

# MOTORIZED SCREW JACK IN AUTOMOBILES

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**Abstract** - Inside Street, road emergencies like tyre puncture or automobile upkeep and restore, traditional automobile jacks used mechanical gain to permit human electricity to elevate the automobile with the aid of using guide pressure. A screw jack is a device in which a small pressure is applied in a horizontal plane which is used to elevate or decrease a huge load. The concept on which it really works is just like that of an inclined plane. This challenge suggests amendment of contemporary-day mechanical jack with the usage of an electric powered DC motor with inside the screw in an effort to make load lifting easier. Advantage of this machine is that it attracts the power from the battery of automobile. For torque multiplication generated with the aid of using motor spur tools are used. This machine may be positioned in any vehicle under any working condition. Also we're searching out to boom the performance of motorized screw jack with the aid of using various helix angle through which power drawn by the battery can be decrease.

**Key Words:** Power screw, Mechanical jack, Lifting arm, Spur Gears, D.C Motor.

## 1. INTRODUCTION

In daily lifestyles it is very tedious process to function the jack manually and it's also a completely time-eating work as well. Also, while tyre is puncture; to restore or changing tyre jack is needed particularly at rear wheels that is tough to function jack. In maximum of the automobiles garages, the automobiles are lifted with the usage of screw jack which required excessive work force and professional labor. So, the primary cause of this challenge is to lessen human attempt and keep away from coincidence danger and attempt to design the motorized jack in this kind of manner that it may be used to raise the automobile very easily with less amount of work force & Power. The operation is made easy in order that even unskilled labor can use it comfortably additionally, moreover the built in jack in automobiles for higher handy for replacement of tyre on roads. A screw jack is an assembly of gearbox in which either spur gear, bevel gear or worm gear are used which connected to a transmission road having lead screw type mechanism which is further connected with dc motor which convert the circular motion of the motor in linear motion use to uplift & decrease the height. This jacks can also be used for pull, push, creating tension etc. In this mechanism the D.C motor is attached with the screw jack by some coupling techniques which is further said to be a motorized screw jack.

## 2. COMPONENTS

To construct a motorized screw jack the following are the components use to build it all the way,

### 1) Spur Gear

In this project external spur gears are used in this the teeth are cut on the outside diameter while the internal diameter is kept smooth. This are used to transmit rotary movement among parallel shafts and the shafts that rotate in opposite directions. They have a tendency to be noisy at excessive speeds as the equipment surfaces come into touch at once.

**Design considerations for a gear drive in the design of a gear drive, the subsequent information is typically given:**

1. The power to be transmitted,
2. The speed of the driving gear,
3. The velocity ratio, and
4. The center distance.

**The following necessities should be met for a gear drive:**

- (a) The teeth of the gear should have sufficient strength so that it can with stand the static or dynamic load applied during working.
- (b) The gear teeth need to have wear characteristics in order that there lifecycle is satisfactory.
- (c) The use of space and material need to be economical.
- d) Gears alignment & shaft deflection should be taken in consideration as they impact the performance and life of gears.
- (e) The lubrication of the gears should be satisfactory.

### 2) DC Motor:

A D.C motor utilize the D.C current to convert electric power into mechanical power. Its work on the principle that "when a current-carrying conductor is positioned in a magnetic field, it experiences a magnetic force whose direction is given with the aid of using Fleming's left-hand rule" ("Keep

the fore finger, center finger and thumb of the left hand mutually perpendicular to one another. If the fore finger suggests the direction of magnetic field and middle finger suggests course of current with inside the conductor, then the thumb suggests the direction of the movement of conductor.”).

A DC motor's speed can be controlled with, the usage of both a variable deliver voltage or with the aid of using changing the strength of current in its field windings. When a motor is in operation, it develops torque, which is used to rotate the shaft of the mechanism through belts, chains or shaft coupling.

**3) Screw Jack:**

A jack is a simple tools used for lifting the required job, a jack is a superb device use to apply forces or convey heavy loads. A mechanical uses a screw thread mechanism for lifting heavy work piece, load. A hydraulic jack uses hydraulic strength. The most often used jacks are automobile jack, ground jack or garage jack, which lifts automobiles, or to lift heavy load to displace from one place to another or to perform restoration. Jacks are rated for a maximum safe lifting capacity under which it work without failure also to remind the limit up to which it can hold force applied on it (for example, 1.5 tons or 3 tons). Jacks used in industries are rated for hundreds of tons of load. Scissor automobile jacks normally use mechanical benefit to allow a human to elevate a car with the aid of using manual force alone. Earlier variations of jacks used in garage have a platform to elevate an automobile's frame or axle. Electrically operated automobile scissor jacks are used which are powered with the aid of the usage of 12-volt electricity supplied directly from the car's cigarette lighter receptacle. The electricity is used to power those automobile jacks to elevate and decrease automatically. Electric jacks require tons much less effort than the manual jacks.

**4) Switch:**

It is used in an effort to begin or prevent the whole operation of the object lifting jack. The type of switch used that meet this requirement is referred as a toggle switch. The toggle switch is a category of electrical switches which might be manually actuated with the aid of using a mechanical lever, handle, or rocking mechanism. This is designed to offer the simultaneous actuation of multiple sets of electrical contacts, or the control of huge amounts of electrical current or mains voltages.

**5) Battery:**

A car battery or automobile battery is a chargeable lead acid which is used to begin a motor car. Its primary cause is to offer an electric current to the electric-powered starting motor, which in flip begins the chemically-powered inner combustion engine that actually propels the automobile. Once the engine is running, electricity for the automobile's

electrical systems is still supplied by the battery, with the alternator charging the battery as needs boom or decrease. We are going to apply this battery in our venture for deliver electricity to DC motor.

**5) Electrical wires**

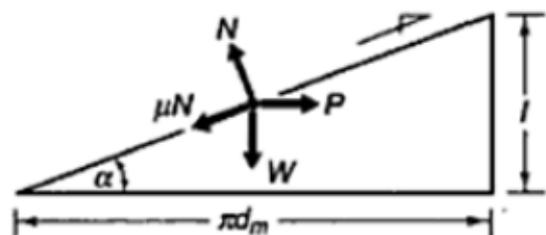
An automobile's wiring has to distribute electricity from the battery to gadgets positioned everywhere in the automobile. It additionally has to transmit statistics on a statistics bus, in addition to a whole lot of virtual and analog signals from switches and sensors. There are many distinct types of wires used in automobile industry. Some wires that transmit signals from switches or sensors convey nearly no current, & also those that offer electricity to huge electric powered motors carry lots of current.

**3. PRINCIPLE OF WORKING**

**Torque Requirement- Lifting Load**

The screw rod used in screw jack is considered as an inclined plane with angle of inclination as  $\alpha$ .

When the weight placed on the inclination is raised, following forces come into action.



**Load W:** When a weight is applied on an incline, it always operates vertically downward.

**Normal reaction N:** Normal force or Reaction Force always acts perpendicular (normal) to the inclined plane.

**Frictional force  $\mu N$ :** Direction of friction force is always acts in opposite direction of motion. Because the load is increasing, frictional force operates in a downward direction along the sloped plane.

**Force "P" required to move upward:** Force P required to move the load upwards acts in a direction perpendicular to the load W. The net force on the inclined plane may act towards right to overcome the friction and raise the load upwards.

In order to achieve horizontal force equilibrium,

$$P = \mu N \cos \alpha + N \sin \alpha \text{----- (a)}$$

In order to achieve vertical force equilibrium,

$$W = N \cos \alpha - \mu N \sin \alpha \text{----- (b)}$$

Dividing expression (a) by (b),

$$P = W(\mu \cos \alpha + \sin \alpha) / (\cos \alpha - \mu \sin \alpha) \text{----- (c)}$$

Dividing the above equation numerator and denominator on R.H.S by  $\cos \alpha$

$$P = W(\mu + \tan \alpha) / (1 - \mu \tan \alpha) \text{----- (d)}$$

The coefficient of friction  $\mu$  is expressed as,

$$\mu = \tan \theta \text{----- (e)}$$

Where  $\theta$  is the friction angle. Substituting  $\mu = \tan \theta$  in Eq. (c),

$$P = W(\tan \theta + \tan \alpha) / (1 - \tan \theta \tan \alpha)$$

Or

$$P = W \tan (\theta + \alpha) \text{----- (f)}$$

The torque ‘T’ required to raise the load is given by,

$$T = (Pd_m) / 2$$

$$T = ((Wd_m) \tan(\theta + \alpha)) / 2 \text{----- (g)}$$

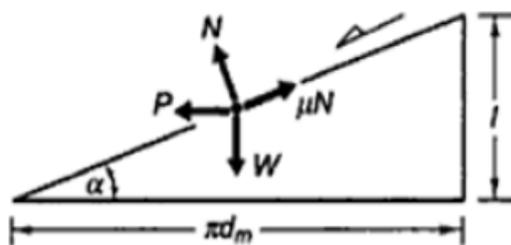
**Torque Requirement Lowering Load:**

The provided forces act at a spot on the inclined plane when the load is lowered.

**Load W:** When a weight is applied on an incline, it always operates vertically downward.

**Normal reaction N:** Normal force or Reaction Force always acts perpendicular (normal) to the inclined plane.

**Frictional force  $\mu N$ :** Direction of friction force is opposite to the direction of motion. Since the load is coming downward frictional force acts along the inclined plane in upward direction.



**Force ‘P’ required to move downward:** The net force P acts in a direction perpendicular to the load W. To overcome the friction and lessen the load, it should move to the left.

In order to achieve horizontal force equilibrium,

$$P = \mu N \cos \alpha - N \sin \alpha \text{-----(a)}$$

In order to achieve vertical force equilibrium,

$$W = N \cos \alpha + \mu N \sin \alpha \text{-----(b)}$$

Dividing expression (a) by (b),

$$P = W(\mu \cos \alpha - \sin \alpha) / (\cos \alpha + \mu \sin \alpha)$$

Dividing the above equation numerator and denominator of the right hand side by  $\cos \alpha$ ,

$$P = W(\mu - \tan \alpha) / (1 + \mu \tan \alpha) \text{----- (c)}$$

The coefficient of friction  $\mu$  is expressed as,

$$\mu = \tan \theta \text{-----(d)}$$

Substituting  $\mu = \tan \theta$  in Eq. (c),

$$P = W(\tan \theta - \tan \alpha) / (1 + \tan \theta \tan \alpha)$$

Or

$$P = W \tan (\theta - \alpha) \text{-----(e)}$$

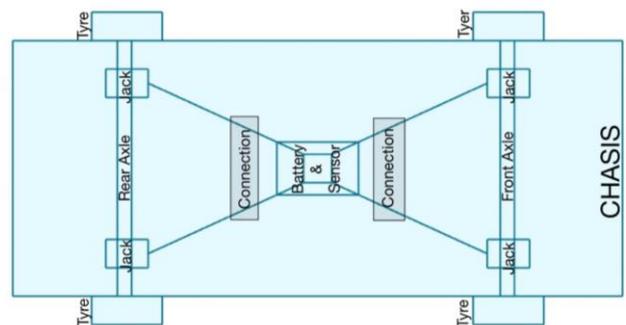
The torque ‘T’ required to lower the load is given by,

$$T = (Pd_m) / 2$$

$$T = ((Wd_m) \tan(\theta - \alpha)) / 2$$

**4. DESIGN OF MODEL**

The basic idea is to implant this jack on the axle near all the four wheels of automobiles so that it can be use in a situation of changing tyre or to perform the needful action required, as this diagram is providing only a basic idea of the project, well we are preparing a full 3D model of its design & working.



**5. CONCLUSION**

Screw jacks are the best product to push, pull, carry, lower and position loads of anything from multiple kilograms to kilos of tones. The need has long existed for a progressed transportable jack for automobile vehicles. It is incredibly suitable that a jack become available that may be operated inside of the automobile or from a location of safety off the road on which the automobile is positioned. Such a jack have

to desirably be strong sufficient and be compact sufficient in order that it may be placed in an automobile trunk or be fitted on chassis, may be lifted up and carried by maximum adults to its position of use, and also enough capable to lifting a wheel of a 4,000-5,000-pound automobile off the ground. Further, it have to be stable and effortlessly controllable by a switch in order that jacking may be completed from a position of safety. It have to be easily movable either to a position underneath the axle of the

automobile or a few different reinforced support floor. Thus, the product has been advanced thinking about all of the above requirements.

## 6. REFERENCES

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1	Ivan Sunit Rout, Dipti Ranjan Patra, Sidhartha Sankar Padhi, Jitendra Narayan Biswal, Tushar Kanti Panda	ISSN : 2250-3021; Vol. 04, Issue 05 (May. 2014)	IOSRJEN	Design and Fabrication of motorized automated Object lifting jack	Power screws are used to convert rotary motion into translatory motion. An object lifting jack is an example of a power screw in which a small force applied in a horizontal plane is used to raise or lower a large load. In this fabricated model, an electric motor will be integrated with the object lifting jack and the electricity needed for the operation will be taken from the D.C battery and thereby the mechanical advantage will be increased.
2	Mounika.Kandi.Reddy, Priyanka CH	ISSN : 2278-0181; Vol. 04, Issue 05 (Sept.2011)	IJERT	Design and fabrication of motorized screw jack for a four wheeler	In this paper, an electric motor will be integrated with the screw jack and the electricity needed for the operation will be taken from the battery of the vehicle and thereby the mechanical advantage will be increased.
3	Osueke, Obot, Emeka-Opara, Oguh,	ISSN: 2208-2379; Vol-3, Issue-4 (April,2016)	JIAATS	Design and fabrication of motorized screw jack, using local content for higher workshop productivity.	In this Journal, the outstanding issues in automotive maintenance on how to reduce human effort in load carriage and how to increase the efficiency of the screw jack applicable in automotive workshop
4	Asst Prof.Anand A. Kulkarni, Avinash V. Roy, Chaitanya Kale, G Praveen, Himalay Jakuti	ISSN: 2395-0056; Vol: 04, Issue: 09 (Sep -2017)	IRJET	Design and fabrication of automated motorized mechanical jack	Our research in this regard reveals the facts that mostly some difficult methods were adopted in lifting the vehicles for reconditioning. This paper attempts to overcome this difficulty and a suitable device is to be designed such that the vehicle can be lifted from the floor without any application of impact force. The operation remains to be an essential part of the system although with changing demands on physical input, the degree of mechanization is increased.

5	Radhakrishna.K, K.P.V.S.R Vinay Kumar, P Mohan Sai Manikanta, V Karthik, T Rajesh, M Vinay Kumar	ISSN 2456 – 5083; Vol 08, Issue 12, (Dec 2019)	IJIEMR	Performance of android operated screw jack	In this Paper, an electric motor will be integrated with the screw jack and the electricity needed for the operation will be taken from the battery of the vehicle and thereby the mechanical advantage will be increased. An Android device is used to Control the DC Motor by using a Printed Circuit Board.
6	Parmeshwar Durge, Nitesh Thakur, Abhishek Ghawalkar, Sunil S. Patil	ISSN: 2395- 0056; Vol: 06, Issue: 06, (June 2019)	IRJET	Inbuilt motor operated screw jack and automatic tyre inflation system	This project shows modification of current mechanical manual jack with the use of an electric DC motor in the screw in order to make load lifting easier as we know reduction in mileage is due to drop of few pressure units in vehicle, tyre life, safety and performance. This system can be placed in every in automobile under any operating condition, this will not only maintain the correct tyre pressure but also increase tyre life, mileage and safety. So, to inflate and deflate the tyre automatically by using control unit we have fabricated system.
7	Benjamin Ezurike, Modestus Okwu	ISSN: 2297- 623X, Vol. 13, Issue: 02, (Dec.2017)	IJET	Modified Screw Jack for Lifting Operation in Industrial Setting	In this Journal, we should give the brief introduction of the crank and gear mechanism, would help reduce difficulty in operation, reduce time, increase efficiency and effectively control. The difficulties concomitant with Ergonomics - which is an ultimate sensitivity in design process.
8	Venkatesh , Karunakaran, Arun Shenbaga Raj, Dhinesh Kanna, Mohammed Safiur Rahman	ISSN: 2395- 0056; Vol. 46, Issue: 09, (Feb.2021)	IRJET	Design and structural analysis of inbuilt car jack system	This jack is modified and made in such a way that it can be fitted to the frame of the vehicle. Hence when the jack operates, the car can be lifted up. The jack operation is made possible with the buttons fitted to the dashboard of the vehicle. In case of puncture or any other service, there is no need for external jack. The system is user-friendly such as in case of the power window.
9	Akshay M. Rokde, Akshay R. Telang, Awanish R. Upadhyay, Bhushan V. Nagdeve, Pavan V. Nandeshwar, Saurabh R. Barapatre, Prof. Narendra N. Wadaskar7	ISSN: 2395- 4396; Vol.4, Issue: 02 (Feb.2018)	IJARIIIE	Design and fabrication of integrated mechanical jacks for four wheelers	This research paper analyses the modification of the existing mechanical jack by incorporating an electric motor in the screw and attaching whole assembly to the car body (chassis) in order to make car lifting easier. In this modified design, mechanical jack and motor are attached to the four corners of chassis of car.
10	Suman Kirtaniya, Sumegh Moon, Atul Rajak, Suyog Khadilkar, Suraj Patil	ISSN 2229- 5518; Vol. 11, Issue 7, (July-2020)	IJSER	Design and manufacturing of automatic screw jack Stepney for automobiles car	We have designed and developed a system called automatic screw jack Stepney. In this system we have used IR (Infrared sensor) and screw jack with small wheel attached to the vehicle axel.

1	Prashant Kumar Srivastav, 1 Vipin Kumar Pandey, Shailesh Kumar Maurya, Ajit Tiwari, Prof. Jawed Rafiq, S.K. Dwivedi	ISSN 2347-3878; Vol. 03, Issue: 5, (May 2013)	IJSER	Highly efficient motorized screw jack	The effort required to rotate the screw can be eliminated by using a 12V DC motor to rotated screw of jack; which facilitate in easy replacement of tyre. Advantage of this system is that it draws the energy from the battery of vehicle. For torque multiplication; generated by motor two spur gear are used. A small gear is mounted on motor shaft and a large spur gear on power screw of jack. Also we are looking for to increase the efficiency of motorized screw jack by varying helix angle by which energy drawn by motor can be decrease.
1 2	Akash Mali, Suraj Patil, Harshwardhan Veer, Sanket Bhagat, Mahesh Thorat	ISSN: 2349-6002; Vol. 8, Issue 4, (Sept.2021)	IJIRT	Inbuilt Motorized Screw Jack for Vehicle	In this Journal, we try to reduce human effort by using the motorized operated jack is placed at rear end of car chassis. In case of puncture once driver knows tyre is puncture a switch is provided. When driver switch on button motor start running and shaft of jack is connected to motor. Hence by employing a motor jack is operate and lift the vehicle from rare end and this is easy to remove tyres of rare end.
1 3	JayeshChouksey, Pratik Jawade, Sohail Shaikh, PradiumJadhav	ISSN 2229-5518; Vol. 11, Issue 7, (July-2020)	IJSER	Design and Development of Automatic Handbrake System for Four Wheeler	Our aim is to increase the safety by using modified parking brake system named as Automatic Handbrake engagement and release system. In this modified system, we are going to control Handbrake automatically without manual interface. This system works on the input by ignition key position. As when the ignition switch turned ON, handbrake must disengage and vice versa when ignition switch is OFF, handbrake must engage. System may work electro-pneumatically using solenoid and pneumatic circuits.
1 4	Proff. G. K. Lamdhade, Vishal Wadkar, Ranjit Marne, Abhijeet Taware, Vinayak Bhairashetti	ISSN 0007-473X; Volume 21, Issue 05, (May-2020)	BULLETIN MONUMENT AL	Design and Manufacturing of in Built Screw Jack for an Automobile Car with Spare Wheel.	We have designed and developed a system called automatic screw jack Stepney. In this system we have used IR (Infrared sensor) and screw jack with small wheel attached to the vehicle axel.
1 5	Aishwarya B. Shinde, Pratiksha S. Nilange, Vrushali H. Dongre, R.K. Nanwatkar	ISSN 2455-5703; Vol. 2, Issue 1, (Dec-2016)	GRD Journal	Design and Fabrication of Mechanical Lift for Transportation	Our aim in this project is to design equipment that would replace or can be an alternate for conventional lifts used to lift cars. To use the mechanical power for lifting cars to a certain height. This will help reducing traffic problems on heavy traffic roads and we are using mechanical power this will lead to reduce cost of end product as compared to hydraulic and pneumatic based lifts.