DESIGN AND STRUCTURAL ANALYSIS OF TIRE WITH AUTOMATIC PRESSURE MAINTAINING SYSTEM SETUP

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Abstract: It is realized that legitimate abuse of wheel tires are troublesome and it relies upon many affecting elements. Tire expansion pressure has a noteworthy significance on their anxiety conveyance. Tire strain impacts the size of the contact surface with the moving track. Low weight produces a misrepresented flexing of the tire remains, expanding the moving obstruction of the wheel. Too huge weight causes the diminishing of tire bond, sporadic and quicker wear, particularly for the driving wheels. For different soil conditions relying upon the tire pressure, distinctive soil pressure appropriations can be gotten. The paper presents an investigation a model of a wheel tire, by methods for the Finite Element Method. A model of the tire is created utilizing solid works programming.. The investigation was created for different tire pressures. The outcomes and ends got from the investigation are helpful to distinguish the need of any mechanical innovation to keep up vehicle tire Pressure. Thus, we additionally show the one handy arrangement, which fills the tire pressure naturally at whatever point the tire pressure diminishes from its ordinary worth. This additionally assists with actualizing wellbeing framework which occurs because of tire swelling pressure.

Index Terms - ansys, solidworks, tire, safety, automization.

I. Introduction

According to AAA (American Automobile Association), about 80 percent of the cars on the road are driving with one or more tires under-inflated. Tires lose air through normal driving, especially after hitting pot holes or curbs, permeation and seasonal changes in temperature. They can lose one or two psi each month in the winter and even more in the summer. And, it is not possible to tell if they're properly inflated just by looking at them. You have to use a tire-pressure gauge. Not only is under-inflation bad for your tires, but it's also bad for your fuel mileage, affects the way your car handles and is generally unsafe.When tires are under-inflated, the tread wears more quickly. According to Goodyear, this equates to 15 percent fewer miles you can drive on them for every 20 percent that they're underinflated. Underinflated tires also overheat more quickly than properly inflated tires which cause more tire damage. The faded areas below indicate areas of excessive tread wear.

Since tires are adaptable, they straighten at the base when they roll. This contact fix bounce back to its unique shape once it is no longer in contact with the ground. This bounce back makes a rush of movement alongside some contact. When there is less air in the tire, that wave is bigger and the contact made is more prominent and grinding makes heat.

II. Effect of tire rolling resistance with pressure

Tire rolling resistance decreases with increase in pressure on level road surface as other parameters are kept constant. As the pressure increases, the tire holds its shape more firmly and vertical deflection decreases. Thus the deformation of rubber is lesser compared to that in a tire with lower pressure. Hence the hysteresis losses reduce thereby decreasing rolling resistance in case of level road surface which is reflected in the figure above. In case of deformable surfaces, deformation of other contact surface which is the ground is taken into consideration for overall deformation. As inflation pressure reduces, there is a lot of bending and shearing of tire sidewall and tread region, which amounts to losses in the rubber resulting in an increase in rolling resistance.

III. Motivation behind STUDY

As we are aware that maintenance of correct tire pressure is extremely important for the enhancement of tire life. Due to drop in the pressure the tire goes underinflated and reduces fuel economy, quickest tire wear, not proper rolling, discomfort ride etc. So to solve out all these problems we make an automatic tire inflation system, which will properly inflate the tire all the times.

IV. Problem Statement

The point of the venture is to explore the impact of inward tire pressure on tire grating. The decrease of impact speed and thusly a further decrease in the seriousness of a mishap and coming about wounds is one potential result. Expanded proficiency in street vehicle is an interest in the present society in the perspective on rising fuel cost and emanation guideline. A significant hotspot for misfortunes in street vehicles is tire moving obstruction. In that case tire inside pressure assumes a noteworthy job in moving resistance.So dependent on study If the inward can be keep up properly, then misfortunes can be decreased.

1.1 Objective

-To design and analyze the tire deformation with the change in pressure.

-To increase Safety of vehicles: Properly inflated tires increase car stability and reduce the danger of blowouts. They also ensure a car's proper braking distance and overall vehicle handling and maneuverability.

-To improving Fuel efficiency: Correct tire pressure leads to lower rolling resistance, significantly improving fuel efficiency.

-To increase tire longevity: Proper inflation considerably improves a tire's lifespan.

-To provide Convenience: Drivers have confidence in knowing that their tires always operate at optimal air pressure. Elimination of tires inflating at fuel stations, for an obviously easier and cleaner solution.

1.2 Data and Sources of Data

For this investigation auxiliary information has been gathered from the different research papers. All the literature that we have studied so far is applied different methodology. In some of the papers the tire is designed by different software and analysis is done for more than two model. In all the cases they perform the analysis at flat road surface. Such researches also take other parameter into consideration, while some researches also take different pressure values for front and rear. All the literature collects data from software and compare to one other materials and provide the conclusion for their work.

1.3 Tire Deformation: A Virtual Approach

Here In our Project we are adjusting Visual Approach as it has a larger number of focal points than test approach. So in the initial step of philosophy we chose to deal with FEA reenactment strategy. There are numerous suspicions in the work, for example, contact fix shape is thought to be immaculate square shape; tire material and track design are kept steady. Anyway cruiser tires or round profile tires are considered in the examination. Temperature is thought to be a consistent, consistent state parameter. While this may not be altogether evident, it has been found from writing that they are sensible approximations in the journey to start a comprehension. Because of restricted time and assets, a large portion of the tire data has been taken from different research papers and correspondingly, most constants utilized have been acquired thereof.

I. RESEARCH METHODOLOGY

Most importantly we make a 3d model in Solid works programming. The model is demonstrated as follows. Here we use Solid works parametric programming for demonstrating tire.

2.1 Model Development

Fig 1:3d Model

2.2 About Ansys Software

ANSYS 14.5 conveys creative, emotional reproduction innovation propels in each significant Physics discipline, alongside upgrades in figuring velocity and improvements to empowering advancements, for example, geometry taking care of, cross section and post-preparing

2.3 About Finite component examination

1) Finite component examination is a numerical procedure to deal with complex geometry, any material properties, any limit condition and any stacking condition.

2) Mathematical model of any geometric model depicts the conduct of geometry by differential condition and limit condition.

3) Mathematical model is separating the object of enthusiasm into limited number of components.

2.4 FEA Simulation-Case 1: In this case, we are taking tire pressure below to nominal value (16psi).The road surface is taken flat.

In below figure the model is imported to ansys and creates a mesh for simulation.

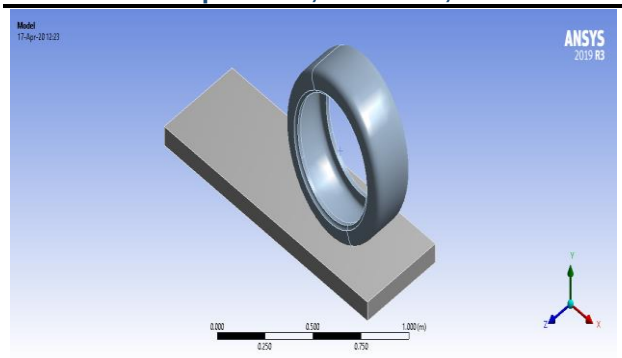

Fig 2:Importing Model

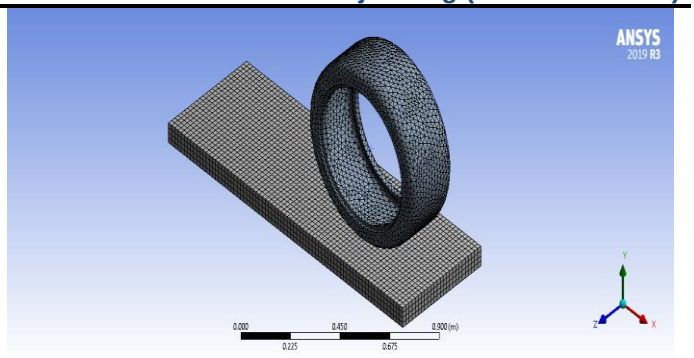

Fig 3:Meshing

II.FEA Simulation-Case 1: In this case, we are taking tire pressure below to nominal value (16psi).The road surface is taken flat.

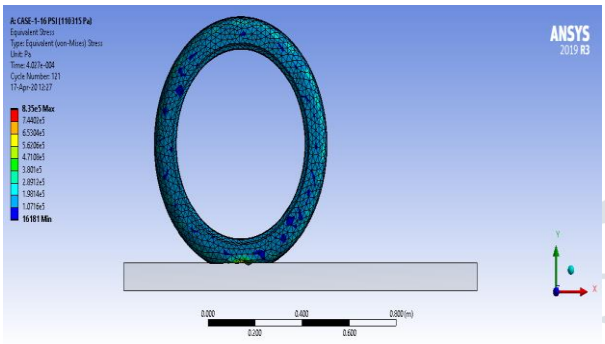

Fig 4:Equivalent Stress

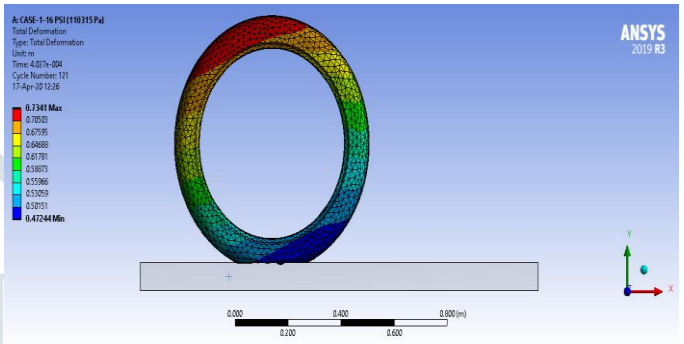

Fig 5:Total deformation

III.FEA Simulation-Case 1: In this case, we are taking tire pressure to nominal value (33psi).The road surface is taken flat

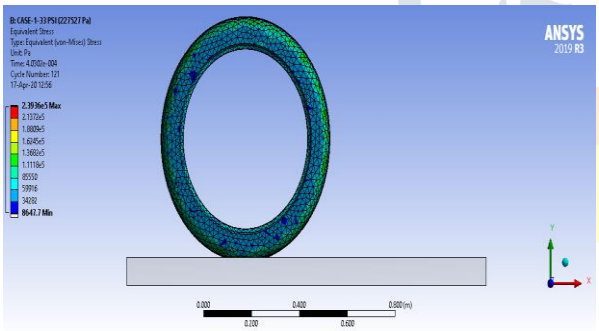

Fig 6:Equivalent Stress

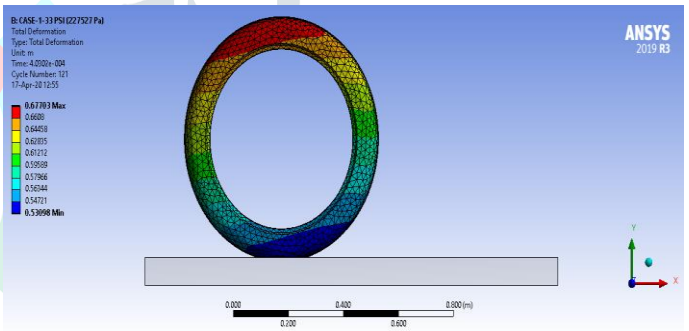

Fig 7:Total deformation

IV.FEA Simulation-Case 1: In this case,we are taking tire pressure above to nominal value (40psi).The road surface is taken flat.

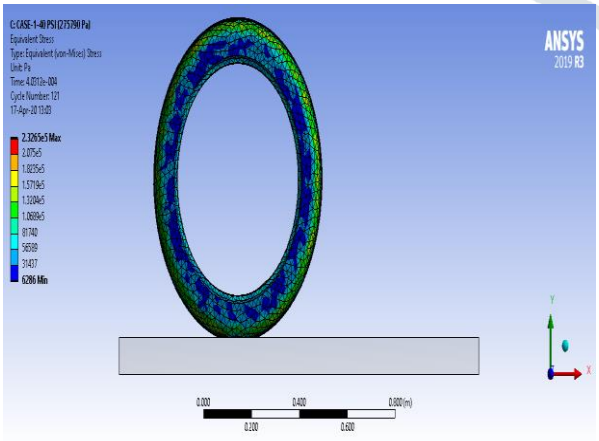

Fig 8:Equivalent Stress

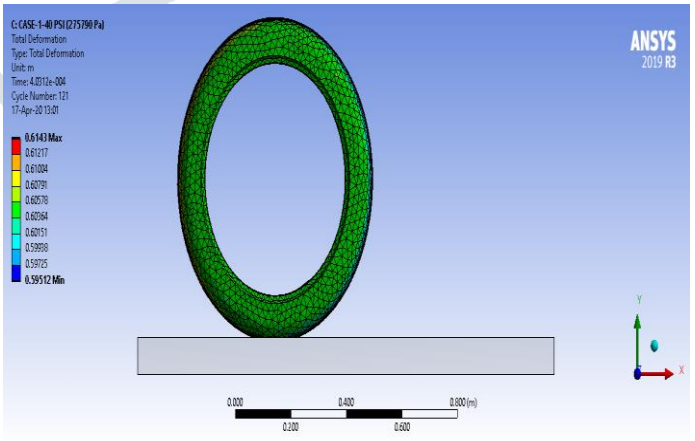

Fig 9:Total deformation

2.5 Need of Technological Advance safety system

As per above process, we take two more cases in which bump and step is added in flat road surface. And from that we get clearer results of tire deformation for three different pressure values. From analysis the effect of tire pressure changes the tire life which directly affects the fuel economy. The need of advance safety system arises from that point of view. So below is the setup for create electronics control system in which safety is prime importance. The setup, list of components, Principle is described below.

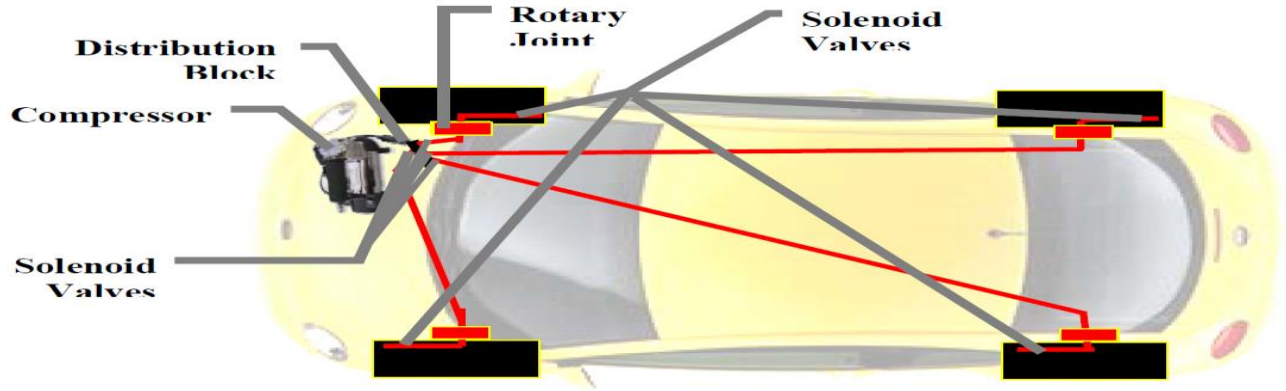

Fig 10: Tire Inflation System Configuration

2.6 Components:

1. Portable Compressor

12V Car Electric Air Compressor Tire Pump - Tire Inflator also for Bikes, Cycles, Boats, Inflatable Toys 100% Brand New 12V Air Compressor/Tire Infiltrator Simply use this for fast & easy inflation of car tires" No strength required for pumping air as it is all electronic & is powered directly from your car battery Perfect for anyone who wants a ease while inflating a tire Time saving as compared to mechanical pump .Quick operation, very Compact and easy to store in car dickey.

2. Solenoid Valves

2/2 air solenoid valves are direct acting solenoid valves and do not require a minimum operating differential pressure. As shown below when the coil is energized (right diagram), it lifts the solenoid plunger, which normally rests on the valve seat and lifts it to open the main valve orifice. When the coil is de-energized (right diagram), the spring force the plunger return to the valve seat to close the valve orifice.

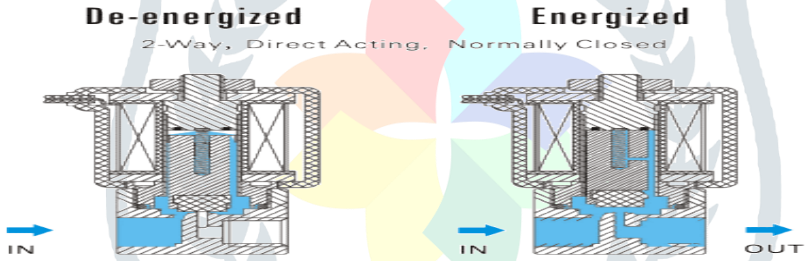

Fig 11: Soleniod Valve

3. Pressure Sensor

A pressure sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical. Pressure sensors are used for control and monitoring in thousands of everyday applications. Pressure sensors can also be used to indirectly measure other variables such as fluid/gas flow, speed, water level, and altitude. Pressure sensors can alternatively be called pressure transducers, pressure transmitters, pressure senders, pressure indicators and piezometers, manometers.

4. Rotary Joint

We are designing this device for common passenger vehicles, and the main challenge is the presence of the axle shaft that runs straight into the centre of the wheel forcing us to find an alternative method of routing the air. Our proposed solution to this challenge is to place rotary joint that has one half spinning with the drive axle hub and the other half stationary with the spindle. Within this rotary joint will be an air chamber that will allow air to pass from the stationary half of the joint into the half that is rotating.

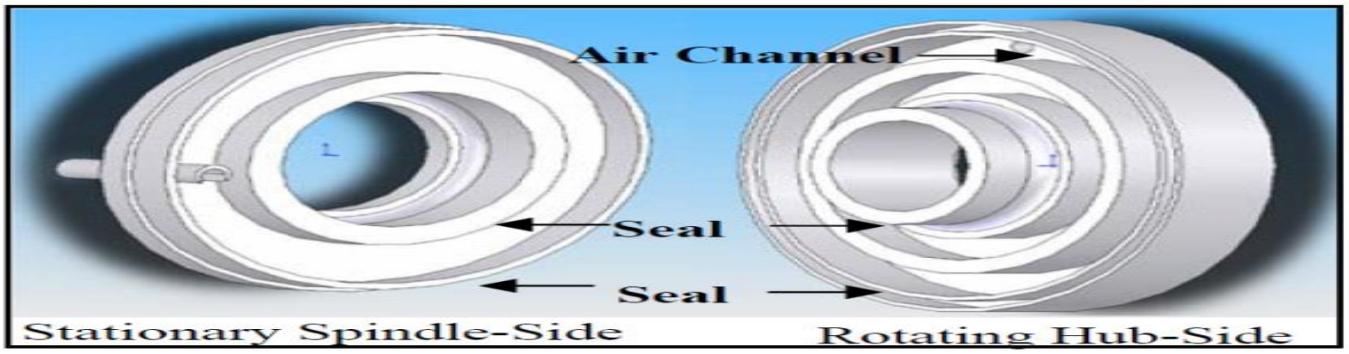

Fig 12: Rotary Joint

5. Pressure Switch

A pressure switch is a form of switch that makes electrical contact when a certain set pressure has been reached on its input. This is used to provide on/off switching from a pneumatic or hydraulic source. The switch may be designed to make contact either on pressure rise or on pressure fall.

6. Car Battery 12 V

Fig 13 Battery

An automotive battery is a type of rechargeable battery that supplies electric energy to an automobile. Usually this refers to an SLI battery (starting, lighting, ignition) to power the starter motor, the lights, and the ignition system of a vehicle's engine.

IV. RESULTS AND DISCUSSION

4.1 Results of two different materials

Table 4.1: Stress values for different pressure and for different cases

Case/Pressure	16 PSI	33 PSI	40 PSI
Case-1	8.35e5	2.3936e5	2.3265e5
Case-2	3.0544e6	3.365e6	4.3039e6
Case-3	1.6303e6	1.2053e6	1.8929e6

Table 4.2: Deformation values for different pressure and for different cases

Case/Pressure	16 PSI	33 PSI	40 PSI
Case-1	0.7341	0.67703	0.6143
Case-2	0.11236	0.098347	0.083849
Case-3	0.064185	0.048822	0.033882

4.2 Conclusion

From Above all tables and graphs, we can see that when the tire pressure is at 16psi, then the stress values is 8.35e+5Pa.When we increase tire Pressure, the stress value reduces to 2.35e+5. Same from deformation table when tire pressure is at 16psi, the value of deformation is 0.7341m. When we increase tire pressure, the deformation value decreases to 0.67703 m.We analyze the same tire at different road condition. From all the results, we can conclude that the nominal value for tire pressure is 33psi.To maintain this pressure in emergency condition we built automatic tire pressure filling system in which each and every tire is properly inflated to the proper tire pressure throughout the journey and it also improves tire life, reduces tire wear, increases fuel efficiency and also increases the overall safety of the vehicle, it also monitors the tire pressure constantly, provide us the proper inflation and deflation of the tire, and helps in providing a comfortable ride with better mileage.

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