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Engine Operated Screwjack

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Abstract – Automobiles prove to be the heart of locomotion. Even after decades of this industry appearance, one issue which was never solved is the avoidance of flat tyres. A long drive might be a soothing one to the heart but a flat tyre on such a drive collapses everything. Even a flat tyre on the way to the office may cause the day sick. There is no way out but to call a mechanic or in case of barren roads, change the tyre ourselves. Present day methods for changing the tyre requires a lot of mechanical power which may prove to be difficult for the weak and old people. To overcome this problem, an automatic engine operated screw jack is designed which outweighs the pneumatic and electrical automatic system in various aspects like reliability, maintenance, cost etc. This device uses only the engine power to lift the car in any terrain and altitude. An engine was selected for this purpose to work on and its characteristics were studied. Based on the result it proves that the device will be a success upon installation on any type of vehicle. Even heavy duty vehicles like trucks, lorry, and buses can be lifted at a very minimal cost. The device will be of low maintenance and the initial cost is also low when regarding its use. It is a onetime installation and so no recurrent cost needed at the time of puncture.

Key words - *Engine operated screw jack, Effortless lifting, Reliable operation, Lifting for weak, Power screw jack.*

I. INTRODUCTION

The day to day usage of cars is keeping on increasing as the world moves on to a hectic stage. One big problem everyone faces is a FLAT tyre on a voyage to any destination. If the tyre gets punctured the driver has to undergo a lot of pressure and rigorous mechanical work to lift the car using a screw jack. Then the changing of a tyre is a job that can be done systematically and relatively easy. In the hunt for sophistication we have introduced a method to ease the lifting of the car. Introduction of the power screw does the trick. Introducing a power screw solves the matter of lifting but the power required to lift is our next goal to solve. For the power input, the car engine itself can be used.

This automatic engine driven jack is a device which avoids the need for the driver to use his valuable energy. Just engagement of the gear and a foot on the pedal is enough to raise the car in a matter of seconds. Using this device not only sets the day right but it gives a fearless drive around the city anywhere at any time. Even women or old people can go for long journeys without having the fear of knowing the mechanics around the place. This is a day to day problem which can be solved by using the device we have introduced. This device makes use of the available energy from the engine and spends only a fraction of its energy to lift the car. The importance of this method can be further emphasized when a big truck or a lorry is taken under consideration.

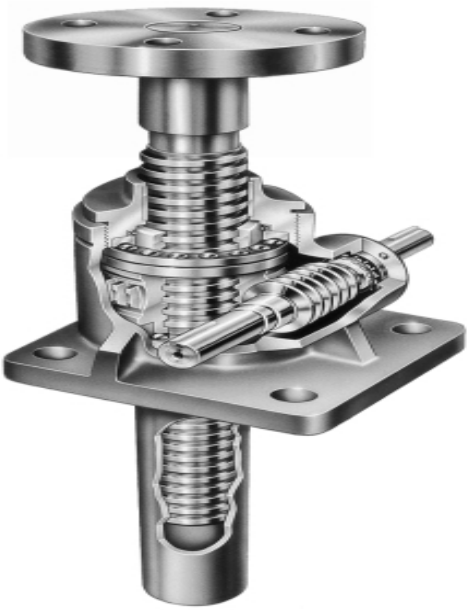
To start off, a study on an available engine was done to display the characteristics of the engine under such loads. Further it was concluded that the engine can withstand the excess load given at the moment of time. It is sure that the drive is going to be a peaceful one when the engine driven screw jack is installed in a car.

II. VIEW OVER CONVENTIONAL METHODS

The basic methods we follow while a car gets punctured are to lift the car using a manual screw jack and change the tyre. Recent development gave the automatic lifting systems like the electrically operated system, pneumatic system. But it failed in various aspects like cost, reliability, maintenance, complexity in usage etc. Those methods encountered a series of problems and to solve that the engine driven jack is used. The electrical systems were not reliable because during rainy seasons often the system gets corrupt. The pneumatic system, apart from being large has a serious issue of leakage of the pneumatic fluid and also the complexity involved in using the system. It weighs very much and it needs to be carried along the drive which will consume some space we use. So the basic problem to overcome was to install the system in the car itself so that it does not need additional space. Then it was the complexity in usage which should be solved. These problems were identified as major things to be rectified. A month's study gave out good results over the problems.

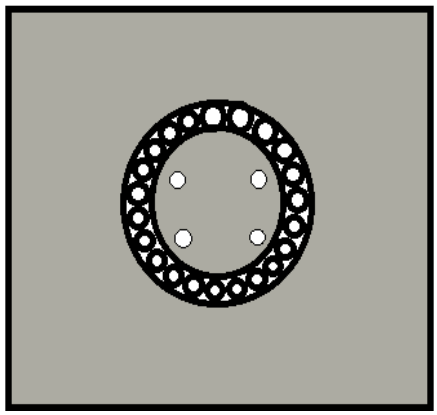
III. WORKING OF THE DEVICE

To start off, the first task is to decide over the type of screw used to raise the car. A standard power screw was selected from the powerjacks group company of UK. The model was selected as SM-1804. The model was selected based on the load selected as a Maruti swift-LXI model. The rated load of the LXI model is 1100 Kg. The power screw is also based on the torque requirements. The screw has a collar with the worm gear. The worm gear ratio is also based on the usage.



The image shows the power screw of model no:SM1804. The actual usage is done with the inverted type of this power screw. The housing for the lead screw is given under the hood of the car based on the position of the car. The housing has internal threads for facilitating a rigid support as well as a pilot for the screw to move. The lead screw is more rigid and sturdy with the usage of the housing. The housing does not need more space since the car needs to be lifted just to a limited height of a few inches.

The next modification to be made is the lifting pad. Since the lead screw is rotating, even if the pad is on the ground and power is applied, there is a danger of twisting the car and eventually breakdown. To overcome this, the pad is given a base with a bearing surface.



This modification allows the power to be transmitted even when the pad is on ground, facilitating the lift. The pad can be made of any robust material like cast iron.

The standards selected for the power screw as follows

Actuator Model	SM-1801
Capacity (Short Tons)	2
Worm Gear Ratios	6:1
Turns of Worm for 1" Raise	24
Max. HP per Actuator	2
Start-Up Torque at Operating Load* (In.-lbs)	40
Efficiency Rating	0.232
Weight with Base Raise of 6" (lbs)	19

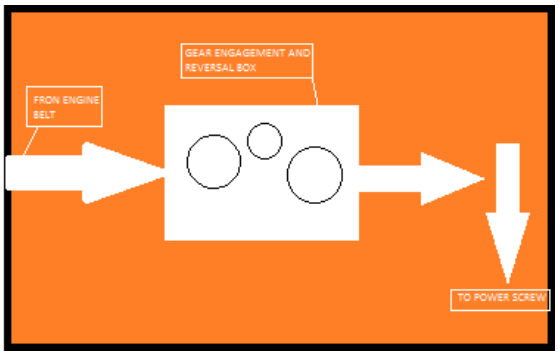
The worm gear is powered through a power belt from the engine. The belt is connected where the belt for radiator fan is connected. So an additional shaft must be extended to facilitate the power transmission to the device.

As the standard shows, the worm gear needs to rotate 24 times to lift the load by an inch. The rpm usually got from a swift car engine is 2000 to 4500 rpm. This shows that the car load will be lifted in no time. Moreover these power screws are manufactured for operation which needs robust conditions. So the system ensures stability and reliability.

When the engine is engaged with the power screw, power is transmitted through the belt to the powerscrew; raising the car to the needed height. The belt connects a

gear in the power screw assembly. The power screw assembly will contain a lever to actuate or engaging lever. The lever must be engaged in reverse order to lower the car. Engaging in reverse order is nothing but the gear reversal technique (i,e) a small gear is introduced in between two rotating gears will cause the driven gear to rotate in the reverse order.

The flow of power and the working can be well defined by the chart below



Now the whole device is installed and ready to use. The power screw is installed in the inverted position such that on engaging, the pad is lowered. When the pad hits the ground further power is given, it raises the car to the desired height. Addition of the worm gear arrangement reduces the torque requirement to a greater extend and prevents backlash.

SFC (kg/kW-h)	FUEL POWER (Kw)	IP (Kw)	η mech	η b.th	η I.th
	6.355	1.2	0	0	18.88
0.61	7.578	2.212	45.8	13.35	29.18
0.38	8.433	3.021	60.3	21.59	35.81
0.39	11.244	3.512	65.8	20.56	31.23
0.35	13.322	4.292	72	23.2	32.21
0.32	14.911	5.044	76.2	25.77	33.82

S. No	Load(kg)	Time taken for 10cc fuel
1	0	59
2	3.5	49
3	6.3	44
4	8	33
5	10.7	28
6	13.3	25

IV. CALCULATIONS

The torque required by a screw to lift a load is given by

$T_r = Fd_m (l + \pi f d_m \sec\alpha) / (\pi d_m - f l \sec\alpha)$

The torque required for the collar is

$T_c = F f_c d_c / 2$

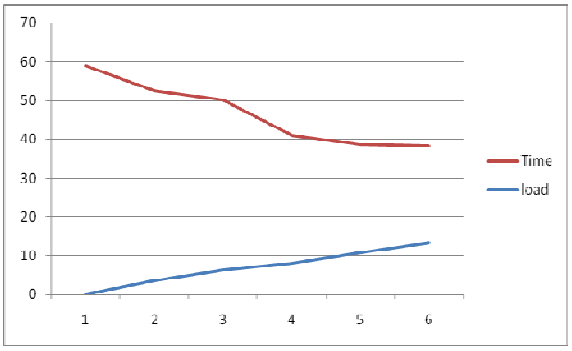
The total torque acting on the screw is

$T = T_r + T_c$

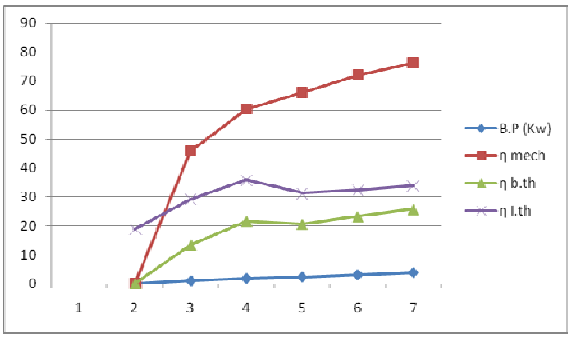
The required torque can be calculated based on this equation. Greater torque is needed to lift. This is overcome by the worm gear arrangement. The gear ratio determines the torque needed to lift.

To check for the characteristics of the engine under higher loads, a kirloskar engine was selected and load test was done. It's characteristics curve is drawn from the tabulations.

The characteristics curve was obtained as



The efficiency of the transmission is the basic parameter to check. The effiiency of the engine based on the above tabulations was done.



The chart shows that the torque is enough to lift the car even at very high loads under considerable efficiency.

The formula used are:

Brake power(bp)=2πNT/60(kw)

η_{mech}= bp / ip

Where bp is the brake power and ip is the indicated power .

brake thermal efficiency $\eta(b.th)=b.p/m_f*c.v$

where m_f is the fuel consumption in (kg/s)

indicated thermal efficiency $\eta(I.th)=i.p/m_f*c.v$

where c,v is the calorific value of the fuel

and m_f = t.f.c/3600(kg/s)

t.f.c=10/t*3.6*44,000 Kg/h

where t is the time for10 cc fuel consumption.

V. RESULTS

Based on the above table we have interpolated for many engines and found that the max fuel consumption does not exceed 0.09 lit. The main advantage is engine screw jack is more cost effective then the methods which are used now. Its also has more reliability t hen the conventional methods .It does not need any mechanical power as in case of screw jack or electric power as in case of electrically operated jack.. Simply said we does not need an external power source .The power for driving the engine operated automatic jack is obtained by just running the engine. In case of construction also its very simple and it does not need any expensive parts.

The maintenance cost for other methods such as hydraulics and electrically operated jacks is high whereas there is no maintenance cost in case of engine operated jack.. The operation is also simpler. It just needs the shifting of gears which can be even done by the child. This method is also safer than the other method. Heavy load vehicles can also be lifted using the engine jack. The unscrewing of the jack is also simpler. It just needs the reversing of gear. Time is also saved in this mechanism. Since it is mounted on the vehicle itself, there is no need of extra space for caring any tools. This device can be extended to heavy wheelers and it will be useful in expenditures.

VI. CONCLUSION

The performance of this device can be expanded by using sensors. The sensors can be used to detect the punctured wheel and facilitate the function of device from the driver seat itself. This will increase the scope of the device. The device certainly will create a level of sophistication needed by the customers for so long. The installation of this setup gives the owner a little bit more confidence in using the car.

REFERENCE

[1] Mechanical engineering design by Joseph E. Shigley

[2] Ehow.com

[3] http://www.howstuffswork.com

[4] Power screw group

http://www.powerscrewgroup.com

[5] IEEE journals.

[6] Thermal Engineering by R.K.Rajput

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