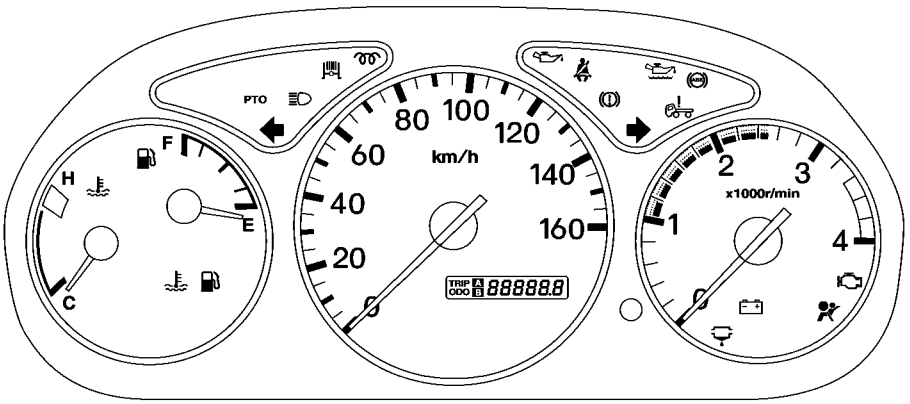
METER

■COMBINATION METER

1. General

- The combination meter is a 3-dial analog meter with independently arranged speedometer, tachometer.
- The speedometer has a built-in LCD (liquid crystal display) for an electronic odometer and trip meter. The trip meter is a twin trip meter with two independent trip functions.
- An electric speedometer was adopted that electrically computes vehicle speed using signals from a speed sensor mounted on the transmission.
- A low fuel warning light, cab tilt indicator light, and other indicators a reincorporated in the combination meter.
- The tachometer was provided with an economy zone display that indicates the rpm range for economical driving.



239BE01

▶ Speedometer Specifications ◀

Display	Function
• Display range: 0~160 km/h (100 mph) • Display speed in 5 km/h (5 mph) increments.	• Stepping motor type • Displays speed using pulse signals from sensor.

▶ Tachometer Specifications ◀

Display	Function
• Display range: 0~ 4000 r/min. • Redzone 3800~5500 r/min.: 14B, engine 3400~5500 r/min.: 15B-FTE engine 3400~4000 r/min.: W04D-J, S05C-B engine 3200~4000 r/min.: S05C-TB, S05C-TA engine • Economy zone 1000~2400 r/min.: 14B, 15B-FTE engine 1000~2500 r/min.: Other engine	• Stepping motor type • Displays speed using pulse signals from sensor.

▶ Fuel Gauge Specifications ◀

Display	Function
• Display range: E~F • Low fuel warning light comes on when fuel level is about 15% of tank capacity.	• Stepping motor type • Displays remaining fuel level using fuel center gauge output voltage.

▶ Water Temperature Gauge Specifications ◀

Display	Function
S05C series, W04D-J • Display range: C~H (50~116°C) • Red zone starting at 110°C 15B-FTE, 14B • Display range: C~H (50~126°C) • Red zone starting at 120°C	• Stepping motor type • Displays coolant temperature using water temperature gauge output voltage.

▶ Odometer/Trip Meter Specifications ◀

Display	Function
• LCD digital display • Display range: • Trip meter A/B: • 0.0~9999.9 km Odometer: 0.0~999999 km	• Stepping motor type • Computes pulse signals from speed sensor and displays number of kilometers driven. • Also computes distance traveled in reverse. • Selector switch displays odometer, trip meter A, and trip meter B in that order.

▶ ON/OFF and Warning Indicator Lights Specifications ◀

Display	Function
• Turn signal indicators, oil pressure warning light, PTO indicator light, low fuel warning light, oil level warning light, exhaust retarder indicator light, check engine warning light, brake warning warning light, charge warning light and cab tilt warning light	• Light up to indicate corresponding system operation or malfunction.

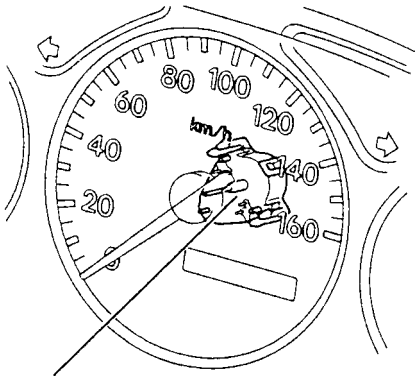
2. Electric Speedometer

A stepping motor system and pointer drive were adopted for the vehicle speed indicator.

▶ Stepping motor type movement ◀

[1] Construction

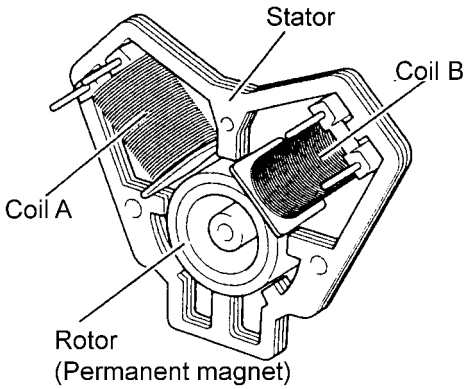
The stepping motor used to drive the speedometer needle is a PM (permanent magnet) type stepping motor that uses a permanent magnet in the rotor.
The rotating force generated by the stepping motor is transmitted to the speedometer needle via a reduction gear.
With a meter that uses a stepping motor, the speedometer needle may twitch around the zero point for a short time after power is applied to the meter (the ignition switch is turned on).
This is normal and does not indicate a malfunction.



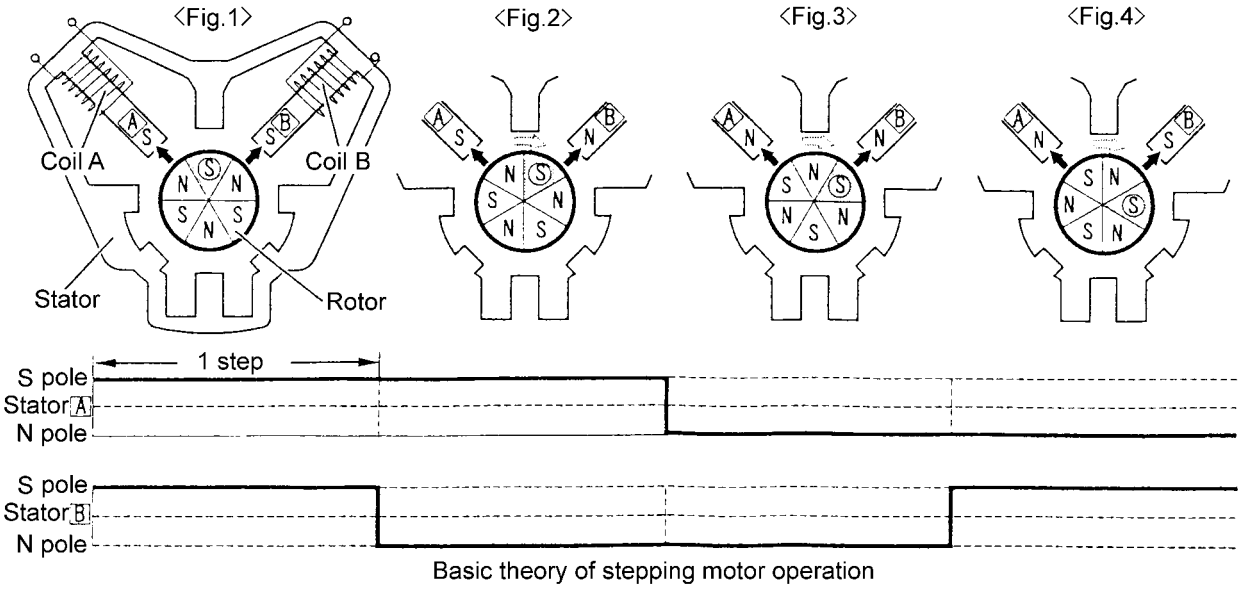
Stepping motor type movement assy
(include reduction gear)

a. PM type stepping motor

A PM type stepping motor has a rotor made of a permanent magnet on the inside, and on the outside it has a stator with coil wrapped around it. When current flows through this coil and the coil is energized, the rotor is pulled in and rotates in steps.



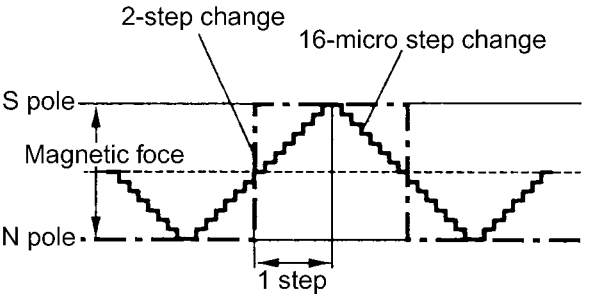
When current is flowing through coils A and B and both phases A and B and the S-poles of the stator are excited, the two rotor N-poles are pulled in and stop (Figure 1). By respectively changing the direction of the current flowing through coils A and B, we can switch the stator phase A and phase B poles (N/S) at will, pulling in the rotor and moving the speedometer needle in the vehicle acceleration or deceleration direction (Figure 2-4).
Stepping motor type movement Assy (built-in reduction gear)



Basic theory of stepping motor operation

BE

By finely controlling the strength of the magnetic force (2-stepchange) used for changeover in step 1, we can get the rotor to move in even smaller steps (microsteps), which are more suitable for driving the speedometer needle.

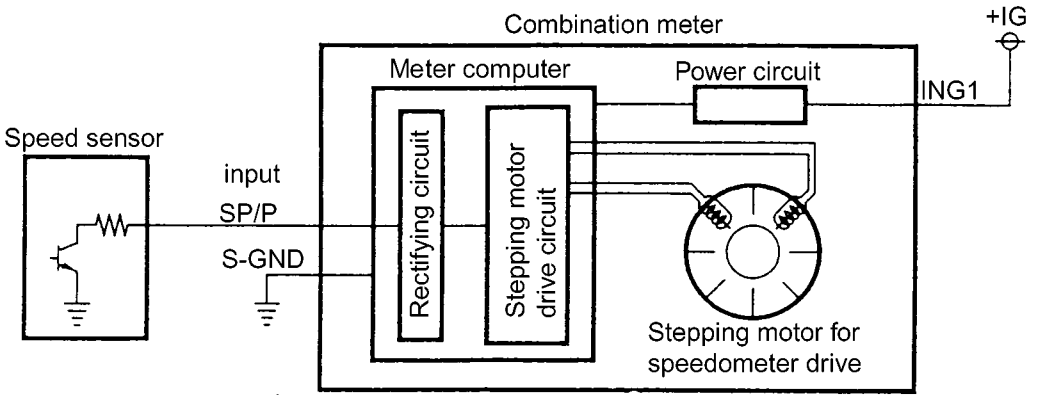


b. Stepping motor initialization control

The stepping motor that controls the speedometer needle by means of the motive force of a magnet coil does not apply a force to return the needle to the zero point when there is no power supplied to the combination meter, resulting in possible movement of the needle.
Consequently, each time power is supplied to the combination meter (the ignition switch is turned on), an initialization operation is performed to return the needle to the zero point.

[2] Operation

The meter computer controls the initialization operation that returns the needle to the zero point each time power is supplied to the combination meter. The meter computer calculates the numeric values to display from data such as the vehicle speed pulse signal and the engine speed pulse signal and the resistance values of the fuel center gauge and the engine coolant temperature sensor.
Using the stepper motor drive circuit, the meter computer controls the turning angle, direction, and speed of the needle (stepping motor rotor), and displays the corresponding vehicle speed, engine speed, fuel level, and engine coolant temperature.



Speedometer circuit