

## **FRONT DIFFERENTIAL (APTRAC TYPE LIMITED SLIP DIFFERENTIAL)**

MANUAL TRANSMISSION AND DIFFERENTIAL

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### **10.Front Differential (APTRAC Type Limited Slip Differential)**

#### **A: GENERAL**

The limited slip differential (LSD) automatically limits the differential action and distributes torque to the left and right wheels adequately to enhance driving stability when the left and right wheels are rotating at speeds different from each other during driving on a slippery road (muddy, snow-covered or slushy road) or cornering.

#### **B: CONSTRUCTION**

In the APTRAC differential, there is a set of hexagonally-shaped cam followers placed between and kept in contact with the left and right face cams (which correspond to the side gears in a conventional differential).

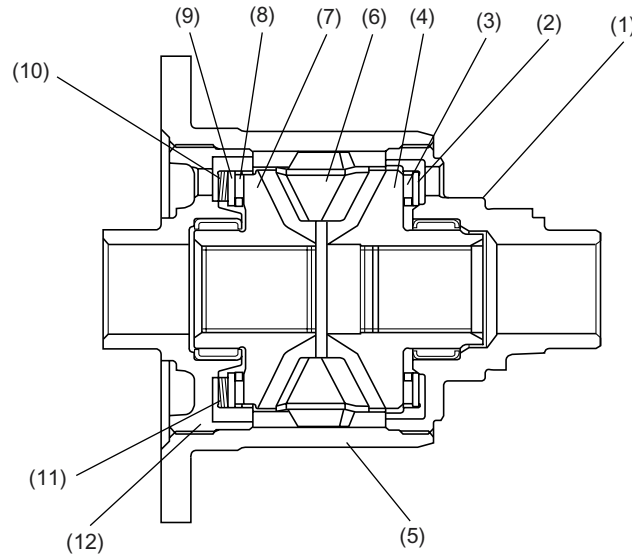
The cam followers engage at their outer ends with the slots that are cut on the inner surface of the cage in the axial direction, so they can slide laterally in the slots but must rotate together with the cage. Since the cam followers push the face cams as the cage rotates, the input torque to the cage is transmitted to the axle shafts.

There are a needle bearing and thrust washer pair between the face cam on each side and cage. Moreover, there is a Belleville spring between one of the needle bearing and thrust washer pairs to give preloading, thus ensuring proper initial friction between the cam followers and face cams.

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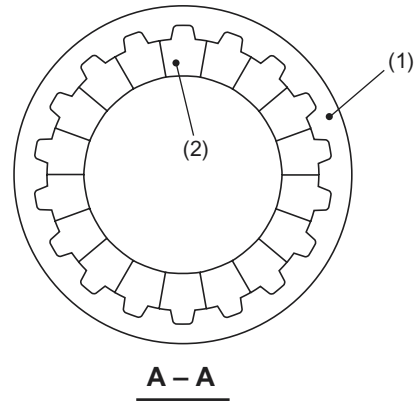
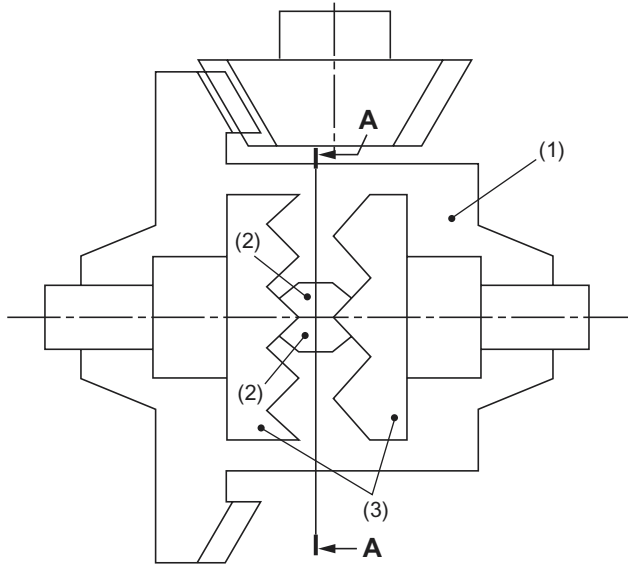
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- |                    |                    |                        |
|--------------------|--------------------|------------------------|
| (1) Hub            | (5) Cage           | (9) Thrust washer      |
| (2) Thrust washer  | (6) Cam follower   | (10) Belleville spring |
| (3) Thrust bearing | (7) Face cam       | (11) Shim              |
| (4) Face cam       | (8) Thrust bearing | (12) Hub               |

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- (1) Cage
- (2) Cam follower
- (3) Face cam

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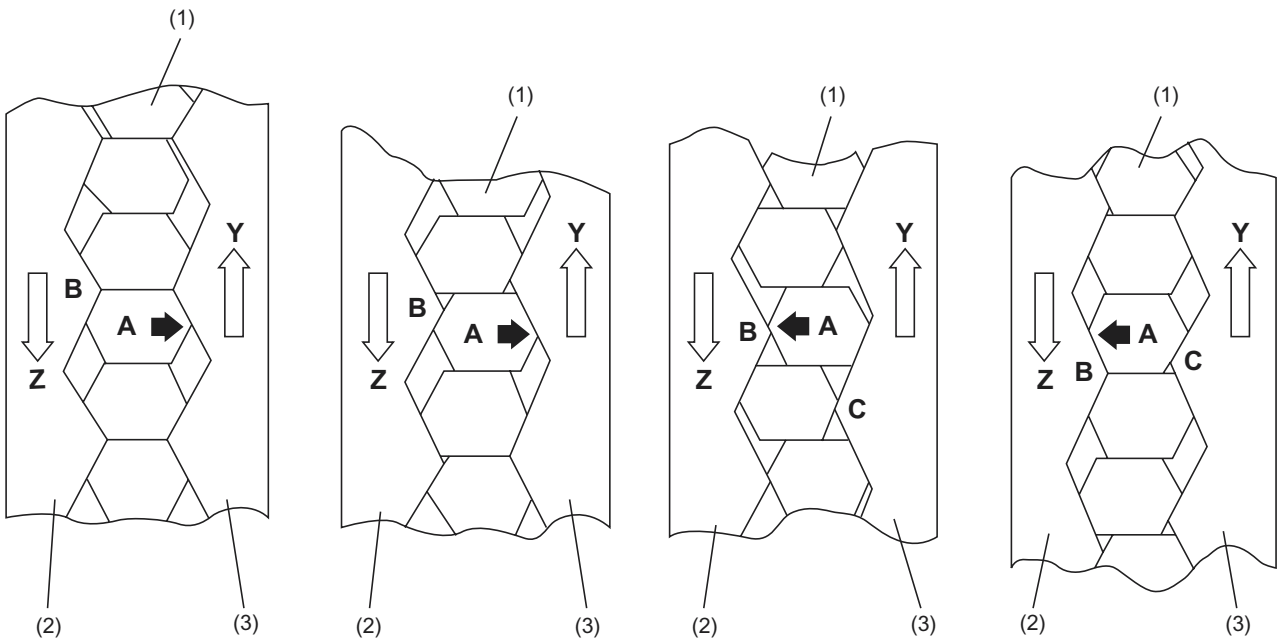
MANUAL TRANSMISSION AND DIFFERENTIAL

## C: OPERATION

### 1. WHEN RIGHT AND LEFT WHEELS ROTATE AT DIFFERENT SPEEDS

If the left and right wheels move relative to each other in the direction of arrow Z and in the direction of arrow Y, respectively, the cam follower A is pushed by the slope B of the left face cam, moving to the right. Then the cam follower A is pushed by the slope C of the right face cam, now moving to the left.

Likewise, all the other cam followers also repeat rightward and leftward movements as long as the right and left wheels continue rotating at different speeds, so the vehicle can turn a corner smoothly.



MT-00930

- (1) Cam follower
- (2) Left face cam
- (3) Right face cam

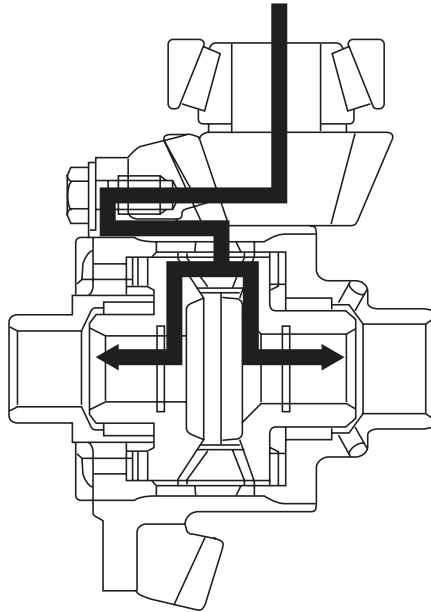
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## 2. WHEN RIGHT AND LEFT WHEELS ROTATE AT THE SAME SPEED

During normal straight-ahead driving where the right and left wheels rotate at the same speed, the cage and cam followers rotate together, just as in conventional differentials. As a result, driving torque is distributed equally to the right and left side gears.



MT-00931

# FRONT DIFFERENTIAL (APTRAC TYPE LIMITED SLIP DIFFERENTIAL)

MANUAL TRANSMISSION AND DIFFERENTIAL

## 3. WHEN TRACTION IS DIFFERENT BETWEEN RIGHT AND LEFT WHEELS

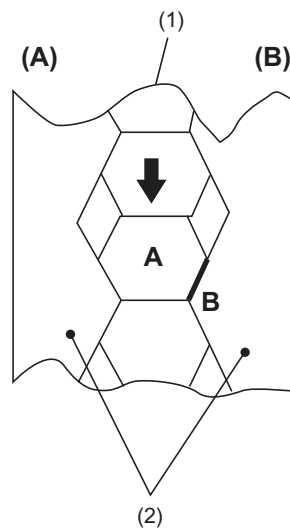
For example, if the left wheel spins on a slippery surface and loses traction, the left face cam starts rotating at a speed faster than the right wheel.

Like when the right and left wheels rotate at different speeds mentioned earlier, the cam follower A starts moving to the left.

This time, however, as the right wheel has traction, the drive torque pushes the cam follower A strongly against the right face cam when it makes the cam follower get over the slope B of the face cam, generating a large friction force between the contacting surfaces (shown by a thick line in the drawing).

This large friction force allows the drive torque to be transmitted to the right wheel.

In this way, the APTRAC differential can keep the drive torque distributed to a wheel with traction even when the other wheel spins and loses traction.



MT-00932

(1) Cam follower

(2) Face cam

(A) High speed rotation

(B) Low speed rotation

## D: SERVICE PROCEDURES FOR LSD

It is not recommended to disassemble this LSD assembly as components of this LSD assembly are not available individually.