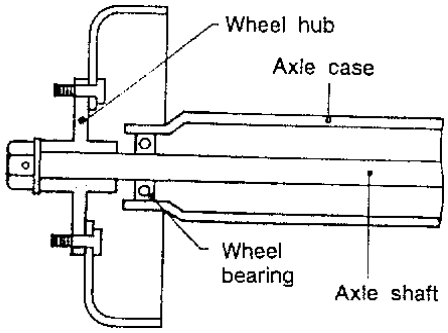
(2) SEM FLOATING TYPE

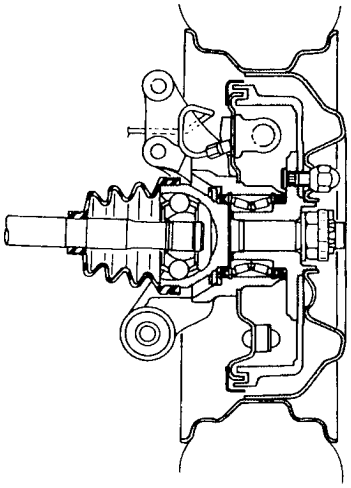
On the semi-floating axle, there is a bearing between the rear axle shaft and the axle case. The rear axle shaft not only transmits torque, it also supports the weight of the vehicle. Because of the simple and light-weight structure of this type, it is often used in small trucks.



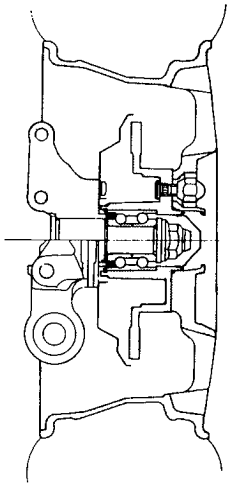
TAX005

(3) INDEPENDENT SUSPENSION REAR AXLE

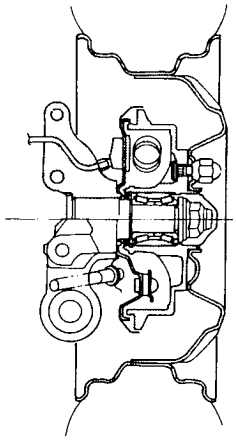
This type does not require an axle case. Most are similar to the structure shown in the illustration. On FF vehicles, it is not necessary for the rear axle to transmit torque. Most axles of this type will be part of an integrated unit with the strut similar to the front axle on FR vehicles.



FR drive



FF drive with disc brake



FF drive with drum brake

TAX006

2. SUSPENSION

2-1. DESCRIPTION

The suspension connects the axle to the body. Along with the tires, it improves ride and protects the body and load by absorbing road vibration and bumps that would otherwise be transmitted directly to the body. The suspension's basic functions are to insure smooth vertical movement and correct side and lateral positioning over the wheels.

2-2. SUSPENSION STRUCTURE AND FUNCTION

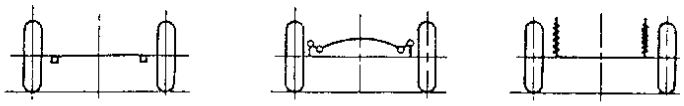
The main parts of the suspension systems are spring, shock absorber, stabilizer and link.

Spring ... Supports the weight of the body and absorbs shock from the road
Shock absorber.... Controls vertical movement of the body
Stabilizer… Reduces body roll
Link…Determines body positions and transmits motion and braking to the body.
Through changing the layout of these basic parts, many types of suspension systems have been designed.

2-3. SUSPENSION TYPES

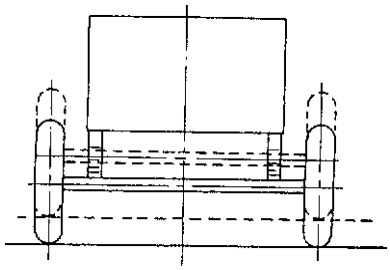
(1) AXLE SUSPENSION

On axle type suspensions, the left and right wheels are connected by one axle. The body is connected to the axle by springs. Because of the strength and simple structure of this type, it is often used in large trucks and buses.



TSU001

Leaf springs are the most commonly used spring type suspension. Depending on the layout, parallel spring or leaf spring types may be used. The parallel spring type is the most common.



TSU002

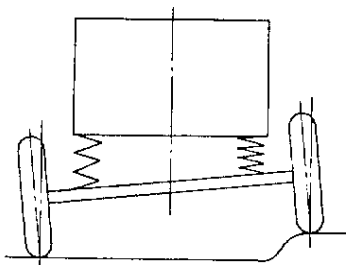
AXLE TYPE
(Even when the body and axle move vertically in relation to each other, the tread camber does not change)

(2) INDEPENDENT SUSPENSION

When passing over a bump, the angle of the wheel changes with the up and down movement. This movement also effects the wheel on the other side on flat ground.

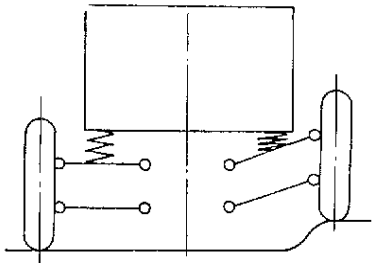
This is excess movement that is undesirable from the viewpoint of both safety and comfort. In order to eliminate this, a system called independent suspension was developed to allow the left and right wheels to respond independently without affecting the other side.

Independent suspension adds much to comfort by reducing weight below the spring and preventing one wheel from affecting another. Type of independent suspension and functions.



TSU003

RIGID AXLE TYPE SUSPENSION WITH ONE WHEEL RAISED
(The angle of both wheels is affected)

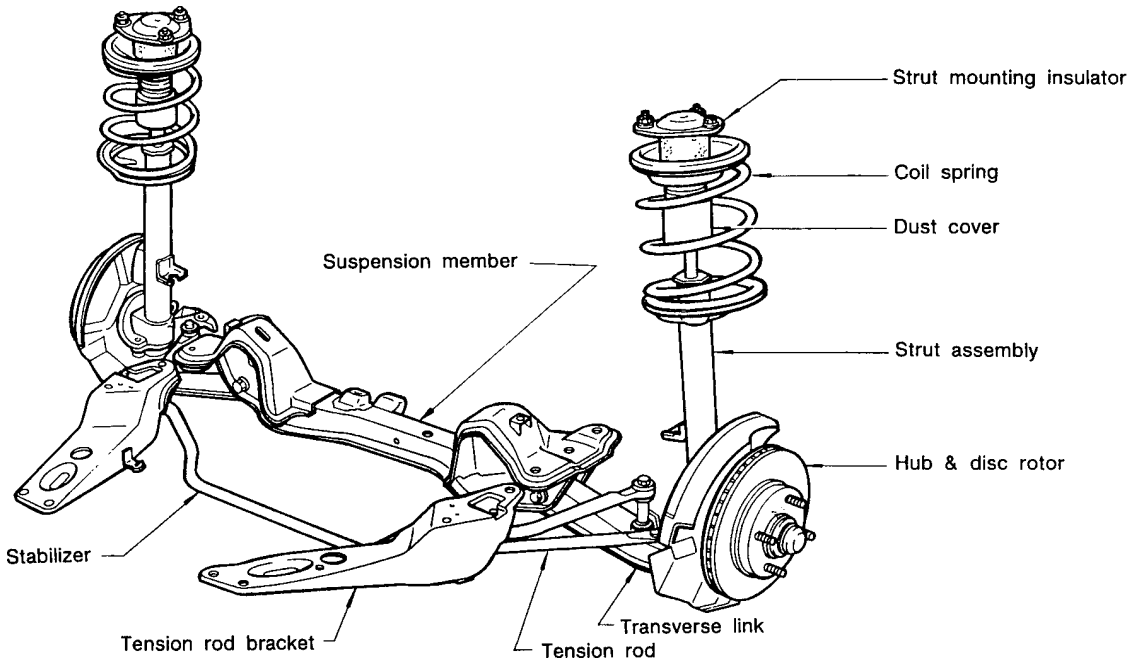


TSU004

INDEPENDENT SUSPENSION WITH ONE WHEEL RAISED
(The angle of the wheels to the ground has not changed)

2-4. FRONT SUSPENSION
(1) FRONT SUSPENSION TYPES

(a) Strut types
Characteristics
This type usually uses shock absorbers called suspension struts that are heavy-duty and highly rigid. Strut suspension and McPherson strut are other names also used. The structure is simple with few parts. Besides being light, it does not occupy much space. The bilateral force on the wheels is received by the transverse link. The fore and aft force is received by the tension rod.

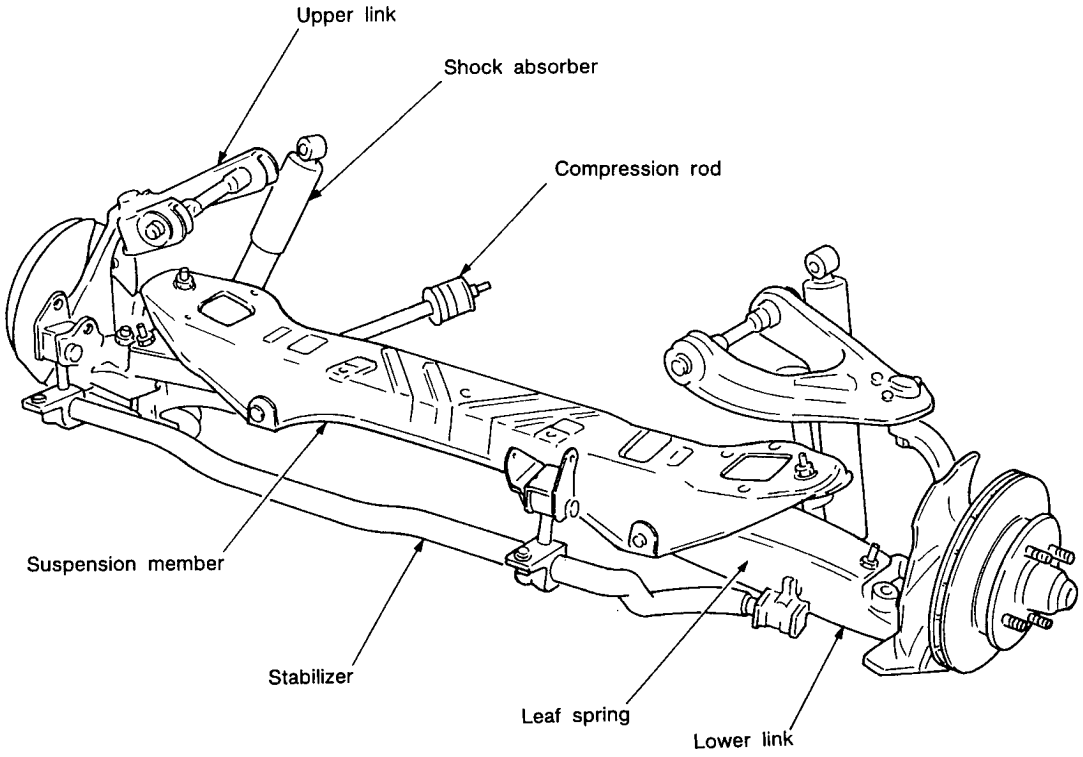


TSU005

(b) Double wishbone (lateral leaf spring) type

Characteristics

The structure in the figure is similar to the old coil spring type wishbone suspensions except that the coil spring has been replaced by a leaf spring (placed sideways). The vertical movement is controlled by the leaf spring and shock absorber while lateral and side movement is controlled by the upper and lower link. When compared with the strut type, this is more complicated, but the vertically operated link has greater rigidity.

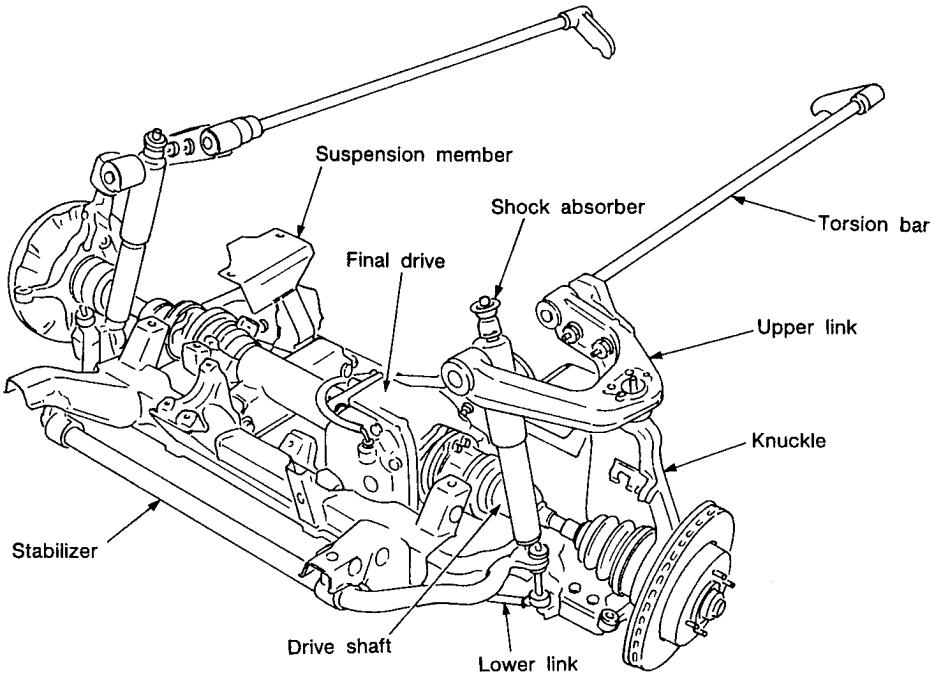


TSU006

(c) Double wishbone (torsion bar spring) type

Characteristics

On this type, when the upper arm shakes, the torsion bar connected by serrations (joint where boss and shaft connect together is serrated) twists to soften the shock.



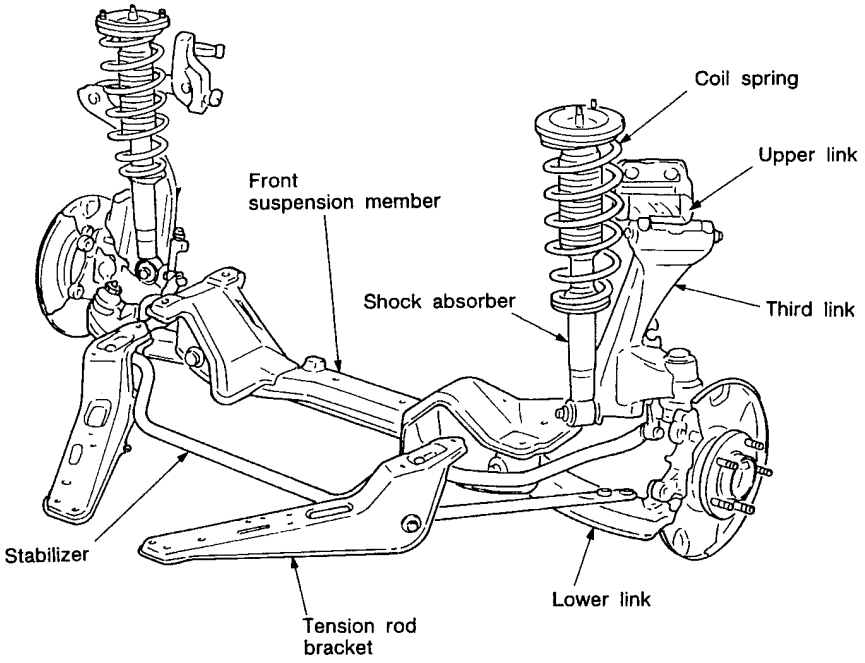
TSU007

(d) Multi link type

Characteristics

The multi link type uses the double wishbone suspension as a base with an added third link. This allows the kingpin shaft to be free from the upper link unlike on the former type.

In other words, the kingpin shaft can be set in the most ideal position regardless of the upper link position. The upper link and kingpin shaft are connected together by this third link. This makes it possible to set alignment at any position. Also, because this third link only works during vertical movement and is not affected by drive turning, the spring and shock absorber system can be installed on the same shaft. With this arrangement, the wheel stroke and the shock absorber stroke work efficiently to reduce shock on a 1:1 ratio.



TSU008

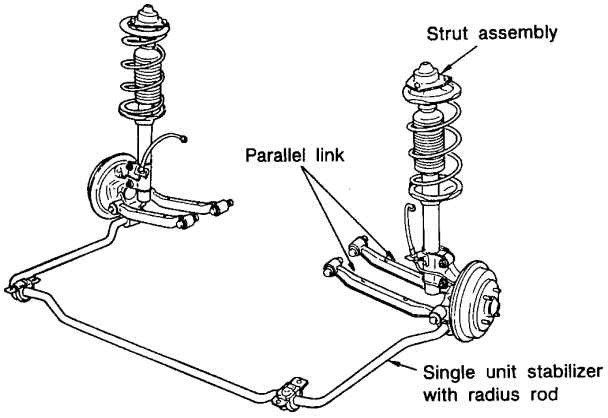
2-5. REAR SUSPENSION

(1) REAR SUSPENSION TYPES

(a) Parallel link type

Characteristics

As shown in the figure, because two parallel links of the same length are used, there is very little tire alignment change resulting in high stability. With the parallel link type, when high reverse load is added on the tires, when stopping for example, or during bound and rebound, the toe change can be controlled against the change of the floor height in order to maintain stability.

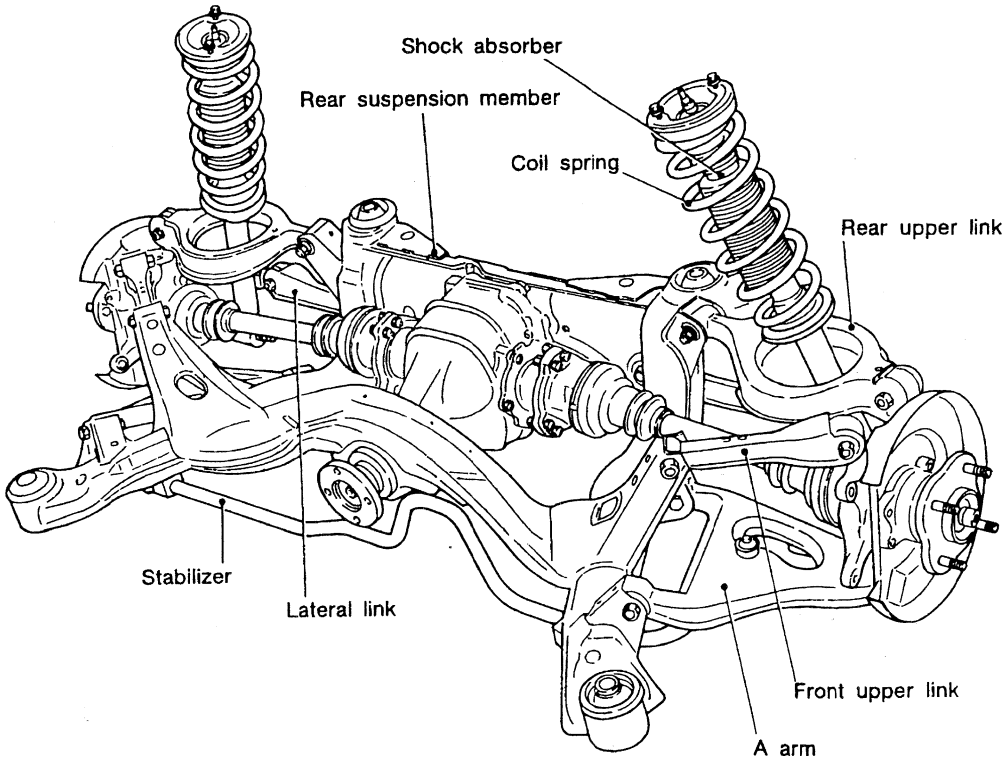


TSU009

When turning corners, the lateral force on the tire is located slightly to the rear of center; but by moving this lateral force close to the elastic center of the rear parallel link, toe change will be small and stability can be maintained.

(2) Multi link type

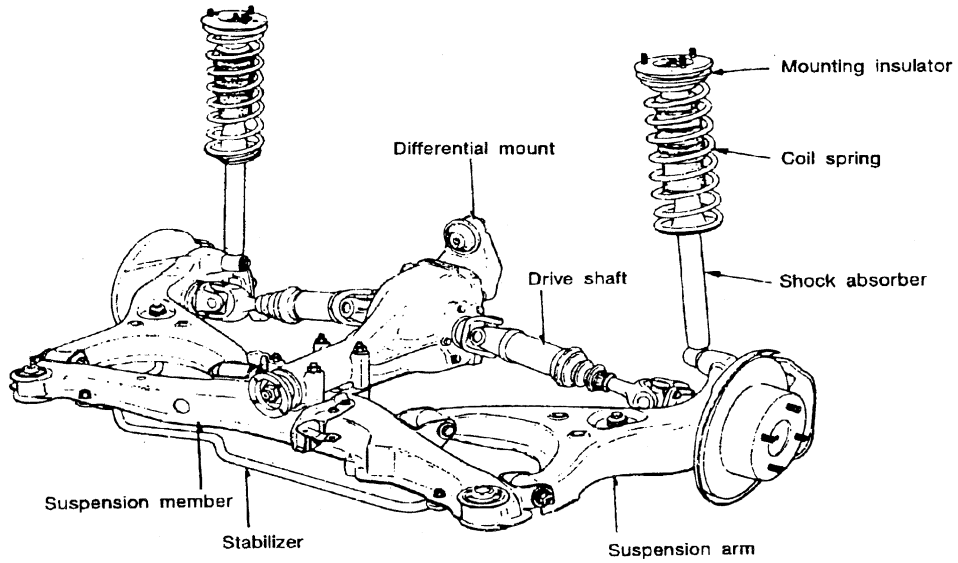
A double upper link (front upper link and rear upper link) is installed on the upper part and the lower arm. It consists of an A arm placed on a slant and the lateral link behind it. The lower arm is arranged on the lower part. This facilitates the most ideal movement of the tires to absorb the force from fore and aft, lateral and vertical directions.



TSU010

(a) Semi trailing arm type

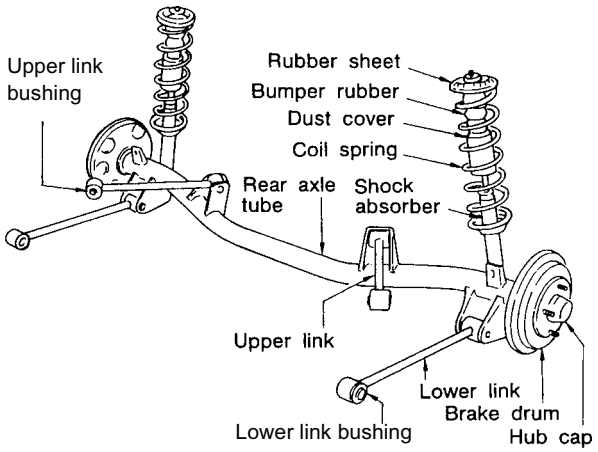
In structure, the semi trailing arm is somewhere between the trailing arm and the swing axle type. The trailing arm pivot shafts slant towards the center of the body. This type is most often used on FR vehicles. The defining characteristic is the semi trailing arm's ability to change pivot shaft angle to control the camber and horizontal angle of the wheels.



TSU011

(b) 4-link coil spring type

On 4-link suspension systems the link determines the axle position of the vehicle. The ride comfort is improved because the spring can be used exclusively to absorb much of the vibration. There are two ways of supporting the lateral weight: an upper link shaped like a reverse V (4-link type) and also a specialized support rod (5-link type).

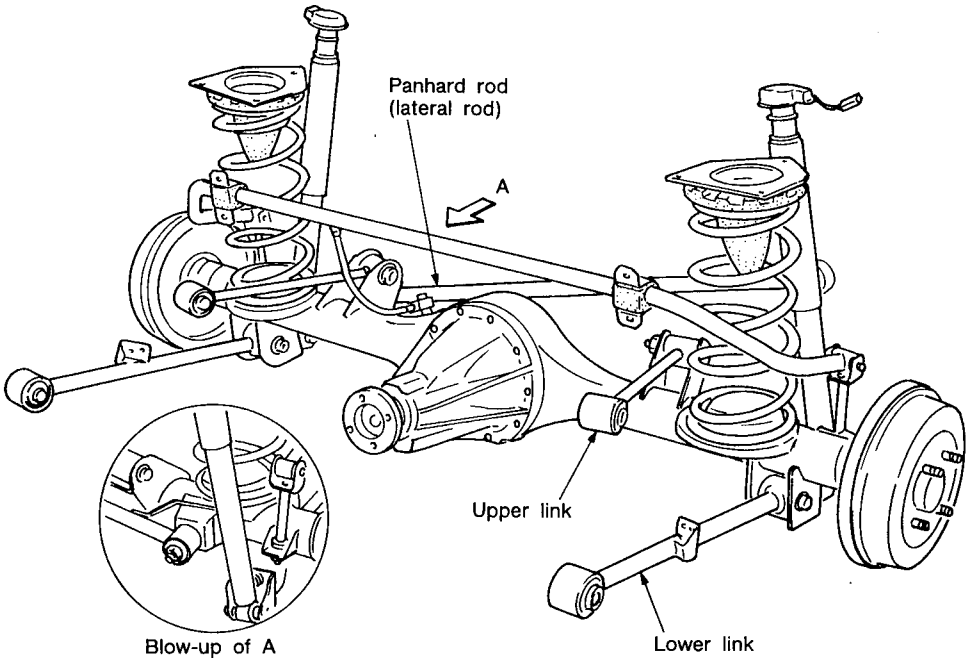


TSU012

(c) 5-link coil spring type

The roll center is lower and bilateral rigidity is higher on the 5-link coil spring than on the 4-link coil spring type. Because of this, there is less lateral movement which makes travelling on rough roads more comfortable.

*The panhard rod gets its name from a French engineer named Panhard. This support rod restricts lateral movement. Recently it is also being called a lateral rod.

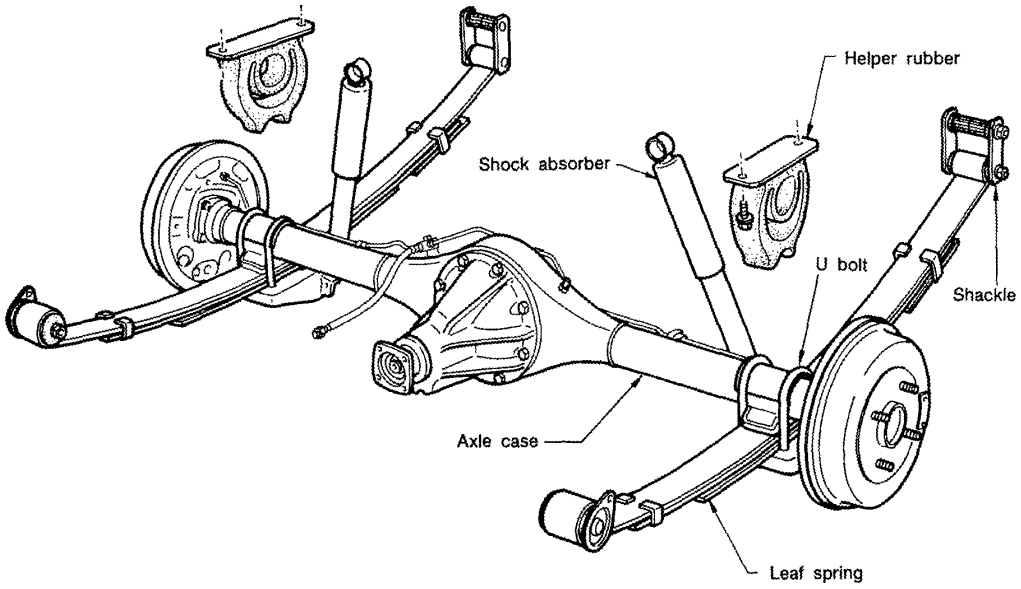


TSU013

(d) Rigid leaf spring type

The rigid leaf spring is installed parallel to the vehicle. Besides absorbing road shock, it also holds the axle in position.

All of the wheel traction, brake force, and lateral force from turning is transmitted through the spring to the body.

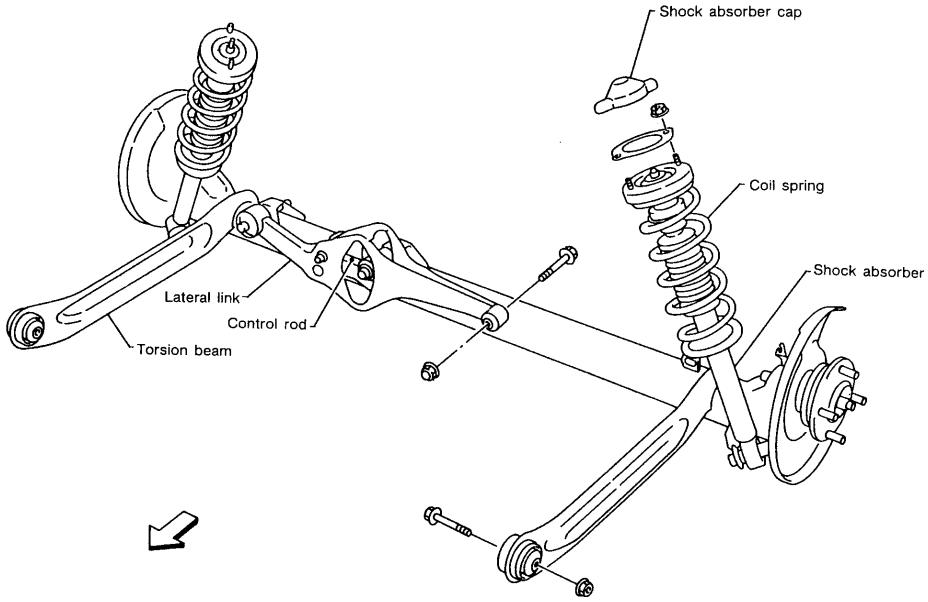


TSU014

(e) Multi-link beam suspension

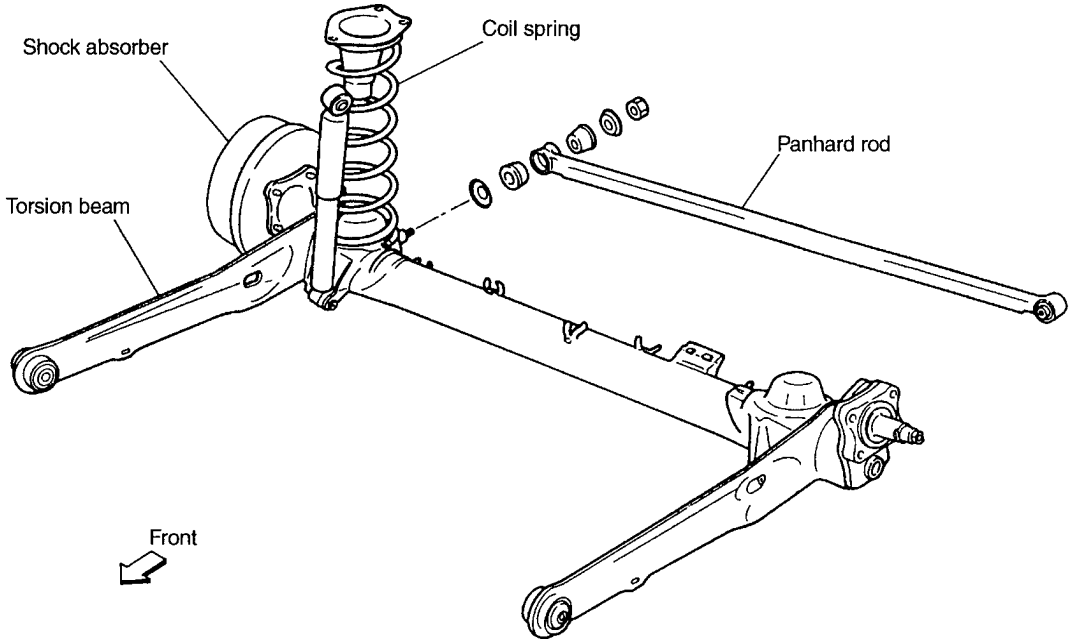
This system has the newly developed multi-link beam type suspension. Designed on the basis of the torsion beam type suspension, the multi-link suspension system now has an additional structure of a lateral link and a control rod.

MULTI-LINK BEAM



TSU015

TORSION BEAM



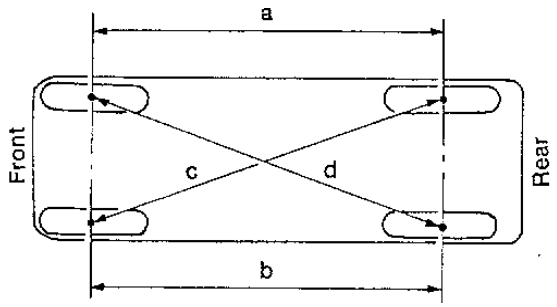
TSU016

WHEEL ALIGNMENT

1. DESCRIPTION

Wheel alignment usually refers to the front wheels but in effect it means that all the wheels on a vehicle should be aligned. Incorrect wheel alignment may cause uneven tyre wear or the steering to be effected by wheel jerking. When the wheels on a vehicle are aligned- there is balance between the points shown in the figure. In the following description, we will assume that front and rear alignment is correct and focus on front wheel alignment.

RELATIVE POSITION OF FRONT AND REAR WHEELS



TSU017

2. FRONT WHEEL ALIGNMENT

The front wheels determine the direction of travel. When coming out of a turn, the front wheels should return smoothly to a straight position. This requires that parts such as the front axle and kingpin work smoothly together. This is what is meant by front wheel alignment. Front wheel alignment is affected by the following factors.

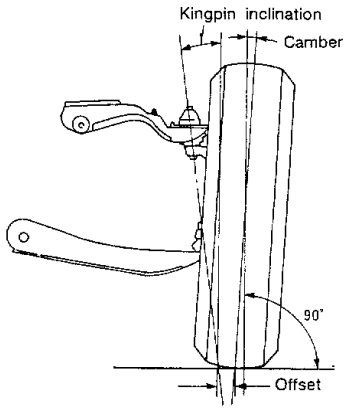
- Camber
- Caster
- Kingpin inclination
- Toe in

These factors work together for the following functions.

- Make steering wheel easy to handle
- Maintain steering wheel in stable forward position
- Give steering wheel return power
- Reduce tyre wear

2-1. CAMBER

When looking at the front of the front wheel as shown in the figure, the wheel appears to be leaning outward. The angle between the surface and the centre line of the wheel is called the camber. Camber varies from model to model, but generally the camber angle is between 0.5 and 2 degrees. The wheel in the figure which is leaning outwards is said to have a positive camber; wheels that lean in have a negative camber.

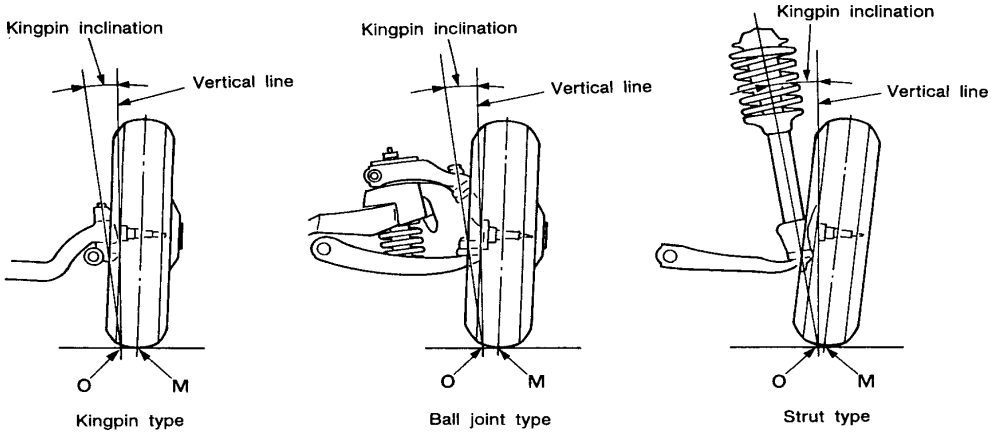


TSU018

CAMBER

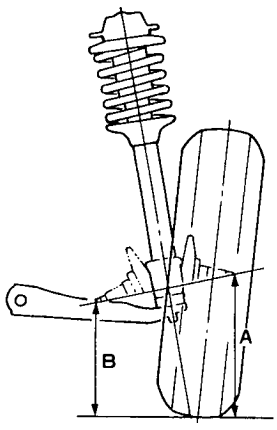
2-2. KINGPIN INCLINATION

When looking at the front wheel from the front, the upper part of the kingpin appears to be on an inward angle. The perpendicular line of the kingpin with the ground is called the kingpin inclination.



TSU019

The kingpin inclination varies between models. It is generally in the range of 6 to 9 degrees.

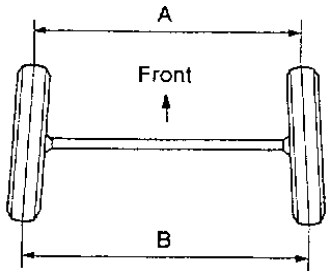


TSU020

RETURN TO POSITION OF STEERING WHEEL BY KINGPIN INCLINATION

2-3. TOE-IN

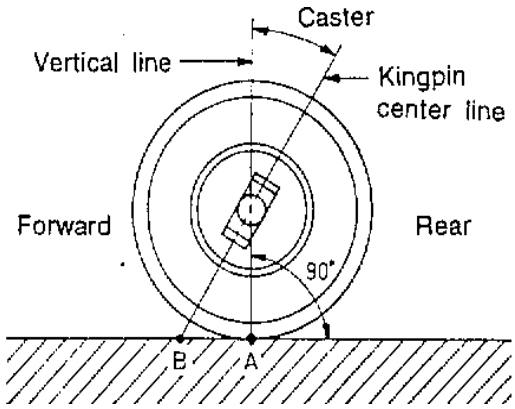
The figure, a view from above, shows that the distance between the front of the wheels is shorter than the distance between the rear of the wheels. This is what is meant by toe-in. Toe-in is the difference between the tread centre on the front of the wheels and the centre of the tread in the rear of the wheels. The toe-in is generally in the range between 2 and 8 mm (0.08 and 0.31 in). If the front of the wheels is wider than the rear of the wheels, this is called toe-out. Toe-in keeps the wheels straight when driving.



TSU021

2-4. CASTER

When looking at the vehicle from the side, most kingpins will be set at an angle as shown in the figure. This angle is called the caster and is generally in the range of 0.5 to 4 degrees. The B point where the kingpin centre line intersects with the road surface is farther ahead than the centre contact point A. Thus, the wheel running resistance will pull the contact point A back which prevents side run-out. This also tends to return the steering wheel back into the straight forward position. This so called caster effect stabilizes the direction of travel and helps the steering wheel return to position.



TSU022

CASTER ANGLE