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Design and Development of Puncture Kit

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Abstract: *Demand of customers in term of ergonomics, aesthetics and efficient engine are also increasing. Customer expects that vehicle which they purchase should be resistance to all type of failure or company should provide easy solution whenever they get any problem in their vehicle. In other words, human factor involved while handling sick vehicle should be very ergonomic. If a customer's vehicle has a punctured tyre or a flat tyre, it is a dangerous situation that disrupts their thoughts, causes anxiety, and causes health problems if they are forced to tow the punctured vehicle. When dragging a ruptured vehicle, the tyre is also damaged. It's a novel idea for assisting drivers in effortlessly pulling their vehicle to a repair shop. The puncture kit is a rescue equipment meant to assist vehicles that may experience wheel troubles in continuing their journey by providing quick remedies to the issue. When wheel encountered a problem (flat tyre, burst tyre, dislodged tyre, brake jammed, bearing jammed) and our solution is to provide a simpler and more stable structure which the front plate and rear plate of the smart auxiliary kit will hold the hold the punctured tire and then user can drive normally at the speed of 20 km/h. This product not only provide quick solutions, it is also assisted user to be out from dangerous situation quick as imaging user were alone at the breakdown site with nobody surrounding.*

Keywords: Puncture Kit, Dislodged Tyre, Front Plate, Inflation, etc.

I. INTRODUCTION

When the vehicle gets punctured, the driver has to drag the vehicle as close as possible to the shop for repair. Vehicle is dragged in such a condition damages the tire in multiple places when the wheel rotates on the road. Four-wheeler driver has difficulty in getting Quick Roadside Assistant. so, there is a need for getting a vehicle assistant in physical form. therefore, we have developed a portable puncture kit for every type of four-wheeler. When wheel encountered a problem (flat tyre, burst tyre, dislodged tyre, brake jammed, bearing jammed) and our solution is to provide a simpler and more stable structure which the front plate and rear plate of the smart auxiliary kit will hold the hold the punctured tire and then user can drive normally at the speed of 30 km/h. This product not only provide quick solutions, it is also assisted user to be out from dangerous situation quick as imaging user were alone at the breakdown site with nobody surrounding.

II. OBJECTIVE

1. To remove health hazards like back pain, cramps in body due to changing the punctured tire of vehicle.
2. To reduce our dependency on other people when the tires get punctured.
3. Apparatus has to be portable so that the driver can attach it without difficulty to his/her vehicle.
4. Quick assembly of apparatus and quick assistance in needful situation of punctured vehicle.

III. LITERATURE SURVEY

In the [1] research paper, run flat (or self-supporting) tires are specially designed to keep working for a short while even after they suffer a puncture. So, if tire get puncture on a hot day, dark night, there's no need for an uncomfortable roadside tire change, they can safely drive home or to nearest garage to get the tire changed. The main goal of this project is to design and create a run flat tyre mechanism. We have ones that are self-supporting in the tyre and assist the driver in the case of a car breakdown; they can support the weight of the car precisely in the event of a puncture.

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In the next paper [2], this survey showcases the problem faced by the people while travelling by their own vehicle, this paper focuses this issue because is time revolving people are moving toward buying their own vehicles, in India at least one house owns one bike/car. And all family members use it on daily basis. Idea we proposed is to provide mobile app base solution, this app will help you to locate nearby puncture service center and the service center contact details so that they can come and fix the puncture whenever, wherever we need at any time.

In the next research paper [3], run flat or self-supporting tires are specifically designed to keep working even after a puncture for a short time. So, if tire gets puncture on a hot day, dark night, they can safely drive home or to the nearest garage to get the tire fixed, there's no need for an inconvenient roadside tire change. Run flat tires have an additional internal structure providing support in deflation situations.

In this proposed work [4], the system was designed to automate the jacking and puncture detection system for four wheeled automobiles. They designed embedded based system and tested the automatic jacking and puncture detection system. Based on the results this method was used to reduce the manual workload. Their system will automatically detect the puncture, indicates the location of the wheel and jack indication will appear on the LED screen.

IV. CONCEPTUAL MODEL DEVELOPMENT

Pre-requisite for modelling is weight of model has to be kept less because apparatus will be resting on four-wheeler as one of the accessories, so the efficiency of vehicle will not be altered by overweight. So provisions are made to reduce weight of system. It should be strong enough to hold weight of vehicle. Model should occupy less space on vehicle so it should be thin not bulky. Tires of apparatus should run very smoothly. Fixing mechanism between tire rim and apparatus should be tight enough.

Figure 4.1: Model 1

Plate type chassis is used for taking load of vehicle. In this model, mild steel material is used for constructing chassis and wheel frame. Rotation of apparatus is possible by revolving of front shaft in restricted angle as shown in Figure 1. One major problem for this model is, tire slips over the chassis in lateral as well as in longitudinal direction because of plane surface. So, Model 2 is proposed to remove this slipping problem.

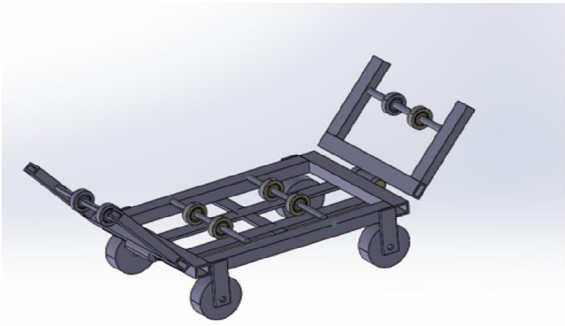

Figure 4.2: Model 2

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Plate type chassis with stopper has been provided to top slipping of four-wheeler in longitudinal direction as shown in Figure 2. Wheels are attached for weight reduction. Cost increases as castor are expensive. Because of Small tire diameters, the wheels are getting locked up on discontinuous road. Also, there is slipping of tire on plate in lateral direction. So, model 3 is proposed.

Figure 4.3: Model 3

V. METHODOLOGY

Please ensure your vehicle hazard lights is "on" during emergency and ensure you have parked your vehicle at safe location and safe to operate (not in danger situation. Ensure the puncture kit lay flat on the ground, both front and rear plate in open position, then slot it in front of puncture tyre.

Ensure front wheel of the kit must facing with the driving direction of the vehicle. When the clearance gap between ground and vehicle's front bumper /body is less than 24 mm height (especially when your vehicle stopped at slow condition), you will need to apply the lift up step to assist. Start the engine ignition and drive slowly to the front until vehicle has freely moved on in front smoothly at this point, you may break to stop the vehicle and apply accelerator again so that the puncture tyre could finally sit on the top of the kit. Take out the safety latching strap / belt provided, insert the safety latching strap from underneath until across the bottom of the kit and pull up to the nearest ventilation hole of the tyre rim.

Tightening of the belt / Fastening Means to prevent movement of the trolley as shown in Figure 5.1. When your vehicle is at stopped position, please don't turn the steering while your front wheel is on the kit this will damage the wheel of the kit. Drive slowly (less than 10 km/hr) and maneuvering to exist from park location carefully. Observe for any abnormality including any strange sound, might surface. If there are no any abnormality after approximately five minutes driving, you may increase the speed.

Figure 5.1: Puncture Kit under Puncture Tyre

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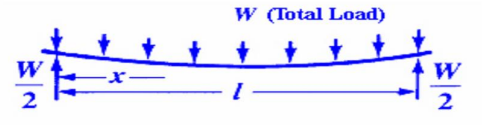
VI. CALCULATIONS



Calculate the required section modulus based upon the given load condition Maximum bending moment in beam shown in Figure.

M_{max} =ql^2/8

Where,

Q = total load per unit length = 300 kg/360mm
L = length of span=360 mm

M_{max} = 3000*360/8 = 135000 N-mm

The required section modulus is:
S = M_{max}/ σ_{allow} =13500/160 = 843.75 mm^3
σ_{allow}=160n/mm^2
Section modulus for required beam section is S = I/0.5b
I=b^4-(b-2t)^4/12
Where,

B = outer length of square cross section
T = thickness of square cross section

For our case b=25 mm
t= 1.5 mm
So, I=13030.75 mm^4
S= 1042.46 mm^3
Section modulus of square tube S= 1042.46 mm^3
is greater than required modulus S= 843.75 mm^3

Stress developed = M_{max}/S = 135000/1042.46 =129.50N/mm^2
Which is less than allowable stress i.e., 160 N/mm^2, so apparatus is safe from bending failure.

Deflection in chassis Actual deflection at centre = 5/384*WL^3/EI
Where,
I= Moment of inertia
E= Modulus of elasticity
W= load in N
Actual δ =5*3000*360^3/384*200000*13030.75 = 0.699 mm

Design for Revolute Joint

Permissible stresses are 80MPa in tension (t σ), 120 MPa in crushing (c σ), 60 MPa in shear (τ).
Diameter of rivet
As the thickness of the plate is less than 8 mm, the diameter of the rivet is determined by equating the shearing resistance to the crushing resistance.
$F_s=F_c$

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$\frac{\pi d2}{4}$ x $T = d \; x \; t \; x \; \sigma_c$

$\frac{\pi d2}{4}$x $60 = d \; x \; 4 \; x \; 120$

$d = 10.19 \; mm$

VII. RESULT

Table 6.1: Trial on Straight Plane Road

No. of Trials	Distance	Noise	Running Condition
First Trial	1 km	Minimum Noise	Good
Second Trial	1.5 km	Minimum Noise	Good
Third Trial	1.5 km	Minimum Noise	Good

Table 6.2: Trial on Turning Road

No. of Trials	Distance	Noise	Running Condition
First Trial	1 km	Moderate Noise	Difficult
Second Trial	1.5 km	Minimum Noise	Good
Third Trial	1.5 km	Minimum Noise	Good

Fatigue Testing:

Applied Load: 300 Kg
Test Speed: 5 kmph
Test time: 30 Minutes

Tracking Rubber wheel with metal bush inside, test was successful in fatigue testing Lab. Pulling load has been reduced by 40% with our device attached to puncture tire as shown in Pulling load test. Chassis is safe under Static and Dynamic loading. Tension belt is easy to close and open for tightening of this system with tire rim. These systems successful on different terrain of road surface. Four wheeler's handles with this system attached at any of the wheel can be rotated on turning road because tightening of rim and this system is proper with tension belt.

VIII. CONCLUSION

The proposed apparatus minimises the physical effort required to transport a punctured two-wheeler vehicle for repair in the most user friendly and preferred manner. This system is beneficial to the end user because it is portable and attractive (sporty look attracts young generation. Simple to install and operate on the wheel. There's no need to worry about carrying it separately (as it can be fixed on crash bar of Four-wheeler). Cost effective in comparison to other options in a market at a price of more than 2000 rupees. It's light in weight. There will be no financial loss as a result of tyre damage a tyre replacement (approximate 8k- 10k is spend in a year for tyre change).

REFERENCES

[1] H.S.Cheah, M. S. Mohammad, N. Ali, A. I. Din. Hakim, Design and Development of The Mechanism For Run Flat Tyre, 2nd Integrated Design Project Conference (IDPC) 2015, Faculty of Mechanical Engineering, University Malaysia Pahang, 9 Jan 201.6

[2] Saheel Mansuri, Chandrashekhar Kumbhar, Paper Emergency Tyre Puncture Assistant, Journal of Emerging Technologies and Innovative Research (JETIR)© May 2019, Volume 6, Issue 5.

[3] Vikas Kumar Choubey, Paper on Run Flat Tires, International Journal of Engineering Research in Computer Science and Engineering (IJERCSE), Vol 5, Issue 3, March 2018.

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International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
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[4] Anandha Raja A, Ilakkiya K and Ebinesar P, Automatic Jacking and Puncture detection system for Four-wheeler vehicle (CAR), 5th International Conference on Advanced Computing & Communication Systems (ICACCS) ©2019 IEEE.

[5] Dubois G, Cesbron J, Yin HP, Anfosso-Ledee F. Numerical evaluation of tire/road contact pressures using a multi-asperity approach. International Journal of Mechanical Sciences, Elsevier. 2012; 54(1):84–94.

[6] Wallman C-G, Astrom H., Friction measurement methods and the correlation between road friction and traffic safety: a literature review. Swedish National Road and Transport Research Institute [Statens vagoch transport for sknings institute], Linkoping, 2001.

[7] Choudhary S., Ravi Kumar D., Pasbola D., and Dabral S.et al, "Development of Motorized Car Jack"; Journal of Applied Mechanical Engineering, Vol. 05, Issue 04, 2016.

[8] Mohanish Shah, and Sakshi Kokil Shah,"Design and Analysis of Puncture Assistant Device (PAD)", Indian Journal of Science and Technology,Vol9 (34), DOI:10.17485/ijst/2016/ v9i34/ 100880, September 2016.

[9] J. Ejsmont, J. Jackowski, W. Luty, G. Motrycz, P. Stryjek, and B. Ś. Zurek, "Analysis of rolling resistance of tires with run flat insert," Key Eng. Mater., 2014, doi: 10.4028/www.scientific.net/KEM.597.165.

[10] X. Jin, C. Hou, X. Fan, Y. Sun, J. Lv, and C. Lu, "Investigation on the static and dynamic behaviors of non-pneumatic tires with honeycomb spokes," Compos. Struct., 2018, doi: 10.1016/j.compstruct.2017.12.044.