SCANIA

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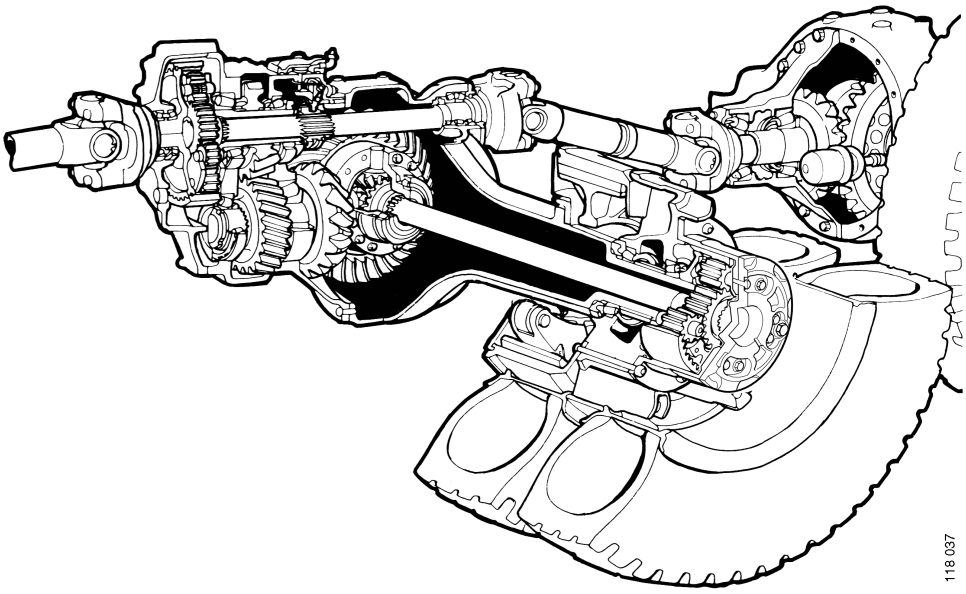
Issue 1 **en**

Central gear

Function description



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Contents

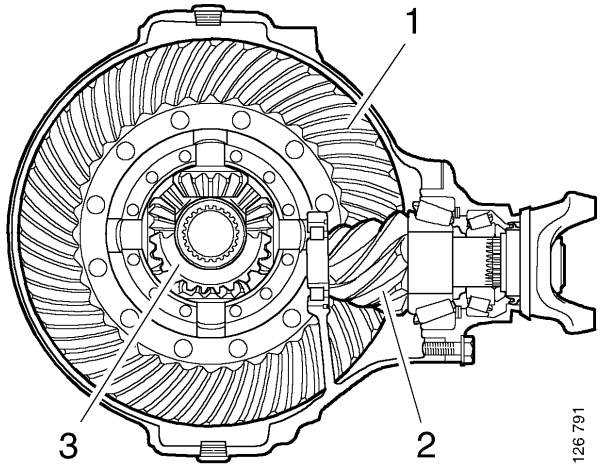
Central gear

General

The central gear transmits the propeller shaft torque to the driving wheels.

The central gear consists of a conical gear set comprising a pinion, crown wheel and axle differential.

On vehicles with double rear driving axles, the front central gear is combined with a bogie differential and one or two transfer gears.



1 Crown wheel
2 Pinion
3 Axle differential

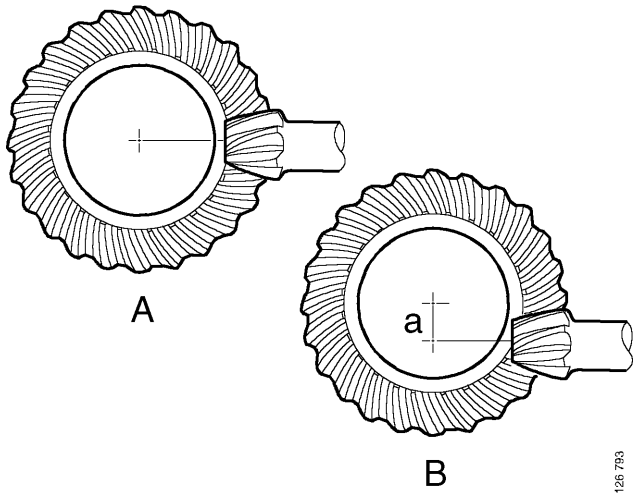
The pinion and crown wheel have specially cut teeth, thus ensuring that the teeth have high strength, low noise and low power losses. Since high torques need to be transmitted, there should be an optimum fit between the pinion and crown wheel. The pinion and crown wheel are therefore paired in a running-in procedure in production. When renewing a crown wheel or pinion, both items must therefore be renewed.

Conical gear set

There are two different types of conical gears, a conical spur gear and a hypoid gear.

In a conical spur gear, A, the centre line of the pinion matches that of the crown wheel.

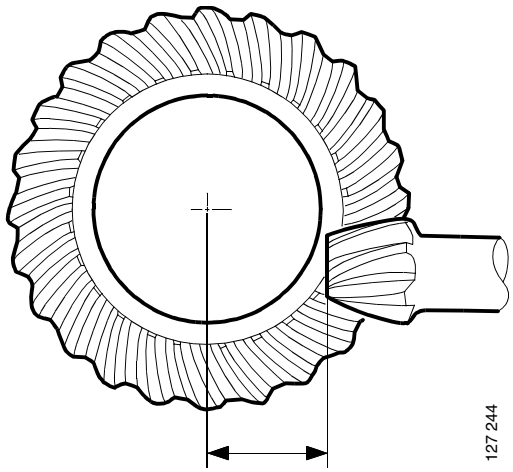
In a hypoid gear, B, the centre line of the pinion is offset from that of the crown wheel, giving the teeth increased strength as a result of longer sliding meshing and better overlapping of the teeth.



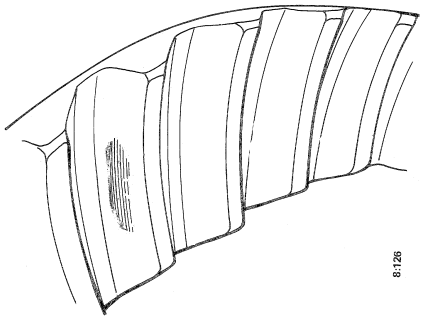
The distance a is called the offset.

Mesh image

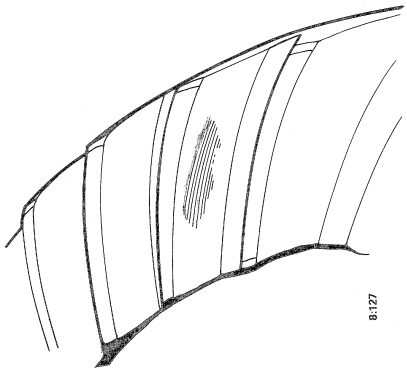
The distance between the centre of the crown wheel and the pinion is important for the service life of the central gear.



The teeth of the pinion and crown wheel should mesh in the centre of the tooth. The mesh location, mesh image, should be checked with indelible ink when assembling the central gear. A badly located mesh image reduces the service life of the central gear and results in a high noise level.



Mesh image on the front of the tooth.



Mesh image on the rear of the tooth.

Gear ratio

A gear ratio is a relationship between the number of teeth on the crown wheel and pinion. On vehicles with no hub reduction gear, the reduction takes place in the central gear which means that the half shafts rotate more slowly than the propeller shaft. On vehicles with a hub reduction gear, the final reduction takes place in the hub reduction gear. Reduction results in a corresponding increase in torque.

Each type of central gear has several different gear ratios. The gear ratio of the central gear should be adjusted to the specific driving conditions of the vehicle.

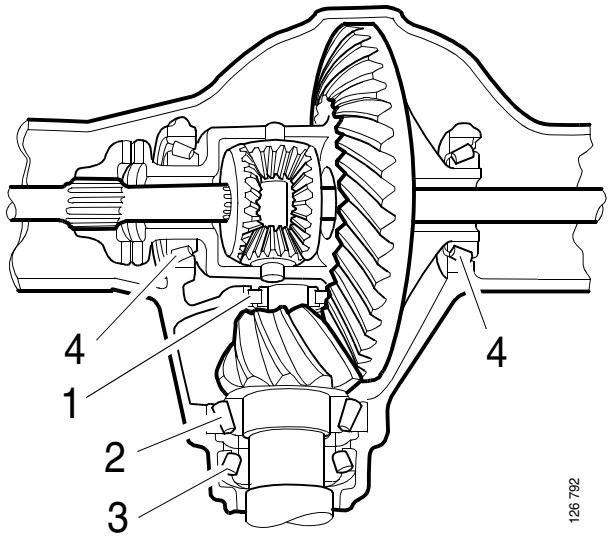
Bearings

Under load the pinion and crown wheel are subjected to forces which seek to push the pinion forward as well as force apart the pinion and crown wheel. To counteract this, the pinion is supported on strong, taper roller bearings.

On some central gears the pinion has a cylindrical support bearing located in the gear housing inside the crown wheel ring gear.

The crown wheel is assembled with the differential housing which is supported on strong taper roller bearings in the gear housing.

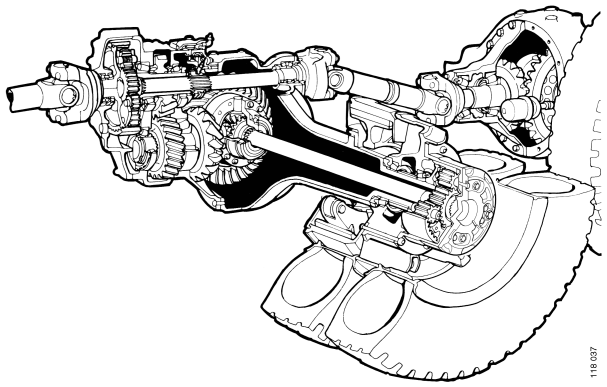
The bearings are preloaded to increase the service life of the bearings and central gear.



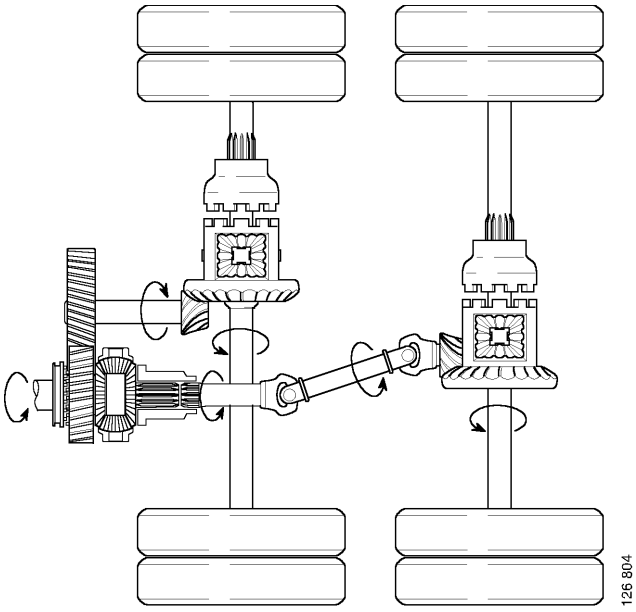
1 Support bearing
2 Rear pinion bearing
3 Front pinion bearing
4 Differential housing bearing

Double rear driving axles

In the front central gear the propeller shaft torque is transferred to the front and rear central gears. Torque transfer takes place in the bogie differential.



The pinions in the front and rear central gears rotate in different directions because of the transfer gear in the front central gear. The crown wheel is therefore positioned on different sides of the pinion in the front and rear central gears.



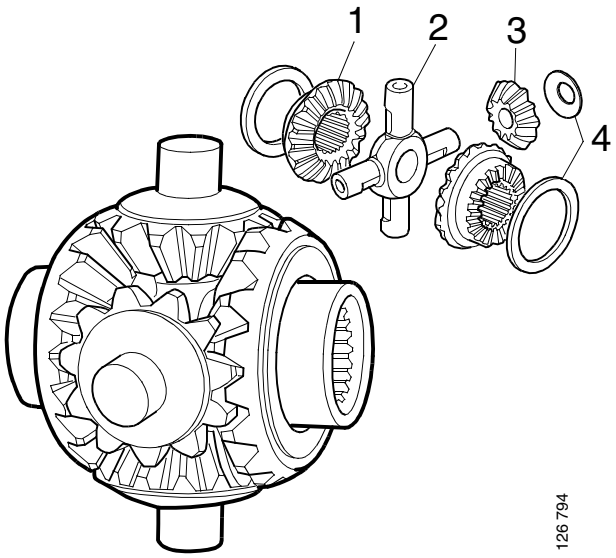
Axle differential

General

When cornering, the driving wheels travel different distances and therefore have different rotation speeds. The rotational difference between the wheels is transferred to the axle differential.

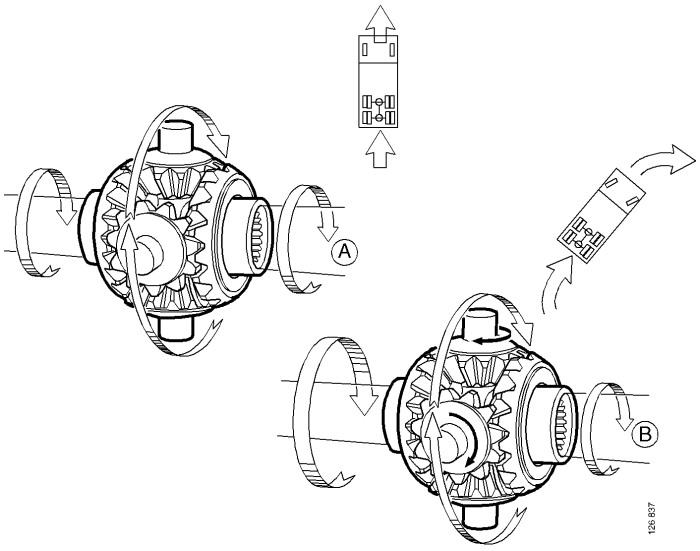
The axle differential consists of four tapered differential pinions fitted on a differential spider. The differential pinions are constantly meshed with two opposed differential gears which are connected to the relevant half shafts.

The axle differential is integrated into the differential housing.



1 Differential gear
2 Differential spider
3 Differential pinion
4 Support washer

Rotational distribution



When the vehicle is driven straight ahead and the rotational speed of the driving wheels is the same, the differential pinions on the differential spider do not rotate but operate only as drivers between the crown wheel and half shafts. See A in illustration.

When the vehicle turns, the inner driving wheel will travel a shorter distance than the outer one. Since the driving wheels then have different rotational speeds, so do the differential gears on the half shafts. The differential pinions will then rotate. See B in illustration.

Since the combined speed of the driving wheels is constant, the outer driving wheel will rotate faster in relation to the crown wheel by as much as the inner one rotates slower.

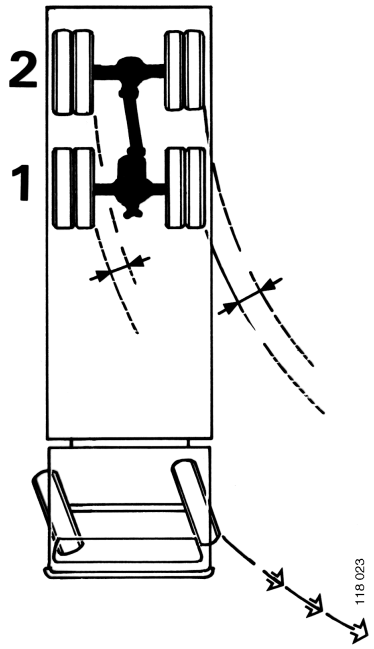
In extreme cases, when one driving wheel is stationary and the other one is slipping, the slipping wheel will rotate twice as fast as the crown wheel.

If one driving wheel does not have sufficient friction and starts to slip, the vehicle remains stationary. The friction on the slipping wheels determines the overall amount of torque. This torque determines the driving force for both wheels, since the axle differential always transfers the torque to both wheels.

Bogie differential

General

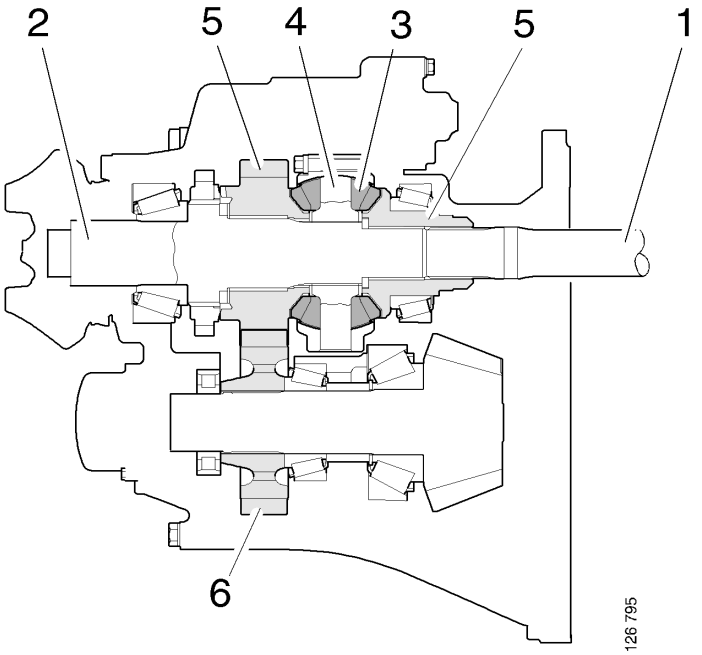
When the vehicle turns, the wheels on the rear driving axles will travel different paths. The front pairs of wheels travel longer distances than the rear ones. This means that the wheels have different rotational speeds. The rotational difference between the front and rear pairs of wheels is distributed in the bogie differential.



Two variants of bogie differential are available:

- A new variant in which the bogie differential functions as an axle differential.

  A differential spider is connected to the input shaft. The differential spider is in constant rotation when the vehicle is moving. The differential pinions on the differential spider are constantly meshed with two differential gears which are connected to the transfer gear and output shaft.

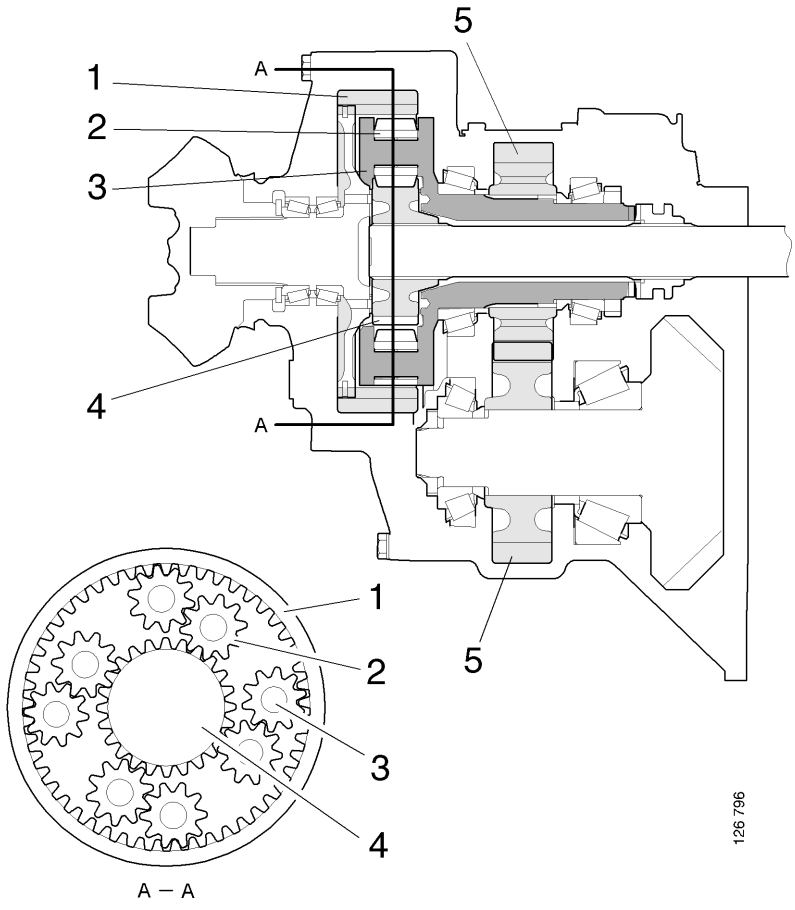


1 Output shaft
2 Input shaft
3 Differential pinion
4 Differential spider
5 Differential gear
6 Transfer gear

- An old variant in which the bogie differential is a planetary gear.

  The internal ring gear is connected to the input shaft via a driver. The internal ring gear is in constant rotation when the vehicle is moving. The sun wheel is connected to the output shaft. The planet wheels are constantly meshed with the internal ring gear and sun wheel. The planet wheels are supported in the planet wheel carrier. One of the transfer gears is fitted on the planet wheel carrier.

  The planet wheels are arranged in pairs to retain the direction of rotation between the internal ring gear and the sun wheel.



1 Internal ring gear
2 Planet wheel
3 Planet wheel carrier
4 Sun wheel
5 Transfer gear

Rotational distribution

The following example explains the rotational distribution in the bogie differential:

- Driving straight ahead.
- Front driving wheels slip, an extreme case.
- Rear driving wheels slip, an extreme case.

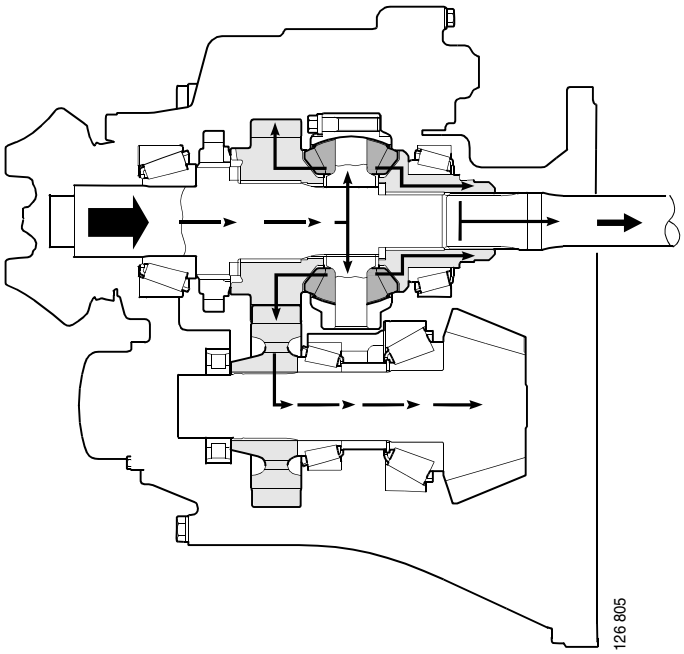
Since there are two variants of bogie differential, explanations will be given for both variants.

Driving straight ahead

When the vehicle is driven straight ahead and the rotational speed of the pairs of driving wheels is the same, the rotational power driving the propeller shaft will be distributed in the same way in the bogie differential.

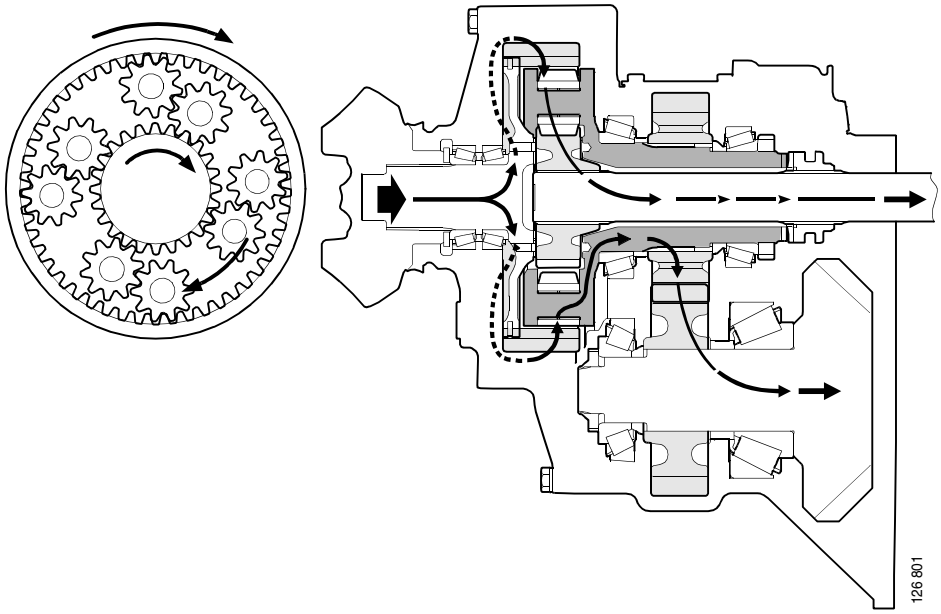
New bogie differential

The differential pinions do not rotate on the differential spider but operate only as a driver. The rotational power is distributed between the front and rear differential gears. The front differential gear transfers the rotational power to the front pinion via the transfer gear. The rear differential gear is connected to the output shaft which transfers the rotation to the rear central gear.



Old bogie differential

Part of the rotational power is distributed to the front pinion via the planet wheel carrier and the transfer gears. The remaining rotational power is transferred via the sun wheel, which is connected to the output shaft, to the rear central gear.

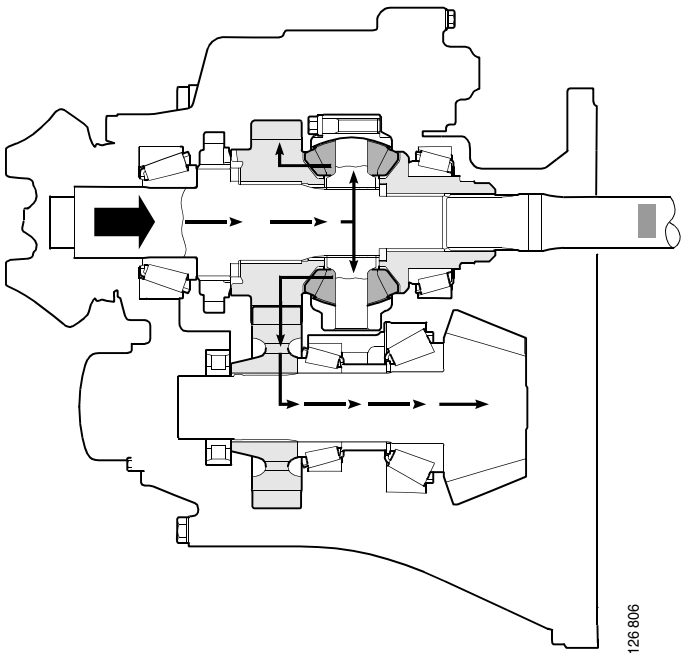


Front driving wheels slip

When the wheels on the front driving axle slip, the rotational motion passes from the propeller shaft to the front pinion.

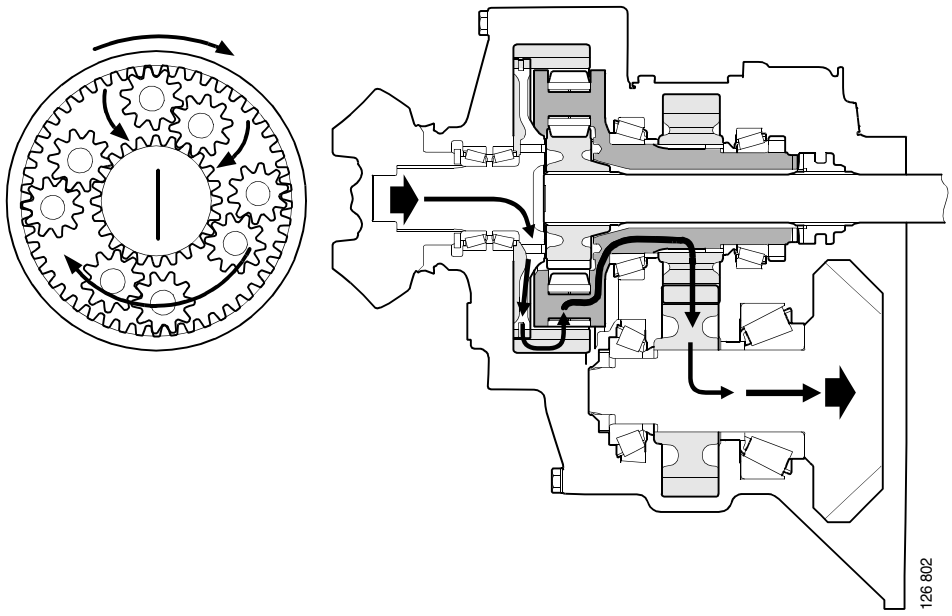
New bogie differential

The rear differential gear remains stationary which means that the differential pinions on the differential spider rotate. The front differential gear rotates twice as fast and transfers the rotational power to the front pinion via the transfer gear.



Old bogie differential

The sun wheel on the output shaft remains stationary which means that the pairs of planet wheels rotate. The planet wheel carrier rotates twice as fast and transfers the rotational power to the front pinion via the transfer gear.

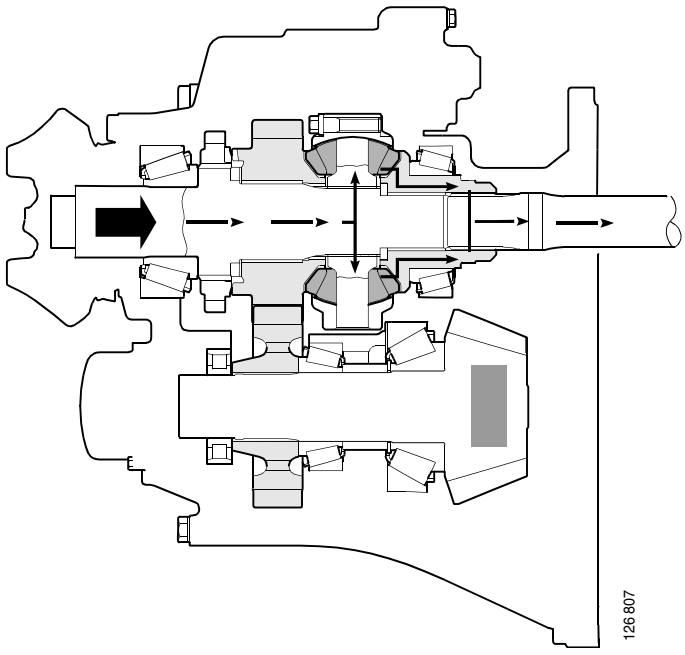


Rear driving wheels slip

When the wheels on the rear driving axle slip, the rotational motion passes from the propeller shaft to the rear pinion.

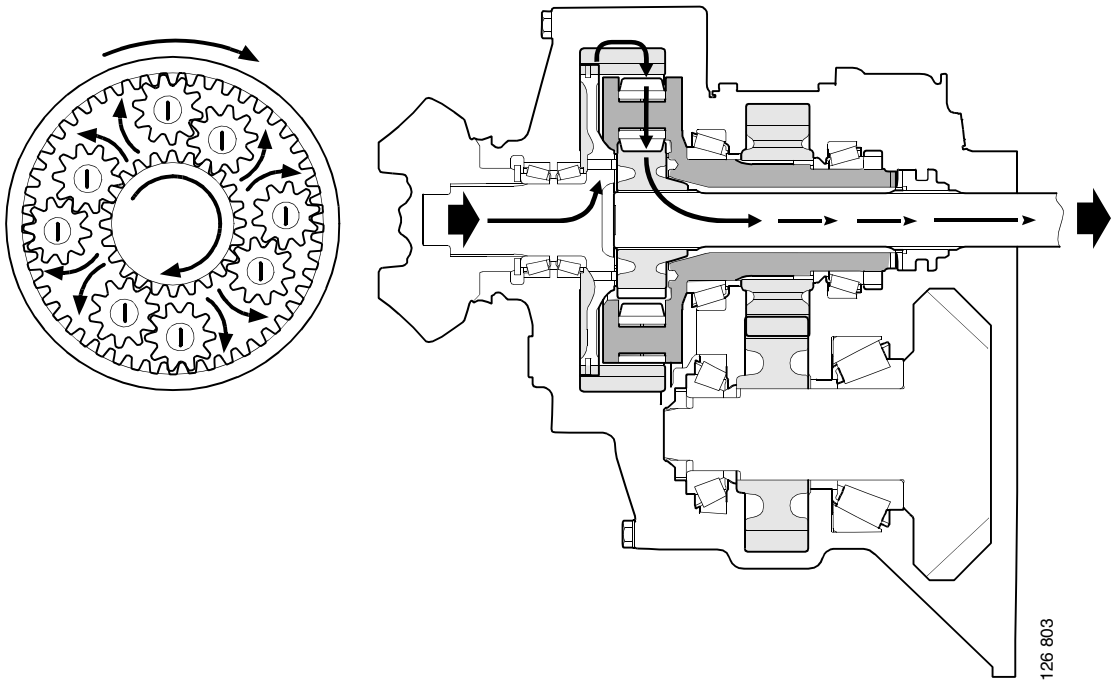
New bogie differential

The front differential gear remains stationary which means that the differential pinions rotate. The rear differential gear rotates twice as fast and transfers the rotational power to the rear central gear via the output shaft.



Old bogie differential

The planet wheel carrier remains stationary which means that the pairs of planet wheels rotate. The sun wheel rotates twice as fast and transfers the rotational power to the rear central gear.



Differential locks

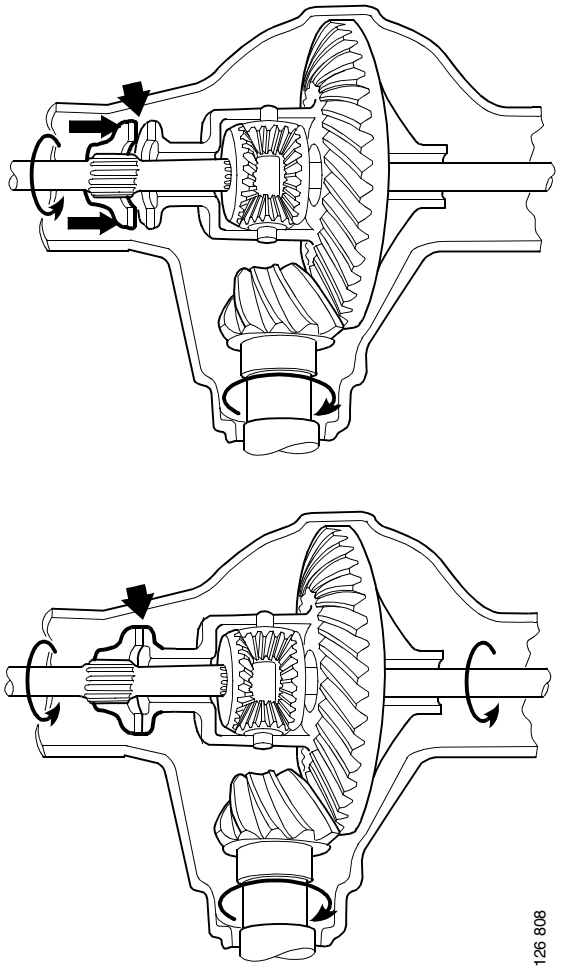
Axle differential lock

The central gear is equipped with an axle differential lock to prevent wheels on the same axle from rotating at different speeds.

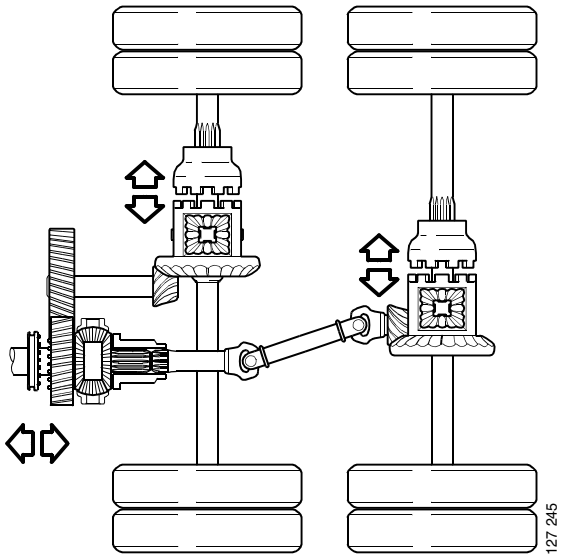
The axle differential lock has a sliding coupling half on one half shaft. When the coupling half is pushed to the side, it locks the half shaft to the differential housing or the differential housing to the differential gear. The axle differential with the crown wheel and half shaft then becomes a rigid unit and thus forces the driving wheels to rotate at the same speed.

The axle differential lock can be engaged and disengaged when driving straight ahead if no wheels are slipping. If the axle differential lock is engaged when the wheels are slipping, the central gear may be damaged.

The axle differential lock should not be used when driving on a dry and firm surface, because it could cause considerable tyre wear, reduce vehicle steerability and in the worse cases the central gear and half shafts may be damaged.



Bogie differential lock



In addition to an axle differential lock on each axle, vehicles with double rear driving axles have a bogie differential lock. The bogie differential lock prevents the pairs of wheels on the front and rear axles from rotating at different speeds.

Since there is a new and old variant of bogie differential, the same also applies to the bogie differential lock:

- The new bogie differential lock is a sliding coupling half connected to the input shaft.

  When the coupling half meshes with the differential gear, the input shaft and differential gear become a single unit. This forces both pinions to rotate at the same speed.

- The old bogie differential lock is a sliding coupling half connected to the output shaft.

  When the coupling half meshes with the planet wheel carrier, the output shaft and planet wheel carrier become a single unit. This forces both pinions to rotate at the same speed.

Operation

Axle differential lock and new bogie differential lock

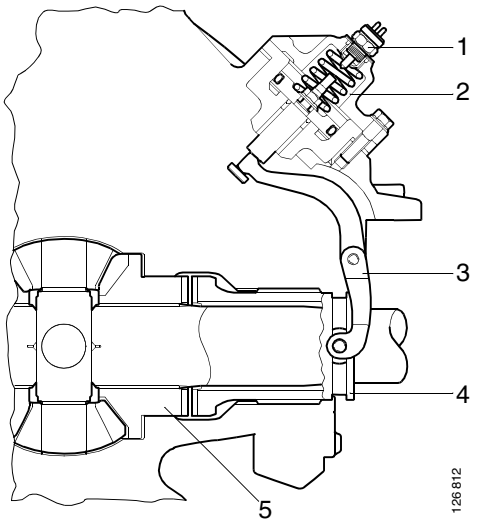
The control cylinder for the differential lock is located on the gear housing.

When the control button on the instrument panel is pressed, a solenoid valve is actuated which opens the air line to the control cylinder.

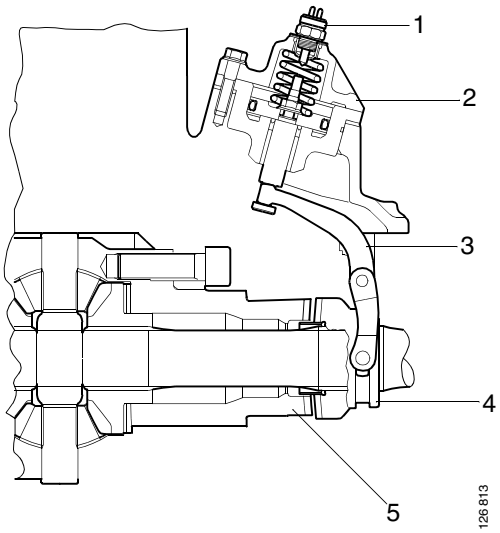
The piston in the control cylinder has a spring-loaded pull rod which actuates a lever. The lever pushes the coupling half so that it meshes with the differential gear or differential housing.

When the differential lock has become engaged, the pull rod also actuates a switch causing a lamp in the control button to come on. The warning lamp in the instrument cluster starts to flash when the circuit is closed.

When the control button is deactivated, the control cylinder is vented. The spring-loaded pull rod retracts and disengages the coupling half. The circuit is broken and the lamps go out.

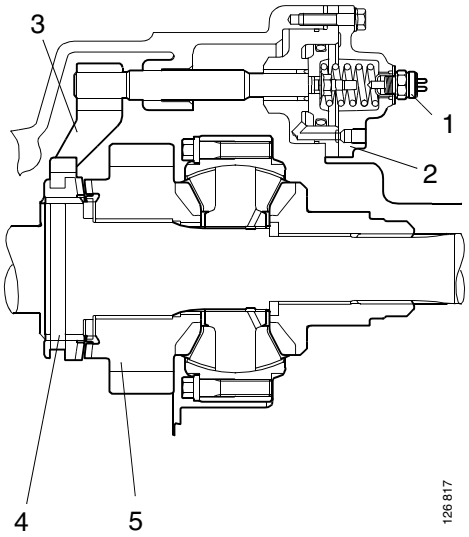


Axle differential lock in RB660



Axle differential lock in RBP735

1 *Switch*
2 *Control cylinder*
3 *Lever*
4 *Coupling half*
5 *Differential gear (RB660) or differential housing (RBP735)*



New bogie differential lock

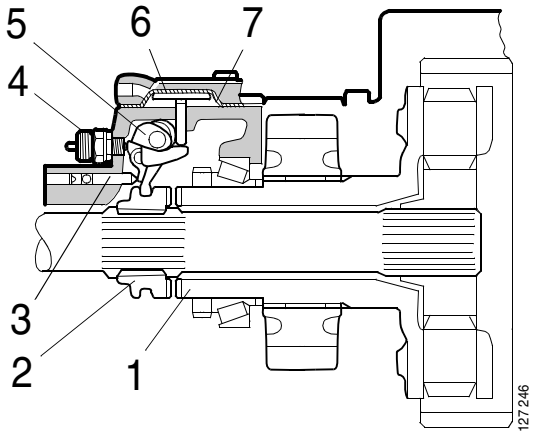
1 *Switch*
2 *Control cylinder*
3 *Lever*
4 *Coupling half*
5 *Differential gear*

Old bogie differential lock

The old bogie differential lock is controlled via a diaphragm-actuated piston which is operated by air from the solenoid valve. The piston pushrod actuates a spring-loaded lever assembly which pushes the coupling half until it engages in the planet wheel carrier.

The lever assembly actuates a switch when the bogie differential lock has engaged and a lamp in the control button comes on. The warning lamp in the instrument cluster starts to flash when the circuit is closed.

When the control button is deactivated, the solenoid valve is vented and the piston pushrod retracts. The lever assembly disengages the coupling half. The circuit is broken and the lamps go out.



1 *Planet wheel carrier*
2 *Coupling half*
3 *Setting screw*
4 *Switch*
5 *Lever mechanism with return spring*
6 *Piston*
7 *Diaphragm*

Lubrication

General

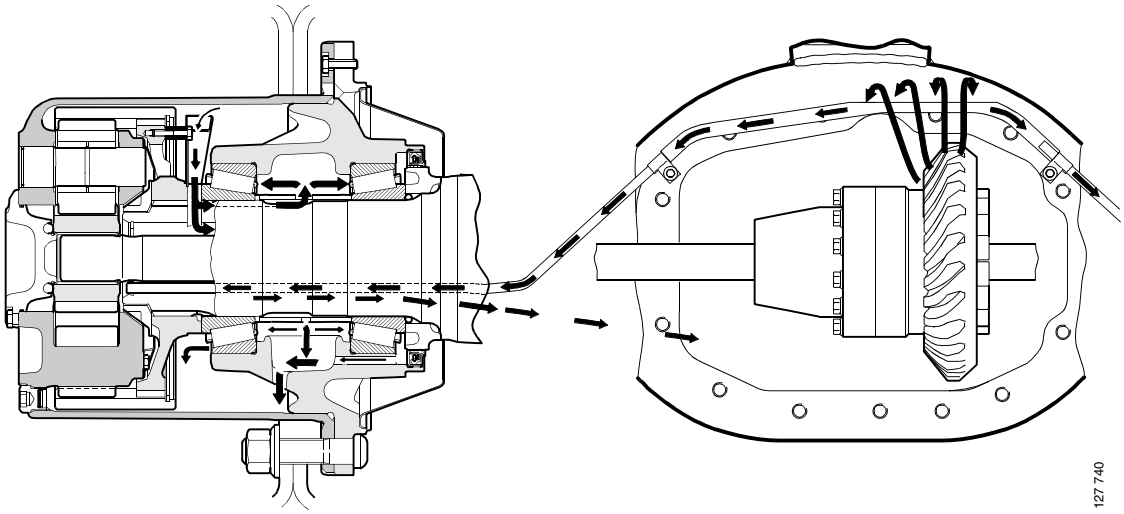
The central gear is lubricated via oil spray from the rotation of the crown wheel in the oil pool.

In vehicles with double rear driving axles, the front central gear has an oil pump to provide lubrication for the output and input shafts and the bogie differential.

Most central gears have an oil filter.

Common lubrication

In vehicles with the new hub reduction gear, the oil circulates between the central gear and hub reduction gear. An oil pipe in the rear axle housing collects the oil sprayed up by the crown wheel. The oil is carried in the oil pipe to the hub reduction gear. An oil collector in the hub reduction gear collects the oil along the edge of the hub cover. The oil recirculates in the rear axle housing to the central gear where it is cleaned.



Because of the common lubrication system, the oil level varies in the central gear depending on how the vehicle has been driven before the oil level is checked. There is more oil in the central gear at a higher speed and there is less in it at a lower speed.

Refer also to the function description for the hub reduction gear in the Workshop manual, main group 9.