

Unit– 8

Suspension system

Understanding Suspension System

The vehicle's chassis is connected to the front and rear wheels by springs, shock absorbers, and axles. A Suspension system refers to all parts that work together to protect parts from shocks. Springs connect the automotive chassis to the axles in an indirect manner. It is done to protect the body of the vehicle from road shocks caused by bounce, pitch, roll, or sway. These road shocks make for a bumpy ride and put additional strain on the car's frame and body.

What is a suspension system?

A suspension system is a set of mechanical connections, springs, and dampers that connect the wheels to the chassis. It has traditionally performed two functions: managing the vehicle's handling and braking for safety, and keeping passengers comfortable from bumps, vibrations, and other factors. It is a mechanical system of springs or shock absorbers connecting the wheels and axles to the chassis of a wheeled vehicle.

It also aids in maintaining proper vehicle height and alignment. It also controls the vehicle's orientation and must keep the steering wheel perpendicular to the ground for maximum grip. The suspension also helps to safeguard the car and its contents from damage and wear. The front and rear suspensions of a car may be designed differently.

The suspension system of your car is in charge of smoothing out the ride and keeping the vehicle in control. To offer steering stability and good handling, the suspension system increases the friction between the tires and the road.

Functions

A suspension system in an automobile serves the following functions:

- Shock forces are reduced as much as possible
- Maintain the proper ride height of your car
- Maintain proper alignment of the wheels
- Serve as weight support for the vehicle
- Maintain tire contact with the road
- Controls the vehicle's travel direction.
- To eliminate transmission to car component road shocks.
- To maintain a solid grip on the road while driving, cornering, or braking.
- To maintain the correct steering geometry.
- To achieve a specific body structure and height.
- Torque and braking reflexes must be resisted.
- Maintaining vehicle stability while traveling over uneven terrain or turning in order to reduce the tendency for rolling, pitching, or vertical movement.
- To protect passengers from road shocks and give a comfortable ride.
- To reduce the strains caused by road shocks on the motor vehicle's mechanism and offer a cushioning effect.
- While traveling over tough, uneven terrain, keep the body absolutely level. The up and down movements of the wheels should be proportional to the movement of the body.
- To protect the vehicle's structure from stress loading and vibration caused by road surface irregularities while maintaining its stability.
- To achieve the necessary height for body structure.
- To retain the right geometrical relationship between the body and the wheels, the body must be supported on the axles.

Components of a suspension system

Suspension systems have the following components:

Knuckle or Upright:

It is the component of the suspension system that is installed over the wheel's hub and connects the wheels and the vehicle's suspension through the linkages provided. A knuckle is equipped with a king-pin and caster angles that assist the vehicle's front wheels in steering right or left, hence steering the vehicle. The hub of the wheel revolves around the rotation of the wheels, and the knuckle provides housing for the center bearing.

Linkages:

The rigid connections utilized in a suspension system to connect the mainframe of the vehicle with the knuckle of the wheels using mechanical fasteners are known as links. Wishbones or A-arm, Solid axle or live axle, and Multiple links are the types of suspension that use linkages.

Shock absorbers or Springs:

They are the flexible mechanical components that are put between the linkages (wishbone) to absorb the shock caused by the road condition. Solid axle, multi-links) and the mainframe is designed to reduce road shock before it reaches the vehicle's mainframe. Out of the various types, spring and damper shock absorber, leaf spring, and air spring are the common types.

Components of a suspension system can be summarized as follows:

- The shocks from the road surface are neutralized by the use of springs.
- Dampers, also known as shock absorbers, are used to reduce the free oscillation of springs and so increase riding comfort.
- The purpose of a stabilizer, also known as a sway bar or anti-roll bar, is to keep the car from swaying to the side.
- The longitudinal and lateral movements of wheels are controlled by a linkage system that holds the above components.

Unit– 9

Wheels and tyres

The **wheels and tyres** have to take the cushioning effect and the vehicle load so that they can cope up with the steering control.

What is a Wheel?

A wheel is a circular object having a rim and a hub as the major parts revolve around an axle to enable it to move easily over the ground.

Types of Wheels:

There are 5 types of wheels, those are as follows:

1. **Pressed Steel Disc Wheel**
2. **Wire Wheel**
3. **Light Alloy Wheel**
4. **Divided Rims Wheel**
5. **Split Rims**

What is Tyre?

A tyre is a cushion provided within the wheel of an automobile.

Functions of Tyre:

- **To support the load of the vehicle.**
- **To transmit the braking and driving forces to the road.**
- **For smooth steering, cornering power is provided.**

Properties of Tyre:

The properties of tyre are as follows.

Cushioning Effect:

The tyre should be in a position to absorb the vibrations set up by the uneven road surface by providing cushioning effect to make the ride smoother.

Non-skidding:

This is one of the important property of the tyre which makes the vehicle not to skid even on the wet road and this can be possible by designing a proper tread pattern on the tyre.

Load carrying ability:

When the vehicle is running on uneven or even roads, the tyres experience alternating stresses during the each revolution of the wheel. The design and the material of the tyre must be good enough to sustain the load properly.

Uniform wear:

The non-skidding property is maintained by the uniform distribution of wear on each wheel. To achieve this, the ribbed tread patterns will be used.

Parts of Tyre:

The parts of a tyre are as follows.

- Tire belts
- Tire Tread
- Tire sidewall
- Tire shoulder
- Tire grooves
- Tire bead
- Tire plies

Types of Tyre:

In general tyres are classified into two categories, those are:

1. **Conventional Tubed Tyre**
2. **Tubeless Tyre**

1. Conventional Tubed Tyre:

As the name indicates that it has a tube within the tyre and rim assembly.

It generally consists of the following parts:

- **Rim**
- **Tube**
- **Tyre**

Rim:

It is the steel material which is used to hold the tube and the tyre on it so that it can withstand the load of the vehicle. It has a hole on its circumference to allow the tube valve through it.

Tube:

It is the material made of rubber and it consists of a valve which is pressurized by means of air so that it can bulge according to the need and can fit into the tyre properly.

It has the disadvantage that, whenever there is a puncture then the air will be lost suddenly from the tube, tyre and the valve region also.

Tyre:

It is the material made up of rubber and acts as the major part of automobile. The power from the engine is to be transmitted to the wheels via axles such that the vehicle can move smoothly.

It consists of Treads separated by grooves on its circumference such that they can act as a friction between the road and the tyre.

Working of Conventional Tubed Tyre:

- The tube is placed between the tyre and the rim properly such that the valve of the tube can pass through the hole of the rim.
- Then the air is pressurized into the tube up to the desired value such that it can run on the road properly.
- Make sure that the air in the tube is up to the desired value described by the manufacturer. If the air is less, then the vehicle moves slowly.
- If the driver does not know about this, then he can apply the pressure on the accelerator so that the vehicle can move fast which decreases the fuel in the vehicle.
- So the air is to be filled up properly before driving it onto the road.

2. Tubeless Tyre:

As the name indicates that it does not have a tube within the tyre and rim assembly as per the physical structure.

Tubeless Tyre

Tube is an integral part of the tyre as it is lined on inside with a special air-retaining liner made up of halogenated butyl rubber-like bromobutyl or chlorobutyl for better air impermeability with high heat and weather resistance.

The purpose of the bead in the tyre is to stabilize the tyre and also serve to maintain the air pressure within.

The valve cap is used to pressurise the air into the tyre so that the vehicle moves faster.

Reduction in the air in tube or tubeless tyres reduce the mileage of the vehicle because the system requires more effort to move the vehicle.

If the puncture happens during driving then the air loss will not take place suddenly compared with the tubed vehicles.

classifications of tyres based on Types of Carcass:

- 1. Bias Ply tyre**
- 2. Belted Bias tyre**
- 3. Radial Ply tyres**

Bias Ply tyre:

- The construction of Bias Ply Tyre is one of the oldest type.
- Various plies are added one on the other and are dependent upon the cross section of the tyre and the load that it can carry or hold.

- Due to this, the cushioning effect will be increased and there will be a safer ride on rough roads too.

Belted Bias tyre:

- In order to increase the stiffness of the tread, Bias-Ply tyres are loaded with belts and hence the name Belted Bias tyre.
- The belts can lay under the tread area only but not around the sidewalls.
- In addition to the plies in the Bias-ply tyre, the belts and plies run across each other in the Belted bias tyre.
- Due to this, there will be a smoother ride and good traction.

Radial Ply tyres:

- In Radial Ply tyres, the plies can run in radial direction i.e. in the direction of the axis of the tyre.
- In a circumferential direction, a number of breaker strips can run on the basic structure and without them, the radial plies will not have lateral stability but having a soft ride.

Also if we consider grooves of tyre, then it classified as follows:

- **Directional tyres**
- **Non-directional tyres**

Directional Tyres:

The directional tyres are designed in such a way that they can be rolled only in one direction.

Non-Directional Tyres:

The non-directional tyres are designed in such a way that they will perform opposite to directional tyres i.e. they can rotate in either direction regardless of the road directions with equal performance.

Now, let's see the main types of tyres as Conventional Tubed tyres and Tubeless tyre and are as follows.

Advantages of Tubeless Tyres over Tubed Tyres:

The advantages of Tubeless Tyres over Tubed Tyres are as follows.

Better cooling for increase in tyre life:

As in the case of a tubeless tyre, heat will be passed out to the atmosphere very easily because there is no tube within the tyre whereas, in the case of tubed tyres, heat in the compressed air has to pass through the tube (rubber) material which is not a good conductor of heat. Thereby the life of the Tubeless tyres is more compared with the Tubed tyres.

Lesser rolling resistance:

Due to the presence of tube in tubed tyres, the friction is more between the tyre, tube and rim whereas, in the case of tubeless tyres, there is less rolling resistance because of the absence of tube within the tyre.

Comfortable ride:

In the case of tubeless tyres, the vibrations and shocks will be absorbed at the level of tyre only. Thus it makes the ride more comfortable.

Leakage of air:

In the case of a tubed tyre, when there is a puncture then the air will be lost suddenly from the tube resulting in the unbalance of the vehicle. Whereas, the inner liner in the tubeless tyres is not stretched like a tube and retains the air which results in the slower leakage.

Simpler assembly:

As there is no danger of the tyre puncture or tyre burst takes place in the tubeless tyres and Just the tyre has to be fitted on the rim.

Defects in Tyres:

The defects in tyres are as follows.

- Tread separation
- Bead failure
- sidewall failures
- continuous punctures on the same spot.
- manufacturing defects
- belt and tread separation
- During mounting process, the tyre may be damaged

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