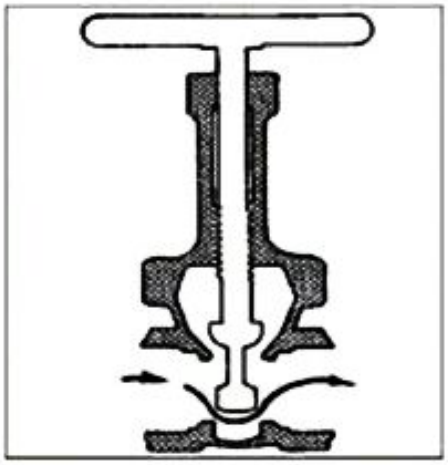
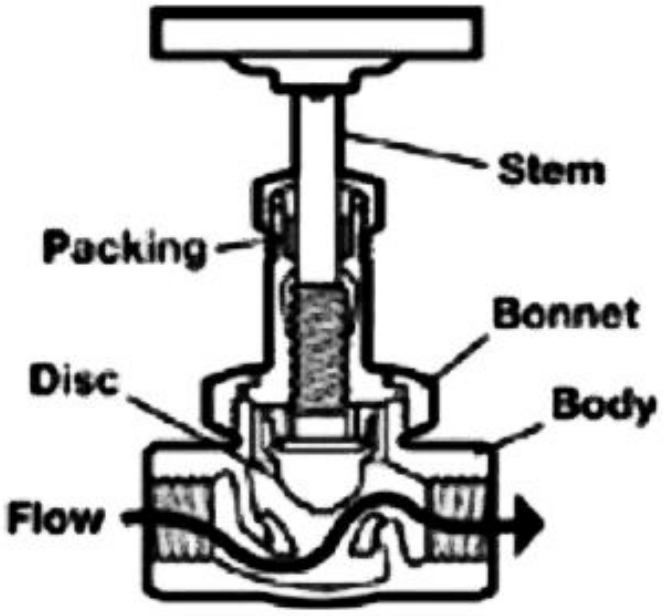


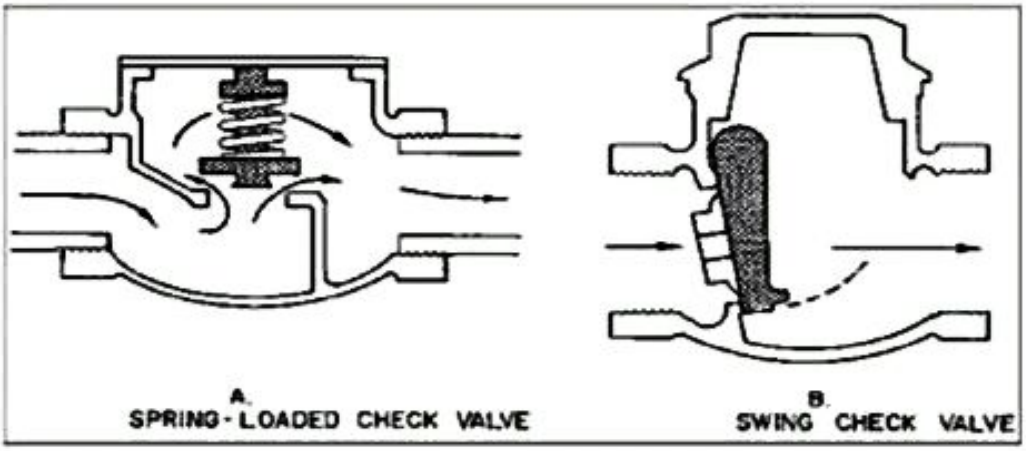
a) Washing out valve (drain valve): It is gate valve type. Used to facilitate emptying of pipeline where repair is required, or for removing stagnant or dirty water. Size between 100 – 400mm, & spaced from 2km to 5km located at lowest point of pipeline.

b) Isolating valves: They enable pipeline section to be isolated for inspection & repair.

2. **Globe and angle valve**: high heed losses used in household plumbing.



3. **Check valve:** permit water to flow in only one direction (used to prevent reversal flow when pumps are shut down).



4. **Butterfly valve:** used in low pressure application (filter in the plant), also can be used in high pressure distribution on system (minimum friction and easy in operation and low cost).

5. Air & vacuum (double) and air-relief (single) valves

6. Altitude Valves:

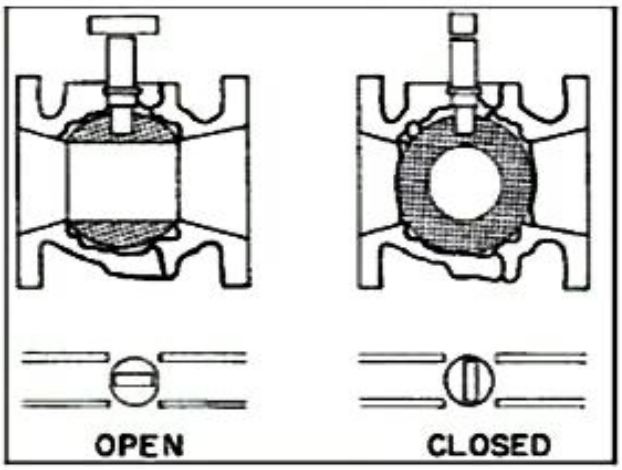
These are used to close automatically a supply line to an elevated tank where the tank is full.

7. Pressure Regulating Valves

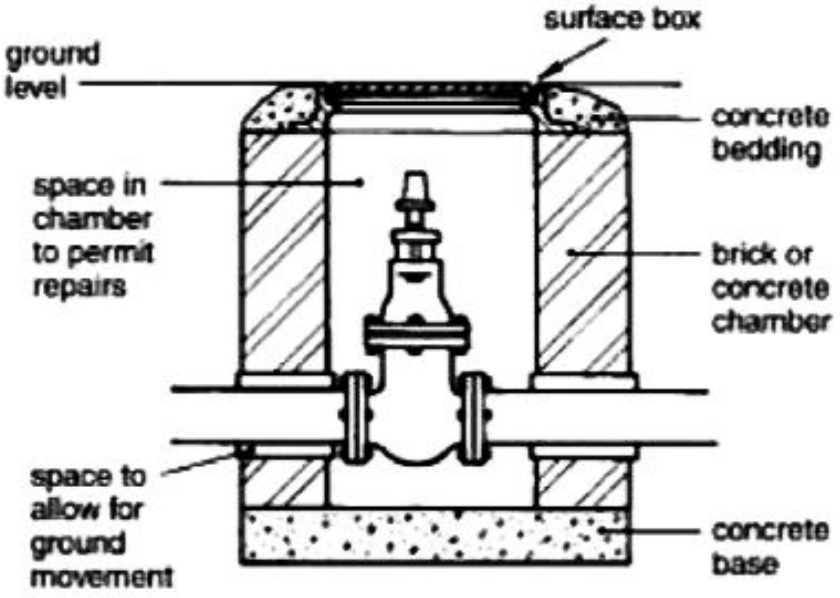
These automatically reduce pressure on the downstream side to any desired magnitude. They used on branches entering low areas of a city & tall building.

8. Ball Valve(*quarter turn valve*)

It is opens by turning a handle attached to a ball inside the valve. The ball has a hole, through the middle so that when the port is in line with both ends of the valve, flow will occur. When the valve is closed, the hole is perpendicular to the ends of the valve, and flow is blocked.



Valve Chambers: They are provided for valves. They give access for maintenance.



D. Pumps:

It is a mechanical device that will cause a fluid to flow or to be discharge at higher elevation or higher pressure.

Why need pump

1. To lift water from the lakes, reservoir, or river to the treatment plant.
2. To force water from treatment plant to the distribution system and to elevated storage tanks.
3. Booster pumps may be needed to keep the pressure at desirable levels.
4. To raise the water from wells into the collection basin.

Types of pumps

1. Reciprocating pump
2. Rotary pump
3. Centrifugal pump
4. Air lift pump

Pumps and pump station

Pump capacity: It is the volume of liquid pumped per unit of the time (L/sec, m^3/sec, gal/min,…).

Head: It is the elevation of a free surface of water above or below reference datum.

By another word it is a hydraulic energy either kinetic or potential energy equivalent to column of water (1m=9.8 kpa).

Static suction head: It is the difference elevation between the suction liquid level and centre lines of the pump (h_s).

Static discharge head: It is the difference in elevation between discharge liquid level and centreline of the pump (h_d).

Static head: It is the difference in elevation between static discharge head and static suction head ($H_{static}= h_d-h_s$)

Friction head: head of water must be supplied to overcome friction losses by flow of fluid (h_{fs})

h_{fs}: friction head loss suction

Minor head loss: head of water must be added to loss of head through fitting and valves.

$h_m = k\frac{v^2}{2g}$ where: k: head loss coefficient

Total Dynamic Head (TDH):

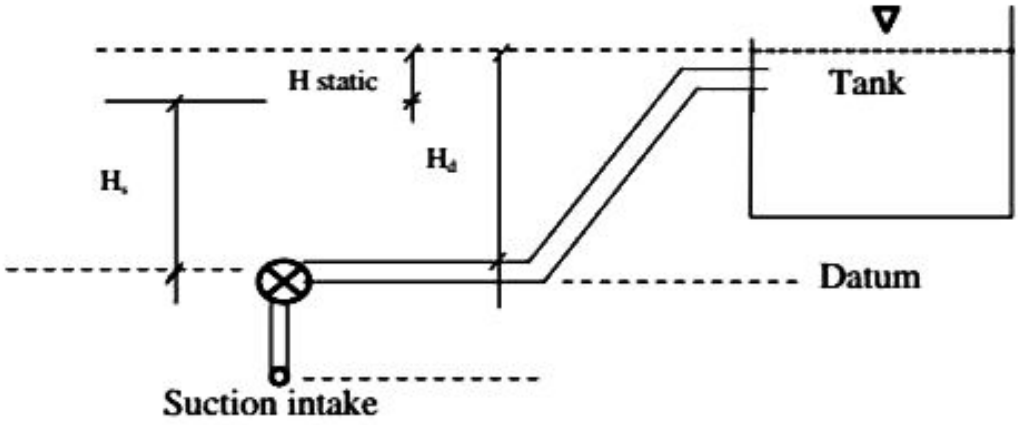
It is the head against which the pump must work when water is being pumped.

It can be determine by considering the static suction head friction head and velocity head and minor head loss.

$$TDH = H_s + H_d + H_L + \frac{v^2}{2g}$$

Where:

H_s: suction head H_d: discharge head H_L: losses head



Pump efficiency (Ep): It is the ratio of the useful output power of the pump to the input power to the pump.

$$E_p = \frac{output\ power}{input\ power} = \frac{\gamma QH}{p_i}$$

Where:

Ep: pump efficiency,
P: power input (kw, kw.m/sec)
γ: $specific\ weight\ kn/m^2$
Q: pump capacity m^3/sec