SUSPENSION

- Introduction to suspension system
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- Springs
- Dampers(or shock absorbers)

Introduction to suspension system

- The suspension system of an automobile is one which separates the wheel/axle Assembly from the body.

- The primary function of the suspension system is to isolate the vehicle structure from shocks and vibration due to irregularities of the road surface.

History

- 1903 ➡ Mors from Germany fitted a car with shock absorbers.
- 1920 ➡ Layland used torsion bars in its suspension system.
- 1922 ➡ Unitary construction and independent front suspension were pioneered on the Lancia Lambda.
- 1932 ➡ By this year ,the independent front suspension become more common in popular cars.

- 1948 ➡ Triumph Mayflower introduced the combined coil spring/damper unit.
- 1950 ➡ Ford adopted the McPherson strut independent front suspensionon MK 1 consul.
- 1959 ➡ Use of independent rubber suspension.
- 1962 ➡ Introduction of hydrostatic suspension.

Function of suspension system

- To prevent the road shocks from being transmitted to the vehicle frame.
- To preserve the stability of the vehicle in pitching or rolling.
- To safeguard the occupants from road shocks.
- To provide good road holding while driving, cornering and braking.


Yaw
Pitch

Requirements of a suspension system

- Low initial cost.
- Minimum weight.
- Minimum tyre wear.
- Minimum deflection consistent with required stability.

Elements of suspension system

- Spring ➟ It absorbs road shocks or impacts due to bump in road by oscillating.
  Tyres also provides spring effect , but to a smaller extent.
- Damper ➟ They reduce the tendency of the carriage unit to continue to "bounce" up and down on its springs .
  Oscillation due to road shocks are restricted to a reasonable level by damper.

Springs

- Springs are resilient members and as such act as reservoirs of energy . They store the energy due to the sudden force which comes when vehicle encounters a bump or a ditch . This energy is released subsequently and with the action of damper, the energy is converted into heat and bounce is avoided.
- Springs used for suspension system should absorb road shocks quickly and return to the original position slowly.

Types of springs

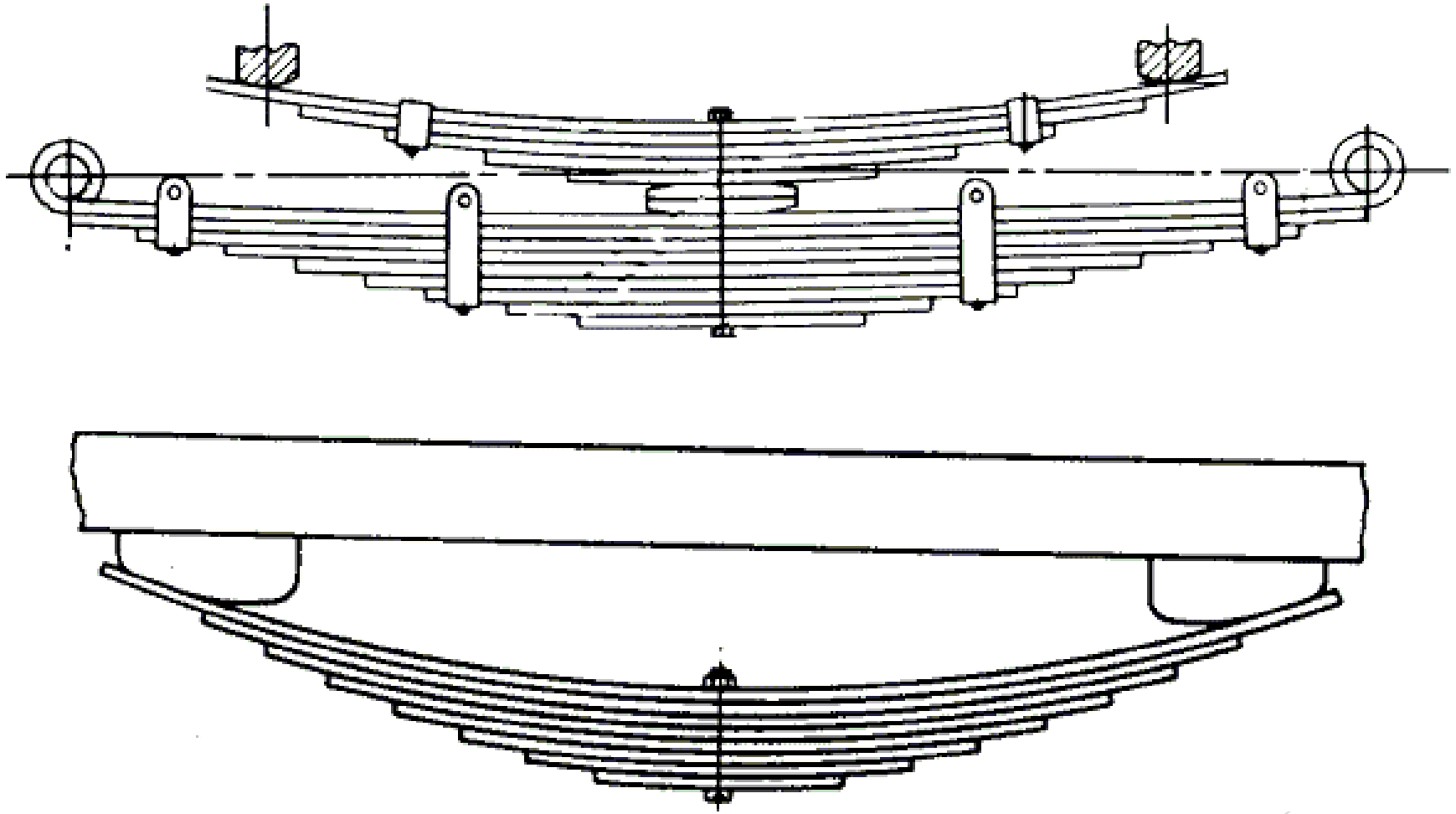
1. Leaf spring
2. Coil spring
3. Torsion bars
4. Air and gas spring
5. Rubber spring

1. Leaf spring

- Referred to as Laminated springs since they use steel strips or lamination one over the other with reducing length.
- They are also called as Semi elliptical springs as they are bent in that form.
- Leaf strips are made from strips of spring steel .
- Each strip is called a leaf. They are joined together by clamps and a central bolt.
- The length of each leaf decreases so that the spring assembly act as a flexible

  beam and is of uniform strength.
- The ends of master leaf are formed into loops called spring eyes.
- One end of the spring is attached with frame through a spring bolt passing through the eye. The other end is secured through a shackle .
- The shackle helps in accommodating the change in length of the spring.

1.2 Helper spring

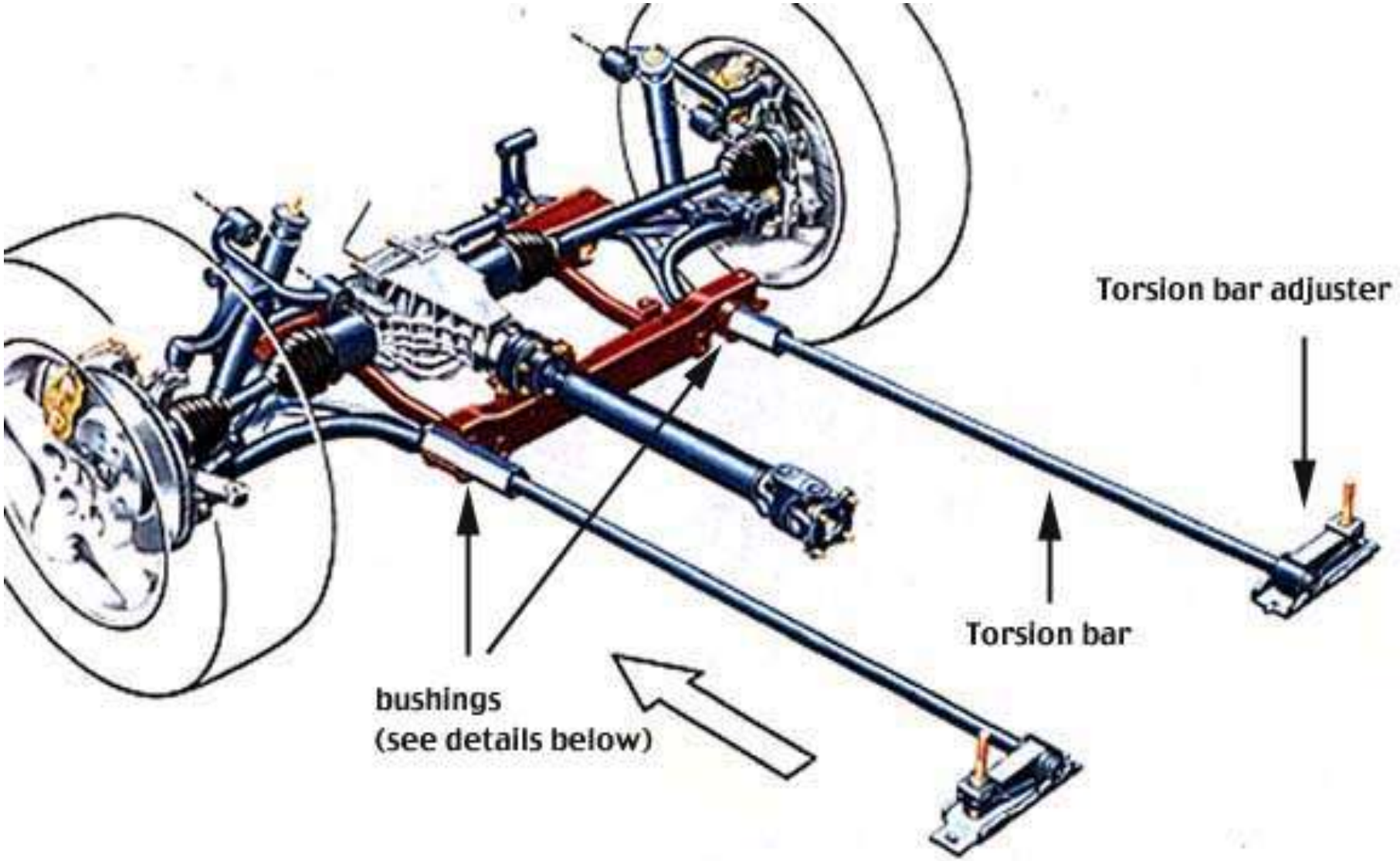


- A helper spring is just like a semi elliptical spring but without eyes at the ends
- Its ends touches the brackets fitted on the frame when the truck is heavily loaded .
- These springs allow for a wide range of loading
- Generally it is used on rear suspension only.

2.Coil spring

- A section of Spring steel rod wound in a spiral pattern or shape. Widely used in both Front and Rear suspension systems. Like large metal bed springs, these coils cushion and absorb the shocks and bumps as the vehicle is driven. They are usually found near the front wheels, but some cars have them in the rear as well. Often the Shock absorbers run up the center of the coil springs.

3. Torsion bars



- A torsion bar is a solid bar of steel which is connected to the car chassis at one end, and free to move at the other end. They can be mounted across the car or along the car .The springing motion is provided by the metal bar's resistance to twisting.
- To over-simplify, stick your arm out straight and get someone to twist your wrist. Presuming that your mate doesn't snap your wrist, at a certain point, resistance in your arm (and pain) will cause you to twist your wrist back the other way. That is the principle of a torsion bar.

- Torsion bars are normally locked to the chassis and the suspension parts with splined ends. This allows them to be removed, twisted round a few splines and re-inserted, which can be used to raise or lower a car, or to compensate for the natural 'sag' of a suspension system over time. They can be connected to just about any type of suspension system listed on this page.
- The rendering below shows an example longitudinal torsion bar. The small lever at the far end of the torsion bar would be attached solidly to the frame to provide the fixed end. The torsion bar itself fits into that lever and the suspension arm at the front through splined holes. As the suspension at the front moves upwards, the bar twists along its length providing the springing motion.

4.Air and gas spring

- In these springs compressed air or gasis filledin the cylinder or bellows against which the wheel movement is transmitted through diaphragm. As soon as the wheel passes over a road irregularity the compressed air returns the system to its original position.

4.1. Disadvantages

1. High cost .
2. Risk of breakdown.
3. Freezing of moisture in air in cold weather.
4. Greater maintenance required.

5.Rubber spring

Types of hydraulic damper

- Telescopic damper
- Rocking lever damper

2 MR DAMPER BEHAVIOR AND MODEL

2.1 MR fluid

"MR fluid" is the short form of magneto-rheological fluid, which is used in the MR damper. These fluids are novel materials, which are suspensions of micron-sized, magnetizable particles in oil. Normally, MR fluids are free flowing liquids having a consistency similar to that of motor oil. However, when a magnetic field is applied, particle chains form, and the fluid becomes a semi-solid. Figure 2.1 shows this characteristic of the MR fluids.