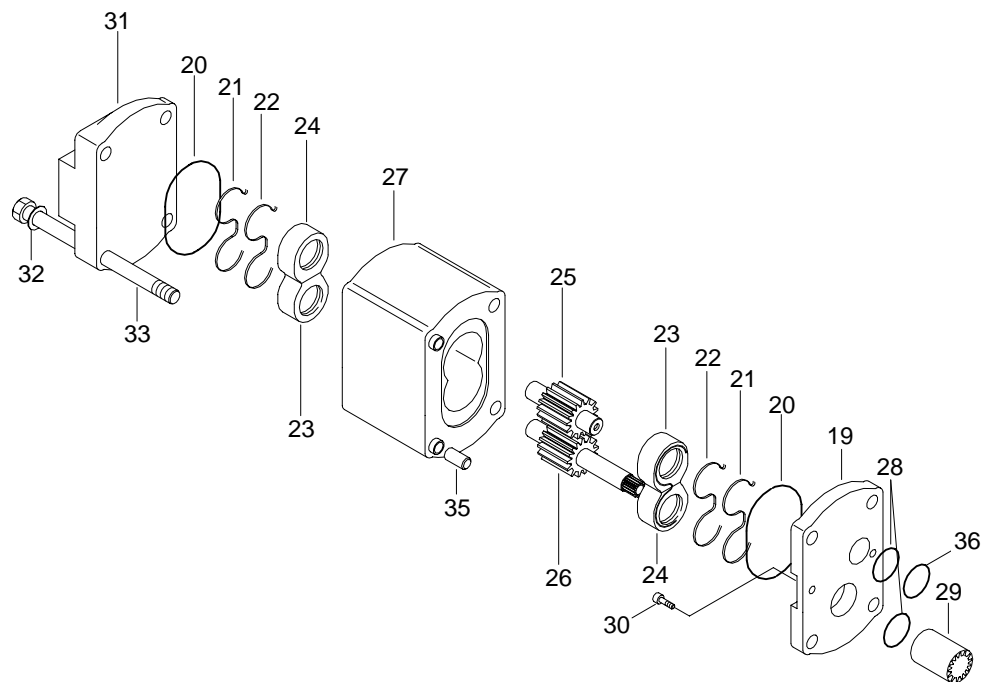


3. BRAKE PUMP

1) STRUCTURE



19	Spacer plate	25	Driven gear	31	Cover
20	O-ring	26	Drive gear	32	Washer
21	Back up seal	27	Rear body	33	Bolt
22	Seal element	28	O-ring	35	Dowel
23	Bushing	29	Coupling	36	O-ring
24	Bushing	30	Cap screw		

Brake pump used for the brake of this machine is pressure loaded type gear pump. This gear pump have a maximum delivery pressure of 150kg/cm²(2130psi).

The pressure loaded type gear pump is designed so that the clearance between the gear and the side plate can be automatically adjusted according to the delivery pressure. Therefore, the oil leakage from the side plate is less than that in the case of the fixed side plate type under a high discharge pressure. Consequently, no significant reduction of the pump delivery occurs, even when the pump is operated under pressure.

2) PRINCIPLE OF OPERATION

(1) Mechanism for delivering oil

The drawing at right shows the operational principle of an external gear pump in which two gears are rotating in mesh.

The oil entering through the suction port is trapped in the space between two gear teeth, and is delivered to the discharge port as the gear rotates.

Except for the oil at the bottom of the gear teeth, the oil trapped between the gear teeth, is prevented from returning to the suction side with the gears in mesh.

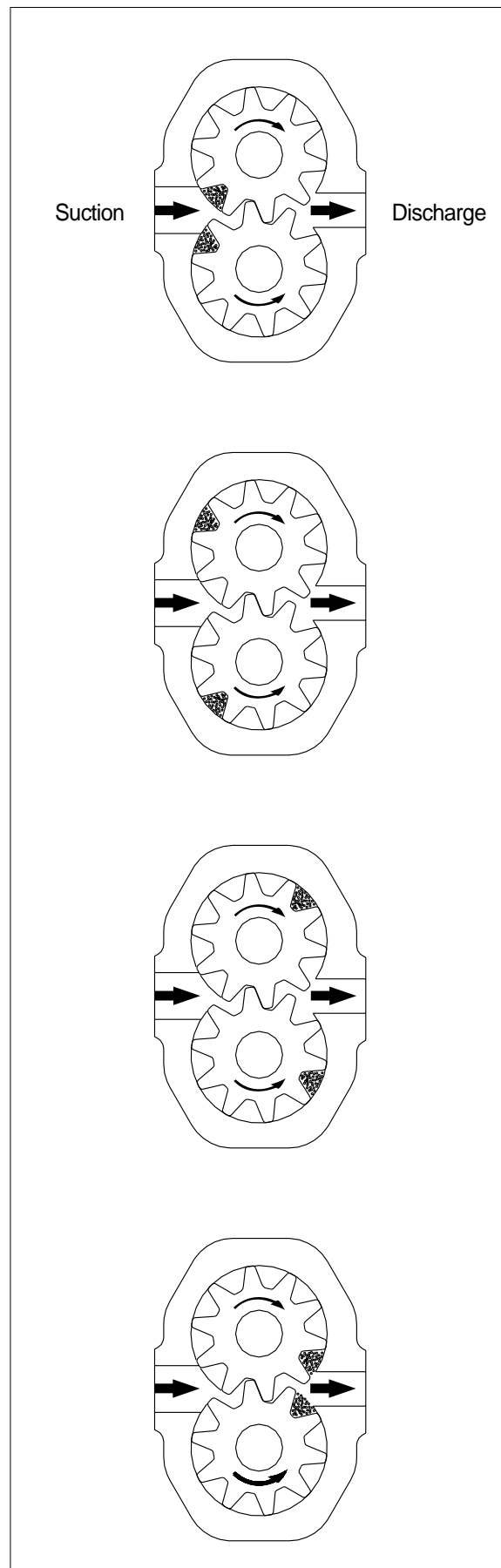
Since the gears are constantly delivering oil, the oil delivered to the discharge port is forced out of the port.

The amount of discharge increases with the speed of rotation of the gear.

If there is no resistance in the oil passage into which the discharged oil flows, the oil merely flows through the passage, producing no increase in pressure.

If however, the oil passage is blocked with something like a hydraulic cylinder, there will be no other place for the oil to flow, so the oil pressure will rise. But the pressure which rises in this way will never go higher, once the hydraulic cylinder piston starts moving because of the oil pressure. As described earlier, the pump produces the oil flow, but not the oil pressure. We can therefore conclude that pressure is a consequence of load.

In other words, the pressure depends on a counterpart.



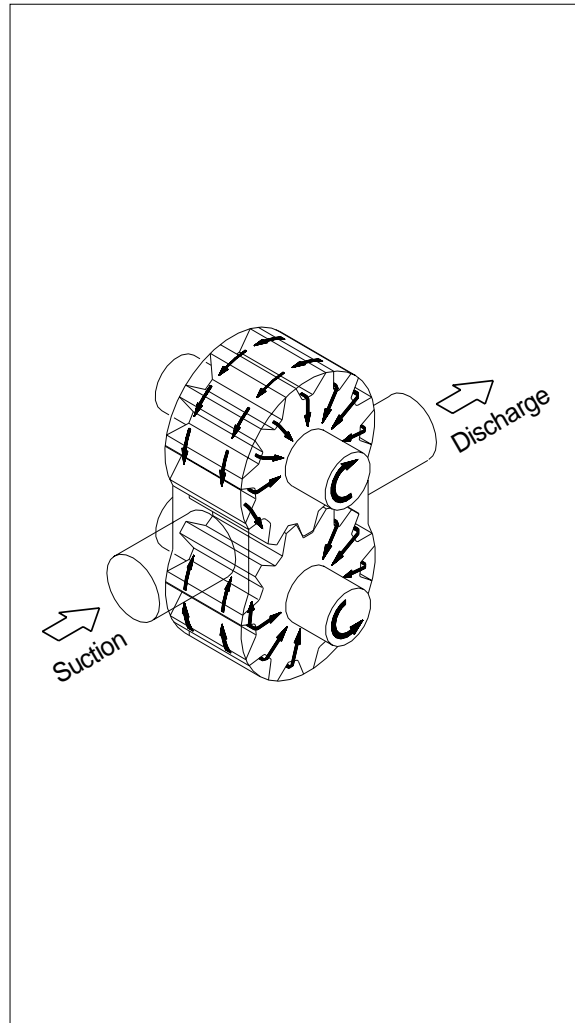
(2) Internal oil leakage

Oil leaks from a place under higher pressure to a place under lower pressure, provided that a gap or a clearance exists in between.

In the gear pump, small clearances are provided between the gear and the case and between the gear and the side plate to allow the oil to leak out and to serve as a lubricant so that the pump will be protected from seizure and binding.

The drawing at right shows how the leaked oil flows in the pump. As such, there is always oil leakage in the pump from the discharge side (Under higher pressure) to the suction side. The delivery of the pump is reduced by an amount equal to the pump discharge.

In addition, the delivery of the pump will also decrease as the amount of oil leakage increases because of expanded radial clearance resulting from the wear of pump parts, the lower oil viscosity resulting from increases in the oil temperature, and the initial use of low viscosity oil.



(3) Forces acting on the gear

The gear, whose outer surface is subjected to oil pressure, receives forces jointing towards its center.

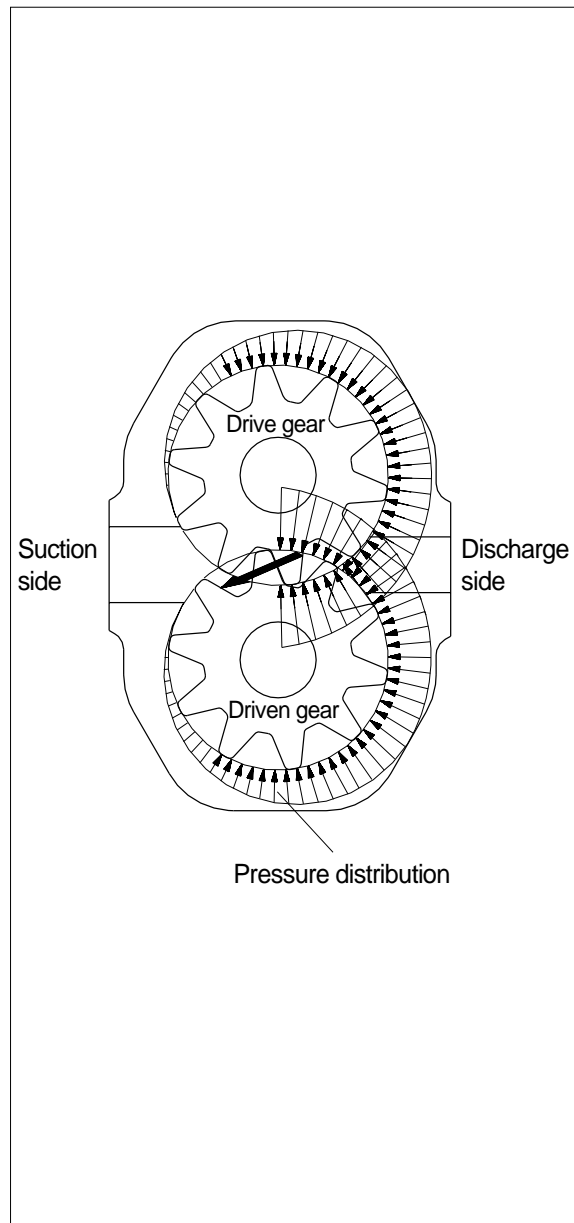
Due to the action of the delivery pressure, the oil pressure is higher on the delivery side of the pump, and due to suction pressure, is lower on the suction side. In the intermediate section, the pressure will gradually lower as the position moves from the delivery side to the suction side.

This phenomenon is shown in the drawing at right.

In addition, the gears in mesh will receive interacting forces.

These forces pushing the gears toward the suction side are received by the bearings. Since the gears are pressed toward the suction side by these forces, the radial clearance becomes smaller on the suction side in the case. In some pumps, the clearance may become zero, thus allowing the gear teeth and the case to come into light contact.

For this reason, an excessive increase in the delivery pressure must be avoided, since it will produce a large force which will act on the gears, placing an overload on the bearings, and resulting in a shortened service life of the bearing or interference of the gear with the case.



(4) "Trapping" phenomenon of the oil

When a gear pump is rotating with the gears in mesh as shown in the drawing at right, in some instances two sets of gear teeth are in mesh while in other instances only one set of the gear teeth is in mesh. When two sets of the teeth are in mesh simultaneously, the oil in the space between the meshed gear teeth will be trapped inside-the front and rear exits will be completely shut.

This is called the "trapping" phenomenon of oil.

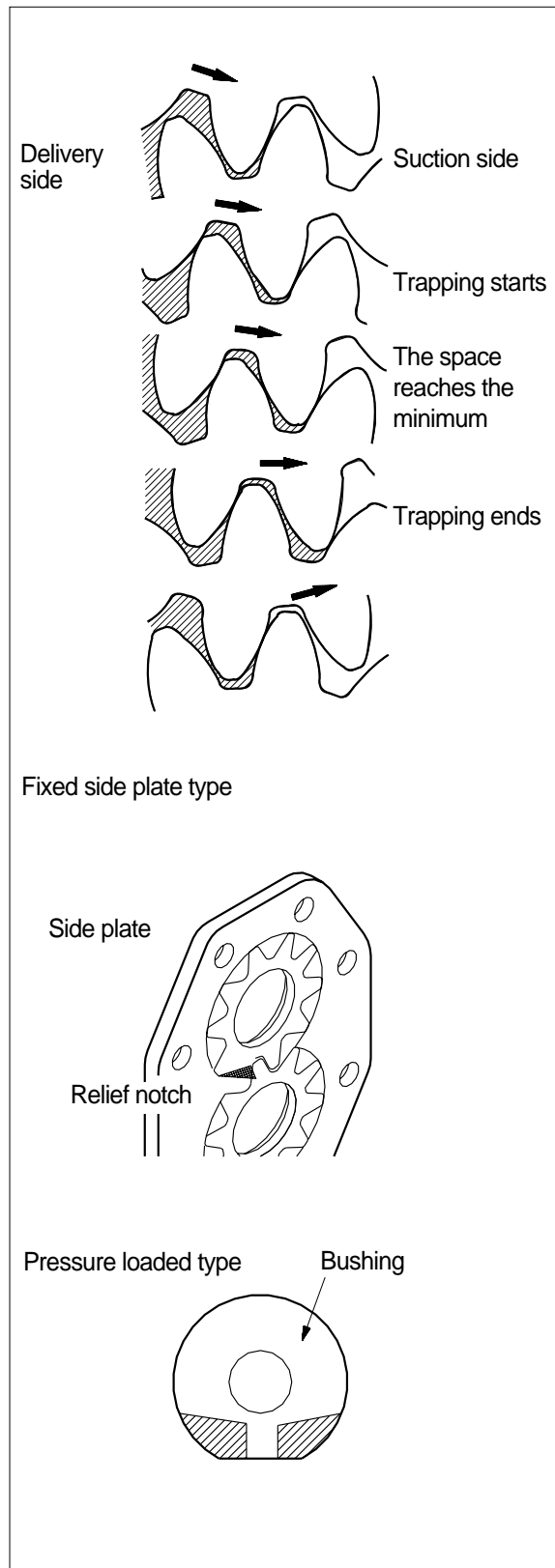
The space in which the oil is trapped moves from the suction side to the delivery side as the gears rotate. The volume of the space gradually decreases from the start of trapping until the space reaches the center section, and then gradually increases after leaving the center section until the end of trapping.

Since the oil itself is non-shrinkable, a reduction of the volume of space will greatly increase the oil pressure, unless some provision is made to relieve oil pressure. The high pressure oil will cause the pump to make noise and vibrate.

To prevent this, relief notches are provided on the side plates to release the oil to the delivery side.

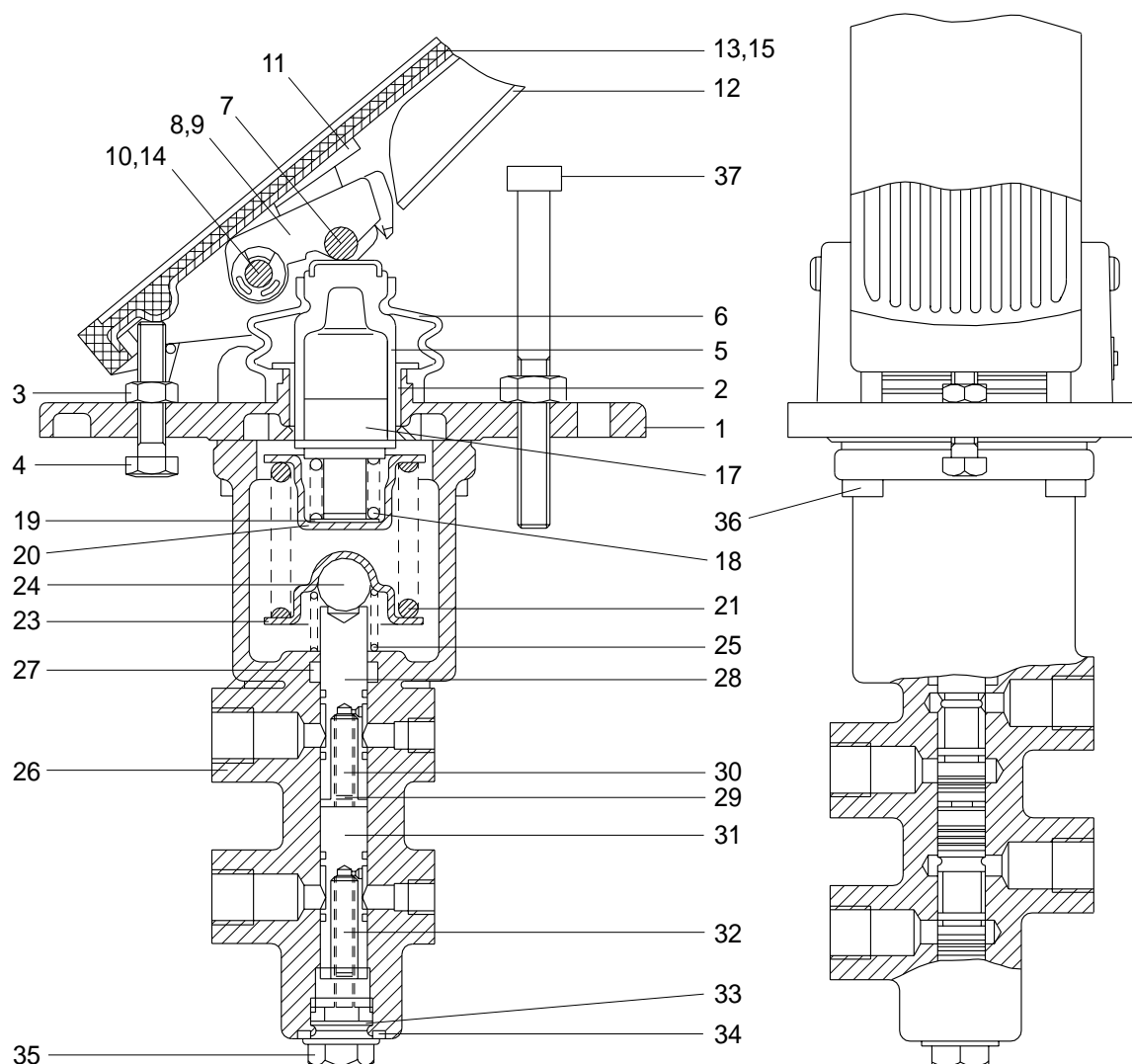
As shown in the drawing at right, the relief notches are provided in such a way that the oil can be relieved from the trapping space to the delivery side when the volume of the space is reduced.

Relief notches are also provided on the suction side to prevent the formation of a vacuum in the space by allowing the oil to enter the space from the suction side when the space is reduced.



4. BRAKE VALVE

1) STRUCTURE



1	Base plate	13	Rivet	27	Ring
2	Bushing	14	Pin	28	Spool
3	Nut	15	Pedal cover	29	Retainer
4	Screw	17	Guide pin	30	Spring
5	Piston	18	Spring	31	Spool
6	Bellows	19	Washer	32	Spring
7	Pin	20	Cap	33	Snap ring
8	Bracket	21	Spring	34	Washer
9	Bracket	23	Cap	35	Plug
10	Retaining ring	24	Ball	36	Bolt
11	Plate	25	Spring	37	Bolt
12	Pedal	26	Housing		