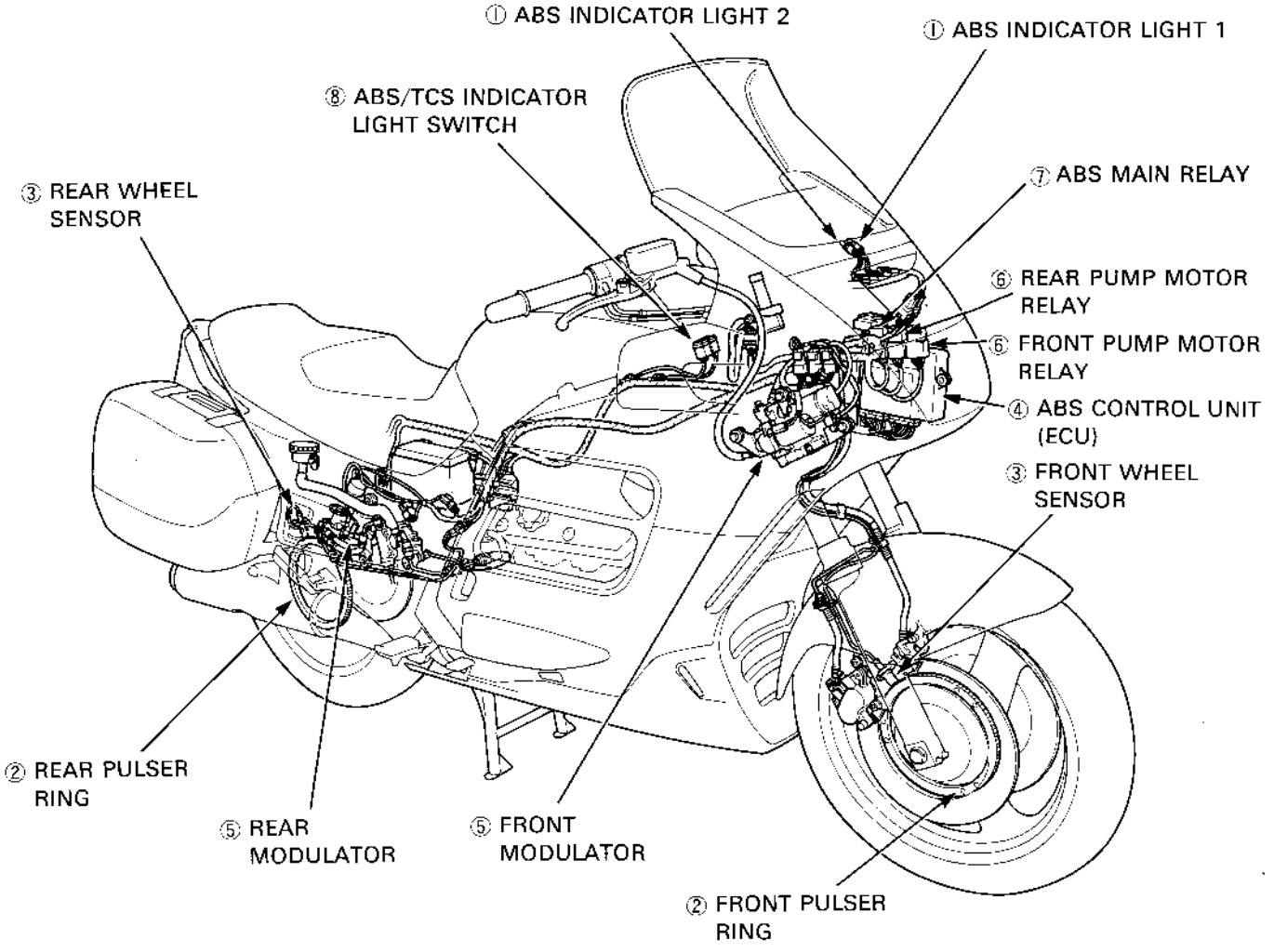
23. Technical Features

ABS (Anti-lock Brake System) ['92–'95]

Summary

The Anti-lock Brake System (ABS) is designed to help prevent wheel lock up during hard braking or braking on loose or slippery surfaces. ABS momentarily reduces the brake caliper fluid pressure when the wheels are about to lock. When the system senses that the tendency for wheel lock is reduced, brake caliper fluid pressure is restored. ABS repeats this cycle as required for secure brake performance with minimum possibility of wheel lock.

The braking effectiveness and balance of the motorcycle can be significantly affected by the way the front and rear brakes are applied. This ABS system is characterized by high deceleration and follow-up performance thanks to its quick response to a variety of road surface conditions. It is also characterized by its compact size, which is achieved by collective arrangement of the hydraulic control components in the modulator.



① ABS indicator lights
Blinks of stays ON when a problem occurred in the ABS.

② Pulser ring
Rotates together with the wheel and detects the wheel speed using the wheel sensor.

③ Wheel sensor
Inputs the pulse signal, generated proportionally to the rotating speed of the pulser ring, in the control unit.

④ ABS control unit (ECU)
Controls ABS by monitoring the input signal of each sensor and switch.

⑤ Modulator
Adjusts the caliper fluid pressure.

⑥ Pump motor relay
Controls the modulator motor power source based on a signal from the control unit (ECU).

⑦ ABS main relay
When the control unit detects abnormality, power to the solenoid valve is shut off by the ABS main relay as it receives the signal from the control unit.

⑧ ABS/TCS indicator light switch
A common switch for the ABS and TCS. When the ABS indicator lights 1 and 2 blink, the ABS indicator light 1 can be dimmed and the indicator light 2 can be turned OFF in order not to interfere with the rider's vision. The ABS/TCS indicator light switch is also used to output the problem code.

System Construction

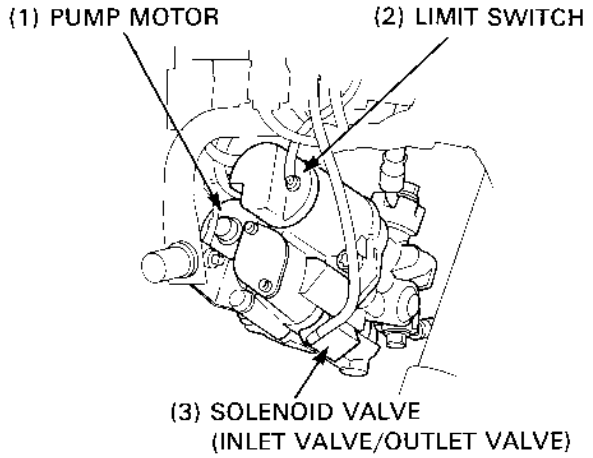
Modulator:

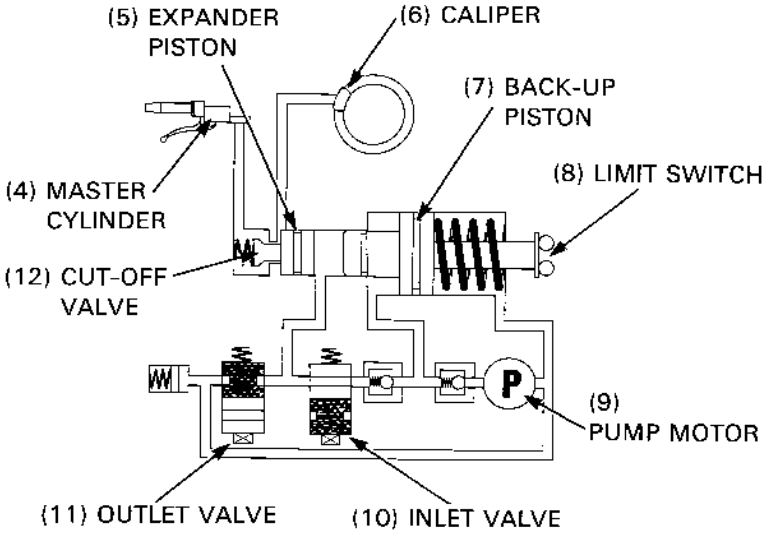
The modulator controls and supplies the brake fluid that is essential for the ABS operation. The motorcycle is equipped with separate and independent front and rear modulators.
The modulators are sealed type containing the brake fluid and constituent parts, and are maintenance free. Additionally, they have no reservoir pipe and are light-weight and compact. These features make the modulators well suited for motorcycles.

The modulator consists of the following parts;

Expander piston: Operates in accordance with the change in the piston fluid pressure and adjusts the caliper fluid pressure.
- Back-up piston: Pushes the expander piston up when fault occurs.
- Limit switch: Detects the pressure in the system by detecting the back-up piston position.
- Pump motor: Drives the pump to generate puressre in the system.
- Inlet valve/Outlet valve: Adjusts the puressure in the system.

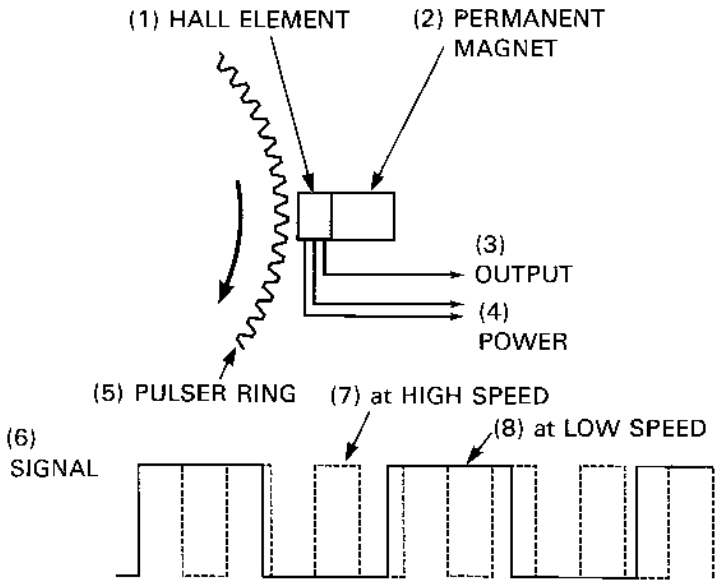
Front modulator shown:

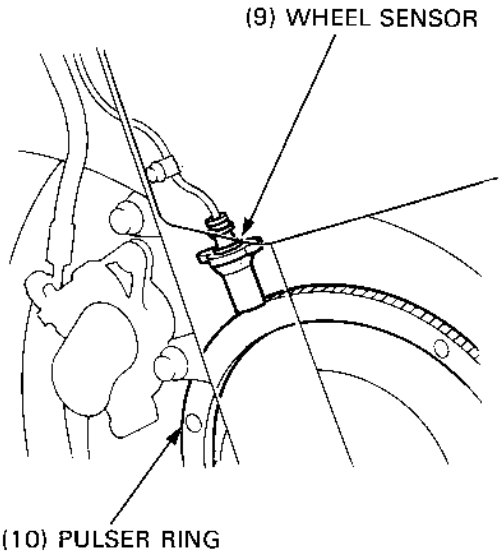




Wheel sensor/pulser ring:

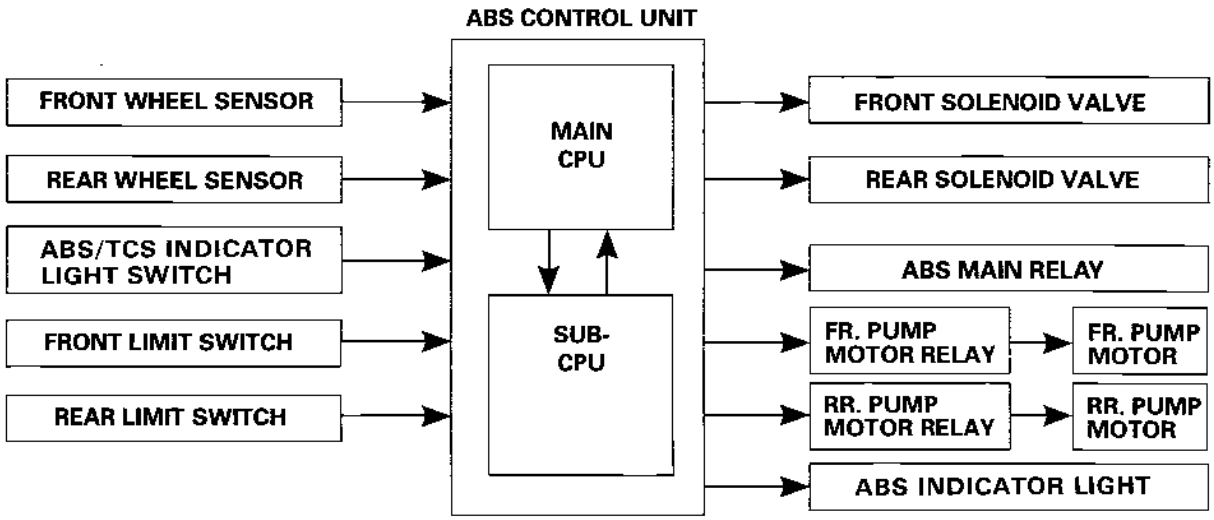
The wheel sensor is the contactless sensor that detects front and rear wheel speed. Consisting of a permanent magnet and Hall element, the sensor is connected to the ABS control unit. When the projection on the outer circumference of the pulser ring that is rotating with the front/rear wheel passes across the wheel sensor, a pulse signal is generated at the sensor. The control unit detects the wheel speed as it receives the pulse signal, because the frequency of the signal increases proportionally to the wheel speed.



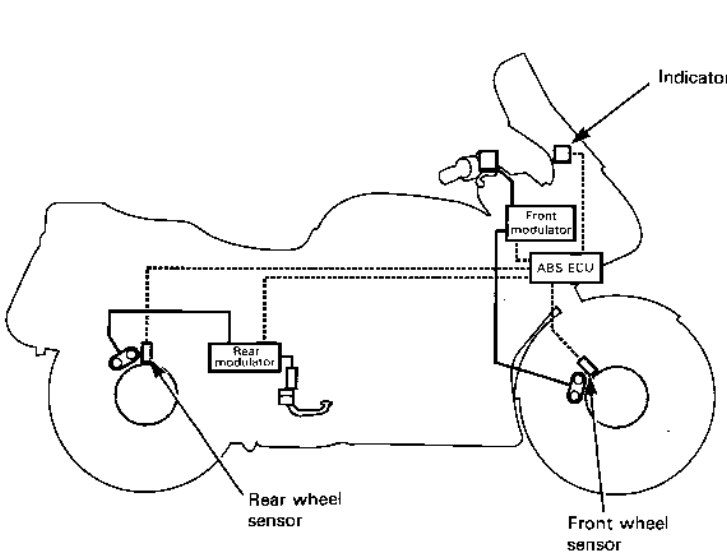


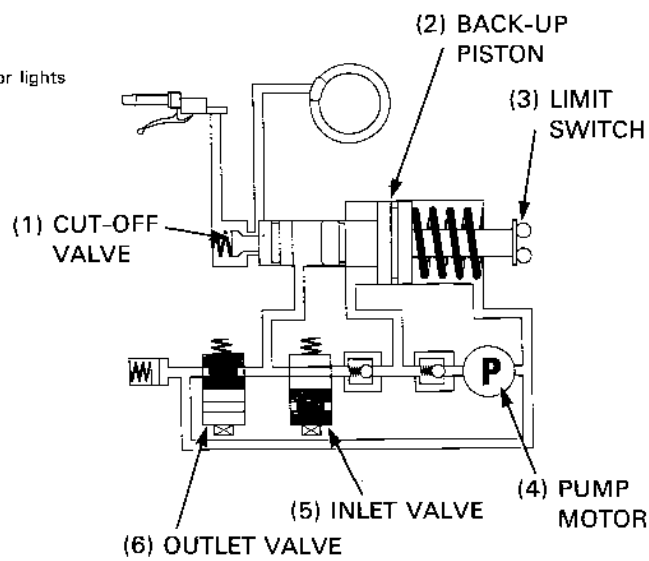
ABS control unit (ECU):

The ABS control unit consists of two systems that monitors each other:the main CPU and the sub CPU. The control unit is designed to activate the solenoid valve and pump motor only when the calculation results of both systems agree with each other.



The control unit detects the wheel speed as it receives the signal from each wheel sensor. When the unit senses that the wheel are about to lock, it controls the caliper fluid pressure by activating the solenoid valve of each modulator.
The control unit also includes a change-over function to the regular system that monitors the system condition by receiving signals from the limit switch, pump motor etc. It stops the ABS function and switches back to the regular brake system when the control unit detects an abnormality in the ABS.





- Pump motor control

The ABS control unit monitors the pressure accumulation by receiving a signal from the limit switch. When the pressure drops, the back-up piston moves forward and the limit switch turns OFF to operate the pump. When the pressure rises to a given level, the limit switch turns ON to stop the pump. (The pump is operated continuously while the ABS is active.)

· Self-diagnosis function

When the engine starts, the ABS control unit evaluates the hydraulic circuit condition by activating the pump motors and solenoid valves and receiving the signal from the limit switch. The ABS indicator light blinks when an abnormality is detected in the circuit. When the circuit is normal, the ABS indicator light stays ON indicating that the control unit is in the stand-by mode for the wheel sensor signal. The wheel sensors send signals to the ECU after the motorcycle starts to move (approximately 10km/h or above). The ABS indicator light goes off when the ECU receives signals from the wheel sensor and the wheel sensor system is found to be normal.

The ABS control unit monitors the main function while the motorcycle is moving, too.

When it detects a problem with the system, it blinks the ABS indicator light and stops the system immediately. When the control unit detects a problem while the ABS is active, it stops the system and blinks the ABS indicator light, notifying the rider of the problem and that the system is diactivated.

· Change-over function to the regular system

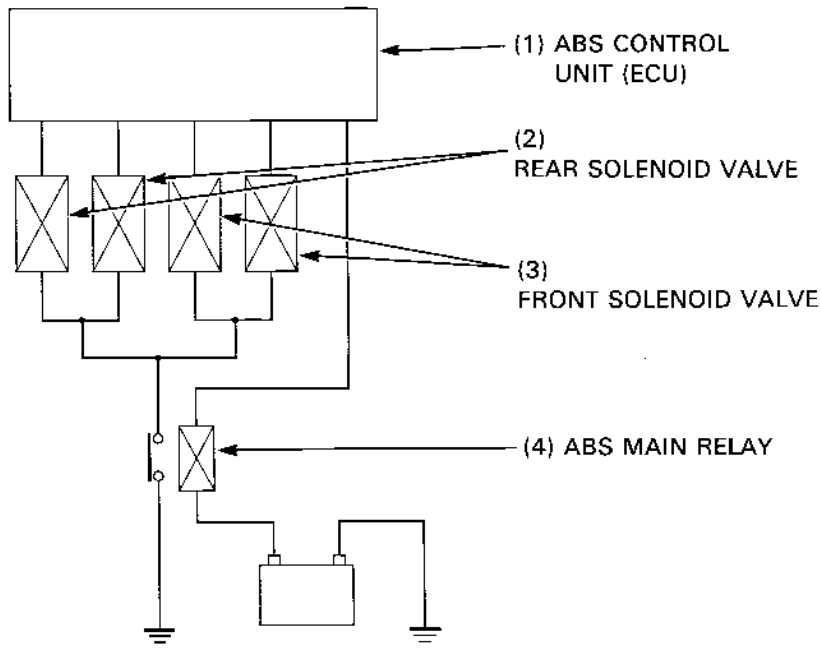
When the ABS contol unit detects a problem in the system by the self-diagnosis function, the control unit activates the ABS main relay and shuts off the ground circuits of the front and rear solenoid valves to stop the solenoid valve. The ABS stops its function when the system is faulty and switches to the regular brake system.

· Problem code storage function

The problems can be memorized and stored in the control unit (up to two codes), and can be retrieved and indicated by the number of blinks of the ABS indicator light (page 16-A-6).

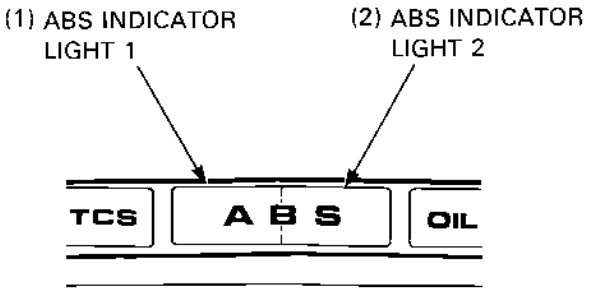
ABS main relay:

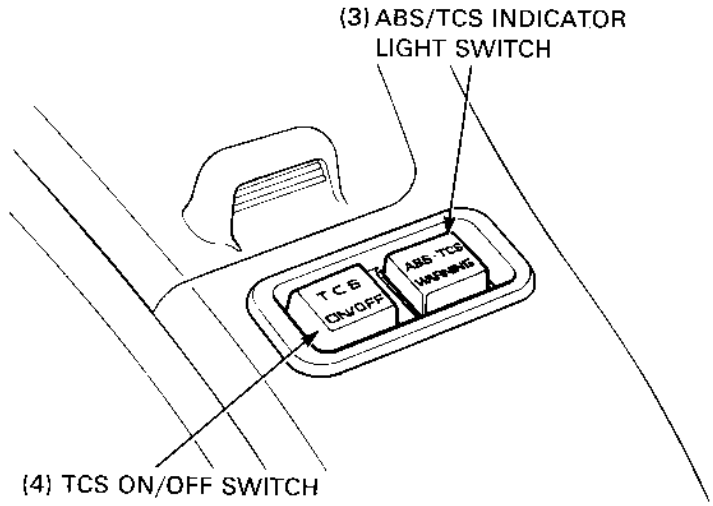
The secondary side contact points of the ABS main relay is the normal open type, where the electric current does not normally flow. When the current flows to the primary side relay coil, the contact points close forming the ground circuit of the solenoid valve.



ABS/TCS indicator light switch:

When a problem occurs with the ABS and ABS indicator lights 1 and 2 blink, ABS indicator light 1 can be dimmed and the indicator light 2 can be turned OFF by pressing the ABS/TCS indicator light switch.
Dimming and turning off these indicator lights keeps them from interfering with the rider's vision.
Another function of the ABS/TCS indicator light switch is to retrieve the problem codes that are stored in he control unit according to the problem code storage function explained in the previous page. The problem codes are indicated by the number of times the ABS indicator light blinks. When two problem codes are stored, the latest problem code is output first.

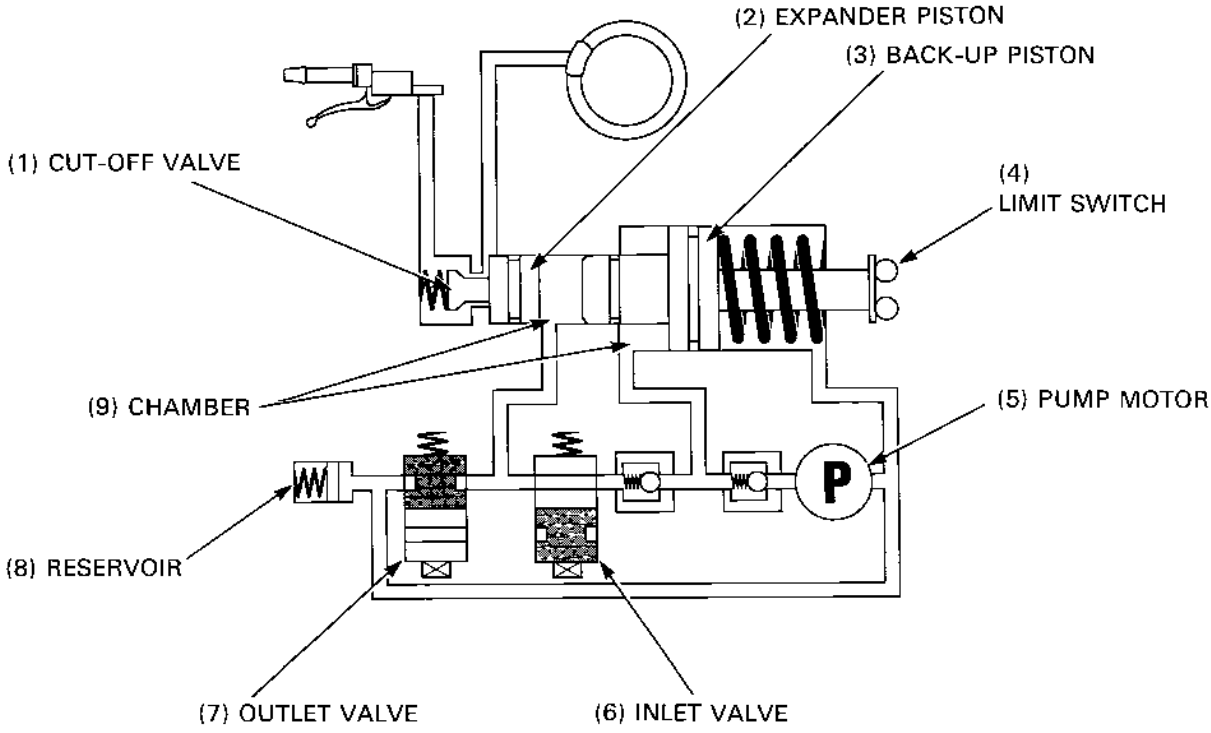




ABS Operation

Regular brake system operation:

Brake fluid pressure is accumulated fully in the system. When the pressure drops, the pump motor operates to accumulate pressure. The expander piston and back-up piston are supported by this brake fluid pessure. The cut-off valve is pushed by the expander piston as it opens at this time and the master cylinder and caliper are interconnected with a passage. The fluid pressure in the master cylinder is transmitted to the caliper by way of the cut-off valve; allowing the brake to operate.
As the outlet valve closes, the high pressure of the brake fluid is maintained in the chamber and the expander piston is not affected by the operation of the regular brake system.
This condition is the same as when the ABS is in the stand-by mode.



When ABS is working:

- Pressure DECREASE

When the control unit detects that the wheels are about to lock, the control unit sends signals to activate the pump motor and to open the outlet valve, while closing the inlet valve. The brake fluid in chamber B flows through the outlet valve into the reservoir side and pushes the expander piston back. Then, the cut-off valve, supported by the expander piston, is closed by the spring force shutting the passage between the master cylinder and caliper. Simultaneously, as the expander piston moves backward, the volume of chamber A increases and, the caliper fluid pressure is reduced.

- Pressure HOLD

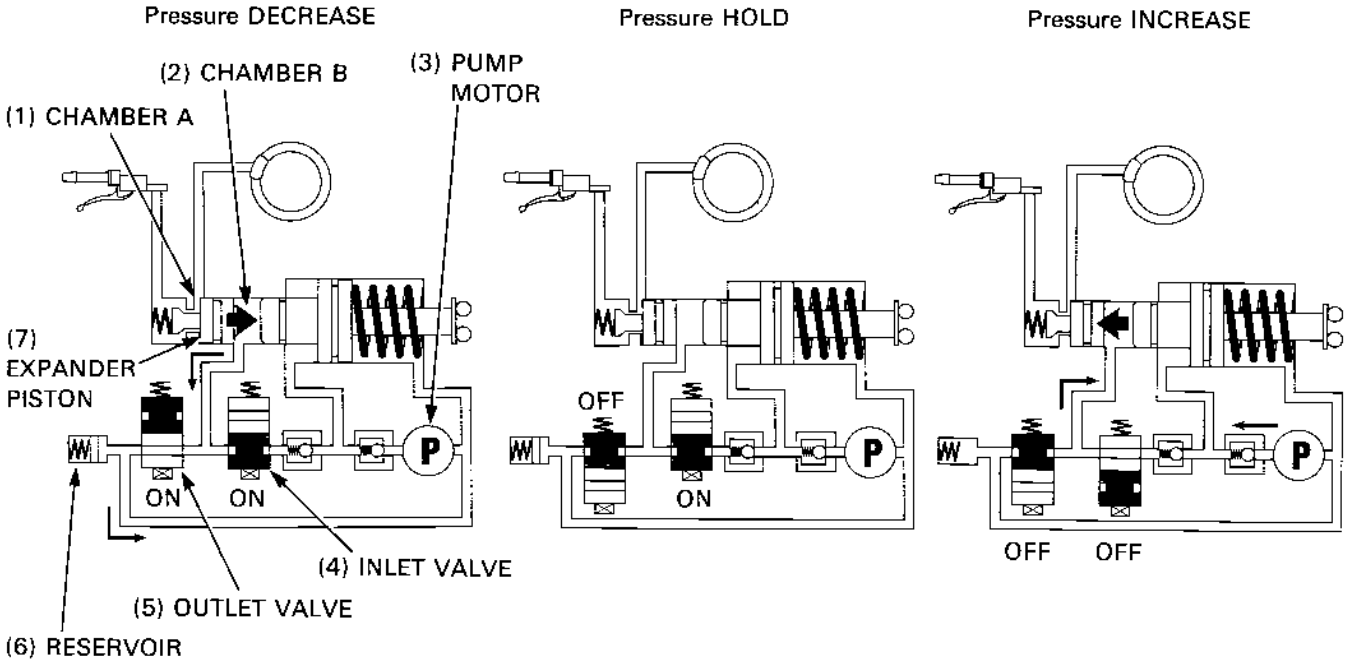
When both the outlet valve and inlet alve are closed, the brake fluid pressure in chamber A is maintained.
The caliper fluid pressure can then be maintained at a given level.

- Pressure INCREASE

When the pressure is increasing, the outlet valve closes and the inlet valve opens; this allows the brake fluid from the pump to flow through the inlet valve to chamber B. The brake fluid then pushes the expander piston forward and fluid flows to the caliper.

The ABS control unit controls the brake fluid pressure and prevents a wheel from locking by performing the sequential operations of the above "Pressure Decrese", "Pressure Hold" and "Pressure Increase" in accordance with the wheel rotation.

When the control unit senses that the possibility of wheel lock has passed, it closes the outlet valve and opens the inlet valve to move the expander piston to the forward-most position. This in turn opens the cut-off valve and the passage between the master cylinder and caliper to restore regular brake operation (page 23-7).



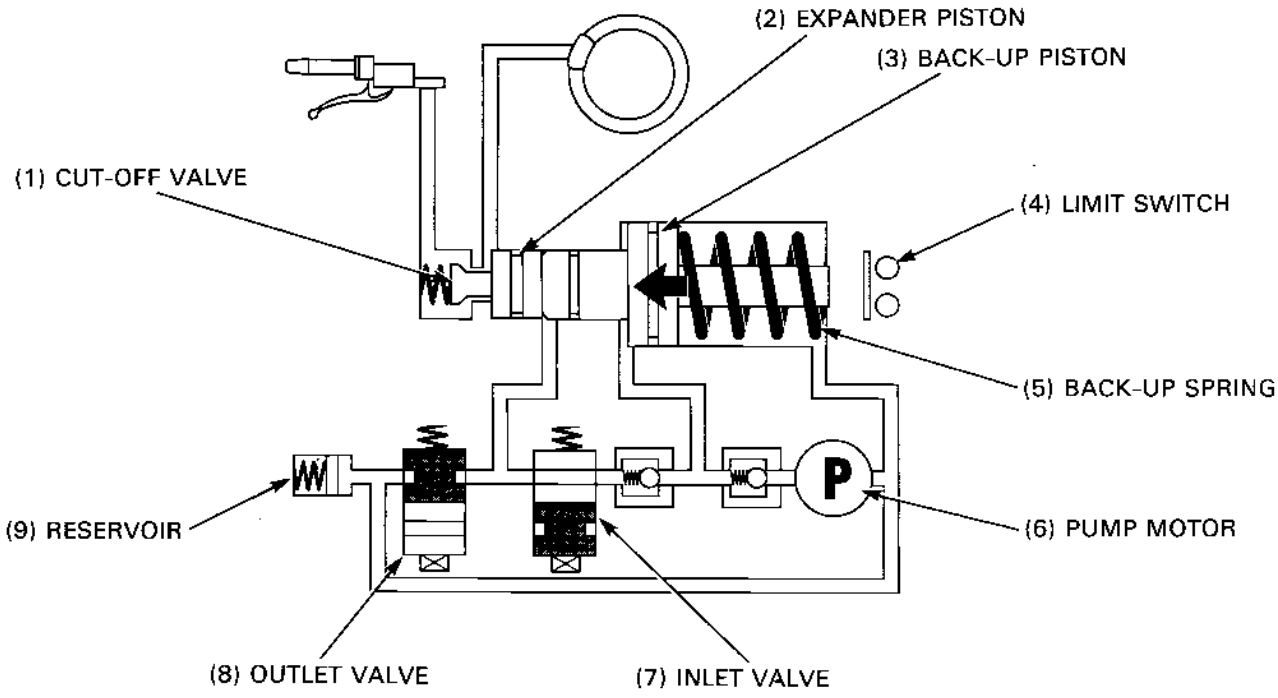
- Fluid Pressure Control

Operation	Caliper fluid pressure	Inlet valve		Outlet valve	
		Electric signal	Pressure relief passage	Electic signal	Pressure relief passage
To release braking force	Decrease	ON	Closes	ON	Open
To maintain braking force	Hold	ON	Closes	OFF	Closes
To apply braking force	Increase	OFF	Opens	OFF	Closes

When trouble occurs:

When the fluid pressure in the chambr (page 23-7) cannot be maintained for some reason, the back-up piston is pushed forward by the mechanical back-up spring force, which in turn pushes the expander piston up and the cut-off valve opens fully. Fluid pressure in the master cylinder can then be transmitted by way of the cut-off valve to the caliper. Regular brake operation can then be maintained.

As the back-up piston spring is preloaded enough to with stand the maximum brake pressure from the master cylinder the expander piston cannot move backward during regular brake operation.

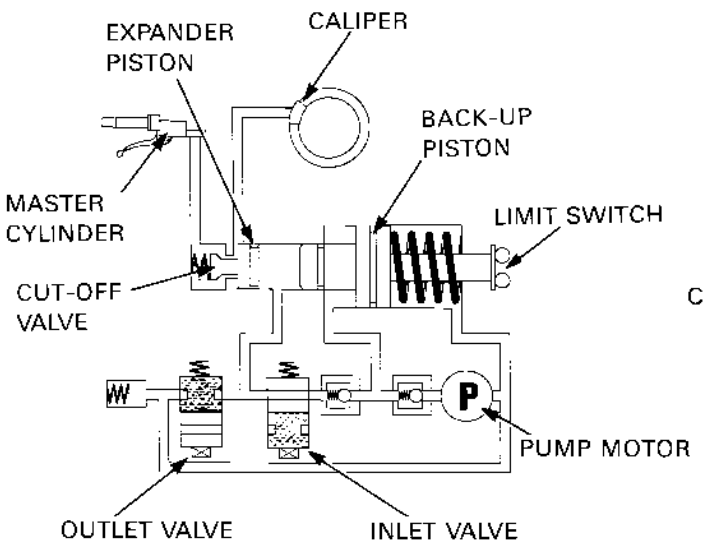


ABS (Anti-lock Brake System) [After '95]

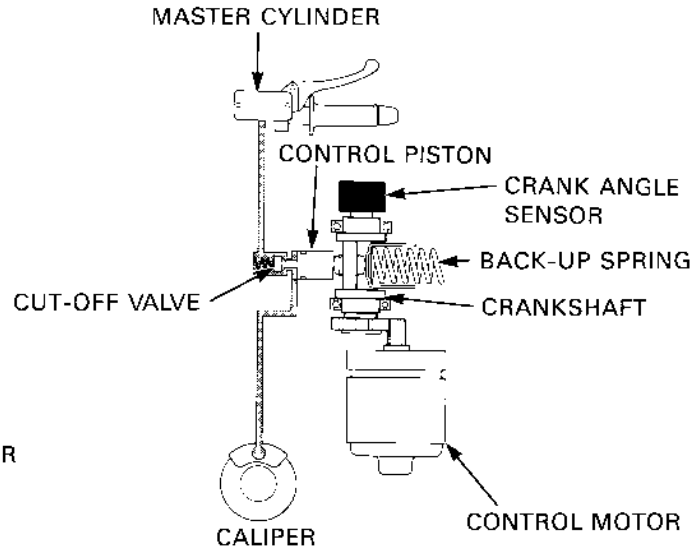
Summary

The ABS is designed to help prevent wheel lock up during hard braking or braking on loose or slippery surfaces. ABS momentarily reduces the brake caliper fluid pressure when the wheels are about to lock. When the system senses that the tendency for wheel lock is reduced, brake caliper fluid pressure is restored. ABS repeats this cycle as required for secure brake performance with minimum possibility of wheel lock.

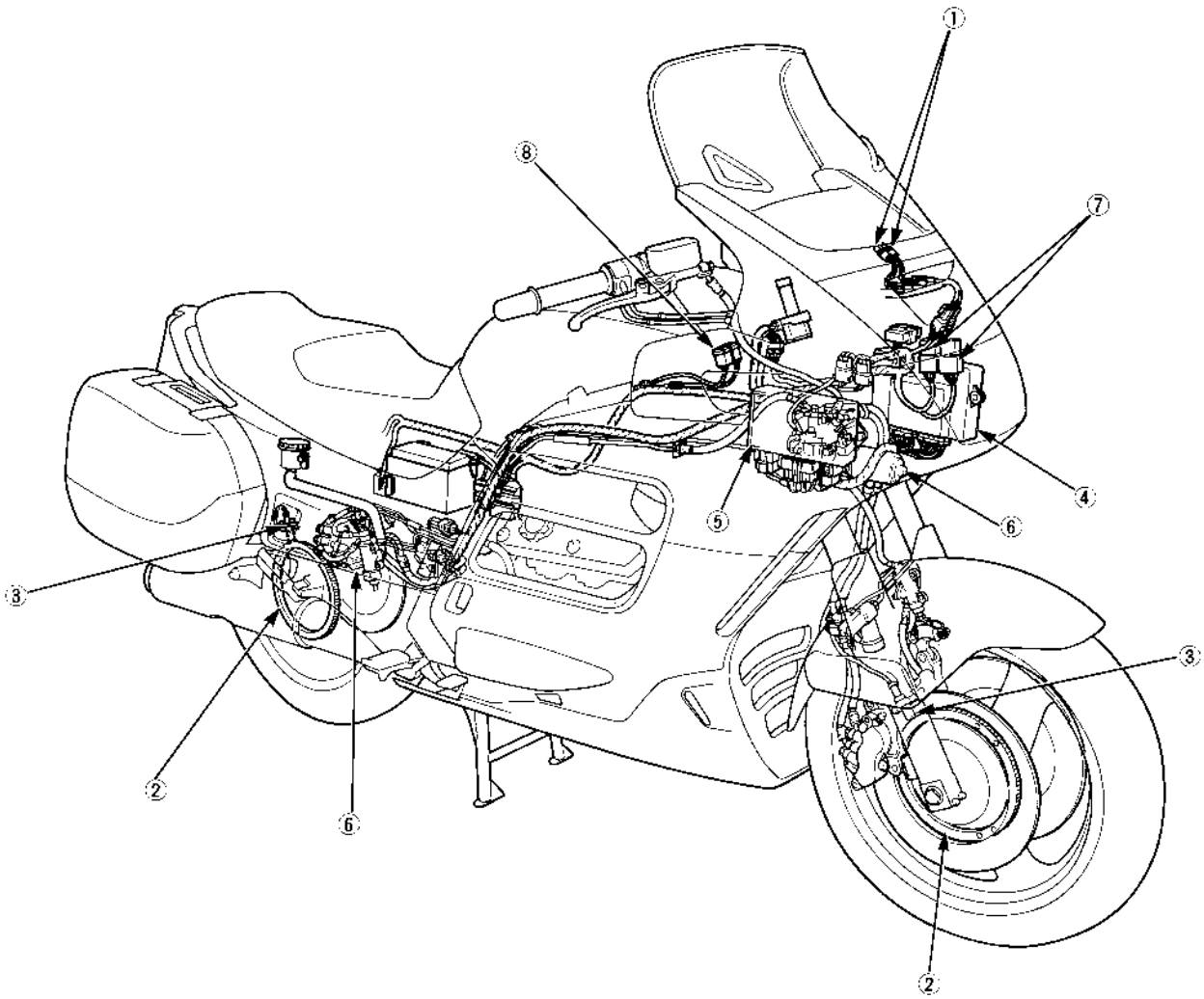
The conventional ABS is composed of the modulator with controlled hydraulic pressure circuit consisting of the pump and inlet/outlet solenoid valves. The system indirectly controls brake fluid pressure that regulates the fluid pressure inside the controlled hydraulic circuit by actuating the solenoid valves.
In this ABS, brake fluid pressure is directly controlled by motor's regulating of the rotational angle of piston-crank mechanism, which in turn controls the brake fluid. Therefore, in comparison with conventional systems, the modulator size, number of parts required, and weight are all substantially reduced. In addition, the fluid pressure can be regulated continuously, unlike the conventional ABS which has staged control. This ABS embodies such a high accuracy control system in a more simplified system.



CONVENTIONAL ABS



NEW ABS



① ABS indicator lights
Blinks or stays ON when a problem occurrs in the ABS.

② Pulser ring
Rotates together with the wheel and detects the wheel speed using the wheel speed sensor.

③ Wheel speed sensor
Inputs the pulse signal, generated proportionally to the rotating speed of the pulser ring, in the ABS control unit (ECU).

④ ABS control unit (ECU)
Controls ABS by monitoring the input signals of each sensor.

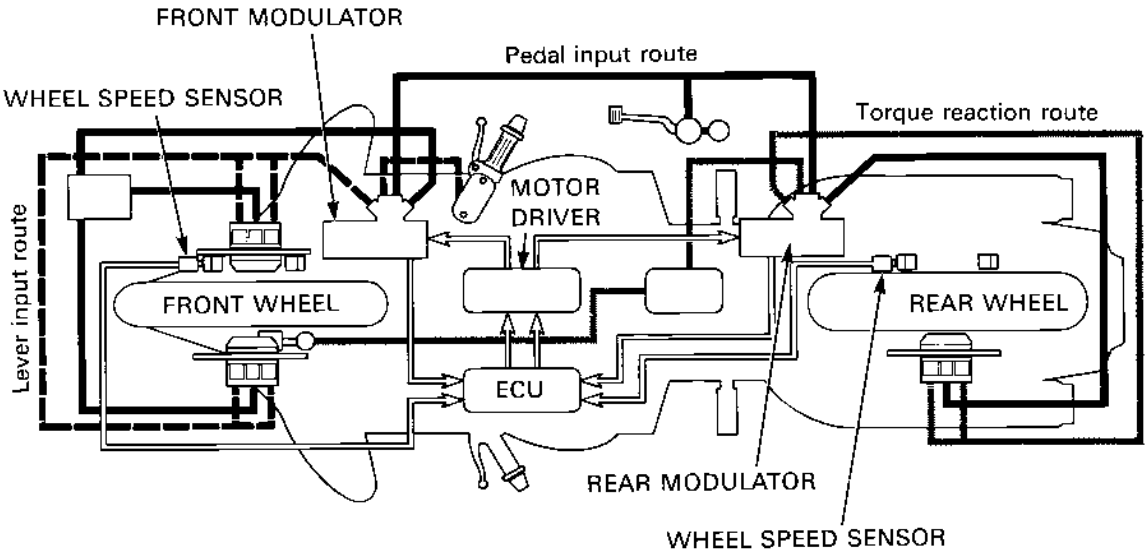
⑤ Motor driver
Receives control signal from the ABS control unit (ECU) and delivers high-amperage electrical power output to the modulator's motor for quick changes in operation.

⑥ Modulator
Adjusts the caliper fluid pressure.

⑦ Modulator control motor relays (front and rear)
When the ABS control unit (ECU) detects abnormality, power to the motor driver is shut off by the control motor relays as it receives the final from the ABS control unit (ECU).

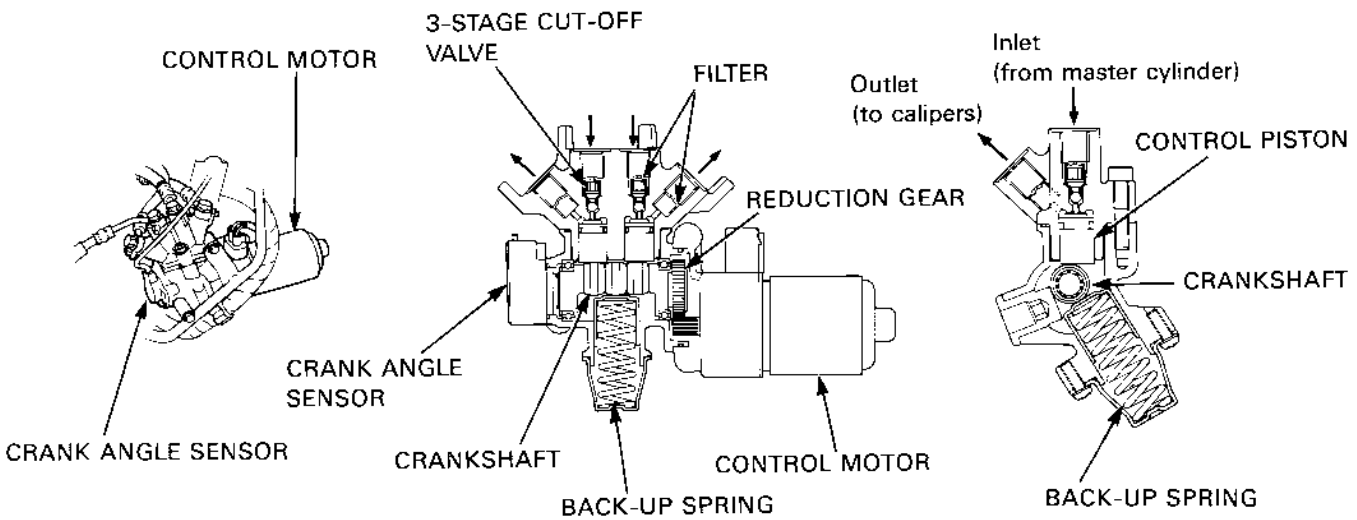
⑧ ABS/TCS indicator light switch
A common switch for the ABS and TCS. When ABS indicator lights 1 and 2 blink, ABS indicator light 1 can be dimmed and indicator light 2 can be turned OFF in order not to interfere with the rider's vision. The ABS/TCS indicator light switch is also used to output the problem code.

System Construction

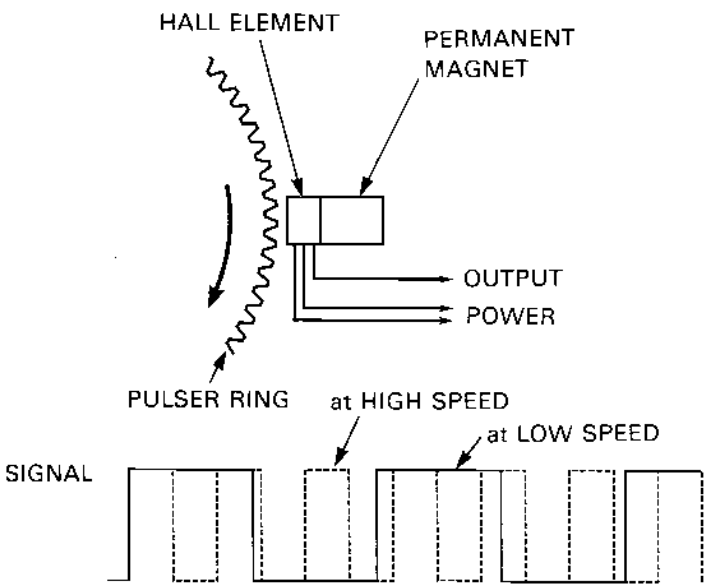


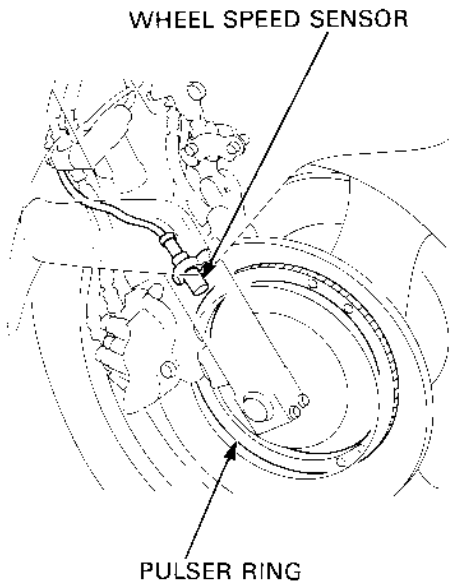
Motor Driven Modulator:
The modulator controls the brake fluid pressure that is essential for the ABS operation. The motorcycle is equipped with separate and independent front and rear modulators. At the same time, in order to combine with the LBS (Linked Brake System), a single modulator controls two routes for brake fluid pressure, as two routes for braking input are given respectively to the front and rear wheels.

The modulator consists of the following parts;
— Control piston: Operates in accordance with the change of the crankshaft angle and adjusts the caliper fluid pressure. Because each modulator must provide simultaneous control over two separate systems, each features two sets of control pistons.
— Crankshaft: Turns with the control motor to change the piston position.
— Back-up spring: Pushes the control pistons up (hold the cut-off valve open) by way of the crankshaft.
— Control motor: Drives the crankshaft and adjust the pressure in the system.
— Crank angle sensor: Detects the crank angle.
— Cut-off valve (3-stages): Cuts hydraulic pressure to the brake caliper.

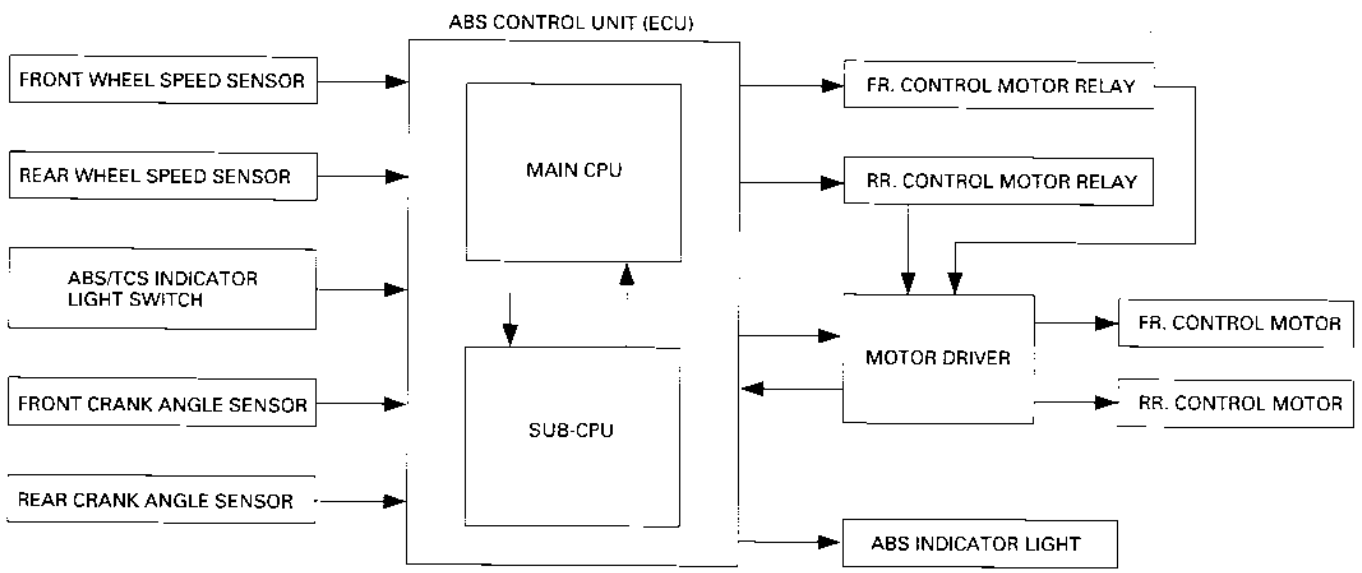


Wheel Speed Sensor/Pulser Ring:
The wheel speed sensor is the contactless sensor that detects front and rear wheel speed. Consisting of a permanent magnet and Hall element, the sensor is connected to the ABS control unit. When the projection on the outer circumference of the pulser ring that is rotating with the front/rear wheel passes across the wheel speed sensor, a pulser signal is generated at the sensor. The ABS control unit detects the wheel speed as it receives the pulse signal, because the frequency of the signal increases proportionally to the wheel speed.





ABS Control Unit (ECU)/Motor Driver:
The dual-CPU configuration ensures instant recognition of computer-related malfunctions, since the parallel CPUs run constant checks on each other whenever the ignition switch is ON. The ABS control unit (ECU) is designed to activate the modulator control motor only when the calculation results of both systems agree with each other.



The ABS control unit (ECU) detects the wheel speed as it receives the signal from each wheel speed sensor. When the unit senses that the wheel are about to lock, it controls the caliper fluid pressure by activating the control motor of each modulator. The control unit also includes a change-over function to the standard LBS operation that monitors the system condition by receiving signals from the wheel speed sensor, crank angle sensor, etc. It stops the ABS function and switches back to the standard LBS operation when the control unit detects an abnormality in the ABS.

• Modulator motor control

The ABS control unit monitors both front and rear wheel speed sensors and the modulator crank angle sensors that provide precise readings of each modulator's crankshaft positioning (i.e., control piston position). The ABS control unit directs its control signals to the motor driver that delivers high-amperage electrical power output to the control motors and operate the system.

• Self-diagnosis function

When the ignition switch is ON, the ABS control unit evaluates the control motor relays. The indicator light blinks when an abnormality is detected in the system. When the system is normal, the ABS indicator light stays ON indicating that the ABS control unit is in the stand-by mode for the wheel speed sensor and modulator crank angle sensor signals. The wheel speed sensors send signals to the ABS control unit after the motorcycle starts to move (approximately 10 km/h or above), then the ABS control unit evaluates the system condition by activating the modulator control motors and receiving the signal from the crank angle sensors. The ABS indicator light goes off when the system is found to be normal.

The ABS control unit monitors the main function while the motorcycle is moving, whether the brakes are engaged or not. When it detects a problem with the system, it blinks the ABS indicator light and stops the system immediately. When the control unit detects a problem while the ABS is active, it stops the system and blinks the ABS indicator light, notifying the rider of the problem and that the system is deactivated.

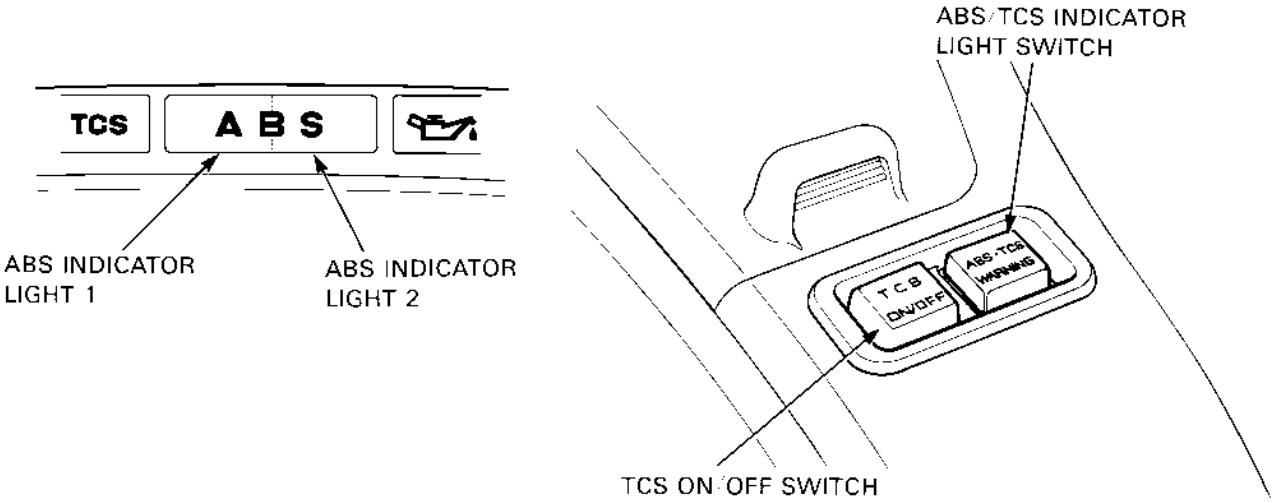
• Change-over function to the standard (LBS) system

When the ABS control unit detects a problem in the system by the self-diagnosis function, the control unit stops the ABS function. The back-up spring pushes the control piston automatically to open the cut-off valve and restore standard LBS operation (page 23-16).

• Problem code storage function

The problems can be memorized and stored in the ABS control unit (up to two codes), and can be retrieved and indicated by the number of blinks of the ABS indicator light (page 16-B-6).

ABS/TCS Indicator Light Switch:
When a problem occurs with the ABS and ABS indicator lights 1 and 2 blink, ABS indicator light 1 can be dimmed and the indicator light 2 can be turned OFF by pressing the ABS/TCS indicator light switch.
Dimming and turning off these indicator lights keeps them from interfering with the rider's vision.
Another function of the ABS/TCS indicator light switch is to retrieve the problem codes that are stored in the ABS control unit according to the problem code storage function explained above. The problem codes are indicated by the number of times the ABS indicator light blinks. When two problem codes are stored, the last problem code is output first.



3-Stage Cut-off Valve:
In conventional ABS configurations, a ball-type cut-off valve is used to cut hydraulic pressure to the brake calipers. In this ABS, an additional orifice valve is positioned directly behind the cut-off valve to realize three stages of valve operation.

- 1st stage

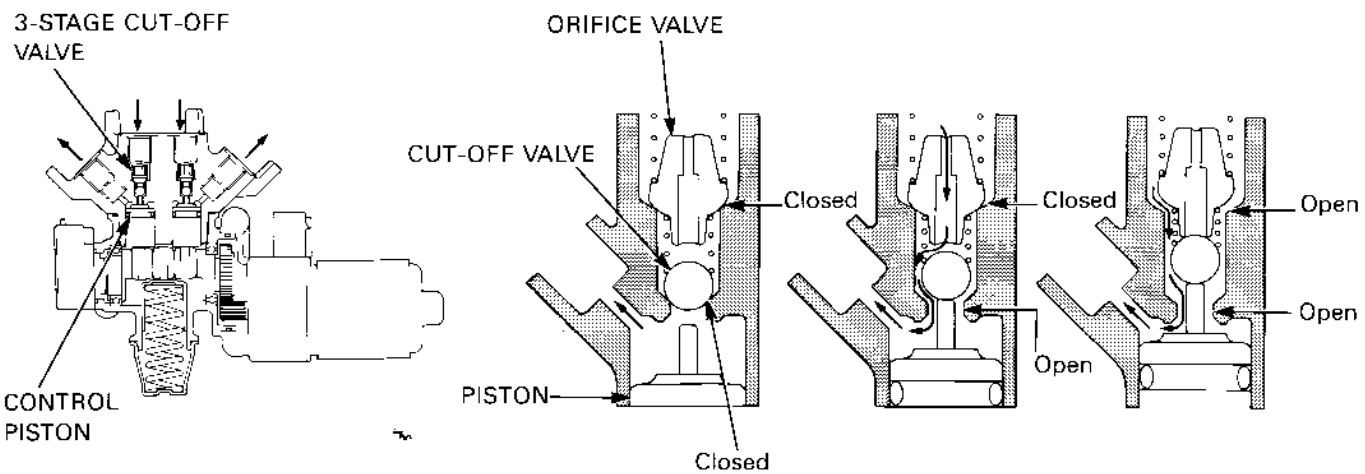
When the ABS is enabled, the control piston moves down to close both the cut-off valve and the orifice valve, cutting the hydraulic line between the master cylinder and the brake caliper.

- 2nd stage

The control piston moves up slightly to open only the cut-off valve, leaving the orifice valve closed. This stage permits only a small amount of hydraulic pressure to seep through the center of the orifice valve to the brake caliper.

- 3rd stage

The control piston returns to its uppermost position, opening both the cut-off valve and the orifice valve, and restoring the full hydraulic pressure needed for standard LBS brake operation.

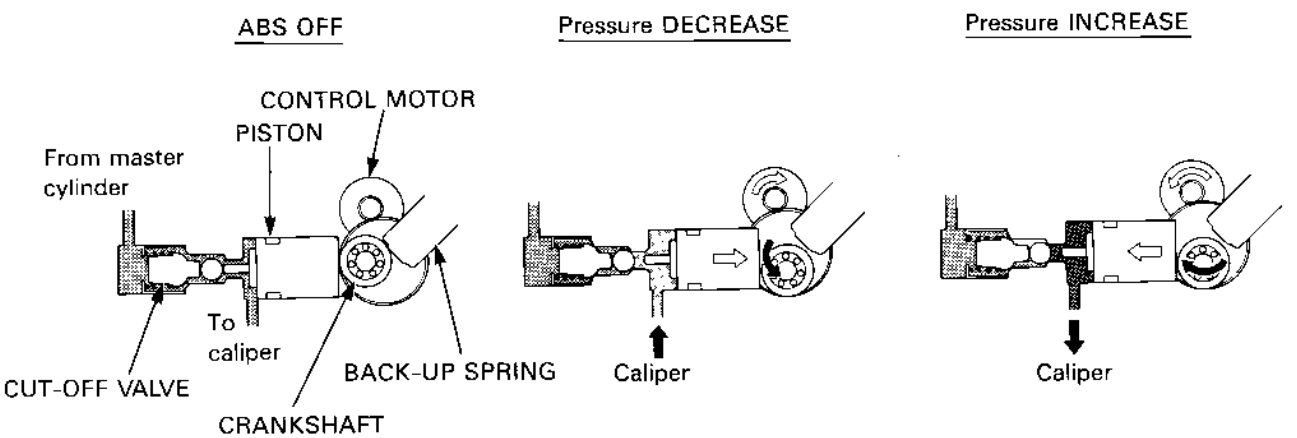


ABS Operation

• Pressure DECREASE
When the ABS control unit (ECU) detects any tendency towards wheel lock, it rapidly reduces hydraulic pressure to the brake caliper by rotating the crankshaft to lower the control pistons, closing the 3-stage cut-off valves.

• Pressure HOLD
Following a predetermined decompression interval, the crankshaft is rotated up slightly to move the control pistons into the pressure HOLD position, which permits the slipping wheel to recover its rotational speed.

• Pressure INCREASE
One the ABS control unit detects full wheel speed recovery, it rotates the crankshaft back into its highest position. This rapid cycle of pressure DECREASE, HOLD, and INCREASE makes possible nearly instantaneous correction of changes in wheel rotation while ensuring highly accurate control of hydraulic pressure to both independent sets of brake caliper pistons.

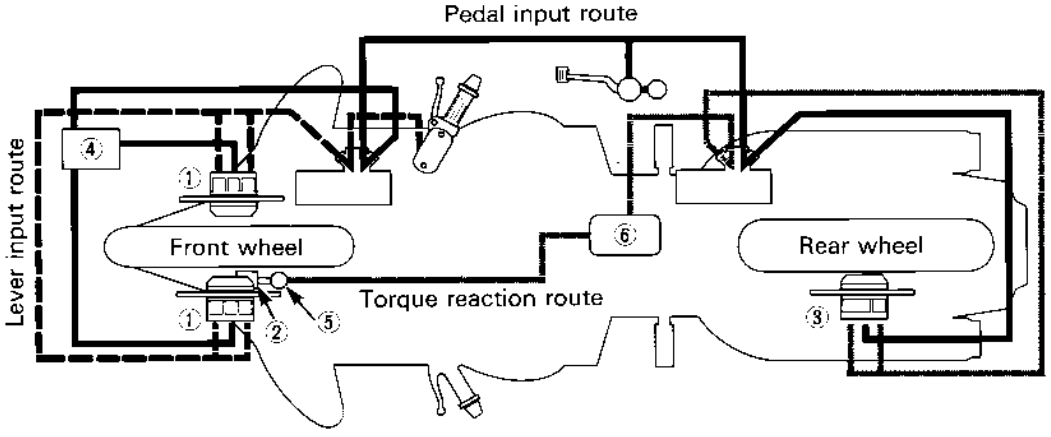


• Automatic protection against system failure
During conventional braking operation, the modulator's control piston remains in its uppermost position to hold the cut-off valve open. If any malfunction in the ABS is detected at this time, the system is turned off without affecting the control piston's position, thus maintaining standard LBS operation. During ABS operation, if any malfunction—such as loss of the modulator motor's power—is detected, the control piston back-up spring pushes the control piston into its upper most position to open the cut-off valve and restore standard LBS operation.

LBS (Linked Brake System) [After '95]

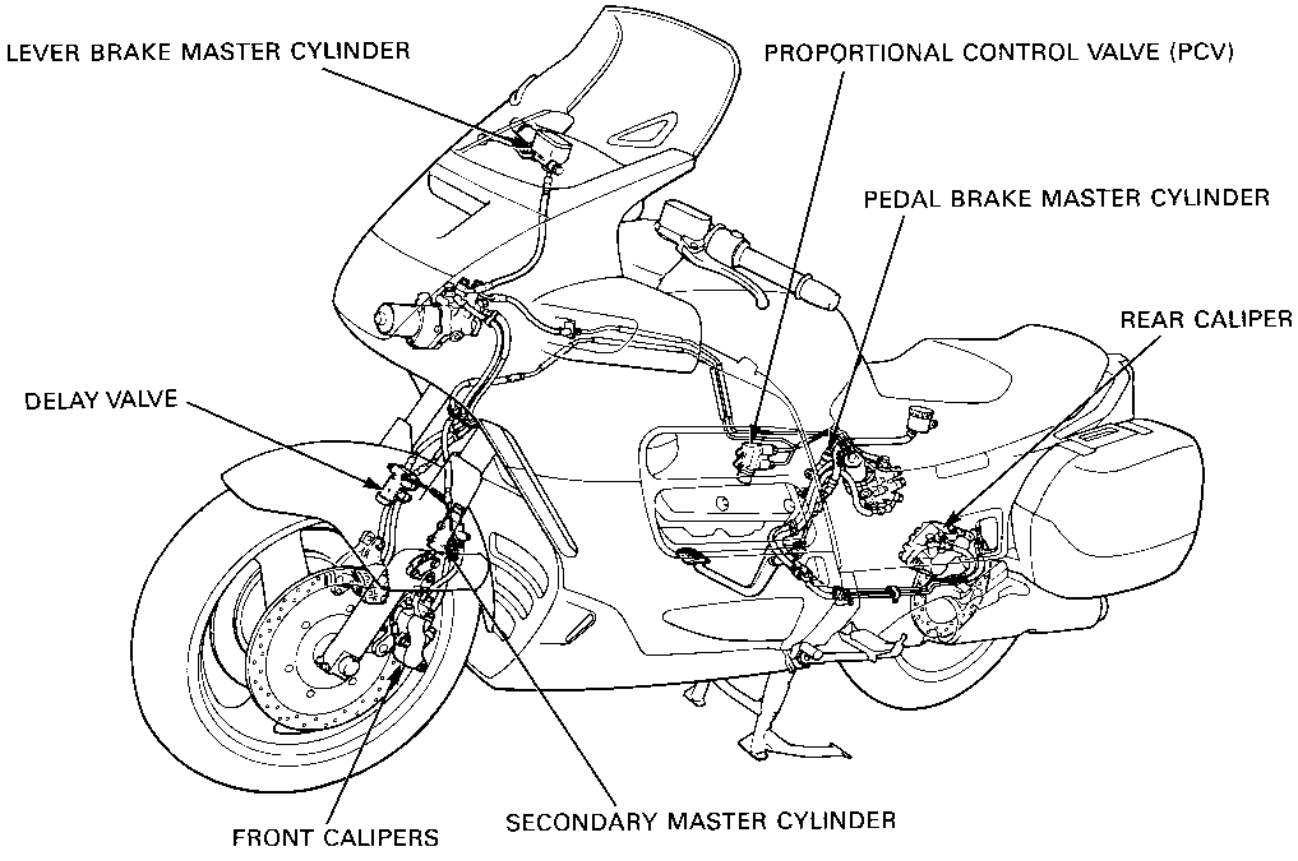
Summary

The Linked Brake System (LBS) was designed to engage both front and rear brakes when either the front brake lever or rear brake pedal is used.
Not merely a linked system that divides pedal braking force between the rear caliper and one of the front calipers, this system features a set of 3-piston calipers that are connected to two independent hydraulic systems. These combine to provide an optimal balance of front and rear braking forces whenever either the brake lever and and/or the brake pedal is used. Featuring no electronic control about the LBS, the completely hydraulic system's key component is a mechanical linkage that transmits front caliper braking force to a secondary master cylinder mounted on the left fork slider.



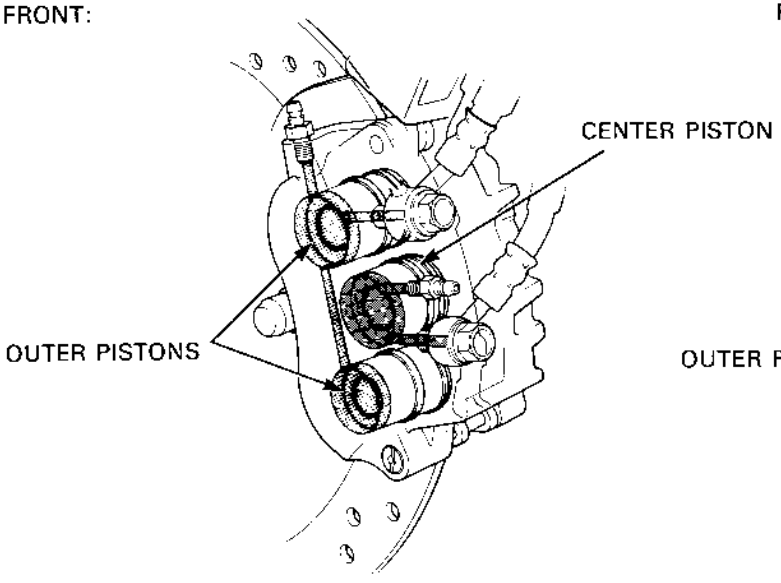
① Front calipers (3-pistons)
② Link mechanism
③ Rear caliper (3-pistons)
④ Delay valve
Slows front brake engagement to minimize its associated dive when performing minor speed corrections with only the brake pedal.
⑤ Secondary master cylinder
Transmits the rotational torque exerted on the front caliper to the rear brake caliper by way of the Proportional Control Valve (PCV).
⑥ Proportional control valve (PCV)
Regulates the rear caliper hydraulic pressure from the secondary master cylinder.

System Construction

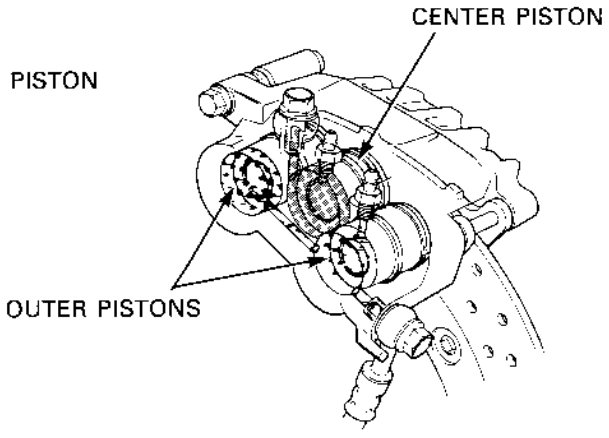


3-Piston Caliper:
A set of three newly designed 3-piston calipers are controlled by two independent hydraulic systems.
The center piston of all three calipers are operated directly by the brake pedal.
The two outer pistons of the front calipers are controlled by the brake lever, and the two in the rear are controlled by the servomechanism-actuated secondary master cylinder (page 23-17).
This arrangement delivers a broad, yet easily controlled range of braking force, depending on which either or both of the two (lever and pedal) brake are engaged.

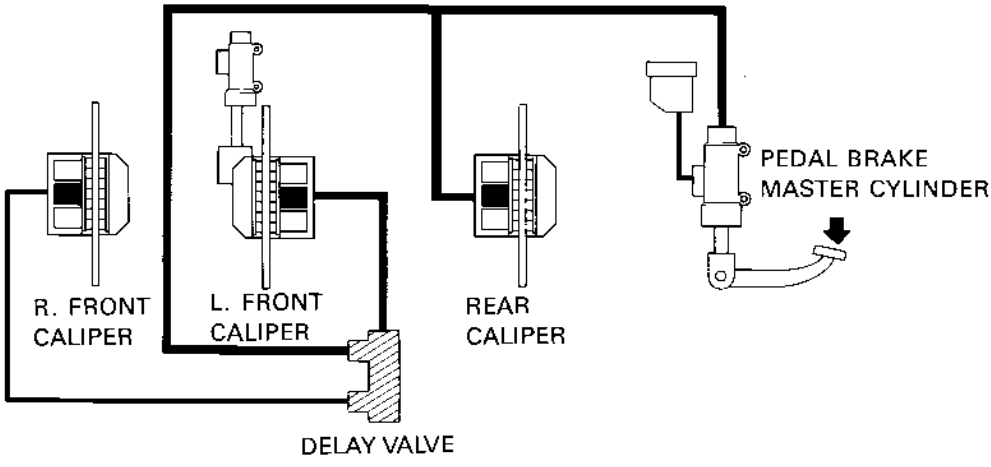
FRONT:

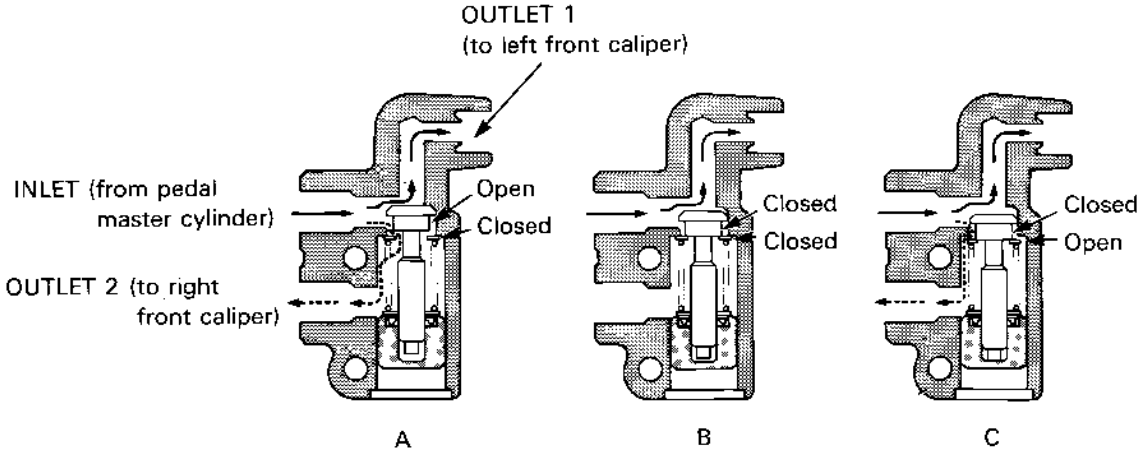


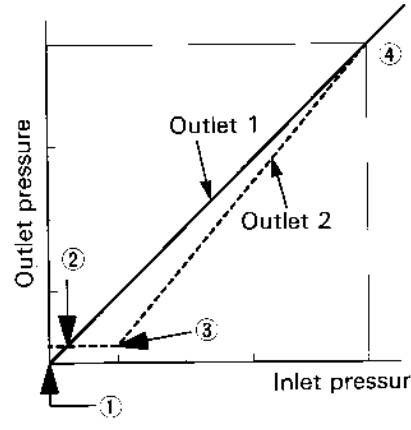
REAR:



Delay Valve:
The delay valve positioned between the pedal brake master cylinder and the center pistons of the front calipers, the delay valve engages only the left front caliper at first, effectively reducing the initial front wheel braking force (Fig. A-B).
As pedal pressure gradually increases, the delay valve introduces pressure to the right front caliper, which increases to match the pressure to the left front caliper at a predetermined level (Fig. C). The resulting feel is of comfortably even deceleration that begins at the rear, with little of the rapid forward dive that is usually brought on when the front brakes are suddenly applied.

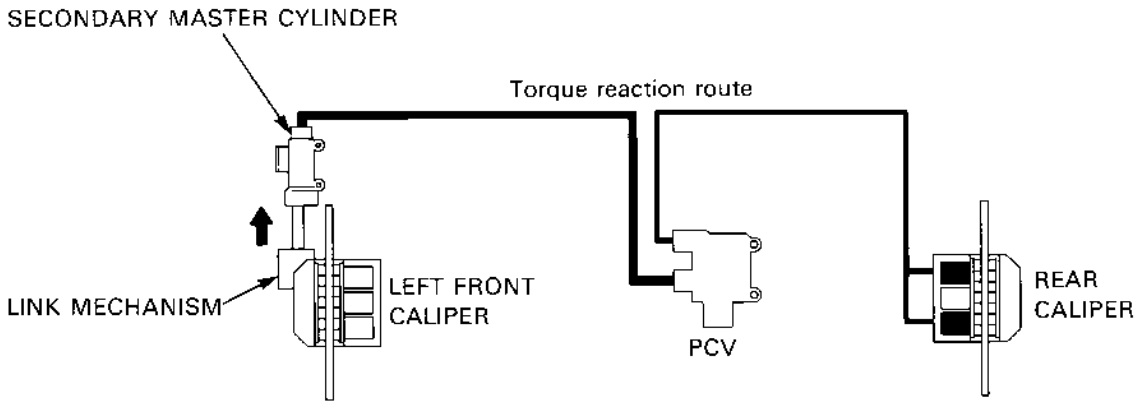




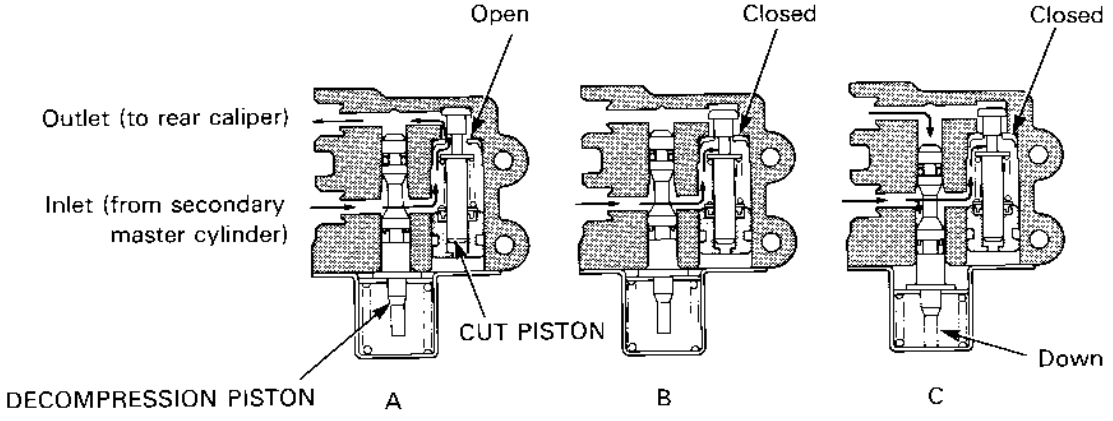


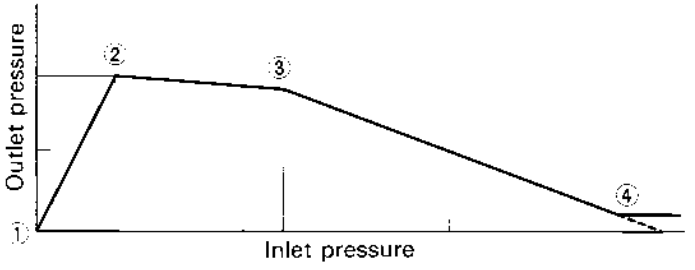
①–②: Fig. A
②–③: Fig. B
③–④: Fig. C
④– : Alternating Fig. B and C

Link Mechanism/Secondary Master Cylinder:
The system's servomechanism uses the rotational torque exerted on the front caliper when they are engaged to actuate a secondary master cylinder by way of its caliper mounting linkage.
This secondary master cylinder then applies a corresponding amount of pressure to the rear brake caliper.



Proportional Control Valve (PCV):
The PCV installed between the secondary master cylinder and the outer pistons of the rear caliper, regulates pressure in three stages of operation.
Initially, the PCV's output pressure increases in direct proportion to the increasing input pressure originating from the secondary master cylinder (Fig. A).
As input pressure continues to increase, the cut piston activates, closing the valve and causing the output pressure to hold (Fig. B).
A further increase in input pressure forces the decompression piston down, which expands a sub-chamber that draws pressure off the output side of the PCV (Fig. C)

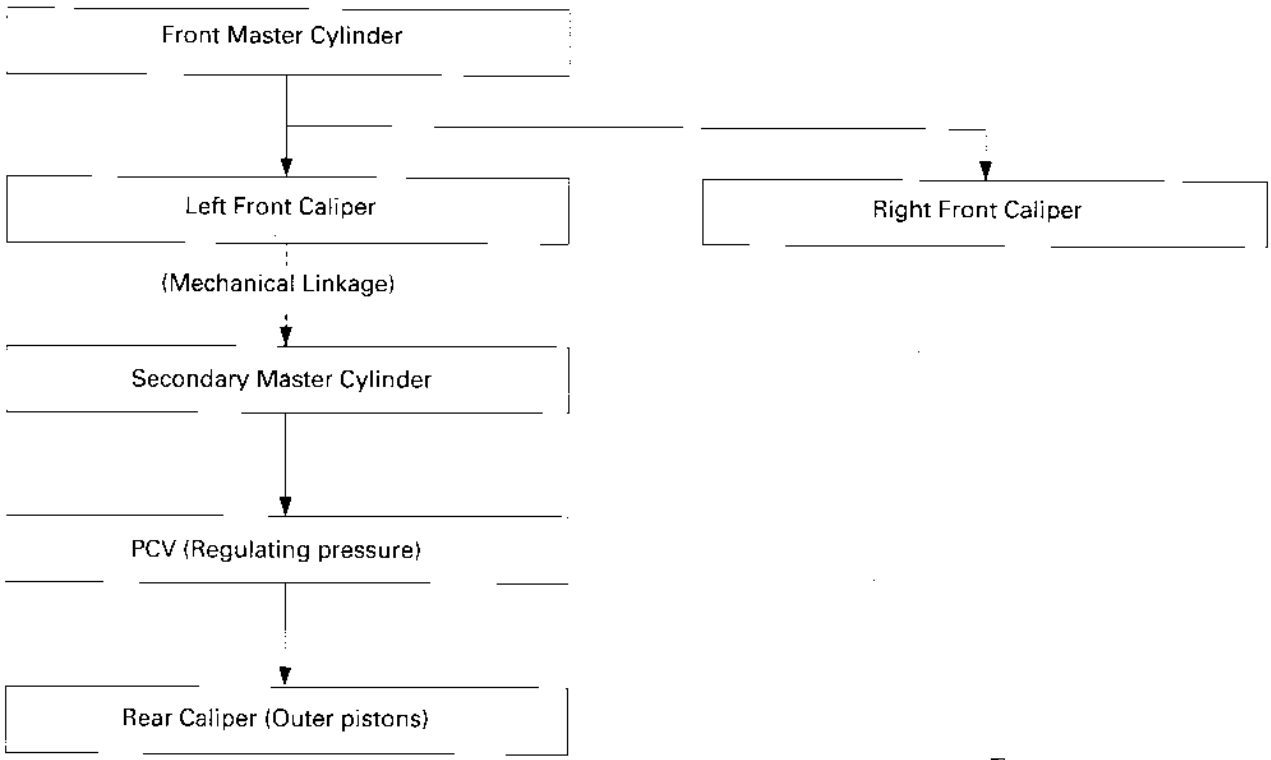


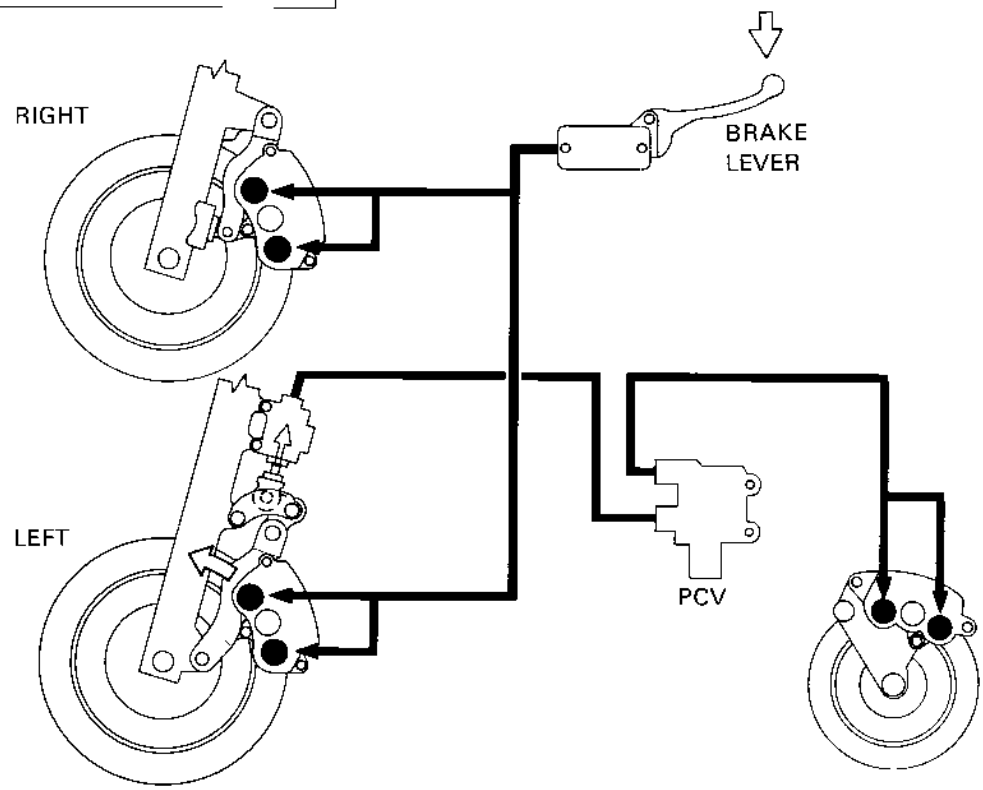


①–②: Fig. A
②–③: Fig. B
③–④: Fig. C

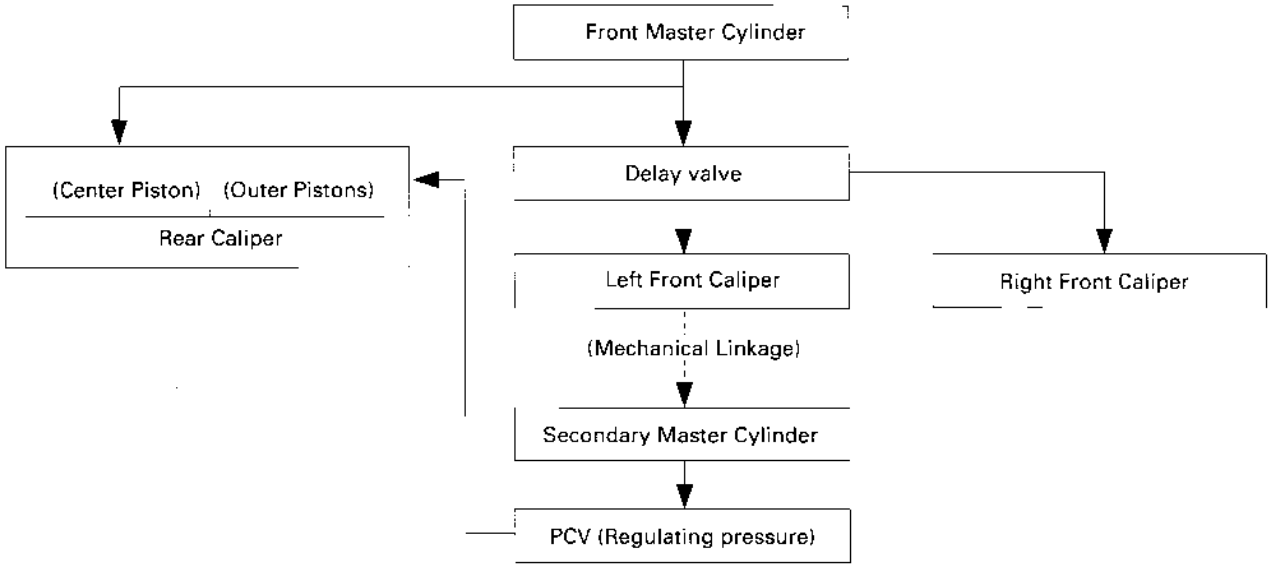
LBS Operation

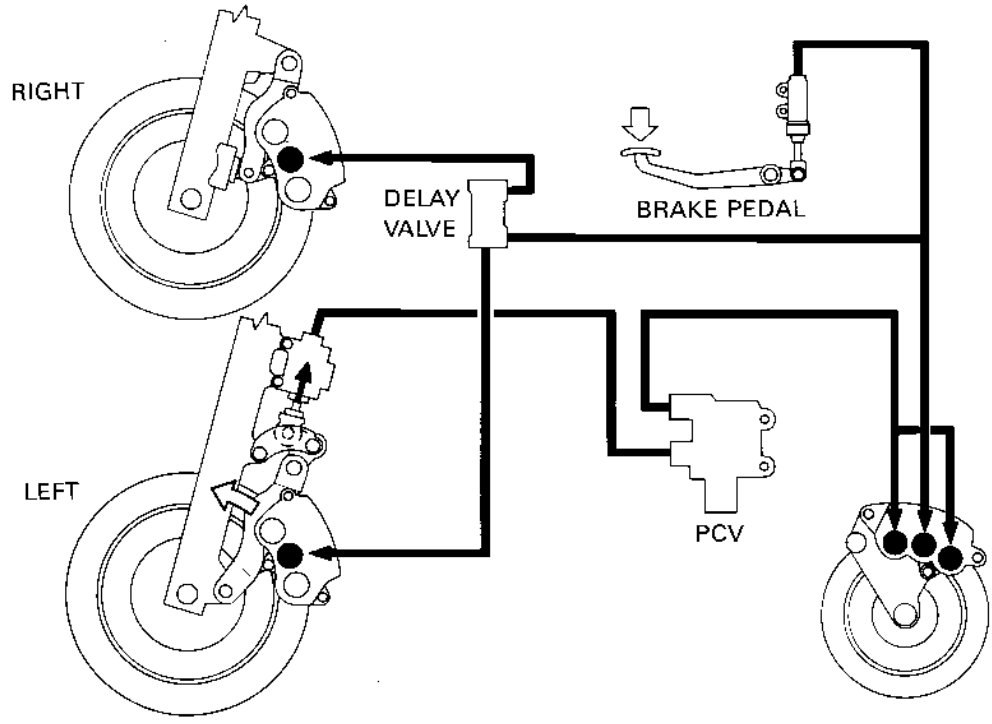
When hand brake is applied:
On initial operation, the hand brake works like any conventional motorcycle front brake system. A squeeze on the brake lever pressurizes the master cylinder which transmits its increased hydraulic pressure to the two outer pistons of the front calipers, causing a corresponding braking force to be applied to the front wheel.
In response to the braking force applied by the front caliper onto the spinning brake rotor, the caliper is pulled in the direction of wheel rotation, around its lower caliper pivot. This forward caliper motion also acts on the link arm which is connected to the secondary master cylinder. This direct pressure on the secondary master cylinder is regulated by the PCV which then transmits its hydraulic pressure to the outer pistons of the rear caliper.





When foot brake is applied:
When the brake pedal is pressed, hydraulic pressure from the rear master cylinder is routed through two lines. One connects directly to the rear caliper and acts on the center piston. The other line runs to the center pistons of the front calipers by way of the delay valve that slows front brake engagement to minimize its associated dive. As during hand brake operation, hydraulic pressure from the secondary master cylinder passes through the PCV, and acts on the outer pistons of the rear caliper. Because hydraulic pressure from the rear master cylinder is also being applied by the rear caliper's center piston, the braking force applied to the rear wheel is greater than that applied when using the brake lever only.



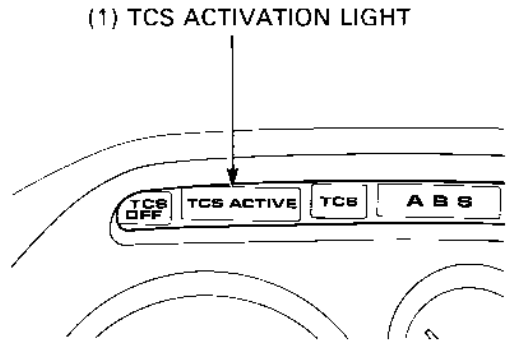


The system offers the same braking feel as conventional brake systems, but adds a more progressive range of brake control and enhanced balance of braking capability. Because the two systems are independent of each other, both the brake pedal and the lever can be used in any combination without resulting in excessive braking force or other unusual responses.

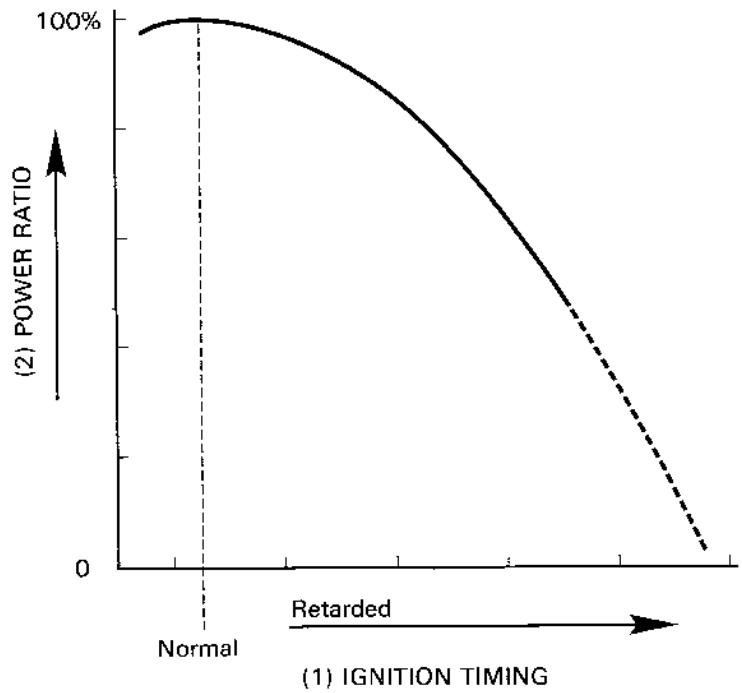
TCS (Traction Control System) [After '91]

Summary

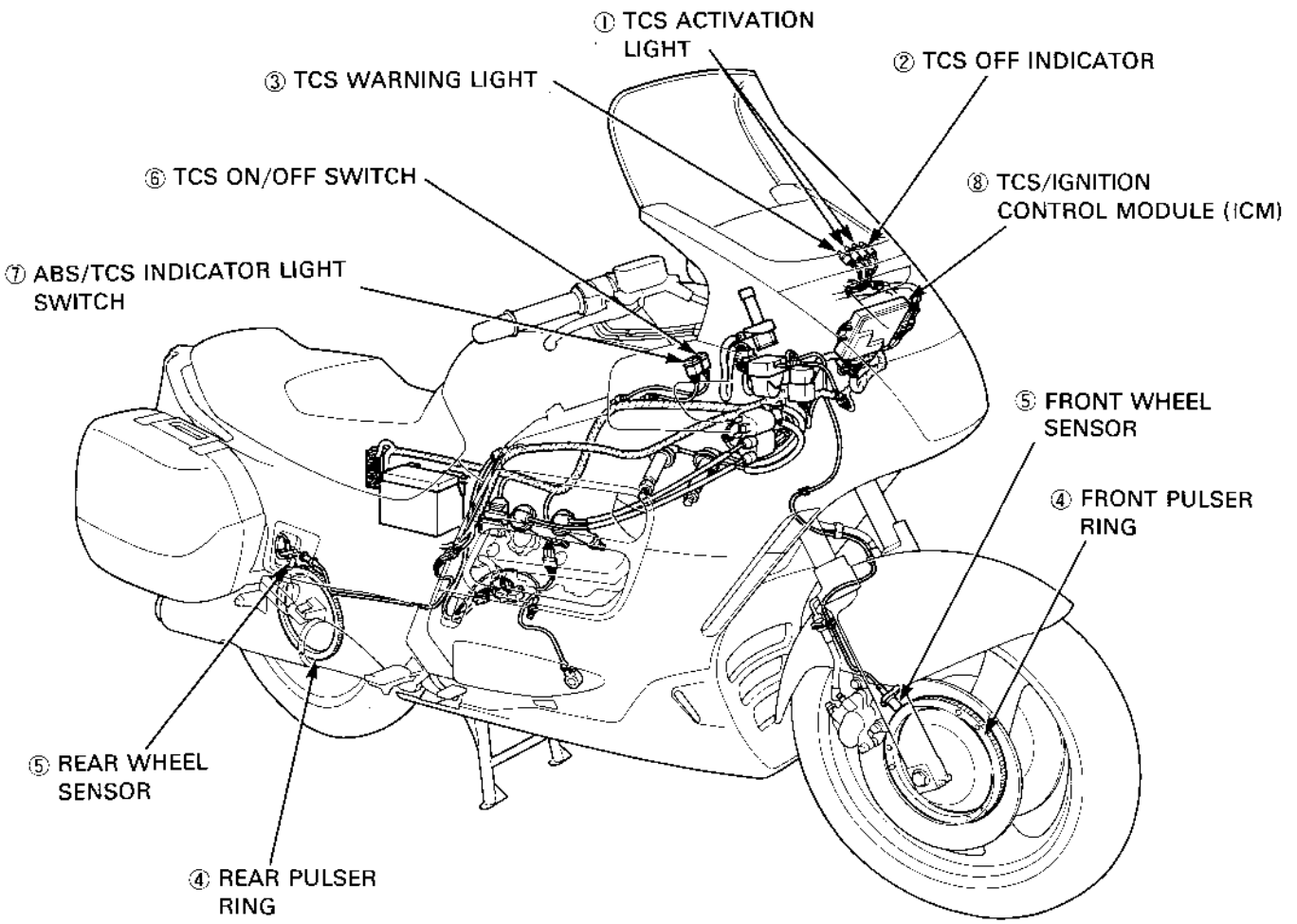
The Traction Control System (TCS) is designed to help prevent excessive rear wheel slippage during hard acceleration or acceleation on loose or slippery surfaces. TCS helps maintain rear wheel traction by controlling the ignition timing when it senses rear wheel slippage. The system alerts the rider that TCS is active by turning the TCS activation light on.



The TCS adjusts and controls the engine power by adjusting the ignition timing. This helps match the rear wheel torque to the road surface traction condition.



The TCS/ignition control module (ICM) judges the rear tire traction conditions as it receives the signal from the front and rear wheel sensors.
When the TCS is activated the TCS/ICM turns on the TCS activation light and controls engine power through changes in ignition timing. The TCS automatically turns ON by turning the ignition switch ON, and can be turned OFF manually as the rider wishes by pushing the TCS ON/OFF switch.
Note that the TCS cannot be turned OFF when it is active or while the motorcycle is moving.



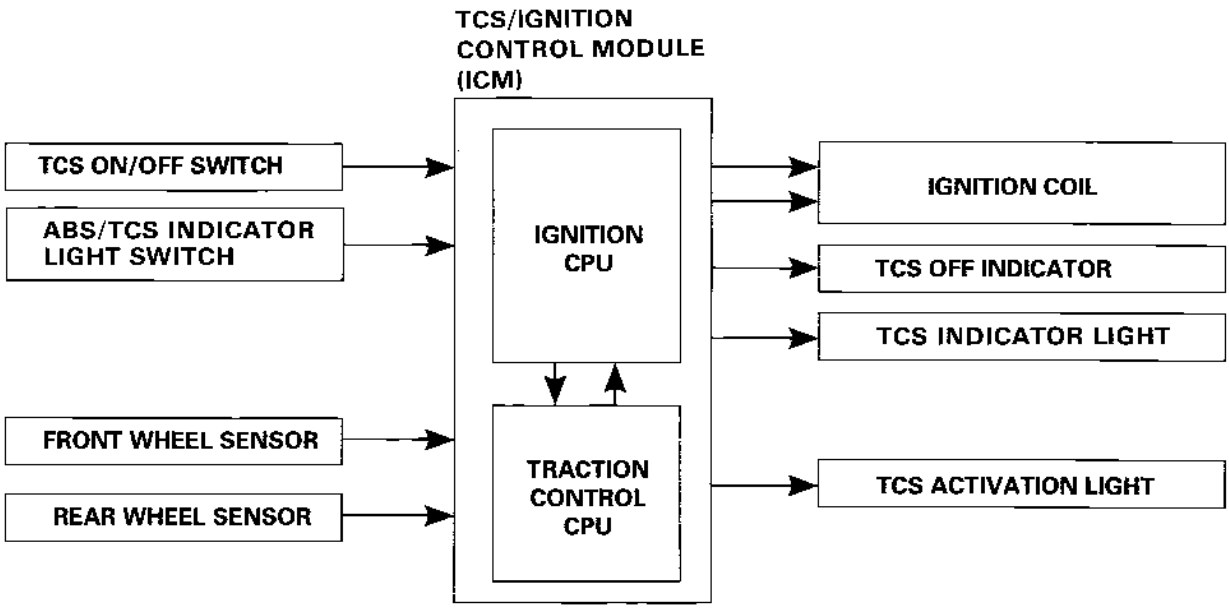
① TCS activation light
Turns ON when the TCS is active.
② TCS OFF indicator
Turns ON when the TCS is turned OFF using the TCS switch or when the TCS is not activated because of a problem with the TCS.
③ TCS indicator light
Blinks when a problem occurs in the TCS. The light stays ON when the pre-start self-diagnosis is not passed.
④ Pulser ring
Rotates together with the wheel and detects the wheel speed using the wheel sensor.
⑤ Wheel sensor
Sends the pulse signal, generated proportional to the rotating speed of the pulser ring, to the TCS/ICM.
⑥ TCS ON/OFF Switch
The TCS can be turned ON and OFF by pushing the TCS ON/OFF switch. The TCS OFF indicator comes ON when the TCS ON/OFF switch is OFF.
⑦ ABS/TCS indicator light switch
The indicator light switch is the common switch between the ABS and TCS.
When the TCS indicator light blinks, it can be turned OFF so it does not interfere with the rider's vision. (The TCS OFF indicator stays ON).
⑧ TCS/ignition control module (ICM)
While receiving signals from the front and rear wheel sensors, the TCS/ICM judges the running condition and it outputs a signal for appropriate ignition timing.

System Construction

TCS/ignition control module (ICM):

The TCS/ICM detects front and rear wheel speed by receiving signals from the wheel sensors. When the rear wheel speed exceeds a given ratio of front-to-rear wheel speed, the TCS/ICM judges that the rear driving wheel is beginning to slip and it activates the TCS.
The TCS/ICM body is the ECU that is integrated with the spark unit. As the ignition CPU and the traction control CPU communicate with each other and the ignition CPU monitors the traction control CPU, the engine will operate normally even if the TCS becomes inoperative due to a problem in the system.
When the TCS in inoperative, the TCS indicator light and TCS OFF indicator turn ON.

The TCS/ICM constantly monitors the input signal inside the TCS/ICM, and shuts off the TCS when it detects a problem with the system.
Simultaneously, the TCS/ICM turns ON or makes the TCS indicator light blink notifying the rider of the problem with the system, and turning the TCS OFF indicator ON to notify the rider of the inoperative state of the TCS.

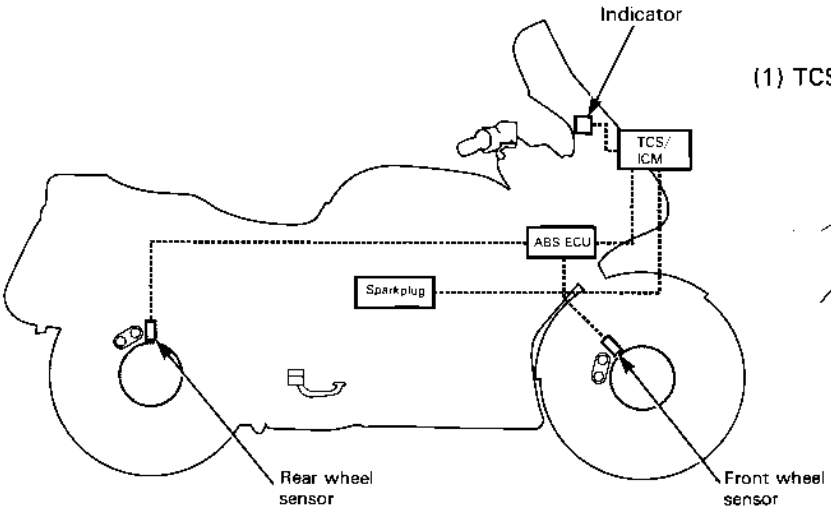


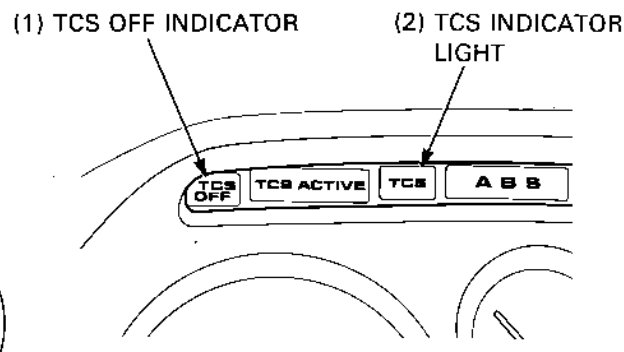
· Self-diagnosis function

The TCS/ICM starts self-diagnosis as the ignition switch is turned ON. It diagnoses the TCS/ICM itself and the wheel sensor power source. When it detects a problem, it stops TCS operation, makes the TCS indicator light blink and turns on the TCS OFF indicator light to notify the rider of a fault in the TCS. When the TCS/ICM is found to be normal, it moves to the stand-by mode for the wheel sensor signal and the TCS indicator light turns ON. (The TCS does not function when the TCS indicator light is ON).

The wheel sensors send signals to the TCS/ICM after the motorcycle is in motion [approximately 10km/h(6 mile/h) or above] , and the TCS indictor light goes OFF after the wheel sensor signal is input and the wheel sensors are found to be as normal.

If the TCS indicator light stays ON, there is an abnormality with the wheel sensors.





Wheel sensor/pulser ring:

The ABS and TCS share the same wheel sensor/pulser rings.

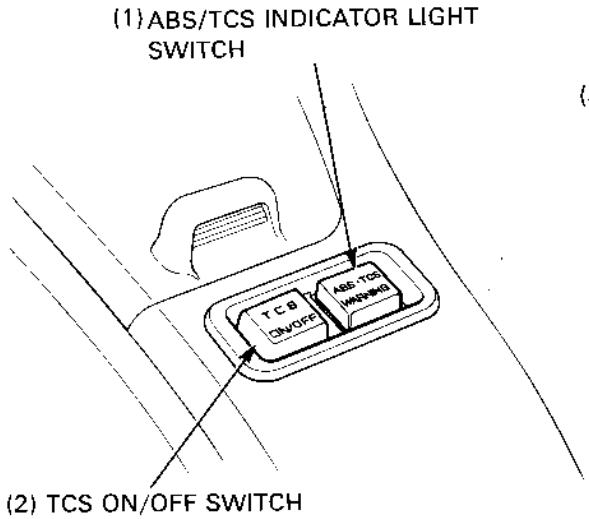
They transmit the vehicle speed signal to both the ABS control unit and the TCS/ICM. (See page 23-3)

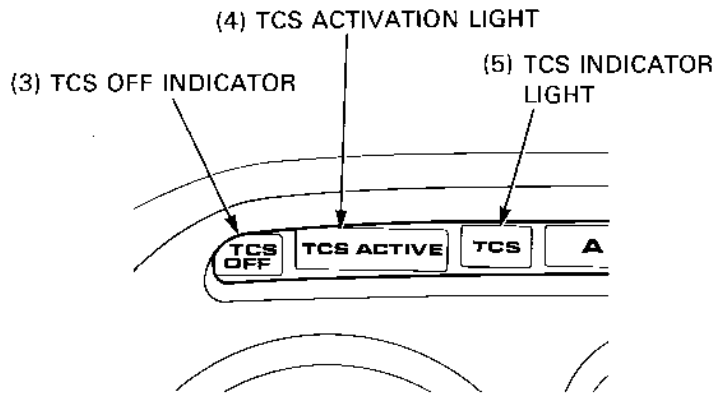
ABS/TCS indicator light switch:

When a problem with the TCS occurrs, the TCS indicator light blinks and the TCS OFF indicator turns ON. The TCS indicator light can be turned OFF by pressing the ABS/TCS indicator light switch. Turns off the indicator light prevents the light from interfering with the rider's vision. The TCS OFF indicator does not go off but stays ON.

TCS ON/OFF switch:

The TCS can be turned ON and OFF by pushing the TCS ON/OFF switch. The TCS is activated when the switch is ON, the TCS activation light turns ON, and when the TCS is active. When the TCS ON/OFF switch is OFF, the TCS cannot be activated but the TCS OFF indicator comes ON. The TCS cannot be shut off when it is active or while riding.

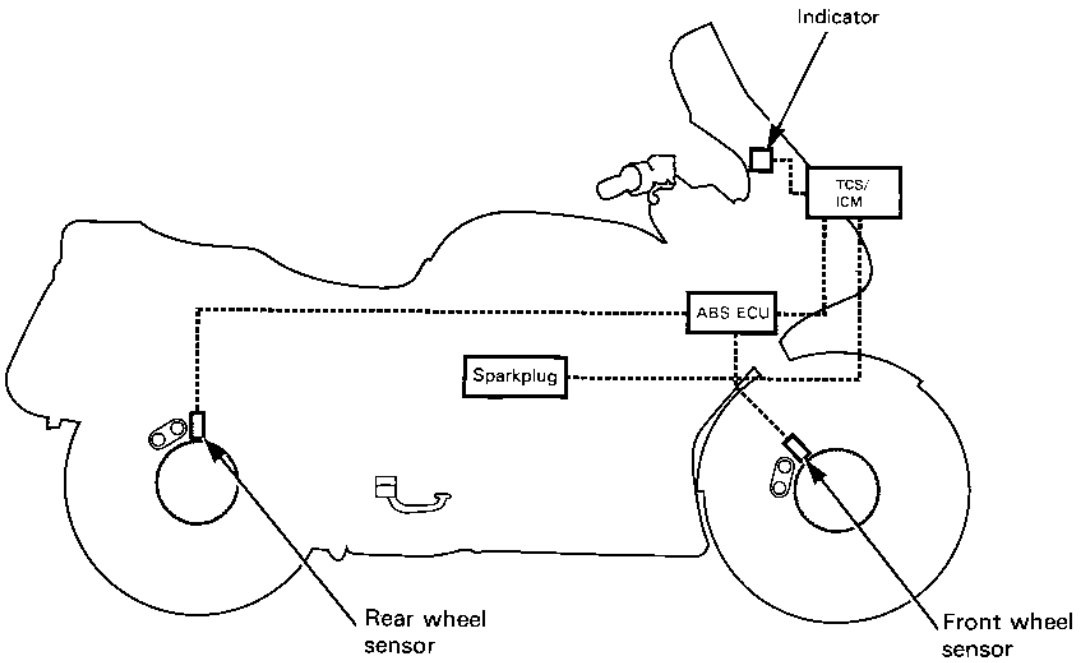




TCS Operation

When TCS is active:

After receiving the signal from the front and rear wheel sensors, the TCS/ICM judges whether traction control is required by detecting the rear wheel speed and comparing it to the front wheel speed (i.e. vehicle speed). The engine will operate normally when the TCS is not active. When the rear wheel speed exceeds a given ratio of the front-to-rear wheel speed, the TCS/ICM judges that the rear wheel is slipping excessively and controls the engine power by determining the suitable ignition timing. The TCS performs the above operations instantaneously to help prevent the skid from becoming excessive and to hold it within a specified range.



When a problem occurs:

When the TCS/ICM detects a problem with the TCS, it makes the TCS indicator light blink, turns the TCS OFF indicator ON, and immediately shuts off the TCS function. When the TCS/ICM detects a problem while the TCS is active, it returns the engine slowly to regular ignition timing, then deactivates the TCS.

Symbols

The symbols used throughout this manual show specific service procedures. If supplementary information is required pertaining to these symbols, it would be explained specifically in the text without the use of the symbols.

	Replace the part(s) with new one(s) before assembly.
	Use special tool
	Use optional tool. Use the same procedure you use to order parts.
 10 (1.0, 7.2)	Torque specification. 10 N·m (1.0 kg-m, 7.2 ft-lb)
	Use recommended engine oil, unless otherwise specified.
	Use molybdenum oil solution (mixture of the engine oil and molybdenum grease in a ratio of 1 : 1).
	Use multi-purpose grease (Lithium based multi-purpose grease NLGI #2 or equivalent)
	Use molybdenum disulfide grease (containing more than 3% molybdenum disulfide, NLGI #2 or equivalent) Example: Molykote® BR-2 plus manufactured by Dow Corning, U.S.A. Multi-purpose M-2 manufactured by Mitsubishi Oil Japan
	Use molybdenum disulfide paste (containing more than 40% molybdenum disulfide, NLGI #2 or equivalent) Example: Molykote® G-n Paste manufactured by Dow Corning, U.S.A. Honda Moly 60 (U.S.A. only) Rocol ASP manufactured by Rocol Limited, U.K. Rocol Paste manufactured by Sumico Lubricant, Japan
	Use silicone grease
	Apply a locking agent. Use a middle strength locking agent unless otherwise specified.
	Apply sealant
	Use brake fluid, DOT 3 or DOT 4. Use the recommended brake fluid, unless otherwise specified.
	Use Fork or Suspension Fluid.