c. Valve Sleeve

The opening and closing of oil inlet and outlet ports are controlled by the movement of the plunger follower inside the valve sleeve.

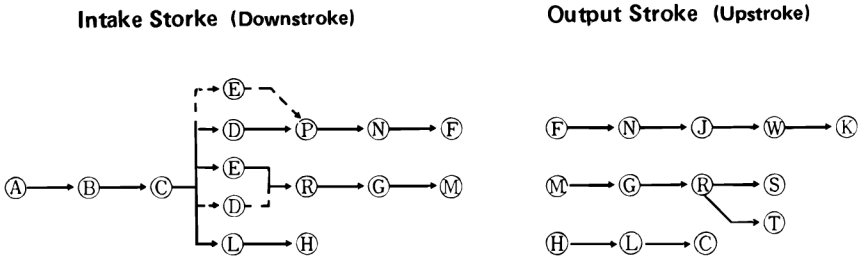
The valve sleeve, which is prevented from turning by a pin in one side, contains three sets of two holes, a total of six holes. The two holes in each set are spaced opposite each other 180° apart to conform with the plunger operation and complete one cycle for each half rotation.

When the forward notch Ⓡ in the plunger follower coincides with the center cylinder outlet hole Ⓢ or the left cylinder hole Ⓣ in the valve, oil is pumped to that cylinder from the forward pump chamber. Each of these two cylinders receives oil every other cycle, or once per plunger rotation.

When the rear notch Ⓟ coincides with either of the two rear holes Ⓙ oil is pumped into the space Ⓦ between the valve sleeve and the inside of the outlet end cover. From space Ⓦ the oil travels around to outlet Ⓚ and from there to the right cylinder. This part of the pump supplies oil to the right cylinder once every cycle, i.e. twice per plunger rotation, but the capacity of the rear pump chamber is only half that of the front, so that each engine cylinder is supplied with the same amount of oil.

Center hole Ⓓ is aligned with the inlet passage Ⓒ and connected to hole Ⓔ by a groove cut into the outer circumference of the valve sleeve. Once each cycle when the plunger follower notches Ⓟ and Ⓡ coincide with holes Ⓓ and Ⓔ, oil is drawn into the two pump chambers Ⓕ and Ⓜ.

Oil Flow Chart



d. Pump Cycle

(1) Downstroke

During the plunger upstroke, space Ⓑ between the plunger cam face and the inlet end cover enlarges, drawing in new oil through the inlet at Ⓐ.

As the plunger and plunger follower move toward the camshaft on the downstroke, space Ⓑ grows smaller and three other spaces open: (1) Void Ⓗ containing the piston and the plunger spring enlarges; (2) The piston moving out of the rear pump chamber Ⓕ increases the volume of this space; (3) The plunger follower moves out of the valve sleeve into the plunger cylinder, but since the cylinder inside diameter is larger than the follower outside diameter, a void (the forward pump chamber) is developed between the follower and the cylinder wall.

Suction from these expanding spaces, in conjunction with pressure from the oil at the pump inlet and the oil being compressed in space Ⓑ, draws oil into the inlet passage Ⓒ, and moves it in the direction of the arrows.

Oil enters chamber Ⓗ at point Ⓛ.

The rear pump chamber Ⓕ is supplied via valve hole Ⓓ (or Ⓔ on the other half rotation), follower notch Ⓟ and hole Ⓝ into the inside of the follower.

The forward pump chamber Ⓜ receives oil through valve hole Ⓔ (or Ⓓ), notch Ⓡ and hole Ⓖ cut through to the tip of the follower.

(2) Upstroke

As the plunger starts its upstroke, notch Ⓟ coincides with hole Ⓙ or its matching hole on the opposite side; and notch Ⓡ coincides with either hole Ⓢ or hole Ⓣ in the valve sleeve.

The plunger starts pushing the plunger follower back inside the valve sleeve, closing up the forward pump chamber Ⓜ. This forces oil back out passage Ⓖ, and by way of notch Ⓡ into either Ⓢ or Ⓣ to the center or left cylinder outlet.

At this same time, the plunger pushes onto the piston, and the piston entering the rear pump chamber Ⓕ, decreases its capacity and forces out the oil. Oil leaves the chamber via hole Ⓝ and flows into space Ⓦ to the engine right cylinder outlet at Ⓚ.

Oil in chamber Ⓗ flows back into the inlet passage at point Ⓛ. This oil serves only to prevent unwanted low pressure areas inside the pump, and ensure smooth pump operation and oil flow.

3) Check Valves

The check valves open when oil pressure exceeds 0.3 kg/cm² (4.3 lbs/in²) in the direction of the arrow, and allow oil flow in the one direction only. When the engine is stopped – and therefore the oil pump is also stopped – the check valves stop oil flow, and any oil that has passed a check valve is prevented from returning.

Disassembly of the check valves should be avoided; if these are reassembled incorrectly, oil will not flow in the correct quantities, if at all, and the engine will be damaged.

To clean a check valve, use a squirt can filled with solvent. Never use compressed air as this will distort the valve spring and cause the valve to malfunction.