CAUTION

UNIT-II

RUNNING SYSTESM

ROAD WHEELS:

Wheels are as important of a vehicle as the ether parts. lithe parts being perfectly in working order, the vehicle can't move on the road, without wheels. The wheels not only support the weight of the vehicle, but also protects it from the ad shocks. Whereas the rear wheels move the vehicle, the wheel steers it to take a right or left turn. All the four heels must resist the braking stress and with stand side rust.

FJNCTIONS OF WHEELS:

1.Strong enough to with stand the weight of the vehicle

2.Flexible to absorb the road shocks which are caused when the vehicle is on move.

3.It should be able to grip the road surface

4.Perfectly balanced dynamically and statically.

5.Light and easily remarkable.

TYPES OF WHEELS:

1.Disc wheel

2.Wire wheel or spoked wheel.

3.Magna wheels

4.Heavy vehicle wheels (three pieces)

DISC WHEEL:

This type of wheel (Fig) consists of a steel rim d a pressed steel disc. The rim is a rolled section, some times riveted but usually welded to the flange of the disc. e steel disc performs the function of the spokes. The wheel assembly is bolted to the brake drum. Some slots are genesis provided in the wheel disc for better cooling of the brake

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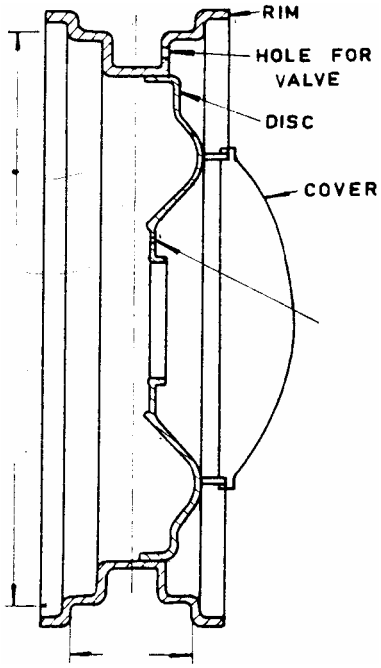

Fig Disc wheel

A separate cover is also provided on the wheel disc. A ho ip the rim serves to accommodate tube valve.

This type of wheel is cheap, robust in construction an simple. It is most commonly used in heavy motor vehicle cars buses, trucks and tractors.

WIRE WHEEL OR SPOKED WHEELS:

Unlike the disc wheel, the wire wheel has a separate hub, which is attached to the rim through a number of wig~ spokes as shown in Fig 3.J~ The spokes carry the weight and transmit the driving and braking torque in tension The initial tension of the spokes can be adjusted by means screw nipples which also serve to secure the spokes to the rim. The hub is provided with internal splines to corrosion to the splines provided on the axle shaft. A wing nut or the hub on the axle shaft, The advantages of this

ORIVING TORQUE BRAKING TORQUE

WIRE WHEEL

CAUTION

This type of wheel are light weight and high strength, and above all it provides much better Cooling of the brake drum. It is also very easy to change the wheel when required because only one nut has to be opened.

MAG WHEELS:

Plain steel wheels, decorated with hub caps or wheel covers are used on cars to day. A variety of special wheels are available. These special wheels can be classified as styled steel or styled aluminum wheels. The mag wheel is very popular. It looks like a magnesium wheel which is very light. However for passenger cars, mag wheels are made of aluminium. Actually the term 'mag wheel' can mean almost any chromed, alluminium off set, or wide-rim wheel of spoke design.

HEAVY VEHICLE WHEELS (THREE PIECE):

Split rim wheels are used on heavy truck strainers, earthmovers and so on. They are heavily made and require a different method of disc installation. One split rim wheel has three pieces. the wheel assembly piece, flange and lock ring. The whole wheel and rim with tyre are removed as an assembly for the service. Then the lock ring and flange can be removed so that the tyre can be taken off the' rim. To tighten the wheel and also to increase air flow to the brake drum, large slots or holes are mag disc.

If you ever work on tyres mounted on split-rim wheels make sure all air pressure has released from the tube before begining to remove the lock ring or flange. If air pressure u still in the tube, it could blowthe tyre off the rim when the lock ring or flange is removed and it may seriously injure or fall on any one near by. Make sure the lock ring or flange is securely in place'before attempting to inflate the tyr.e.

TYRE

The tyre is mounted on the wheel rim. It hash two functions. First it is air filled cushions that absorb most of the shocks caused by road irregularities. Thus they reduce the effect of the shocks on the passengers in the car.

Second, the tyres grip the road to provide good traction. Good traction enable the car to accelerate, brake, and take turns with skidding.

TYPICAL TYRE

The use of solid tyres on automobiles is now absolute and only the pneumatic tyres are used universely. These pneumatic tyres are of two types vii. the conventional tyre with a tube and the tubeless tyre.

1. CONVENTIONAL TUBED TYRE

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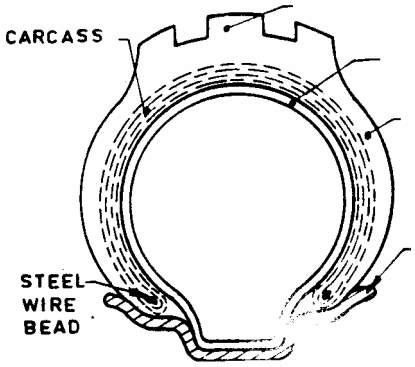
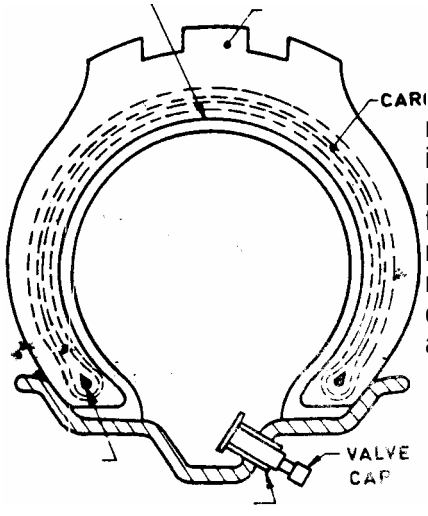


Fig gives the cross section of such a tyre. It consists of two main parts viz the carcass and thread. The car cass is the basic structure taking mainly the various leads and consists of a number of plies wound in a particular fashion from the cords of rayon or any suitable material. The thread is generally made of synthetic rubber and on the design of the tyre thread depend on various tyre properties viz, the grip, the noise and £h wear. At' the inner edge, beads are formed by forcing with steel wires. This provides the tyre with strong shoulders for bearing against the wheel rim.

2. TUBELES TYRE



This type of tyre does not need a separate tube, instead the air under pressure is filled with the tyre for wh~ch purpose a non- return valve is fitted to the rim. The inner tyre is constructions of the almost tne same as

CAUTION

that of tubed tyre, except that it is lined one side with a special air retaining liner as shown in fig *3.36* This type has the advantage that in case of any hole being caused in the tyre, some can be repaired simply by plugging, where as in case of the conventional tyres, it takes quite some time to remove the tube for repair. Apart from this,, a tube less tyre retains the air

pressure for long periods even when punctured provided the same is held in place.

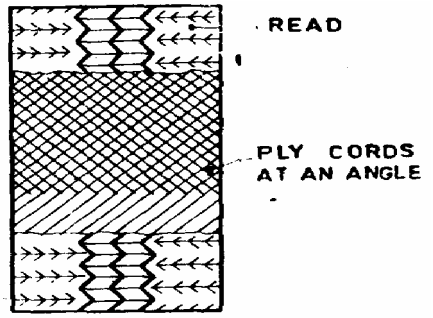
RADIAL PLY AND CROSS PLY TYRES:

Skeleton of the tyres is of three types.

1.Cross ply or bias piy
2.Radial ply
3.Belted-bias type.

1. CROSSPLYTYPE:

In this type, the plycords are woven at an angle to the tyre axis. There are two layers which run in opposite directions as shown in the Fig3.37a However the cords are not woven like warp and wept of ordinary cloth, because that would lead to rubbing of the two layers and thus produce heat which would damage the tyre material.



CROSS PLY

This typ. of tyres ~eve better wear and, road holding characteristics. They are fitted both front and rear wheels. But they must not be fitted on the front wheels only

RADIAL PLAY TYPE:

CAUTION

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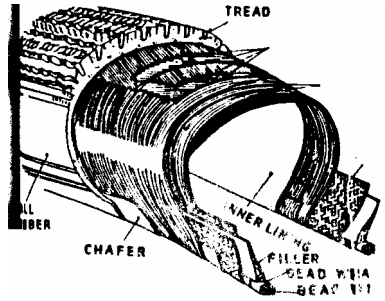
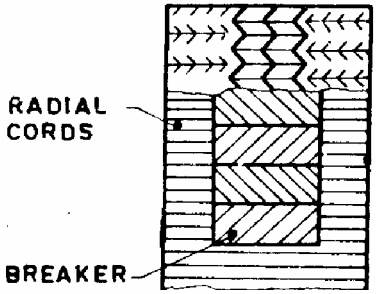
CAUTION



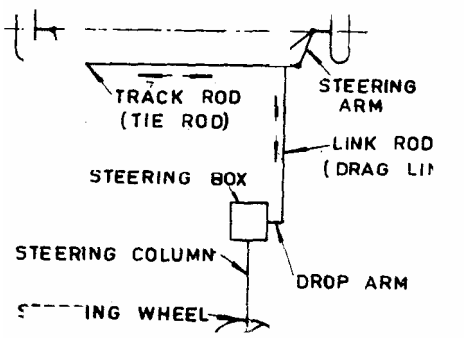


In this type the plycords run in the radial direction ie in the Direction of the tyre axis. Over this basic structure an number of breakes strips must be flexible but inextensible, so that no change of circumference takes place with binge in the amount of inflation. With out the breaker trips radial plies would give very soft ride but there will not a any lateral stability. The in extensible breaker strip shaves like a girder in its own plane and provides the directional stability.

STEERING SYSTEM:

For effective control of the vehicle through out its speed range with safety and without much conscious effort on wide variety of road surfaces. -providing bumps and bounces to the vehicle, proper steering is necessary. The control of an automobile is done by means of a steering system which provides directional changes to the moving automobile and with the help of accelerator and gear shift lever as well as the brakes.

CAUTION



The steering in addition to directing the vehicle in a particular direction must be arranged geometrically in such *a* way so that the wheels un dep go true rolling motion without slipping or scuffing. More over the steering must be light, stable with a certain degree of self adjusting ability.

FUNCTION OF A STEERING SYSTEM:

To convert the rotary motion of the drive's steering wheel into the angular turning of the front wheels as welt as to multiply the driver's effort with leverage or mechanical advantage for turning the wheels *fairly easily* is the function of the steering system. In order to prevent the road shocks from being transmitted to the drivers and the passengers, the steering system should also absorb these shocks.

ACKERMAN PRINCIPLE OF STEERING MECHANISM:

The main function of the steering system of a vehicle is to convert the rotary movement of the steering wheel into angular turn of the wheels. For perfect steering we must always have an instantaneous centre about which all the wheels must rotate. For this purpose inner wheel has

4.7.2.'. CAMBER:

to turn more than the outer wheel. To achieve two types of mechanisms, fate been devised viz,

Straight the Davis and ackermann steering mechanism. Out of these Ackermann mechanism it almost universally used. Referring in the Ackermann steering mechanism the track rod is placed behind the axle beam. The track arms AB and CD are suitably inclined to each other. This system gives true rolling of the wheels in three positions of the stub axles. One when the wheels are parallel and the other two cinch corresponding to the turn to left or right. In any other Position the axes of the stub axles do not intersect on the axis of the rear wheels. The ackermann linkage is not complicated therefore it is used almost Universally When fh. track rod is moved to the right during turn, it pushes almost a right angle against the sight knuckle arm. The left end of thi track rod however, not only moves to the right but also swing forward as shown in so that left wheel ii turned an additional amount. therefore the of inner wheel with l~0tm axle is greater than that outer wheel is 90 greater than ~ Similarly when a right turn is made the right wheel will be turned an additional amount over thai which the left wheel turns

STEERING GEOMETRY:

when an automobile makes a ~turn, in order to avoid :he slipping of the tyre and over turning of the vehicle.. each wheel of the vehicle must roll on an arc having a common centre with the arcs made by the other wheels of the vehicle The most important feature of a vehicle f_0t steering is its ability to maintain it on a straight path or deviated from at the will of the driver. Over a wide variety of roads, this control is to be effected with little conscious effort on the part of the driver. Further for effective Control of the steering wheels must rotate with a true rolling motion free from side drag under all conditions.

The angular relationship among the front wheels, the front wheel attaching parts and the car frame is known as steering geometry. It also involves the angle of steering axis or king pin away from the vertical, the pointing in of the front wheels, the tilt of the front wheels from vertical. The various factors entering into the front end geometry and influencing the steering case, steering stability, riding qualities of the car and having a direct effect on tyre wear are camber, king pin inclination, toe in, toe-out on turns, caster. etc.

The angle between the centre line of the tyre and the vertical line when viewed from the front of the vehicle is known as camber .

When the angle Is out ward, so that the wheels are further apart at the top than at the bottom, the camber is positive. When the angle is inward, so

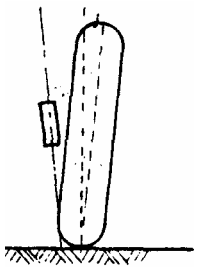
4.7.2.'. CAMBER:

that the wheels are closer together at the top than at the bottom, the camber is negative.

Any amount of camber, positive or negative, tends to cause uneven or more tyra wear on one side that on the other side. Camber should not exceed Excessive camber prevents the tyre from having correct contact with the road which causes it to wear only on the side directly beneath the load. Unequal camber uses of vehicle to roll in the direction of the wheel having greater camber which upsets directional stability and tends to scuff the tread on the opposite tyre.

KING PIN INCLINATION

The angle between the vertical life and centre of the king pin or steering axle, when viewed from the front of the vehicle, is known as king pin Inclination or steering axle inclination.



Positive Camber Angle

The angle between the centre line of the tyre and the vertical line when viewed from the front of the vehicle is known as camber Kingpin Inclination When the angle is out ward, so that the wheels are farther apart at the top than at the bottom, the camber is positive. When the angle is inward, so that the wheels are closer together at the top than at the bottom, the camber is negative.

Any amount of camber, positive or negative, tends to cause uneven or more tyra wear on one side that on the other side. Camber should not exceed 20,

Excessive camber prevents the tyre from having Con Oct contact with the road which causes it to wear only on the side directly beneath the load. Unequal camber causes of vehicle to roll in the direction of the wheel having greater camber which upsets directional stability and tends to scuff the tread on the opposite tyre.

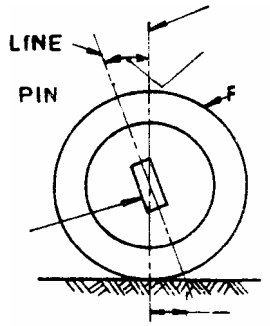
4.7.2.'. CAMBER:

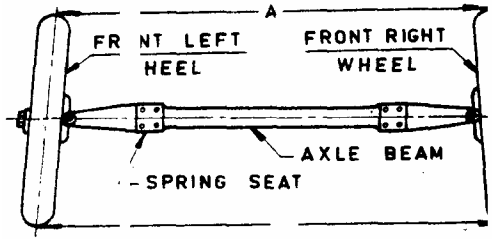
CASTER:

In addition to being tilted in ward towards the centre of the vehicle, the king pin axis may also be tilted forward or backward from the vertical line. This tilt is known as

The angle between the vertical line .and the king pin centre line in the plane of the wheel (when viewed from the side) is called the caster angle. When the top of the king pin is backward the caster angle is positive, and when it is forward the caster angle is negative. The caster angle in modern vehicle is from 2 to 8-The caster produces directional stability by causing the wheels to lead or follow in the same direction as the vehicle travel. When both the front wheels have positive caster the vehicle tends to roll out or lean out on turns. But if the front wheels have negative caster, then the vehicle tends to back or lean in on turns. .There is another important effect of the caster angle, positive caster, tries to make the front wheels toe-in. With positiv$_9$ caster, the vehicle is lowered as the wheels pivot inward. Thus, the weight of the vehicle is always trying to make the wheel toe-in with negative caster the wheels would try to toe-out. The positive caster increases the effort required to steer tries to keep the wheels straight ahead. This makes steering easier.

TOE-IN





The front wheels are usually turned in slightly in front so that the distance between the front ends A is slightly less than the distance between the back ends B, when viewed from

4.7.2.'. CAMBER:

The amount of toe-in is usually 3 to. 5mm. The toe-in is provided to ensure parallel rolling of the front wheels, to stabilize steering and to prevent side slipping and excessive . wear. It also serves to off set the small deflections in he wheel-support system which come out when the car is moving forward. Although the wheels are set to toe-in slightly when the car is standing still, they tend to %ll parallel on the road when the car is moving forward. Some alignment specialists the front wheels in 'straight - away alignment' in preference to "toe-in" adjustment.

TOE-OUT

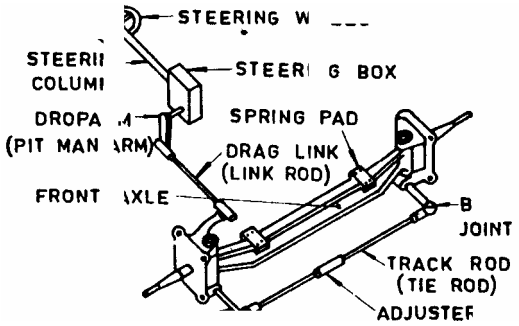
Toe-out is the difference in angles between the two front wheels and the car frame during turns. The steering system is designed to turn the inside wheel through. larger angle than the out side wheel when a turn le 0 is Rater than0~. This condition causes the wheels to toe-out on urns, due to the difference in their turning angles. When the are is taking a turn, the outer wheels roll on a radius than he inner wheel, and the circles on which the two front wheels must roll are concentric. Therefore the inner wheel lust make a larger angle with the car frame than that of the inner wheel makes. Toe-out is secured by providing the roper relationship between the steering knuckle arms, the ids and pitman arm.

STEERING LINKAGES:

The steering wheel is mounted at the top of the steering alumni and it controls the motion of the stub axles. The motion of the steering wheel is transmitted through the leverage between the steering wheel and the stub axles. Due to leverage system the effort that has to be applied to the steering wheel in order to over come the friction opposing the turning of the road wheels is minimised. For Steering linkage For Rigid control the system is **so** designed that the steering wheel turns through larger angles than the stub axles at the road turns. The amount of leverage depends upon the weight of the vehicle, and the type of tyre. Steering Linkages For Independent Suspension

To transmit the motion, several types of steering linkages are used between the pitman arm and the steering knuckles of the stub axles are shown in When the steering wheel is turned the pitman arm swings insides or backward and forward directions. This movement displaces the stub axles from their straight position by the linkages Thus the steering linkage is a connection of various links between the steering gear box and the front wheels.

4.7.2.'. CAMBER:



Axle suspension

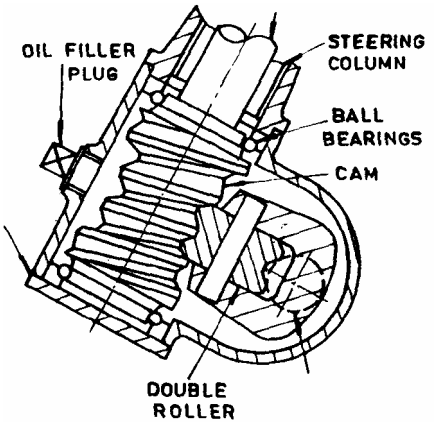
TYPE OF STEERING GEAR BOX

The steering gear is a device for converting the rotary motion of the steering wheel into straight line motion of the linkage with a mechanical advantage. The steering gears are enclosed in a box called the steering gear box. These are many differential designs of steering gear box, the important are discussed below.

CAM AND DOUBLE ROLLER STEERING GEAR BOX:

Fig illustrate the cam and double roller steering used on commercial vehicle. It consists of a cam gear on the input shaft with rotating double roller on the rocker shaft.

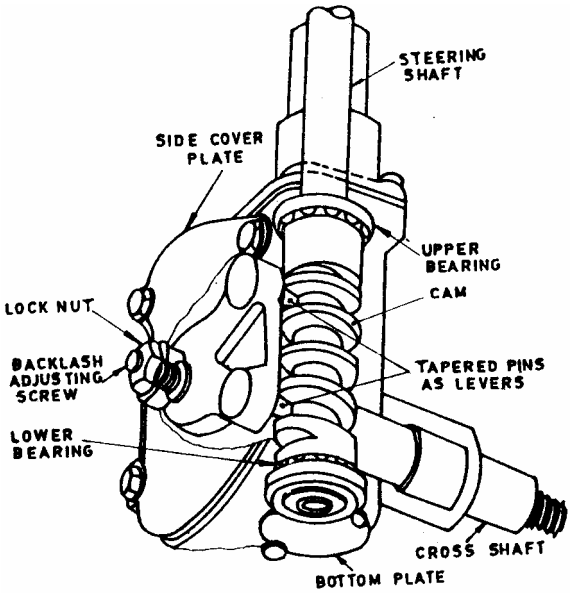
A two roller is fastened to the rocker shaft so that it meshes with the cam gear. The cam gear is formed on the bottom of end of the steering shaft. The outer end of the cross shaft is formed in the spindle to fix the drop arm. As the cam rotates, the inner is compelled to follow the cam and in doing so causes the rocker shaft to rotate, thus moving the drop arm. The contour of the cam is designed to mesh with the arc made by the roller, so maintaining a constant depth of mesh and evenly distributing the load and wear on the mating parts.



CAM AND TWIN LEVER STEERING GEAR BOX

Cam and Twin Steering Gear Box

Fig illustrate the cam and twin lever steering gear used in commercial vehicle. It consists of a constant diameter worm, called a cam in this case, on the Input shaft and a cone shaped stud on the lever which follows the helix on the cam. The cam is cylinder~ I in shape, its actuating part being a groove of variable pitch wade narrower at the centre than at the end. This provides non-reversibility in the centre part of the cam where most of the car Steering takes place. The twin levers are mounted on the cross shaft and are located so that the studs engage the cam from the side. When the cam is turned, the studs move along the cam groove to cause the lever to swing through an arc, and thus turning the cross shaft.



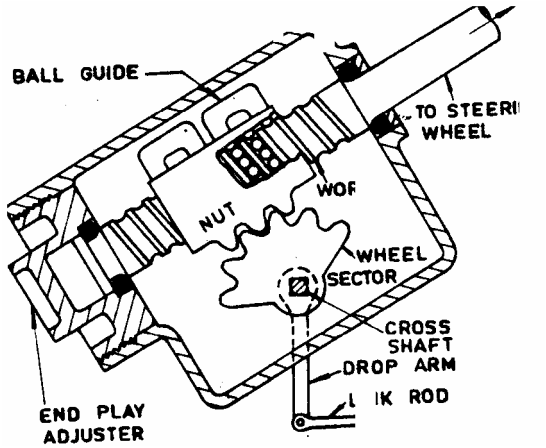
RACK AND PINION STEERING GEAR BOX:

This is very simple and common type mechanism, the system is shown in simplified sketch This type is very well suitable in an independent suspension system.

The system consists a rack housed in tubular casing. The casing is supported on the frame near its ends. The ends of the rack are connected to the track rods with the help of ball end. socket joints. The pinion shaft is carried in the plain bearing housed in casing. The pinion is meshed with the rack and the clearance is adjusted with the adjusting screw. when the pinion is given rotary motion with the steering wheel then the rack slides in either sides. The sliding motion of the rack is used through the track rods to the wheels in desired side

2) To safe gaurd the occupants from road shocks.

RECIRCULATING BALL STEERING GEAR BOX:



Recalculating Ball Type Steering Gear

Fig shows the recirculation type of steering gear. The input shaft portion of this gear has a semi circular grooved helix with constant lead that provides one half of the path of travel for the recirculation balls. The other half of the path is provided by a mating semi circular grooved helix cut on the inside of the follower nut.

FRONT AXLE

The front axle is used to carry the weight of the front part of the vehicle as well as to facility steering and absorb shocks due to road surface variation. It must be rigid and robust in construction. It is usually steel drop forging having 0.4 ⁄ carbon steel or 1 to 3 Nickel steel.

TYPES OF FRONT AXLES:

Usually there are two main types of the front axles.

1. Live front axle
2. Dead front axle.

The front axles are usually dead axles because they do not rotate. A live front axle, as compared to the dead axle has the additional function of transmitting the driving power taken from a transfer gear box to the front wheels having a different swiveling mechanism. The dead front axle has sufficiently rigidly and strength to transmit the weight of the vehicle from

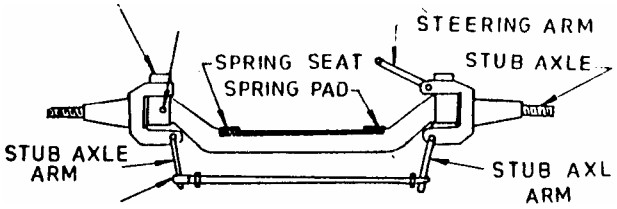
2) To safe gaurd the occupants from road shocks.

springs to the front wheels. The ends of the axle beam are shaped suitably assemble The stub axle, The ends of the beam are usually shaped either as yoke or plain surface with drilled hole for connecting the sub axle assembly.

A typical front axle with stub axle is shown in An other front axle assembly with stub axle and track rod is shown in shows front axle components with steering linkage. facilitate steering and absorb shocks due to road surface vibrations. When there is no braking system in the front wheels of the vehicle then there will be only, bending load on the axles therefore a simple forging of I-beam section is used. If there is braking systems in the front wheel the ends of the axle are given proper shapes to carry the stub axles and the seats are made to attach the springs between the ends. The downward sweep is given to the axle beam at the central portion to keep a low chassis. This type of axles are made of I-sections in centre portions, while the ends are made either circular or elliptical. With this construction it takes bending loads due to the load of the vehicle and also torque due to braking of the wheels.

STUB AXLE:

The front road wheels are mounted on the stub axle themselves are connected to the front axle by means of king pin. Vertical loads are taken by a steel washer or a thrust bearing located either on the top form of stub axle or between the lower fork and the under side of the axle



2) To safe gaurd the occupants from road shocks.

SUSPENSION

The frame as well body of the vehicle is attached to the rear axle and the front axle by springs. These springs damp the road shock transmitted to the body structure by the wheels when they travel over the road. In this way the springs are the protecting units supported directly by the frame of the vehicle. Therefore all the parts which perform the function of protection are collectively called a suspension system. These springs are generally of the laminated leaf type, coil type, torsion bar type and may be of any other special type according to the need. These springs provide a best suspension system to the vehicle thereby protecting the passengers and load from jerks, The suspension system of vehicle is divided in to (i) the front-end suspension and (ii) rear end suspension.

FUNCTIONS OF SUSPENSION SYSTEM

1)To prevent the road shocks from being transmitted to the vehicle frame.
3)To provide good road holding while driving, cornering and braking.
4)To maintain proper steering geometry
5)To preserve vehicle stability in pitching and rolling.

FRONT INDEPENDENT SUSPENSION

Independent suspension has become almost universal in the case of front axle due to the simplicity of construction of such a suspension system. In this type of suspension, each front wheel is independently supported by a coil, torsion bar or leaf spring. Almost all the passenger cars now use the independent front suspension. in which the coil spring arrangement is the most common.

ADVANTAGE OF INDEPENDENT FRONT SUSPENSION

I. The independ. it front suspnsio provides more space for engine accommodation.

2. It enables front springs to be arranged for enough, apart to to propose under steer conditions, which is preferable to overstear.

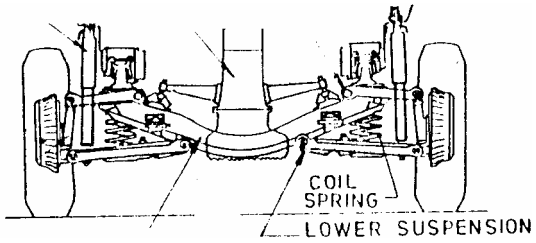
3. It may provide after suspension. because the low spring rate enables large wheel movement.

4. One beams axles, spring defection affects the caster. angle, especially when braking or accelerating. causing the axle to twist !~between the stub axle and the seats. Thug effect on the steering geometry is overcome with independent front Suspension.

S. The unsprung weight is low. The weight of the chassis and body to

2) To safe gaurd the occupants from road shocks.

relat.ve to that of the wheels and axle is known as the unsprung weight. the unsprung weight is heavy, the chassis/body combination has high inertia or, resistance to change of state, and the wheels tend to move lather than the classis / body.



6. The independent front suspension reduce the tendency of this rotating wheels to turn about the king pins, due to ~gyroscopic action, causing wheel wobble or shimmy.

COIL SPRING FRONT INDEPENDENT SUSPENSION

2) To safe gaurd the occupants from road shocks.

DROP ARM

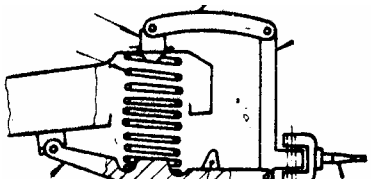
This type is used on a majtAty of passenger' cars. This design permits either front wheel to react' to changes in the road surface level without affecting the opposite wheel, A typical coil spring type indeoendent front suspension arrangement is shown in Fig

longitudinal Axis Independent Front Suspension

The steering knuckle is pivoted at each end to the upper and lower control arms at the ball joints. The upper control arms, in turn are pivoted to the frame cross member at their inner ends by means of nibbler bushed or hardened steel threaded bushed . Control arms are usually V or wish bone shaped

below. As can be seen from me illustration, the lower control arm is longer than the upper one, The lower control arms longer than the upper one. The arrangement of the linkage is such that the point of road contact of the tyre moves up and down in a straight line during all normal movement of the control arms. and thereby avoiding the tyre Scrup. This is some times called knee action springing.

The two helical coil spring (one on each side) are supported at their lower ends in seats that are attached to the lower control arms. The upper ends of the springs are compressed against saats in th9 frame. A shock. absorber usually is employed to control the reaction of each of the coil springs.



TORSION BAR FRONT INDEPENDENT SUSPENSION

The system contain a torsion bar as shown in the Torsion bar is simply a rod acting in torsion and taking shear stress only. The amount of energy stored per unit weight of material is nearly the same as for coil springs. Torsion bars are often used will independent front suspensions. Hence it is termed torsion bar front independent suspension. The bar is fixed to the frame, while the other end is fixed to the end of trie wheel arm and supported the bearing. The other end of the wheel arm is connected to the wheel hub. When the wheel strikes a bump, it starts vibrating up and down, thus exerting torque on the torsion bar, which acts as a spring. Torsion bar spring is lighteras compared to leaf springs and also it occupies less space. Some times the torsion tubes are used instead

2) To safe gaurd the occupants from road shocks.

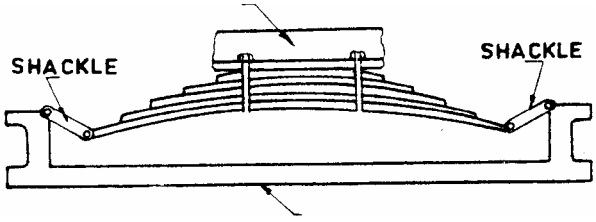
of the bars, the former being stiffer than the latter ones. There are two main disadvantages of the torsion bar suspension. The first is that it does not take the braking or driving torque so that additional linkages have to be provided for that purpose. The second disad~,antages is the absence of friction force, and hence of damping which is a necessity to control the vibrations produced due to road.

TRANSVERSE LEAF SPRING : SUSPENSION

This type of transverse leaf spring is arranged transversely across the vehicle instead of parallel to the frame. As shown in Fig. 48 this spring is bolted rigidly to the frame at its centre. The ends of it are shackled to the axle

This type of suspension is the cheapest one, but has the disadvantage that the springs in this case are attached to the frame at only places, which imparts the vehicle a tendency to roll easily when it runs fast on sharp corners.

REAR SUSPENSION:



There are three types of rear end suspensions usually found in motor vehicles.

1)Longitudinal leaf spring rear end suspension.

2)Transverse leaf spring rear end suspension.

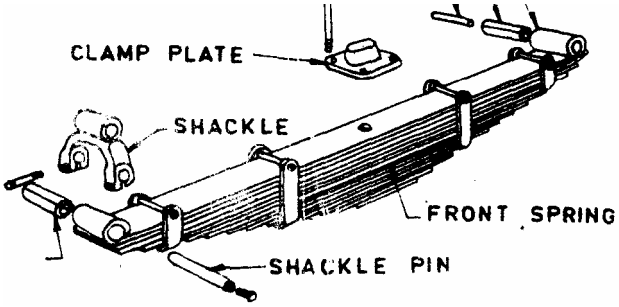
3) Coil spring rear end suspension.

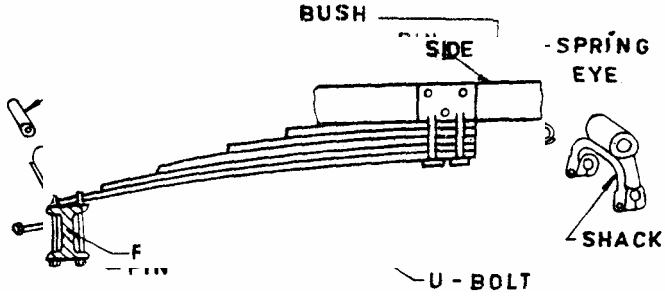
LEAF SPRING SUSPENSION:

Longitudinal leaf spring suspension is generally used in conjunction with the Hotchkiss drive. The leaf springs must be made strong and resilient enough to transmit the driving thrust and torque and to resist side ways, in addition to support the spring weight of the body. The spring weight is kept as less as possible, in order to improve the side of the vehicle. Because the springs do noi generally support the wheels, rims. tyres, brakes and rear axle, the

weight of these parts is called spring weight.
is clamped to the rear axle housing by U-bolts, its each end is pivoted to the frame, by means of eyes formed in the ends of the longest leaf.

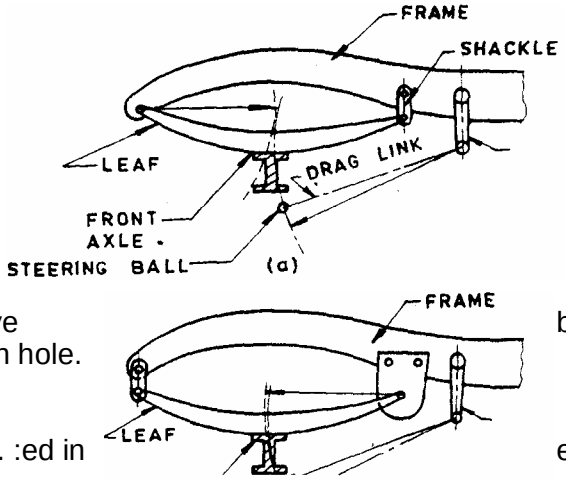
The spring consists of a number of [eaves called blades. These blades vary in length. The composite spring is based upon the theory of a beam of uniform strength. The lengthiest blade has eyes on its ends. This blade is called, master leaf. All the upper sides and edges of all the springs are hot peened to increase their resistance to fatigue. All the blades are bound together by means of steel strips.





The spring is supported on the axle, front or rear. One end of the spring is mounted on the frame with a simple pin, while on the other end, connection is made with a shackle. The spring elongates in compression and shorten in expansion, This change in length of the spring is compensated by the shackle. At the intermediate position of the spring length, the rebound clips are located. They are loose enough to permit the leaves to slide one on the other, and yet tight enough to hold these leaves together when the spring rebound. The spring eyes are usually provided with bushings or some anti frictional material such as bronze or rubber. 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 increase in length rebound the spring assumes back shape there by in length. The shackles make the springs swing in and out.

2) To safe gaurd the occupants from road shocks.



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

Different types of shackles ar. :ed in event vehicles. Which are

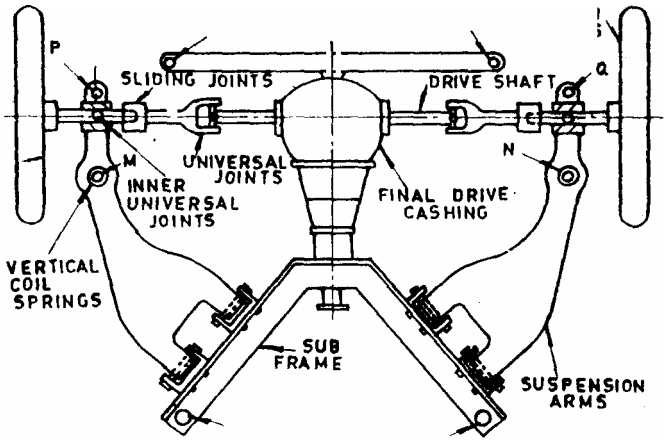
1) 'U' type

2)'Y' type (Most commonly used one)

3)Link type.

The shackle position in front and rear end are shown in Fig

REAR WHEEL INDEPENDENT SUSPENSION



The rear wheels of the general vehicles are power driven therefore considerable difficulties are there to provide independent suspensions. But looking some advantages of independent rear suspensions over the rigid axle type it is used in some vehicles. Referring Fig. 4. 13 M. and 'Nare two

2) To safe gaurd the occupants from road shocks.

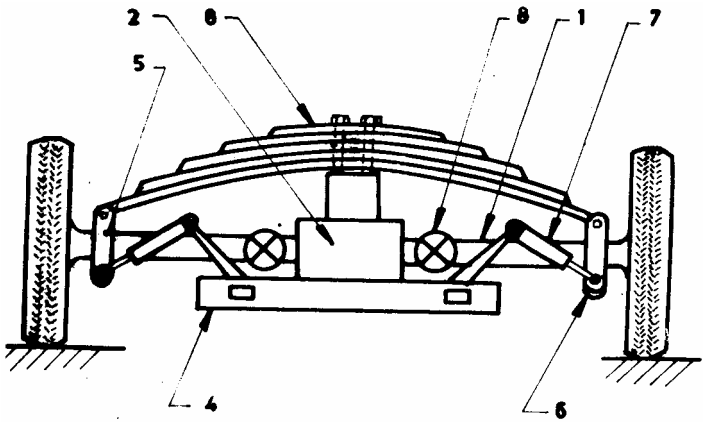
coil springs in vertical positions and are mounted on the suspension arms. The arms are jointed on rubber bushes carried by the sub-frame. The sub-frame incorporates Rear Wheel Independent Suspension the final drive tasing and which is mounted on the body structure on the four rubber mountings A, B, C .and D. The other ends of the suspension arms are connected with the drive shafts in such a way that the shafts may be housed inside the ends with universal drives. One sliding joint is also provided between the two universal joints. To release the stresses gradually two shock absorbers are provided at the tail of the suspension arms. A line diagram of this type is also shown in Fig

Some of its drawbacks are:

1)The initial cost is high
2)Greater maintenance required
3)Misalignment of steering geometry with the wear of components.

TRANSVERSE SPRING TYPE

The upper ends of the wheel bearing supports are attacked to the ends of the springs and the lower ends are attached to the dampers as shown in fig. The half shafts are driven via universal joints at the differential end.



Transverse Spring Rear

2) To safe gaurd the occupants from road shocks.

37373737264.5 SHOCK ABSORBER:

Indepentend Suspension bearing support. The spring is mounted above the differential unit. Dampers are inclined and damp down the vibration of the spring and the wheel bearing supports. In this arrangements chassis is kept below the transverse spring.

Advantages:

1. Unspring weight is greatly reduced
2. Provide comfortable drive
3. Less spring deflection

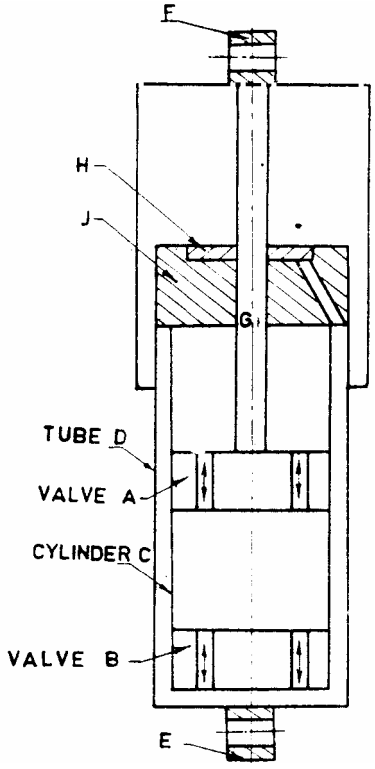
The shock absorber is a device which introduces resistance to the motion of the spring and road wheel so as to damp out vibrations This resistance is obtained by causing a fluid to pass at high speeds through small holes. The energy absorbed depends upon the viscosity of the fluid, and appears as heat in the fluid. The advantage of the fluid type is that the fluid resistance is proportional to the square of the speed of flow through the orifices and so increases rapidly with the speed of the suspension movement.

CONSTRUCTION:

The device consists of two valves, A and B. Rod G is attached to the two way valve A. while another, similar two-way valve B is attached at the lower end of cylinder C. There is fluid in the space above valve A, below valve A and also in the annular space between cylinder C and tube D, which is connected to the space below the valve B. H is a gland in the head I and any fluid scrapped off by rod G is brought down into the annular space through the

2) To safe gaurd the occupants from road shocks.

4 10 .s I BRAKE SHOES:



Telescopic Type Shock Absorber

inclined passage as shown ‘n ~he head. The eve E is connected to the axle. While the eye F is attached me chassis frame. The fluid generally used in shock absorbers is a mixture of 60 percent transformer oil and 40 percent turbine oil.

ACTION OF THE SHOCK ABSORBER

When the vehicle has come across a bump, then eye **E** would move up and there by the fluid will pass from the lower side of valve A to its upper side. But since the volume of the space above A is less by the volume of the rod G, the fluid will also exert its pressure on the wheel.

BRAKE

BASIC REQUIREMENTL OF A BRAKE:

1. The brake must be strong enough to stop the vehicle with a
   2) To safe gaurd the occupants from road shocks.

4 10 .s I BRAKE SHOES:

minimum distance. The Distance should be the shortest during Emergency braking. The distance moved by the vehicle after the application of the brake is known is “braking distance -.

2. The brakes must have good antifade Characteristics. In other words the brakes should not loose their effectiveness on prolonged application. This is only possible by- proper and effective cooling of brakes.

PURPOSE OF BRAKES:

1) To control the speed of the vehicle as well as to stop it when and where desired quickly and efficie ntly without skidding.

2) To keep the vehicle in any possible position after it had bJen actually brought to a complete rest when the driv~4 is not present.

These purposes are accomplished by providing two independent braking system in a motor vehicle, i. e. service rake and a parking or emergency or hand brake.

MECHANICAL BRAKES:

In the motor vehicle the wheel is attached to an auxiliary wheel called a drum. The brake shoes are made .. the contact this drum. In most design, two shoes are used with each drum to form a complete brake mechanism at each wheel. The brake shoes have brake linings on their Outer surfaces. Each brake shoe is linked at one end by an anchor pin, the other end is operated by some means so that the brake shoe expands outwards the brake linings comes into contact with the drum. Retracing spring keeps the brake shoes into position when the brakes are not applied. The drum encloses the entire mechanism to keep out dust and moisture. The braking plate completes the brake enclosure, holds the assembly to the car axle, and acts as the base for fastening the brake shoes and operating mechanism. When the brake pedal is pressed, the cam turns by means of brake linkage. When the cam turns, the shoes expands out wards against the drum. A toggle lever is also used for the same purpose. The brake rub against the drum and thus stop its motion.

TYPES OF MECHANICAL ACTUATION BRAKES:

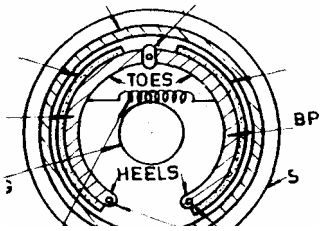
There are in general two main classes of mechanical actuating drum brake system. One is the Internal expanding drum brake and other is the external contracting drum brake.

1. INTERNAL EXPANDING DRUM BRAKE: This type of brake used most modern motor vehicles. It is formed by mounting the shoes to rule or slide against the inside surface of the drum.

2) To safe gaurd the occupants from road shocks.

4 10 .s I BRAKE SHOES:

Internal Expanding Brake



The system consists of brake drum, stationery plate, two shoes hinged at the anchor pins, cam system to expand the shoes and a retracting spring. Brake linings are fixed at the out sides of the shoes, For operation when the cam, is turned, the shoes with brake linings are forced against the drum. The brake linings create friction between the rotating drum and the expanding shoes. Thus the force of friction opposes the direction of drum rotation, there by stopping or slowing down the vehicle. When the brake is released the retracting or returning spring brings the shoes back to the off-position.

EXTERNAL CONTRACTING DRUM BRAKE:

This type of brake is only used as a parking in the motor vehicle. The system consists of drum, band with lining, operating lever with adjusting lever and push rod with returning spring. For operation when the push rod is operated by the hand or foot operated lever, then the lined brake band fitted around the drum is tightened to lock or slow down the rotating drum When the brake is released the return spring brings the band back to the off position.

This system to atmosphere therefore the dirt is thrown between the rubbing surfaces which reduces the braking efficiency. It has greater wear and tear so found unsatisfactory for running brakes

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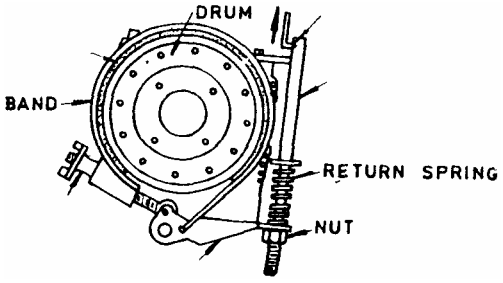
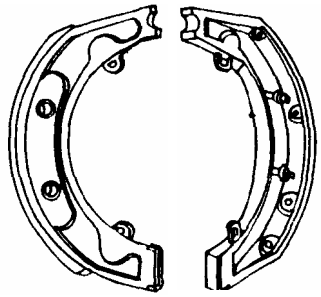


2) To safe gaurd the occupants from road shocks.

4 10 .s I BRAKE SHOES:

BRAKE SHOES:

A typical brake drum is shown in Fig. Brake drums are thin cylindrical members made of cast iron; cast iron and steel ; steel and chrome . Nickel iron They- have a composite and centrifugal construction. In order to admit the brake shoes, their inside ends are opened while the out side ends are closed. 'The outer



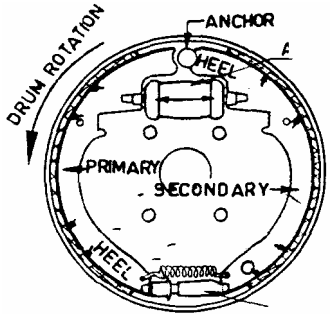
brake Drum most portion of the brake drums include a cast iron liner with a steel back. In this case, the steel provides the strength while the cast iron inner surface liner having a high co-efficient of friction dissipates the heat more rapidly. In certain front wheel brakes, a cast aluminium alloy drum with a cast iron liner is also used. The diameter of the brake drums usually range between 200 mm and 375 mm. The diameters of the circles made by the out side. of the shoe-linings are generally kept smaller than their inside diameters from 0. 25 . 0. 6 mm. In order to ir'creast. dissipation of heat, ribs or fins are also provided on the out side of the braking surfaces.

2) To safe gaurd the occupants from road shocks.

4 10 .s I BRAKE SHOES:

Wheel brakes usually contain two shoes - a primary shoe on the left and a secondary shoe on the right provided as shown in Fig These shoes are usually welded or riveted to the out side or bearing surface or semi-circular segments of steel provided with specially treated asbestos lining~ or made of heat and wear resisting friction materials. The brake linings provided may be molded type lining on both shoes or even brake lining on the primary shoe and molded brake lining on
Fig Brake Shoe the secondary shoe. The linings are usually 28 to 63 mm wide and from 4 to 10 mm thick in case *of* passenger motor vehicles.

SERVO OR SELF ENERGISING ACTION OF BRAKE SHOES:



These are modern type of hydraulic wheel brakes of drum type. They have a special feature known as self-energizing or servo feature. To increase the brake pressure, the force of rotating drum is utilized fully because the drum is rotating in a counter clock wise direction (Fig 4.34) when the vehicle is traveling forward. More over the primary shoe ~provided at the left tends to move in the direction ot rotating drum due to its friction when the brakes are applied. Now the primary shoe is linked to the secondary shoe at the bottom while the secondary shoe is forced around against the anchor pin at the top. Due to this wrapping action, both the shoes are forced into tighter contact with the drum to cause the braking pressure to be applied more uniformly.

'Fig. 4.36 Hy&aulic Brake System

4 10 .s I BRAKE SHOES:

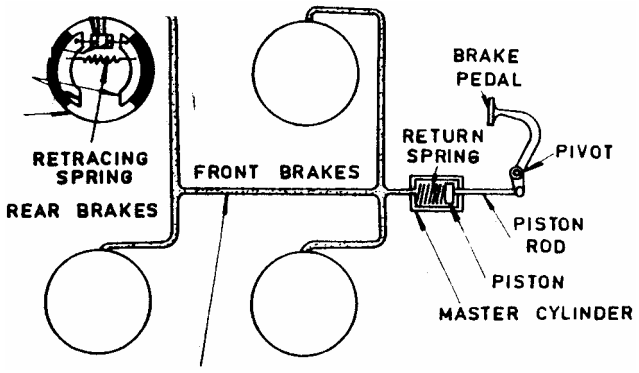
The secondary shoe will tend to move in a clock wise direction against tie primary shoe which is forced against the anchor pin. This usually happens when the brakes are applied as the car is in reverse.

HYDRAULIC BRAKING SYSTEM:

The hydraulic. brakes are applied by the liquid pressure. The pedal force is transmitted to the brake shoe by means of a confined liquid through a system of force transmission. The force applied to the pedal is multiplied and transmitted to all the brake shoes by a force transmission system. This system is based upon Pascal's principle, which states that the confined liquids transmit pressure without loss equally in all directions.

The hydraulic brake system as shown in Fig. 4.3E essentially consists of two main components master cylinder and wheel cylinder. ~~The master cylinder is connected by tubing to the wheel ~cylinders at each of the four wheels. The system is filled with the liquid under light pressure when the brakes are not in operation. The liquid is known as brake fluid: and *IS* usually a mixture of glycerin and alcohol or Castor oil or denatured alcohol and some additives.

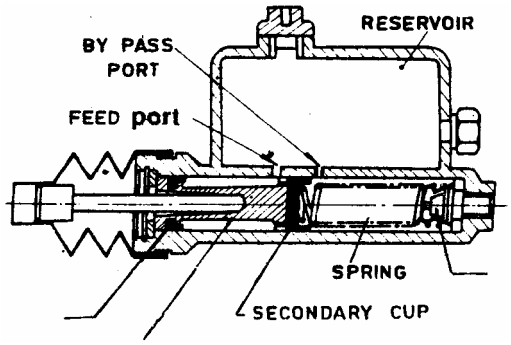
Each wheel brake consists of a cylinder brake drum which is mounted on the inner side of the wheel and revolves with it and two brake shoes which are mounted inside the brake drums and do not rotate. The shoes are fitted with a heat and wear resisting brake lining on their surfaces.

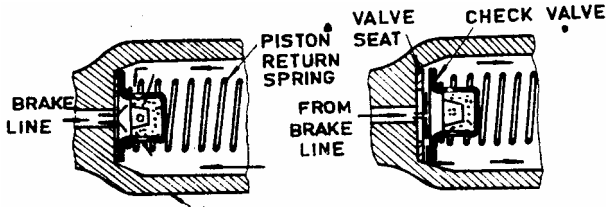


The brake pedal is connected to the master cylinder piston by means of a piston rod. When the brakes are to be applied, the driver depresses the pedal, the piston is forced into the master cylinder, this increasing the pressure of the fluid in the master cylinder and in the entire hydraulic system. This pressure is conducted instantaneously to the wheel cylinders,

'Fig. 4.36 Hy&aulic Brake System

4 10 .s I BRAKE SHOES:





on each of the four brakes, where it forces the wheel cylinder pistons outwards. These pistons, in turn, force the brake shoes out against the brake drums. Thus the brakes are applied.

When the driver releases the brake pedal, the mast cylinder piston returns to its original position due to the return spring pressure, and thus the fluid pressure in the entire system drops to its original low value, which allows retracing springs on wheel brakes to pull the brake shoes out of contact with the brake drums into their original positions. This causes the wheel cylinder pistons also to come back to their original inward positions. Thus, the brakes are released.

MASTER CYLINDER:

The master cylinder is the heart of the hydraulic brake system. It consists (Fig.4.361 of two main chambers . the fluid reservoir which contains the fluid to supply to the brake system and the compression chamber in which the piston operates. The reservoir supplies fluid to the brake system through 2 ports. The larger port is called the feed or intake,

'Fig. 4.36 Hy&aulic Brake System

port and is connected to the portion of the piston between the primary and secondary cups which act as piston seats. The smaller port is called the relief, by pass or compensating port which connects the reservoir directly with the cylinder and lines when the piston is in the release position. The reservoir *is* vented to the atmosphere so that the atmospheric pressure causes the flow through the filler port. The vent is placed in the filler cap. The boot covers the push rod and the end of the cylinder to keep it free from foreign matter.

When the brake pedal is pressed the master cylinder piston moves forward to force the liquid under pressure (Fig. 4.36 a) into the system. The relief port is sealed out of the system. The liquid pressure is conducted to the wheel cylinders, where it forces the wheel cylinder pistons outward. These pistons force the brake shoes out against the brake drums.

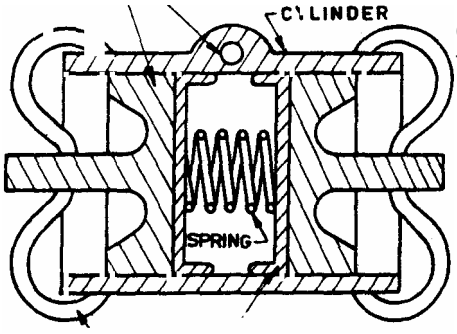
'Fig. 4.36 Hy&aulic Brake System

4 10 .s I BRAKE SHOES:

When the brake pedal is released, the return spring quickly forces the master cylinder piston back against the piston stop. Because the fluid in the lines returns (Fig~ 366) rather slowly, a vacuum tends to form in the cylinder in front of the piston. This causes the primary cup to collapse to allow the liquid to flow from the reservoir through the filler port; pass the piston to fill the vacuum. When the pedal is in 'off' position, the liquid may flow from the reservoir through the relief port in the master cylinder, supply lines, and Wheel cylinders to make up for any fluid that may be lost or to compensate for shrinkage cooling of the liquid. In this way a complete column of liquid is always maintained between the master cylinder piston rod wheel cylinder pistons.

WHEEL CYLINDER:

Wheel cylinder is the second impgrtant component of thu hydraulic bral~e system. A typical wheel cylinder shown in Fig 4.37~consists of two pistons which can move in opposite directions by the fulid pressure. It is rigidly mounted on the brake shield or backing plate. The boots protect the cylinders from foreign substances Bleeder valves are provided in the cylinder to permit air and liquid to be pumped out of the system during th~ l$eeding operation.

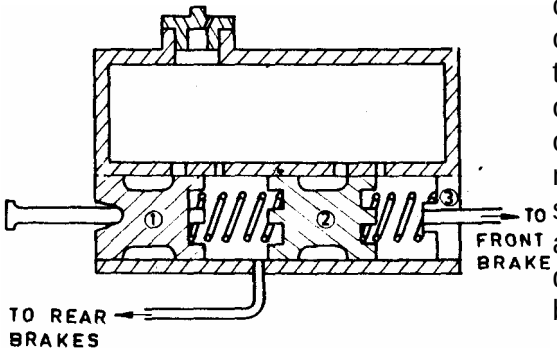


Piston cup fits tightly in the cylinder against each piston and seal the mechanism against leakage of the brake fluid

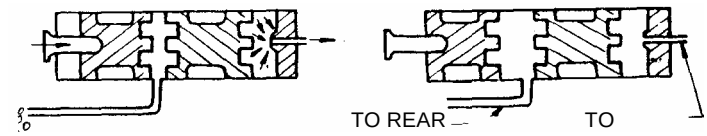
'Fig. 4.36 Hy&aulic Brake System

4.8.2. CAM AND TWIN LEVER STEERING GEAR BOX:

A spring serves to hold the cups against the piston when the pressure is decreased. When the brakes are applied, the brake fluid enters the cylinder from ~ brake line connection inlet between the two pistons, It causes to the force out the two pistons in opposite directions. This motion is transmitted to the brake shoes directly or torchlight links and force them against the brake drum, thus applying the brake.



The copper-coated, tin-plated annealed steel tubing and flexible hose are used to connect the master cylinder and the wheel cylinders. The hoses are used to connect the lines to the front wheel cylinders to permit the front wheel to be turned. Rear wheel cylinders are generally connected directly to a line fastened to the rear-axle housing. The ,brake lines are attached directly or by means of brackets to the frame or axle housings.



OPERATING THE FRONT BRAKES ONLY

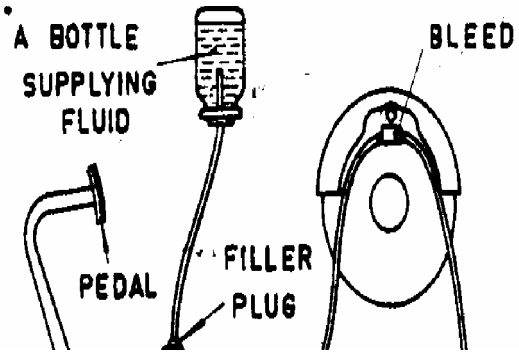
OF~ POSITION OF BOTH THE BRAKES

5. 3.TANDEM MASTER CYLINDER

When due to fracture in the pipe line or due to leakage at joints the hydraulic brakes fail which may be the cause of a serious accident of the vehicle. There fore to over come this difficulty and to provide safety against the accidents the master cylinder is designed in such a manner so that the separate lines go to rear and front brakes. The lines are so arranged that if one pair of the brake failed, the other will be still effective. A master cylinder designed on these base is called Tandem Master Cylinder. Fig. 4.38 shows the construction and working principle of a Tandem Master cylinder.

Under ordinary conditions the brake fluid will transmit pressure both to front as well as to the rear brakes, when the brake pedal is applied. How ever, when the front brake lines are damaged, piston (2) will move till it comes up against stop (3). After this pressure will start building up in space

'Fig. 4.36 Hy&aulic Brake System



CAM AND TWIN LEVER STEERING GEAR BOX:

between piston (1) and (2) arid rear- brakes will be applied. Similarly when the rear brake lines are damaged no pressure will build up in space between pistons (1) and (2). So piston (1) will move freely till it comes up against (2). Further push at the brake pedal will move both pistons (1) and (2) together thereby applying the front brakes.

BLEEDING OF HYDRAULIC BRAKES:

In hydraulic brakes the air enters into the system through the joints or when the fluid~ level has become low. Air being compressible, the effort of brake pedal goes waste in applying brake. Until and dtfless air from the system is removed, the brakes could not function properly. The

Bleeding of The Hvd Brake System

The construction and procedure of bleeding shown in Fig. 4.39 is as follows: The bleed pipe is connected with the bleeder valve. The end of this bleeder pipe is kept dipped in a bottle containing the fluid. There is another bottle which is connected to the master cylinder filler plug by means of a pipe. This fluid enters the master cylinder through the bleeder valve and bleeder pipe. Finally it goes to the bottle which is connected to the bleeder pipe.

When the pedal is pressed from time to time, the air travels along with the liquid through the bleeder pipe and to the bleeding bottle. The air escapes in the form of bubbles for sometime. After the pedal has been pressed for a few times, a stage will come when only oil and no air will enter. At this time close the bleeder valve and remove the bleeder pipe. Also, remove the bottle with its cap at the filler plug of the master cylinder. The whole system is now free from air. This is the procedure of bleeding the hydraulic brakes.

'Fig. 4.36 Hy&aulic Brake System