

Suspension System

It's a system of shock absorbers connecting the wheels and axles to the chassis of a wheeled vehicle. It protects the vehicle from road shock.

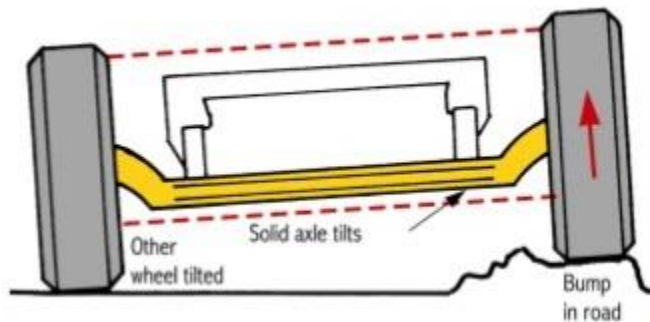
Function of suspension system:

1. It supports the weight of vehicle and passenger and/or cargo.
2. Provides a smooth ride.

Types of suspension system:

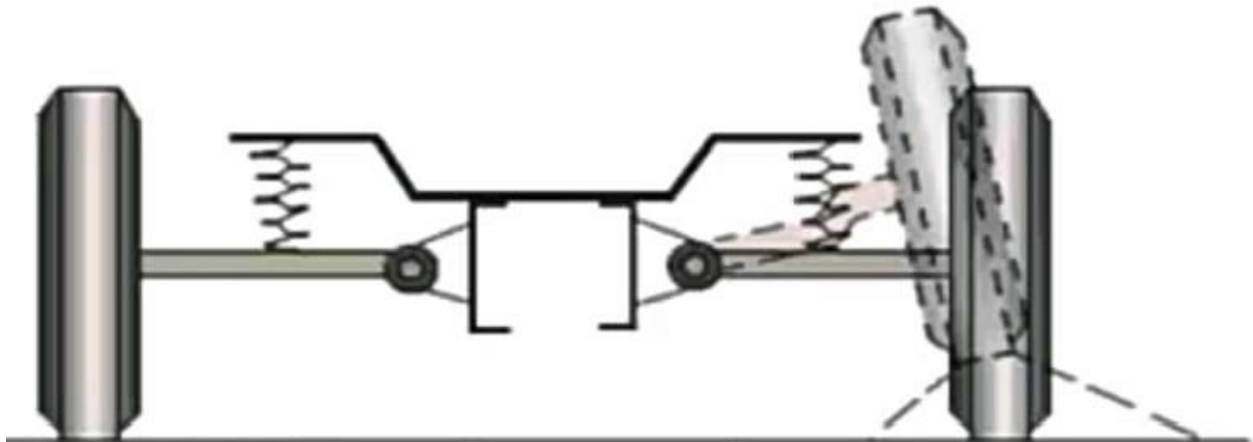
1. Rigid axle suspension system (Conventional).
2. Independent suspension system.

Rigid axle suspension system (Conventional):



In this type of suspension system, two wheels are rigidly mounted on each side of wheel axle. When one wheel is displaced upward due to uneven road surface, the other one also gets displaced since both are rigidly connected through an axle. On all rigid axles the axle beam casing also moves over the entire spring travel. Consequently, the space that has to be provided above this reduces the boot at the rear and makes it more difficult to house the spare wheel. At the front, the axle casing would be located under the engine, and to achieve sufficient jounce travel the engine would have to be raised or moved further back. For this reason, rigid front axles are found only on commercial vehicles. The centrifugal force acting on the body's centre of gravity during cornering increases the roll pitch where there is a rigid axle suspension system.

Independent suspension system:

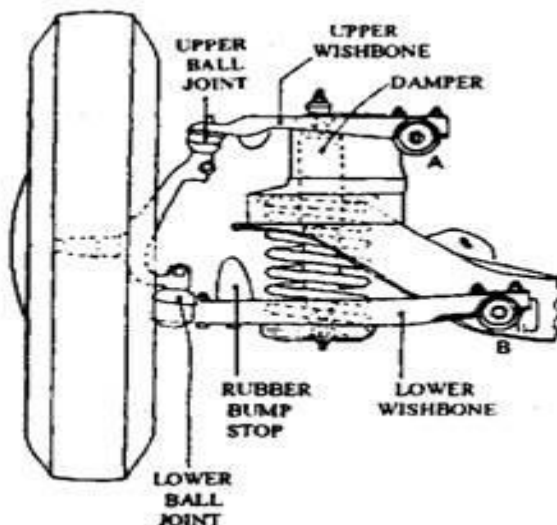


In this type of suspension system, both left and right wheels are connected to the axle via different links. This arrangement eliminates the effect of one wheel on the other. In other words, when a wheel rolls over a bump, it doesn't cause the other wheel to tilt.

Types of Independent suspension system:

1. Double wishbone type.
2. Mac Pherson Strut type.
3. Vertical guide type.
4. Trailing link type.
5. Swinging half axle type.

Double wishbone type:

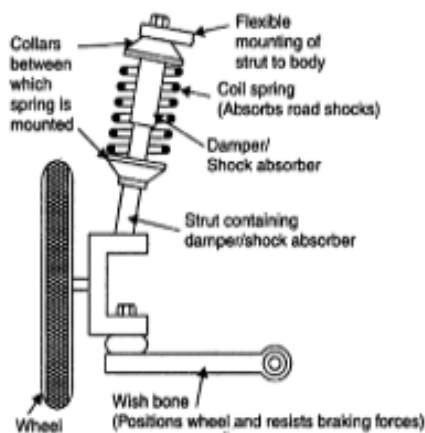


It consists of two control arms, called upper wishbone and lower wishbone, for each wheel. These arms are named as wishbone because they take the shape of letter 'V' or chicken wishbone. The open end of both the control arms are pivoted to the chassis frame whereas the closed end is connected to the stub axle with the help of connecting arm and king pin. The coil spring with the shock absorber is placed between lower wishbone and the frame member. Now when the wheel hits a bump, the control arms move up thus compressing the coil spring. Since the shock absorber is fitted with coil spring, it damps the vibration set up in the coil spring. The V shape of control arm helps in many ways.

- It keeps the wheel in correct position.
- It transmits the sprung weight to the spring.
- It rests the acceleration, braking and cornering forces.

The upper control arm is kept shorter than the lower control arm. This is done to keep the wheel track constant while cornering thereby proving less tyre scrub.

Mac Pherson Strut type:

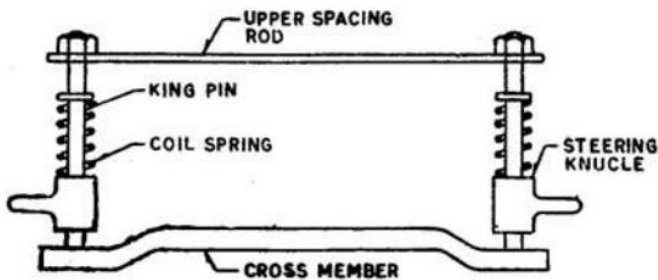


Mac-pherson strut Suspension

It consists of a single lower wishbone arm which is hinged to the chassis of the automobile. The other end of the wishbone arm is connected to the strut through a joint. The strut containing a shock absorber and a coil spring is connected to stub axle which carries the wheel. The upper end of this strut is fixed to the body structure through a flexible mounting. Due to this, a stronger body is required to absorb the full suspension load. Therefore, frameless chassis construction is preferred for this suspension. Here the steering motion of the wheel is provided through the lower wishbone arm. It has many advantages:

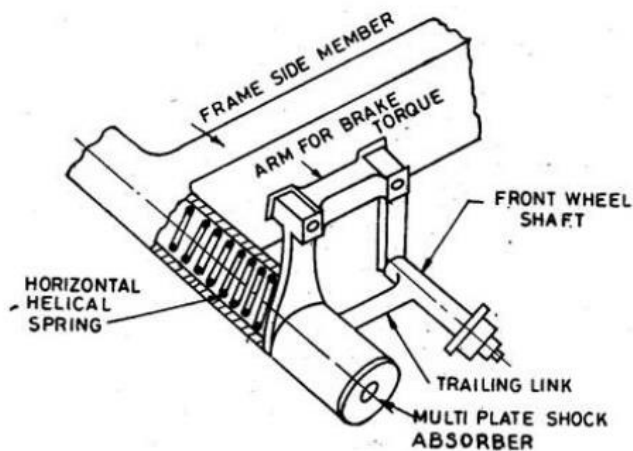
- It is easy and cheap in construction.
- It requires very less maintenance.
- It's lighter and simpler than double wishbone suspension system thus keeping the unsprung weight lower.
- It requires very less space so preferred in front wheel driven automobiles where more room is required in the engine compartment.

Vertical guide type:



It consists of an extended cross member to which king pin of the stub axle is attached at one end. The coil spring and the shock absorber are attached on this stub axle. The other end of king pin is fixed to an upper spacing bar. According to the up and down motion of the wheel, the king pin is also allowed to move up and down thus compressing and elongating the spring. Major disadvantage of this system is decreased stability of the automobile.

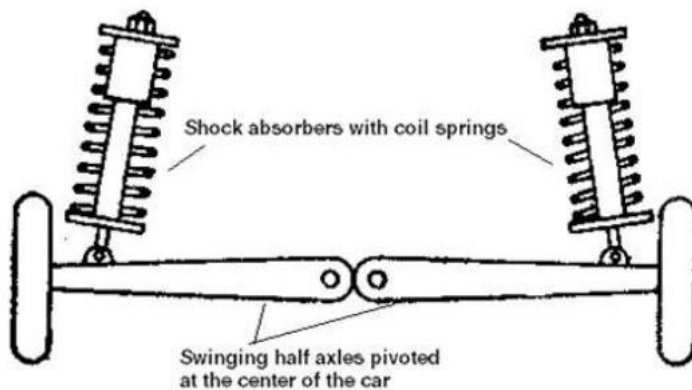
Trailing link type:



It consists of a horizontal torsion spring with shock absorber which is attached to a trailing link. The trailing link is attached to a shaft that carries the wheel hub. The other end of the torsion spring is attached to the frame side member. Now when the wheel moves up or and down, the spring winds and unwinds respectively. In some automobiles, torsion bars are used in place of automobiles. The major disadvantages of this system is:

- The distance between front and rear wheel changes.
- It requires very much space.

Swinging half axle type:



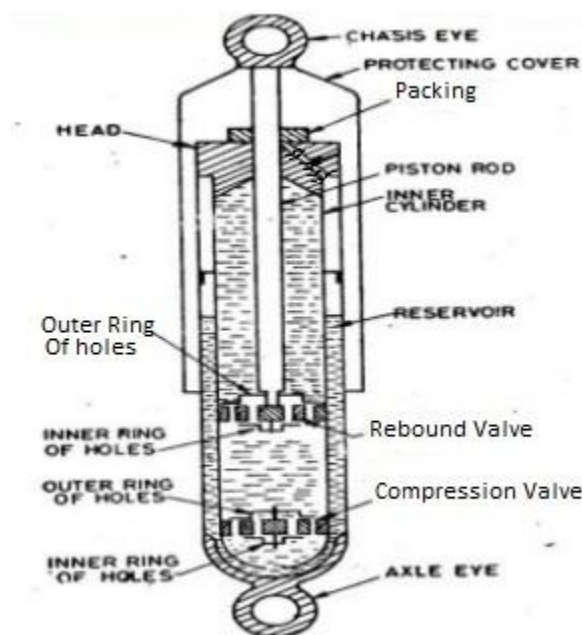
Both wheels are mounted rigidly on the half axles which are pivoted at the other end to the chassis member at the centre of the vehicle. The spring with the shock absorber is mounted on the half axle. Now when one wheel experiences a road shock, the axles attached to the wheel moves up and down without affecting the other wheel. The major disadvantage of this system is that:

- During up and down movement, the wheel doesn't remain perpendicular to the surface.
- During cornering, the outer wheel tilts outwards, thus losing traction.

Note:

Out of above five suspension types, Double wishbone type and Mac Pherson Strut type are most commonly used.

Telescopic Shock absorber:-



It consists of an inner cylinder, an outer cylinder. The inner cylinder is called working chamber and the outer cylinder is called reservoir. There is a piston rod that can reciprocate inside the working chamber. One end of the piston rod is connected to chassis of vehicle and the other end is fitted with a valve called rebound valve. Outer cylinder is connected to the axle of vehicle. The working chamber is completely filled with oil. The reservoir or outer cylinder is partially filled with oil.

A vehicle is subjected to a suddenly applied force, when it travels on a bump. This causes the piston rod move into the working chamber suddenly. As a result the oil in the working chamber passes through the rebound valve from lower side of the valve to the upper side. Also, the oil passes through the compression valve from working chamber to the reservoir. The piston rod moves in the reverse direction, when a vehicle moves down the bump. During this process, the oil passes from the upper side to lower side of the rebound valve through it. And the oil passes from the reservoir to the working chamber through the compression valve. This passing of the oil in the shock absorber causes it to get heated due to the friction between oil and the valve holes. This heat in the oil is transferred to the atmosphere due to difference in temperature between oil and the atmosphere. This is how the impulse on the vehicle caused due to bumps is converted to heat

energy. In other words the shock due to bumps on the road is not transferred to the passengers. As a result the passengers feel comfortable in the vehicle while travelling.