

Subaru Brake Systems

Front Disc Brakes

The front brakes are ventilated disc types which feature high heat dissipation and superb braking stability. In addition, the front brake quickly restores the original braking performance even when wet.

The brake disc, which is externally mounted, is secured together with the disc wheel using the hub bolts, to facilitate removal or installation when servicing the vehicle.

The inner brake pad is provided with an indicator which indicates pad wear limits.



Front Caliper and Disc

Pad Wear Indicator

A wear indicator is provided on the inner disc brake pads. When the pad wears down to 1.5 mm (0.059 inch) the tip of the wear indicator comes into contact with the disc rotor, and makes a squeaking sound as the wheel rotates. This indicates that the pad needs to be replaced.

Rear Drum Brakes

The rear drum brake is a leading-trailing type. When fluid pressure is applied to the wheel cylinder, the piston moves to expand the leading and trailing shoes while the lower shoe return spring joint acts as a pivot. Thus, the shoes come in contact with the inner surface of the drum, producing braking action.

When brakes are applied during the forward movement, the tip of the brake leading shoe lining is pressed against the inner surface of the drum so as to oppose the drum direction. This increases the braking force. The trailing shoe, however, undergoes a force that pushes back so that braking force applied to the trailing shoe decreases.

The above shoe operation is reversed

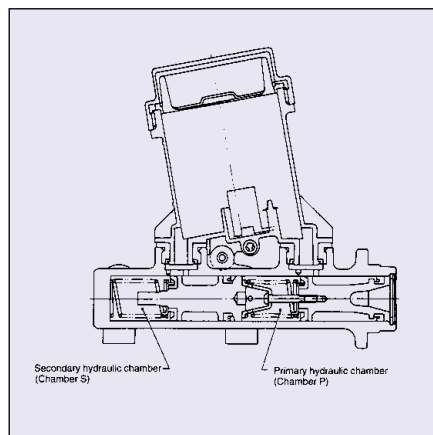
while the vehicle is backing up, with the braking force exerted on the trailing shoe greater than that on the leading shoe. It follows that there is no difference in braking force between the directions in which the vehicle moves.

Automatic Adjuster

The brake lining-to-drum clearance is automatically compensated for by the automatic adjuster. When the brake shoe is contracting after expansion, the adjuster lever rotates the adjuster assembly's screw to lengthen adjuster assembly so that the clearance is maintained at the specified value.

Master Cylinder

The master cylinder has a sealed reservoir tank to extend the service life of the brake fluid. The fluid level indicator is built into the reservoir tank for easy



Master Cylinder

and correct monitoring of the fluid level when adding brake fluid.

Brake Fluid Level Indicator

Under normal conditions, the float remains above the reed switch, and the magnetic force

from the permanent magnet in the float is unable to activate it. Therefore, the circuit is kept open, and the warning light remains off. The float lowers as the brake fluid level lowers, and if it falls below the specified fluid level — approx. 30 mm (1.18 in) below the MAX level line, the reed switch will be activated by the permanent magnet, closing the circuit. In this event, the warning light comes on and warns the driver of a reduction of the brake fluid level.

However, the warning light may be lighted momentarily even when the brake fluid surface is still above the specified level, if the vehicle body momentarily tilts or swings more than normal.

Brake Booster

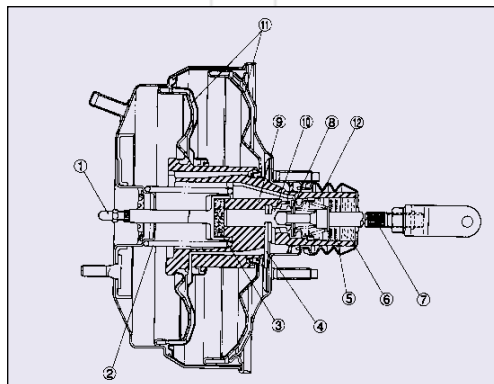
The brake booster is a tandem type that utilizes two small diam-

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eter diaphragms to provide high brake boosting effects.



Brake Booster



Brake Booster Cutaway

1. Push rod
2. Return spring
3. Reaction disc
4. Key
5. Filter
6. Silencer
7. Operating rod
8. Poppet valve
9. Valve body
10. Plunger valve
11. Diaphragm plate
12. Valve return spring

Operation

Brake Booster "Off"

The plunger valve comes in contact with the poppet valve so that atmospheric air passing through the filter and silencer is shut out by the atmospheric valve (of the poppet valve).

The plunger valve is moved to the key at the right by the return spring so that the poppet valve is held at the right. Since the vacuum valve of the valve body and the poppet valve are

kept away from each other, passage A is linked with passage B and the constant-pressure chamber is also linked with the variable-pressure chamber. At this point, pressure differential does not occur between the two chambers; the diaphragm plate is moved back to the right by return spring tension.

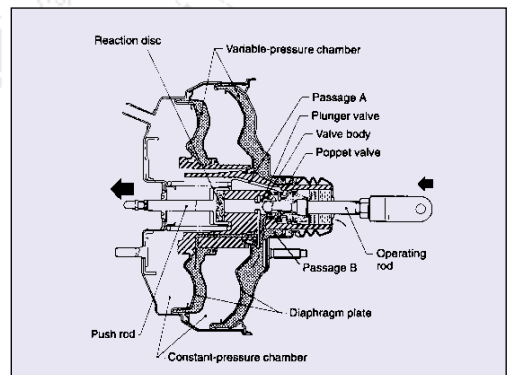
Brake Booster "On"

When the brake pedal is depressed, the operating rod pushes the plunger valve so that the poppet valve comes in contact with the vacuum valve of the valve body. This shuts off the circuit between passages A and B, as well as the circuit between the constant- and variable-pressure chambers.

Further movement of the plunger valve moves the atmospheric valve away from it so that atmospheric air is directed to the variable-pressure chamber via passage B. This produces a pressure differential between the constant- and variable-pressure chambers.

As a result, the diaphragm and its plate are moved to the left as a single unit.

The power applied to the diaphragm plate by the pressure differential is then transmitted to the reaction disc via a hub, as well as to the push rod, and produces a booster output.



Brake Booster On

Brake Booster Under Medium Load

The poppet valve comes in contact with the plunger valve and valve body when a force pushes the center of the reaction disc (at the contact portion of the plunger valve) via the operating rod and plunger valve. This occurs when brake pedal depression is balanced with a force pushing the plunger valve (via the push rod and reaction disc) due to the reaction force of oil pressure

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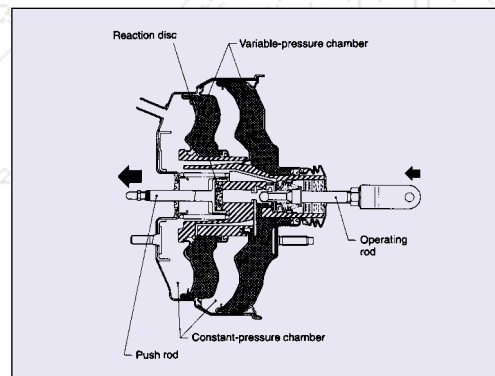
delivered from the master cylinder.

As a result, pressure differential is maintained between the constant-pressure chamber and variable-pressure chamber unless the pedal depression force is changed.

Brake Booster Under Full-Load Conditions

When pedal depression increases to such an extent that the variable-pressure chamber is maintained at atmospheric pressure, the maximum pressure differential acts on the diaphragm plate.

Further pedal depression does not act on the diaphragm plate but rather on the push rod.



Full Load Conditions

Brake Booster Released

When the force of brake pedal depression decreases, the forces acting on the reaction disc and plunger valve are unbalanced, so that the plunger valve is moved to the right.

The plunger valve then comes in contact with the atmospheric valve of the poppet valve to shut off the passage between the variable-pressure chamber and atmospheric air and, at the same time, moves the poppet valve back. Movement of the poppet valve opens the vacuum valve so that passages A and B are linked with each other.

Air from the variable-pressure chamber is then delivered to the constant-pressure chamber. This eliminates any pressure differential between the two chambers. As a result, the diaphragm plate is pushed back to the 'release' position by the return spring.

Brake Booster With No Vacuum

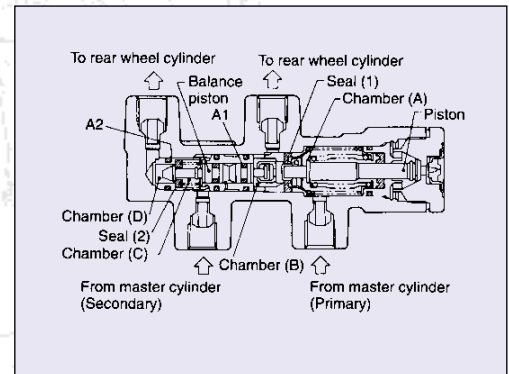
When the brake pedal is depressed while the constant- and variable-pressure

chambers are held at atmospheric pressure, the operating rod moves to the left. This moves the plunger valve which in turn pushes the hub via the key.

The reaction disc (which is built into the hub) then moves the master cylinder piston via the push rod. At this point a boosting force does not occur, but oil pressure is produced by movement of the master cylinder piston. As a result, the system serves as a hydraulic brake.

Proportioning Valve (Non-ABS Models)

The proportioning valve for dual piping systems is adopted for controlling the braking force.



Proportioning Valve

Operation During Normal Conditions

When the fluid pressure in the master cylinder is low (the fluid pressure before the split point), the piston is pressed by the spring load and the valve remains inoperative. As a result, the fluid pressure in the master cylinder is held equal to the fluid pressure in the rear wheel cylinder.

When the master cylinder fluid pressure rises, the piston in the primary circuit is moved right-ward against the spring load, and brought into contact with the seal 1. The master cylinder fluid pressure chamber (chamber A) is therefore cut off from the rear wheel cylinder fluid pressure chamber (chamber B), and the fluid pressure to the rear wheel cylinder is thus controlled. (The pressure at this moment is the split point pressure.)

If the fluid pressure in chamber A rises further, the piston is moved left-ward, off the seal 1, and this causes the

fluid pressure in chamber B to rise. The piston is then moved rightward, and brought into contact with the seal 1 again. After this, the piston repeats this contact with the seal 1 in this way, thereby controlling the fluid pressure in the rear wheel cylinder.

When the fluid pressure in chamber B is controlled in the secondary circuit, the balance piston is moved rightward by the fluid pressure difference between chamber B and chamber C, and brought into contact with the seal 2, and the fluid pressure in chamber D is controlled. Since sectional areas A1 and A2 are equal, the balance piston is pushed by equal forces from the right and left. If the fluid pressure rises in chamber B, the balance piston performs control to equalize the fluid pressure in chamber D and chamber B by repeating open-close operation with the seal 2.

Failure Of Primary Circuit

If the primary circuit fails, the fail-safe piston and balance piston are moved rightward by the fluid pressure in the master cylinder in the secondary circuit until the piston contacts the plug. In this case, the balance piston remains off the seal 2, and no split point is created in the graph. That is, the fluid pressure in the secondary side rear wheel cylinder is equal to the fluid pressure in the master cylinder.

Failure of Secondary Circuit

If the secondary circuit fails, the balance piston is moved leftward by the fluid pressure in chamber B until the end of the piston contacts the stopper. Since sectional area A1 is greater than A2, the piston remains unmoved even after the master cylinder fluid pressure has reached the split point, and the piston is kept off the seal 1. Hence, no split point is created in the

graph, and the rear wheel cylinder fluid pressure of the primary circuit is kept equal to the master cylinder fluid pressure.

Proportioning Valve (ABS models)

Operation During Normal Conditions

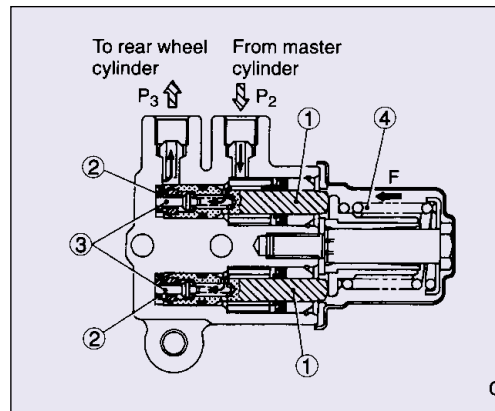
Operation before the split point:

- Piston 1 is held by spring 4 so that valve 3 is kept away from valve seat.
- Under this condition, fluid pressure “P₃” to rear wheel cylinders equals fluid pressure “P₂” from master cylinder.

Operation near the split point:

- Force “f₁”, applied to piston 1 by spring, is spring force “F.” In other words, “f₁” = ½ “F.”
- Force “f₂” is also applied to piston 1 in the direction opposite to spring force “F” due to fluid pressure “P₂” generated by master

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ABS Proportioning Valve

cylinder according to cross sectional area "A".

- Spring force " f_2 " increases correspondingly with fluid pressure " P_2 ". When " f_2 " is greater than piston 1 moves in direction opposite to spring force "F." This causes valve 2 to come in contact with valve seat 3, blocking the fluid passage.

Immediately before the fluid passage is closed, fluid pressure " P_2 " is held equal to pressure " P_3 ." When brake pedal is depressed to increase fluid pressure " P_2 ," piston moves in the same direction as spring force "F," opening fluid passage.

However, since fluid passage is closed again immediately after pressure " P_2 " equals " P_3 ," pressure " P_3 " is held at a value of less than pressure " P_2 ."

Hill-Holder™

The Hill-Holder™ is a device to make starting on an uphill road easier and permits even a driver not yet familiarized with starting by use of the parking brake to start the vehicle smoothly.

When pressing down the clutch pedal with the brake pedal depressed in order to start the vehicle on an uphill road, this device holds the brake temporarily upon taking your foot off the brake pedal (until the clutch pedal is released). Therefore, smooth starting is enabled by usual engagement of the clutch while depressing the accelerator pedal.

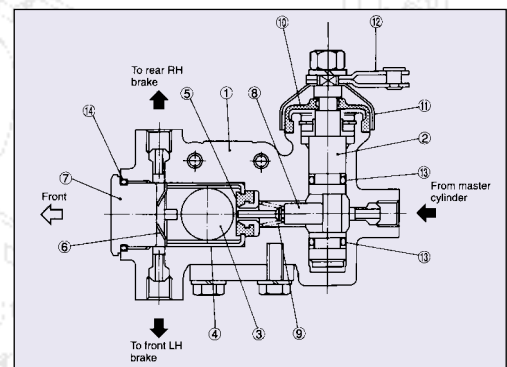
Note: Models with ABS/TCS are not equipped with the Hill-Holder™.

Pressure Hold Valve (PHV)

PHV (Pressure Hold Valve) is connected to one of the service brake pipes and pushrod 8 is pushed in and/or pulled out by cam shaft 2 interlinked with the clutch pedal to change the clearance between ball 3 and seal 5, thereby opening and/or closing the hydraulic circuit.



Pressure Hold Valve



Pressure Hold Valve Cutaway

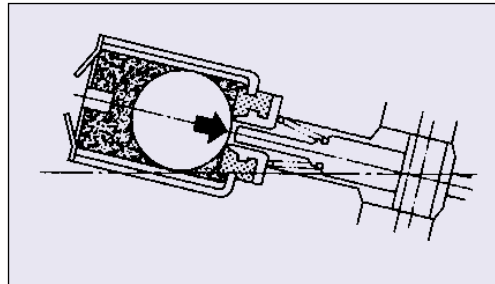
Normally, on a flat road, ball 3 is located at the front and the valve is kept opened regardless of the position of the pushrod. (This status is the same as on a downhill road.)

When stopping the vehicle on an uphill road by depressing both brake and clutch pedals, the ball rolls toward the rear and, at the same time, the push rod retracts to close the valve, so that hydraulic pressure is maintained. Even when taking your foot off the brake pedal, the hydraulic pressure is maintained so far as the clutch pedal is kept depressed. In this status, when engaging the clutch ordinarily while depressing the accelerator pedal, the maintained hydraulic pressure is released simultaneously with the generation of driving force to permit smooth starting.

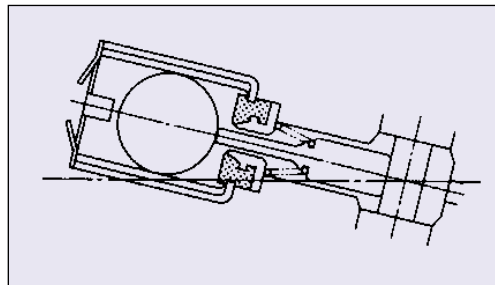
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Activating Condition:

This device is activated only when depressing the clutch and brake pedals with the vehicle stopped on an uphill road. When stopping the vehicle on an uphill road, the ball rolls toward the rear to seal the port and therefore the hydraulic pressure is maintained even by releasing the brake pedal.



Activating Condition



Inactive Status

Inactive Status:

The Hill-Holder™ is not activated under any conditions other than above.

While driving:

During acceleration or normal driving, the clutch pedal is not depressed, so the pushrod is located outside the port. Hydraulic pressure can not be maintained.

During deceleration:

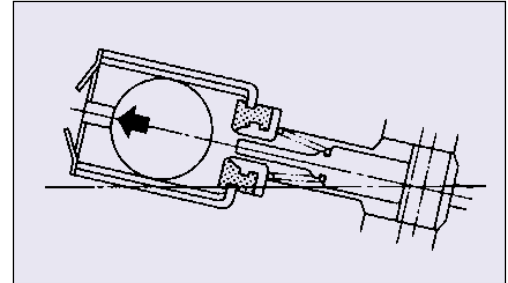
Even when depressing the clutch pedal, the ball is kept at the front by decelerating force. Hydraulic pressure is not maintained.

When stopping:

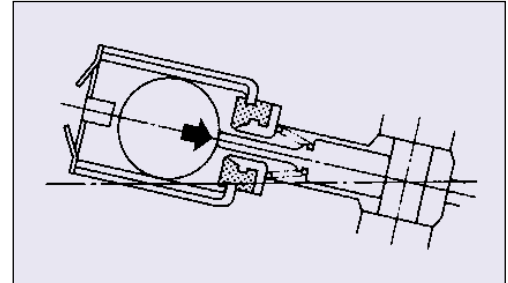
Even when stopping on an uphill road, hydraulic pressure is not maintained unless the clutch pedal is depressed.

On a flat road:

The Hill-Holder™ is not designed to operate on a flat road, except for reversing.



During Deceleration



When Stopping

Operational Precautions

- The Hill-Holder™ is a device used to facilitate starting on an incline. When stopping on an incline, therefore, you must keep the brake pedal depressed or pull the parking brake.
- The Hill-Holder™ may not be activated on a slope of an extremely small incline.
- If the brake is not held sufficiently upon releasing the brake pedal with the clutch pedal depressed, press down the brake pedal a little more strongly once again.
- If the clutch pedal is depressed again in the course of the starting operation, the brake may be released. In this case, depress the brake pedal again (the brake is released when returning the clutch pedal halfway).
 - Before you leave the driver's seat, be sure to pull the parking lever and confirm that the vehicle is kept stopped upon releasing the clutch pedal.
- When reversing the vehicle on a flat road, the following may be felt. These are caused by the activation of the Hill-Holder™, and do not constitute abnormality.
 - a. Brake effect remains even after releasing the brake pedal if depressing the clutch and brake pedals when reversing the vehicle.
 - b. A slight shock may be felt when starting the vehicle after stopping the