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# **4 Wheel DRIVER**

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# LEAF SPRINGS

## Suspension system

A suspension system is an integral part of a vehicle. It serves three main purposes namely

- to protect the passengers and loads from road shocks,
- to reduce the stresses due to road shocks on the mechanisms of the vehicle and
- to maintain the vehicle on an even level when travelling over rough terrain or when cornering so that rolling, pitching or vertical tendency is minimised.

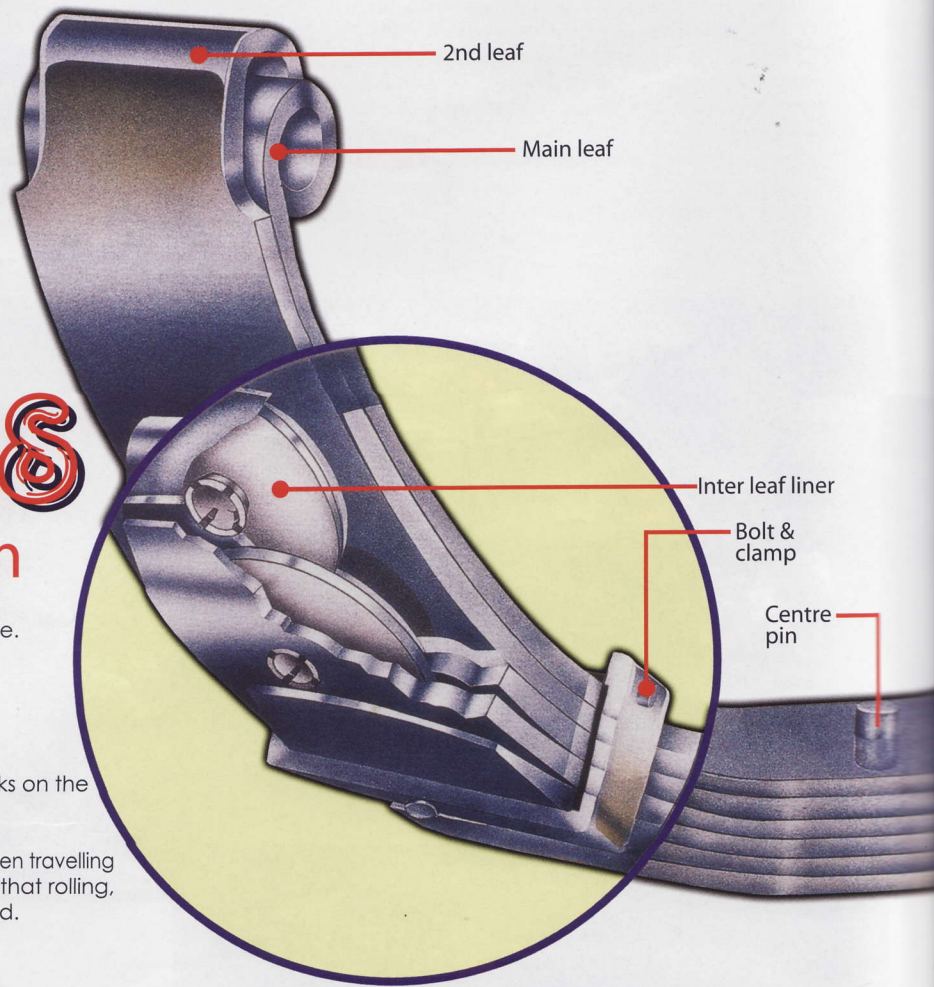
Suspension system consist of the following parts

- springs
- dampers (shock absorbers)
- bushes
- stabilisers/antiroll bars
- and/or other electromechanical device controlling ride height, etc

These days automobile springs come in various forms. Since the olden days leaf springs has been used on carts, trucks, and agriculture vehicles. Till today, leaf springs are still in use by trucks busses and heavy duty 4WD vehicles. Coil springs emerged some time back as an alternative to absorb shocks by compression and provide a more comfortable ride. Both leaf and coil springs take up a considerable space.



The forward mounting of the spring is fixed, while the rearward is shackled connected

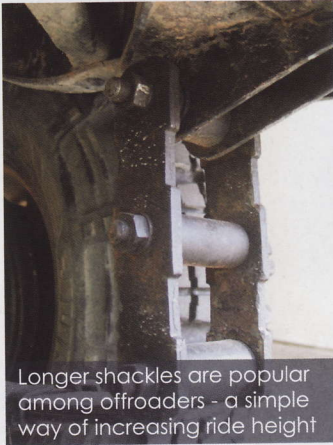


On the contrary torsion bar springs are compact and serve the same function, mostly used at the front set-up of independently suspended vehicles. Air-springs are the most recent addition to the spring line-up, used mostly on European luxury vehicles.

In this series of articles on suspension systems, we will look at the leaf springs first.



Note the different length of U-bolts clamped to mount the springs to the axle housing



Longer shackles are popular among offroaders - a simple way of increasing ride height

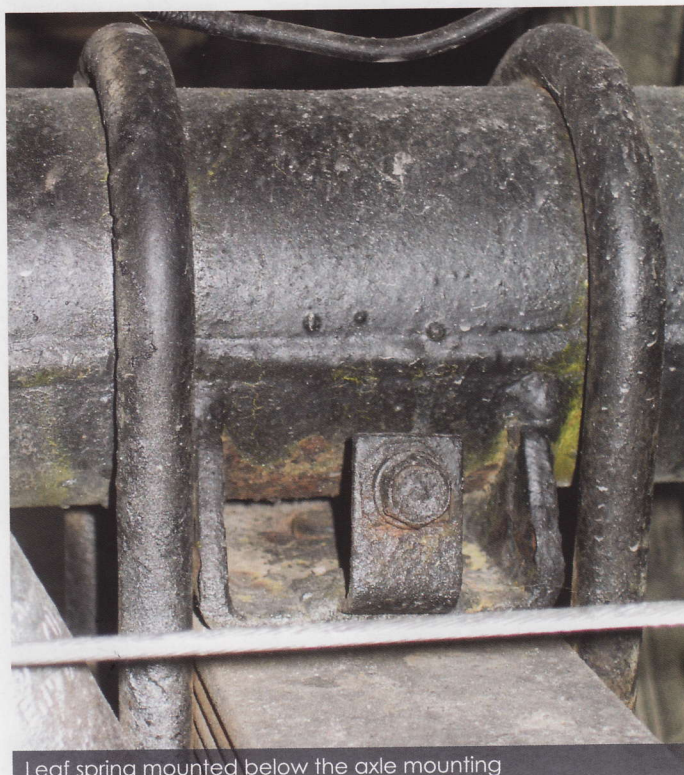


**Leaf springs**

Leaf springs are made of long, flat strips of spring steel. Several strips are placed one on top of the other and held together by means of a centre bolt and clamps. Each strip is called a leaf. There is one leaf which extends the full length of spring and usually contains eyes at both ends for making connections with the chassis and is called the main leaf. Each succeeding leaf is shorter than the preceding one. Leaf springs are of elliptical shape. Its camber and degree of 'curve' is a predetermined factor which is set at the time of manufacture. Leaf springs combined with rigid axles offer the advantage of forming a simple yet complete suspension system.



A typical leaf spring pack with a clamp



Leaf spring mounted below the axle mounting

The simple structure and small number of parts make leaf springs easy and inexpensive to manufacture. They are strong and easy to maintain. For the rough and unpaved roads, they are adequate to absorb the stress and shocks it is for these reasons that leaf springs continue to appear. However, leaf springs add considerable weight to the suspension particularly the unsprung weight, making them no longer practical in independent suspensions which use coils or torsion bar springs.

Furthermore, as the leaves bend and rub each other, they are no longer able to absorb all the small vibration from the surface. Hence why leaf springs do not provide the most comfortable ride. Leaf springs absorb shocks by bending. As such they do not provide good articulation. Nonetheless, combined with the shackles and bushes, they work together to allow both bending and slight twisting giving more freedom leading to better articulation.



A standard leaf spring shackle



In theory, leaf springs should not be modified as they have been designed and manufactured to provide specified stiffness factor for specific vehicle. In addition, each leaf spring pack has also been designed to withstand a certain load limits. However many people have modified leaf springs to suit their needs. Many have added extra leaf or leaves. Some have thickened the spring plates while a large number of offroaders replace the standard shackles with longer ones. All these modifications leads to a firmer and rougher ride albeit with an increase in load carrying capacity.

Modifications of leaf springs adversely affect the character of the host vehicles. During cornering, the axle tends to drift diagonally rather than holding its course. This phenomenon of "axle steer" will exaggerate itself when driven on uneven ground. Further, quite a number of owners drastically change the location of their springs. Instead of being mounted below the axle assembly, the leaf springs are relocated above the axle so as to give a higher ride height. This alters the caster angle and hamper the steering movement, leading to a deteriorated steering effect.