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Motorized Screw Jack

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Abstract: ***Over the past decades upkeep in vehicle designing turn into a testing assignment among the specialists. Sparing economy has turned into the errand of most astounding need in our era. Plan alteration of existing item permits the work as much as less demanding than the past model. In this work, outline and manufacture of screw jack is created to lessen the power utilizations and to diminish the human exertion. Tyre cut can be ordinarily watched now-a-days. Motorized screw jack accompanies vehicles obliges clients to apply manual drive to lift a vehicle. This paper is focused to examine the improvement in existing scissor motorized screw jack with a specific end goal to make stack lifting less demanding by using Car battery(12V) which can be utilized as a part of difficult circumstances. In this outline, the cigarette lighter point is associated in car, which drives the power from the car battery(12V), this will run the DC motor and along these lines associated control screw is turned. By this, the motorized screw jack will lift the vehicle. The constrictions or development of motorized screw jack can be controlled by a remote joystick according to necessities. This altered motorized screw jack can be effortlessly worked by any individual and it spares time, subsequently decrease wastage of human effort and time. Assembling and manufacture work have been done utilizing processing, boring, pounding and threading machines.***

Keywords: D.C Motor (12v), Screw Jack, Worm Gear

1. Introduction

In the midst of side road emergency like tyre puncher, scissor car jack is required to lift the vehicle. A mechanical jack can lift all or a part of vehicle into the air for repairing breakdowns or vehicle maintenance. Changing the punctured tyre is a difficult movement. Nowadays numerous assortments of motorised screw jack have been created for lifting a vehicle from ground. However, accessible screw jacks are physically worked along these lines requires additional physical endeavours from the client. It is troublesome for elderly and impeded to work on such jacks. For utilising these jacks administrators are required to be in delayed hunching down or twisted position. Working in these positions for some time is disorderly. This can prompt to spinal pain problem. The vehicle workstations are outfitted with howdy tech auto lifting framework, wherein auto are raised and brought down through the electrically controlled framework. Be that as it may, because of their high cost, upkeep and size, such lifts wither be set in auto not even claimed via auto proprietor. Mechanized versatile motorized screw jack reduces human endeavors in a vehicle as well as sheltered time expected to repair the car. Such component is helpful for repairing the vehicle in favor of the roadway. This altered motorized screw jack is composed so it can be effectively worked, safe and can lift or lower the vehicle without much physical exertion. This paper concentrates on the outline and dissects changed in screw jack.

This paper manages the outline and manufacturer of mechanized screw jack which is utilized for lifting overwhelming cars, utilizing the power from a dc motor. The project helps in reducing the exertion and additionally, time is taken to lift the heap in contrast with the standard screw jack. It comprises of a D.C motor, battery, worm gear and a screw jack. A screw jack's compressive drive is acquired through the pressure compel connected by its lead screw. A square string is regularly utilized, as this string is extremely solid and can oppose the substantial burdens imposed. These sorts are self-locking, which makes them more naturally safe than other jack innovations. This sort of screw jack will be useful for ladies and physically challenged people to lift the vehicle. Electrical incitation is picked here in light of the fact that the power acquired through this is relatively high. The bearing of the turn of the motor is acquired by the beat tweak from the control hand-off. Therefore it is thought to be the most proficient and simple strategy to activate. A scissor lift (jack) or instrument is a gadget used to amplify or position a plate framed by mechanical means. The expression "scissor" is utilised since the collapsing backings are in bundle "X" design. The augmentation or removal movement is accomplished by applying power to one of the backings and in this way, the lengthening of the crossed example happens. The constraint connected to broaden the scissor instrument might be hydraulic, pneumatic or mechanical means. Our goal is to impel through electric mean.

2. Ease of Use

A screw jack is a mechanical gadget utilized for changing over rotational movement into straight movement and transmitting power. A control screw is likewise called interpretation screw. It utilizes helical translatory movement of the fasten string transmitting power instead of cinching the machine components. The fundamental uses of force screws are as per the following:

- To raise the heap, e.g. screw-jack,
- To get exact movement in machining operations, e.g. lead-screw of machine,
- To cinch a workpiece, e.g. bad habit, and
- To stack an example, e.g. all inclusive testing machine. There are three basic parts of a screw jack, viz. screw, nut and a section to hold either the sink or the nut its place.

Contingent on the holding game plan, control fastens work two distinctive ways. At times, the tighten turns its bearing, while the nut has hub movement. The lead screw of the machine is a case of this classification. In different applications, the nut is kept stationary and the tighten moves hub course. Screw-jack and machine failure are the cases of this class. Control screws offer the accompanying points of interest:

- Screw jack has huge load conveying limit.
- The general measurements of the screw jack are little, bringing about reduced development.
- Screw jack is easy to outline
- The assembling of force screw is simple without requiring

particular hardware. Square strings are turned on the machine. Trapezoidal strings are fabricated on string processing machine.

- Screw jack gives extensive mechanical preferred standpoint. A heap of 15 KN can be raised by applying an exertion as little as 400 N. Subsequently, a large portion of the power sinks utilized different applications like screw-jacks, clasps, valves, and vices are generally physically worked.
- Screw jacks give correctly controlled and exceedingly precise direct movement required in machine device applications.

In the repair and support of vehicles, it is frequently important to raise a car to change a tyre or get to the underside of the car. In this manner, an assortment of screw jacks has been produced for lifting a car from a ground surface. Accessible screw jacks, be that as it may, are commonly physically worked and thusly require considerable arduous physical exertion with respect to the user. Such jacks are way challenging for the elderly and debilitated and are particularly disadvantageous under unfavorable climate conditions. moreover, accessible jacks are ordinarily vast, substantial and furthermore hard to store, transport, convey or move into the best possible position under a vehicle. Furthermore, to the troubles in collecting and setting up jacks, such jacks are by and large not adjusted to be promptly dismantled and put away after car repairing have been finished. Screw jacks must be anything but difficult to be utilized even by ladies or whoever had an issue with the tyre amidst nowhere. In the light of such natural burdens, business car repair and administration stations are ordinarily furnished with huge and howdy tech auto lift, wherein such lifts are raised and brought down by means of electrically-fueled frameworks. Nonetheless, because of their size and high expenses of acquiring and keeping up electrically-fueled auto lifts, such lifts are not accessible to the normal auto proprietor. Designing is about Article Indexed in making things more straightforward or enhancing and powerful. Such electrical-controlled compact jacks not only just evacuate the laborious errand of lifting a vehicle by means of physically worked jacks, but adds, diminish the time expected to repair the car. Such a component can be particularly invaluable when it is important to repair a car in favor of a roadway or under different dangerous conditions. There are likewise provides.

3. Working

Under ideal conditions, the jack can lift a vehicle body when it interacts with the upper plate, which is created by the revolution of force screw through the electric power taken from the car battery (12V) by means of cigarette lighter repository connected to auto. Firstly, mechanized jack will be put under car body with some freedom space between top plate and skeleton. The cigarette lighter repository associated with jack will be connected to the port, consequently interfacing specifically with car battery. At the point when a course of development will be given by joystick, the power will be taken and Motor begins turning. The motor will exchange its shaft velocity to the pinion equip coinciding with a greater apparatus which is associated with screw jack and it will turn. On surrendering course, the screw jack will pivot inside strung cubical bore in far-reaching heading, which will make joints move along strong segment towards each other in load raising procedure and the other way around. Amid stacking process, jack will take out the freedom space amongst itself and frame by ascending. At the point when the case will interact with jack, the heaviness of auto will step by step exchange to jack. These created strengths will be disseminated among connections and cubical bore. The drive transmitted to cube shape will be exchanged to screw strings

Figure 1: Working of motorised screw jack

A) Material Selection

For a large portion of the standard jacks, the material utilized is depicted as "Overwhelming Duty Steel". The American Iron and Steel Institute (AISI) built up an arrangement framework for various sorts of iron and steel composites. After some examination, it was resolved that a Nickel-ChromiumMolybdenum steel composite might be conceivable material to develop the proposed scissor jack. The specific compound has a grouping of AISI 4340 designing steel in businesses utilize. Be that as it may if, after Analysis, it is found that the material influences the constraint of the plan, it might be changed to something more fitting Figure 1. High-Strength Low-Alloy Steel (40Ni2Cr1Mo28/AISI 4340) is utilized for connections and top plate Table 1. Properties of . The life traverse of the jack will depend significantly on the kind of materials utilized for every part to evade disappointment. The contact individuals, associating individuals, lifting individuals, pins and the screw jack will all utilize the High-Strength Low-Alloy Steel with 50 ksi (345 N/mm2) least yield point, 70 ksi (485 N/mm2) least rigidity and 21 % prolongation) because of the accompanying reasons:

- Good Machinability
- Good Ductility
- High Strength
- Wear Resistance
- Ease of delivering confounded parts
- Economical

Table I

A) Design Calculations of Motor and Gear Design

S.No.	Name	Dimension
1	Gear supporting plate(mm)	10*40*60
2	Connection between motor and shaft(nylon bush)(mm)	30
3	Inner dimension(mm)	10
4	Jack(MS), link size(mm)	4*22*120
5	Base plate(MS)(mm)	170*170

Table 2

B) Motor and Gear Specification's

S.No,	Name	Dimension
1	Dc(v)	12
2	R.p.m(revolution per minute)	100
3	Teeth depth(mm)	5
4	Teeth thickness(mm)	4
5	Diameter of the gear(mm)	60
6	Thickness of the gear(mm)	28(30 teeth's)
7	Warm gear(mm)	T=30 D=30 L=30
8	Warm gear (Inner dimension)(mm)	10
9	Warm gear rotation	20
10	Ratio	1:4

Table 3

C) Components of Motorized Screw-jack

Component No.	Name	Quantity (No's)
1	Top Plate	1
2	Links	8
3	DC Motors	1
4	Screw jack	1
5	Joystick	1
6	Base	1
7	Cigarette Lighter Receptacle	1

A) Gear Design And Selection

The primary physical parameters of the outline are resolved through the suitable computations and down to earth contemplations with sensible presumptions. The inspiration driving the framework figuring is the suppositions and conjectures of possible nerves or miss hapenings in the genuine parts and in this way picks sensible estimations for those parts of the machine so it will satisfy the arrangement objectives and further accomplish its acknowledged life expectancy. The drive arrangement of the jack will make use of an motor as its prime mover. The motor required for this particular framework is depended upon to transmit a decently low speed at high power. The going with data has henceforth been picked in perspective of the above requirements:

- Power of a Prime Mover: Direct Current Electric Motor of 2.34 kW/276 RPM
- Diameter of rigging : 90mm
- Diameter of Pinion rigging: 30 mm

The two widths have been picked on the premise of accomplishing a sensible speed proportion of 1:4 between the pinion and the rigging individually. The drive transmission of the D.C Motor is by means of the shaft.

B) Worm And Gear Arrangement

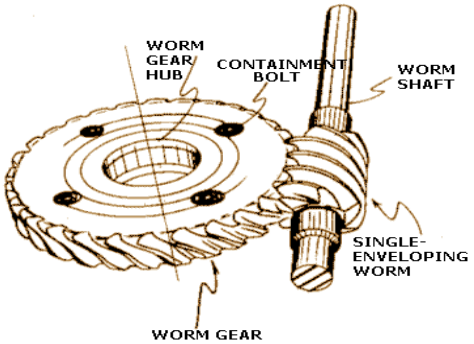


Figure 2: Worm Gear

The course of action of gears seen above is known as a worm and worm wheel. The worm just has one tooth however it resembles a screw thread. The worm wheel resembles an ordinary gear or spur gear. The worm dependably drives the worm wheel round, it is never the inverse route round as the framework tends to bolt. The ordinary set up of worm rigging frameworks is found in the figure. As the worm rotates the worm wheel (spur gear) likewise spins, however, the turning movement is transmitted through a ninety-degree point The rigging proportion of a worm apparatus is worked out through the accompanying equation: number of teeth on the worm wheel number of teeth on the worm

C) Screw Jack

A Screw jack is a kind of jack that works by turning on a lead screw. A screw jack it is normally used to lift modestly substantial weights, for example, vehicles

D) Design And Construction

A scissor lift (jack) or system is the gadget used to develop or position a plate frame by mechanical means. The expression "scissor" comes from mechanical use which is arranged with connected, collapsing underpins in a mismatch "x" pattern. The expansion or dislodging movement is accomplished by compelling one of the support coming about and an extension of the intersection design; The drive connected to augment the scissor instrument might be water driven, pneumatic or mechanical (by means of a lead screw or rack and pinion framework).

E) Fabrication Methods

Boring is being done on the base with a specific end goal to affix the bolts. Welding; the clip is being welded to the jack keeping in mind the end goal to bolster the motor. Grinding, is done to acquire a decent surface complete on the base and the brace pounding is being done.

4. Appendix and Annexure

1) Raising the load

To determine the force 'p' required to overcome a certain load W. It is necessary to observe the relationship of the load to the distance travelled. The total force on P_n is represented by Pn

$$\sin\theta_n = \cos\theta_n \cos\alpha \tan\frac{\beta}{2}$$

$$\theta_n = \tan^{-1}\left(\cos\alpha \tan\frac{\beta}{2}\right)$$

summing the vertical forces

$$P_n = \cos\theta_n \cos\alpha = \mu p_n \sin\alpha + w$$

$$p_n = \frac{w}{\cos\theta\cos\alpha - \mu\sin\alpha}$$

The torque required to the load is obtained by multiplying the horizontal forces by the appropriate radil. Thus

$$T_r = P_n\left(\frac{d_p}{Z}\right)(\cos\theta_n \sin\alpha + \mu\cos\alpha) + \gamma_c$$

2) Design and Description

Figure shows a load W into when the supporting screw is

threaded and which can be raised or lowered by rotating the screw. The lead angle α relatives the lead to the (pitch cir-cumference through the equations

$$\alpha = \tan^{-1}\frac{1}{\pi}d_p$$

where L= lead = in p
here m = 1
The distance travelled in the axial direction can be expressed as $d_s = n_o l = n_o mp$

where $h_0 = numberofrevolution$

thus the power screw uses rotary motion to obtain a uniform linear motion $T_r = \frac{d}{2}\frac{\cos\theta\tan\theta + \mu}{\cos\theta - \mu\tan\alpha}$

A) Lowering the Load

Lowering the load differs from raising the load only in that the friction force components become negative. These changes result in the summation of the vertical forces being

$$P_n = \frac{w}{\cos\theta\cos\alpha + \mu\sin\alpha}$$

equation one

The torque required to lower the load is obtained by multiplying the horizontal forces by the appropriate radil, thus

$$T_t = P_n\left(\frac{d_p}{2}\right)\left(\cos\theta_n\sin\alpha - \mu\cos\alpha\right) - r_c m$$

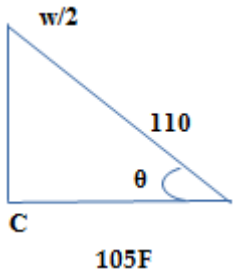
substituting equation one into the previous equation gives

$$T_1 = -Wd_p\frac{\left(\mu - \cos\theta_n\tan\alpha\right)}{\cos\theta_n + \mu\tan\alpha} + \lambda_c + \mu_c$$

B) Design of Square Threaded Screw

Max load = 4kn = 4000N
Link length + 110mm + 0.1m
Tensile stress = 100 N/mm^2
Shear stress = 50 N/ mm^2
Bearing pressure on pins P_b = N/mm^2
Pitch = 6mm
Coefficient of friction = μ = tanϕ = 0.2

4.1 Design of Screw



from the geometry
cosθ = 105-15 = 0.812
θ =35.1
The magnitude of the pull on the square threaded screw is given by

$$= \frac{4000}{2*0.7028} = 2848N$$

since a similar pull acts on the other nut then tensile pull on the square threaded rod
W_1=2F=2*2846 = 5692N
d_c = core diameter of the screw
we know the load on the screw W_1
5692 = Π/4 d^2 σ_t
=Π/4 d^2*100
d_c=8.5~10mm

The screw is also subjected to torsional shear stress then when have to increase the core diameter of the screw then d_c=14mm nominal or outer diameter of screw
d = d_o _ p/2 = 20-6/2 = 17mm
as we know

$$\tan\alpha = \frac{p}{\Pi d} = \frac{6}{\Pi * 17} = 0.1123$$

we know that effort required to rotate the screw-jack
p = w_1(tan(α+Φ)

$$W_1\left(\frac{\tan\alpha + \tan\Phi}{1 - \tan\alpha\tan\Phi}\right)$$

$$5692\left(\frac{0.1123 + 0.2}{1 - 0.1123 * 0.2}\right) = 1822N$$

torque required to rotate the screw
T=p*d/2 = 1822*17/2 = 15487 Nm
and shear stress in the screw due to torque

$$T = \frac{16T}{\Pi d^3} = \frac{16 * 15487}{\Pi(14)^3} = 28.7N/mm$$

we know that direct tensile stress in the screw

$$\sigma = \frac{w_1}{\frac{\pi}{4}d^2} = \frac{w_1}{0.7855d^2} = \frac{5692}{0.785514^2} = 37N/mm^2$$

maximum principal stress

$$\sigma_{tmax} = \frac{\sigma_t}{2} + \frac{1}{2}\sqrt{\sigma^2 t + 4^2}$$

$$\frac{37}{2} + \frac{1}{2}\sqrt{37^2 + 4(28.7)^2}$$

=18.5+34.1=52.6 N/mm^2
and maximum shear stress

$$T_{max} = \frac{1}{2}\sqrt{\sigma t^2 + 4T^2}$$

$$\frac{1}{2}\sqrt{37^2 + 4(28.7)^2} = 34.1N/mm^2$$

4.2 Design of Links

For bucking in vertical plane the links are considered as hinged at both ends and for buckling in a plane perpendicular to the vertical plane it is considered as fixed at both ends

The load on the link
= F/2 = 2846/2 = 1423N

F.os = 5 assume
Wer = 1423*5=7115N
t_i= thickness of the link
t_l = width of the link

generally the width is 3 to 4 times the thickness of link then the cross-sectional area of the link

$$A=t_1*3t_1=3t_1^2$$

and moment of inertia of the cross-sectional of the link

$$I=\frac{1}{12}t_1(b_1)^2=\frac{1}{12}t_1(3t_1)^3=2.25t_1^4$$

the radius of gyration

$$k=\sqrt{\frac{I}{A}}=\sqrt{\frac{2.25t_1^4}{3t_1^2}}=0.866T_1$$

since for buckling of the link in the vertical plane, the ends are considered as hinged, therefore equivalent length of the link

L= l = 110mm

and rankine's constant

$$a=\frac{1}{7500}$$

according to rankine's formula buckling load way

$$7115=\frac{\sigma_c*a}{1+a\left(\frac{L}{K}\right)^2}=\frac{100*3t_1^2}{1+\frac{1}{7500}\left(\frac{110}{0.866t}\right)^2}$$

$$7115=\frac{300t_1^2}{1+\frac{2.15}{t_1^2}}$$

t_1 = 6mm

b_1= $3t_1$ = 3*6 = 18mm

now let us consider the buckling of the link in a plane perpendicular to the vertical plane moment of inertia

$$I=\frac{1}{12}mb_1(t_1^3)$$

$$\frac{1}{12}3t_1(t_1)^3=0.25t_1^4$$

radius of gyration

$$k=\sqrt{\frac{I}{A}}=\sqrt{\frac{0.25t_1^4}{3t_1^2}}=0.29t_1$$

equivalent length of the link

$$L=\frac{l}{2}=\frac{110}{2}=55mm$$

a gain according to rankine's formula,

buckling load

$$w_{cr}=\frac{\sigma_c*A}{1+a\left(\frac{L}{K}\right)^2}=\frac{100*3t_1^2}{1+\frac{1}{7500}\left(\frac{55}{0.29t_1}\right)^2}=\frac{300t_1^2}{1+\frac{4.8}{t_1^2}}$$

substituting the value of t_1 = 6mm

we can get to

$$Wcr=\frac{3006^2}{1+\frac{4.8}{6^2}}=9532N$$

since the obtained value is within the limit the design is safe and the link is also safe for the buckling now can take

t_1=6mm, b_1 = 18mm

5. Conclusions

The current screw jack is created by making little changes and utilizing an electric motor to pivot control screw. The car battery (12V) is the power source to an motor, to make stack lifting simpler. The upsides of this modified jack will make less effort. In this manner viably disposing of the issues identified with Efficiency-which is an essential idea of planning procedure. On watching all accessible screw jacks in the business sectors, this model has been enhanced by a couple of changes in a few elements and plan. The destinations are to outline an motorized screw jack that is protected, effective, dependable and ready to work with simple working. Based on testing and figuring, this motorized screw jack is viewed as protected to use under a few particulars. Besides, the torque provided by the framework is all that could possibly be needed to lift an auto weighing around 1000 kg.

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