Manufacturing of Toggle Jack

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Abstract - *Manufacturing of toggle jack is a quit challenging job. Toggle jacks are available in standard ranges and the capacities vary from 3kN - 1000kN. The power to magnify input forces, Toggle jacks allow us to raise vast loads using only a fraction of the force ordinarily needed. A power screw is a drive used in machinery to convert a rotary motion into a linear motion for power transmission. It produces uniform motion and the design of the power screw may be such that. Either the screw or the nut is held at rest and the other member rotates as it moves axially. Power screws should be designed for smooth and noiseless transmission of power with an ability to carry heavy loads with high efficiency.*

Key Words: **Toggle Jack, Worm, Nut, Cables, lead screw etc**

1. INTRODUCTION

In the olden days the energy or effort was the manual effort. But, over the years new technologies have been developed and implemented in each and every field. These techniques/devices help in great extent to reduce the manual effort. Mechanical machine toggle jack is one such device commonly employed to reduce the manual effort.

Manufacturing involved in conversion of raw material into the finished product used for some useful purpose. To understand the manufacturing system in a better way, it is divided in to three parts.

1. Input: Man, machine, material and energy.
2. Process: Related to design, the product and the production management.
3. Output: Finished product or service.

1.1 Process Planning:

Process planning is an important function, which takes place directly after the design of a product. It takes the information received and creates a plan for manufacture. The process planning involves an application of a systematic procedure, which involves following steps.

A) Preliminary Part Print Analysis:

1. Size configuration
2. Material
3. Dimensional relationships and identification of various reference Surfaces.
4. Implicit and explicit remarks regarding from Error and finish.

B) Determination Logical sequence of operation:

1. Identification of surface to be machined, selection of machine tool.
2. Supporting accessories, pictures, gauges etc.

2. Operation sheet for different type of component used in project assembly

2.1 Operation Sheet for lead screw:

Component: Lead screw

Material: Malleable Carbon Steel

Material Specification: ø18mm x 260mm

Quantity: 1

Sr. No.	Operation	M/C. Used	Tool Used	Measuring tool	Jigs and Fixtures	Measuring time (min)	Machining time (min)	Total time (min)
1.	Facing both side of shaft Ø 18mm x 15mm	Lathe machine	Single point cutting tool	Vernier caliper &scale	Chuck	2	10	12
2.	Turning Ø 14mm x 300mm	Lathe machine	Single point cutting tool	Vernier caliper &scale	Chuck	2	10	12
3.	Chamfering 2mm x 45^0	Lathe	Chuck	-	Chamfering tool	1		6
4.	Threading SQ14 x 2mm	Lathe machine	Square Thread tool	Vernier caliper &scale	Chuck	3	30	33
5.	Filling on both end	Flat file	-	-	Vice	-	5	5
							Total	68

Table no. 1 : Operation sheet for lead screw

2.2 Operation Sheet for worm:

Material: Carbide Steel

Material Specification: ø 20mm x 30mm

Sr. No	Operation	M/C. Used	Tool Used	Measuring tool	Measuring time (min)	Machining time (min)	Total time (min)
1.	Cut the rod of 30 mm thick for ø 20 mm	Gas cutter set	Compass	Vernier caliper &scale	3	15	18
2.	Facing 5mm x Ø 20mm and turning Ø 17 mm x 25mm	Lathe	Single pt. Tool	Vernier caliper &scale	2	15	17
3.	Tooth Cutting	Hobbing m/c	Hob cutter	Vernier caliper &scale	4	60	64
5.	Heat treatment	furnace	Tongue	-	-	30	30
	Table no.2 : Operation sheet for worm					Total	129

2.3 Operation Sheet for nut:

Material: WM 350

Material Specification: ø 30 mm x 40 mm

Sr. No.	Description of the operation	M/C Use	Jigs and Fixtures	Tool Used	Measuring time (min)	Machining time (min)	Total time (min)
1	Facing Ø 30 x 10 mm	Lathe	Chuck	Single pt. cutting tool	2	5	7
2	Turning Ø 25 mm x 30mm	Lathe	Chuck	Single pt. cutting tool	3	10	13
3	Drilling Ø 14 mm x 30mm	Lathe	Chuck	Drills	4	15	19
4	Boring Ø 15 mm x 30mm	Lathe	Chuck	Boring tool	2	3	5
5	Threading SQ14 x 2mm	Lathe	Chuck	Sq. thread tool	5	15	20
6	Chamfering 45^0 x 2mm	Lathe	Chuck	Chamfering tool	-	5	5
7	Polishing	Lathe	Chuck	Polish paper	-	7	7
	Table no.3: Operation sheet for nut Total						76

2.4 Operation Sheet for pins:

Material: 14C6

Material Specification: ø 12 x 45mm

Sr. No.	Operation	M/C. Used	Tool Used	Measuring tool	Measuring time (min)	Machining time (min)	Total time (min)
1.	Facing Ø 12 mm x 5mm	4 – jaw lathe	Single pt. cutting tool	Vernier caliper &scale	2	5	7
2	Turning Ø 8mm x 40mm	4 – jaw lathe	Single pt. cutting tool	Vernier caliper &scale	3	5	8
3.	drilling Ø 7mm x 40mm	4 – jaw lathe	Center drill	Vernier caliper &scale	3	10	13
5.	Polishing	Lathe	Polish paper	-	-	5	5
						Total	33

Table no.4: Operation sheet for pins

3. FABRICATION

The following are the various manufacturing process used in mechanical engineering.

A) Primary shaping process:

The processes used for the preliminary shaping of the machine component are known as primary shaping process.

B) Machine Process:

The process used for giving final shape to the machine component, according to planned dimensions is known as machining process.

C) Surface finishing process:

The process used to provide a good shape surface finish for the machine components are known as surface finishing processes. The common operations used for the process are polishing, buffing, lapping etc.

D) Joining Process:

The processes used for joining machine components are known as joining process. The common operations used for this process are soldering, brazing, welding etc.

E) Process affecting change in properties:

These are intended to import specific properties to material e.g., heat treatment, hot working, cold rolling etc.

3.1 Process Planning for Turning:

A) The general steps when process planning for turning external parts are,

- Rough cuts all diameters to within 1/32" starting with the largest dia. first.
- Rough cut all shoulders and steps to within 1/32"
- Do special operations such as knurling and grooving
- Cool the work piece to get it close to the final dimension.
- Finish turn the diameters, then the shoulders and steps

B) If the part is to be mounted between centers, plan should precede by,

- Put the work in the lathe, in a chuck, and face and centre drill the end.
- Reverse the piece in the chuck and face the piece to size, and centre drill.
- Mount the work between centers

3.2 Thread cutting on a lathe: -

A) Threads are cut using lathes by advancing the cutting tool quickly so that it cuts in a helical band. This helical band is actually a thread. The procedure calls for correct settings of the machine, and also that the helix be restarted at the same location each time.

B) The basic procedure is,

- The tool point must be ground so that it has the same angle as the thread to be cut. Typical angles are 60° for V threads, and 29° for ACME threads. A thread gauge can be used to measure thread angles. (Also called Centre Gauge or Fish Tail Gauge).
- The correct gear ratio is required between the machine spindles to the lead toggle. This can be determined with the equation,
- The compound slide is set at half the thread angle. This is so those as multiple passes are made to cut the thread (most threads require a few passes to cut), the tool will be advanced in by the compound slide in such a way that only one face cuts. If both faces were used for cutting there would be a good chance of vibrations and chatter. For example, if a 60° thread is being cut, the compound rest is often set at 29°.
- The cutting tool is set in the holder perpendicular to the work, and the fishtail gauge is used to check the angle of the point.
- The In-feed is set to the surface of the part for the first pass (quite often the first pass just scratches the surface to allow visual checking of the settings). On each subsequent pass the in feed will be set closer.
- The cross slide is set at the same location for each cutting pass. i.e., the dial setting is zero.

4. COST ESTIMATION

Cost estimation may be defined as the process of forecasting the expenses that must be incurred to manufacture a product. These expenses take into a consideration all expenditure involved in a design and manufacturing with all related services facilities such as pattern making, tool making as well as a portion of the general administrative and selling costs.

4.1 Purpose of Cost Estimating:

1. To determine the selling price of a product for a quotation or contract so as to ensure a reasonable profit to the company.
2. Check the quotation supplied by vendors.
3. Determine the most economical process or material to manufacture the product.
4. To determine standards of production performance that may be used to Control the cost.

4.2. Basically the Cost estimation of two types:

1. Material cost
2. Machining cost

4.2.1 <u>Material cost estimation</u>:

Material cost estimation gives the total amount required to collect the raw material which has to be processed or fabricated to desired size and functioning of the components. These materials are divided into two categories.

- Material for fabrication:
- Standard purchased parts:

4.2.2 Machining Cost estimation:

This cost estimation is an attempt to forecast the total expenses that may include manufacturing apart from material cost. Cost estimation of manufactured parts can be considered as judgment on and after careful consideration which includes labor, material and factory services required to produce the required part.

4.3 Total Cost of project:

Sr. No.	Name of the parts	Raw material cost	Rate per hr.	Quantity	Total time (hrs)	Total cost (Rs.)
1.	Lead screw	200	75	1	1.13	285
2.	Worm wheel	200	75	2	3.06	630
3.	Worm	250	75	1	2.15	415
4.	Nut	100	75	2	1.26	389
5.	Pins	150	75	4	0.55	765
6.	Motor	-	-	1	-	950
7.	Bearing	-	-	2	-	200
8.	Reversible switch	-	-	1	-	150
9.	Wire	-	-	-	-	250
10.	Labour cost	-	-	-	-	500
11	Sensor	-	-	1	-	500
Total Cost of the Project						**5984**

Table no.. 5 : Total cost project

5. CONCLUSIONS

Here we are concluding that, Electric operated toggle jack is used to replace the tyre of the car with no effort when it gets punctured, in shortest time, and it is easy for handling & operating, it is compact & mobile. Women, children's & aged persons can operate the jack.

We understand the practical knowledge of our project and concluded that availability of power has a vital role in the development of nation.

REFERENCES

[1] Prof. Nitinchandra R. Patel, Sanketkumar Dalwadi , Vijay Thakor & Manish Bamaniya, "DESIGN OF TOGGLE JACK CONSIDERING MATERIAL SELECTION OF SCERW - NUT COMBINATION," IJIRSET, Vol. 2, Issue 5, May 2013, pp- 1748 to 1756.

[2] Abhishek Madhukar Barewar, Abhishek Ashok Padole, Yugal Dhanpal Nagpure, Pranav Shivraj Gaupale , Sagar Bhimraoji Nagmote, Chandan Kumar Ram & Rupali Suresh Raut "Fabrication of automatic screw jack," IJARnD, Vol. 3, Issue 4, 2018, pp- 64 to 67.

[3] Musa Nicholas, Abodunrin Tosin & Oladipo Sarafadeen, "Development of an Integrated Toggle Jack for Lifting Automobiles," ISDAE, Vol.7, No.1, 2016, pp- 21 to 30.

[4] Dr. Vijay Kuma & Mr. K. P. Sing, "AUTOMATIC SCREW JACK TO REDUCE MAN EFFOR," GJFRA, VOLUME-7, ISSUE-2, FEBRUARY-2018 • PRINT ISSN No 2277 - 816.

[5] Mr. Onkar Vade, Prof. Dr. Mr. Premendra Bansod, "Design and Optimization of a Scissor Car Jack for Improvement in Operation," IJSEAT, Issue 5, 2021,9.3.

[6] Manoj R Patil and S D Kachave, "Design and analysis of scissor jack," International Journal of Mechanical Engineering and Robotics Research, vol. 4, pp. 327–335, January 2015.

[7] Chetan S. Dhamak, D. S. Bajaj and V. S. Aher, "Design and optimization of scissor jack," International Journal of Advances in Production and Mechanical Engineering, vol. 2, pp. 29–34, 2016.

[8] C.S. Dhamak, D.S. Bajaj, V.S. Aher and G. Nikam, "Design and standardization of scissor jack to avoid field failure," International Journal of Advance Research and Innovative Ideas in Education, vol. 1, pp. 1–10, 2015.

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