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NON PNEUMATIC TYRE

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ABSTRACT

Every person has driven car. The most important part on car is tyre. In olden days firstly wheel are made up of wood or stone later it was developed in to tube (rubber tyre) and tube less tyre. Such tyre are tested on bicycle and the applied on various vehicle. But both have problems of puncture, tube tyre get quickly puncture where tubeless tyre take some time for air leakage. But what if the tyre doesn't get puncture? In recent years a number of companies and inventors have been working on creating airless tires that would be impossible to puncture. Non pneumatic tyre are the tyres which does not supported by air i.e. they are airless. The most well known design in this field is the Michelin Tweel, a combination wheel and tyre. But which tyre are better air or airless?

KEYWORDS: Pneumatic tyre, Non pneumatic tyre, Michelin Tweel.

I. INTRODUCTION

A tyre is most important part of any vehicle. Tyre is a rubber member which provides cushioning effect as well as provides clearance to vehicle. The rubber member is mounted on wheel rim. In tube tyre, tube is present inside the tyre while in tubeless tyre there is no tube. A tire is a ring shaped component that was mounted on a wheel's rim to transfer the vehicle's load from the axle. Tyre which is used in automobile, bicycle, motorcycle is pneumatically inflated structures which provide a good rolling, cushioning effect.

Such tyre is using numbers of year and they are developing. Some companies are trying to develop tyre which are airless that means they are non pneumatic. Michelin and Bridgestone are the tyre which are firstly design, they are non pneumatic. So begins an article discussing the development of air less tires, something that has become more prevalent in the past few years. Honeycomb tyre are also a typr of non pneumatic tyre.

II. MATERIALS

A. Material For Pneumatic

The materials of modern pneumatic tires can be divided into two groups, the cords that make up the ply and the elastomer which encases them.

(i) Cords:- The cords, which form the ply and bead and provide the tensile strength necessary to contain the inflation pressure, can be composed of steel, natural fibers such as cotton or silk or synthetic fibers such as nylon or kevlar**.**

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(ii) Elastomer:- The elastomer, which forms the tread and encases the cords to protect them from abrasion and hold them in place, is a key component of pneumatic tire design. It can be composed of various composites of rubber material the most common being styrene-butadiene copolymer with other chemical compound such as silica and carbon black.

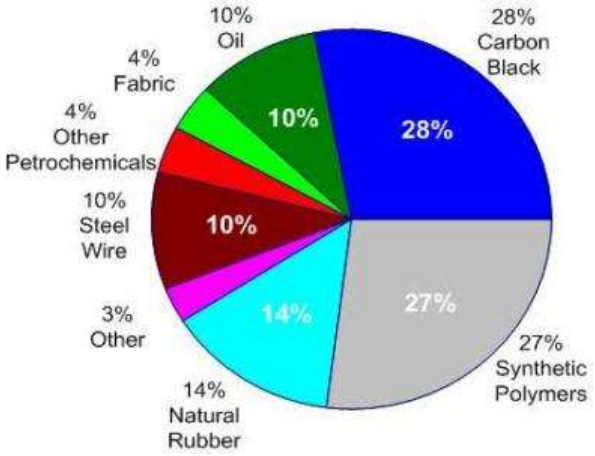

Fig:-Material Of Pneumatic tyre

The material for tyre is synthetic rubber with 27%, natural rubber with 14%, fabric with 10% and wire with 10%, along with carbon black with 28% and other chemical compounds with 4%. They consist of a tread and a body. The tread provides traction while the body provides containment for a quantity of compressed air. Before rubber was developed, the first versions of tires were simply bands of metal fitted around wooden wheels to prevent wear and tear.

B. Material For Non Pneumatic

The tyre consists of a band of conventional tyre rubber with molded tread, a shear beam just below the tread that creates a compliant contact patch, a series of energy absorbing polyurethane spoke. In short the hole tyre are made up of polyurethane which is a polymer which can sustain heavy shock and can with stand over it.

III. PNEUMATIC TYRE

Fig:-Pneumatic Tyre

Pneumatic or air filled tyre is tyre which is made up of hard rubber and work on compressed air. A tread, usually reinforced with steel belting or other materials, covers this inner core and provides the contact area with the road. The pressure of the air inside the tyre is more than atmospheric air pressure, so the tyre remains inflated even with the weight of a vehicle resting on it. The tyre air pressure provides resistance against forces that try to deform the tyre, but it gives to a certain degree of cushioning effect as the tyre hits bumps in the road.

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There are generally two types of tyre:-
(i)Tube tyre
(ii)Tubeless Tyre

A. Tube Tyre

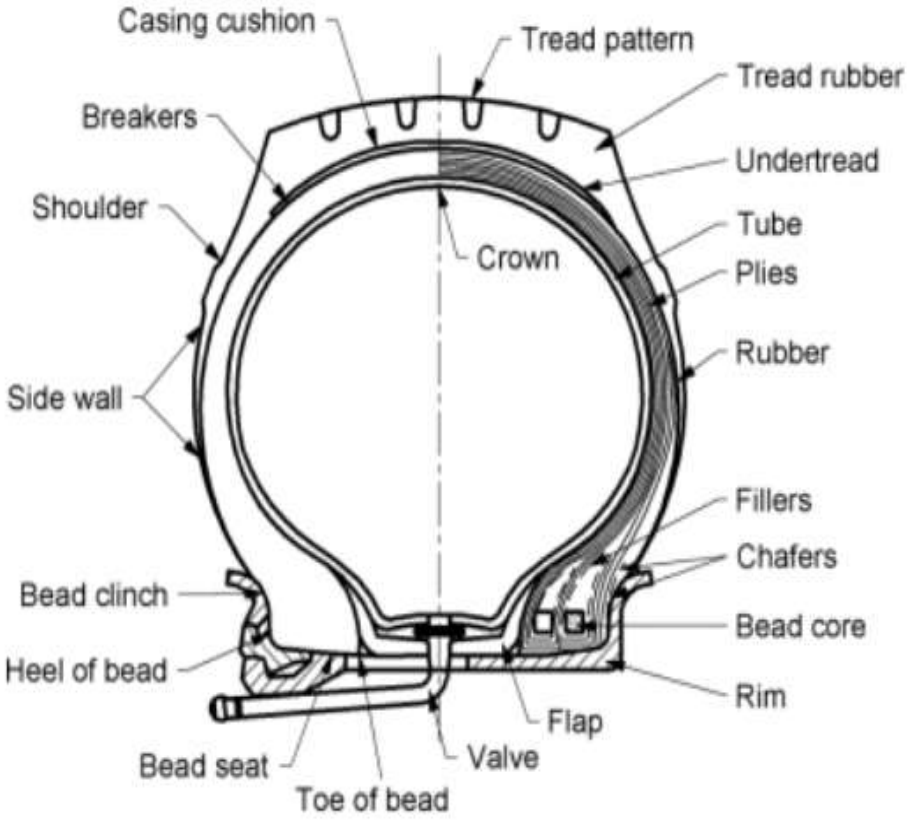

Fig:-Tube Tyre

It is a traditional tyre. It encloses a tube in which air is forced to a high pressure as a cushioning medium. The tyre is manufactured from different parts that are molded together to form a complete Structure.

The Parts of tyre are:-

A. Liner.
B. Tread layer.
C. Cord and piles.
D. Bead or rib.
E. Side wall.
F. Outer rubber covering

The liner and piles form together called as carcass or inner casing. The tire is manufactured by vulcanization process in which rubber is heated under pressure to obtained desired properties like load caring capacity, cushioning, uniform wear, balancing, none skidding, fuel or power consumption and Noise.

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B. Tubeless Tyre

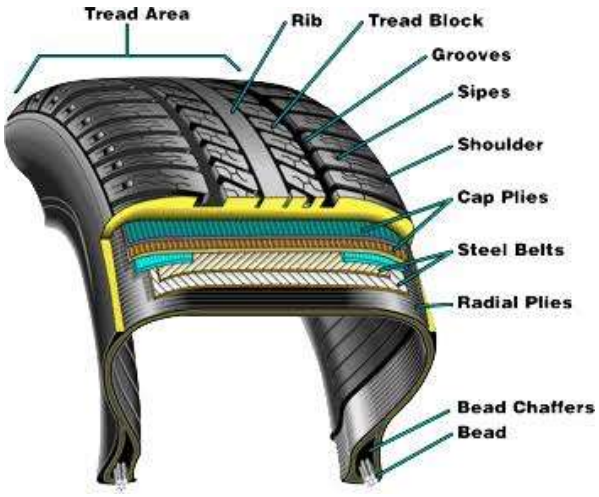

Fig:-Tubeless Tyre

Tubeless tyre is an advance version of tube tyre. The basic difference between tube and tubeless is that there is no presence of tube inside it. In this type of tyre there is a special air retaining bead arrangement. These tyres are directly mounted on the rim.

In this tyre the air is filled with the help of non returning valve which provide restriction to air to do not leave it from tube. The valve is mounted on rim. The bead is the air tight part which fit on the circumference of the wheel rim. It consists of bead cores made of number of strand of steel wire. Carcass is the main structural element that takes the load and consist of rubber bounded cords and beads.

Tread is the surface part that comes in contact with road surface made of synthetic rubber. Non return valve is an integral part which allows high pressure air in one way. The tubeless tyre is lighter and runs cooler than the tube tyre.

C. ADVANTAGE OF PNEUMATIC TYRE

1. Simple assembly.
2. Improve safety.
3. Puncture can easily repair.
4. Better cooling.
5. Lesser unstrung weight.
6. Longer tread life.
7. Lower rolling resistance.
8. More comfort.

D. Disadvantage of pneumatic Tyre

1. Heavier steering at low speed.
2. Uncomfortable ride at low speed.
3. Instability during cornering.

IV. NONPNEUMATIC TYRE

Non-pneumatic tyre (NPT), or Airless tyres, are tyre that is not supported by air pressure. Airless tyre generally have higher rolling friction and provide much less suspension than similarly shaped and sized pneumatic tyres. Other problems for airless tyre include dissipating the heat buildup that occurs when they are driven. Airless tyre is often filled with compressed polymers (plastic), rather than air. Resilient Technologies and Wisconsin-Madison's a company specializing in Polymer Engineering and design are creating a "non-pneumatic tyre" (no air required) which is basically a round polymeric honeycomb wrapped with a thick, black tread and that will support the weight of add on armor, survive an IED attack, and the tyres are expected to maintain a speed of 75 mph for 60 miles with 10% damage to the honey comb structure. Honeycomb structure is designed to support

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the load placed on the tyre, dissipate heat and offset some of these issues. The patent-pending design mimics the precise; six sided cell pattern found in a honeycomb and best duplicates the "ride feel" of pneumatic tyres, according to the developers. The goal was to reduce the variation in the stiffness of the tyre, to make it transmit loads uniformly and become more homogenous, and the best design, as nature gives it to us, is really the honeycomb.

V. CONSTRUCTION AND WORKING

Fig: - Construction of Michelin (airless) Tyre

The pneumatic tyre is made up of polymer which has high resistance to shock of road as well as have good elastic property. They are made up of tread, shear band, deformable wheel and flexible spoke. Thread is place on the upper side of wheel which provides good tensile strength and help to wheel to stay in position. Shear band is outer covering of the pneumatic tyre which transmits shock. Flexible spokes are attached to the shear band which is generally in triangular in shape. The shock from the shear band was get absorb by these spokes. The spokes are further attached to deformable wheel.

The wheel are attach to the vehicle. While the vehicle is in running various shock effects by the vehicle. As the shock get trapped the flexible spokes get bend and the shock get absorb. As the shock leave the spoke gets in their original shape.

VI. ADVANTAGES OF PNEUMATIC TYRE

1. No more air valves.
2. No more air compressors at Petrol Pumps.
3. No more flat tires in the middle of long drives.
4. The Tweel promises performance levels beyond those possible with conventional pneumatic technology.
5. Potential benefits of the Tweel include the obvious safety and convenience of never having flat tyres. Also, the concept has the potential for true performance gains.
6. The Tweel can also withstand a police 'stinger' spike strip, which would force law enforcement to adapt in order to catch a suspect in a vehicle equipped with Tweels.
7. It provides a comfortable ride and increases vehicle handling
8. Its flexibility provides an increase in surface area of contact thereby increases the grip with the ground.
9. It can take gun fires and spikes without becoming immobile.

VII. Disadvantages of non pneumatic tyre

1. The non-pneumatic tyre are expensive as compared to pneumatic tyres.
2. The replacement of any component in the non-pneumatic tyre is impossible i.e. Every time the tyre is worn-out we have to replace the whole assembly.
3. It can withstand police spikes which may make it difficult for law enforcement.
4. Lack of adjustability is one disadvantage of non-pneumatic tyres if once manufactured cannot be altered or adjusted.

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VIII. VEHICLE USING PNEUMATIC TYRE

There are a number of vehicles using non-pneumatic tyres. Some of them are below:

- Earth movers
- Wheelchairs
- NASA Lunar rover
- Military vehicles

1. EARTH MOVERS

Fig:- Earth Mover

The non-pneumatic tyres give high stability to the earth movers to climb in all terrains. It provides a much smoother ride than a pneumatic tyre due to its excellent shock absorption. Even if the vehicle is heavy it will no damage the running surface. The NPT are very resistant to cuts than the traditional tyres, so it last longer.

2. WHEELCHAIRS

Fig:- Wheel Chair

Non-pneumatic tyres are used in motor powered wheelchairs which can climb stairs. It was first introduced by a company called Michelin so that the suspension system in the wheelchairs can be eliminated.

3. NASA LUNAR ROVER

Fig:- Nasalunar Rover

It is a six legged robot designed by NASA for moon exploration. It has 6 legs, all of them contain NPT. It is able to roll or walk over large range of terrains.

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4. MILITARY VEHICLES

Fig:- Military Vehicles

American military vehicles such as Hummer, trucks, etc.Are using the non- pneumatic tyres. The main advantage of the military vehicles using this tyre is that it requires very little or no maintenance. It will still remain mobile even with some spokes damaged or missing. It passed the ballistic test i.e. it will remain mobile eve if it is hit by a bullet.

IX. COMPARISON BETWEEN PNEUMATIC AND NON PNEUMATIC TYRE

Sr.no.	Parameter	Pneumatic Tyre	Non pneumatic Tyre
1.	Life	Life of tyre is less.	Life of tyre is long as it was made of polymer.
2.	Efficiency	More efficiency about 80%	Less efficiency about 40%
3.	Cost	cheaper	High costlier.
4.	Air	Air is essintional factor	No need of air
5.	Air valve	Valve is needed	No need of valve
6.	Puncture	Occurred	No puncture occurred

X. CONCLUSION

Tyres are most important part of automobile. Tyre may seem to be a trivial part of an automobile that cannot be improved, but research into airless tyre can gives more efficiency as well as more rolling effect. This new technology will increase the safety of cars as well as have a positive impact environmentally. As this tyre are made up of high quality polymer, the cost of such tyres is high which cannot be affordable to people. But research into it can make it cheaper than pneumatic tyre. This innovative project is also backed and guided by engineering codes of ethics which will ensure that the development is conducted in a way that it responsible and fair. It is also important to think about the implications of a technology such as this. This type of innovation will become increasingly valuable in the future because of the advantages that this tyre has and the wide range of applications in which it can be used. So that in all cases non pneumatic tyre is more valuable and has more scope in future. Thus it concludes that non pneumatic tyre is more profitable in future than pneumatic tyre.

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