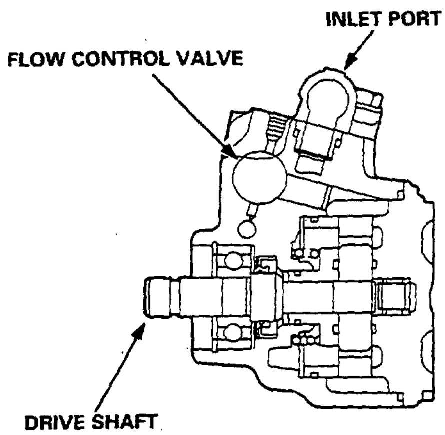
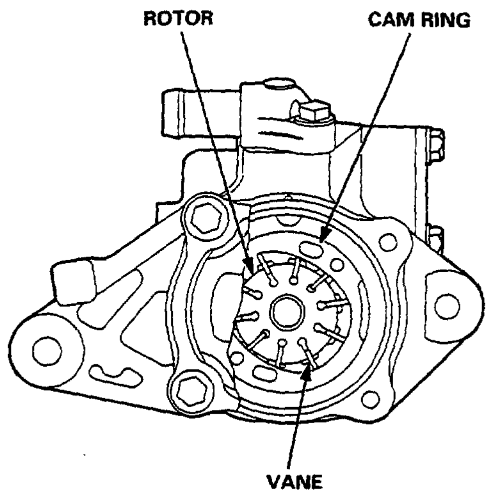
System Description

Steering Pump

Construction

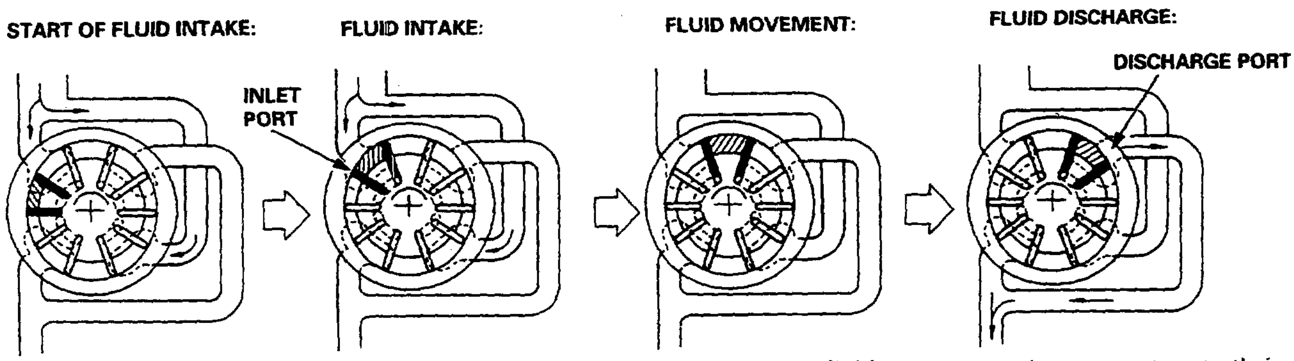
The pump is a vane-type incorporating a flow control valve (with an integrated relief valve) and is driven by a V-belt from the crank pulley. The pump features 10 vanes. Each vane performs two intake/discharge operations for every rotation of the rotor. This means that the hydraulic fluid pressure pulse becomes extremely small during discharge.





Operation

The belt-driven pulley rotates the rotor through the drive shaft. As the rotor rotates, the hydraulic pressure is applied to the vane chamber of the rotor and the vanes will rotate while being pushed onto the inner circumference of the cam ring. The inner circumference of the cam ring has an extended portion with respect to the center of the shaft, so the rollers move downward in the axial direction as the carrier rotates. As a result of this roller movement, the internal volume of the vane chamber will change, resulting in fluid intake and discharge.



The vanes are pushed onto the inner circumference of the cam ring.

The volume of the vane chamber increases so that fluid is sucked in.

The sucked-in fluid moves toward the discharge port.

As the vanes return to their original position on the inner side, the volume of the vane chamber decreases so the fluid is discharged from the discharge port.

Flow Control

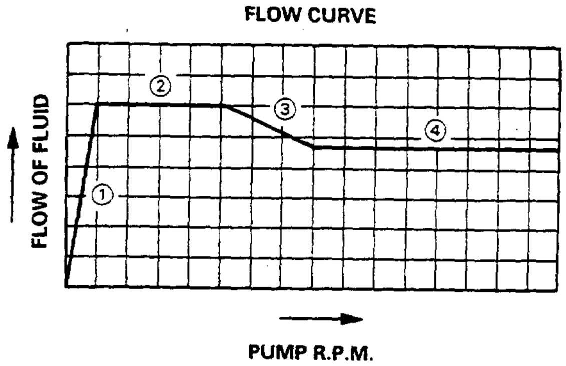
The flow control valve in the pump performs the following steps ① through ④ to control the flow of fluid, i.e., to increase the discharge volume when engine speed is low and to decrease it when the engine speed increases. The assistance thrust of the steering gearbox changes in compliance with the change in the discharge volume.

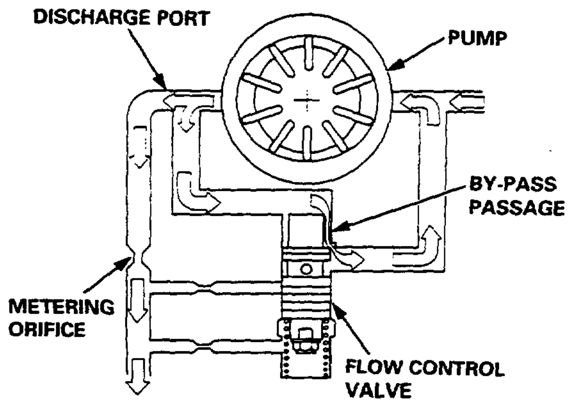
① When the engine starts, fluid discharged from the discharge port starts to run through the metering orifice in the pump. The discharge volume increases as the engine speed increases.

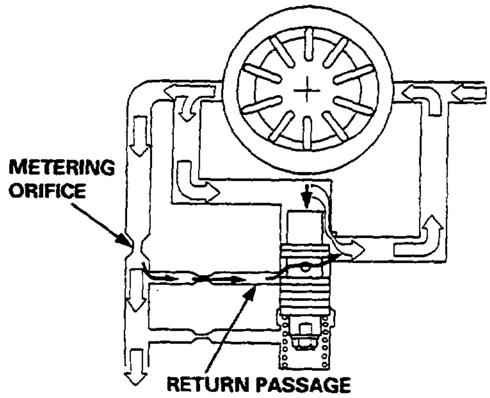
② As the flow has already been regulated by the metering orifice when the engine speed is at or near the idle speed, a constant and regulated amount of fluid is discharged until the engine speed reaches the middle speed range. As the engine speed increases, the pressure difference between the ends of the metering orifice increases. A pressure difference is created between the top and bottom ends of the flow control valve, too, pushing the flow control valve to open the by-pass passage. This allows the excess fluid to return to the inlet port preventing pressure at the discharge port from rising excessively.

③ As the engine speed continues to increase, the flow control valve is pushed back further. When the engine speed reaches a given speed, the return passage outside the metering orifice is connected to the inlet port, and the opening to the inlet port widens in proportion to the increase in engine speed. This makes part of the fluid regulated by the metering orifice return to the inlet port of the pump; there by discharged fluid from the pump is decreased slowly by this amount.

④ The orifice in the return passage regulates and maintains the flow of fluid discharged from the pump at a given level until the engine speed reaches the high speed range.







Pressure Relief

Pressure outside of the metering orifice is directed to the bottom of the flow control valve. When the pressure builds up, the relief valve in the flow control valve opens to relieve the pressure. As the flow control valve is pushed back by the pressure difference this time, the flow of fluid in the bypass passage increases, controlling the pressure outside the metering orifice. The above operations are repeated to provide constant discharge pressure from the pump.