Design and Fabrication of Manually Operated TOE - in Mechanism

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Abstract— Wheels are an important component of a motorcycle .Tires is a ring shaped component that covers the wheels rim to protect it and enable better vehicle performance. Maintaining them is very important. Tires of the motorcycle often get punctured, and we are left with some problems. To tackle these problems we have come up with a mechanism. In this mechanism we have provided additional wheels of comparatively smaller diameter and thickness. Whenever a tire punctures we are left with a flat tire, so in this situation our mechanism comes in effect. The motorcycle is put on a main stand with some clearance on the front end of the wheel. The two additional wheels come on the ground and support the vehicle in front. Now the front punctured tyre is above the ground. To move the vehicle power is supplied from the rear wheel thus driving the front supporting wheels.

Key words: TOE, Part Components of Airless Tire

I. ACKNOWLEDGEMENT

Keeping in view the increasing importance of automation in machineries, this project work done. This is giving a new direction for developing existing hand lay-up process method for manufacturing of corrugated fiberglass roofing sheet and other FRP products.We are indebted to many persons for their help and contributions during the preparation of this prototype. We are very thankful to our guide Prof. D.B. Meshram for his help in providing reviews, ideas and suggestion that improved our project work. Because of inspiring and guidance provided by him, the project work is reached up to success level.We also acknowledgement with gratitude Dr. S. V. Prayagi HOD Mechanical Engineering Department, DBACER, Nagpur, for his constant support and encouragement throughout the course work.We are obliged to Dr. V. H. Tatwawadi Principal, DBACER, Nagpur, for his constant support in overcoming various different we faced during the course work.We would like to thanks our all professor for their guidance from time to time and inspiration at different stages of ourB.E. Studies.Weare grateful to the institution D.B.A.C.E.R. and R.T.M. Nagpur University for granting permission to us to undertake this project.

II. INTRODUCTION

In day to day life we come across many of the two wheels get punctured, in such a situation people carry the motorcycle with toe-in it directly by applying human efforts alone. In this case there are few choices in front of them, this leads to lots of loss of human efforts and time. So to handle this situation some substitute must be introduced. In this project we are trying to work on this problem and innovate a possible substitute. It is still vital to check tyre pressures regularly to ensure they are inflated to the manufacturers recommended pressure, and to also check the tires for damage. The chances of needing the run flat capabilities of the tire are much reduced if the tire is well maintained.

III. LITERATURE REVIEW

A. Impact of Tire Compliance Behavior to Vehicle Longitudinal Dynamics and Control (American Control Conference, 2007 ACC '07):

1) Abstract:

Empirical tire models, generally obtained through lab tests, are commonly used in vehicle dynamics and control analysis. Most of the empirical tire models describe the linear (or nonlinear) static tire behavior and overlook the tire compliance with one exception: the relaxation length tire (RLT) model inserts first order tire dynamics. However, the RLT model creates an undamped oscillation when describing the low-speed tire dynamics. This paper presents an improved longitudinal tire model that describes the tire compliance without exhibiting the undamped vibrations. By incorporating this improved tire model into a vehicle longitudinal model, the dominant flexible modes of the vehicle can be easily captured. The predictions from the improved vehicle model show that the often-ignored tire compliance can impact longitudinal ride comfort and vehicle control designs. Experiments were conducted on a passenger car as an example and the experimental data verified the model predictions.

B. A paper published in the year 2009, which is about the fatigue analysis of aluminum wheel rim by Liangmo Wang-Yufachen-Chenzhi Wang-Qingzheng Wang School of Mechanical Engineering, Nanjing University of Science & Technology, China:

1) Abstract:

To improve the quality of aluminum wheels, a new method for evaluating the fatigue life of aluminum wheels is proposed in that paper. The ABAQUS software was used to build the static load finite element model of aluminum wheels for rotary fatigue test. Using the method proposed in this paper, the wheel life cycle was improved to over 100000 and satisfied the design requirement. The result indicated that the proposed method of integrating finite element analysis and nominal stress method was a good and efficient method to predict the fatigue life of aluminum wheels.

In this paper, predicting the wheel fatigue life, the nominal stress method was integrated into the CAD/CAE technology to simulate the rotary fatigue test.

C. Static Analysis of Airless Tyre (Manibaalan, Balamurugan. S, Keshore, Dr. Joshi. C. Haran) 3rd Year, Mechanical Engineering, Amrita University, Coimbatore:

1) Abstract:

Airlesstyres or Non-pneumatic tyres is introduced with a replacement of poly- composite materials in place of air in a definite structure as in [1]. The construction and material study of these tyres is done by comparing it with pneumatic tyres. A brief structural study on spokes of airless tyres is done and is related with rolling resistance and fuel efficiency.

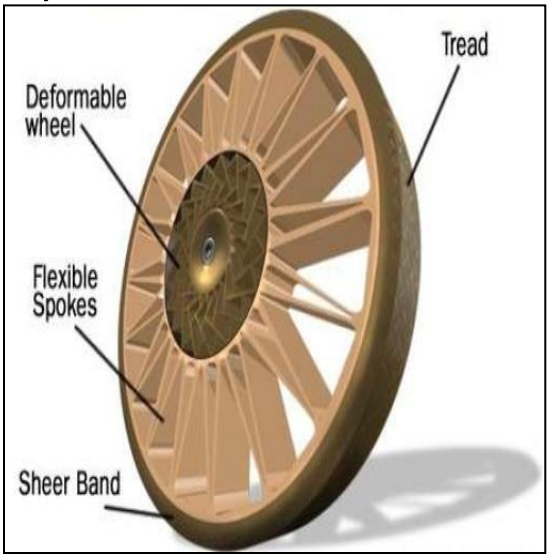

Fig. 1: Part Components of Airless Tire

The first pneumatic tyres for bicycle by Dunlop have been dominant since 1888. Its market was stable due to the following four advantages over rigid wheel: (I) low energy loss on rough surfaces, (II) low vertical stiffness, (III) low contact pressure and (IV) low mass. But as study says they do have four compensating disadvantages: (I) the possibility of catastrophic damage – flat while driving, (II) the required maintenance for proper internal air pressure, (III) the complicated manufacturing process. In the next stage of development wire spokes in the tire material were added to increase the resilience property. Engineers, in the aspect of overcoming the disadvantages of pneumatic tires, invented non-pneumatic tires by replacing air column with elastomers or polygon flexible spokes.

Airless tires are similar to pneumatic tires in that they carry significant loads at large deformations but are quite different in that they carry these loads without the benefit of inflation pressure. Whereas all pneumatic tyres of a given size, inflated to a particular pressure.

IV. Working principle Before puncture wheel

Fig. 2: Mechanism before Puncture Wheel

Initially the two links carrying the wheel is fixed at the top portion of the chassis of the vehicle. This is the initial position of the mechanism when the mechanism is not in use. In other words it is the resting position of the mechanism

V. After puncture wheel

Fig. 3: Mechanism before Puncture Wheel

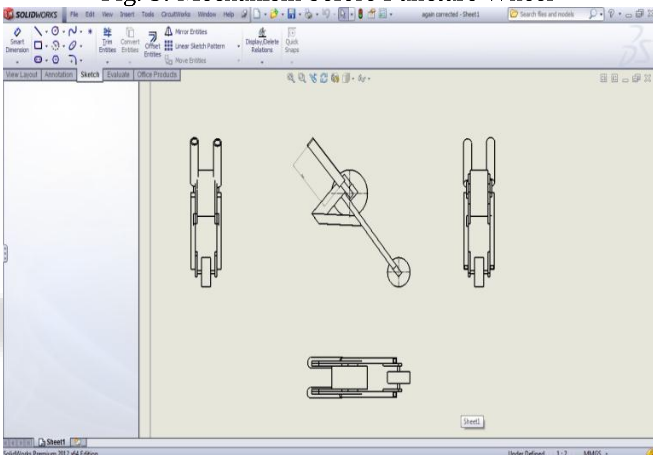

Fig. 4: Design of Mechanism

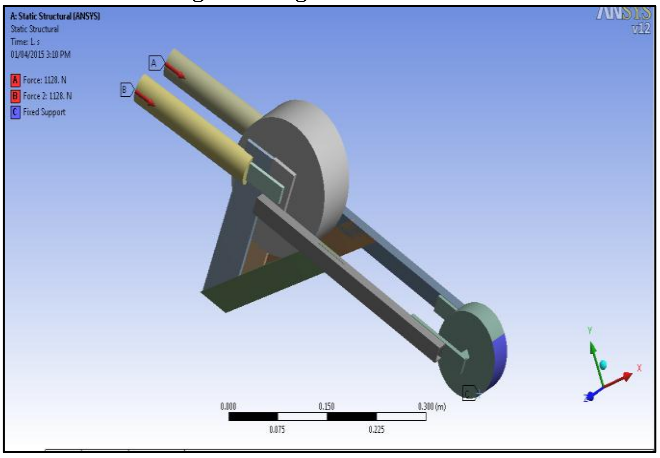

Fig. 5: Design of Actual Mechanism

When the front wheel of the vehicle gets punctured, the rider has no hectic work to do but to simply stand up his vehicle to main stand and simply release the nuts of the main push rod and initiate the mechanism by simply rotating the linkages to the lowermost position till it gets rotated up to the stopping plates. As soon as we reach that position we just need to tighten up the previous loose nuts. After this, the mechanism will do all the required work and all the rider needs to do is sit comfortably and ride the vehicle with ease and reach up to the tire repair center.

VI. Calculation

A. *Calculation without Mechanism:*

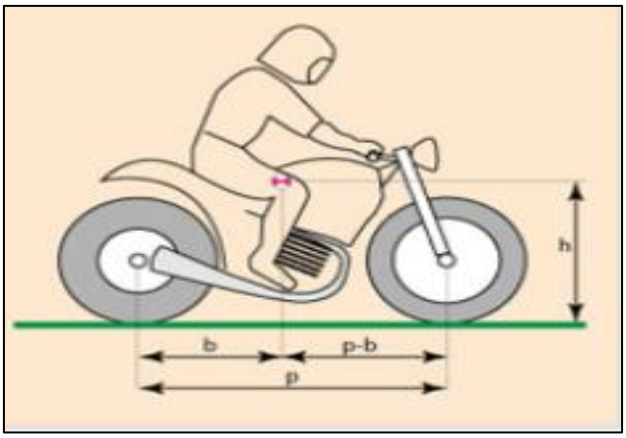

Fig. 6: Weight Carried Without Mechanism

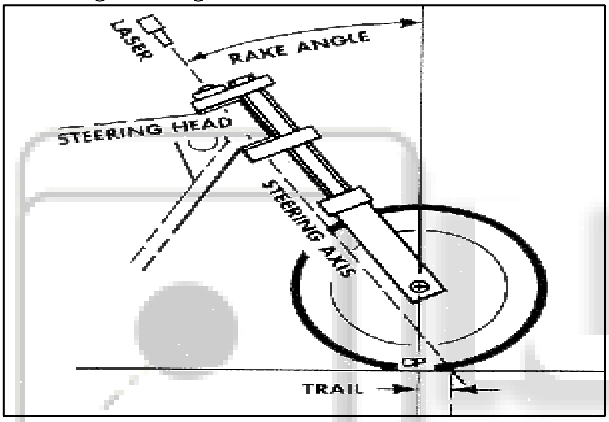

Fig. 7: Rake Angle and Trail

1) *Specifications and Calculations:*
   1) Weight of vehicle = 280 pounds
   2) p = Wheelbase = 45’’
   3) h = Distance between center of gravity and contact surface = 34’’
   4) b = Distance between center of rear wheel and center of gravity = 11’’
   5) Dividing ‘b’ by ‘p’, we get weight bias carried by the front tire (Wf)
      = 24.4%
   6) Weight bias carried by rear tire (Wr)
      =100- 24.4 = 75.56%
   7) Nf = weight carried by front tire
      = % of weight bias carried by front tire * weight of the vehicle
      =68.43 pounds
   8) Nr = weight carried by rear tire
      = % of weight bias carried by rear tire* weight of the vehicle
      = 211.56 pounds
   9) Trail (n) = 5’’
   10) Rake angle = 30 degrees

B. *Calculation with Mechanism:*

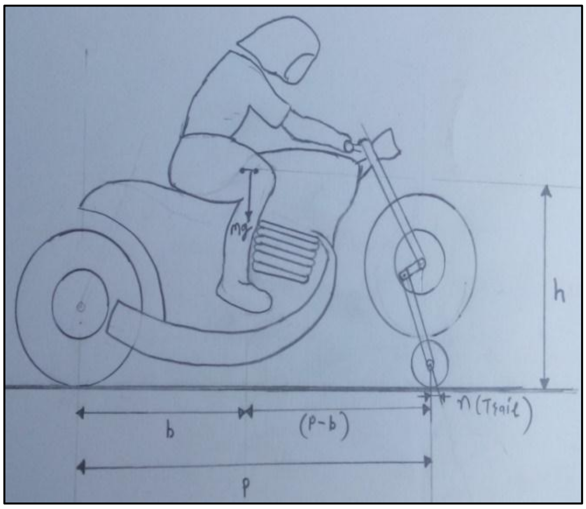

Fig. 8: Weight Carried With Mechanism

1) *Specifications and Calculations:*
   1) Weight of vehicle = 291 pounds(including mechanism mounted)
   2) p = Wheelbase = 49’’
   3) h = Distance between center of gravity and contact surface = 35’’
   4) b = Distance between center of rear wheel and center of gravity = 6’’
   5) Dividing ‘b’ by ‘p’, we get
      Weight bias carried by the front tire (Wf)
      = 12.24%
   6) Weight bias carried by rear tire (Wr)
      =100- 24.4 = 87.76%
   7) Nf = weight carried by front tire
      = % of weight bias carried by front tire * weight of the vehicle
      =35.61 pounds
   8) Nr = weight carried by rear tire
      = % of weight bias carried by rear tire* weight of the vehicle
      = 255.39 pounds
   9) Trail (n) = 7.5’’
   10) Rake angle = 40 degree

VII. Advantages

1) The biggest advantage of our concept is that anyone can toe the vehicle using our mechanism without depending on any other help.
2) With this concept introduced in two wheelers the human efforts can be reduced considerably
3) The loss of time will be less and problem will be solved quickly.

VIII. Future Scope

1) This concept of toe-in mechanism can also be implemented for the rear wheel of the vehicle.
2) Depending on the outcome of the results and the response from people using this mechanism, it can be designed for four wheelers as well.
3) With a positive response this mechanism can be implemented on a larger scale and can be provided by the manufacturers initially.

4) The solution to punctured wheels has a very vast scope of future research as this topic has not been further studied or researched previously.

IX. CONCLUSION

In the process of engineering, these mechanisms we faced create various problems Such as our initial attempts were not successful and therefore we had to try out different design that fit our vehicle best in terms of comfort and the stability of the person driving the vehicle.

After carrying out a total of three trials, we concluded that the third trial was best amongst the others and was must providing of desired standards of stability and comfort. The problem of vibration was eliminated and the comfort level was achieved to the accepted standards.

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