"DESIGN & FABRICATION OF FLEX LOWERING & LIFTING TABLE MECHANISM"

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ABSTRACT

A scissor lift is a type of platform that can usually only move vertically. The mechanism to achieve this is the use of linked, folding supports in a criss-cross "X" pattern, known as a pantograph (or scissor mechanism). The upward motion is achieved by the application of pressure to the outside of the lowest set of supports, elongating the crossing pattern, and propelling the work platform vertically. The platform may also have an extending "bridge" to allow closer access to the work area, because of the inherent limits of vertical-only movement.
The contraction of the scissor action can be hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system). Depending on the power system employed on the lift, it may require no power to enter "descent" mode, but rather a simple release of hydraulic or pneumatic pressure. This is the main reason that these methods of powering the lifts are preferred, as it allows a fail-safe option of returning the platform to the ground by release of a manual valve.

KEYWORDS
Screw jack, Design, Lifting & Lowering device

INTRODUCTION
The screw has a thread designed to withstand an enormous amount of pressure. This is due to the fact that it is generally holding up heavy objects for an extended amount of time. Once up, they normally self lock so that they won't fall if the operator lets go, and they hold up well to the wear of repeated use. If they are made with a ball nut, they will last longer because there is less friction created with this type of jack. However, they will not self lock. This can be dangerous and handled carefully.

DATA COLLECTION
THROUGH LITERATURE SURVEY
A screw jack is a portable device consisting of a screw mechanism used to raise or lower the load. The principle on which the screw jack works is similar to that of an inclined plane. There are mainly two types of jacks-hydraulic and mechanical. A hydraulic jack 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.

Jacks are used frequently in raising cars so that a tire can be changed. A screw jack is commonly used with cars but is also used in many other ways, including industrial machinery and even airplanes. They can be short, tall, fat, or thin depending on the amount of pressure they will be under and the space that they need to fit into. The jack is made out of various types of metal, but the screw itself is generally made out of lead.

While screw jacks are designed purposely for raising and lowering loads, they are not ideal for side loads, although some can withstand side loads depending on the diameter and size of the lifting screw. Shock loads should also be avoided or minimized. Some screw jacks are built with anti-backlash. The anti-backlash device moderates the axial backlash in the lifting screw and nut assembly to a regulated minimum.

A large amount of heat is generated in the screw jack and long lifts can cause serious overheating. To retain the efficiency of the screw jack, it must be used under ambient temperatures, otherwise lubricants must be applied. There are oil lubricants intended to enhance the equipments capabilities. Apart from proper maintenance, to optimize the capability and usefulness of a screw jack it is imperative to employ it according to its design and manufacturer's instruction.

PROBLEM IDENTIFICATON
Lifting and lowering mechanism is not available at low price.

DEVELOPMENT OF OUR CONCEPT
The body frame is constructed with the help of angle. The angle where cut to desired size using a hand cutter .The parts were then welded so as to support all the accessories.

Screw jack used in car was cut and geared motor shaft screwed to it. The whole assembly firmly welded on the basic floor made of angles.

A scissor mechanism is made of M.S. strip ,which has link length of 12".The links of the scissor mechanism is then welded on the pedestal of car jack, so that links follows the exact angular profile of the jack.
The other end of the link is made to slide in a guide which is mounted beneath the plywood so that it provide the proper movement inside the guide.

The limit switches provided at two location ensure the end movement of the jack. We have added two limit switches in the lift table for lower end and upper end position of the table.

The wires were then connected to the motor, limit switches and a hand held remote .Motor receives the power through the transformer placed at the bottom of the table.

After testing the working of the lift table, a primer coat is applied. On complete drying of coat for a day, it is painted with two coats of desired color with a time interval of two days.

WORKING

First of all place the lift to the desired position. Lower the lift table, place the job to be lifted on the center of the table. Plug the power supply. The center has been marked red at the center of the table. This will make the job balanced on the lift table as lift moves up. Now table can be lifted up using the remote provided, by pressing the up navigation key. On pressing the key, the motor rotates in one direction rotating the lead screw of the jack with the help of gear trains at the speed of 20 rpm. The rotation of lead screw causes the movement of the jack in upward direction which in turns moves the scissor links and the top of the table moves at a speed of 10mm/sec. The other end of the link is connected to the slider on the back side of the top of the table. When the table has reached the maximum height the motor will stop automatically and no further movement is observed in upward direction because of upper limit switch. But the table can now be moved down using down navigation key on remote. When the table has moved to its lowest position, another lower limit switch is activated and it further stops the movement in lower direction while allowing the movement in reverse direction. By this way a load can safely be lifted and lowered down.

Material for screw

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 have 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

DESIGN CALCULATIONS

LEAD SCREW

Maximum Load to be lifted = 80Kg

= 80× 9.81N

= 784.8N

For a 784.8N capacity screw jack, the suitable screw is the one whose nominal (major) diameter is 30mm.
Corresponding to the nominal diameter 36mm, the pitch (p) selected is 6mm.

The core diameter (d_c) = 30mm

The mean diameter (d_m) = 33mm

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

The compressive stresses induced in lead screw due to load of 490.5N is given by

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

= (784.8x 4)/ (π x 30^2)
= 1.110N/mm^2

Factor of safety = 230/70.73= 3.25

Hence lead screw will bear 784.8N easily

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

= 6/ (πx33)
= 0.057

Therefore, α = 3.31°

Assuming coefficient of friction between screw and nut,

μ = tan (ϕ) = 0.14

ϕ= tan^{-1}(0.14) = 7.96°

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

The turning moment required to rotate screw under design load is given by

T =W (d_m/2) tan (α+ϕ)

= (784.8) (33/2) tan (3.31°+7.96°) =2580.45N.mm

The shear stress due to torque, F_t = 16T/ (πd_c^3)

= (16x2580.45)/π(30)^3
= 0.4867N/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 lead screw 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 screw material and nut material is P_b =15N/mm^2

n = Number of threads in contact with the screwed spindle.

H = height of nut = n x p

t = thickness of screw = 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 (36^2-30^2) (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- 36^2)

= 61.68 N/mm² which is less than 216 N/mm²
Factor of safety=216/39.29

= 5.55

Design of Scissor lift
A scissor lift (jack) or mechanism is device used to extend or position a platform by mechanical means. The terms "Scissor" comes from the mechanism utilized which is configured with linked, folding supports in a crisscross 'X' pattern. The extension or displacement motion is achieved applying of force to one of the supports resulting and an elongation of the crossing pattern.
The force applied to extend the scissor mechanism may be hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system).

Length of each link=300mm
Height of table taken =10 mm

=10× 300mm

=3000mm

Design calculation:
Assuming Weight =80 Kg
Force, F=80×9.81

=784.8 N/mm^2

Here total load, W=80Kg+ Wt of links+ Upper table

=80+5+1

=86 Kg

Angle of inclination of links:
The angle made by link with horizontal is 71.5^0.

Total force needed to support the platform f = (86+0.2/2) tan (71.5)

= 28.80 N.

For finding shear stress acting on bolt

τ = F/$\frac{\pi}{4}$ ×d^2

= 28.80/$\frac{\pi}{4}$ × 3^2

=4.07 N/mm^2

APPLICATIONS

Domestic purpose

- For painting walls.
- For repairing ceiling fans.
- For decoration of halls.

Industrial purpose

- For maintenance of large machine.
- Lifting the loads.
- For loading & unloading
- Assemble &dissemble of large machines.

Advantages

- The loaded light trey can be easily lifted.
- Checking and cleaning are easy, because the main parts are screwed.
- Handling is easy
- No Manual power required.
- Easy to Repair.
- Replacement of parts are easy

- Even a layman or unskilled worker can handle it

DISADVANTAGES

- Cost of the equipment is high.
- Care must be taken in handling the equipment such as proper wiring connection, limits switches remote etc. It requires external power supply.

FUTURE SCOPE

- The lift table can be very useful for patients in a stretcher, which has to be shifted to location having difference of height.
- The lift table, if suitably modified can be useful for a handicapped person wheel chair for reading ,dining and routine activities.
- Even in industrial applications where there is a need for lifting heavy loads to much larger heights

CONCLUSION

Scissor Screw lifting table are the ideal product to push, pull, lift, lower and position loads of anything from a couple of kilograms to hundreds of kilograms. The need has long existed for an improved portable jack table for industrial material handling. It is highly desirable that a motorized lifting tables become available that can be operated alternatively using a power supply or a battery. Such a jack should desirably be light enough and be compact enough so that it can be stored in an automobile trunk, can be lifted up and carried by most adults to its position of use, and yet be capable of lifting a load of hundred of kilograms off the ground to the desired height. Further, it should be stable and easily controllable by a switch so that jacking can be done from a position of safety. It should be easily movable either to a position underneath the most of machineries or some other reinforced support surface designed to be engaged by a lift table.

Thus, the product has been developed considering all the above requirements. This particular design of the motorized scissor screw jack will prove to be beneficial in lifting and lowering of loads.

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Actual Project Photo