"DESIGN & FABRICATION OF NET CUTTER MACHINE"

Mr. Tushar Khode[1], Mr. Akhil Bahale[2,]
[1,2] Directors- Sterling Electricals & Technology

E-mail:- [1] tkhode@gmail.com

ABSTRACT
The rack and pinion mechanism can be synthesized for a maximum of seven precision conditions with specified values for various combinations of coupler point position, its velocity, rotation of the pinion, and its angular velocity at one or more design positions.
The general form of synthesis equations for each one of the four different types of precision conditions. The solution procedure depends upon the number of available free choices and is slightly different from one case to another.
The present work concentrates on the case in which the mechanism generates a path passing through the three precision points satisfying the specified velocity at one of the three points together with prescribed finite rotation of the pinion.

KEYWORDS
Heating, Coil, Net cutter

INTRODUCTION
The heating is given to the die edges to raise the temperature above the melting point of the plastic net. The temperature is controlled by the washer type sensor. Induction heating is the process of heating an electrically conducting object (usually a metal) by electromagnetic induction, where eddy currents (also called Foucault currents) are generated within the metal and resistance leads to Joule heating of the metal.
An induction heater (for any process) consists of an electromagnet, through which a high-frequency alternating current (AC) is passed. Heat may also be generated by magnetic hysteresis losses in materials that have significant relative permeability
The frequency of AC used depends on the object size, material type, coupling (between the work coil and the object to be heated) and the penetration depth.
A hydraulic press is a device using a hydraulic cylinder to generate a compressive force. It uses the hydraulic equivalent of a mechanical lever, and was also known as a barman press after the inventor, Josephbarman, of England. He invented and was issued a patent on this press in 1795.As barman installed toilets; he studied the existing literature on the motion of fluids and put this knowledge into the development of the press.
With the industrial revolution of the late 18th and 19th centuries came the first use of pitches in machine tools, via English inventors such as John Wilkinson and Henry Causley. The most notable inventor in mechanical engineering from the early 1800s was undoubtedly the mechanical genius Joseph Whitworth, who recognized the need for precision had become as important in industry as the provision of power.
Load. The principle on which the rack & pinion works is similar to that of an inclined plane. There are mainly two types of jacks-hydraulic and mechanical. A hydraulic rack consists of a cylinder and piston mechanism. The movement of the piston rod is used to raise or lower the load. Mechanical jacks can be either hand operated or power driven. A large amount of heat is generated in the rack & pinion and long lifts can cause serious overheating. To retain the efficiency of the rack & pinion, it must be used under ambient temperatures, otherwise lubricants must be applied. There is oil lubricants intended to enhance the equipments capabilities. Apart from proper maintenance, to optimize the capability and usefulness of a rack & pinion it is imperative to employ it according to its design and manufacturer's instruction.

DATA COLLECTION
THROUGH LITERATURE SURVEY
The heating is given to the die edges to raise the temperature above the melting point of the plastic net. The temperature is controlled by the washer type sensor. **Induction heating** is the process of heating an electrically conducting object (usually a metal) by electromagnetic induction, where eddy currents (also called Foucault currents) are generated within the metal and resistance leads to Joule heating of the metal
An induction heater (for any process) consists of an electromagnet, through which a high-frequency alternating current (AC) is passed. Heat may also be generated by magnetic hysteresis losses in materials that have significant relative permeability
The frequency of AC used depends on the object size, material type, coupling (between the work coil and the object to be heated) and the penetration depth.

- 10A NO NC type
- 125 VAC
- Mounted in a 7/16'' hole.

DEVELOPMENT OF OUR CONCEPT

The body frame is constructed with the help of angle. The angle was cut to desire size using a hand cutter .The parts were then welded so as to support all the accessories.

Net cutter was used to cut and geared shaft pitched to it. The whole assembly firmly welded on the basic floor made of angles.

Arrack and pinion mechanism is made of M.S. strip ,which has link length of 12".The links of the rack and pinion mechanism is then welded on the pedestal of body, so that links follows the exact angular profile of the heating coil.

The other end of the link is made to slide in a guide who is mounted beneath the plywood so that it provides the proper movement support the guide.

The limit switches provided at two locations ensure the end movement of the heating coil. We have added two limit

switches in the control panel to control the temperature as it keep van with respect to material.

The wires were then connected to the heating coil; limit switches and a hand held lever. Heating coil receive the current through the control panel placed at the top of the table.

WORKING:

The body frame is constructed with the help of angle. The angle was cut to desire size using a hand cutter .The parts were then welded so as to support all the accessories.
The is of fine thickness of 0.2mm which is inserted under the die & operated byte worker behind. The heating coil is assembled with the rack & pinion arrangement also consist of the gear inter mess with the rack. The rack slides over the pinion and the heating assembly reciprocate in the vertical direction.

The heating coil is tend to reciprocate with the rack & pinion arrangement which form the impression on the net rested under the die .the operator grip the handle and apply force on the downward direction and hold it to form impression on the net or material to be cut. The temperature of the heating coil is to be maintained between 200 to 300^{0}C .Therefore the control canal is given where the adjustment can be done
.
The adjustment of the control panel is depending on the thick of the net which is to be cut by the die temperature. The control panel consists of three elements .the mcg, comparator and the capacitor .as the main components of the control system. The capacitor is used to maintain the temperature at the set temperature. The mcg is used to corporate the maximum temperature of the system which indicate the present temperature of the heating coil.

The capacitor is used to operate the supply of the current conducting in the wire .this current rate of transfer result the change in the temperature of the heating coil .which also help us to regulate the varying temperature.The lever is to be operated to form impression of die on the net. The die after impression is to be drawn up which will not harm the net.

Design of rack and pinion
The general procedure for synthesizing the rack and pinion mechanism up to seven
Precision conditions is developed

- The pitch threads and force F at the handle to reciprocate the pitch.
- The load W is compressive in nature and induces the compressive stress in the rack. It may also lead the rack into the pinion...
- The load F produces compression and it is maximum, when the rack is at its maximum lift.

The rack also experiences twisting moment due to F. the shear stress is also induced in the pitch due to the twisting moment between the threads of pitch.

MATERIAL OF PITCH
EN8 is a very popular grade of through-hardening medium carbon steel, which is readily machinable in any condition. EN8 is suitable for the manufacture of parts such as general-purpose axles and shafts, gears, bolts and studs. This material has high wear resistance property.

080M40 (EN8)	**Specification**
Chemical composition	
Carbon	0.36-0.44%
Silicon	0.10-0.40%
Manganese	0.60-1.00%
Sulphur	0.050 Max
Phosphorus	0.050 Max

080M40 (EN8) – mechanical properties in "R" condition	
Max Stress	700-850 n/mm^2
Yield Stress	465 n/mm^2 Min (up to 19mm LRS)
0.2% Proof Stress	450 n/mm^2 Min (up to 19mm LRS)
Elongation	16% Min (12% if cold drawn)
Impact KCV	28 Joules Min (up to 19mm LRS
Hardness	201-255 Brinell

EN8 in its heat treated forms possesses good homogenous metallurgical structures, giving consistent machining properties.
Good heat treatment results on sections larger than 63mm may still be achievable, but it should be noted that a fall-off in mechanical properties would be apparent approaching the centre of the bar.
It is therefore recommended that larger sizes of EN8 are supplied in the untreated condition, and that any heat treatment is carried out after initial stock removal. This should achieve better mechanical properties towards the core

5.2 DESIGN CALCULATIONS
RACK & PINION
Maximum Load to be lifted = 10Kg

= 10× 9.81N

= 98.1N

For a 98.1N capacity OF RACK & PINION
the suitablePitch is the one whose nominal (major) diameter is 6mm.

Corresponding to the nominal diameter 36mm, the pitch (p) selected is 6mm.

The core diameter (d_c) = 4mm

The mean diameter (d_m)= 9mm

EN8 material is used for rack &pinion. The ultimate and yield stresses are 450N/mm^2 and 230N/mm^2 respectively.

The compressive stresses induced in lead pitch due to load 0f 98.1n is given by

$$\sigma_c = \frac{W}{\frac{\pi}{4}\times dc^2}$$

= (98.1* 4)/ (π x 6^2)
= 34.69N/mm^2
Factor of safety = 230/70.73= 3.25=4

Hence lead pitch will bear 78.8N easily

The helix angle of pitch = tan (α) = $\frac{p}{\pi d}$

= 6/ (πx9) = 0.212

Therefore, α = 0.212°
Assuming coefficient of friction between pitch and nut,

μ = tan (ϕ) = 0.14

ϕ= tan^{-1}(0.14) = 7.96°

α <ϕ, hence it is a self locking pitch.

The turning moment required to rotate pitch under design load is given by
T =W (d_m/2) tan (α+ϕ)

= (784.8) (9/2) tan (0.212°+7.96°) =490.17n/.mm
The turning moment required to rotate pitch under design load is given by
T =W (d_m/2) tan (α+ϕ)
= (784.8) (9/2) tan (0.212°+7.96°) =490.17n/.mm

The shear stress due to torque, Ft= 16T/ (πdc3)

= (16x490.17)/π(6)^3
= 536.22N/mm^2
Direct stress is given by

F_s= ½√ (σ_c^2 + 4τ^2)

= ½√0.6939^2 + 4(0.4867)^2

= 0.5985N/mm^2

The RACK &PINION material has 115N/mm^2 shear strength.
Safety factor = 115/47.03

= 2.44

Design calculations to check the safety of nut

The material of the nut used is stainless steel. The yield stress in tension and compression are 216 N/mm^2 and 294N/mm^2 respectively.
Shear stress = 186N/mm^2

Bearing pressure between lead PITCH material and nut material is B_P =15N/mm^2
n = Number of threads in contact with the pitched spindle.
H = height of nut = n x p
t = thickness of pitch = p/2 = 6/2 = 3mm
The number of internal thread (n) in nut for the load 490.5N is given by

$$n = \frac{W}{\frac{\pi}{4}(d_o{}^2 - dc^2)}$$

= (4 x 784.8)/ (π (9^2-6^2) (15))
≈ 16
H = n x p
= 16x6 = 96mm
The outer diameter of the nut, D_1 = 54mm
The inner diameter of the nut, D_0 =36mm
The tensile stresses induced in the nut is given by

$$\sigma_t = \frac{4W}{\pi(d_o{}^2 - dc^2)}$$

= (4x784.8)/π (54^2- 36²)
=61.68 N/mm²
which is less than
216 N/mm²
Factor of safety=216/39.29
=5.55

Operational Considerations of net cutter machine

1. **Maintain the temperature**
   Maintain the temperature of heating die in the range of 200-300^0 c. this will help us minimum shrinkage of the net which to be cut by the die.

2. **Prepare the machine before use**
   Switch on the heating and sensing element or component half an hour before starting the working on the machine. This will provide desired product.

3. **Keep the mating surfaces well lubricated**
   The better the lubrication, the longer is the service life. Grease fittings or other lubrication means must be provided for the power pitch and nut.

4. **Keep the mating surfaces clean**
   Dirt can easily embed itself in the soft nut material. It will act as a file and abrade the mating pitch surface. The soft nut material backs away during contact leaving the hard dirt particles to scrap away the mating pitch material.

ADVANTAGES

- It reduces the labor cost.
- It reduces the production time
- It does not require skilled labor.

- Less scrap is produced.
- Maintenance cost is less

DISADVANTAGES

- The initial cost of machine is more.
- Specific die is required.
- The machine cannot work till the die is heated to the specific temperature.

APPLICATIONS
Industrial purpose

- For mass production of net
- For cutting the plastic net of specific diameter

Future scope

- The net cutter can be made automatic and can be used in mass production in various plastic industries.
- The net cutter can be made for steel cutting which can be used for sealing in industries for protection purpose.
- Arrangement for multiple die can be done to cut the net of different sizes.

CONCLUSION

- Thus, the machine is preferred in the plastic industries which reduce the cost of machine & also easy in handling.
- The machine can be operated by any semi skilled or UN skilled worker which also reduces the cost of human labor.
- The material which is required is also been required in specific quantity.
- The time required for production is also minimized by providing lever foe operation.

Reference

1. Khruni gupta,s machine desine
2. Wikipedia
3. Narali publication , s design of machine elements
4. Production engineering tech max.
5. Production engineering by r.k. jain
6. Design of machine elements by V.B.Bhandari
7. A text book of machine design by Rajendra Karwa
8. Analysis and Design of Machine Elements by V K Jadon, Suresh Verma
9. Tribology in Machine Design by T. A. Stolarski
10. A text book of Machine Design by R.S.Khurmi,J.K.Gupta
11. Design of Machine Elements by Farazdak Haideri
12. Machine Design by S.G.Kulkarni
13. Design of machine elements by K.Rao

PROJECT SNAP SHOT