International Journal of Innovative Studies in Sciences and Engineering Technology
ISSN 2455-4863 | Open Access | Volume 7, Issue 2, 2021
DOI: https://doi.org/10.20431/2455-4863.070203

Study and Development of A Safety Valve to Relief The Excess Pressure to Safe Guard for Tyre

S.S.Jadhav[1] , H.R.Kale[2] ,P.S.Gunjawate[3] ,P.D.Hajare[4] , S.P.Khade[5] ,P.V.Mali[6]

[1,2,3,4,5]U.G.Student, ADCET Ashta

[6]Research Supervisor, ADCET Ashta

ABSTRACT

Tyre blowouts are caused due to various reasons, but people do not pay any attention to the conditions of the tires. Maintaining the proper pressure limit within the tires is extremely important. If the pressure within the tires is low, the walls of the tires flex more, which may heat them up at high rate and cause them to blowout. Overfilled tires can burst due to the expansion of air that is caused by the heat generated when in motion.

Tyre burst is one of the major cause behind the accidents in India and abroad. Hence it is necessary to have an efficient safety device for the tires. The blowouts causes due high pressure built inside the tire while in use. In this project we have tried to develop a safety valve to relief the excess pressure to safe guard the tire, vehicle and the occupants in the vehicle, that is a mechanism similar to the one used in pressure cooker whistle. Our efforts are to develop a pressure relief valve and mount it on the tire, of all sorts from small vehicles to trucks. We have proposed the design for the valve and analysed its sustainability to the given pressure along with its working. As the life of every living being is important this should also help in preventing fatal accident.

Keywords: Tyre,Burst, Blowouts,Pressure,Whistle

INTRODUCTION

There isn't a doubt that a tyre blowout ranks the highest on any highway driver's list of fears. With good reason too, as a tyre burst could lead to a complete loss of car control. With SUVs & MUVs, there is the possibility of a flip-over too. A blowout is dangerous no matter how good a driver you are or how safe your car is. Start with maintaining a safe driving speed; there are just no two sides to this. The lower your speed, the higher your chance of survival. A blowout at 80 - 90 kph will be far less dramatic than one at 140 - 150 kph. Indeed, if you survive a tyre burst at 150 kph, consider it a gift of God. Don't abruptly take your foot off the accelerator. Do it slowly & gradually. In fact, Michelin recommends that you maintain accelerator input momentarily, before releasing it slowly. The deceleration force from a blown tyre is so strong that your car will anyway slow down rapidly. If you have engaged cruise control, be sure to disengage it immediately. Try your best to keep the vehicle pointed straight. Cornering or turning with a blown tyre will greatly upset the car's composure. If your car is pulling to one side, you might need to pull the steering in the opposite direction to keep it going straight. This is critical, else you risk drifting into the road divider or worse still, the opposite lane. Tire burst is one among the first reasons behind the accidents in India and abroad. At a high speed, gaining back the control of a vehicle with tire burst is next to impossible tire bursts often leads to dangerous accidents and may cause massive accidents too and it not only affects the damaged vehicle but also the vehicles within its proximity. In India, there are many cases caused by tire blow-outs at high speeds.

Tire blowouts are caused due to various reasons, but people do not pay any attention to the conditions of the tires. Maintaining the proper pressure limit within the tires is extremely important. If the pressure within the tires is low, the walls of the tires flex more, which may heat them up at high rate and cause them to blowout. Overfilled tires can burst due to the expansion of air that is caused by the heat generated when in motion. It should be noted that one should always keepcheck on the condition of the tires. Signs of bad health are cut or bulges. It's always an honest idea to stay the minimum tread depth of 2mm, which is extremely important for the tires to take care of the grip and dissipate water during the rainy seasons. Tires are one among the foremost important safety aspects in a car, and one should never ever neglect it.

Design of mechanism to prevent tire bursting

Specification of proposed mechanism:-

- Function: Prevent tire bursting by using pressure relief valve
- Specification:

o Can be used on already manufactured vehicles. o Low cost

o Low weight o Can be adjusted for range of the pressure.

Design of mechanism

o Design of pressure relief valve. o Design of triggering mechanism.

o Design of spring. o Design of rim.

- Selection of materials, components.
- Analysis of mechanism.

o Analysis of mechanism. o Analysis of rims.

Design and Working

Design and Working

The primary condition for a design of our casing was about its inner diameter, inner diameter is such that it will fit the outer diameter of the Schrader valve. The casing contains all the components like Triggering component, plunger, and spring. So the length and width of the casing is such that it satisfies both the above conditions. The material used for the casing is stainless steel which is the best material for our working conditions. The casing contains threading at its inner surface, at the end where it will be mounted on the Schrader valve, the threading is the same as that of Schrader valve for the perfect fit. The casing comes with an inside partition which is specially provided for the plunger to be rested upon, which leads in partition of casing in two parts. The lower half contains triggering components and the upper half contains spring and the rubber plunger.

Design of triggering component

Triggering component plays a very crucial role in our system, Triggering component is part which will be in inner contact with the Schrader valve. This will push the inside elongated part of the Schrader valve which will result in release in air from the tire. The displacement of the triggering component can be adjusted via adjustment of the entire system.

Design of bolt

It is the most outer part of the mechanism. It has threads and is of rounded rectangular shape. It can be used to set the back pressure on the valve or we can say to increase the critical condition of the system. At the very first attempt it was like a regular bolt but as the release the pressure it has to be given a volume to get out hence it has formed a rounded rectangular shape. Then to decrease the weight the head of the bolt was removed and the final drawing was made. It is very similar to the part of the Schrader valve and can be adjusted similarly to set different critical conditions.

Design of springs

Materials for springs: The material for spring should have high fatigue strength, high ductility, high resilience and it should be creep resistant.

- 0.55% - 0.75 % carbon steel material for springs.
- Alloy steels such as chrome - vanadium and silicon manganese steels are used for better grade springs.
- Chrome steel, phosphorus bronze and Monel metal (nickel alloy) can also be used in special cases, to increase corrosion resistance and temperature resistance.
- Oil hardened and tempered spring steel wire.

D = wire diameter of spring = 1mm.

Di = inside diameter of spring (mm).

Do = outside diameter of spring (mm).

D = mean coil diameter (mm).

C = spring index.

K = Wahl factor.

τ = torque max.

T = torque.

k = stiffness.

N = number of coils.

δ = maximum deflection.

D = Di + Do/ 2

= 7 mm

C = D/d

= 7/1

=7

K = {(4*C-1) / (4*C-4)} + (0.615/C)

= 1.2128

τ = 0.3*Sut

= 528 N/mm2

G = 81370N/mm2

Considering the maximum pressure to be 45psi.

45psi = 0.310264N/mm

P = F/A

F =A*P

= (0.310264*3.14*7*7)/4

= 11.9419 F≅12N

T= (K*8*F*D) / (3.14*d*d)

= 259.38N/mm2 < τ

Now,

k = F/δ

Assuming maximum deflection to be 4mm.

k = 12/4

= 3 N/mm

Number of coils

N = (G*d*d*d*d) / (8DDk)

= 9.8 ≅10

Design of rim:

After the mechanism was decided the first thing was to cut down the excess weight and keep it minimum on the weight side to avoid the imbalance in wheel. As going deeper in the wheel balancing technique it surfaced that even slightest change in the weight of wheel it can get imbalance. The talk was about balancing, to balance out the weight it should have similar weight at right opposite part of rim or to remove some of rims weight at close proximity of the valve in direction parallel to the wheel axis. So we have worked on both the solutions proposed about the rim and hence one can use the mechanism on any vehicle regardless of making mush difference in the wheel of the vehicle.

CONCLUSION

Allow the vehicle to gradually coast to a stop. Use engine braking if necessary. Lightly engage the brakes only when your car has decelerated to a slow speed. Use the turn indicators and pull over safely off the road. Drive on the bare metal wheel if you have to, but do NOT stop in the middle of the road as you run the risk of getting rear-ended by a speeding car. Remember to activate your hazard lights when stopped. The structural analysis of the mechanism and the results, the mechanism can be used for reliving pressure from the tire and can be mounted on the Schrader valve without making drastic changes in the wheel of the vehicle. We also conclude that the wheel can sustain the both changes discussed in the above work.

REFERENCES

1. Tire burst phenomenon and rupture of a typical truck tire bead design', L. Michel, A. Vadean, and R. Benoit.
2. Causes of Tire failure on Road Traffic Accident: A case study of Takoradi Township', Isaac Edunyah.
3. Design of Machine Elements', V.B. Bhandari, Tata McGraw-Hill, Third Edition.
4. Firestone Tire Failure Analysis', Dr. Sanjay Govindjee.
5. The Pneumatic Tire', Chapter 5: Tire Load Capacity by S. M. Padula
6. Sizing and Selection of Pressure Relief Safety Valve', Palash Kumar Bhowmik
7. Modeling and Analysis of Wheel Rim Using Ansys', Naveen Kancheti, Atchi Reddy Vemula, Gopi Reddy Gudibandla, Hetesh Krishna P N V Bala Subramanyam
8. Design and Analysis of Automotive Wheel Rim by using ANSYS and MSC Fatigue

Citation: *S.S.Jadhav, H.R.Kale, P.S.Gunjawat, et.al. Study and Development of A Safety Valve to Relief The Excess Pressure to Safe Guard for Tyre. Int J of Innovative Studies in Sciences and Engineering Technology. 2021; 7(2): 10-13. DOI: https://doi.org/10.20431/2455-4863.070203.*