INTRODUCTION

JUNE
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AUTOMOBILE

An automobile is a self-propelled vehicle which is used for the transportation of passengers and cargo over the ground. Automobile is a vehicle driven by an Internal Combustion engine. It can be defined as a vehicle which can move by itself ex Car, jeep, bus, truck, scooter etc.

VEHICLE

Vehicle is a machine which is used for the transportation of passengers and cargo. Vehicle consists of two parts, i.e. carriage portion and the machine portion. Vehicles used upon the ground contain wheels and axles as the main machine portion.

SELF-PROPELLED VEHICLE

A self-propelled vehicle is that in which power required for propulsion purposes is produced from within. Aeroplane, ships, motorboats, locomotive, car, bus, truck, motorcycle etc are examples of Self-Propelled Vehicles.

MOTOR VEHICLE

It is a vehicle which contains motor [DC motor/Engine] to drive it. It is another popular name for the Automobile.
Vehicle + Motor = Motor Vehicle.

TYPES OF AUTOMOBILES

Automobiles can be classified with different regards which are as under :—

(1) With regard to the purpose these are built for :—
- (A) Passengers Carrier.
- (B) Goods Carrier.

(II)- With regard to the fuel used :—
(A)- Steam Carriages.
(B)- Electric Cabs.
(C)- Petrol / Gasoline Automobiles
(D)- Diesel Vehicles.

(III)- With regard to the number of wheels :—
(A)- Two wheelers.
(B)- Three wheelers.
(C)- Four wheelers.
(D)- Six wheelers etc.

(IV)- With regard to the drive of the vehicle :—
(A)- Single Wheel drive vehicles.
(B)- Two wheel drive vehicles.
(C)- Four wheel drive vehicles.
(D)- Six wheel drive vehicles.

(V)- With regard to their construction :—
(A)- Single Unit Vehicles.
(B)- Articulated Vehicles.

DIFFERENT NAMES FOR THE AUTOMOBILE

(I) Automobile
(II) Auto
(III) Auto Car.
(IV) Auto Buggy.
(V) Car.
(VI) Motor.
(VII) Motor Coach.
(VIII) Motor Vehicle.
(IX) Motor Wagon.
(X) Horseless Carriage.

PARTS OF AN AUTOMOBILE

Every automobile consists of two main parts :—
(I)- Machine Portion / Chassis.
(II)- Carriage Portion / Body.

MACHINE PORTION / CHASSIS

It is the machine portion of the automobile which carries the carriage portion. It is the automobile less body.
Chassis = Automobile — Body.
The Chassis contains almost all the parts of an automobile necessary to drive the vehicle. It contains of the following main parts :—

FRAME

It is the main structure around which all the other parts are connected or suspended to form the chassis.

SPRINGS, SHOCK-ABSORBERS, AXLES AND WHEELS

These are the main parts of the suspension system of an automobile with the help of which chassis frame is put on legs and is able to roll on smoothly on the ground.

ENGINE / POWER UNIT

Power plant to develop the requisite power for the propulsion of an automobile.

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CLUTCH, GEARBOX (TRANSMISSION), PROPELLER SHAFT, DIFFERENTIAL AND HALF SHAFTS OR AXLE SHAFTS

These are the main constituents of the transmission line through which power developed by the engine is transmitted to wheels of an automobile.

STEERING, BRAKES, ACCELERATOR

These are the main controls by means of which the vehicle is turned right or left, stopped and ensure speed which ultimately affects the speed of the vehicle is controlled respectively.

FUEL TANK

A tank or reservoir for carrying fuel with the vehicle.

BATTERY

An electro-chemical apparatus to provide electric current for various electrical appliances in an automobile.

LAMPS, GAUGES, SWITCHES, CONTROLS ETC

Lamps provide eyes to the vehicle whereas gauges serve as indicators and with the help of switches and controls, the vehicle is operated.

CARRIAGE PORTION / BODY

It is that portion of an automobile where the passengers have their seats or where the cargo to be carried is placed. The body is designed according to the nature of cargo to be carried. The body of passenger carrier is much different from the body of a load carrier i.e. truck. Its design depends upon the utility for which the vehicle is meant for. It is made either wood and steel or steel alone. Modern research has led to the development of plastic body.

In trucks, tractors and certain other vehicles, a separate cabin known as Cab is provided for the driver where the instrument panel and other controls are housed.

DESCRIPTION OF AUTOMOBILE

Inorder to write down the description of an automobile, the following factors should be taken into consideration so that a clear picture is obtained :—

(I) TYPE

Whether bus, truck, car, motorcycle etc.

(II) CAPACITY

Carriage capacity — whether 5 ton, 3 ton, 1 ton, 15 cwt, ¼ ton, 4 seater, 6 seater, 30 seater, 45 seater etc.

(III) MAKE

It is the actual name allotted by the manufacturer. In most cases, the make also indicates capacity / HP of the engine fitted in the vehicle such as Maruti 800. This means that Maruti makes car of 800cc engine, the total piston displacement is about 800cc (roughly equal to 5HP).

(IV) DRIVE

(A) RIGHT HAND OR LEFT HAND DRIVE

Which means whether the steering is fitted on the right side or left side.

(B) TWO WHEEL DRIVE, 4WHEEL DRIVE, 6WHEEL DRIVE

This means as to how many wheels the engine power flows or how many wheels are directly connected with the engine. In majority of the cars the engine power flows to the rear wheels only and the front wheels are fitted on the steering axle. These types of cars are known as two wheel drive vehicles. In certain vehicles like Jeep, all the wheels are directly in contact with engine and the engine power could be transmitted to all the four wheels.

Drive is usually indicated as follows :—

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Left Hand Drive ; 4x4 (4 wheel drive)

OR

Left hand, Four wheel Drive, 4x4 means that the vehicle contains four wheels and the engine power could flow towards all the four wheels.

6x4 means that there are six wheels but the engine power could flow towards four wheels only.

(v) MODEL

Year of manufacture or special code number allotted by the manufacturer. Hence inorder to mention the description of an automobile, the following information shall be required :— Type, Capacity, Drive, Make, Model.

ex. JEEP — Car 6 seater, 4WD (4x4), Jeep, Mahindra MM-540, DP (Diesel).

CONSTRUCTION OF AUTOMOBILE

Wheel is considered as symbol of civilization. Wheels and axle is the main machine in a vehicle. The most common type of vehicle used in our country-side is bullock cart. Inorder to understand the construction of an automobile, let us follow the construction of cart.

A cart consists of the following main parts :—

(I) Frame.
(II) Wheels and axle.
(III) Yoke.
(IV) Superstructure and Platform.

The cart could be split up into following two main parts :—

(I) Machine Portion.
(II) Carriage Portion.

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Machine portion consists of a frame to which wheels are attached through the axle. A yoke is fitted at the front of the frame through which the cart is pulled by the bullocks.

The carriage portion consists of platform and superstructure which is mounted over the frame. The load of the carriage portion and the contents to be transported is borne by the frame which consists of two long members connected by cross members.

The basic construction of an automobile much resembles with that of a cart. An automobile too, consists of machine portion and carriage portion, similar to a cart. The difference between a cart and an automobile being that cart is a simple vehicle whereas automobile is a motor vehicle. In addition to simple vehicle, an automobile consists a motor or an Engine, which develops rotary motion to drive the vehicle. For transmitting power to the wheels, clutch, transmission, propeller shaft, universal joints, differential, half-shafts etc are provided in the motor vehicle. To keep the automotive vehicle under control, it is properly bricked. Steering for direction control, accelerator for speed control and brakes for stopping purposes are provided in the automobile.

The cart is a slow coach whereas the automobile is a fast moving machine. Due to fast speed, the automobile is subject to more shocks which put more strains on the frame. Inorder to overcome this difficulty, the automobile is needed shock proof and its frame should be robust enough to bear all stresses and strains.

In an automobile, axle is not directly fixed with the frame. Axles are suspended with the frame through strong springs. Shock absorbers are further installed to arrest shocks and thus to save the passengers from jerks due to the road irregularities.

Lamps are provided with the automobile so that these could be driven safely during dark. Horn is installed to provide warning sound to the other road users.

CHASSIS FRAME

In the construction of an automobile, chassis frame is the basic requirement. It is the foundation of the chassis. It serves the following purpose:-

(I)- To form base for mounting engine and transmission units.
(II)- To accomodate suspension system.
(III)- To take engine and transmission thrust and torque stresses.
(IV)- To serve as the body, fuel tank and battery mounting unit.

The chassis frame must be strong, light and designed so that it may withstand the shock blows, twists, vibrations and other stresses to which it is subjected on road. The majority of chassis frames in common used today are of channel or box section and the cross members are the same and are made of pressed steel. In conventional designs, the cross members of a chassis frame are at right angles to side members. Several modern chassis frames have cross members that cross in the form of letter "X" between the side members. The side members and cross members are rigidly attached to each other by riveting or welding.

LOADS ON CHASSIS FRAME

A chassis frame is subjected to following loads:—

(I)- Heavy and suddenly applied loads of short duration such as when the vehicle is crossing a broken patch of road/roads.
(II)- Combined loads of momentary application at long intervals while negotiating curve, applying brakes and striking a pot hole, all at the same time.
(III)- Inertia loads of short duration due to brake application.
(IV)- Externally applied impact loads, when the vehicle collides with another object.
(V)- Overloading of the vehicle.
(VI)- Static load of chassis parts such as engine, transmission, steering, fuel tank, body etc.

LOADS ON AXLES

The front and rear axles act as beams due to carry vehicle weight. The weight carrying portions of the axles are loaded at spring centres and are subject to the following loads:—

(I)- Vertical load at spring centres owing to vehicle weight.
(II)- Load at centre of wheel due to driving or braking effort.
(III)- Side thrust at tyre reaches owing to centrifugal force while cornering.
(IV)- Torque reactions on driving and braking.
(V)- Shock loading when striking an unexpected obstacle during cross country drive.

BODY/CARRIAGE PORTION

The body serves as housing for the passengers and cargo to be carried in an automobile. The type of body constructed over the chassis gives birth to a particular type of automobile. The body is built according to the utility for which the vehicle is meant. The body differs in shape and size/design. The bodies of all the trucks are not of the same type. Similarly, the bodies of all the cars and buses are not of the same nature. There is vast difference between the body of passenger carrier and goods carrier.

In other words, body is a furnished room providing the necessary amenities. Body is thus a composite of wood and steel work, upholstery work, nickel, paint and decoration work. The bodies of car are classified as under:—

Saturday 30

SEDAN — Enclosed type having two or four doors like Fiat and Ambassador cars in India.

COUPE — Having one seat, the rear half of the body being used for luggage space, accessible from a separate door.

CONVERTIBLE — In this type of bodies the top is of fabric and could be folded down. The rear is little narrower to provide room for the folded top.

01 Monday

LIMOUSINE → This is like a sedan with an intervening window to isolate the driver's compartment. In some extra cases folding seats are provided.

STATION WAGON → Originally, station wagons were meant to transport guests and their luggage to and from the railroad station. In most models the centre seats fold down and the rear seats is removed to provide luggage space. Station wagons are built with either two or four doors and all models are provided with a large tail gate.

HARD TOP → This has the same seating arrangements and the same windows as convertible. When the windows are down, the hard top is very much like the convertible with its top up.

The bodies of the trucks usually come under two categories i.e. High and Half. Full size body trucks are used to carry lighter goods occupying more volume whereas half body trucks are used to carry solid materials such as bricks, pig iron, steel, sand, gravel etc. In trucks there is a separate cabin for the driver so that the material carried by the vehicle may not roll towards the driver's seat during sudden stoppings, climbing up and down the hill and also at cornering.

Truck bodies contain superstructure to support tarpaulin to protect the cargo from sun, fog, snow and rain etc. A tail board is provided in the body which serves as a gate to load and unload the goods.

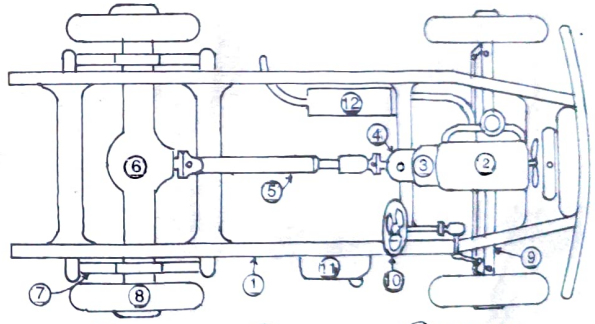
Bodies of the buses are enclosed type. Railing is provided at the roof so that the passengers could keep their luggage there. All the doors and windows are provided with safety glasses. The bodies of deluxe and air-conditioned coaches are much improved. Utmost care is taken to provide maximum comfort to the passengers. Adjustable and cushioned comfortable seats is one of the main provisions.

DETERMINATION

Your level of success is only pre-determined by your level of effort.

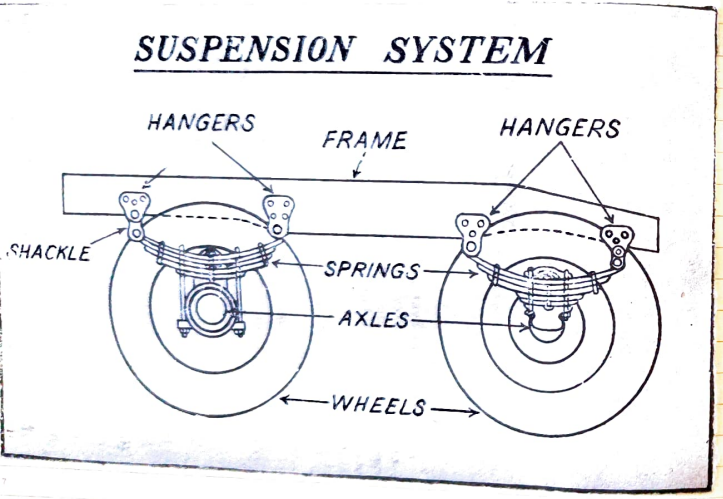
Be Sure!

AUTOMOBILE CHASSIS



(1) FRAME (2) ENGINE (3) CLUTCH (4) GEAR BOX
(5) PROPELLER SHAFT (6) REAR AXLE (7) ROAD SPRING (8) WHEEL
(9) FRONT AXLE (10) STEERING (11) FUEL TANK (12) SILENCER

FRIDAY						
SATURDAY	6	13	20	27		
SUNDAY	7	14	21	28		



SUSPENSION SYSTEM

INTRODUCTION

This system deals with the suspension of wheels and axles with the chassis frame through the road springs. The frame is put on wheels and becomes capable to roll on. It fulfills the following main objectives in an automobile :—

(I)- To protect the passengers from road shocks.
(II)- To reduce the stresses due to road shocks on the mechanism of the car.
(III)- To maintain the body on an even level when travelling over rough ground or when turning so that any rolling, pitching or vertical tendency is minimised.

This system consists of the following main parts :—

(I) Springs.
(II) Spring Shackles.
(III) Axles.
(IV) Wheels.
(V) Shock Absorbers.
(VI) Stabilizers.

SPRINGS

The springs support the chassis frame over which falls the weight of engine, power-train components, body, passengers and their luggages etc. They 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 axles. The following type of springs are employed in the automobiles :—

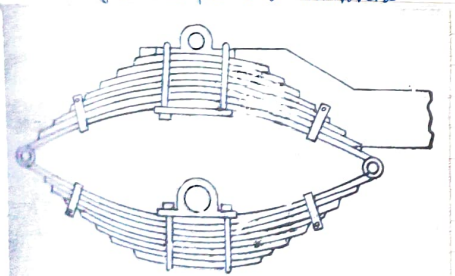
(I)- Leaf Springs (II)- Coil Springs And (III)- Torsion Bars/Units.

Each of these types of springs absorb shocks in a different way. Leaf springs absorb shocks by bending, coil springs by compressing and torsion units by twisting.

LEAF SPRINGS

Leaf springs are made up of long flat strips of spring steel. Several strips are placed one on the other side and held together by means of a centre bolt and clamps. Each strip is called as 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 frame. The other leaves in the spring are assembled with the main leaf by means of centre bolt and clamps. Each succeeding leaf is shorter than the preceding one. The springs which are suspended with the frame through rubber bushings instead of shackles and pins, do not contain loops or holes at the end of the main leaf. Leaf springs are of elliptical shape. Its chamber is a pre-determined factor which is set at the time of manufacture or afterwards during recambering. Leaf springs are of the following types:—

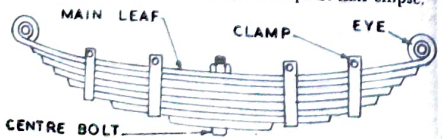
(I) Full Elliptic (II) Three Quarter Elliptic (III) Semi-elliptic (IV) Quarter Elliptic (V) Transverse.



FULL ELLIPTIC

Fig. 3-3.

(iii) Semi-elliptic. Forming the shape of half ellipse.



SEMI ELLIPTIC

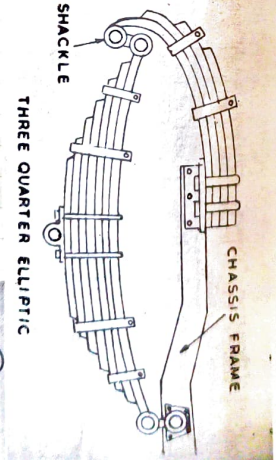
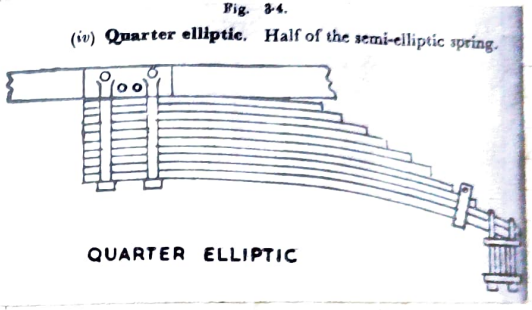
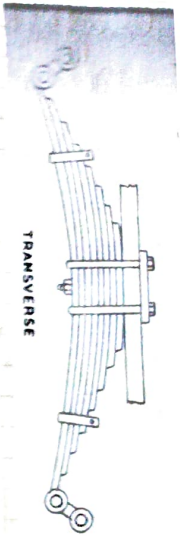


Fig. 3-4.

(iv) Quarter elliptic. Half of the semi-elliptic spring.



QUARTER ELLIPTIC



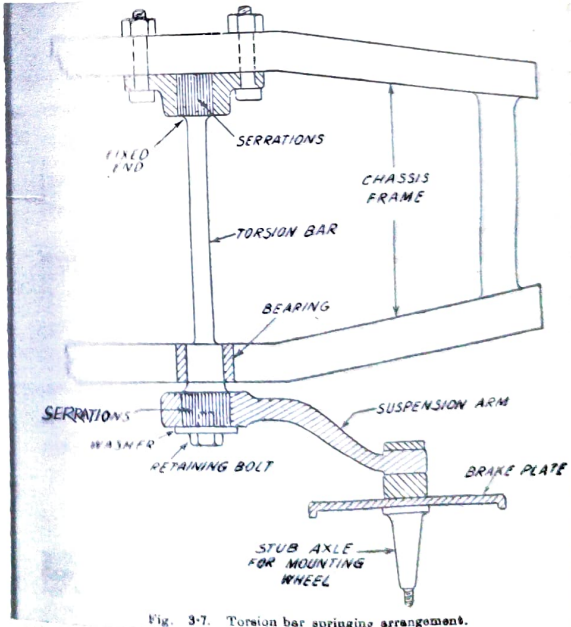


Fig. 3-7. Torsion bar springing arrangement.

COIL SPRINGS

The coil spring is made of a length of special spring steel, usually round in section, which is wound in the shape of a coil. The ends of coil spring are kept flat so that they could seat properly. Coil springs are mostly used in the independent suspension systems.

HELICAL SPRINGS

Helical springs are used in the vehicles to provide additional support for heavy loads. These are both leaf as well as coil spring types.

TORSION UNITS

As the torsion units function by twisting so their spring action is achieved through resistance to twisting. When the twisting effort is discontinued the unit untwists to its original attitude. Torsion units are of the following types:—

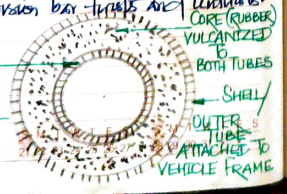
(I) Torsion bar.
(II) Rubber Torsion Unit.

TORSION BAR

It is a steel bar which functions by twisting. It possesses the same characteristics as do coil or leaf springs which are also made of steel. One end of the torsion bar is secured to the frame so that it may not turn. On the other end is fixed an arm over which is fitted road wheel. As the wheel moves up and down, the arm swings like a pump handle and the torsion bar twists and untwists.

RUBBER TORSION UNIT

The general arrangement of rubber torsion unit is similar to that of steel torsion bar types.



The twisting member in this case consists of two tubes of different sizes vulcanized to a rubber core as shown in the figure. The outer tube is fixed with the chassis frame while the inside tube serves as a shaft for the suspension arm over which is fitted the road wheel. As the wheel moves up and down, the suspension arm swings which twist and untwists the inner tube. Since the inner tube is vulcanized with the outer tube so the media of rubber provides springing action.

SPRING SHACKLES

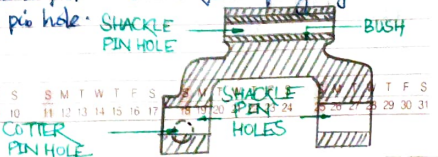
Shackles are a sort of links by means of which leaf springs are connected with the chassis frame. The shackles provide swinging ability to the leaf springs. Due to shock on the road wheel, the spring flattens up and increases in length and during rebound the spring assumes back its shape thereby decreasing in length. The shackles make the springs worthy to swing in and out.

Different types of shackles are used in different vehicles which are as under:—

(I) U-type.
(II) Y-type.
(III) Link type.

U type of shackle is applicable in Jeep whereas link type is provided with Chevrolet vehicles. Y types of shackle is most common in rear suspension.

One end of the shackle is connected with the chassis frame and through the other end connection is made with the spring by means of shackle bolt or pin. The shackle pin contains a hole at which grease nipple is screwed. Lubricant is fed to the shackle or spring eye bushing through the shackle pin hole.



AXLES

Axles act as axis for the wheels to spin around. Beam type axles bear the load of the vehicle. In an automobile, the following types of axles are used :—

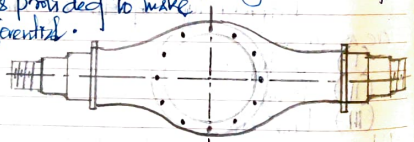
(I) — Live Axles.
(II) — Dead Axles.

LIVE AXLES

These are those axles which contain differential and through which rotary motion is transmitted to the wheels. In these axles, there is a big housing for enclosing differential. These axles are also known as Drive Axles. According to construction, the drive axle housing is of two types which is as under :—

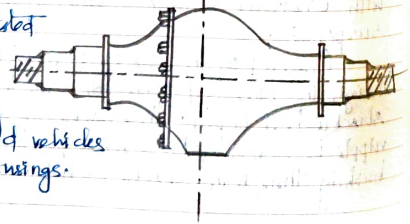
BANJO TYPE

This type of axle housing resembles with banjo instrument. In order to fit the differential in it, the requisite opening is provided on the backside, a cover is provided to make necessary repairs to the differential. These types of axle housings are applicable in Chevrolet vehicles.



SPLIT TYPE

Split type axle can be separated in two halves for putting in or out the differential. Both portions held into one unit by means of nuts and bolts. Ford vehicles contain these types of axle housings.



DEAD AXLES

These are those types of axles which do not contain differential. These are simply beams which support the vehicle weight and serve as axis for the wheels. These axles have no concern with the power transmission system of the automobile. This is the reason why these axles are known as Dead Axles.

Dead axles are usually the front axles. Front dead axle contains I-section beams at both ends of which are connected stub axles by means of kingpins so that the wheels can be steered.

WHEELS

The wheels convert rotary motion into longitudinal one. Wheels support the whole weight of the vehicle. They are legs of the vehicle which carry it to far off distances. The following types of wheels have been used in the automobiles :—

(I) — Artillery Wheels.
(II) — Wire Spoked Wheels.
(III) — Steel disc wheels.

ARTILLERY WHEELS

These wheels were used in the early automobiles. These wheels consisted of wooden hub, spokes and rim having steel or solid rubber tyre just like tonga or cart wheel.

WIRE SPOKED WHEELS

These wheels are quite popular in motor cycles although motor cars too were provided with these types of wheels.

Wire spoked wheels consists of hub, spokes or wries, rim, tyres, tube, flap and tube valve.

STEEL DISC WHEELS

These are in common use with the modern vehicles. These wheels consist of rim, ring or split type rim, tyre, tube, flap & tube valve.

With regard to the type of tyre, the wheels can be classified into following categories :—

(I)- Solid tyre wheels.
(II)- Pneumatic tyre wheels.

SOLID TYRE WHEELS

In early vehicles, solid tyre wheels were used. Solid rubber tyre was mounted over the rim of the wheels. These wheels were much heavy and were a hurdle in the matter of speed.

PNEUMATIC TYRE WHEELS

These tyre wheels use air as media between tyre, tube and rim to cushion out the road shocks. These wheels are much lighter than the solid type wheels. All the modern vehicles are equipped with these types of wheels; whether they are wire spoked wheels or steel disc wheels. These wheels contain tyre and tube in place of a solid tyre.

Pneumatic tyre wheels can be further classified as below :—

(I)- TUBE TYRE WHEELS

which contain both tube and tyre.

(II)- TUBELESS TYRE WHEELS

which contain no tube, air being filled into tyre which is sealed with the rim.

SHOCK ABSORBERS

The shock absorbers contract the spring action, absorbing it down on both compression and rebound and thus prevents the vehicle from bouncing. Vibrations are set upon the road spring while the vehicle is running on bad road, causing shocks. Similarly when a stone comes below the wheel or it falls into a pit, a stern shock is experienced which makes vehicle riding an uncomfortable affair. To avert the shocks, it is necessary that the spring action be controlled. Shock absorbers fulfills this requirements.

Shock absorbers can be classified into two categories :—

(I)- Mechanical Shock Absorbers.
(II)- Hydraulic Shock Absorbers.

MECHANICAL SHOCK ABSORBERS

In this type, the frictional effect of metallic discs is utilized to control spring action. The mechanical shock absorbers consists of two links which are connected with each other by means of a pin. Between the links, are placed a number of frictional discs of different metals. One link is connected with the frame whereas the other is fixed with the axle. The frictional discs which are housed between the arms, controls the spring action due to their frictional effect and thus helps in absorbing shocks/road shocks.

HYDRAULIC SHOCK ABSORBERS

In this type, fluid is used to resist the spring action. According to the acting of shock absorbers these can be divided into two categories :—

(I)- Single Acting Shock Absorbers → which regulate the rebounding action of road springs by controlling the return of the flexed springs to their normal shape.

(II)- Double Acting Shock Absorbers → which control both compression and rebound of the road springs.

In hydraulic shock absorber, fluid is forced to pass through a tiny hole which resists

AUGUST

the movement of fluid. The resistance creates friction in the fluid which gives rise to heat. Fluid in the shock absorber absorbs this heat generated due to spring action and thus energy of motion is absorbed. Thus the road shocks is Absorbed by converting energy of motion into heat which is absorbed in the fluid of shock absorber.

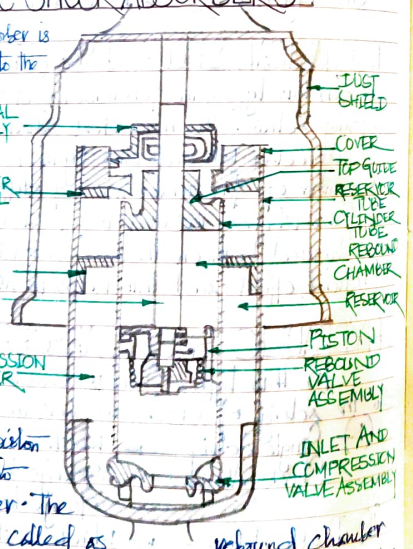
Hydraulic Shock Absorbers can be classified as under:—

(I) Direct Acting Hydraulic Shock Absorbers.
(II) Cam Actuated Piston Type Hydraulic Shock Absorbers.
(III) Rotary Vane Type Hydraulic Shock Absorbers.

DIRECT ACTING HYDRAULIC SHOCK ABSORBERS

One end of this type of shock Absorber is connected to axle whereas the other to the chassis frame. It checks both the compression and rebound of the road spring.

There are two chambers in this type of shock absorbers. The outer chamber serves as a Reservoir in which the inner chamber is housed, which acts as a cylinder. The cylinder contains a combined piston and valve which is connected to a rod. The combined piston and valve divides the cylinder into two chambers — upper and lower. The upper chamber of the cylinder is called as rebound chamber whereas the lower chamber is called as the compression chamber.



When the road spring is compressed, combined piston and valve move into the lower chamber of the cylinder, compressing fluid in this chamber. Since the fluid is incompressible, so it opens the valve connected with the piston and enters into upper chamber of the cylinder. Some of the fluid passes into the outer chamber by opening the inlet and compression valve located at the bottom of the cylinder.

When the road spring comes at rebound, the fluid resistance in the shock absorber puts its effect on it. As soon as the combined piston and valve is pulled up, valve with the piston is closed but due to increase in pressure, it opens out to other direction as this is double type of check valve. Opening of the valve in the other direction, tends the fluid to flow from upper to lower chamber of the cylinder. So this way, this type of shock absorber acts on both ways to check both compression and rebound of the road springs, thereby damping the shocks.

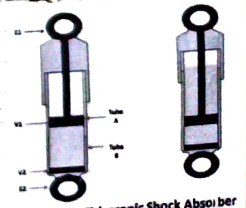
This type of shock Absorber is also known as Telescopic Shock absorber as it moves up and down in one line during its working just like the telescope barrel.

CAM ACTUATED PISTON TYPE HYDRAULIC SHOCK ABSORBERS

These types of shock absorbers are of both single acting and double acting type.

DOUBLE ACTING SHOCK ABSORBER

This type of shock absorber contains two pistons, one of which is rebound whereas the other is of the compression piston. The pistons are actuated by a cam fitted on a shaft. There is a lever attached to cam shaft, which actuates the cam thereby resulting in the movement of pistons.


Twin Tube Telescopic Shock Absorber

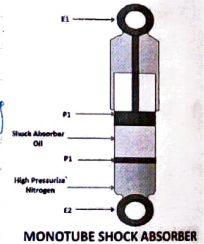
Every piston contains one intake and one relief valve each. Fluid is transferred from one chamber to another through these valves.

During compression of road spring, the fluid goes out from compression chamber through relief valve and enters into the reservoir. During this process, compression of the road spring is checked up. During the same process fluid enters into rebound chamber through the rebound valve.

During rebound of road spring, the fluid goes out of rebound chamber through relief valve and enters into the reservoir and rebound of the spring is checked up. In the meantime, fluid enters into compression chamber through the intake valve.

SINGLE ACTING SHOCK ABSORBER

In this type of shock absorber, there is only one piston and one intake and one relief valve. When the wheel strikes a bump on road, the road springs are compressed and the car frame moves downwards carrying the shock absorber with it. This causes the shock absorber arm to move upward relieving the cam pressure on the piston. Release in pressure by the cam allows the piston spring to force the piston outwards creating a vacuum behind the piston. The vacuum causes the intake valve under the head of piston to open permitting the fluid to flow under the piston head and fill the piston chamber.



MONOTUBE SHOCK ABSORBER

As the wheel pass over the bump, the car springs rebound and the car frame moves upwards carrying the shock absorber with it. This causes the shock absorber arm to move downwards, applying the cam pressure on the piston. The cam forces the piston into the cylinder closing the intake valve. The oil trapped in the cylinder, forces the relief valve off its seat and goes out slowly into the reservoir. Rebounding of road spring is thus damped out by this action.

ROTARY VANE TYPE HYDRAULIC SHOCK ABSORBERS

This type of shock absorber contains a round chamber in which a two lobe rotor moves in the viscous fluid. The main chamber contains two fixed vanes, spring, oil seal, cover and link. When in assembled state, the main chamber is divided into four parts. When the rotor is moved, fluid is

under pressure in two chambers because of the construction of valves which allow very little fluid to flow towards chamber having less pressure. When the rotor moves in the reverse direction, high pressure chambers are connected into low pressure ones.

The chambers of the shock absorber are kept filled with fluid automatically so that the effect of its action may not decrease. The rotor shaft is operated by an actuating arm which is connected with the axle by means of a link. The body of the shock absorber is held with the chassis frame.

STABILIZERS

Stabilizers or Sway Bars are alloy steel bars which connect shock absorber operating arms or independent suspension control arms. There is one separate bar each to connect rear and front shock absorbers.

The stabilizers are placed parallel to the cross members and attached to the front or rear of the frame through rubber bushings or similar material. If one side of the vehicle tries to rise faster than the other, the resultant twist in the bar reacts on the axle or suspension and tends the frame to keep at level. Thus the stabilizers keep the vehicle stable while moving on uphill road or taking corners.

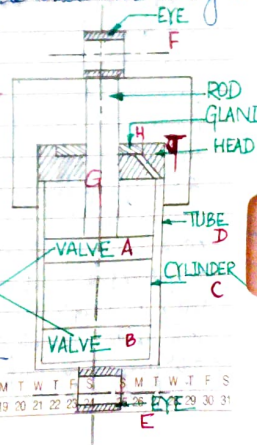
TELESCOPIC SHOCK ABSORBER

CONSTRUCTION

(I) A telescopic shock absorber derives its name from tubular shape of early telescopes used in ancient times.

(II) They are of 2 types viz. mono tube and twin tube type. The twin type shock absorber is as shown in the figure.

(III) Rod G is attached to a 2 way valve A while another similar 2 way valve B is attached at the lower end of cylinder C.



(iv)- There is a fluid (oil) in the space between the valve A and B and also in the annular area between cylinder C and tube D.
(v)- H is a gland in the head J. The eye E is connected to axle and eye F is connected to the chassis frame.

WORKING

(i)- Consider that the vehicle has come across a bump.
(ii)- Then the eye E would move up and thereby the fluid will pass from the lower side of valve assembly A to the upper side. But since the volume of the space above A is less by the volume of rod G, the fluid will exert its pressure on valve assembly B and go to the underside of valve B.
(iii)- This passage of the fluid through valve opening provides the damping.
(iv)- A similar process takes place in opposite direction for rebound.

INDEPENDENT SUSPENSION SYSTEM [COIL SPRINGS]

Coil springs are made from hardened and tempered steel, wound in a spiral formation. Most modern passenger cars built in last few decades features coil springs at all four wheels; and increasing number of pickups and SUVs are now equipped with them in front as well as the rear.

Coil springs can be firm, soft or have a spring rate that varies. As a pound per-square-inch measurement, spring rate is the force required to compress a coil spring 1 inch. The higher the per-inch spring rate, the stiffer the spring. Spring rate is also used to describe whether the spring has the same rate of compression at all points during its travel (linear), gets progressively stiffer the more it compresses (progressive) or is specially configured to change characteristics abruptly (dual rate).

ADVANTAGES

Coil springs allow the most flexibility when it comes to variable rate characteristics. For trucks, variable rate coil springs allow a comfortable ride when the vehicle is unloaded. As weight is added, the spring rate becomes stiffer to increase stability without the ill effects of bouncing and it prevents the ride height from dropping significantly.

For performance-oriented cars, with a low ride heights, variable rate springs allow better absorption of bumps during normal street use, then become stiffer around turns to reduce body roll during aggressive driving. Coil springs can also allow for a greater amount of up and down wheel-travel, which is a huge advantage on rutted and rocky off road trails.

DISADVANTAGES

Coil springs aren't suited to carrying heavy loads as leaf springs are. With coil springs, vehicle weight is concentrated onto a smaller surface area of the vehicle frame, while leaf springs spread a load out more evenly. To save overall weight on cars that keep getting heavier with additional standard and optional equipment, some manufacturers have taken to making coil springs lighter and thinner.

Unfortunately, this makes them more subject to cracking and breaking under pressure — especially if corrosion sets in. As coil springs age, they naturally loose their resilience and starts to sag causing the ride height to drop.

INDEPENDENT SUSPENSION SYSTEM [TORSION BARS]

Torsion bars don't flatten out like a leaf spring or compresses like a coil spring. Instead, a narrow steel tube attached to the vehicle's control arm twists along its axis or length when that control arm travels up and down. The other end of bolted to the frame of the vehicle is fixed in place and doesn't twist. When a wheel strikes a bump and moves upward, the tension is created as the bar twists out of shape. After the bump, the steel bar unwinds and pushes the wheel downward again.

Torsion bars are typically mounted in a front-to-rear position on the vehicle, allowing bars to have greater length for more up and down wheel travel on 4x4s. The attachment ends of torsion bars are usually either hex-shaped or splined and mounted in an anchor piece known as a "key". The position of these keys can be adjusted with a wrench to vary a vehicle's overall ride height. As the key is turned to raised position, the ride height of the vehicle increases or vice-versa.

Spring rates of torsion bars are determined by: A bar's thickness, overall diameter, length and the material it's made out of (steel, alloy usually).

ADVANTAGES

Because torsion bars are very space efficient and take up much less overall volume, drive axles and other suspension components can be located where other types of springs would be in the way. And because ride height can easily be adjusted, it allows a vehicle owner to set it to his/her own taste.

Additionally, adjusting a torsion bar key to raise ride height when the springs have started to wear will extend their useful lifespan—while maintaining proper ride height that doesn't interfere with alignment and tyre wear.

DIS-ADVANTAGES

Because torsion bars are mounted low along the vehicle's underside, they can be more likely damaged by speed bumps, debris in roads, and uneven terrain. It's important to visually inspect them for

21 Sunday damage in the event they have become bent, scrapped or cracked.

ADVANTAGES OF INDEPENDENT SUSPENSION SYSTEM

(I)- Reduced unsprung weight and hence improved ride and better road holding while cornering and braking.

(II)- The frame and body do not tilt but remain horizontal and the wheels vertical when the vehicle encounters a road bumps.

(III)- The wheels being sprung independently, springing movement of one wheel is not transmitted to the other side.

(IV)- Provides a greater degree of vertical springing movement.

(V)- Diminished wheel wobble and steering tramp.

(VI)- Provides scope for the use of springs for greater resilience giving much better springing action than most rigid axle vehicles.

SPRUNG WEIGHT

It is the weight of everything supported by the springs including a portion of weights of springs itself. It is the weight of vehicle minus unsprung weight.

Sprung Weight = Total weight of vehicle — Unsprung weight.

UNSPRUNG WEIGHT

It is the weight of everything between the springs and road and a portion of weights of springs itself. It is the weight of wheels and axles et

BOUNCING

It is vertical movement of the complete body. When the complete body of the vehicle rises up and down, it is known as Bounce or Bouncing. There may be front end or rear end bounce.

PITCHING

It is rocking chair action or rotating action about a transverse axis throu the vehicle parallel to ground. Due to pitching the front suspension moves out of phase with the rear resulting in rocking effect.

ROLLING

It is movement about a longitudinal axis produced by centrifugal force when cornering.

TYRE SPECIFICATION

On the sidewalls of the tyre cover there are several markings indicating tyre size, ply rating, tyre number, tyre make etc. The tyre size is mentioned Like This — 7.50×20

The first figure (7.50) indicates the nominal cross-sectional width of the tyre in inches. The second figure (20) indicates the nominal diameter of the tyre from bead to bead in inches and indicates the correct rim diameter.

On metric size tyres markings such as 155-80-R-13 show 155 = tyre section width in mm; 80 = aspect ratio (section height/section width); R = construction type (R = radial; B = bias belted; D = diagonal; E = elliptic; B = rim diameter in inches); 13 = nominal diameter of the wheel rim in inches.

Example 205/65R15 95H

205 indicates the normal section width of tyre in mm (205 mm).

65 indicates its aspect ratio, a comparision of tyres section height with its section width (65 indicates the height is 65% of its width)

R indicates radial ply construction.

15 indicates the nominal diameter of the wheel rim (15 inches).

95H is a symbol indicating the max. load capacity and speed at which the tyre can be safely operated, subject to the tyre being in sound condition, correctly fitted and with recommended inflation pressures (95 represents a max. load of 690 kg per tyre H represents a maximum speed of 210 km/hr).

CAUSES OF TYRE WEAR

The different causes of tyre wear are as follows:—

(I) Air Pressure.
(II) Balance Issues.
(III) Bent Wheels.
(IV) Alignment.

AIR PRESSURE

Improper air pressure will cause tyres to wear in specific patterns according to whether the tyre is over-pressured or under-pressured.

BALANCE ISSUES

Improper balance will cause the tyre to spin with a wobble due to unbalanced centrifugal forces. This wobble will cause the tyre to wear improperly and probably show up as a vibration as well.

BENT WHEELS

A bent wheel, in addition to probably causing a vibration in the car, will also affect the wear on its tyre and can even affect the wear on the other tyres as well.

ALIGNMENT

A 4 point alignment essentially ensures that the tyres are all parallel to each other and flat to the pavement, giving the tyres their optimal wear profile. If the alignment is incorrect, any number of wear patterns can develop.

(I) — Under-inflation.
(II) — Over-inflation.
(III) — Excessive road speeds.
(IV) — Violent acceleration and braking.
(V) — Presence of oil and grease on tyres.
(VI) — Overloading.
(VII) — Mis-alignment of the wheels.

The tyres should be examined periodically for stones, nails, glasses and other foreign objects which may be embedded in the tread and also for cuts, penetration or contamination by oil.

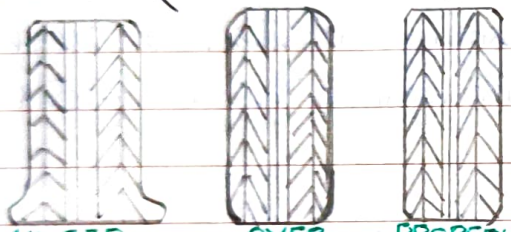
REMEDIES OF TYRE WEAR

Here are some remedies of tyre wear :-

(I)- ADJUST YOUR DRIVING HABITS

You can't avoid all the tyre wear, but you can avoid driving behaviours that tend to trigger it. For instance, taking curves too fast can wear the edges of your front tyres. Hitting a pothole can create tyre leaks and wear, and even mess with the wheel alignment. Take care to avoid speeding over puddles that could be hiding deep potholes.

(II)- MONITOR AND MAINTAIN PROPER TYRE PRESSURE



Check your tyre pressure every other time you fill up gas, or at a minimum, once a month. When properly inflated, your tyres can evenly distribute force from your vehicle to the road. When either under or over inflated though, your tyres can't make proper contact with the road. When a tyre is under inflated, more of its surface area comes in contact with the road. When over-inflated less the tyre's surface area comes in contact with the road. Both the situations can cause premature, uneven tyre wear and lead to reduce gas mileage and also tyre lifespan.

(III)- ROTATE THE TYRES REGULARLY

It is exactly what it sounds like : the tyres are swapped positions to help them wear more evenly (and therefore more slowly). Your front tyres experience more stress when driving since they are the ones that are primarily responsible for steering and turning the car. A tyre rotation makes sure each tyre gets a chance to ride in the front.

(IV)- INVEST IN ROUTINE WHEEL ALIGNMENT

Proper wheel alignment ensures optimal drivability. It helps your tyres last longer, your vehicle drive smoother and ultimately keeps your wheels pointed in the right direction.