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Design and Development of Self Inflating Tyre

Mr.SahilBasene[1], Mr.ChetanBadaki[2], Mr.RahulPatil[3], Mr.SwapnilPawar[4], Dr.R.S.Hingole[5]

[1,] *Mechanical Engineering Department, Dr.D.Y.Patil College Of Engineering, Akurdi, Pune*

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ABSTRACT: Tire is the most essential part of automobile and it plays crucial role in ensuring safe driving. Even then,almost every automobile on the road run with either one or more under inflated tires. Detailed survey hascome with result that drop-in tire pressure by just few psi leads to the reduction in gas mileage, tire life, safedrivingandvehicleperformance.Unawarenessofe xactpressurerequirement,suddenenvironmentalchang es are also some of causes for tire running with improper pressure. Automatic tire pressure controllingand self-inflating system ensures correct pressure in the tire all the time. Drop in pressure is detected byhissing sound made by tire and system will starts refilling the tire automatically according to the requirementof thetire. Thissystemisnamed automatic because it checksthe tirepressure constantlyusing pressuregauge and accordingly gives alert signals to the driver. Aim of this project is to stabilize all automobile tireswith ideal pressure, make system absolutely automatic, achieve satisfactory fuel efficiency, construct anaffordable system, increase tire life and reduce accident rate has been achieved by installing the system invehicle.

KEYWORDS:Automaticcontrol,safedriving,self-inflatingsystem,tirepressure,vehicleetc.

I. INTRODUCTION

A variety of tire monitoring strategies have been proposed to aware driver of low tire pressure. Under inflatedtires run on the road due to unawareness of the fact that properly inflated tires can safe tire life up to 20% whichis nine months more of its life span. It can also save fuel from 4% to 10%, increase braking efficiency up to 20%,and ease the self-steer. The research finding shows that the air pressure in the car drops 10 to 20 kpa a monthwhich is equivalent of adding a 70kg person into the car. Inflating accurate tire pressure save the tire from extraheating, explosion and also help decrease maintenancecost,asshown in Fig.1[1].

Compressor is used in this system to collect the air from atmosphere, compress it and deliver to the tire forinflation. Under inflated tires tend to wear at the edges more than at the center as the pressure is not sufficient atthe center to bear the load. As against this for over inflated tires wear is higher at the center due to bulging of tires. Wearing of the threads causes the skidding of the tire hence leads to major danger accidents. All of related studies shows that under inflation from axle tires result in under steer tendencies while rear axle under inflation creates over steer behavior hence disturbing the car handling. This system is addressed to be automatic as it automatically checks the tire pressure by using pressure gauge and if tire pressure is decreased below ideal condition than the compressor starts to supply the air to refill the tire. It also predicts about the puncture when there is continuous reduction of its set optimal value. The advantage of the system is that it does not require any special attention from user side once after the system being installed. It discards the requirement of checking tire pressure manually, thus saving time and labor. With the recent oil price hikes and ever increasing environmental issues, the system addresses a potential development in a gas mileage, tire wear reduction, and an improvementin handling and tire performance in adverse condition. This kind of systems are all- ready being installed inmilitary vehicles and commercial cars for safety purpose and to feel the luxury driving but this system is beingintroduced for all types of customer vehicles with the absolute motive to give safety assurance andcomfortdriving.Nowwiththeinstallationofthissyst emonecandrivevehicleunderallworstsuddenvaryinge nvironmental conditions like heavy rainfall, snowfall, deserts. Specially at remote places this kind of systemproves to be most helpful as repairing devices for maintenance of the automobile are very

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critically available .Atsome crucial times like war conditions or any flood condition there is no time to refill the tire with air henceAutomatic tire controlling and self- inflating tire system is very essential to be encouraged to install in everyautomobileto facealltire relatedissuesand enjoysafeand comfortdriving[5].

[4].This paper presents the design of Camless Internal Combustion (IC) Engine using the Magnetic platter Disk Sensor instead of conventional mechanism for operating valves. In this work an attempt has been made to integrate the concepts of mechanical and electronics for designing economical, low emission, high performance Camless engine. Objective of this work is to make use of Disk Sensor for developing Camless IC Engine.

[5].The idle speed control problem of a spark-ignited engine equipped with a camlessvalvetrain is considered.

The camlessvalvetrain allows control of the individual intake and exhaust valves of each cylinder and can beused to achieve unthrottled operation, and consequently, optimize the engine performance. We formulatethe speed control problem for this engine and show that it exhibits unstable open-loop behaviour withasigni"cant delay in the feedback loop. The instability is intrinsic to the unthrottled operation and speci"cto the camless actuation used to achieve the unthrottled operation. The delay is caused by the discretecombustion process and the sensor/computer/actuator interface. We demonstrate the inherent systemlimitations associated with the unstable dynamics and the delay and provide insight on the structural (plant)design that can alleviate these limitations. Finally, stabilizing controllers using classical and modern robustdesign techniques are presented and tested on a nonlinear simulation model. Copyright_2001 John Wiley& Sons, Ltd.

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II. LITERATURE REVIEW

Burase et al. surveyed on automobileair inflating system.In this research paper, a newapproach isencouraged for automobile a self-inflating tirethat guaranteesthattires will be properly inflated all thetime.The system uses portable compressor that will supply air to all four tires via hoses and a rotary joint fixedbetween the wheel spindle and wheel hub at each wheel. The rotary joints effectively allow air to be delivered tothe required under inflated tire. This system acknowledges a essential improvement in gas mileage, tire wearreduction,and an increasein handlingand tireperformanceindiverseconditions.[1]

S. Adakmol et al focused attention to the reasons due to which tires lose air and thus tried to develop theautomatic system so that vehicle run safely on road all the time without attaining the under inflating conditionever hence avoiding the accidents. Centralized compressor system is applied over in this paper system. Underinflated tires overheat very rapidly then a well inflated tire which damages the tires within very short time span.In this system as soon as tire pressure goes under inflated state then a pressure sensor senses it and send it to allthecontroller whichactivatesthesolenoid valveand airisfilled upto theexactpressure.[2]

Hemantsonihas studied for automatic tire inflation system and he introduced the centralized compressor-based system with the aim of improving gas mileage, tire life, car safety and working. Using this system air isdelivered to all four tires of the vehicle using hoses and a rotary joint constrained between the wheel spindle andwheel hub at every wheel. This is most beneficial project for society as the system automatically refills all thefour tireswhenever requiredunderallenvironmentaland roadconditions[3].

P. Omprakash et al. worked on the mechanism for air refilling system. The aim of this project was tointroduce a system that can be used in any type of tire either tube or tubeless. The system uses the permanentconnection between valve and hoses with only intention of providing tight connection during rotation of tire sothat it can be lose only when substituting the tire by the driver. Other intention expressed through this paper isthat the vehicle tire must never be either under inflated nor over inflated. Pressure in tires should be alwaysidealized level as under inflation leads to wearing of tire, consumption of excess fuel and over inflation causesexplosion of tires. This system also helps predict about the puncture in the tire when there is continuousreductioninpressureofitsset thresholdvalue.[4]

H. Soni et al. investigated the result of drop in tire pressure. Driven by their studies developed a compressortoobtainairfromatmosphere,compressit andsupplyittothetireforpressureregulation.Thesyste mautomatically examines the tire pressure using pressure gauge. If the tire is under inflated then the compressor.[5]

III. PROBLEM STATEMENT

To develop an automatic air filling system, this recognizes and fills air in respective tyre when its pressure goesbelow the desired/required pressure (under inflated condition). Underinflated tyres overheat more quickly thanproperly inflated tyres, which cause damage to tyres. To reduce this problem, we are designing this system. Assoon as a tyre Pressure goes under inflated, then a pressure sensor senses it and send it to the Controller whichactivatesthesolenoidvalveandair isfilled upto properinflation.

Objective

Maintainstherequiredtyrepressure:Thefunc tionofthesystemistomaintainandadjustthepressurein allthetyresofthesystem accordingtovaryingloading and drivingconditions

AnAutomaticSystem:Anautomaticsystemfurthersav eshumanenergy&timeinfillingtheairintyreswhen theyare in underinflatedconditions.

Builds aLow-costsystem:Theinstallationof suchasysteminvehiclesisalow-costaffair.

Improves fuel efficiency & tyre life: This system helps in less consumption of fuel and also improves tyre life by reducing chances of wear in tyre.

IV. METHODOLOGY

After referring several papers, we got many ideas. This system consists of centralized compressor, rotary joint, pressure sensor, electronic control circuit, battery, wheel and a motor to run that wheel. After getting ideas of different components needed, we will start making rough

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design and after that we will draw a 3-D model in Auto CAD. By referring this 3D model, we will buy the standard component required for the projects. After this we will start manufacturing work in workshop. Along with this electronics part will also be done. In electronics we will have to build controller circuit to get signal from pressure. After this, assembly of different components will be done. Later testing will be started for getting various results.

STEPS:Figure 2 refers to the steps involved.

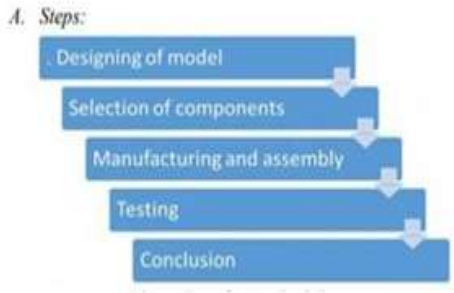

Fig.2.StepforMethodology.

System Design & Cad Model: The project work has been started with literature review as below. Afterreferringseveral papers, we got manyideas.From these ideas we starteddevelopinga typicalairinflationsystem asfollowsfigure 3& figure 4.

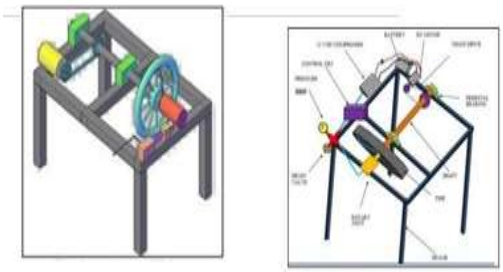

Fig.3.SystemDesign
Fig.4.CADModel

Integral Parts of the System:
Rotary Joint:

Rotary joint or a Rotary Union is a device that provides a seal between a stationary passage and a rotating part.Stationary passage may be a pipe or tubing; whereas rotating part can be a drum, spindle or a cylinder. Thus, itpermits the flow of the fluid into and/or out of the rotating part. Generally, the fluids that are used with therotaryjointsandrotatingunionsaresteam,water,the rmaloil,hydraulicfluidsetc.Arotaryunionwilllockont oan input valve while rotating to meet an outlet. During this time the liquid and/or gas will flow into the rotaryunion from its source and will be held within the device during its movement. This liquid and/or gas will leavethe union when the valve openings meet during rotation and more liquid and/or gas will flow into the unionagain forthenextrotation.Referfigure5.

Fig.5RotaryJoint.

PressureSensor:
A pressure sensor measures pressure of gases or liquids. It generates a signal as a function of the pressure imposed; in our system such signal is electrical. Pressure sensors can also be uses to measure other variables such as fluid/gas flow, speed and water level. Pressure sensors can alternatively be called pressure transducer, pressure transmitters, pressure senders, pressure indicators, piezometers and manometers among other names. Refer figure 6.

Compressor:
The system uses compressor to get the air from atmosphere & to compress it to a required pressure. A 12V DCcompressor has being used in our system. It is perfect for cars, bikes and inflators. It operates from the cigarettelightersocketofaDC-12V.Properdesignhasbeensetupforinstallinghoseand cord.Itisidealforinflatingall vehicle tires and other

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high-pressure inflatables. The following table shows the specification of our portablecompressor. Operating Pressure Range (psi) 0-80 psi Voltage Supply 12 V DC Weight 336-gram Dimensions10.8*4.7*9.5cm
Table1Specificationsofourportablecompressor.
Refer figure7.

Table1:Specificationsofourportablecompressor.

OperatingPressureRange(psi)	0-80psi
VoltageSupply	12VDC
Weight	336grams
Dimensions	10.8*4.7*9.5cm

Specifications:

Thespecificationsandmaterialusedformanufacturingofdifferentcomponentsareasfollows:

Table2:Specifications/Materialusedfordifferentcomponents

Sr.No	Description	Specification
1.	Compressor	80psi(5.516 bar)12VD.C.
2.	RotaryJoint	Size=1/2",Pressure=10kg/cm2
3.	PressureSensor	Pressurerange=0-100psi
4.	Bearing	RollerBearing,CarbonSteel
5.	ChainSprocket	No.ofteeth=18,Carbonsteel
6.	Shaft	CarbonSteel
7.	Frame	30"*20"*13",MildSteel
8.	Wheel	MopedVehicle(HondaActiva)
9.	Hoses	Polyvinylchloride(PVC)
10.	DC Motor	12VDC ,100rpm

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Calculation:
CompressorSelection:
Fortyrepressureof30psi Where,1psi=0.06895.

HOWTYRESSUPPORTSACAR

You may have wondered how a car tyre with 30 pounds per square inch (psi) of pressure can support a car. Thisis an interesting question, and it is related to several other issues, such as how much force it takes to push a tyredowntheroadand whytyresgethotwhenyou drive(and howthiscan leadto problems).

The next time you get in your car, take a close look at the tyres. You will notice that they are not really round.There is a flatspot onthe bottom where thetyre meetstheroad. This flatspot is calledthe contact patch.If you were looking up at a car through a glass road, you could measure the size of the contact patch. You couldalso make a pretty good estimate of the weight of your car, if you measured the area of the contact patches ofeach tyre, added them together and then multiplied the sum by the tyre pressure. Since there is a certain amountof pressure per square inch in the tyre, say 30 psi, then you need quite a few square inches of contact patch tocarry the weight of the car. If you add more weight or decrease the pressure, then you need even more squareinchesofcontact patch, sotheflatspot getsbigger.

You can see that the under inflated/overloaded tyre is less round than the properly inflated, properly loadedtyre. When the tyre is spinning, the contact patch must move around the tyre to stay in contact with the road. Atthe spot where the tyre meets the road, the rubber is bent out. It takes force to bend that tyre, and the more it hasto bend, the more force it takes. The tyre is not perfectly elastic, so when it returns to its original shape, it doesnot return all of the force that it took to bend it. Some of that force is converted to heat in the tyre by the frictionand work of bending all of the rubber and steel in the tyre. Since an under inflated or overloaded tyre needs tobendmore, ittakesmoreforce to pushitdowntheroad,so itgeneratesmoreheat.

Tyre manufacturers sometimes publish a coefficient of rolling friction (CRF) for their tyres. You can use thisnumber to calculate how much force it takes to push a tyre down the road. The CRF has nothing to do with howmuch traction thetyre has; it is used to calculate theamountof drag or rolling resistance caused by thetyres.The CRF is just like any other coefficient of rolling friction: The force required to overcome the friction is equaltotheCRFmultiplied bytheweightonthetyre.ThistableliststypicalCRFfors everaldifferenttypes ofwheels.

SAFETY & RELIABILITY

Since levitation of air bearing produces excellent suspension, earthquakes cannot produce any damage tocapsules. The supporting structures of tubes have foot print of size of telephone pole so they can sway in worstcase and again without any possible damage to capsule. Besides, statistically, it is known that most of accidentare caused by human factor but there is no human factor in hyperloop since everything is managed by computersystem soaccidentsarenexttoimpossible.

DEMERITS

- Thefrictioncreatedisgreater.
- Frictioncreatesheatandifenoughheatisgenerated therubberthatholdstheTyrecordsmeltsandTyretr ails.
- Asiteffectsmileageitcancauseseverelossintheco stconsiderations.

MERITS

- Safety: Properly inflated tires increase car stability and reduce the danger ofBlowouts.
- It also ensures a cars proper braking distance and overall vehicle handling and maneuverability.
- Fuel efficiency: Correct tire pressure leads to lower rolling resistance, significantlyimproving fuel efficiency.
- In United States alone, 1.24 Billion gallons of fuel per year can be saved by proper tire pressure.

V. FUTURE SCOPE

- Micheliniswor kingwithseveralothercompaniest odevelopanactivepressure-managementsystemcalled TIPM(TyreIntelligentPressureManagement).
  - This system has a compressor that automatically adjusts the pressure in each tyre while the vehicle isinoperationtocompensateforleaksandslow-leakpunctures.
- The driver will be able to adjust the pressure depending on the desired driving mode: comfort, sporty, all-terrainorover-obstacle.
- Thegoalistomaintainaspecificpressure.

VI. CONCLUSION

Self-inflatingtyreshelpustoattaincertainhelpfulcriterionssuchas: -

- Itprovidessafedriving.Improvefuelefficiency.
- Tocontroltyrepressure accordingtodrivingconditions.
- Automatic centralized compressor self-inflating tyre system ensures that all tyres are always properlyinflated and thus improves the tyre life, safety, reduction of gas mileage and vehicle performance by supplyingair to all tyres via hoses and a rotary joint fixed between wheel spindleand wheel hub at each wheel wheneverthere isapressuredropinside the tyre.

REFERENCES

[1]. I.Burase,S.Kamble,A.PatilandA.Kharat."ASurveyonAutomaticAirInflatingSystemforAutomobile". International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5(10),2016,ISSN:2319-8753.

[2]. S. Adakmol, T. Shende, D. Poriya, S. Fotedar and S.P. Shinde. "Central Tyre Air Inflation System" IJSRD - InternationalJournalforScientificResearch& Development|Vol. 4(3),2016,ISSN:2321-0613.

[3]. K. Vishnuram, R. Dinesh, S. Krishna, D. Kumar and T. Chazhiyan." Self-Inflating Tyres" InternationalJournalonApplicationsinMechanicalandProductionEngineering,Vol.1(5),2015, pp5-6,ISSN:2395-3500.