive adhesive tapes, foam and sheet metal. In the metalworking and leather industries, the process is known as clicking and the machine may be referred to as a clicking machine. When a dinking die or dinking machine is used, the process is known as dinking. Commonly produced items using this process include gaskets, labels, corrugated boxes, and envelopes [1-4, 6].

Die cutting started as a process of cutting leather for the shoe industry in the mid-19th century. It is now sophisticated enough to cut through just one layer of a laminate, so it is now used on labels, stamps, and other stickers. This type of die cutting is known as kiss cutting [5].

Die cutting can be done on either flatbed or rotary presses. Rotary die cutting is often done in line with printing. The primary difference between rotary die cutting and flatbed die cutting is that the flatbed is not as fast but the tools are cheaper. This process lends itself to smaller production runs where it is not as easy to absorb the added cost of a rotary die.

3. SPRINGS

A coil spring, also known as a helical spring, is a mechanical device which is typically used to store energy and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces. They are made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded. Under tension or compression, the material (wire) of a coil spring undergoes torsion. The

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spring characteristics therefore depend on the shear modulus, not Young's Modulus. A coil spring may also be used as a torsion spring. In this case, the spring as a whole is subjected to torsion about its helical axis. The material of the spring is thereby subjected to a bending moment, either reducing or increasing the helical radius. In this mode, it is the Young's Modulus of the material that determines the spring characteristics. Metal coil springs are made by winding a wire around a shaped former - a cylinder is used to form cylindrical coil springs.

4. DIE

To create a die template the sheet metal tins can be used, since it has a circular shape the centre of gravity can be easily found and according to that point the springs can be fixed in such a form that the force distribution is even in all areas of the material as shown in the Fig. 1.

The edges of the die have to be sharpened or blades have to be fitted at the edges. Since the springs are using inside the die it will push the material outside from the die so that the removal of the material will be much easier compare to the normal way. Based on the [1] proper die can be selected.

5. PNEUMATIC CYLINDER

Since we have a low loading application we can use pneumatics rather than hydraulics. It is more economic compare to hydraulics. Since we are using wide varieties of dies the pneumatic piston has to be changed as a magnetic one so that the dies can be easily attach and detach from the machine. There exists a property called nesting. According to which the dies has to be arranged in such a manner that the

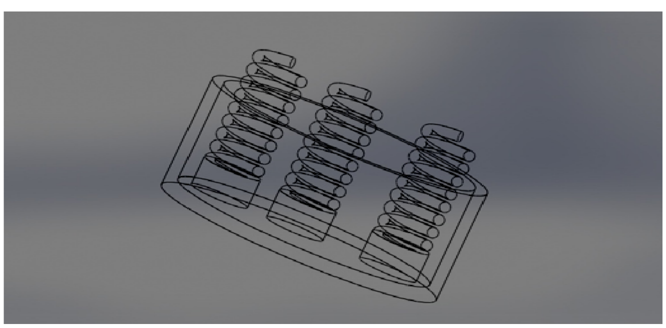

Fig. 1. Die with Springs

material wastage is minimum. To achieve this condition the die position has to be changed for some situations, if we used a permanent joint for the die and piston it is impossible to achieve such a condition so a magnetic piston is used.

Single acting spring return pneumatic cylinder is chosen because after cutting the material the piston has to come back to the initial position, if we are choosing a double acting cylinder a force is required for the backward movement too it will lead to power wastage. In case of single acting spring return cylinder the spring will get compressed during the forward stroke and it will pull back the piston during reverse movement. It will not need any power; inside the cylinder as well as in die the same mechanism is followed.

6. RESULTS

6.1. Construction

This project setup consists of mild steel rods which are welded to form the appropriate structure to hold the pneumatic cylinder as a frame. The article material can be fed on the base table. The pneumatic cylinder is attached to the frame by means of nut & bolts. Various types of dies can be attached to the pneumatic cylinder by means of a magnetic piston which is attached to the pneumatic cylinder. The pneumatic cylinder is actuated by the 5/2 manually operated control valve. The die has springs attached inside it, so that there is no need of removing the article material manually from the die. The 2D diagram of the construction is shown fig. 2.

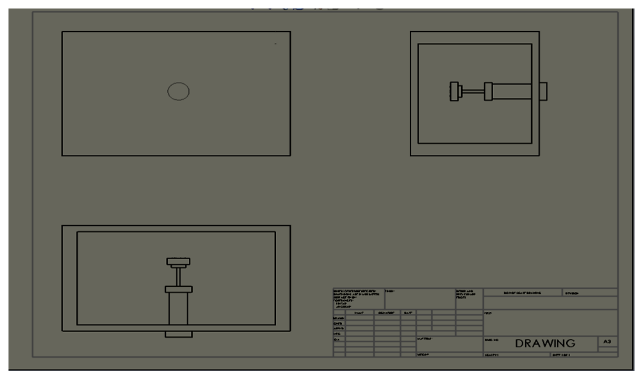

Fig. 2. 2D Drawing

6.2. Working Principle

The concept of clicker machine is same as that of coining process. In this process according to the need various types of dies can be used. The double acting cylinder is controlled by a 5/2 control valve. During the time of cutting springs attached inside the die will get contracted, that means it will apply a thrust on the final article material so that it won't get stuck inside the die. During the return stroke the spring will push the material away from the die so that manual removal is not required. In conventional clicker machine only one die can be used at a time and it has to be placed manually. By using a magnetic piston multiple dies can be used.

6.3. Calculation

Calculation for spring stiffness:

Spring stiffness can be calculated by using the formula. The apparatus used for stiffness calculation and readings obtained are shown in the fig 3.

Coefficient of velocity

Fleischer proposed that literally C_v means coefficient of velocity. C_v is generally used to compare flows of valves. Higher the value of C_v, greater the flow.

Weight in Kg	Deflection in mm	Force in N	Stiffness in N/m
0.5	4.5	4.905	1.09
1.0	8	9.81	1.22
1.5	11	14.715	1.33
2.0	14.5	19.62	1.35
2.5	18	24.525	1.36

Fig. 3. Calculation of Pneumatic Cylinder

Calculation of Pneumatic Cylinder
Area of Cylinder = (π/4)
Diameter of cylinder = 8 cm
Therefore, Area Of cylinder = 50.24 cm^2
Coefficient of viscosity C_v = (78.53×15×0.036×11.2)/(475×1)
C_v = 0.9998

Cylinder thrust

- F = Cylinder Thrust in Kg.
- D = Diameter of Piston in cm.
- d = Diameter of piston rod in cm.
- P = Operating Pressure in bar

Double Acting in Forward Stroke: $F = (\pi/4)\times D^2\times P$

Double Acting in Return Stroke : $F = (\pi/4)\times(D^2-d^2)\times P$

Cylinder Thrust In Forward Stroke:

- $F = (\pi/4)\times 8^2\times 10$
- F = 502.65 Kg

Cylinder Thrust In Return Stroke:

- $F = (\pi/4)\times(8^2-2^2)\times 10$
- F = 471.23 Kg

Free air consumption

The air required for pneumatics is of course not consumed, but the energy stored within it is typically converted from compressed air into movement. The air required for this purpose is called the air consumption.

In Forward Stroke

$C= [(\pi/4)\times D^2\times(P+1)\times L]/100$

$C= [(\pi/4)\times(8^2)\times(10+1)\times 15]/100$

C= 8.29

In Return Stroke

$C= [(\pi/4)\times(D^2-d^2)\times(P+1)\times L]/1000$

$C= [(\pi/4)\times(8^2-2^2)\times(10+1)\times 15]/1000$

C= 7.77

Cylinder size selection

Weight of Die W = 1.5 Kg = 3.30693 lb
Force of Piston F = A×Weight = 1×3.30693= 3.30693 N
Increase the force as necessary to achieve the desired speed. Simply multiply F from step (1) above by S from the table given below.
Under factors F = F×S = 3.30693×1.25 = 4.133

Value of S (Bimba Databook)

Calculation of Power factor

Power Factor PF = Fs / psi

PF = 4.133/0.4979

PF = 8.3

Bore Diameter D = 3.149606 Inche

7. CONCLUSION

It is hoped that this project reduces manpower and also gives more accuracy to the shoe manufacturing industries. This in turn helps us to study more about hydraulic & pneumatic systems and industrial machines. The study done for this project also helped us in generating new ideas for further development and the factors to be considered for fabrication and selection of materials.

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