UNIT – IV

DISTRIBUTION OF WATER (TOPICS)

1. Based on topography
2. Gravity Distribution
3. Direct pumping
4. combined pumping & gravity flow
5. Service Reservoirs
6. continuous supply
7. Intermittent supply
8. Network of distribution
9. Emergency water supply as in case of fire accident..
10. valves, Hydrants, and meters.

UNIT - IV

DISTRIBUTION OF WATER

Treated water reaches the consumer through a network of pipe line. It is the costliest of the water supply project, involving pipes of different sizes, valves, hydrants and storage tanks.

Cost of the distribution system is 60-85% of the total cost of water supply project.

PROPERTIES OF IDEAL DISTRIBUTION SYSTEM :

1. Fresh treated water should reach the consumer as early as possible from treatment unit.
2. The supply should be continuous maintaining desirable pressure to reach the consumer in the first floor without any additional pumping.
3. The water should be in perfect circulation
4. The network of pipe line should be free from dead ends or of limited number of dead ends.
5. Pipe lines laid under public land should be accessible for repairs.
6. Water should reach the consumer through an alternate route in case of repairs.
7. The system should be water tight & free from leakages and wastages, and should not even thro
8. During fire accidental supply should be available from more than one pipe
9. The pipe line etc should never run under sewers nor submerged because of surface water.
10. No cross connection should exist any where.

8a)

SYSTEMS OF SUPPLY OF WATER

1) CONTINUOUS SYSTEM:

Water from the distribution reservoir reaches the consumer any time of the day.

It is an Ideal system of supply

Advantages:

1. Water is under perfect circulation. Hence consumer always gets fresh water.
2. No necessity of any storage
3. Even if leaky infiltration may not take place. Hence less chances for pollution.

Disadvantages:

1. Wastages may be more because of - leakage/ - lack of civic sense.
2. Elevated areas may not receive water as water rushes to depressions.
3. It is not suitable for undulating areas.

2) INTERMITTENT SUPPLY

It is supplying water during fixed periods of the day. It is Ideally suited for undulating country as different zones of elevation are supplied water at different times.

Advantages:

1. Wastage is minimised
2. All zones irrespective of elevations get water at one time or other

Disadvantages:

1. While exfiltration during supply hours pose no problem, infiltration through leaks take place during non supply hours causing pollution.
2. Water is to be stored and hence requires tanks.
3. Taps kept open during non-supply hours may rundown causing wastage of water when supply is resumed.
4. Water left unutilised at the end of the day may be thrown out as waste when supply is resumed.
5. At summits suction may be developed causing flattening of pipes
6. If fire accident occurs during non supply hours water may not be available to fight it.

DISTRIBUTION SYSTEMS FOR WATER SUPPLY

For efficient distribution it is required that water should reach to every consumer with required rate of flow. There some pressure in pipe line is necessary, which should force th water to reach at every place Depending upon the method of distribution, the distribution system is classified as follow

i. Gravity system
ii. Pumping system
iii. Dual system (or) combined gravity and pumping system

i. Gravity system:

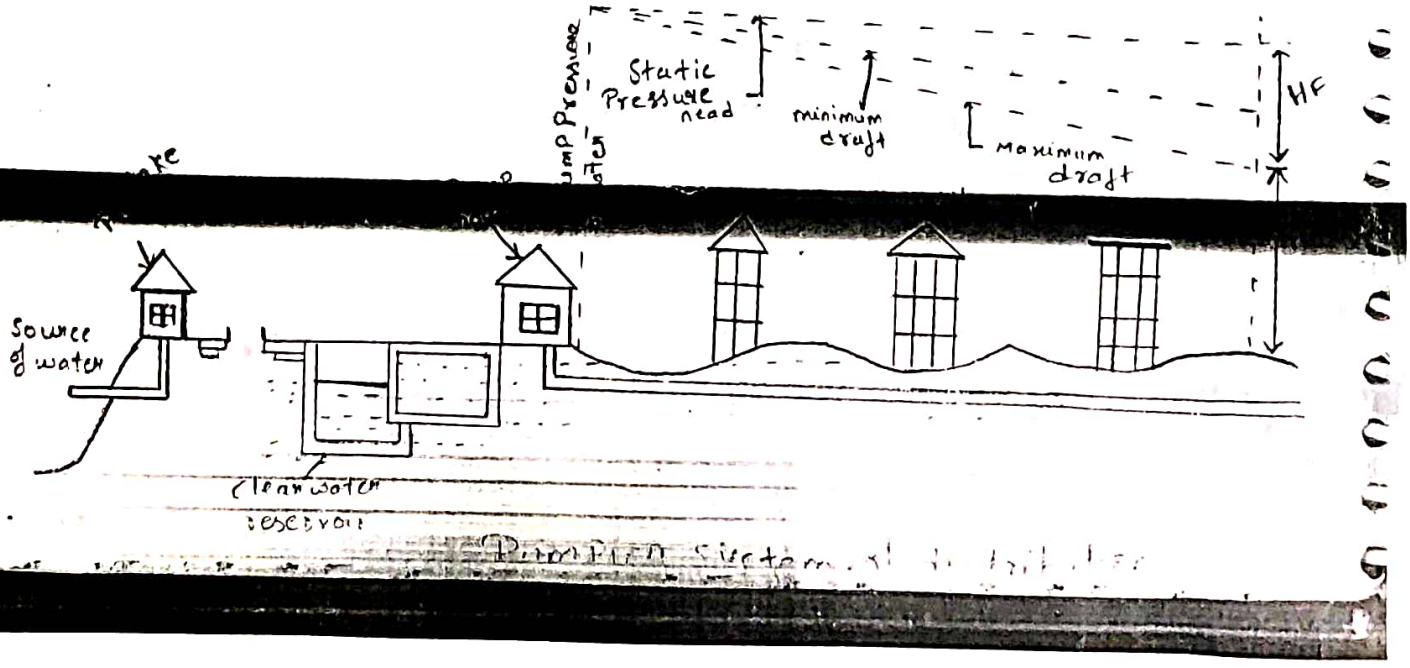
* When some ground, sufficiently high above the city, this c be best utilized for the distribution - system in maintainin pressure in water pipes.
* This method is also suitable when source of supply Su as lake, river or impounding reservoir is at sufficient heigh than city. The water flows in this mains due to gravitational-h
* No pumping is required, therefore it is most reliable.
* If the source of water supply is lake situated at hill, low lift pumping may be required to lift the water upto the water treatment units.
* The water will flow under gravitational force in the treatment units, and will be finally collected to the town again under gravitational force.
* In this system pipes are done in such a way that water head available at consumer's min required, and remain head is fully consumed in frictional and other losses

main

Gravity system of distribution

ii) pumping system:

* In this water is directly pumped in the mains.
* It is preferred to have number of pumps and only th required number may work at various times to meet the varying demand, in place of providing pump of variable spee
* High lift pumps are required and their operations are continuously watched. If power fails, the whole supply the town will be stopped.
* Therefore, it is better to have diesel pumps also in addi to the electric pumps as stand by.
* During fires, the water can be pumped in the required quantity by the stand-by units also.
* But this system is not preferred than other systems



Pumping system of water supply

iii) DUAL SYSTEM:

* This is also known as combined gravity and pumping system
* The pump is connected to the mains as well as to the elevated reservoir

when demand is small the water is [redacted] when demand is small the water is stored in the elevated reservoir but when demand is from elevated reservoir but when the demand increases the rate of pumping. the flow in the distribution system come from both pumping station as well as elevated reservoir

* In this system water comes from two sources and from reservoir (1) and second from pumping station (2) it is called dual system

* This system is most reliable and economical because requires uniform rate of pumping but meets low as well as max demand.

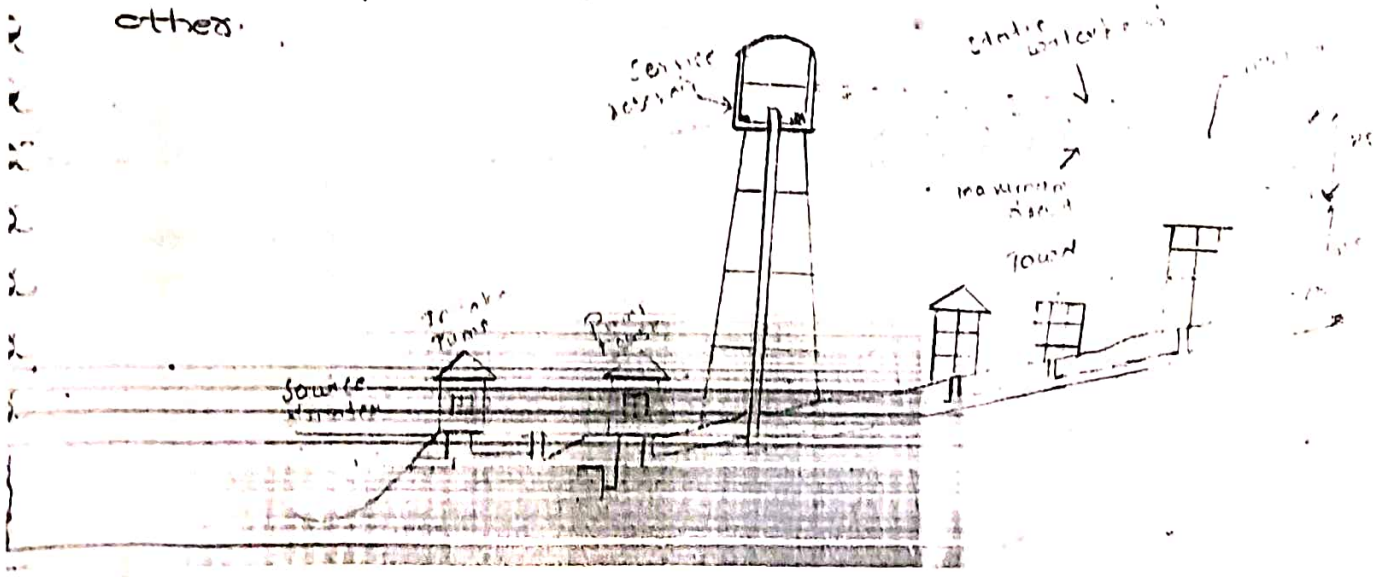
Main advantages of this system:

a) The balance reserves in the storage reservoir will be utilized during fire.

b) During power failure, the balance water stored in the water will be supplied to town.

c) The pumps have to work at constant speed, without variation in their speed.

d) The supervision, operation & maintenance much less compare to other.



NETWORKS OF DISTRIBUTION (OR) LAY OUTS OF DISTRIBUTION:

The layout of water distribution system tells us the network of pipes provided in the area and helps to determine the repair locations if any damages occurs. Here we will discuss about the different layout methods used in distribution system.

The distribution of water means delivering treated water to the user from the source. The distribution should take place in such a way that the users or consumers should meet their demand of water with sufficient quantity and quality.

Methods of Setting Water Distribution System Layouts

Different methods of laying out distribution system are as follows:

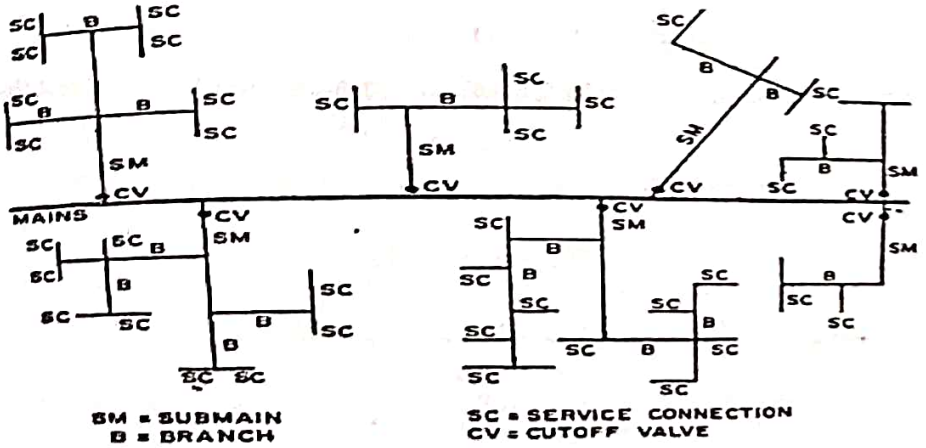
- Dead end system
- Grid iron system
- Ring system
- Radial system

Dead End Water Distribution System

Dead end system, the name itself defining that it contains dead ends in the pipe system. So, the water does not flow continuously in the dead end system. In this system the whole pipe network is divided into several sub networks. Those are namely main line, sub mains, branch lines and service connections.

Firstly, one main line is laid through the center of the city or area. Sub mains are laid on both sides of the main line and then sub mains divided into branch lines from which service connections are given. At every starting point of sub main line, a cut off valve is provided to regulate the flow during repair works etc.

On the whole, this network diagram will look like a tree shape, so it is also called as tree system. This type of system is used mostly for the olden cities which are built in irregular manner without any planning. Now a days, this system is not preferable..



Advantages of Dead End System

- Pipes in this network can be laid easily.
- The pressure and discharge in each pipe can be determined very easily and accurately which makes design calculations very simple.
- The diameters of pipes of main, sub mains and branches can be designed based on the required demand of population. So, cost of the project can be reduced.

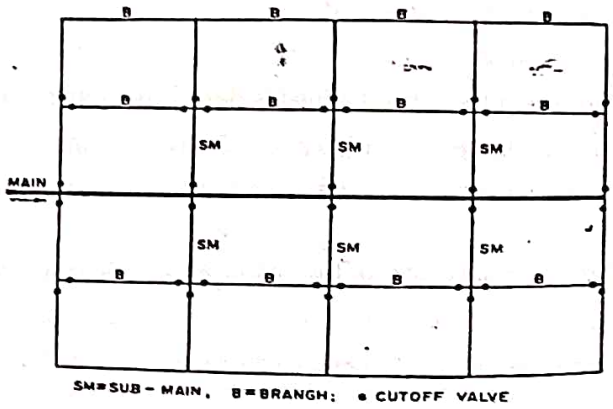
- Dead end system requires less number of cutoff valves.

Disadvantages

- The pressure is not constant and is very less at remote parts.
- Because of dead ends water stagnation takes place which results in deposition of sediment. To remove this sediments, more number of scour valves are to be provided at the dead ends which increase economy.
- If there is any damage occurs in the branch line, the whole portion should be stopped to repair that which creates discomfort to the other users in that sub main line.
- In this system, Limited discharge is available for firefighting.

Grid Iron Water Distribution System

Grid iron system also contains main lines, sub mains and branch lines. But in this system dead ends are eliminated by interconnecting all the lines. Hence, the water flow continuously in this system without stagnating. So, this system is also called as interlaced system or reticulation system. It is more suitable for well-planned cities.



Advantages of Grid Iron System

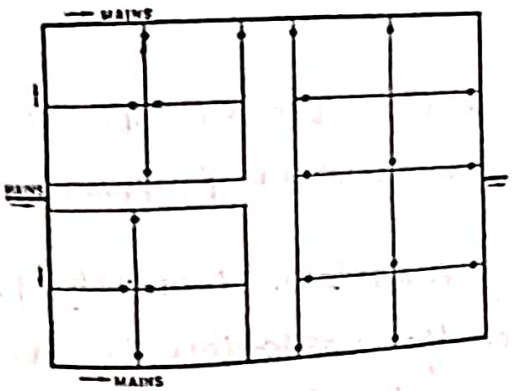
- Water will flow continuously without any dead ends or sediment deposits.
- Head loss is minimum in this case because of interconnection of pipes.
- The discharge will meet the required discharge for firefighting.
- Repair works can be easily done just by closing cutoff valve in that line which do not affect the other users.

Disadvantages

- Because of circulating flow from all directions, the pipes used in this system should be of large diameters and longer lengths.
- We cannot determine the accurate discharge, velocity or pressure in a particular pipe. So, design is difficult.
- Laying of pipes will be done by skilled workers which consume more cost.
- Cutoff valves required should be more in this system.

Ring Water Distribution System

Ring system, can also be called as circular system in which the main pipe line is provided around the city or area i.e., peripherally. From this main line, the branch lines are projected perpendicularly and they are also connected with each other. So, every street of the distributed area will get sufficient quantity of water. For a town with well-planned streets and roads, Circular system is more suitable.



Advantages of Ring System

- No stagnation of water
- Repair works can be done without affecting larger network.
- Large quantity of water is available for firefighting.

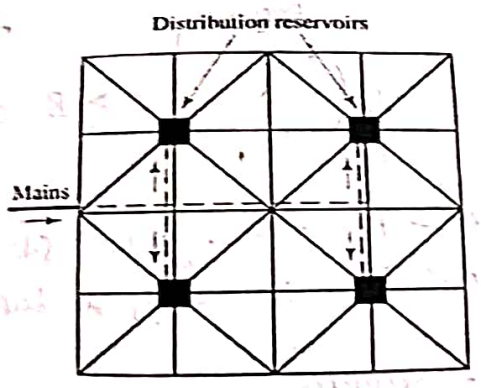
Disadvantages

- Longer length and large diameter pipes are required.
- More number of cutoff valves are necessary.
- Skilled workers are necessary while laying pipes.

Radial Water Distribution System

Radial system is quite opposite to the ring system. In this system, whole area is divided into small distribution districts or zones and an individual distribution reservoir is provided for each distribution zone. The reservoir provided is generally of elevated type. From this reservoir the pipe lines are laid radially to the surrounded streets.

All distribution reservoirs are connected with main line which is passing through center of the city. This type of system is suitable for areas with radially designed roads.



Advantages of Radial System

- The water distributed with high velocity and high pressure.
- Head loss is very small because of quick discharge.

Disadvantages

Cost of the project is more because of number of individual distribution reservoirs.

5) SERVICE RESERVOIR :

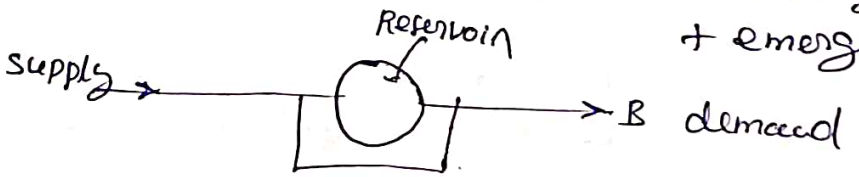
Definition : which stores treated water for supplying water during emergencies (fires & repairs)

Functions
1. To maintain constant pressure
2. To absorb hourly variation in demand
3. water stored can be supplied during emergencies

Location & height of reservoir :
1. Should be located as close as possible to centre of demand.
2. The water level in the reservoirs must be at a sufficient elevation.

Types
1. Underground Reservoirs
2. Small ground Reservoirs
3. Large ground Reservoir
4. Over head Reservoirs

Reservoir capacity Total storage = Dead storage + Live storage + emergencies



when $A > B$ water gets stored (surplus)
when $A < B$ – not only A but (B-A) is withdrawn (Deficit)

where
A – supply
B – Demand
S – surplus
D – Deficit

∴ Minimum storage of capacity of service Reservoir

$$= \Sigma S + \Sigma D$$

EMERGENCY WATER STORAGE

It is the water supply at in case of fire accidents.

Any water storage tank should maintain

1. Dead storage : to be always maintained and only to be utilised during emergencies at in case of fire accidents and electric power supply
2. Live storage : is the amount of water to balance the demand any day independently i.e not involving Dead storage or any other storage.
3. Emergency storage : It is the additional storage provided in certain cases.

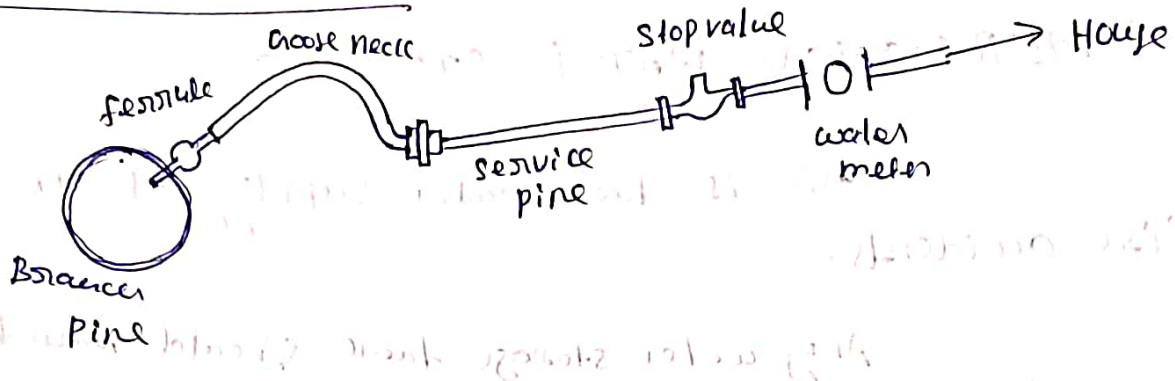
To fight fire additional storage may be provided by using water bodies at lakes, tanks and reservoirs. The water need not be very pure. It shall be adequate if they don't breed mosquitoes and similar insects.

These water bodies improve the ground water table in the adjacent localities so that wells provide more water in any season.

It is the quantity of water required for fire-fighting purposes. Fire may be taken place due to faulty electric wires by short circuiting, fire catching materials, explosion etc. If fires are not properly controlled in minimum possible time they lead to serious damage, and may burn cities.

All the big cities have full-fighting squads having emergency storages at during the fire breakdown large quantity of water is required for throwing it over the fire to extinguish it. Therefore provision is made in water works to supply sufficient quantity of water.

SERVICE CONNECTION



Service connection is to be given from branch. Never from main.

Brass (or) Bronze ferrule is inserted to draw supply.

Goose neck is a flexible metallic elastic pipe provided to take care of vibrations during flow and settlements of sub soil as not to disrupt the water supply.

The bend pipe takes care of extra length to accommodate contraction.

Service pipe is a straight water supply pipe connecting the house.

Distribution system i.e service connections it self have other appurtenances to various purposes i.e for controlling of flow, measuring of flow, fire fightings and air control along the system. That are

1. Values
2. water meter and
3. Fire hydrants.

VALVES, WATERMETER and FIRE HYDRANTS

UNIT 7

Appurtenance in the Distribution System

Learning Objectives

After studying this chapter, students will be able to

- Understand the different valves used in distribution system
- Understand the valves locations and their functions

Introduction

The various devices fixed long the water distribution system are known as appurtenances.

The necessity of the various appurtenances in distribution system are as follows :

1. To control the rate of flow of water
2. To release or admit air into pipeline according to the situation.
3. To prevent or detect leakages
4. To meet the demand during emergency and
5. Ultimately to improve the efficiency of the distribution .

The following are some of the fixtures used in the distribution system.

(i) Valves

(ii) Fire hydrants and

(iii) Water meter.

7.1 Types of Valves

In water works practice, to control the flow of water , to regulate pressure, to release or admit air, prevent flow of water in opposite direction valves are required.

The following are the various types of valves named to suit their function

1. Sluice valves
2. Check valves or reflex valves
3. Air valves
4. Drain valves or Blow off valves.
5. Scour valve.

7.2.1 Sluice Valves

These are known as gate-valves or stop valves. These valve control the flow of water through pipes. These valves are cheaper , offer less resistance to the flow of water than other valves. The entire distribution system is divided into blocks by providing these valves at appropriate places. They are provided in straight pipeline at 150 – 200mm intervals. When two pipelines intersect , valves are fixed in both sides of intersection. When sluice valve is closed, it shuts off water in a pipeline to enable to undertake repairs in that particular block. The flow of water can be controlled by raising or lowering the handle or wheel.

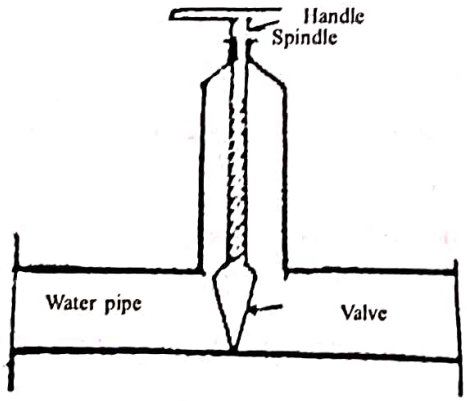


Fig. 7.1 Sluice Valve

7.2.2 Check Valve or Reflux Valve

These valves are also known as non return valves. A reflux valve is an automatic device which allows practice.

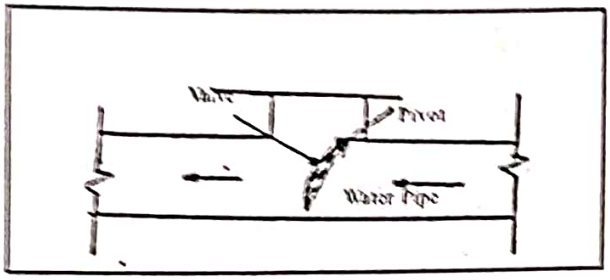


Fig. 7.2 Check Valve

When the water moves in the direction of arrow, the valve swings or rotates around around the pivot and is kept in open position due to the pressure of water. When the flow of water in this direction ceases, the water tries to flow in a backward direction. But this valve prevents passage of water in the reverse direction.

Reflux valve is invariably placed in water pipe, which obtains water directly from pump. When pump ails or stops , the water will not run back to the pump and thus pumping equipment's will be saved from damage.

7.2.3 Air Valves

These are automatic valves and are of two types namely

1. Air Inlet valves
2. Air relief valves.

1. Air Inlet Valves

These valves open automatically and allow air to enter into the pipeline so that the development of negative pressure can be avoided in the pipelines. The vacuum pressure created in the downstream in pipelines due to sudden closure of sluice valves. This situation can be avoided by using the air inlet valves.

2. Air Relief Valves

Sometimes air is accumulated at the summit of pipelines and blocks the flow of water due to air lock. In such cases the accumulated air has to be

removed from the pipelines. This is done automatically by means of air relief valves.

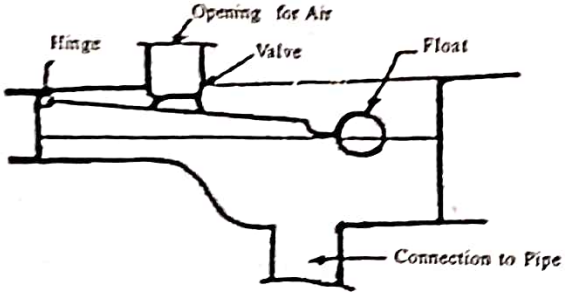


Fig. 7.3 Air Valve

This valve consists of a chamber in which one or two floats are placed and is connected to the pipeline. When there is flow under pressure in the pipeline water occupies the float chamber and makes the float to close the outlet. But where there is accumulation of air in the pipes , air enters the chamber, makes the float to come down, thus opening the outlet. The accumulated air is driven out through the outlet.

7.2.4 Drain Rain Valve or Blow off Valves

These are also called wash out valves they are provided at all dead ends and depression of pipelines to drain out the waste water. These are ordinary valves operated by hand.

7.2.5 Scour Valves

These are similar to blow off valves. They are ordinary valves operated by hand. They are located at the depressions and dead ends to remove the accumulated silt and sand. After the complete removal of slit ; the valve is to be closed.

7.2.6 Water Meter

These are the devices which are installed on the pipes to measure the quantity of water flowing at a particular point along the pipe. The readings obtained from the meters help in working out the quantity of water supplied and thus the consumers can be charged accordingly. The water meters are usually installed to supply water to industries , hotels , big institutions etc, metering prevents the wastage of purified water.

7.2.7 Fire Hydrants

A hydrant is an outlet provided in water pipe for tapping water mainly in case of fire. They are located at 100 to 150m a part along the roads and also a junction roads. They are of two types namely :

1. Flush hydrants 2. Post hydrants.

1. Flush Hydrants

The flush hydrants is kept in under ground chamber flush with footpath covered by C.I. cover carrying a sign board "F –H".

2. Post Hydrants

The post hydrant remain projected 60 to 90cm above ground level a shown in fig 7.4 they have long stem with screw and nut to regulate the flow. In case of fire accident , the fire fighting squad connect their hose to the hydrant an draw the water and spray it on fire.

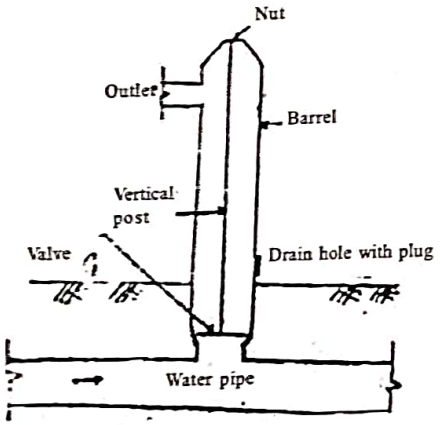


Fig. 7.4 Post fire Hydrant

A good fire hydrant

1. Should be cheap
2. Easy to connect with hose.
3. Easily detachable and reliable.
4. Should draw large quantity of water.