A PROJECT REPORT

ON

"Motorised Screw Jack"

Submitted by

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In partial fulfillment for the award of the Degree

Of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

UNDER THE GUIDANCE

Of

Prof. MOMIN NAFE

DEPARTMENT OF MECHANICAL ENGINEERING

ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL,

NAVI MUMBAI – 410206

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ANJUMAN-I-ISLAM

KALSEKAR TECHNICAL CAMPUS NEW PANVEL

(Approved by AICTE, recg. By Maharashtra Govt. DTE,

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CERTIFICATE

This is to certify that the project entitled

"**MOTORISED SCREW JACK"**

Submitted by

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To the Kalsekar Technical Campus, New Panvel is a record of bonafide work carried out by him under our supervision and guidance, for partial fulfillment of the requirements for the award of the Degree of Bachelor of Engineering in Mechanical Engineering as prescribed by **University Of Mumbai**, is approved.

Internal Examinar	**External Examiner**
(Prof._____)	(Prof.____)
Head of Department	**Principal**
(Prof. _____)	(Dr._____)

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APPROVAL OF DISSERTATION

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(Internal Examiner) **(External Examiner)**

_____ _____

Date: _____

ACKNOWLEDGEMENT

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ABSTRACTS

Mechanical toggle Jack is widely used in the most automobile maintenance. Mechanical toggle jacks are available from the standard range in capacities from 5kN to1000kN (Metric) and 0.25 – 250 tons (imperial). Standard classic and sym-metric toggle jack configurations include upright or inverted translating toggle units with top plate, clevis or threaded end on lifting toggle and the option of keyed lifting toggle or anti-backlash feature, and upright or inverted rotating toggle with flanged lifting nut.

Machine toggle jacks offer positive mechanical actuation, precise positioning and uniform lifting speeds and can be used to lift, position loads, apply pressure or as linear actuators.

Button operated toggle Jack is equipped to design custom built "special" toggle jacks to suit all customer requirements to use it without physical efforts. With our experienced team of application engineers, we pride ourselves in determining the right product to fit your needs.

Table Of Content

CHAPTER 1

INTRODUCTION

INTRODUCTION

Power Jacks is the largest and most experienced manufacturer of mechanical toggle jacks in the India. With over 2 million products in the field, you are assured of quality, reliability, performance and value.

Mechanical machine toggle jacks are available from the standard range in capacities from 5kN to1000kN (Metric) and 0.25 – 250 tons (imperial). Standard classic and sym-metric toggle jack configurations include upright or inverted translating toggle units with top plate, clevis or threaded end on lifting toggle and the option of keyed lifting toggle or anti-backlash feature, and upright or inverted rotating toggle with flanged lifting nut.

Machine toggle jacks offer positive mechanical actuation, precise positioning and uniform lifting speeds and can be used to push, pull or position loads, apply pressure or as linear actuators.

Our wide range of standard machine toggle jacks offers you the combination of design flexibility and economy, with a standard model available for almost any requirement. Power Jacks is equipped to design custom built "special" toggle jacks to suit all customer requirements to use it with out physical effort. With our experienced team of application engineers, we pride ourselves in determining the right product to fit your needs.

1.1 Classification:-

The "jacks" are classified according to the following:-

1) Pneumatically operated
2) Hydraulically operated
3) Rack and pinion operated
4) Square threaded toggle operated

Among all above types, we have selected the worm geared toggle thread operated due to so Many advantages. Brief description of all the types we are mentioning for the sake of comparison.

Pneumatically operated:-

Here the advancement of the piston and the linkage along with the platform is carried out in the upward and the downward direction using the hydraulic piston and cylinder arrangement along with the platform and the linkage.

Hydraulically operated:-

Here the lowering and raising of the platform is carried Over using hydraulic piston and cylinder arrangement. Due to continuous accumulation of the comparatively low pressure oil in the load cylinder gives rise to tremendous increase of the pressure. This increased pressure is utilized to raise the platform using suitable linkage.

Using the hydraulic piston and cylinder arrangement. To actuate the piston and Cylinder, the oil is allowed to enter the cylinder from front or the back side of the piston.

Rack and pinion operated:-

Here the lowering and the raising of the platform along with the load to be raised is carried out manually using the rack and pinion arrangement. In this case the required pressure is applied manually using direct hand pressure on the rack using pinion and lever arrangement. It requires robust man for its handling. This is it's limitation.

Among all the above types we have selected the worm geared (in gear motor) Lead toggle thread Operated due to the following advantages :-

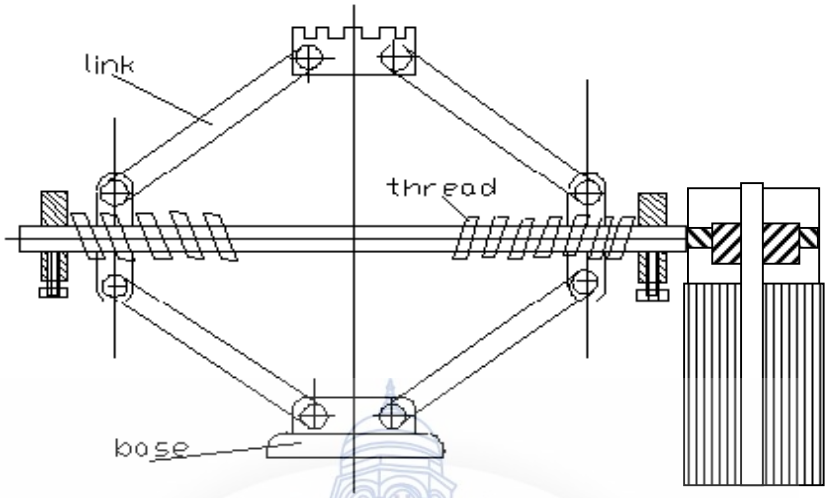
1) Its operation is smooth.

2) No compressor required.

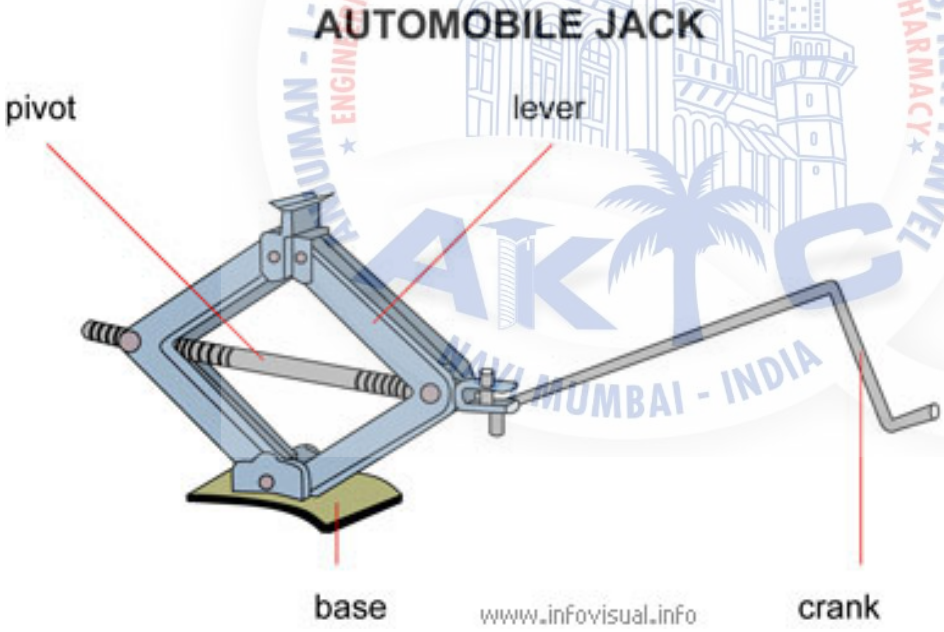
3) It is compact

4) It requires less fatigue for its operation.

5) No electrical power required.



TOGGLE JACK WITH MOTOR AND GEAR BOX AS MOTORISED JACK



1.2 JACKS

The jack is a mechanical device used to raise and lower down the concentrated point mass load or the weight which is kept over it adjusting the center of gravity with the help of the combined mechanical advantage of worm and worm gearing and square threaded lead toggle.

Automobile Jack: a device equipped with a crank that is used to raise an automobile.

Pivot: axis of rotation.

Lever: solid movable part attached to a fixed point, used to increase an applied force.

Crank: arm perpendicular to an axel, used to create circular motion.

Base: foot on which the jack rest.

Requirement of a good jack:-

1) it should have greater mechanical advantage i.e. M.A. = load / power applied should be greater.
2) It should be portable
3) It should be compact and free from maintenance.
4) It should not require power for it's operation.
5) It should have more capacity for the same size.

The high-lift jack is the most useful off-road tool available. It is an indispensable and highly versatile device but can only be used if a strong vehicle adequate bumpers for this, but unfortunately most modern 4X4s do not. Rear tow jacking platform is available. Working four-wheel drive vehicles should have bars

to make good jacking points but on the front end of most vehicles there is nowhere use the jack The cure is simple: have your off-road equipment outlet fit them for you. Armed with a spade and a high-lift jack, in most cases, you are better equipped for the unexpected than a vehicle equipped with a spade and a winch. There are a number of manufacturers of high-lift jacks, but the original American-made Hi-Lift has proved itself time and time again to be the best. In most cases high-lift jacks are carried on the outside of the vehicle and dust clings to the oily lifting mechanism, which causes it to jam. Q-20 or a similar spray lubricant must be used to free the mechanism before it is used. But take care: this can cause the formation of a mixture of dust and oil a grinding paste, which quickly wears the components.

SPECIFICATIONS:-

It is having following specifications:-

Drive ; worm and worm gear

Capacity : 500 Kg of concentrated load with concentrated centre of gravity.

Unit Weight ;- 15 kg

Maximum Lift ; 300 mm from the ground level.

Minimum ground clearance required ; 150 mm from the ground.

1.3 JACK CONFIGURATIONS

Button operated Worm geared toggle jacks can be assembled in a number of different configurations. The first major configuration divides the jacks into translators and rotators. A translating jack has a lifting shaft that moves through the gear box. A nut is integrated with the worm gear such that the worm gear and nut rotate together. When the lift shaft is held to prevent rotation, the lift shaft will move linearly through the gear box to move the load. A rotating jack has a lift shaft that turns moving a nut. The lift shaft is fixed to the worm gear. This causes the load, which is attached to the travel nut, to move along the lift shaft. Both rotators and translators have an upright and inverted configuration

CHAPTER 2

OBJECTIVE

OBJECTIVE

The basic objective of the project is to find out the solution for the reduction in manual efforts, during the maintenance of vehicles. We observed that, there is wide use of small cars in the market. In case of breakdown maintenance or while replacing the tyre, minimum efforts should be required to lift the vehicle.

At present mechanical toggle jacks are being used with lever operated system. With a use of this the required torque to lift the vehicle can be generated with the use of geared motor & reversible switch.

CHAPTER 3

PROJECT PLANNING

PROJECT PLANNING

Selection of group:-

Collection of different talents gathered together to form a potential group with the sole aim of working with dedication to bring out our best considered.

A) **Selection of project**:-

Factors for selection of a project:-

1) It should be innovative.
2) It should be within the limit of financial assistance provided by the Institute.
3) It should be able to be manufactured in stipulated time.
4) It should be preferably feasible to be manufactured in or workshop with the existing facilities.

Need: - Today's world required speed on each and every field. Hence rapidness and quick working is the most important. Now adays for achieving rapidness, various machines and the equipments are manufactured by the man.

"Tons of speech is not equal to an ounce of practice." Goes the professional saying. To prove that the same is true with our Institute we thought of having an innovative project.

The engineer is constantly conformed with the challenges of bringing ideas and design in to reality new machine and techniques are being developed continuously to manufacture various products at the cheaper rates and high quality. Also man is always thinking for bringing more and more changes in the presently available machines to improve it's productivity and efficiency. As a part of this we are thinking to modify such an accessory on the machine tool that will definitely help to improve the out put of the machine tool.

CHAPTER 4

WORKING PRINCIPLE

WORKING PRINCIPLE

The button geared worm-geared jack is mostly used for automobiles. Hence we have used the worm and worm gearing to construct the Button operated jack assembly. It consists of four jacks installed on the four wheels. A pair is installed on the rear axle and at the front side there not being the axle we are directly installing one pair on the chassis body.

To operate this jack system jack following procedure is followed**.**

The jacking mechanism is used in the following way:

TO RAISE THE CAR WHEEL…

- This jack can be taken beneath the wheel side which is to be raised using worm geared gear box with chain drive and nut and lead toggle assembly separately.
- Operate the button for the individual wheel position to be raised up the jack lead toggle will come out toward downward side along with the ground rest plate under the jacking point i.e. it may beneath the vehicle or the machine component.
- Rotate the worm shaft using motor power. The worm will rotate the worm gear. The worm gear in turn will rotate the lead nut, which advances through the lead toggle.
- Raise the jacking lead toggle to the upright position to hoist the entire mechanism up the shaft so that the jacking foot (base post) is positioned under the jacking point of the vehicle.
- Here it is not required to adjust the jacking foot position exactly. Once the lead toggle is raised towards down , thereby lifting and firmly locating the foot(base post) under the vehicle jacking point.
- As the required height enough to free rotating point of the wheel is schieved the wheel nuts can be untoggleed
- sathe position need changing, lift the arm and readjust. Once satisfied with the foot's (base post) position, raise lower the lead toggle using lead nut and worm gear advancing and rotating mechanism by motor drive.

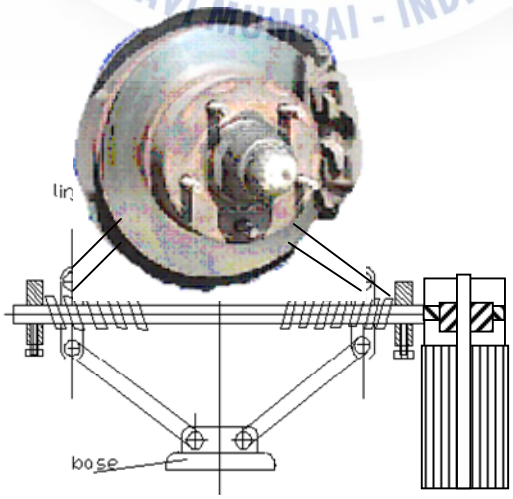
• after the work is over rotate the worm shaft to the upright position until the load is lowered down to the wheel on ground resting position.

- We can press all the buttons simultaneously until the vehicle's all the wheel/s are off the ground.
- **TO LOWER DOWN THE JACK….**

• Rotate the motor in reverse direction using speed reversal switch raising the jacking lead toggle arm to the upright position.

• rotate the worm shaft coupled motor shaft in anti-clockwise direction.

• Gripping the foot post with hand, raise the lead toggle so as to release the job resting circular plate from th ground towards up. At this point the vehicle's weight is in on the wheel.



4.1 APPLICATION OF JACK

Jack and push

Your vehicle is stuck on soft ground with the axles grounded on a ridge; or you have dropped into a gully and two or more wheels are off the ground and spinning. If the ground is soft, place the jack on its broad base and jack up the vehicle, high enough so that the one set of wheels is higher than the ridge on which the axle has been caught. Now push the vehicle sideways. The vehicle will

pivot on the jack and land on the ground with the wheels on the ridge, thereby clearing the axle from the obstacle. In some situations you may need to do the same with the both axles. Vehicles with spare tyres attached to the tailgate may have to either remove them or swing them clear as the falling jack may catch on them and damage the vehicle bodywork. If they are removed from a separate wheel carrying frame, the frame can be closed and used to protect the rear of the vehicle from the jack during this operation.

Once this has been done find something to place under them –sand ladders, trac-mats, carpets, rocks, branches or logs - in fact anything lying around (in wet mud, grass seems to make matters worse). Lie items in the direction of travel so that the wheels can gain some momentum as they ride over them. If all four wheels are deeply dug in, this must be done to all wheels. Before attempting to drive out think about the gear ratio to use. Should you use a gear ratio that is too low, the result may be wheel spin, and you may not only undo all your hard work but still have a bogged vehicle. Select the highest gear you think may work - try to remember the gear ratio that was getting you through difficulties before-hand, because once off the mats or logs you must be able to keep moving without a gear change. Selecting this gear ratio is critical and for each vehicle and for each situation it differs. The vehicle is then lowered and with

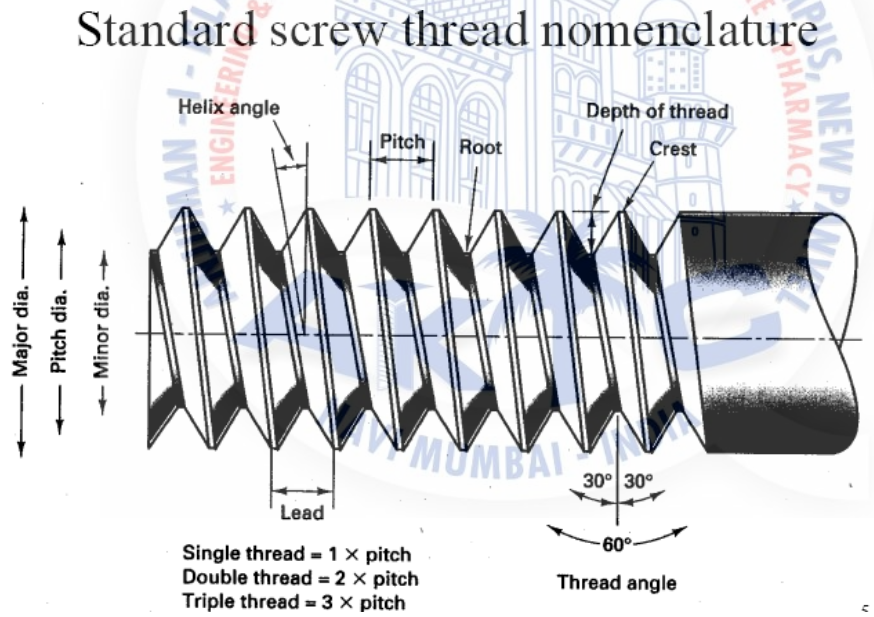
everyone pushing, the clutch is let out gently with acceleration as smooth as possible. If the wheel spin occurs decelerate gently.

There are cases where a vehicle has bogged down so comprehensively that jacking has been the only way out. Personally I would not venture to a place like the Makgadikgadi Pans in a vehicle not suited to jacking with a high-lift.

WORM GEAR OPERATED TOGGLE JACK WHICH IS THE ONE OF THE FOUR JACKS CONSISTS OF FOLLOWING DIFFERENT COMPONENTS:-

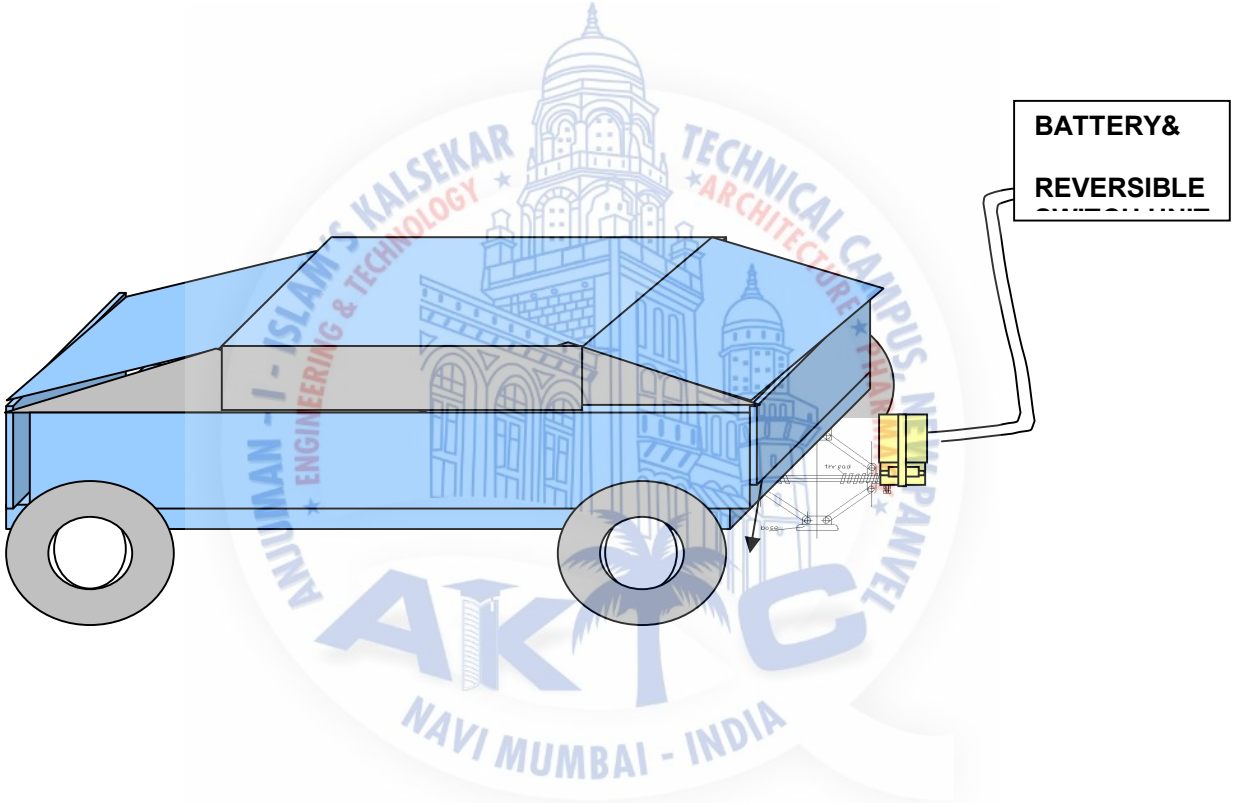
IT consists of the following different components :-

1) **Lead toggle** :- it is the component at the top of which a load raising plate is installed or kept on which the concentrated load to be raised, is resting. It manufacture from mild steel material followed by heat treatement of case hardening.
2) **Nut** :- it is the components which is rotated by the worm shaft because the nut is installed on the worm gear. The load raising lead toggle advances through this nut UP and DOWN. It is applied with the lubricating grease to have it's smooth functioning.
3) **Worm shaft**:- it is that component which actually rotates the worm gear along with the nut to advance the toggle. It is rotated manually using the tomy lever. It perfectly meshes with the worm gear.



4) **Worm gear wheel**:- it the component being rotated by the worm shaft. it is used to transmit the power between shafts with the perpendicular, non intersecting axes. It's teeth are similar to involute rack. The worm wheel is essentially a helical gear with a face curved to fit a portion of worm periphery. It is installed with the nut to advance the toggle.

5) **Plate box:-**It is manufactured from the 8 mm thick m.s. plates to form a rigid body of the worm geared jack instead of casting body. It is installed with the worm and worm gearing along with the lead toggle and nut arrangement hold firmly.
6) **Top (Top rest) :-** it is a trapezoidal foot rest over which all the concentrated load of the car and the jack is resting. It forms a roboust top to be coupled with the car body or the axle for the complete jack.
7) **Foot platform:-** it is the circular plate which holds the concentrated load firmly with out slippage. It may be provided with the serrated area to hold the load firmly.



Let us see THE D.C. MOTOR WHICH WE ARE GOING TO USE FOR OPERATING JACK

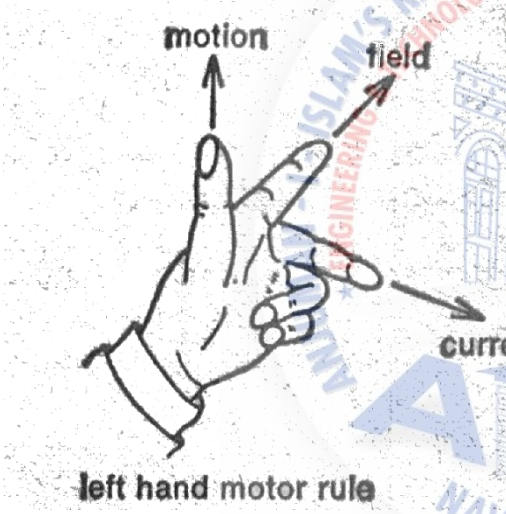
4.2 D.C. Motor principles

All motors require two magnetic fields, one produced by the stationary part of the motor (the *stator*, or *field*), and one by the rotating part (the *rotor*, or *armature*). These are produced either by a winding of coils carrying a current, or by permanent magnets. If the field is a coil of wire, this may be connected in a variety of ways, which produces different motor characteristics.

The basic law of a motor, the reason why they rotate, is governed by Fleming's left hand rule (see figure below). This tells you the direction of the force on a wire that is carrying current when it is in a magnetic field.

If we now bend the wire round in a loop, and place it in a magnetic field caused by two permanent magnets, we have the situation shown in the diagram below. Here, both sides of the wire loop will have a force on them, trying to make the wire loop rotate. The current is applied to the loop through the *commutator*, which is shown as two pieces of metal formed into a ring in the figure.

Current is applied to the commutator by stationary graphite blocks, called *brushes*, which rub against the commutator ring.



USES

It is used to replace the tyre of the automobile. The vehicles like bus, trucks, when gets punctured, it is required to replace the tyre immediately. At ths instant the lifter trolley is taken beneath the vehicle its platform is raised till tyre becomes completely.

It can be used to raise the component of machine tool or structure temporarily.

ADVANTAGES:-

Following are the various advantages to make our worm geared jack, the popular one:

1) It require no mMan-power for it's operation.
2) It is not required to convey the jack from one place to the another place, due to its permanent installation beneath the vehicle being compact size and being installed on the single frame.
3) It is easy for the maintenance.
4) It requires very less skill for it's operation.
5) It is multipurpose.
6) It is automatic and no time consumong as compared to the conventional raising and lowering jacks etc..

CHAPTER 5

DESIGN

DESIGN

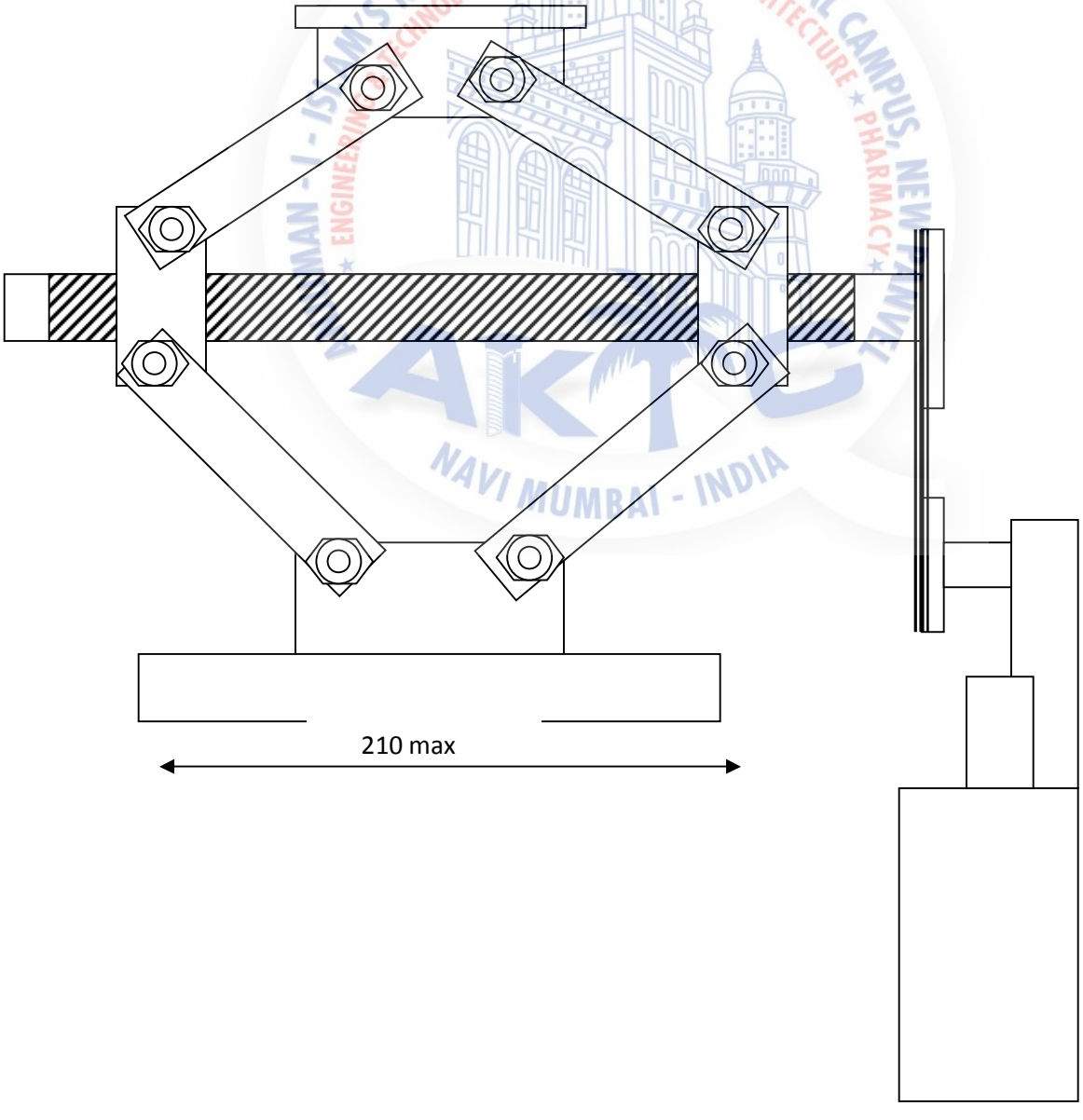
Toggle is made from mild steel

Permissible tensile stress = 100 Mpa= σt

Permissible shear stress = 100 Mpa= τ

As we are going to manufacture the jack to lift the wheel of car, assuming maximum load at one side of the car-wheel = 500 kg = 5000 N

5.1 Design of square threaded lead screw

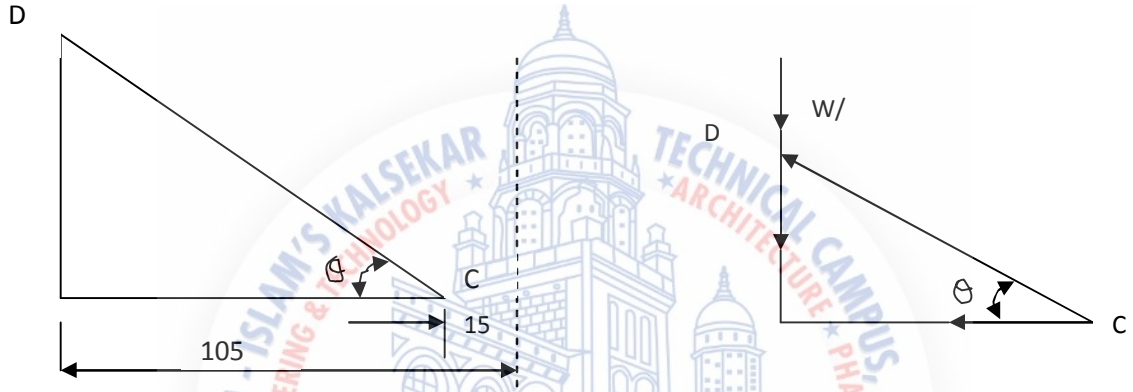


A little consideration will show that the maximum load on the

Square threaded screw occurs when the jack is in top position.

When the jack is at bottom position,

The position of link CD in the bottom position is shown below



Let θ be the angle of inclination of the link CD with the horizontal.

From the geometry of fig we find that

Cos θ = (105 – 15) / 110 = 0.8182 or θ = 35.1^0.

Each nut carries half the total load on the jack and due to this, the link CD is subjected to tension while the square threaded screw is under pull as shown in above fig.

The magnitude of pull on the square threaded screw is given by –

F = W / (2tanθ) = 5000 / (2 tan 35.1^0) = 5000 / (2 x 0.7028) = 3557 N

Since the similar pull acts on the other nut, therefore total tensile pull on the square threaded rod,

W_1 = 2F = 2 x 3557 = 7114 N

Let dc = core diameter of the screw (W_1)

$7114 = (\pi/4)\ dc^2\ \sigma t = (\pi/4)\ dc^2\ 100 = 78.55\ dc^2$

$dc^2 = 7114 / 78.55 = 90.56$

$dc = 9.51$ mm say 10 mm.

Since the screw is subjected to the torsional shear stress we will adopt

dc = 10 mm

Nominal or outer diameter of the screw =

do = dc + pitch, [where 4 mm is pitch]

do = 10 + 4 = 14 mm

let us now check for the principal stresses. We know that

$\tan \alpha$ = Pitch / (πd) = 4 / (π x 14) = 0.0909 where α is the helix angle

5.2 SELECTION OF GEARED MOTOR

TORQUE REQUIRED TO ROTATE THE LEAD SCREW

We know that the effort required to rotate the screw = P = W1 tan (α + Φ1)

= W1 [(tan α + tan Φ)/(1 – tan α tan Φ)]

= 7114 [(0.0909 + 0.20)/(1 – 0. 0909 x 0.20)]

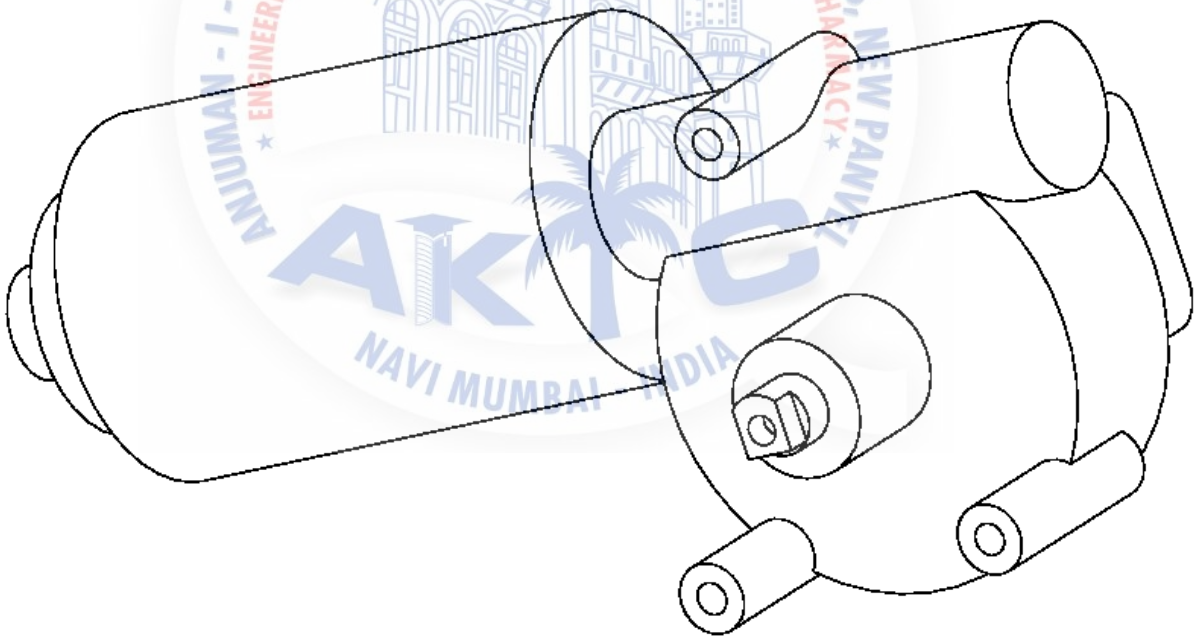
Because coeff of friction = μ = tan Φ = 0.20

Hence P = 7114 [0.3124/ 0.97752] = 1460 N

So torque required = T = P x d/2 = 1460 x 14/2 = 10224 Nmm

To select geared motor and the torque

DC GEARED MOTOR



5.3 DESIGN OF DC MOTOR

Power of motor = ¼ H.P = 746 x .25 = 186.5 N- m /s

Rpm of motor = 1800 rpm

Output rpm required = 24rpm

Number of stage in gear box = 2

Ratio of gearing =1 : 74.8

CALCULATION FO FINAL SPEED & TORQUE OF JACK

Power of motor = P = 186.5 watt.

$$P = \frac{2\pi NT}{60}$$

Where, N→ Rpm of motor = 1800

T →Torque transmitted

$$186.5 = \frac{2\pi \times 1800 \times T}{60}$$

T = 0.989N-m

T = 989.9N-mm

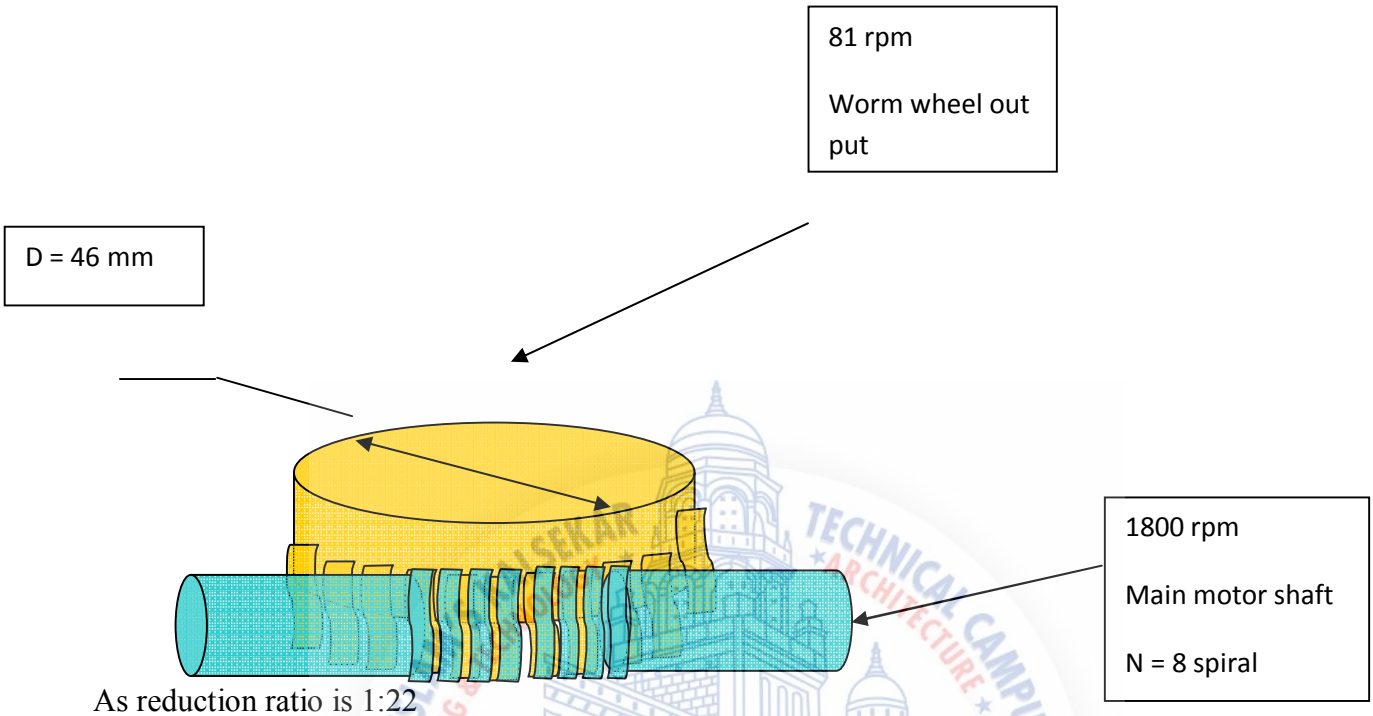
T = 990N-mm

CALCULATION OF TORQUE OBTAIN BY GEAR BOX

In put torque of gear box = 990 N- mm

In put rpm of gear box = 1800 rpm

Torque & rpm obtain at gearing



As reduction ratio is 1:22

So,

Out put rpm of gear box is

$$N2 = N1 / 22$$

$$N2 = \frac{1800}{22}$$

$$N2 = 81.8 \text{ rpm}$$

N 2 = 82 rpm

TORQUE AT GEAR BOX OUT PUT

$$\frac{N1}{N2} \quad \frac{T2}{T1}$$

$$\frac{82}{24} = \frac{x}{21731}$$

$$x = \frac{82 \times 21731}{24}$$

x = 74247.58 N-mm

T2 = 74248 N-mm

As out put torque 74248 N-mm is more than required torque 10224 Nmm so design of transmission system is safe

5.4 .DESIGN OF NUT

Let n = number of threads in contact with the screw

Assuming that the load W1 is distributed uniformly over the cross sectional area of the nut, therefore bearing pressure between the threads (pb),

$do = W1/[(\pi/4)\{(do)^2 - (dc)^2\}n$

$17 = 7114/[(\pi/4)\{(17)^2 - (10)^2\}$

n = 73 / 17 = 4.2 = 4

so thickness of nut = t = n x p = 4 x 6 = 24mm

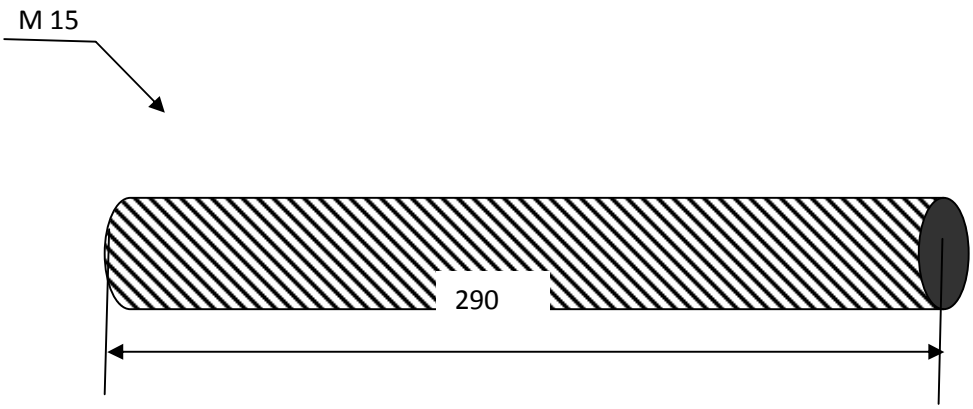
width of nut b = 1.5 do = 1.5 x 17 = 25.5 mm

Let us take thickness of ring to install sprocket wheel = 34

length of screwed portion of the lead screw = 210 + thickness of ring +2 x t

= 210 + 34 + 2 x 24

= 292 mm



LEAD SCREW

M15

Pitch = p =1.5

Do = 15

Dc = 12.6

From corese series.

Allowable stress = 70 N / mm^2

T1 = Torque req. to overcome friction between screw and nut.

$$T1 = \frac{\tan \alpha + \tan \phi}{1-\tan \alpha.\tan \phi}$$

$\tan \alpha$ = helix angle = 2.26^0

$\tan \phi$ = coefficient of friction = μ

d = mean dia.

W = load

$\tan \alpha = \tan 2.26 = 0.0396$

$\tan \phi = \mu = 0.18$

d= do+dc / 2

d=15+12.6 /2

d=13.8

T1 = 0.0396/1-0.0396x 0.18 + 0.18 x 28.10 /2 x 1000

T1 = 3110 N-mm

T2 = μ1 W R W = Assumed 30 kg of motor force = 300 N

R= d / 2 = 13.8 / 2 = 6.9 mm

T2 = 300 x 0.18 x 6.9

=16200 N mm

T = T1 + T2

T = 16200 + 3300

T = 19500N mm

Stress induced in screw

Considering screw under pure compression

$W = fc \times \pi/4\ dc^2$

$Fc = W \times 4 / \pi \times dc^2$

$Fc = 300x\ 4 / \pi \times 13.8$

$Fc = 27.69N/mm^2$

Shear stress due to torque T = 19550

$Fs = 16T1 / \pi (dc)^3$

$Fs = 16 \times 19550 / \pi (13.8)^3$

$Fs = 38.54 N/mm^2$

As stress induced is less than permissible, design is safe.

SELECTION OF SPROCKET WHEELS

CHAIN DRIVE

SPROCKETS

The chain converts rotational power to pulling power, or pulling power to rotational power, by engaging with the sprocket.

The sprocket looks like a gear but differs in three important ways:

1. Sprockets have many engaging teeth; gears usually have only one or two.
2. The teeth of a gear touch and slip against each other; there is basically no slippage in a sprocket.
3. The shape of the teeth are different in gears and sprockets.

Types of Sprockets

HOW TO SELECT CHAINS

In this chapter, we outline the selection process. To choose the right chain, follow the step-by-step procedure for the type of line you're running. The first thing you must

determine the type of application: power transmission or conveyor. The selection process differs for the two applications; see Basics Sections 4.1 and 4.2.

In addition to the procedures described in this book, chain manufacturers usually provide comprehensive selection charts in their catalogs; refer to the manufacturer's catalog for detailed information.

TRANSMISSION CHAIN SELECTION

There are four main uses for transmission chains: power transmission, hanging transmission, shuttle traction, and pin-gear driving.

1. Power transmission. The most frequent application, power transmission involves an endless chain wrapped on two sprockets. There are two ways to select chains for this use.

For general applications, you can select by power transmission capability (tent curve). This is shown in Figure 4.1.

For slow-speed operation, you can make an economical selection using the maximum allowable tension. Use this method when chain speed is less than 50 m/min. and starting frequency is less than five times/day (Figure 4.2).

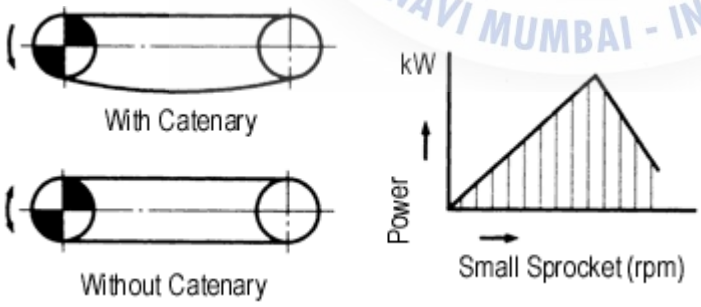


Figure 4.1 Power Transmission Capability

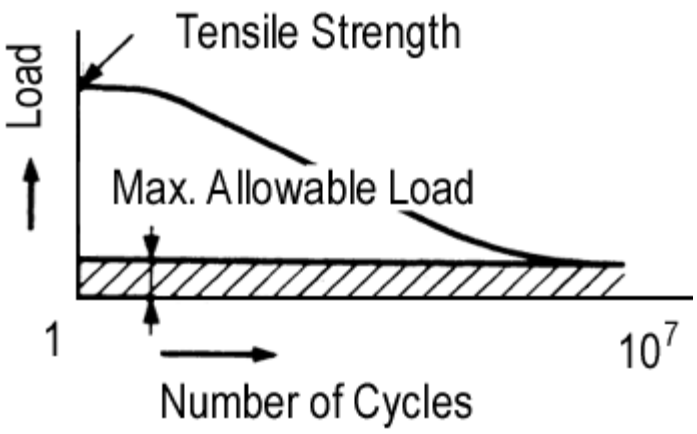


Figure Maximum Allowable Load at Slow Speeds (less than 50 m/min.)

2. Hanging transmission. This design is increasing in popularity. It is used, for example, in parking garage elevators. Sprockets rotate, and conveyed objects can be lifted or suspended at the end of chains. (Figure 4.3).

3. Shuttle traction. (Figure 4.4).

4. Pin-gear drive. In this design, the chains are laid straight or in a large diameter circle and are driven with special tooth form sprockets. This design is more economical than using gears (Figure 4.5).

In this book, we will focus on items 1 and 2. Consult your manufacturer's catalog for information on items 3 and 4.

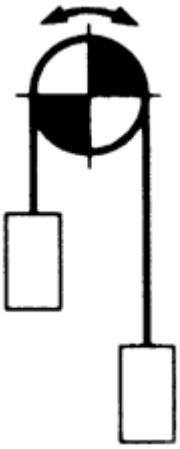


Figure 4.3 Hanging Transmission Where Conveyed Objects Are Lifted or Suspended at the End of Chains

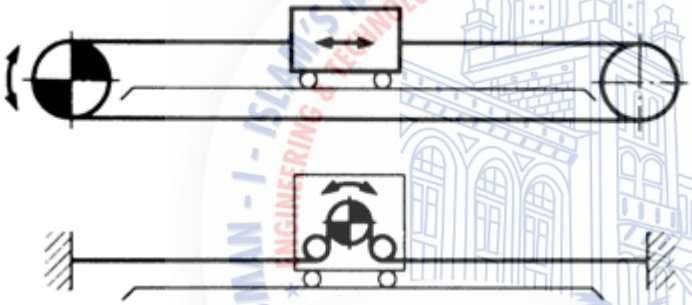


Figure 4.4 Shuttle Traction

Figure 4.5 Pin-Gear Drive Transmission

4.1.1 Chain Selection Factors

You must consider the following conditions:

1. Type of application.
2. Shock load.
3. Source of power: motor type; rated power (kW); moment of inertia, I (kg • m^2); rated torque at driving speed; starting torque; and stopping torque.
4. Drive sprocket rpm and shaft diameter.
5. Driven sprocket rpm and shaft diameter.
6. Center distance between sprockets.
7. Noise constraints.
8. Lubrication (possible or not).

Coefficients Used in Selection

1. Multiple strand factor

   In multiple strand power transmission chains, the loading is unequal across the width of the chain, therefore, the transmission capability is not a direct multiple of the number of chains. You must use a "multiple strand factor," which is shown in Table 4.1, to determine the correct value.

2. Service factor, Ks

The chain transmission capability is reduced if there are frequent or severe load fluctuations. You must apply the appropriate factor based on the type of machine or motors (Table 4.2)

Table 4.1 Multiple Strand Factor

Number of Roller Chain Strands	**Multiple Strand Factor**
2	1.7
3	2.5
4	3.3
5	3.9
6	4.6

Table 5.2 Service Factor

5.5 DESIGN OF CHAIN & SPROCKET

We know ,

TRANSMISSION RATIO = Z2 / Z1 = 40/12 = 3.33

For this transmission ratio number of teeth on pinion sprocket is in the range of 21 to 10 , so we select number of teeth on pinion sprocket as 12 teeth.

So , Z1 = 12 teeth

SELECTION OF PITCH OF SPROCKET

The pitch is decided on the basis of RPM of sprocket.

RPM of pinion sprocket is variable in normal condition it is = 2000 rpm

For this rpm value we select pitch of sprocket as 6.35mm from table.

P = 6.35mm

CALCULATION OF MINIMUM CENTER DISTANCE BETWEEN SPROCKETS

THE TRANSMISSION RATIO = Z2 / Z1 = 40/12 = 3.33 which is less than 5

So from table,

MINIMUM CENTER DISTANCE = C' + (80 to 150 mm)

Where $C' = \frac{Dc1 + Dc2}{2}$

$C' = \frac{80 + 25}{2}$

C' = 52.5 mm

MINIMUM CENTER DISTANCE = 52.5 + (30 to 150 mm)

MINIMUM CENTER DISTANCE = 150 mm

CALCULATION OF VALUES OF CONSTANTS*K1 K2 K3 K4 K5 K6*

Load factor K1 = 1.25 (Load with mild shock)

Factor for distance regulation K2 = 1.25 (Fixed center distance)

Factor for center distance of sprocket K3 =0.8

Factor for position of sprocket K4 = 1

Lubrication factor K5 = 1.5 (periodic)

Rating factor K6 = 1.0 (single shift)

CALCULATION OF VALUE OF FACTOR OF SAFETY

For pitch = 6.35 & speed of rotation of small sprocket = 2000 rpm

FACTOR OF SAFETY = 8.55

CALCULATION OF VALUE OF ALLOWABLE BEARING STRESS

For pitch = 6.35 & speed of rotation of small sprocket = 2000 rpm

ALLOWABLE BEARING STRESS = 2.87 kg / cm^2

= 2.87 * 981 / 100 =28 N /mm^2

CALCULATION OF COEFFICENT OF SAG K

For horizontal position coefficient of sag K = 6

CALCULATION OF MAXIMUM TENSION ON CHAIN

As we know maximum torque on shaft = T_{max} = T2 = 278720 N-mm

Where ,

T1 = Tension in tight side

T2 = Tension in slack side

O1,O2 = center distance between two shaft

From fig.

$\sin \propto = \frac{R1 - R2}{O1O2}$

$\sin \propto = \frac{40 - 12.5}{150}$

$\sin \propto = 0.18$

$\propto = 10.36$

TO FIND θ

$\theta = (180 - 2\propto) \times 3.14/180$

$\theta = (180 - 2*10.36) \times 3.14/180$

$\theta = 2.7$ rad, we know that,

$T1/T2 = e^{\mu\theta}$

$T1/T2 = e^{0.35 \times 2.7}$

$T1 = 2.57T2$

We have,

$T = (T1 – T2) X R$

$278720 = (2.57\ T2 – T2) X 40$

$T2 = 4438$ N

$T1 = 2.57 X 4438$

$T1 = 11406$ N

So tension in tight side = 11406 N

We know ,

Stress = force / area

Stress induced $=11406/ (3.14 * 8^2 / 4)$

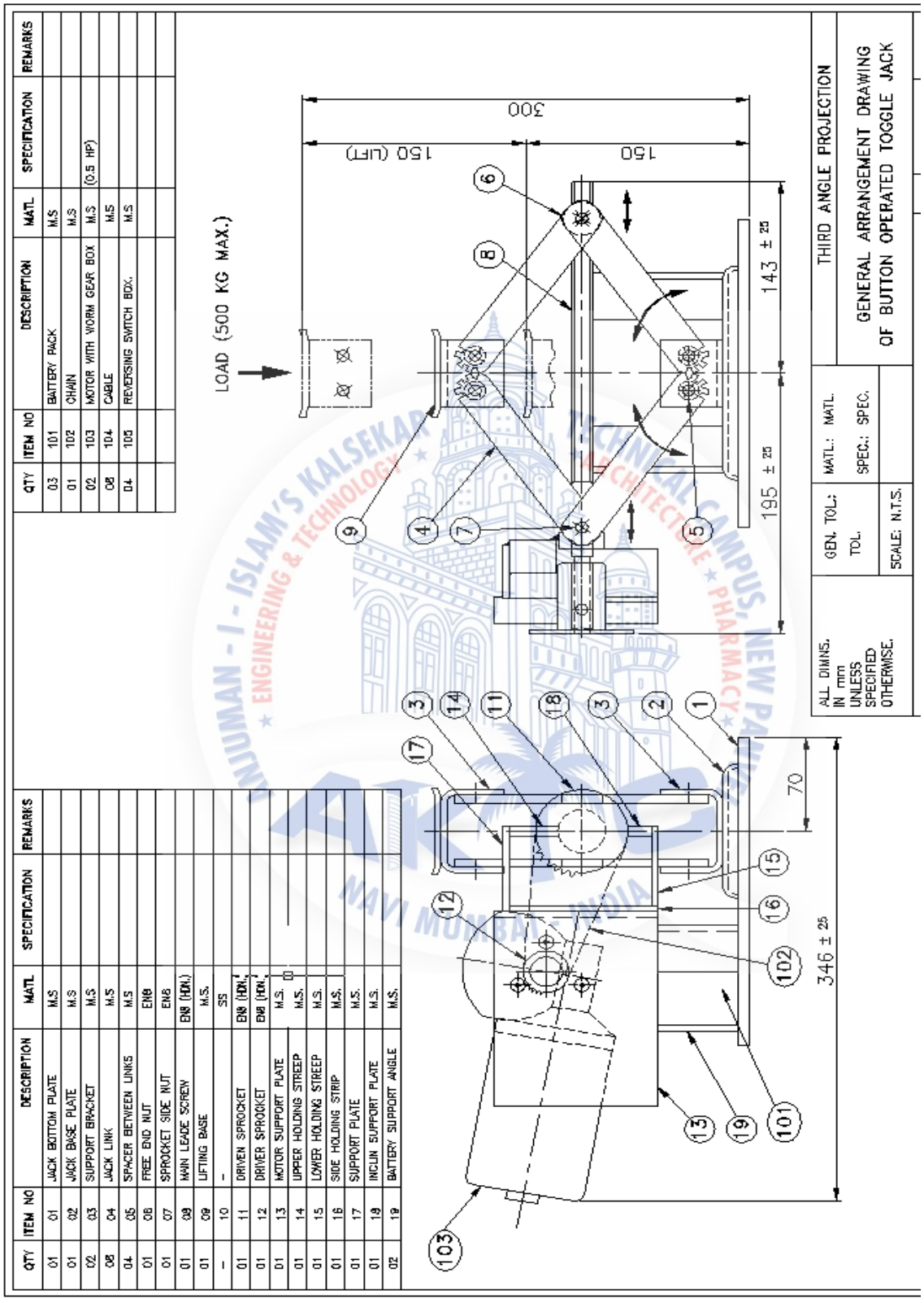
Stress induced = 227 N /mm^2

As induced stress is less than allowable stress = 320N /mm^2design of sprocket is safe

CHAPTER 6

DETAIL & ASSEMBLY DRAWING

DETAIL & ASSEMBLY DRAWING



QTY	ITEM NO	DESCRIPTION	MATL	SPECIFICATION	REMARKS
01	01	JACK BOTTOM PLATE	M.S		
01	02	JACK BASE PLATE	M.S		
02	03	SUPPORT BRACKET	M.S		
08	04	JACK LINK	M.S		
04	05	SPACER BETWEEN LINKS	M.S		
01	06	FREE END NUT	EN9		
01	07	SPROCKET SIDE NUT	EN6		
01	09	MAIN LEADE SCREW	EN8 (HDN.)		
01	09	LIFTING BASE	M.S.		
–	10	–	SS		
01	11	DRIVEN SPROCKET	EN8 (HDN.)		
01	12	DRIVER SPROCKET	EN8 (HDN.)		
01	13	MOTOR SUPPORT PLATE	M.S.		
01	14	UPPER HOLDING STREEP	M.S.		
01	15	LOWER HOLDING STREEP	M.S.		
01	16	SIDE HOLDING STRIP	M.S.		
01	17	SUPPORT PLATE	M.S.		
01	18	INCLIN SUPPORT PLATE	M.S.		
02	19	BATTERY SUPPORT ANGLE	M.S.		

QTY	ITEM NO	DESCRIPTION	MATL	SPECIFICATION	REMARKS
03	101	BATTERY PACK	M.S		
01	102	CHAIN	M.S		
02	103	MOTOR WITH WORM GEAR BOX	M.S	(0.5 HP)	
08	104	CABLE	M.S		
04	105	REVERSING SWITCH BOX.	M.S		

CHAPTER 7

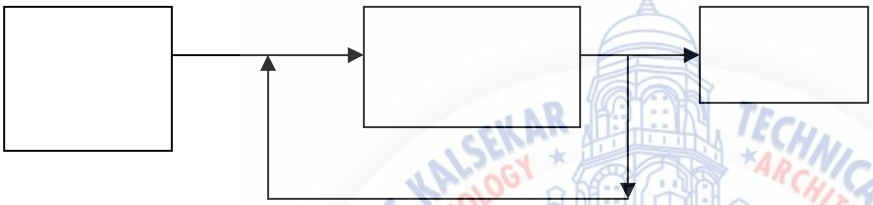
MANUFACTURING

MANUFACTURING

Manufacturing involved in conversion of race 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 2. Process 3. Output



Men Material Product

Process Machine

Service

Input: Man, machine, material and energy.

Process: Related to design, the product and the production management.

Output: Finished product or service.

7.1 MATERIAL SELECTION

Following are some of the important factors on which selection of material is based:

1. Availability and cost of material
2. Strength and rigidity
3. Resistance to fatigue
4. Impact resistance
5. Hardness
6. Weight
7. Mach inability and weld ability
8. Corrosion resistance

However, the most important factors affecting the selection of material for engineering design is the properties of metals in relation to their intended use. The properties of metal define a specific characteristic of the material and behaviors of the metal under different conditions. We have selected low carbon or mild steel for fabrications of various component of our project due to following properties and composition of material.

LOW CARBON OR MILD STEELS :

Low carbon or mild steel has carbon content from 0.15 to 0.30%. They are malleable, wieldable and can be case hardened only. They are similar to wrought iron in properties. Both ultimate tensile and compressive strength of these steel can be increased with increasing carbon content. They can be easily gas welded or electric arc welded, with the increase in the carbon percentage its weld ability increases. Mild steels are quite tough but easily machinable. It is cheaply available at reasonable price.

Manganese 0.30% to 0.60%

Its properties –

Tensile strength is 44.54 kgf/mm^2

Yield strength = 28 kgf /mm^2

Hardness = 170 BHN

TABLE 1.29 SUMMARY OF MATERIAL FEATURES AND APPLICATIONS

Material	Outstanding Features	Applications	Obtainable Precision Rating
Ferrous:			
Cast Irons	Low cost, good machining, high internal damping	Large-size, moderate power rating, commercial gears	Commercial quality
Cast Steels	Low cost, high strength	Power gears, medium ratings	Commercial quality
Plain-Carbon Steels	Good machining, heat treatable	Power gears, medium ratings	Commercial to medium precision
Alloy Steels	Heat treatable, highest strength and durability	Severest power requirements	Precision and high precision
Stainless Steels:			
300 Series	High corrosion resistance, non magnetic, nonhardenable	Extreme corrosion, low power ratings	Precision
400 Series	Hardenable, magnetic, moderate stainless steel properties	Low to medium power ratings, moderate corrosion	High precision
Nonferrous:			
Aluminum Alloys	Light weight, noncorrosive, excellent machinability	Extremely light-duty instrument gears	High precision
Brass Alloys	Low cost, noncorrosive, excellent machinability	Low-cost commercial equipment	Medium precision
Bronze Alloys	Excellent machinability, low friction, and good compatibility with steel mates	Mates for steel power gears	High precision
Magnesium Alloys	Extreme light weight, poor corrosion resistance	Special lightweight, low-load uses	Medium precision
Nickel Alloys	Low coefficient of thermal expansion, poor machinability	Special thermal cases	Commercial grade
Titantium Alloys	High strength for moderate weight, corrosion resistant	Special lightweight strength applications	Medium precision
Die-Cast Alloys	Low cost, no precision, low strength	High production, low quality, commercial	Low-grade commercial
Sintered Powder Alloys	Low cost, low quality, moderate strength	High production, low quality commercial	Commercial
Nonmetallic:			
Delrin	Wear resistant, long life, low water absorption	Long life, low noise, low loads	Commercial
Phenolic Laminates	Quiet operation, highest strength plastic	Medium loads, low noise	Commercial
Nylons	Low friction, no lubricant, high water absorption	Long life, low noise, low loads	Commercial
Teflon (Fluorocarbon)	Low friction, no lubricant	Special low friction	Commercial

We have used following material for different components

SR NO	COMPONENT	MATERIAL	QTY (No.)
1.	JACK BOTTOM PLATE	M.S.	01
2.	JACK BASE PLATE	M.S.	01
3.	SUPPORT BRACKET	M.S.	02
4.	JACK LINK	M.S.	08
5.	SPACER BETWEEN LINK	M.S.	04
6.	FREE END NUT	En 8	01
7.	SPROCKET SIDE NUT	En 8	01
8.	MAIN LEAD SCREW	En 8	01
9.	LIFTING BASE PLATE	M.S.	01
10.	SPACER	M.S.	01
11.	DRIVEN SPROCKET	En 8	01
12.	DRIVE SPROCKET	En 8	01
13.	MOTOR SUPPORT PLATE	M.S.	01
14.	UPPER HOLDING STRIP	M.S.	01
15.	LOWER HOLDING STRIP	M.S.	01
16.	SIDE HOLDING STRIP	M.S.	01
17.	SUPPORT PLATE	M.S.	01

18.	INCLINED SUPPORT PLATE	M.S.	01

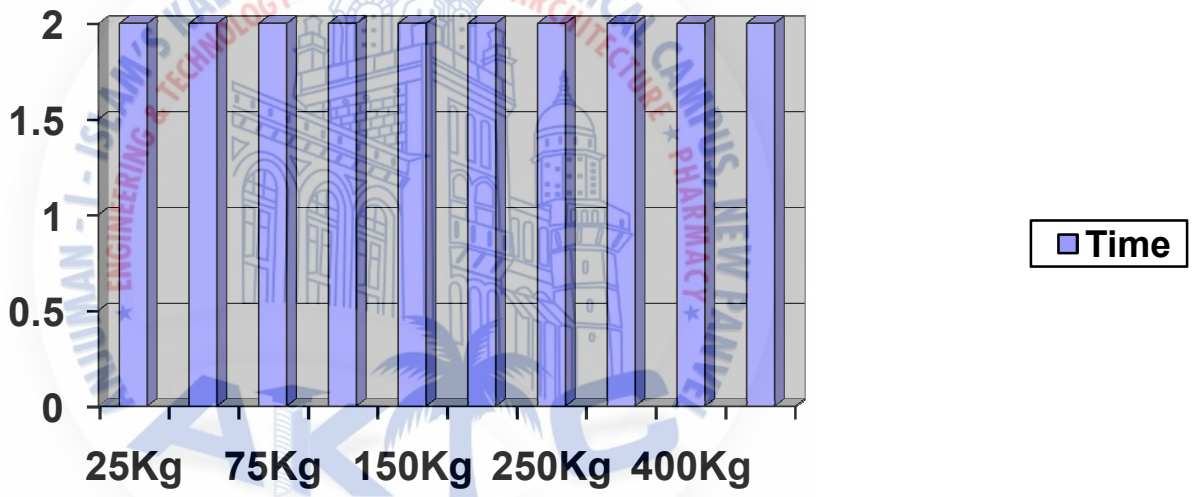
CHAPTER 8

RESULT ANALYSIS

RESULT ANALYSIS

Sr. No.	Test Description	Result	Remarks
01	Tested on weight 25Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
02	Tested on weight 50Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
03	Tested on weight 75Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
04	Tested on weight 100Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
05	Tested on weight 150Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
06	Tested on weight 200Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
07	Tested on weight 250Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
08	Tested on weight 300Kg	Failed to lift	Motor used of 0.25HP was

			insufficient, which changed to 0.50HP
09	Tested on weight 300Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
10	Tested on weight 400Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.
11	Tested on weight 500Kg	Ok lifted upto 150mm height	Lifted in 2 minutes.



Graphical Representation of Result Analysis

CHAPTER 9

CONCLUSION

CONCLUSION

- We started the result analysis with the load of 25 Kg & increased load gradually

- At every trial the jack lifted the load in the same time span. i.e. within 2 minutes

- When it was tried out at 300Kg, it failed to lift the load. So we concluded that the motor capacity was insufficient to lift the load.

- Then the motor capacity was change from 0.25 HP to 0.5 HP, as the load at single point of wheel is approx. 500kg.

- After changing the motor, it could lift the load of 300kg in 2 minutes. Further load of 400kg & 500Kg was also lifted within 2 minutes

- Then Jack was rigorously tried out to lift the Car for number of times.

CHAPTER 10

FUTURE SCOPE

FUTURE SCOPE

Since old age man is always trying to gain more and more luxurious. Man is always trying to develop more and more modified technique with increasing the aesthetic look and economic consideration. Hence there is always more and more scope towards whatever he might have created of course after having the experience of the presently manufactured things. But being the Engineers and having the ability to think and plan. But due to some time constraints, and also due to lack of funds, we only have thought and put in the report the following future modifications:-

1) Motor can be made ON and OFF using remote control sensor and receiver

to make the jack the remote controlled jack.

The only way to prevent this is for the jack to wear a jack-nappy when in transit.

Alternatively wrap the mechanism in cling film and secure it with tape or a rubber band and lightly oil the shaft immediately before use. *A* jack-nappy protects the moving parts from dust.

USE OF THE HIGH-LIFT JACK

There are few bogging down situations that cannot be overcome with a high-lift jack, a spade and a strong back. The high-lift jack is without doubt the most valuable piece of equipment that an off-roader can carry. The jack discussed here is the American standard brick red-coloured unit that has been around for many decades. Although there are competitors' jacks on the market, the 'old favourite' is virtually unbreakable and as long as it is kept well lubricated it is reliable. Unfortunately, more and more 'off-road' vehicles are being introduced with fancy curved plastic bumpers –impractical for bush work because of the absence of points where a high-lift jack can be used

CHAPTER 11

REFERENCES

References

To complete the project report the use of various book is important. The following book is referred for design and other purpose related to project report.

- A book by *Mr. R S Khurmi* , of '**Machine Design**' 5th Edition from 'Khanna Publications
- A book by *Mr. HajaraChoudhary* , of '**Workshop Technology**' 4th Edition from 'Khanna Publications
- A book by *Mr. M S Mahajan* , of '**Production Technology**' 3rd Edition from 'Technova Publications
- A book by *Mr. R C Chapman* , '**Workshop Technology**' 4th Edition from 'Tata Macgrew' Publications
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