

UNIT

4

Suspension System**Structure**

- 4.1 Requirements of Automobiles Suspension system
- 4.2 Types of suspension system - conventional and Independent
- 4.3 Types of Springs - Laminated Spring, coil spring, helical spring.
- 4.4 Need of Shock absorber
- 4.5 Stabilizers bar and torsion bar.
- 4.6 List out the type of suspension system used in various vehicles.

Learning Objectives

After studying this unit the student should be able to learn the

- Requirement of suspension system in automobiles
- Types of suspension system, types of springs
- Need of shock absorber, stabilizer bar, torsion bar.
- Types of suspension system used in different vehicles.

4.1 Requirement of automobiles suspension system

The automobile suspension system is having the following requirement

- (i) To have minimum deflection to the vehicles with required stability

- (ii) To have minimum wheel hop.
- (iii) To safe guard the occupants and cargo against road shocks
- (iv) To minimize the effects of stresses due to road shocks on the mechanism of the vehicle.
- (v) To keep the body perfect in level while travelling over rough and uneven roads.
- (vi) To keep the body of the vehicle safe from road shocks.

4.2 Types of suspension system - conventional and Independent

There are different types of suspension system provided in different vehicles. Those are

- (i) Conventional suspension system
- (ii) Independent suspension system

4.2.1 Conventional suspension system

In this suspension system. The wheels are fitted on beam type which are attached to the chassis frame through road springs. In this type of suspension, the effect on one wheel is directly transmitted to the other side wheel through the axle.

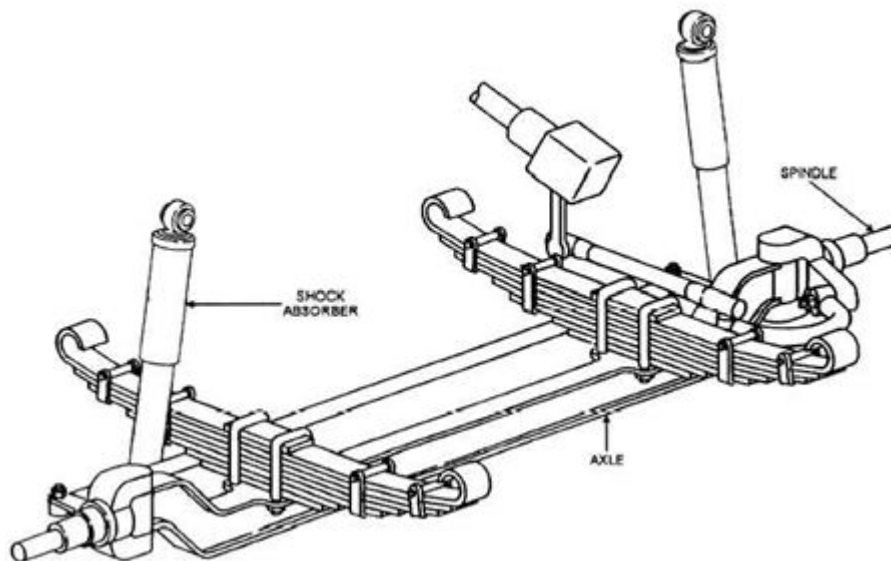


Fig 4.1 Conventional Suspension System

4.2.2 Independent suspension system

In this system the suspension for each wheel is in an independent unit and is free from the effect of one another. There will be no effect of road shocks on the vehicle directly.

4.2.3 Types of independent suspension system

- (i) Wishbone arm system
- (ii) Trailing link system
- (iii) Sliding pillar system

Wishbone arm system

Wishbone arm type independent suspension system is most popular type of all independent suspension system. In this system transverse springs along with coil, springs are mostly used. In European cars, torsion bars instead of coil springs are used. In this system there are two suspension or control arms are used in each side of the vehicle. These arms are like two legs of a chicken wishbone or better 'V'. These wishbone arms are connected with chassis frame on the open end. The closed end spreads out of the chassis frame. One arm is below whereas the other is above the frame. The closed ends of both upper and lower suspension arms are connected with steering knuckle support to which the steering knuckle is attached by means of kingpin. A coil spring is placed between the frame and the lower wishbone arm. Mostly the open end of upper control arm is connected with the shock absorber shaft which is fitted at the frame. When there is a bump, the wheel tends to go up, the control since the shock absorber is fitted with the upper control arm, it damps the vibrations set up in the coil spring due to road irregularities.

Trailing link system

The trailing link independent suspension uses parallelogram linkages lying beside the frame side members. Usually a horizontal coil spring is used in this type of suspension system. During compression and rebound, the spring winds and unwinds. In some vehicles the torsion bar may also be fitted instead of horizontal coil spring.

Sliding pillar system

In this system the pillar or elongated king pin is attached to the wheel and slides up and down in the axle type beam fixed rigidly to the vehicle frame.

4.3 Types of Springs - Laminated Spring, coil spring, helical spring

The springs support the chassis frame. The entire weight of the vehicle live engine, power train, body, passengers, cargo etc, falls on the chassis frame. The spring damp the road shocks transmitted to the wheels as they travel over the road thereby protecting the units supported directly by the frame. The springs are placed between the chassis frame and the axle.

Types of springs

- (i) Leaf springs
- (ii) Coil springs
- (iii) Helical Springs

(i) Leaf springs : The leaf springs are of different types namely-full elliptic three quarter elliptic, semi elliptic, quarter elliptic transverse. In almost all automobiles which are having conventional suspension system the semi elliptic leaf springs are most commonly used.

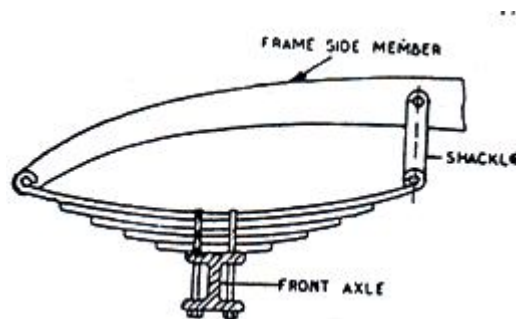


Fig 4.2 Leaf Springs

The leaf springs are made of long flat strip steel. Several strips are placed one on the other and held together by means of centre bolt and chaps. Each strip is called is leaf. There is one main leaf which is extended to full length.

Each succeeding leaf is shorter than the preceding one. The main leaf contains eyes are both ends for making connections with the frame. The entire set is fitted from the chassis frame by hanging with a shackle at one side and the other side is fixed to frame. During jerks, the leaf spring bounces and each strip flexes and rebounds again and again.

(ii) **Coil springs** : Coil spring is made of a length of special spring steel, usually round in section which is wound in the shape of coil. The ends of coil spring are kept flat so that could seat properly. They can store twice energy per unit volume in comparison to leaf spring. To seat the coil springs pan shaped brackets or spring seats are attached to the axles. This suspension is also used in combination with torque tube or torque rod.

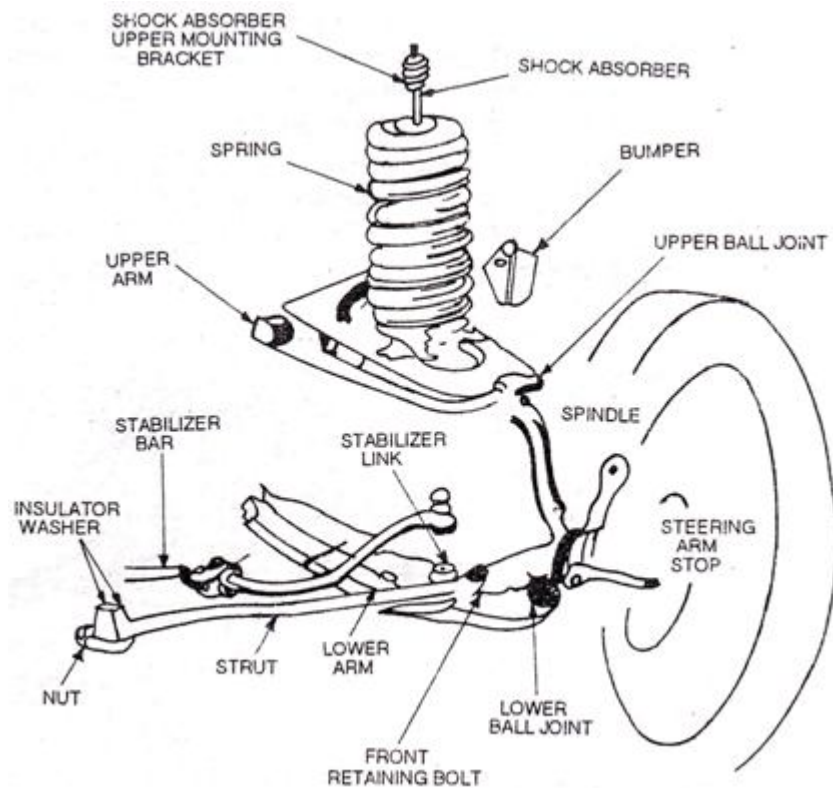


Fig 4.3 Coil Springs

(iii) **Helical Springs** : The helical springs are preferably used in combination with independent suspension system. The length and diameter of the spring wire greatly affect the stiffness of the spring. But the length is controlled by the diameter of the coil and the number of active coils.

4.4 Need of Shock absorber

Shock absorber compresses with the road shock and rebalances while travelling on uneven roads due to usage of this, the effect of road shock is required by the shock absorber suddenly and releases slowly while travelling on uneven roads.

There shock absorber are of two types

- (i) Mechanical type
- (ii) Hydraulic type

Hydraulic Shock Absorber

The shock absorber develop resistance to the spring by forcing a fluid through check valves and small holes. 'Double' acting shock absorber offer resistance both during compression and rebound of the spring. The 'Double acting Hydraulic telescopic shock absorber ' are the commonly used shock absorber which are described as shown in the figure below

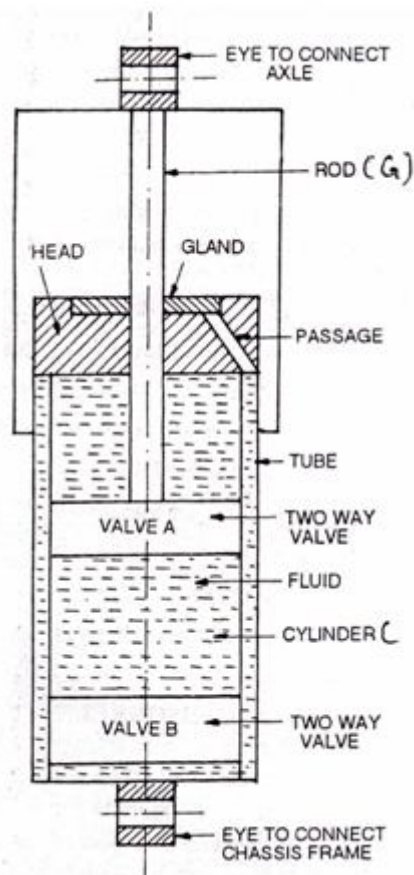


Fig 4.4 Hydraulic shock absorber

Its upper eye is connected to the axle and the lower eye to the chassis frame. A two way valve 'A' is attached to as rod 'G'. Another two way valve B is attached to the lower and of the cylinder C. The fluid is in the space above

and below the cylinder C and tube D, which is connected to the space below the valve B. The J has glad H . Any fluid scrapped off the rod G is brought down into the annular space through the inclined passage.

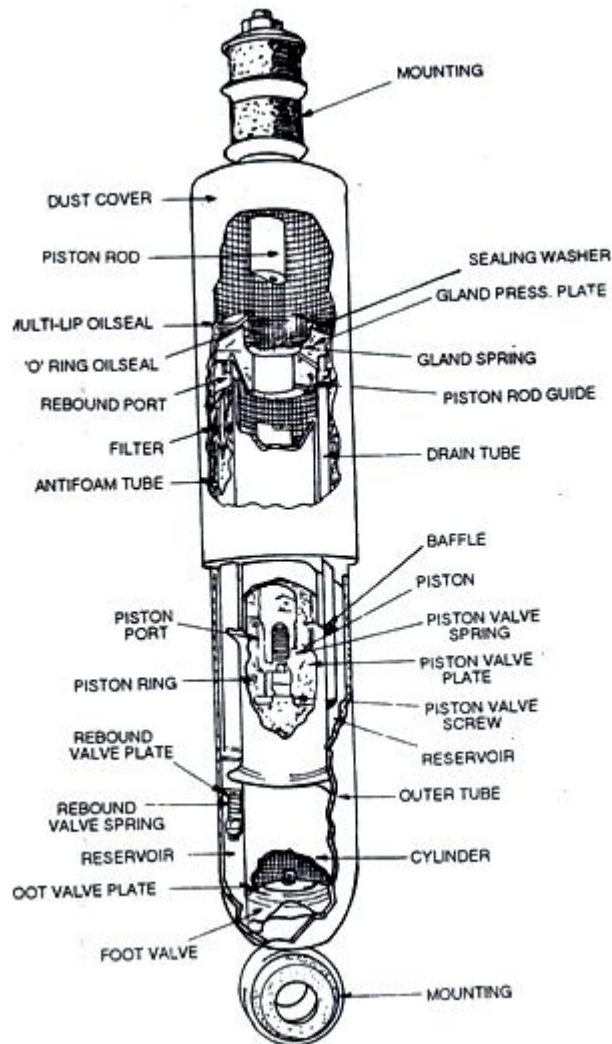


Fig 4.5 Hydraulic shock absorber(detailed construction)

When the vehicle comes across a bump the lower eye E moves up. Therefore the fluid passes from the lower side of the vehicle A to its types side .But since the volume of the space above valve A is less than the volume B. This pressure of the fluid through the valve opening provides the damping force. Similarly when the lower eye E moves down., the fluid passes from the upper side of the valve A to the lower side and also from the lower of the valve B to the upper side.

4.5 Stabilizers bar and torsion bar

4.5.1 Stabilizer

A stabilizer or a sway bar, is necessarily used in all independent front suspension units. It reduces the tendency of the vehicle to roll or tip on either side when taking a turn. This tendency has been increased due to the use of softer springs and independent front end suspension.

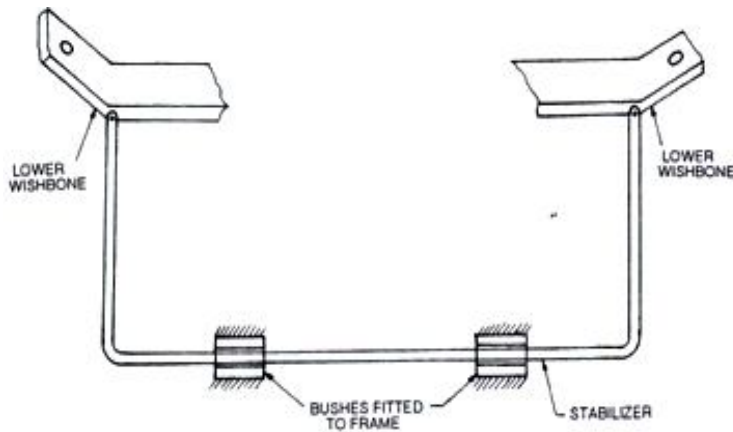


Fig 4.6 Stabilizer

A stabilizer is simply a long steel bar with arms at each end connected to the lower wishbone arm of independent suspension or to the axle. It is supported by bush bearings fixed to the frame and is parallel to the cross member. When both the wheels deflect up or down by the same amount the stabilizer bar simply turns in the bearings. When only one wheel deflects then only one end of the stabilizer moves, thus twisting the stabilizer which acts as a spring between two sides of the independent suspension system. In this way, the stabilizer reduces the heeling or tipping of the vehicle on curves.

4.5.2 Torsion bar

In an independent suspension system, the torsion bar is attached to the axle with the king pin of the front axle. The torsion bar absorbs the shock by moving at a certain angle with the axle. It is almost always used along with any kind of independent suspension system. It is used along with rubber torsion units.

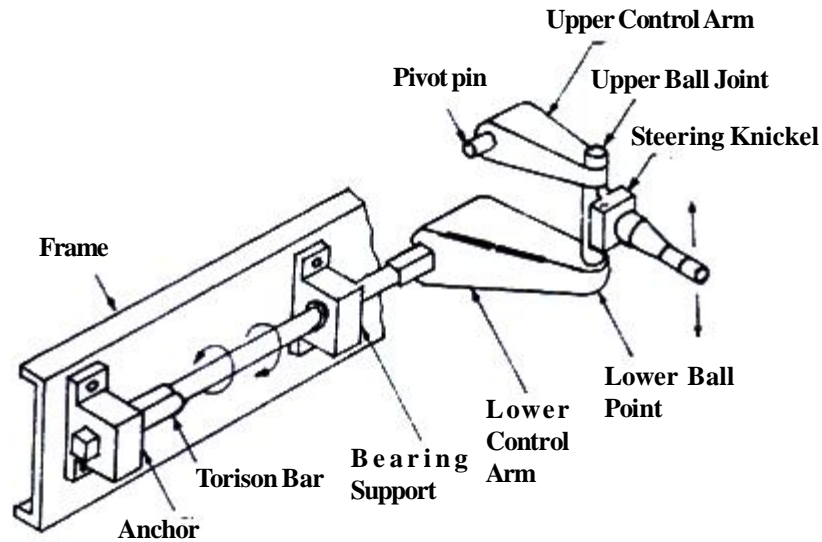


Fig. 4.7

4.6 List out the type of suspension system used in various vehicles

Sl. No.	Front Suspension		Rear Suspension	
	Make	Type	Type	Shock Absorbers
1	Hindustan Ambassador Mark II	Independent torsion bar	Semi-ellipse leaf	Hydraulic telescopic double acting
2	Fiat 1100	Independent coil springs	Semi-elliptic leaf	Hydraulic telescopic double acting
3	Jeep (J-3B)	Semi-ellipse leaf	Semi-ellipse leaf	Hydraulic telescopic double acting
4	Ashok Leyland Comet passenger	Semi-elliptic leaf	Semi-elliptic leaf	Hydraulic telescopic double acting
5	Dodge / Fargo model 89 M4	Semi-elliptic leaf	Semi-elliptic leaf	Hydraulic telescopic double acting

Summary

- Suspension system is provided to safeguard the occupants and cargo in the vehicle against road shocks and to give a smooth and comfortable drive.
- Types of Suspension drive
 - i. Conventional suspension system.
 - ii. Independent suspension system.
- Types of Springs
 - i. Leaf springs
 - ii. Coil springs
 - iii. Helical springs
- Types of Independeng suspension system
 - i. Wishbone arm system.
 - ii. Trailing link system
 - iii. Sliding pillar system.
- Shock absorber compresses with the road shock and rebounds while travelling on uneven roads
- A stabilizer is used in independent front suspension units. It reduces the tendency of the vehicle to roll or tip on either side while taking a turn.
- In independent suspension system, the torsion bar is attached to the angle with king pin.
- The torsion bar absorbs shock by moving in certain angle with the axle.

Short Answer Type Questions

1. What is the purpose of suspension system?
2. Mention the types of suspension system.
3. What is the purpse of stailbilzer?
4. What is meant by independent suspension system?

5. What is the purpose of shock absorber?

6. What is the purpose of Torsion bar?

Long Answer Type Questions

1. Briefly explain leaf spring with neat sketch?
2. Explain about a hydraulic shock absorber with neat sketch.
3. Explain the wishbone arm independent suspension system with a neat sketch.