

SUSPENSION

SYSTEM

SUSPENSION SYSTEM

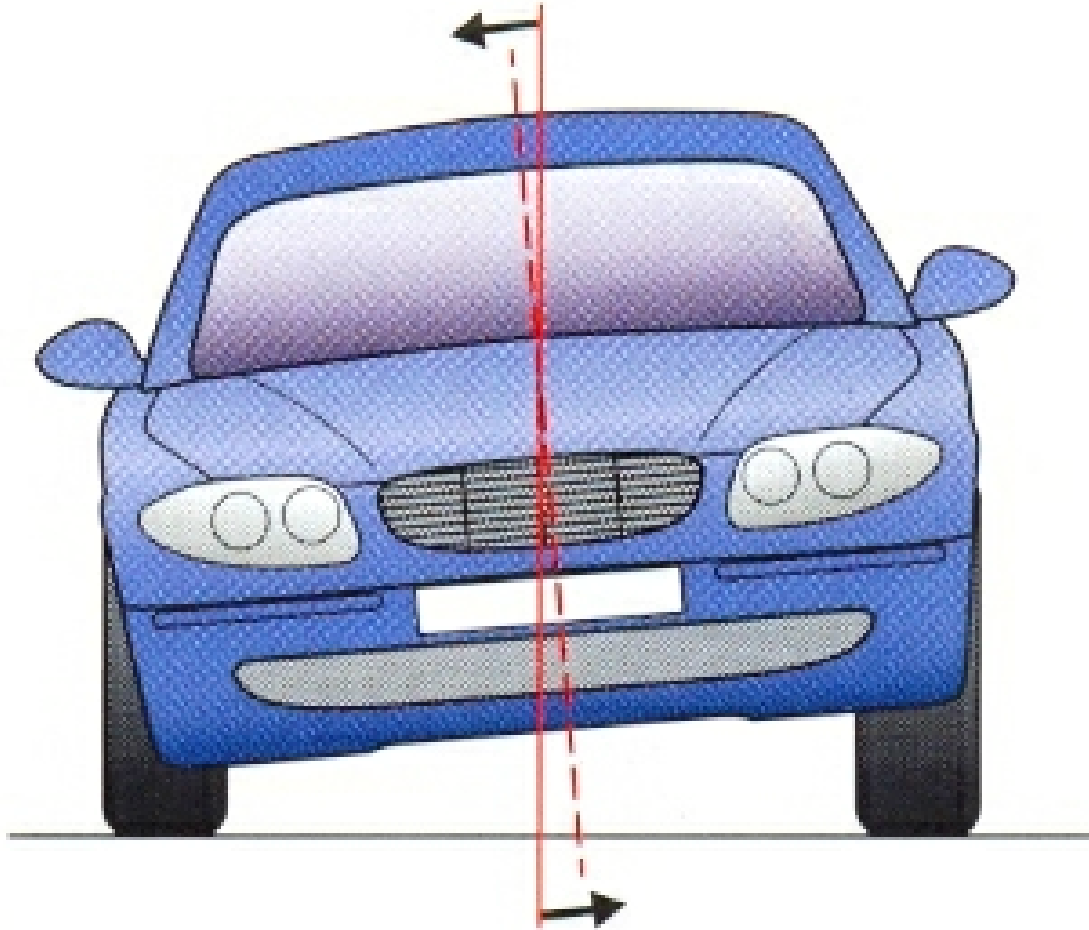
TYPES OF VEHICLE MOTION ON ROAD

- Bouncing – when a vehicle strikes a bump, the vehicle bounces right off the ground and may continue to bounce like a ball. This movement is called bouncing.
- pitching – this is the movement of vehicle body oscillation resulting from the rear wheel, when the front wheel hit a bump or vice versa. That is as the front of vehicle rises the rear drops and then as rear rises over the same bump the front drops making the vehicle to continue pitching fore and aft.
- Rolling – this is the motion felt mostly when connering as a result of centrifugal force pulling the vehicle body away from the centre of the curve as it tend to roll

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Roll

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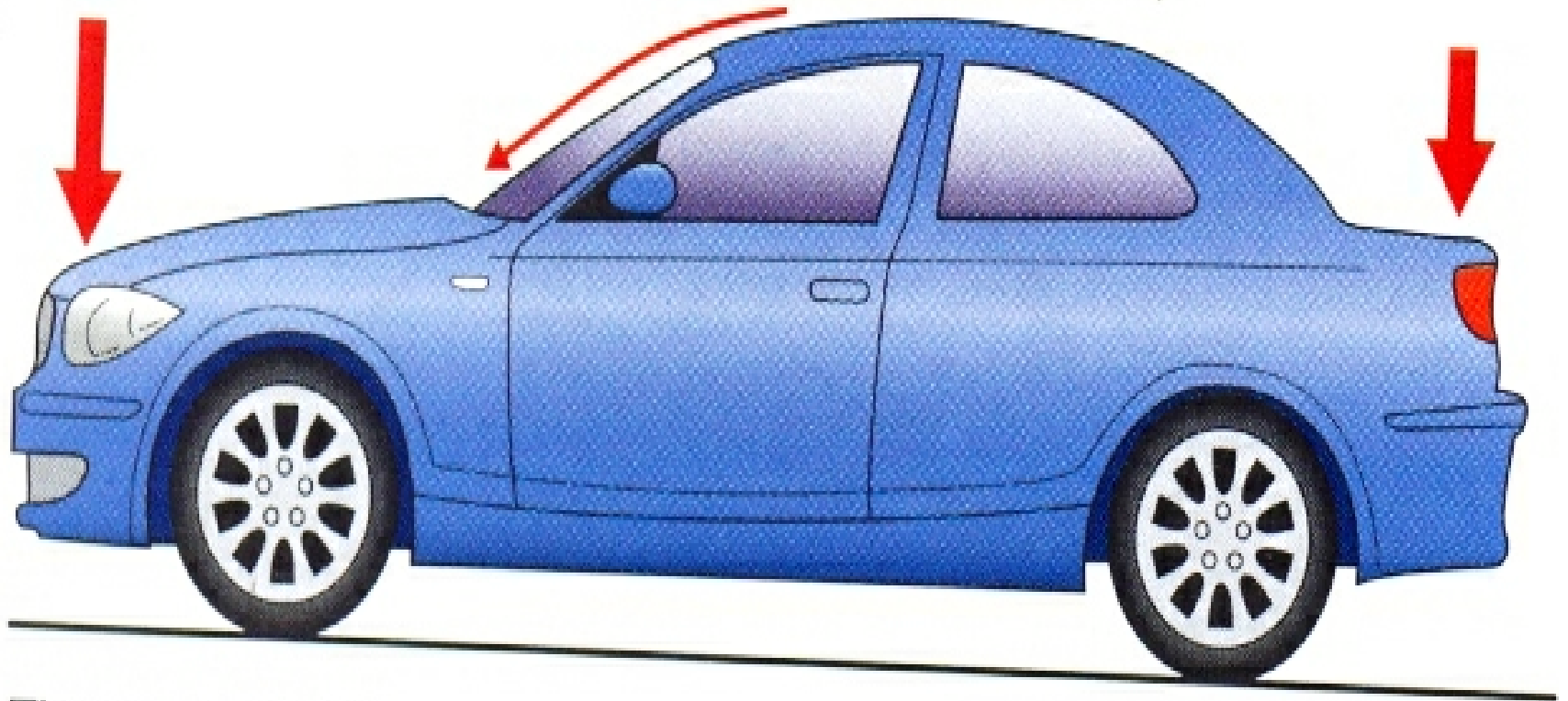


Figure 4.68 Bounce

SUSPENSION SYSTEM

- Mounting the axle directly to the chassis of a vehicle would subject the occupants and general components to severe shocks.
- A spring between a wheel and chassis allows the wheel to move up and down, without causing similar movement of chassis or body.
- All the weight above the suspension system is known as sprung weight of the vehicle.
- While all the weight below vehicle is termed as unsprung weight
- The more the sprung weight the better the vehicle will ride.
- Unsprung weight include the vehicle wheel, brake assembly, hubs and axle parts. This amount to a heavy dead weight on road surface and are only cushioned by the tyres while the other parts include the spring and damper.

SUSPENSION SYSTEM

Function

- To absorb large and small road shocks or impact in order to protect the vehicle occupants or loads from the shocks.
- To maintain the vehicle on an even level when travelling on rough or when cornering so that pitch and roll movement are minimized.
- To reduce the impact stress on vehicle various mechanism particular steering system.
- To reduce unsprung mass that is total mass which is not suspended to a minimum so that the wheel follow the contour road surface more closely.

SUSPENSION SYSTEM

Principle of spring

- There are three types of various form of springing that can be used:-
 - Steel
 - Rubber
 - pneumatic

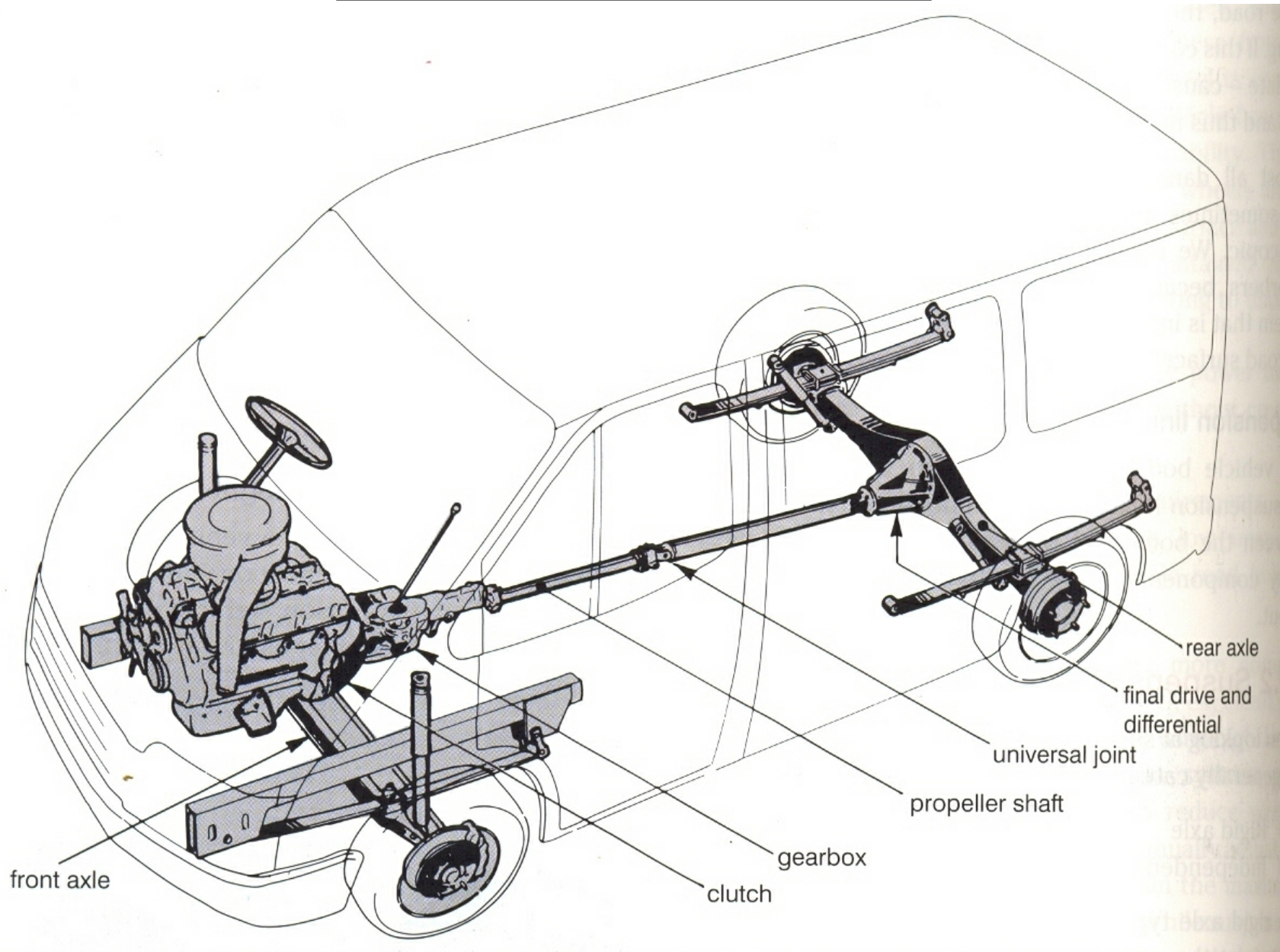
SUSPENSION SYSTEM

TYPES OF SUSPENSION

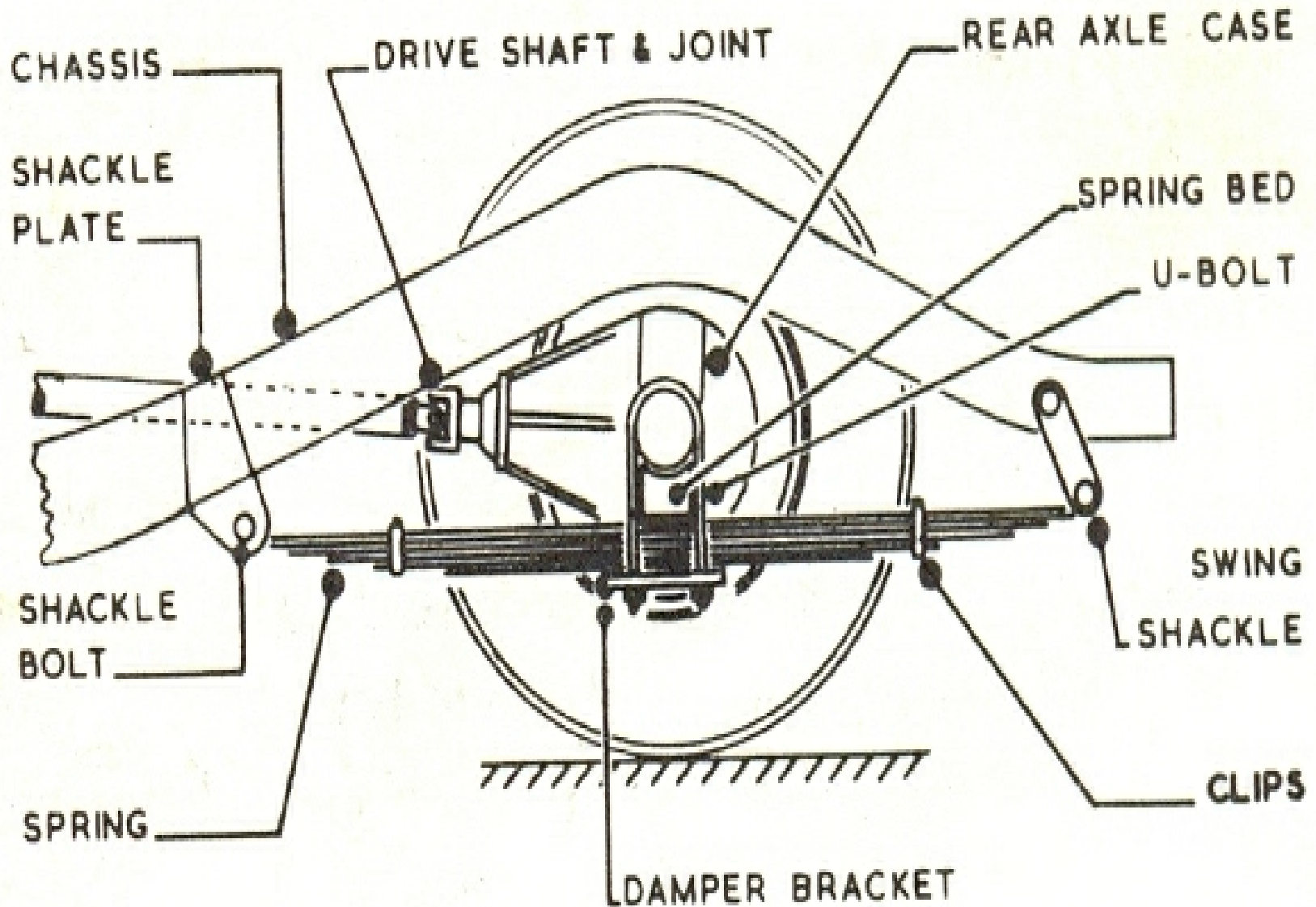
Rigid axle beam(beam axle)

- With this design the road wheels are interconnected by non drive rigid and solid forged axle beam at the front of the vehicle or a rigid tube section beam on rear of vehicle with drive shaft passing through its centre to transmit the drive to the rear wheels.
- The front axle beam is a steel forging usually of I- section between the spring saddle to withstand the vertical bending load while the outer portion are normally of oval section to resist the bending torque.
- The spring saddle or platforms are drilled to take spring centre bolt head. The spring and axle are clamped together with U-shaped bolts.
- Blocks of rubber known as bump stop are usually clamped on top of the axle.

RIGID AXLE BEAM



RIGID AXLE BEAM



RIGID AXLE BEAM

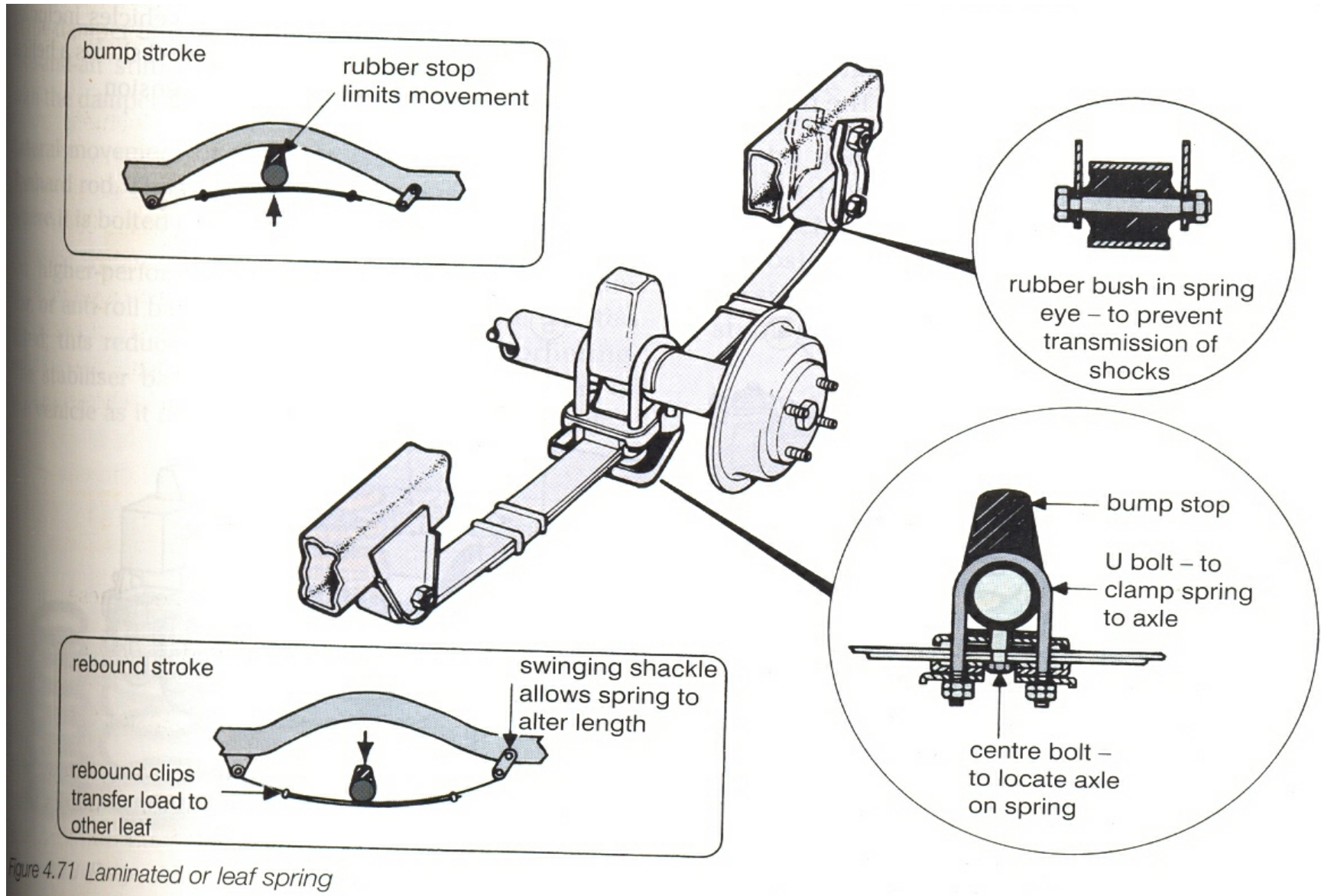


Figure 4.71 Laminated or leaf spring

RIGID AXLE BEAM

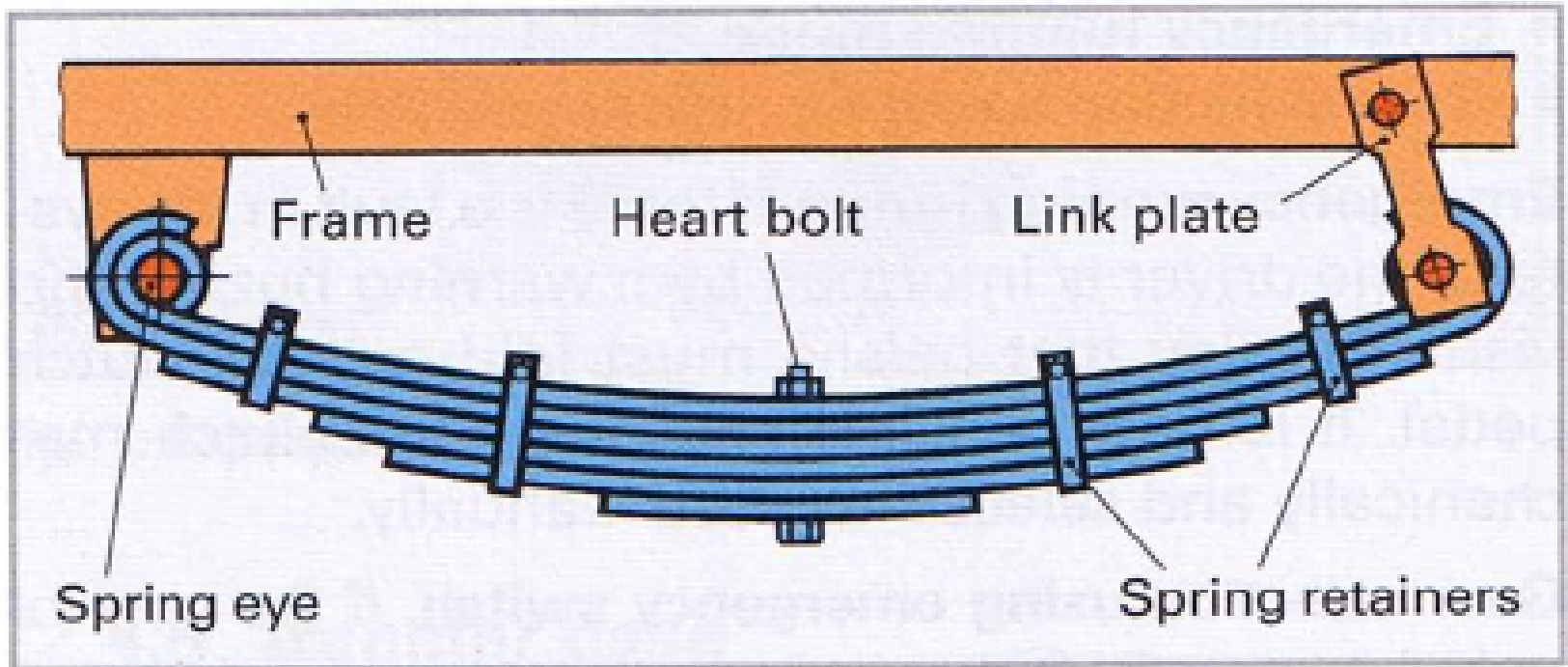


Fig. 1: Semi-elliptical spring, trapezoid spring

RIGID AXLE BEAM(BEAM AXLE)

ADVANTAGES

- The beam axle gives rigid support for each spring both in vertical plane when the sprung body bounces and in horizontal plane when there are side forces involved.
- Maintenance of axle is simple
- The construction of axle is very strong. The rigid axle is fitted to heavy commercial vehicles
- Wheel changes their alignment, when the axle moves up and down, tyre wear is therefore reduced.

RIGID AXLE BEAM(BEAM AXLE)

Disadvantages

- when the wheel travelling at a speed in a vertical position is tilted or hits a bump, it attempts to resist this changes of lines and in so doing severe stress are set up in axle, hub and steering linkages. This undesirable force is called gyroscopic torque.
- When leaf spring are used at front they cannot be fitted very far apart because of need to allow the front wheels to lock over when steered and for this reason, the front of vehicle is supported on narrow base which lacks stability hence allows the vehicle to roll on corners.
- A large amount of unsprung dead weight is in constant with the road.
- Spring deflect is limited and therefore this type of suspension.
- The movement of one wheel will also influence the movement of the other wheel fitted to the axle.
- It necessitates mounting the engine fairly high in the chassis.

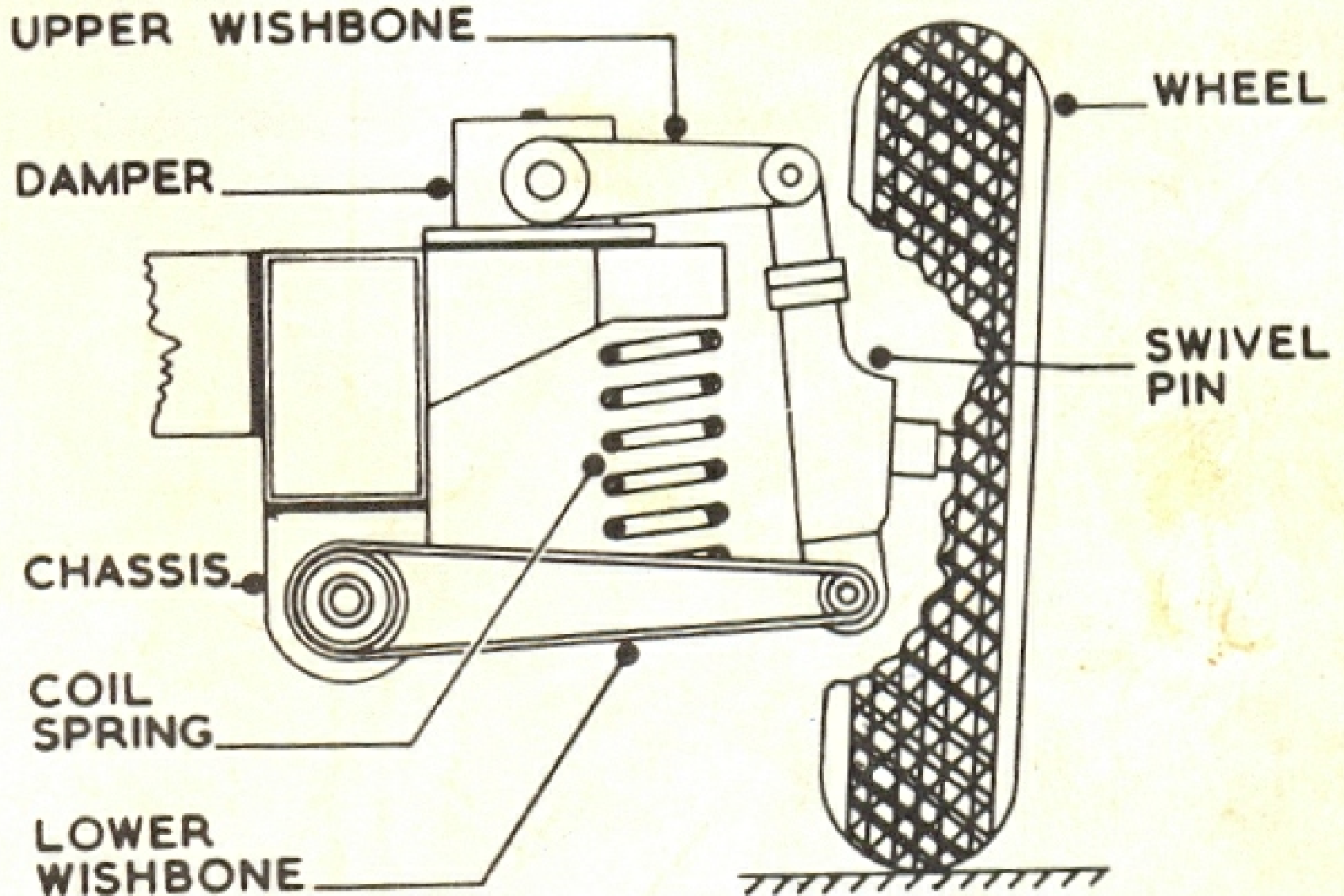
SUSPENSION SYSTEM

INDEPENDENT SUSPENSION

wishborne type

- It uses two moving arm with a shape of a wish borne. The bottom arm is longer than top arm.
- The coil spring is fitted between bottom and car frame or top arm.
- The unequal length of wishborne arm permits the road wheel to move up and down in a more or less vertical plane keeping the same camber angle required.
- A constant castor angle is achieved by mounting the top wishborne slightly behind the lower one.
- Rubber or plastic bushes are fitted in the inner end of the wishborne.

WISHBORNE TYPE

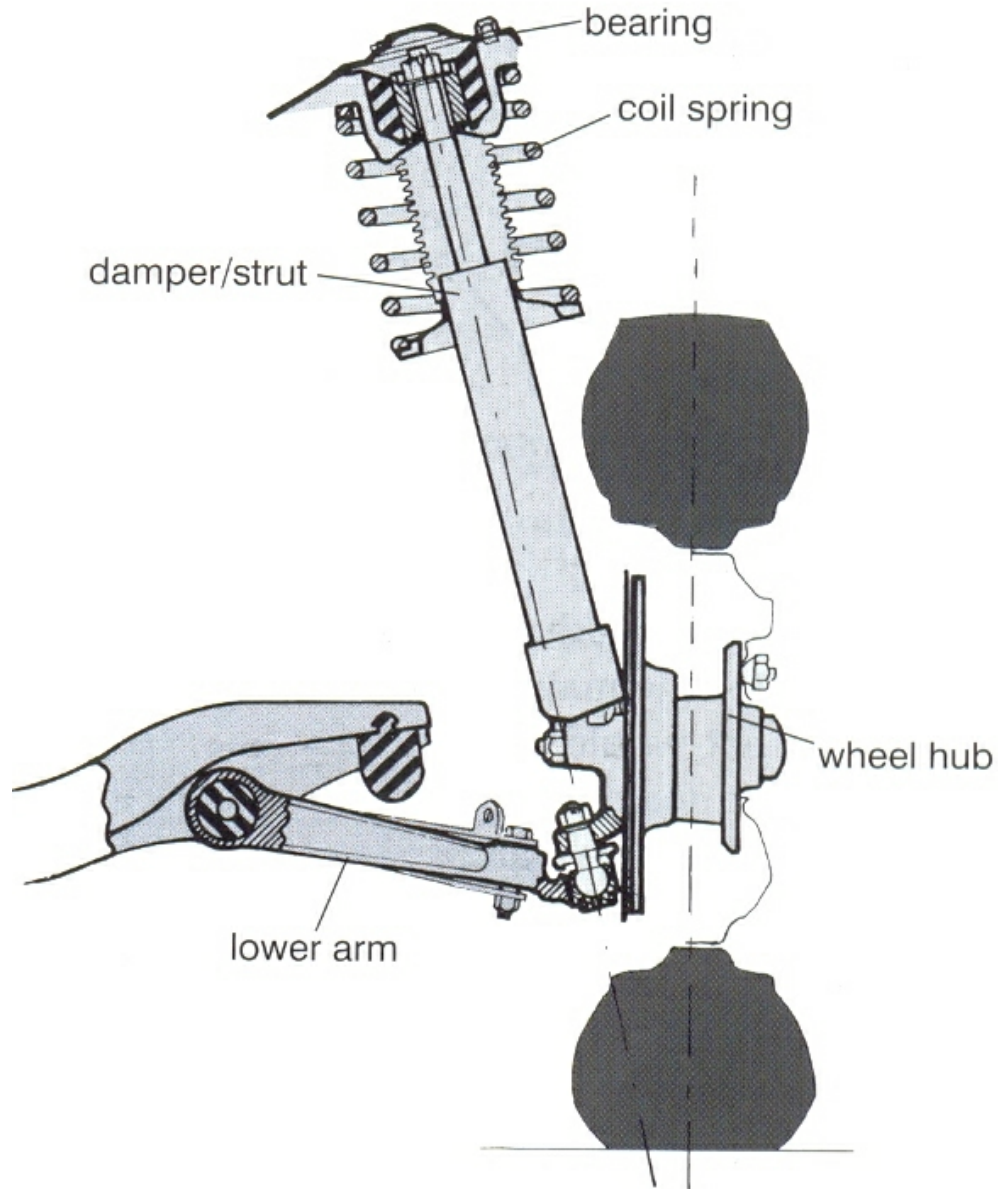


INDEPENDENT SUSPENSION

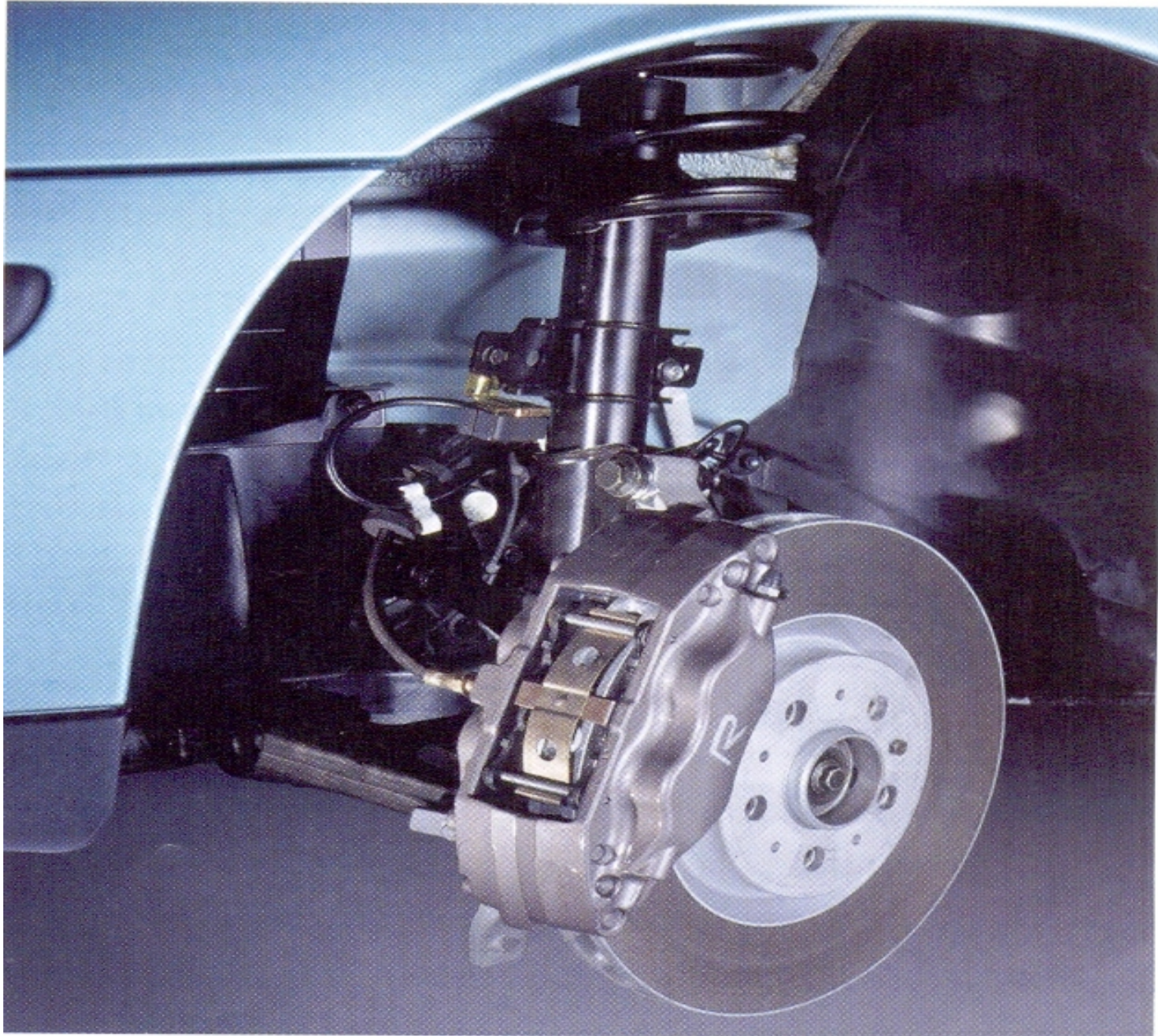
MACPHERSON STRUT

- The hub carrier is attached by welding to the outer tubular member of strut. At base of this member is a sealed ball joint mounted in the intricate (further).
- Since the strut also acts as telescopic damper the inner rod carries a damper piston at its lower end.
- At upper end of this rod a threaded portion of reduced diameter is locked to the rubber mounting and the same time located by the inner ends of ball bearing.
- This thrust bearing allow free angular movement of the strut as wheel is steered.

MACPHERSON STRUT



MACPHERSON STRUT



REAR INDEPENDENT SUSPENSION

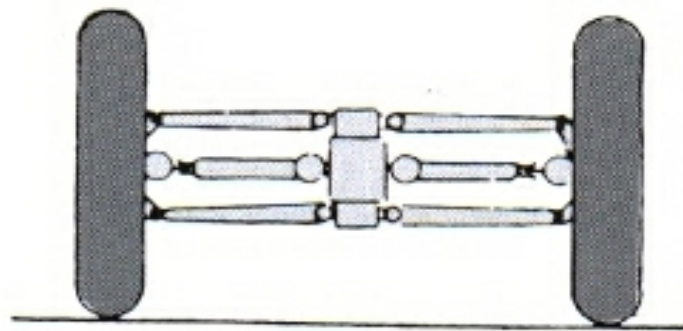
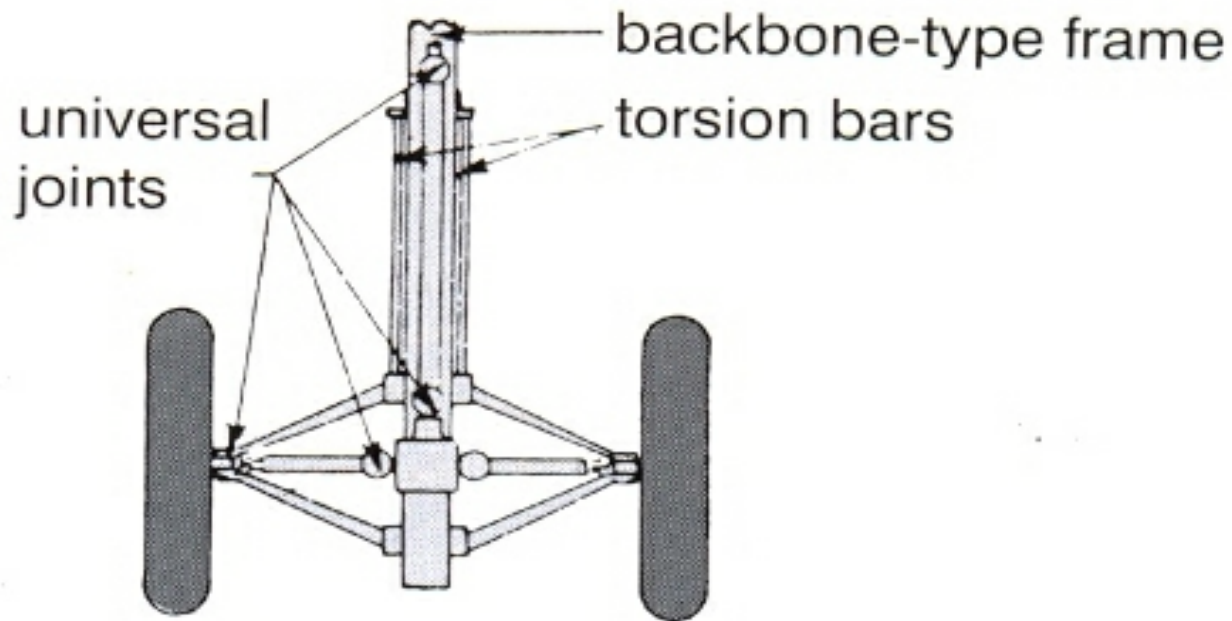
PARALLEL LINK SUSPENSION

- With this suspension system two wishborne shaped link are mounted transversely connect the wheel to the main frame.
- Springing is provided by longitudinally mounted torsion bars which connect with lower wishborne shaped link.
- Drive is transmitted from final drive through wide angle universal joint.

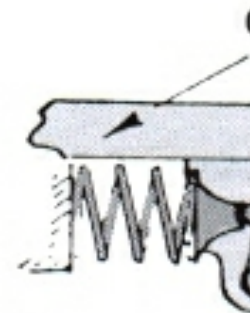
REAR INDEPENDENT SUSPENSION

- An alternative method of mounting the wheel is provided by trailing arm system.
- A spring is mounted as shown in the sketch or torsional bar may be used.

REAR INDEPENDENT SUSPENSION



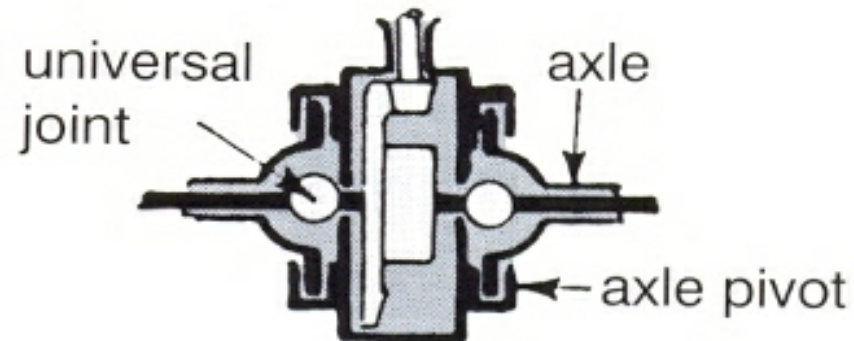
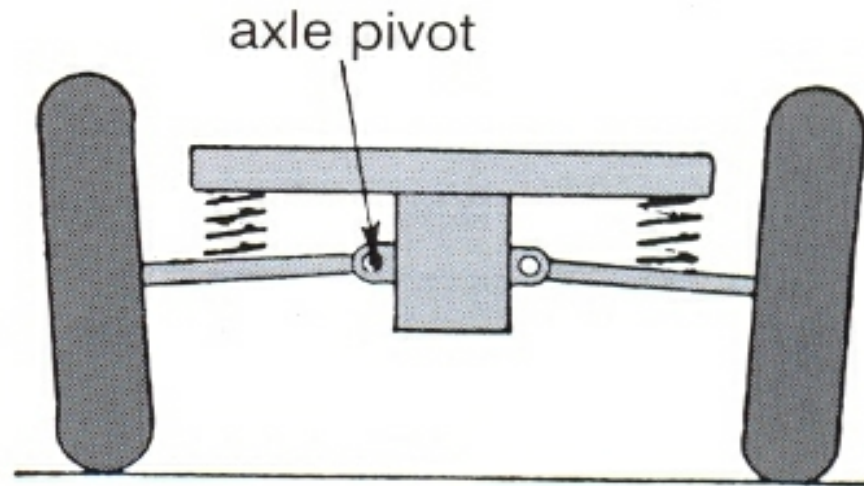
(a) *Parallel link systems*



wheel mounted
on swinging arm

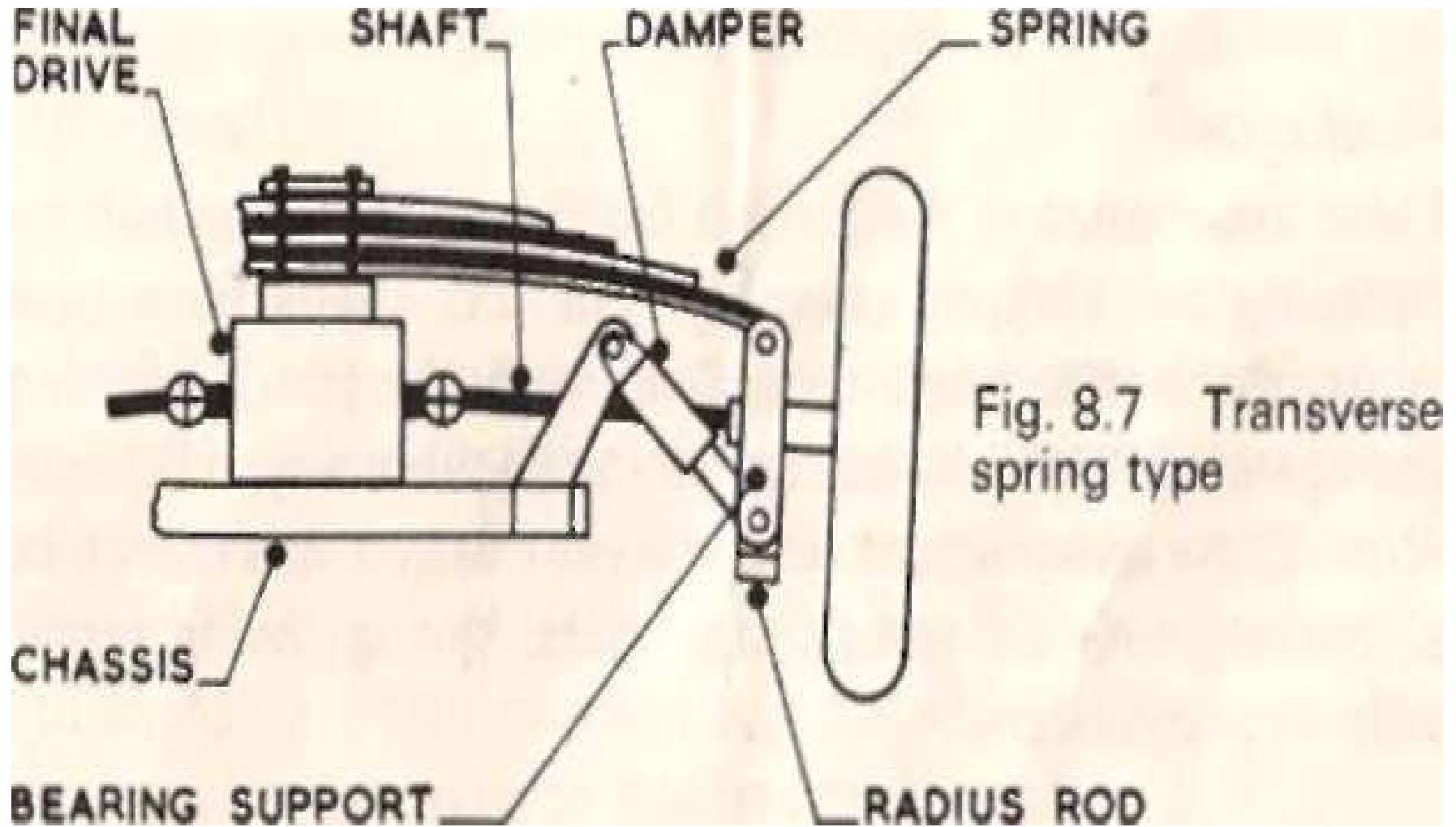
(b) *Swinging arm*

REAR INDEPENDENT SUSPENSION



} *Swinging half-axes*

REAR INDEPENDENT SUSPENSION TRANSVERSE SPRING ARRANGEMENT



SUSPENSION DAMPER

Purpose of the suspension damper

- When the vehicle strike a bump energy is given to the spring which deflect when the bump is past, device the energy stored is released and this carries the spring past the normal position an action that set up an oscillation motion.
- In order to give a comfortable ride/ some device must be fitted to absorb the energy stored in the spring and so reduces the number of oscillation occurring between the initial pump and the return of the spring to the rest position. This duty is performed by the hydraulics dampers or shock absorbers.
- They are two types of hydraulic dampers
 - Lever type (piston lever type)
 - Direct acting(telescopic type |)

SUSPENSION DAMPER

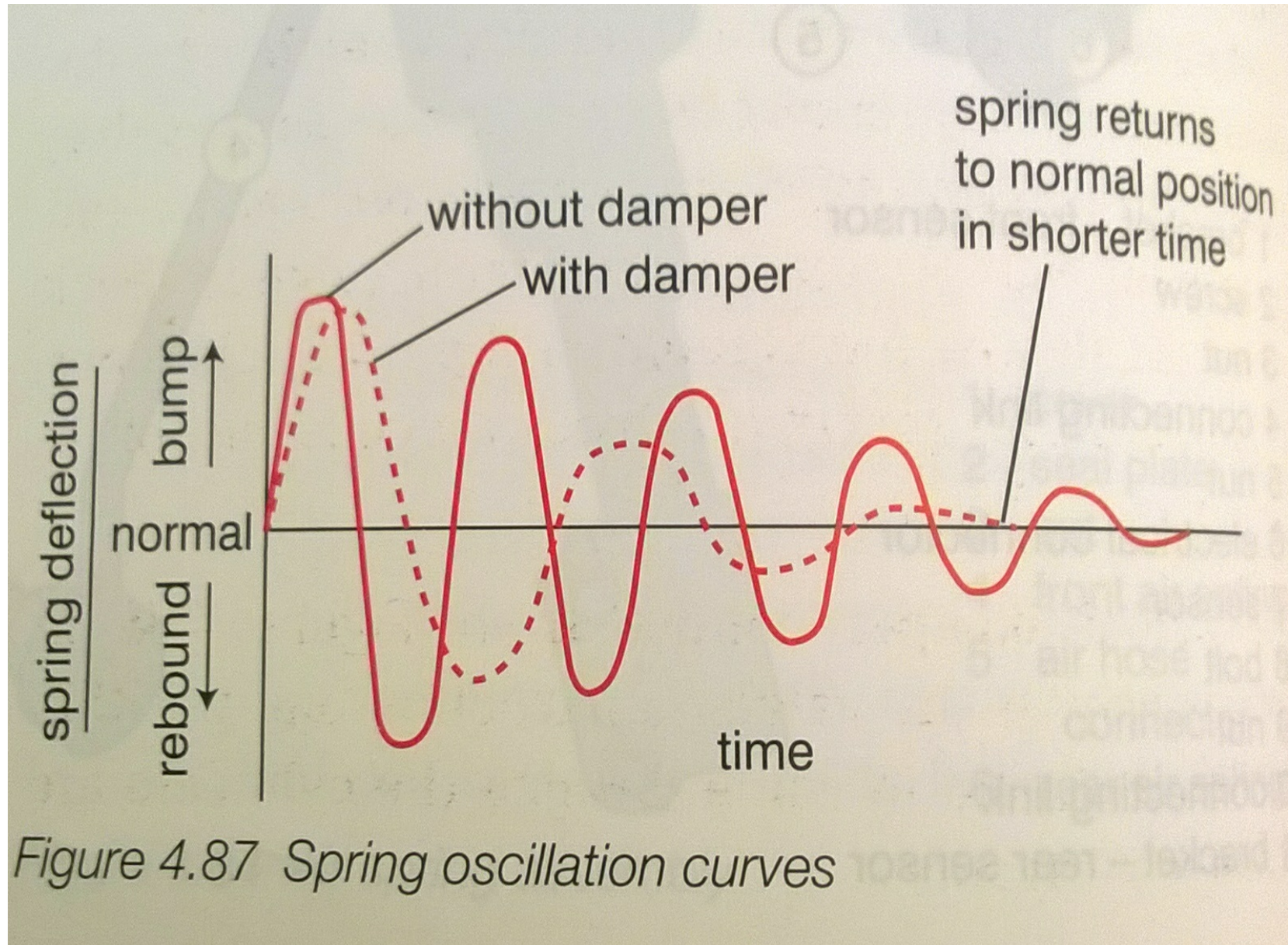
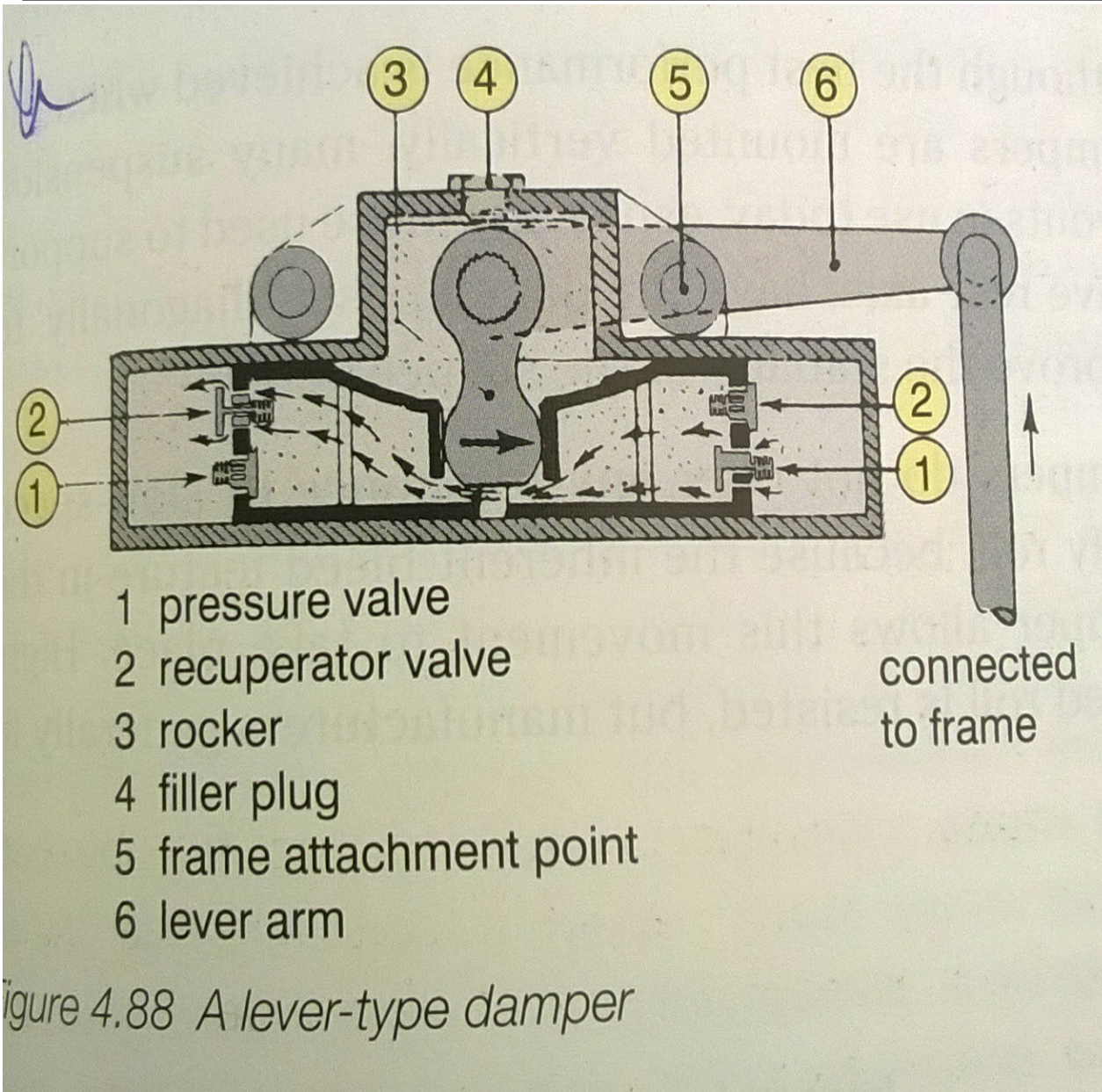


Figure 4.87 Spring oscillation curves

PISTON LEVER TYPE DAMPER

- Lever type damper is mounted to the frame and connected by a lever and link to the axle.
- It has a cylinder that contains two piston in it and this cylinder are fitted with recuperators and pressure valves.
- A thin mineral base damper oil is filled in the cylinder base to the level of bottom of filler plug.

PISTON LEVER TYPE DAMPER



PISTON LEVER TYPE DAMPER

Operation

- The bump movement of the axle operates the damper piston and displaces oil from one chamber to the other. Oil exerts pressure to open the pressure valve allowing the oil to flow through an orifice to provide resistance and passes through the open recuperator valve to breakdown, the depression created in either chamber rebounds of the spring and produces a similar action in the opposite direction.

TELESCOPIC DAMPER

- The main cylinder consist of a piston attached to the rod piston, carries four valves that seal small orifices.
- The piston is enclosed by an inner pressure tube contained in an out tube, both tubes are covered by rod guide at the top and a dust cover.
- A two way valve block is fitted at bottom of cylinder while the piston carries rebound and bump valves.
- A thin oil filled in the cylinder is acted upon by the inner cylinder.

TELESCOPIC DAMPER

Operation

- When the wheel strikes bump the axle pushes the inner cylinder into the upper cylinder. This action reduces the lower chamber and so some oil is forced out of the lower chamber and by so doing the bumping is controlled.
- On rebound reverse flow take place, resistance to each stroke is governed by valve design and orifice diameter.

TELESCOPIC DAMPER

