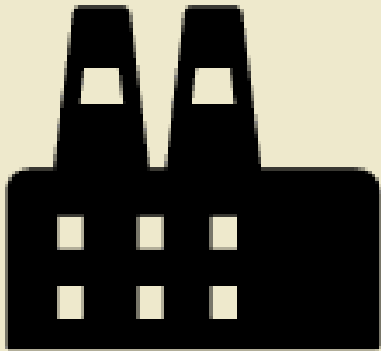
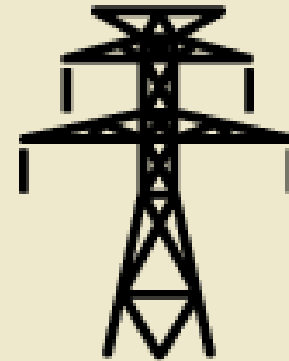


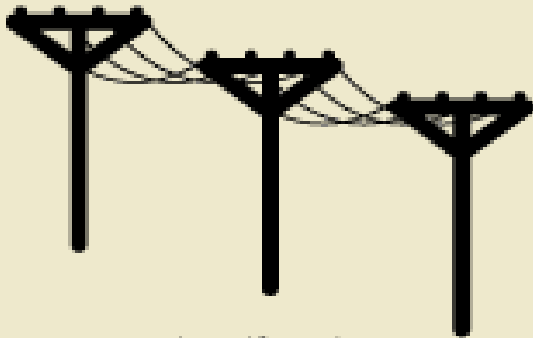
# BUILDING SERVICES II



Generation of Electricity

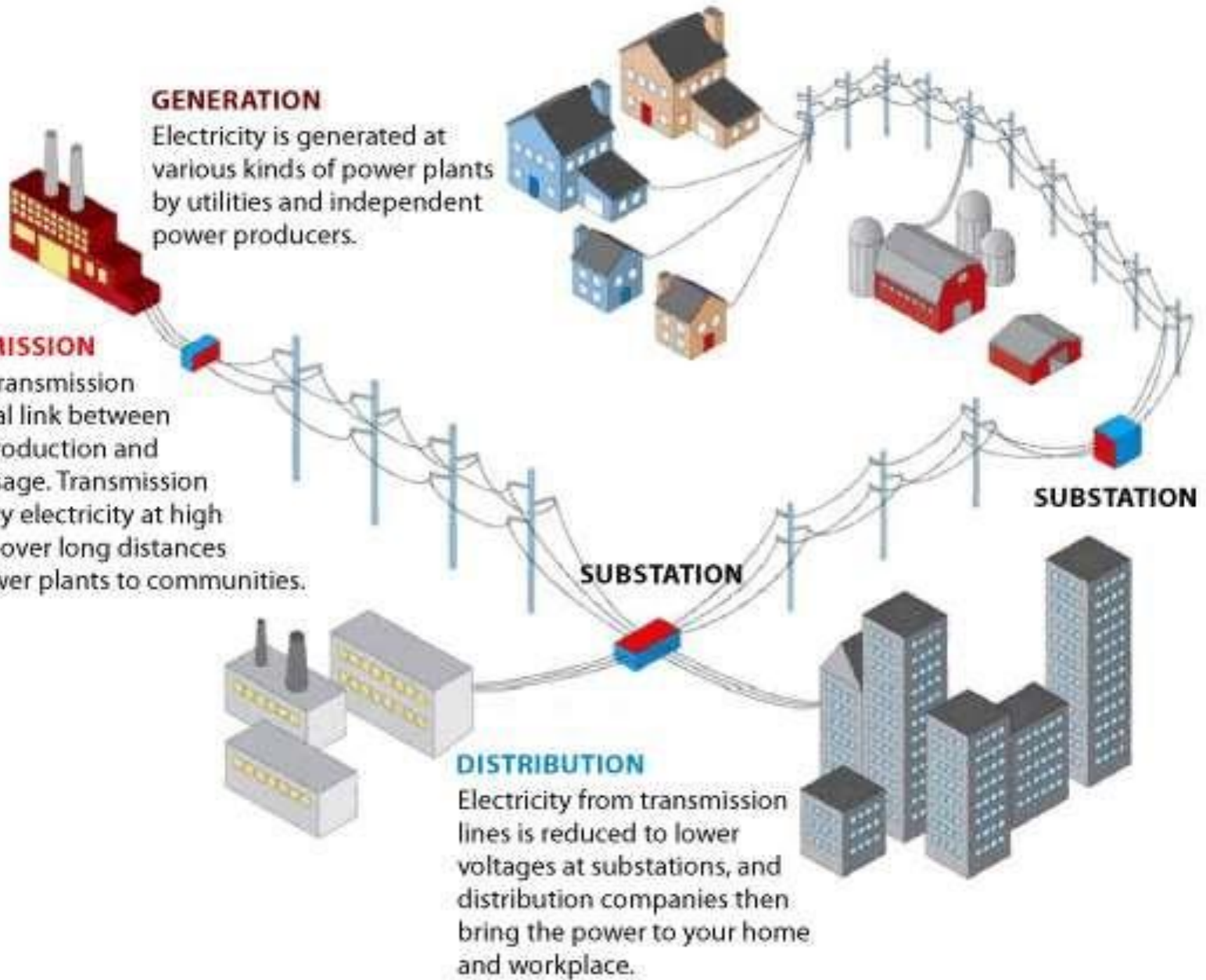


Transmission

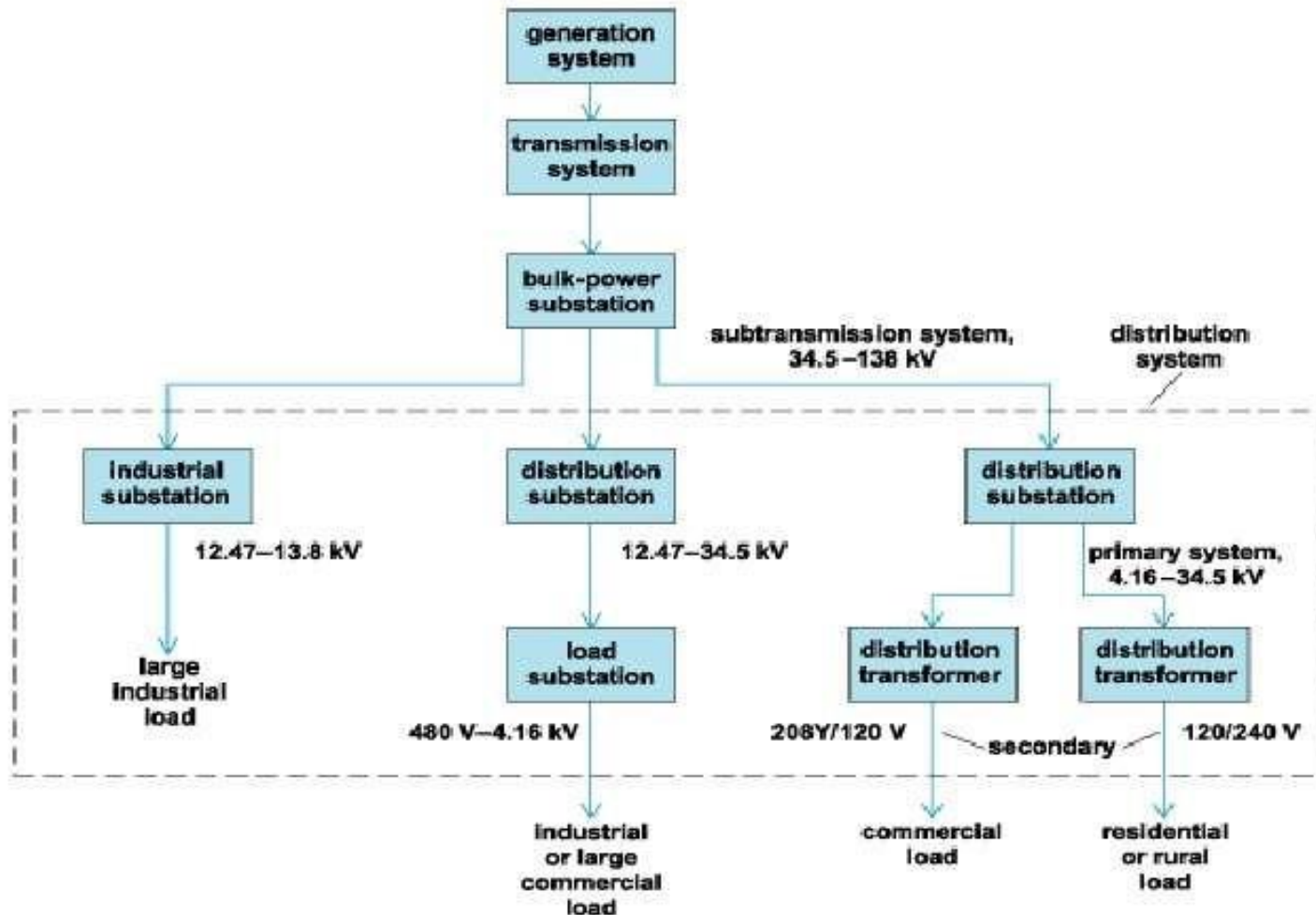


Distribution

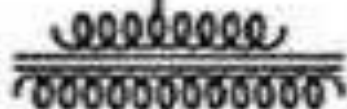




# Distribution system layout



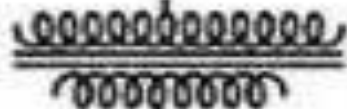
Generating station 11kV



Step up transformer  
11 kV / 220 kV

Primary transmission  
(High voltage)

Receiving station



Step down transformer  
220 kV / 33 kV

Secondary transmission

Feeder

Substation



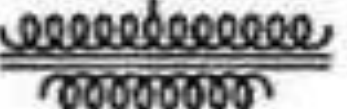
Step down transformer  
33 kV / 6.6 kV

Primary distribution

Feeder

To large bulk loads like  
factories, industries

Distribution  
substation



Distribution transformer  
6.6 kV / 400 V or 230 V

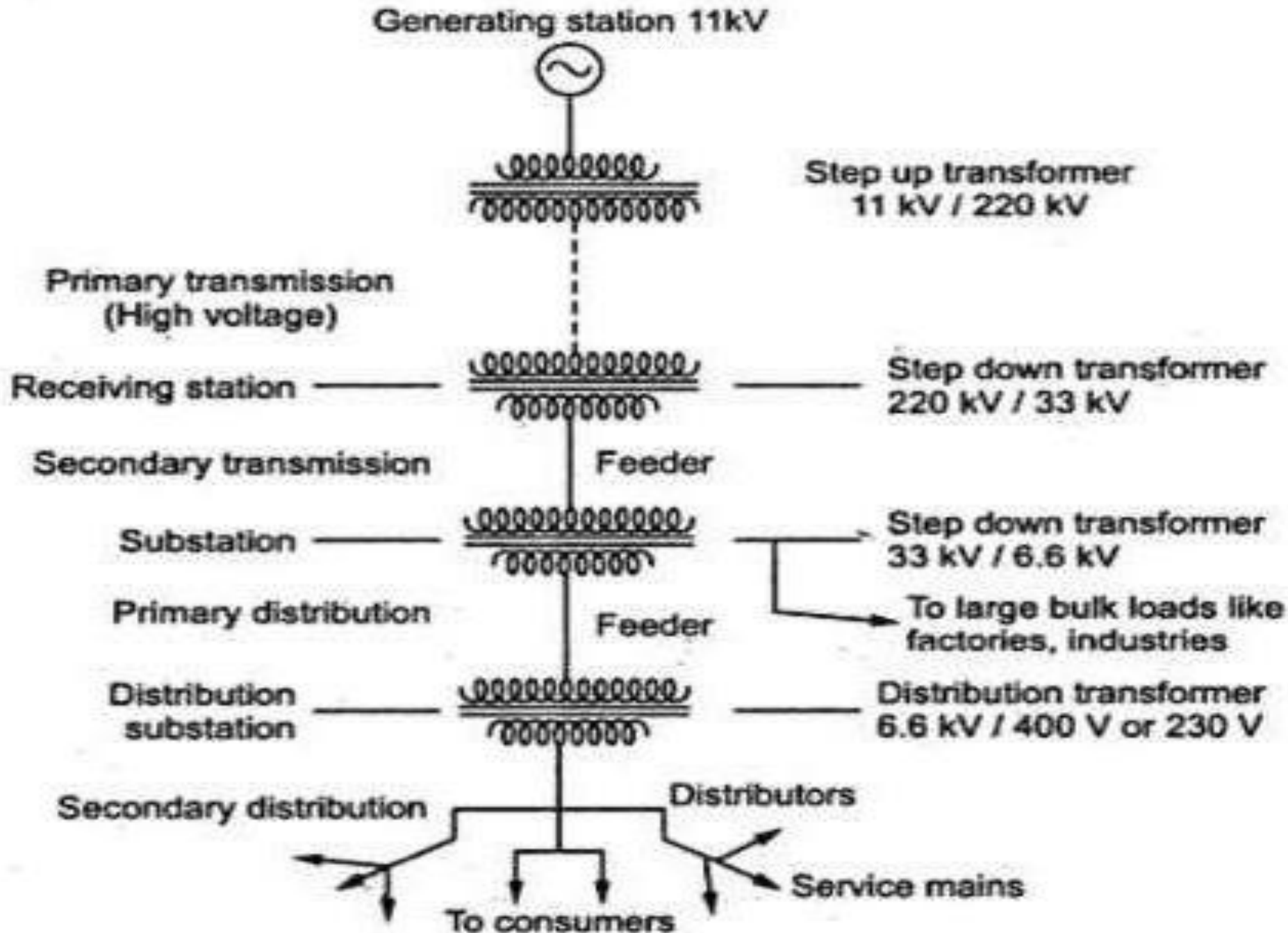
Secondary distribution

Distributors



To consumers

Service mains

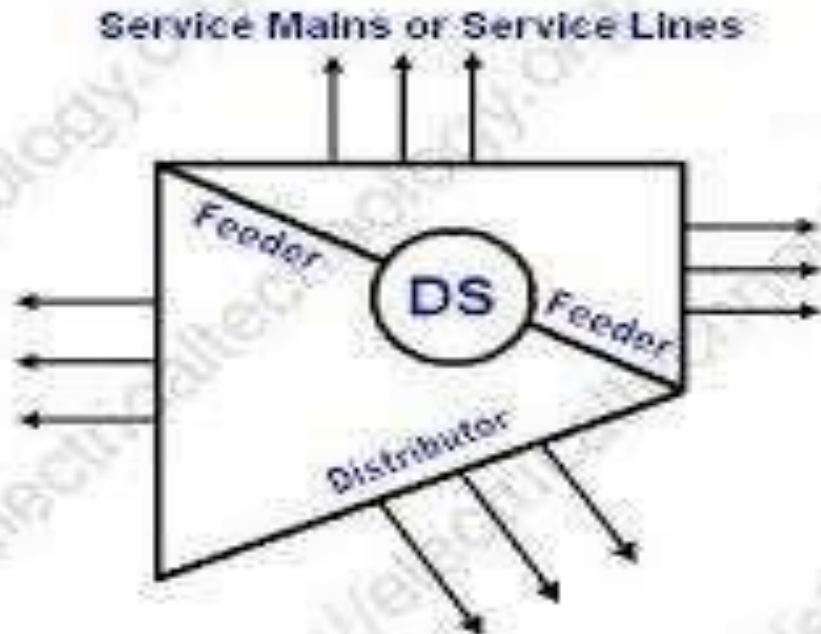
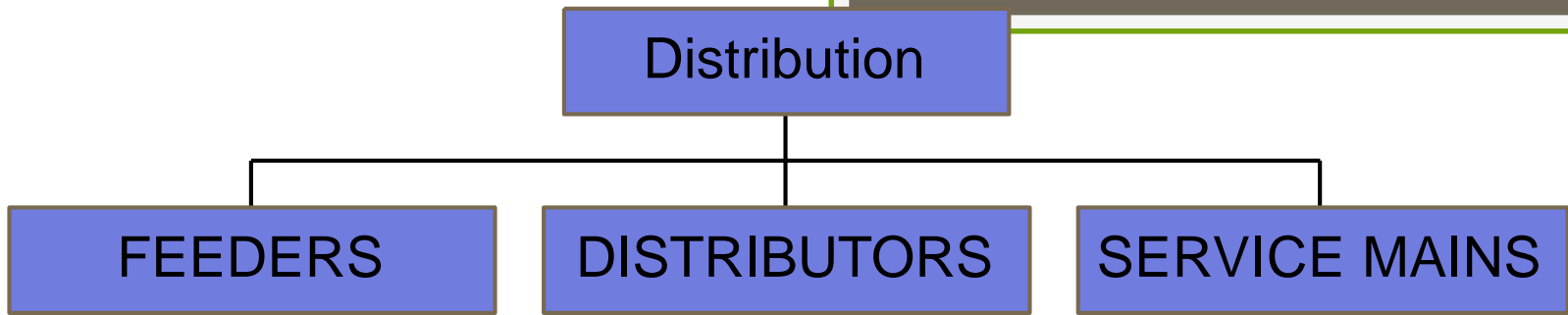


# Contents To Be Covered:

- Definition
- Classification Of Distribution System
- Distribution System Losses

# Distribution System

- “The part of power system which distributes electrical power for local use is known as **DISTRIBUTION SYSTEM.**”
- This system is the electrical system between the substation fed by the transmission system and consumer meter.
- Distribution line generally consist of
  - Feeders
  - Distributers
  - Service mains



**Elements of a Distribution System**

# Feeder

- A Feeder is conductor which connects the substation to the area where power is to be distributed .
- Feeder are used to feed the electrical power from the generating station to the substation
- No tapings are taken from the feeder
- So the current in it remains the same throughout
- Main consideration in the design of feeder is the Current carrying capacity.

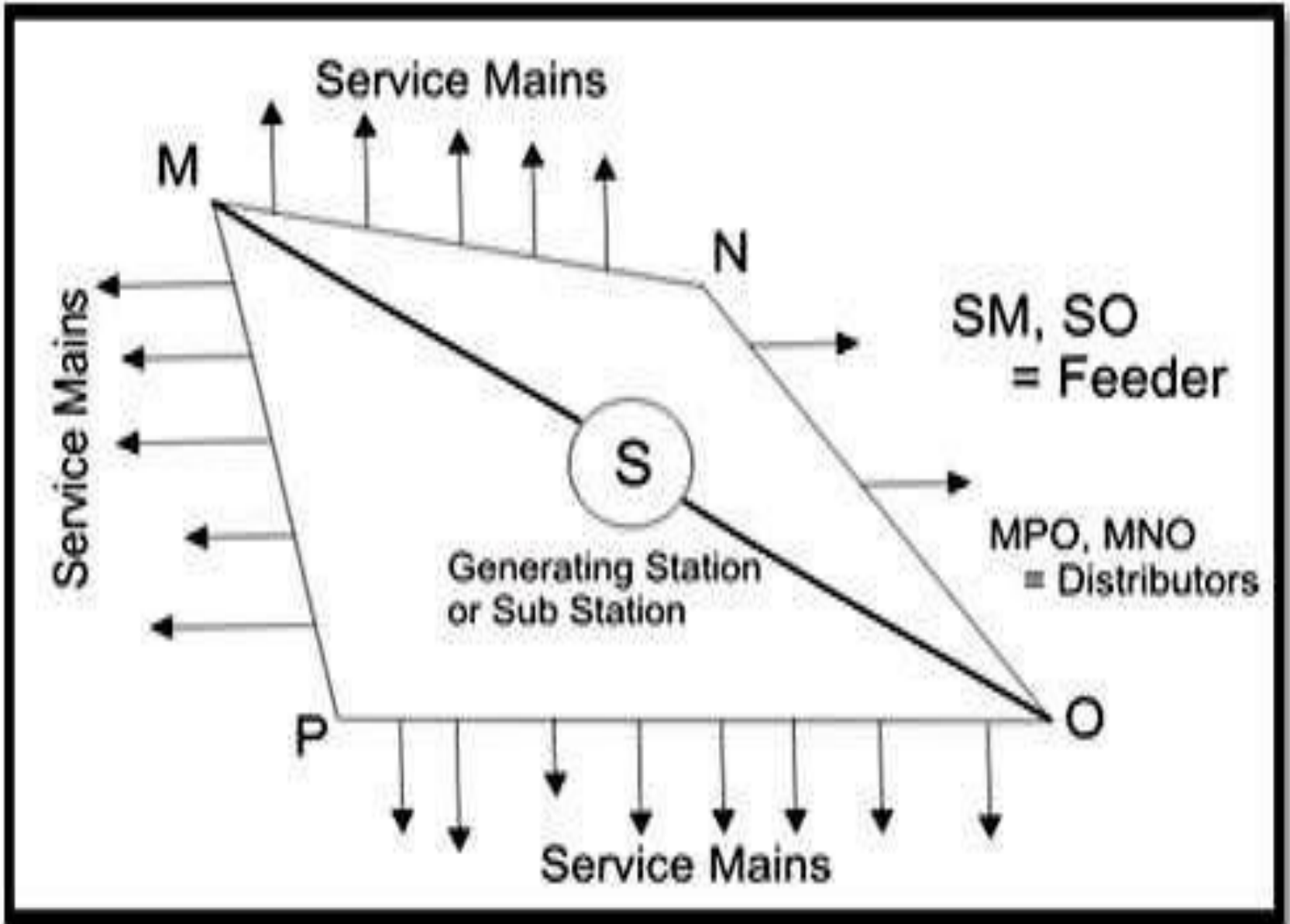


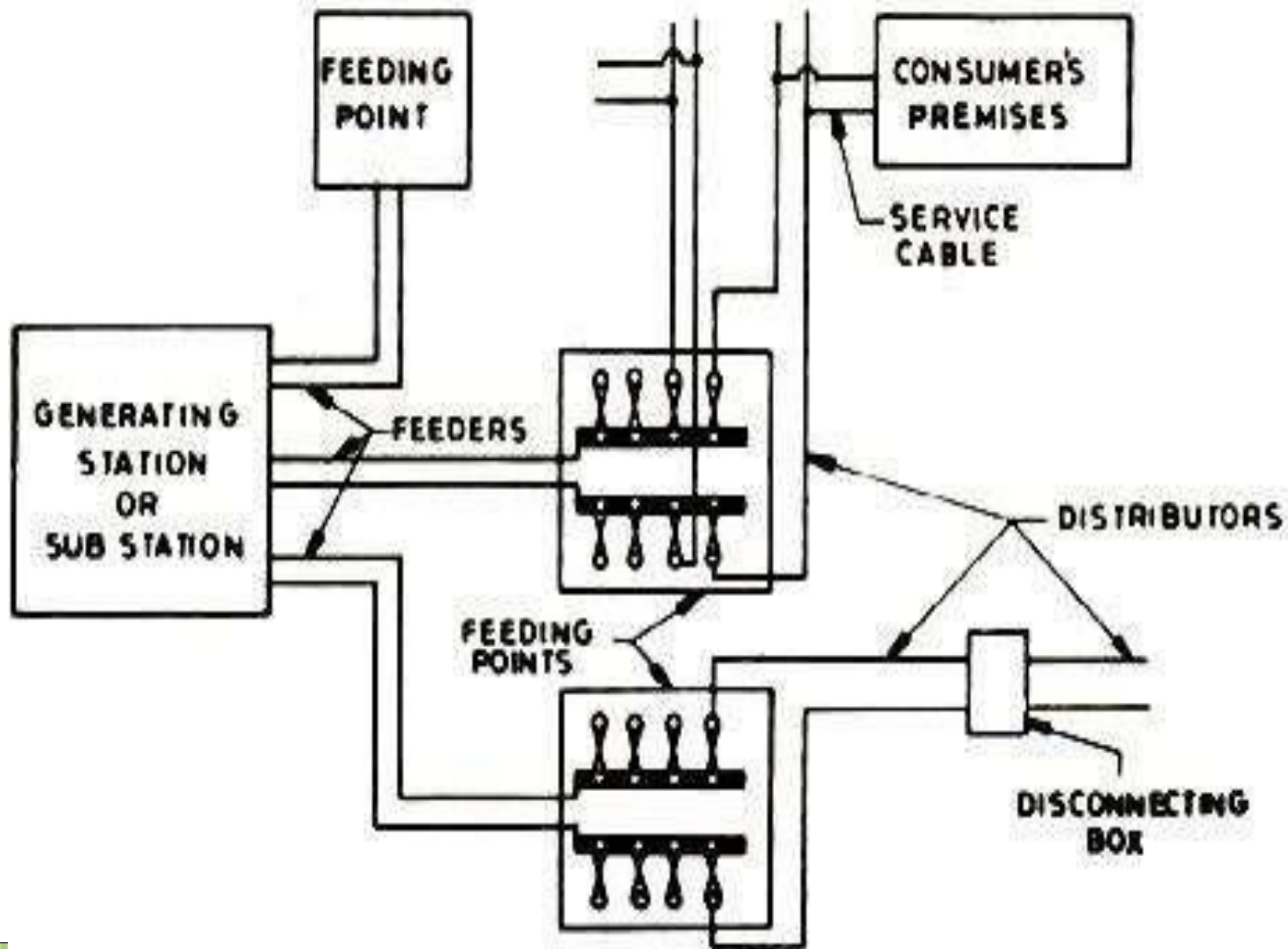
# Distributor

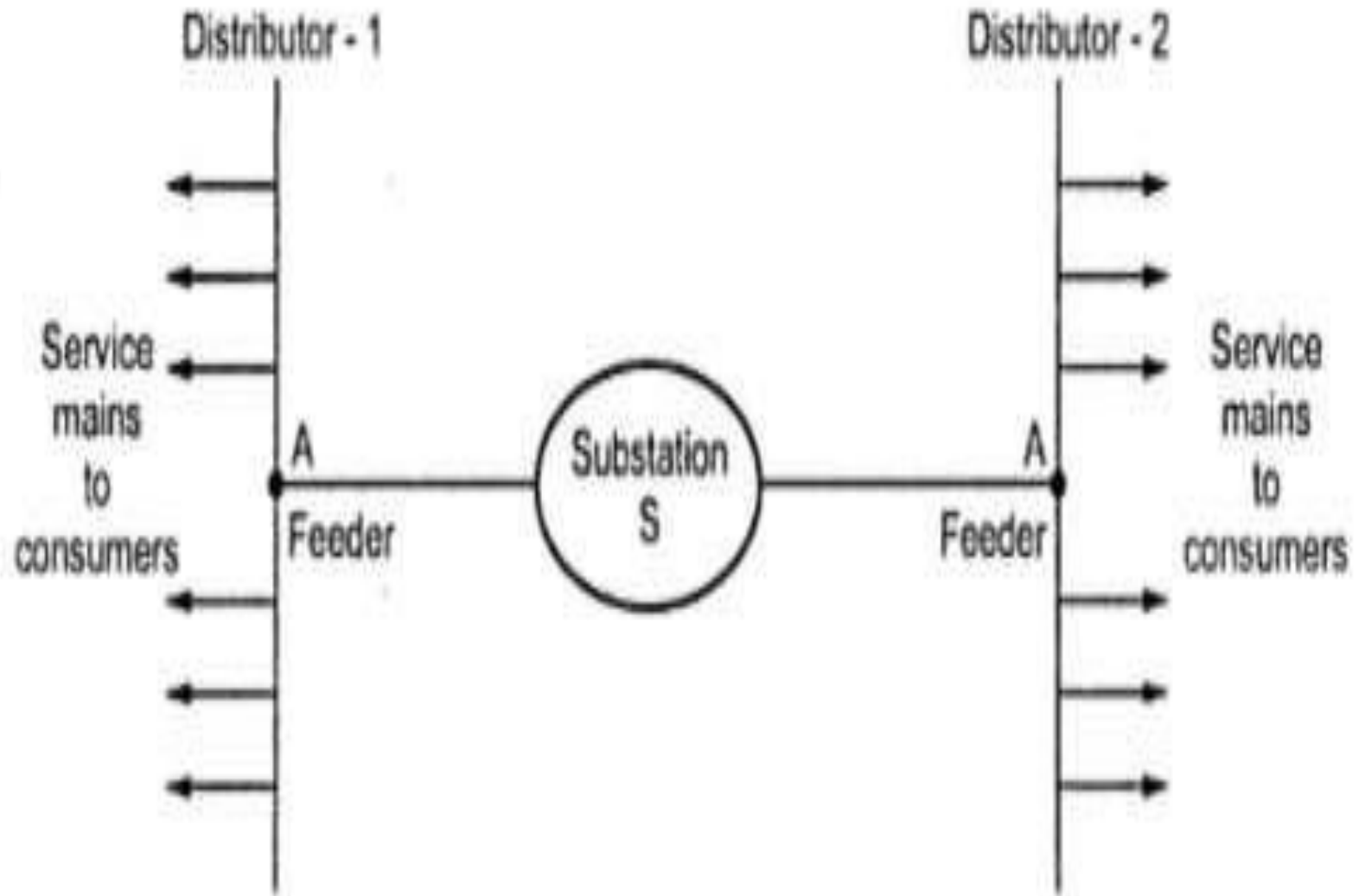
- A distributor is a conductor from which tapings are taken from pole mounted transformer to the consumer
- The current through a distributor is not constant because tapings are taken at various places along its length
- Voltage drop is main consideration
- Limit of variation is 6% of rated at consumer

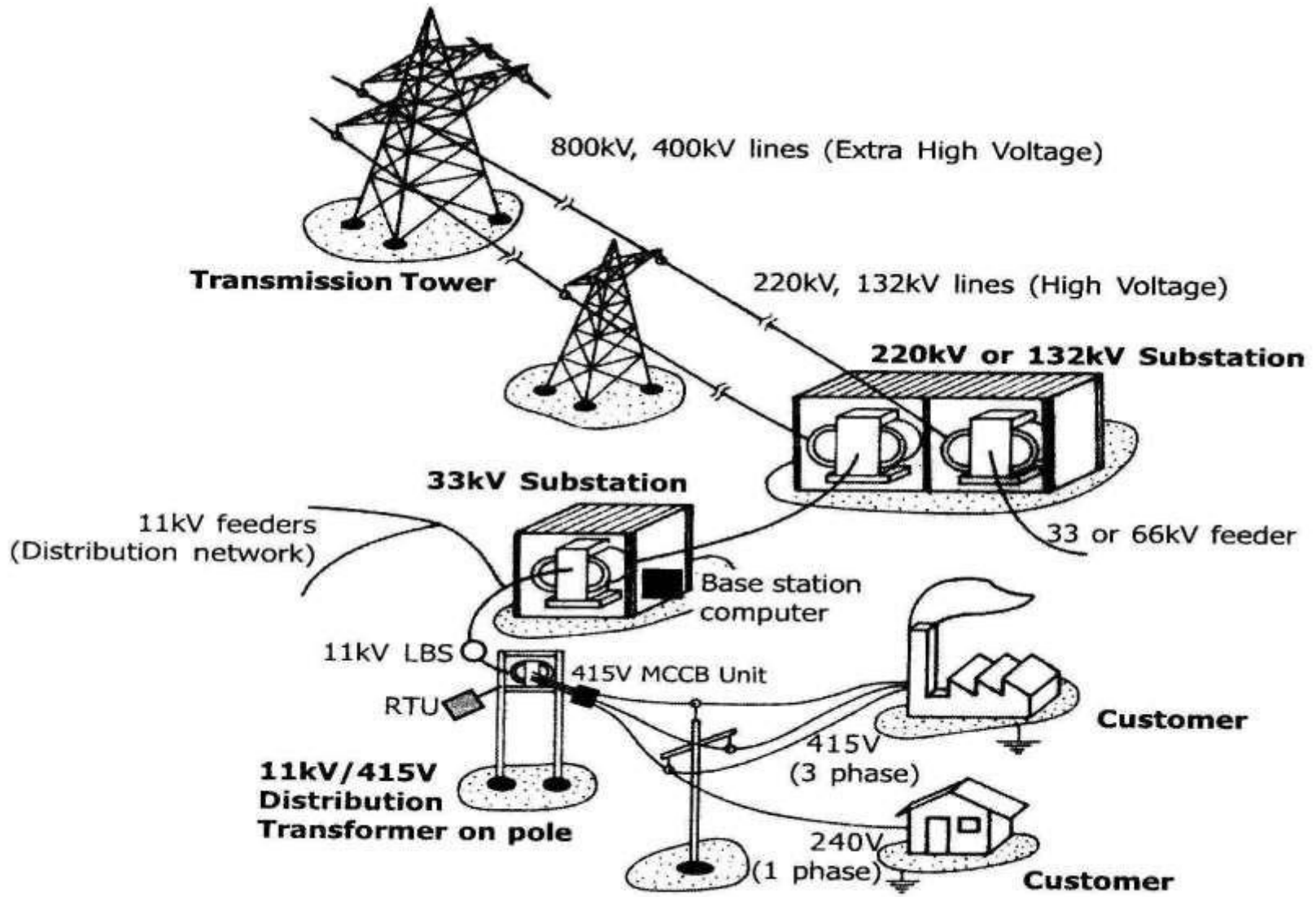
# Service mains

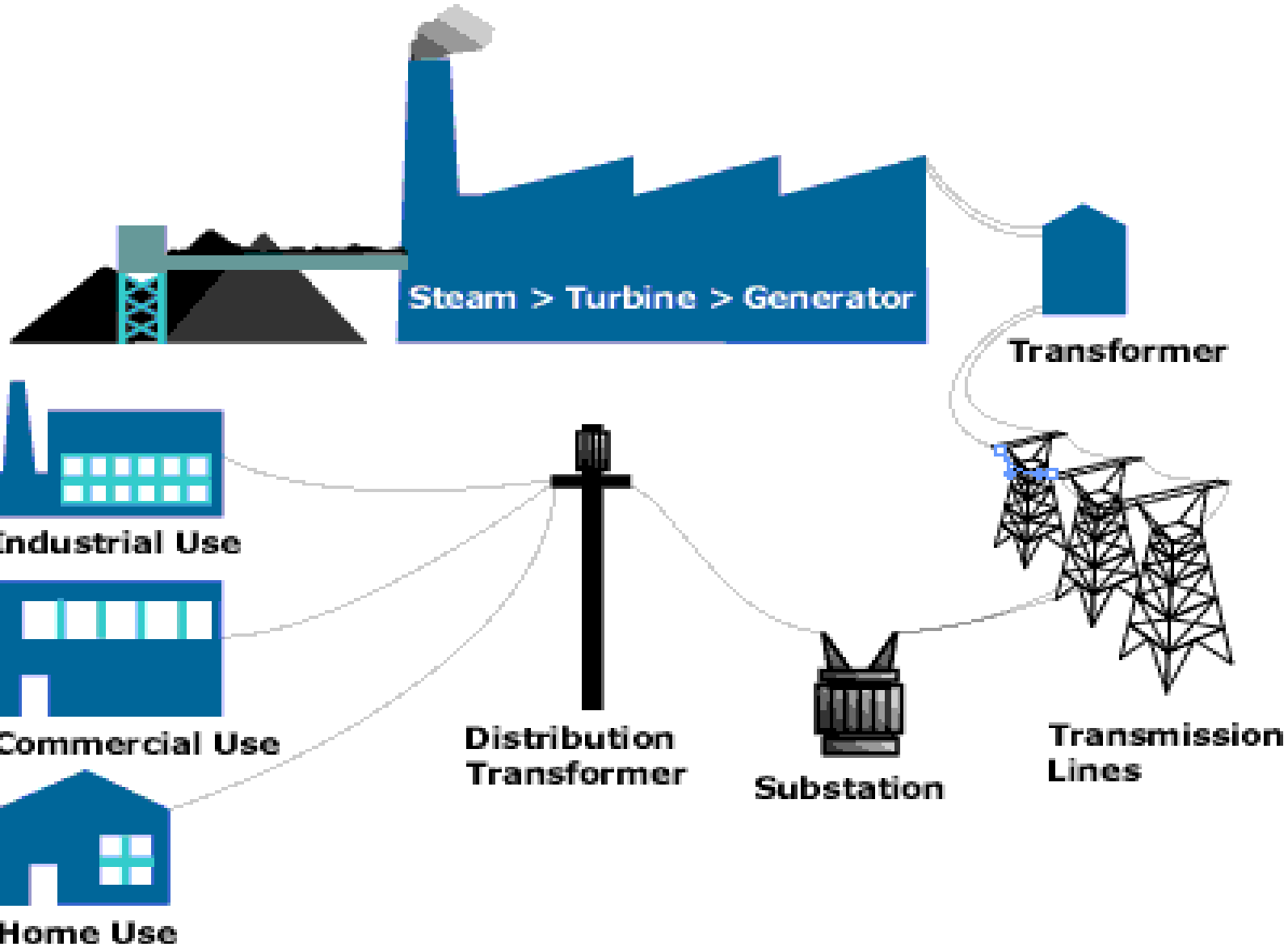
- A service mains is a generally a small cable which connects the distributor to the consumer 's meter.
- The connecting links between the distributor and the consumer terminals.











# Introduction:

- Distribution system is a part of power system, existing between distribution substations and consumers.
  
- It is further classified on the basis of voltage
  - Primary distribution system- **11 KV or 6.6 KV or 3.3 KV**
  - Secondary distribution system- **415 V or 230 V**



# Classification Of Distribution

## System:

It can be classified under different considerations as;

1. Type Of Current:
  - a) AC Distribution System
  - b) DC Distribution System
  
2. Type Of Construction:
  - a) Overhead System
  - b) Underground System

### 3. Type Of Service:

- a) General Lighting & Power
- b) Industrial Power
- c) Railway
- d) Streetlight etc

### 4. Number Of Wires:

- a) Two Wire
- b) Three Wire
- c) Four Wire

### 5. Scheme Of Connection:

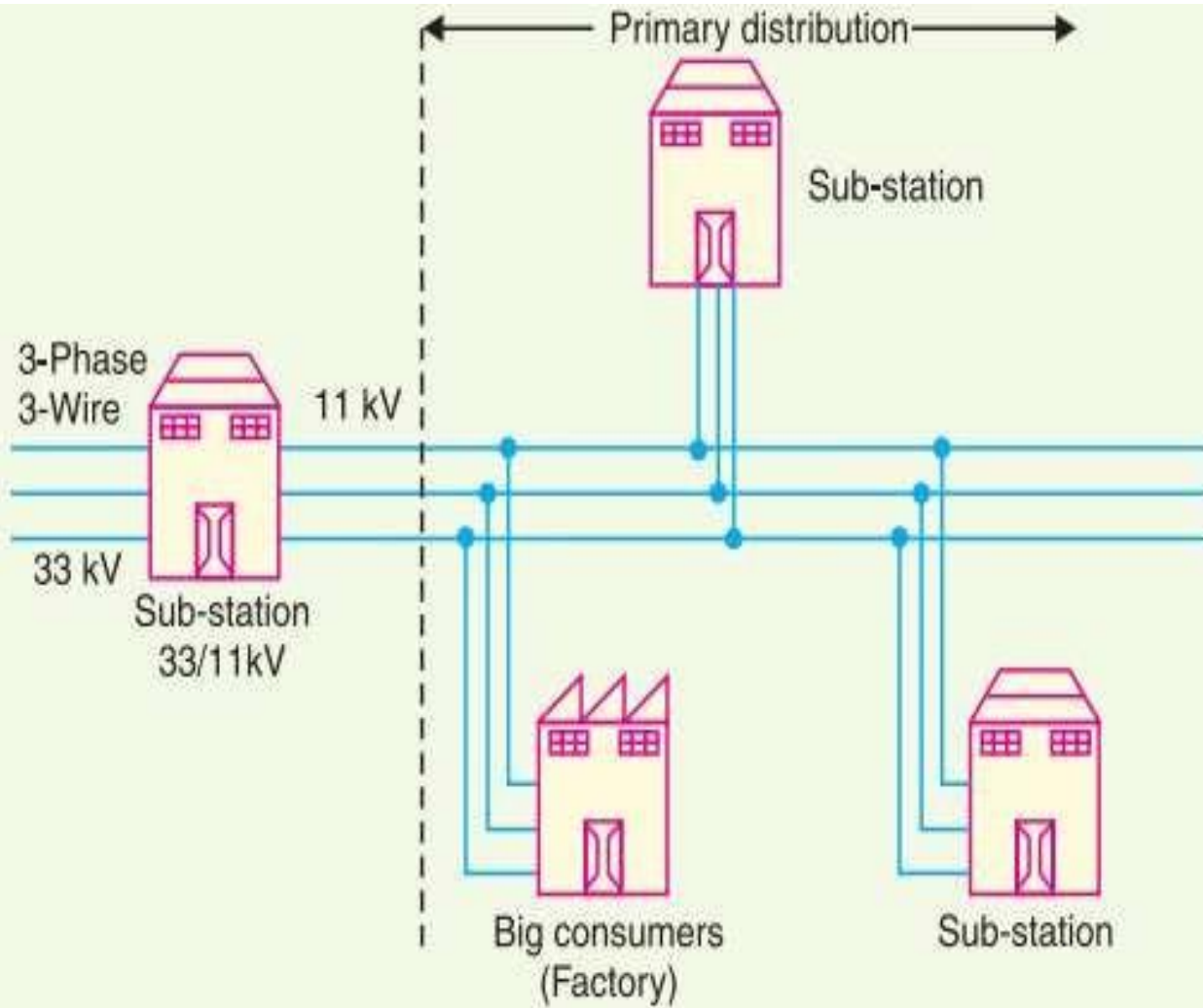
- a) Radial Distribution System
- b) Ring or Loop Distribution System
- c) Interconnected Distribution System

# Ac distribution

- A.c. distribution system is the electrical system between the step-down substation fed by the transmission system and the consumers' meters. The a.c. distribution system is classified into
  - ( *i* ) primary distribution system and
  - ( *ii* ) secondary distribution system.

# Primary distribution system

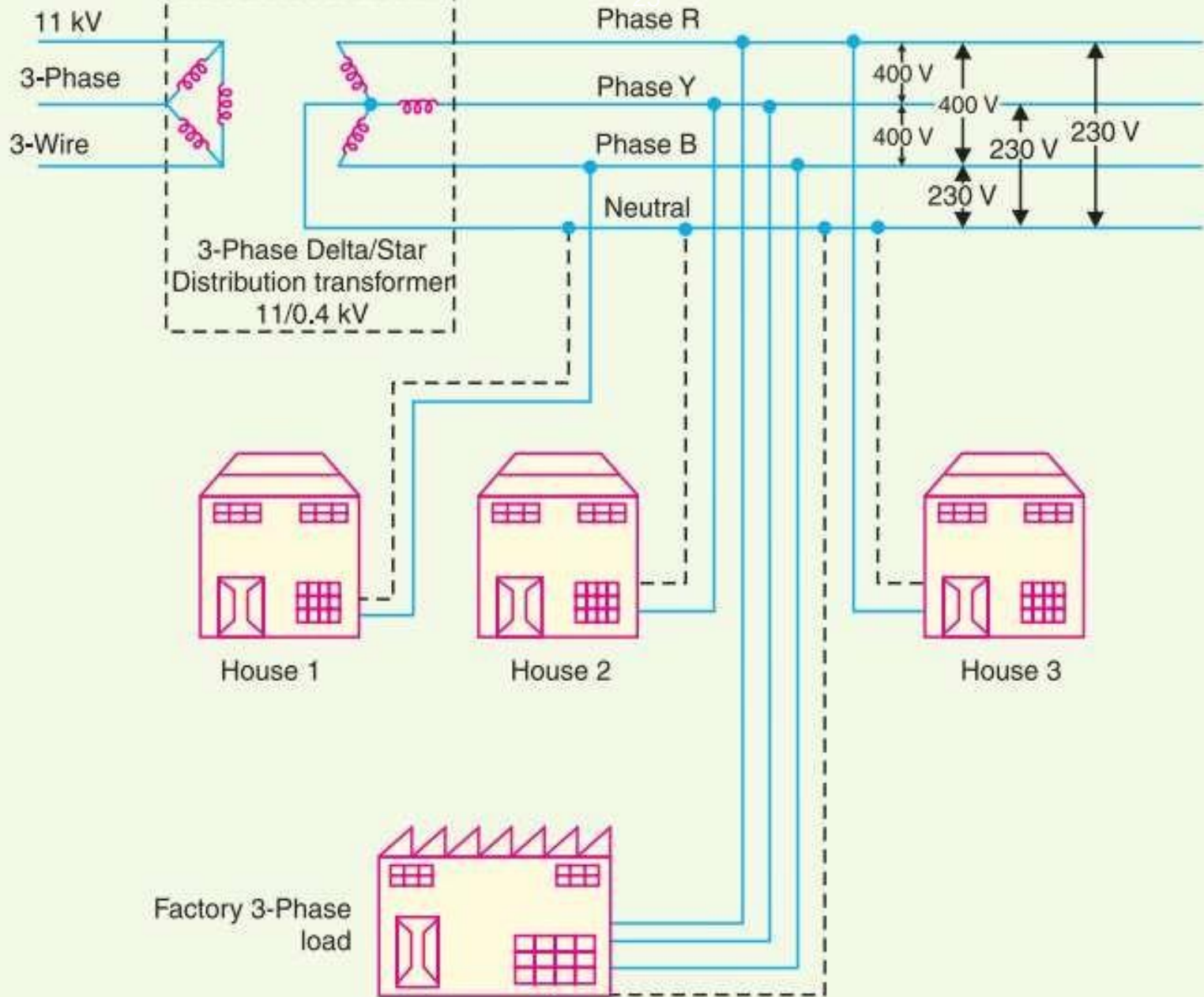
- **voltages somewhat higher than** general utilisation and handles large blocks of electrical energy than the average low-voltage consumer uses.
- Commonly used primary distribution **voltage 11KV, 6.6 KV, 3.3 KV.**
- Electric power from the generating station is transmitted at high voltage to the substation located in or near the city.
- At this substation, voltage is stepped down to 11 kV with the help of step-down transformer.
- Power is supplied to various substations for distribution or to big consumers at this voltage.
- This forms the high voltage distribution or primary distribution.



**Fig. 12.2**

# Secondary distribution system.

- It is that part of a.c. distribution system which includes the range of voltages at which the ultimate consumer utilizes the electrical energy delivered to him.
- The secondary distribution employs 400/230 V, 3-phase, 4-wire system.



## D.C. Distribution

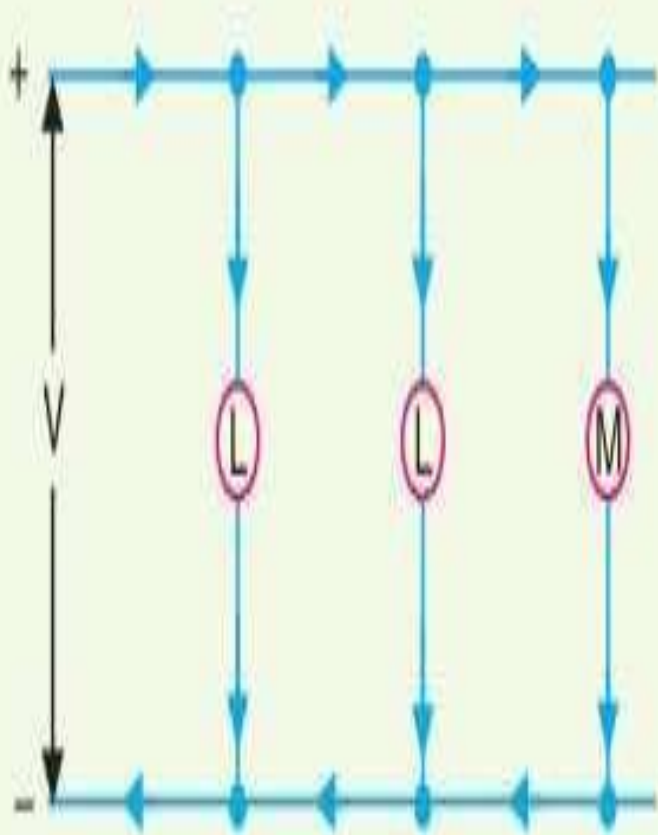
- D.c. supply is required for the operation of variable speed machinery (*i.e.*, d.c. motors), for electro-chemical work and for congested areas where storage battery reserves are necessary.
- For this purpose, a.c. power is converted into d.c. power at the substation by using converting machinery *e.g.*, mercury arc rectifiers, and motor-generator sets. The d.c. supply from the substation may be obtained in the form of



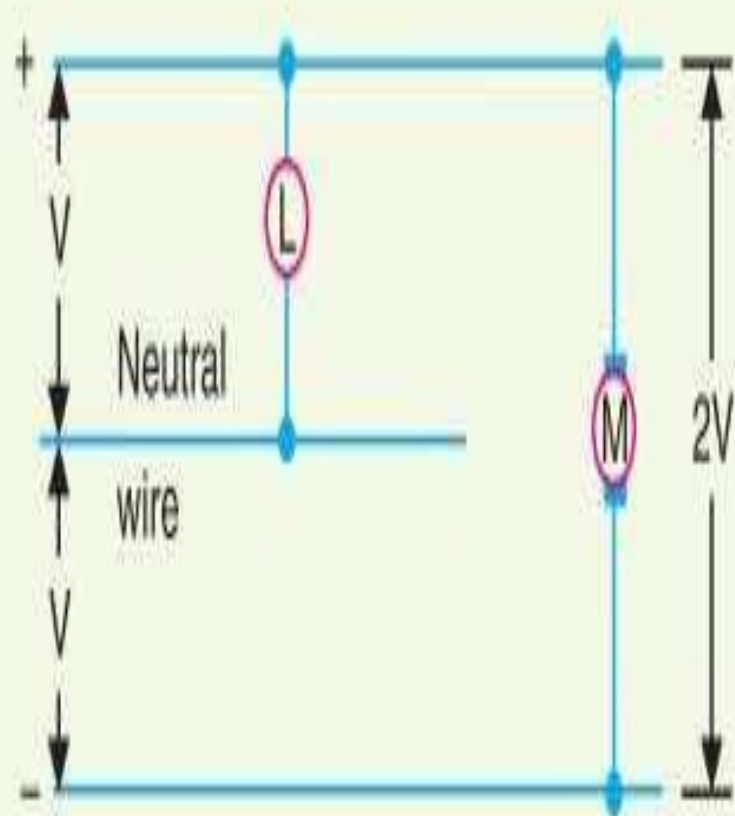
# Type of DC distributor

- The dc supply from the substation maybe obtained in form of
  - ( *i* ) 2-wire or
  - ( *ii* ) 3-wire for distribution.

2 wire



3 wire

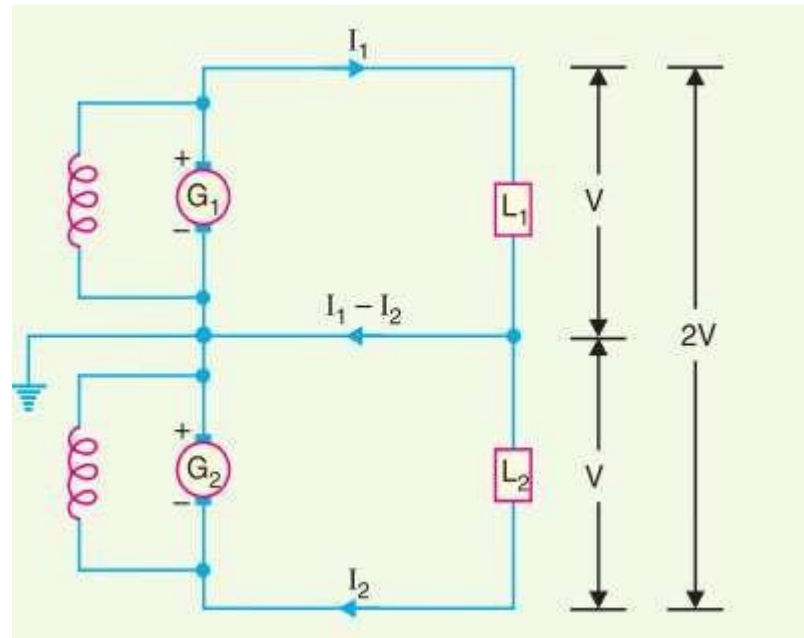


- Two outer and a middle or neutral wire is earthed at the s/s.
- Voltage between the outer is twice the voltage between either outer and neutral wire.
- Advantage – available two voltage at the consumer terminal.
- Loads requiring high voltage connected across the outers.
- Lamps and heating circuits requiring less voltage are connected between either outer and neutral.

# Method of obtaining 3 wire D.c system

- *Two generator method.*
- *3-wire D.c. generator.*
- *Balancer set*

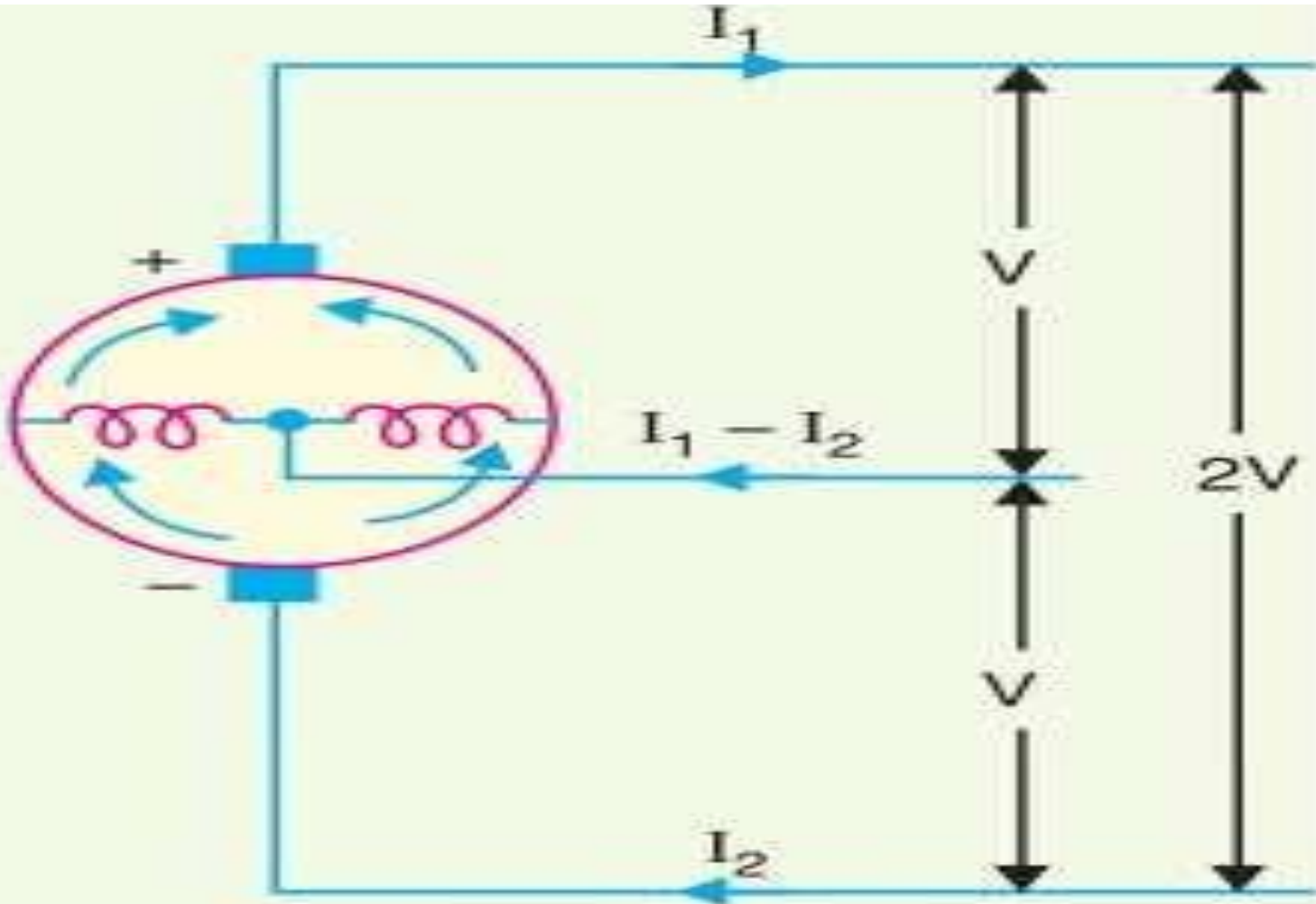
# Two generator method



## Two generator method

- D.c generator G1 and G2 are connected in series and the neutral is obtained from the common point between generator
- G1 supplies a  $I_1$ , G2 supplies a  $I_2$
- Difference of load current on both side ( $I_1 - I_2$ ) flow through the neutral wire.
- Disad.: two separate generator are required.

## 3-wire D.c. generator.



## *3-wire D.c. generator.*

- Consist of a standard 2 wire machine with one or two coils of high reactance and low resistance that connected to opposite points of the armature winding.
- Neutral wire is obtained from common point.



# Connection schemes of distribution system

- Radial system
- Ring main system
- Interconnected system

# Radial Distribution System:

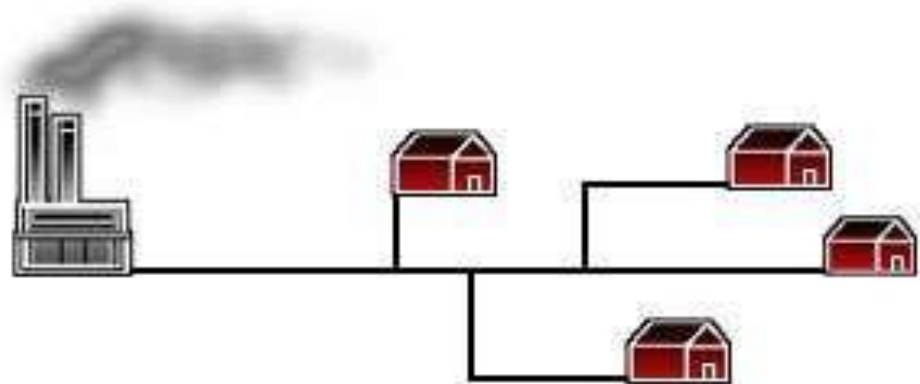
- separate feeders radiate from a single substation and feed the distributors at one end only.
- Only one path is connected between each customer and substation.
- Electrical power flows along a single path.
- If interrupted, results in complete loss of power to the customer.

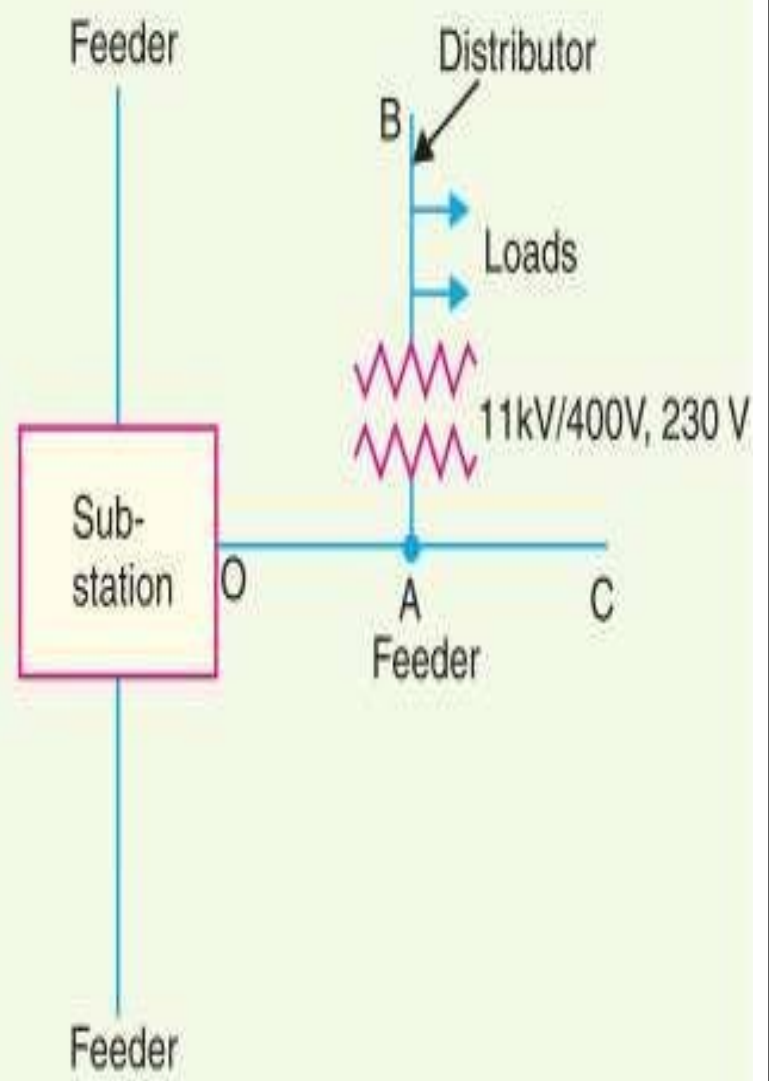
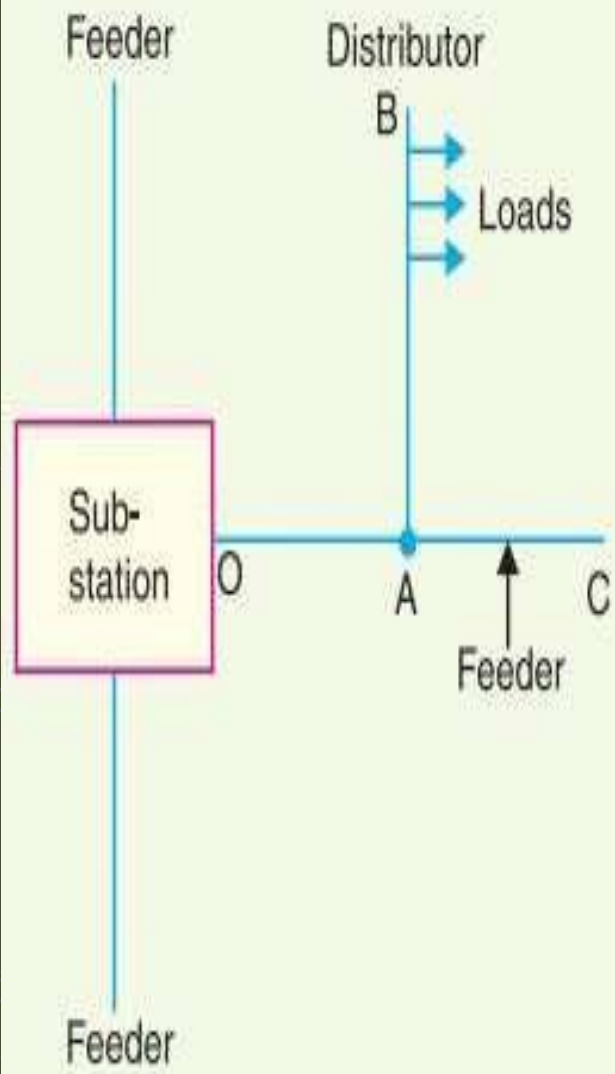
## Advantages:

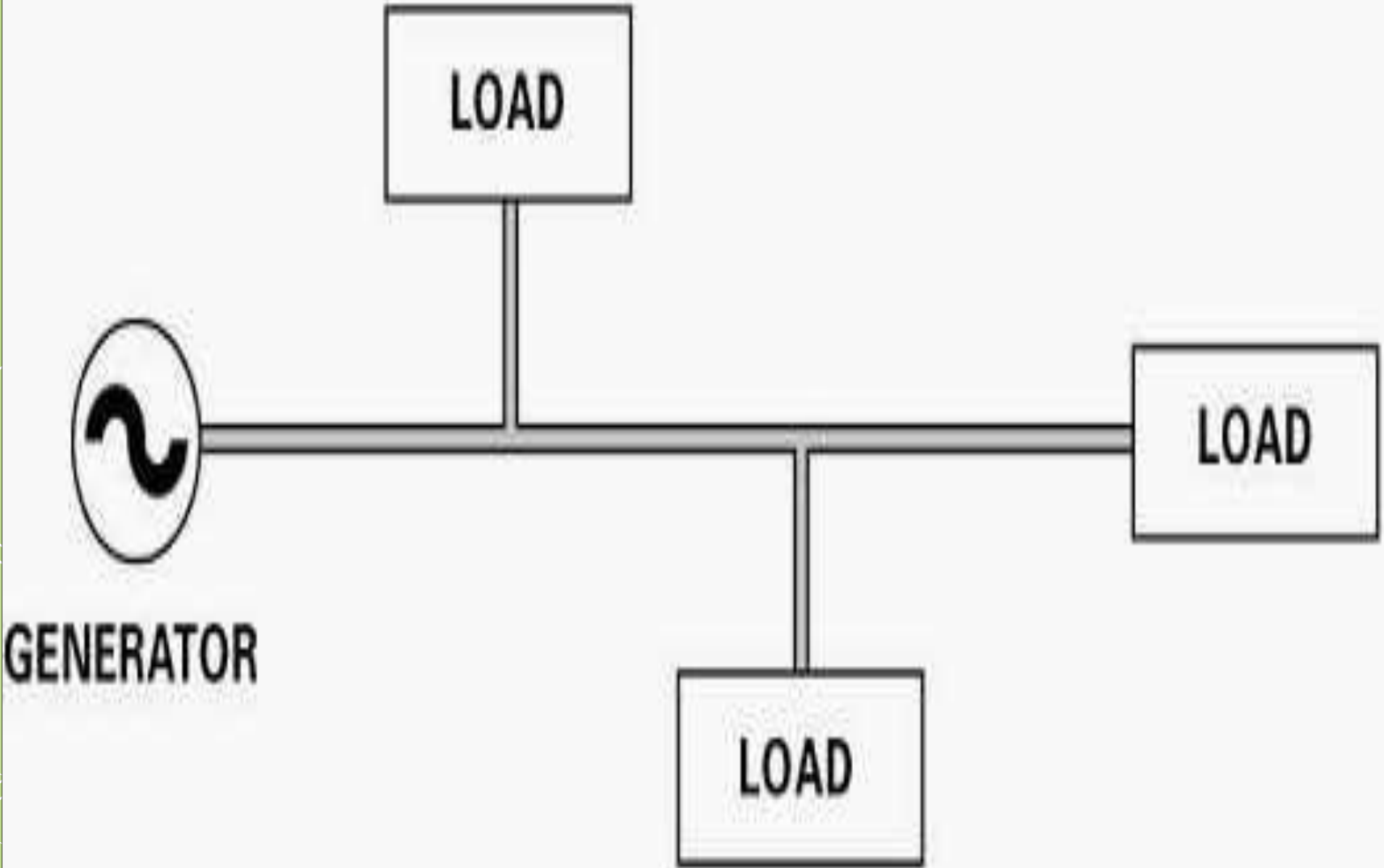
- Low cost .
- Simple planning.

## Disadvantages :

- The radial system is employed where the voltage drop is low and the substation is located near the load.
- Distributor nearer to feeding end has higher voltage.
- Consumers at far end of feeder experience voltage fluctuations.







# Ring or Loop Distribution System:

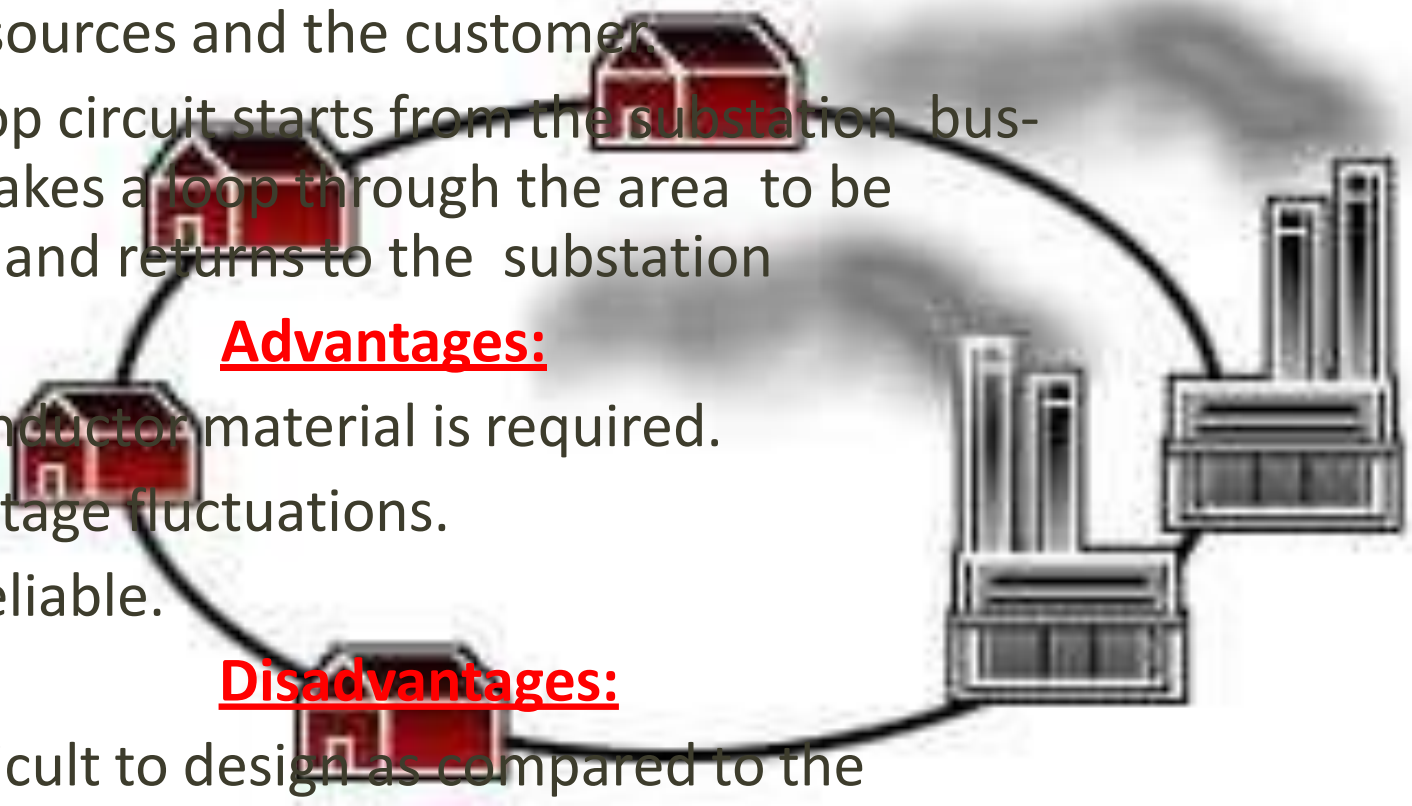
- It consists of two or more paths between power sources and the customer
- The loop circuit starts from the substation bus-bars, makes a loop through the area to be served, and returns to the substation

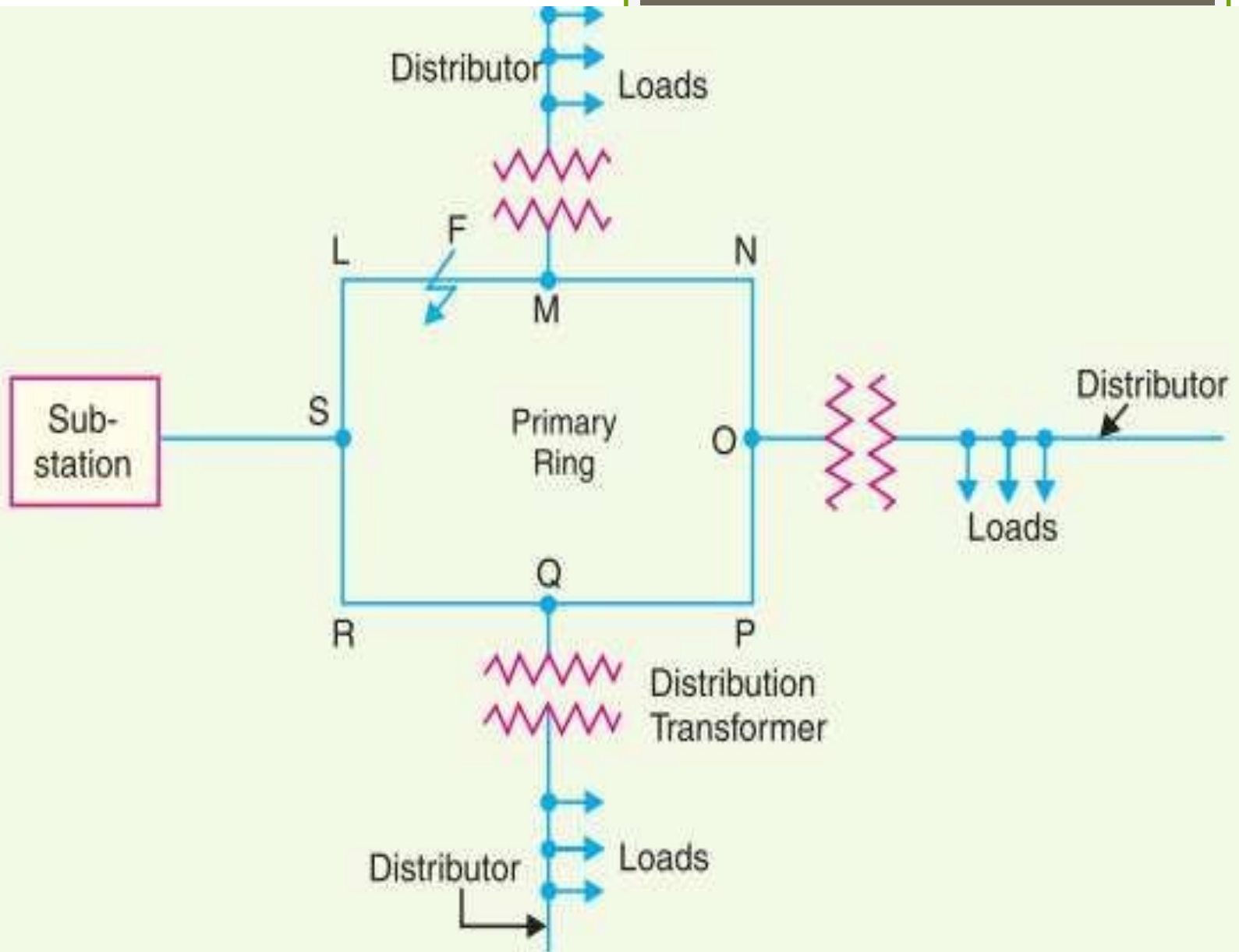
## Advantages:

- Less conductor material is required.
- Less voltage fluctuations.
- More reliable.

## Disadvantages:

- It is difficult to design as compared to the design of radial system.





# Interconnected Distribution System:

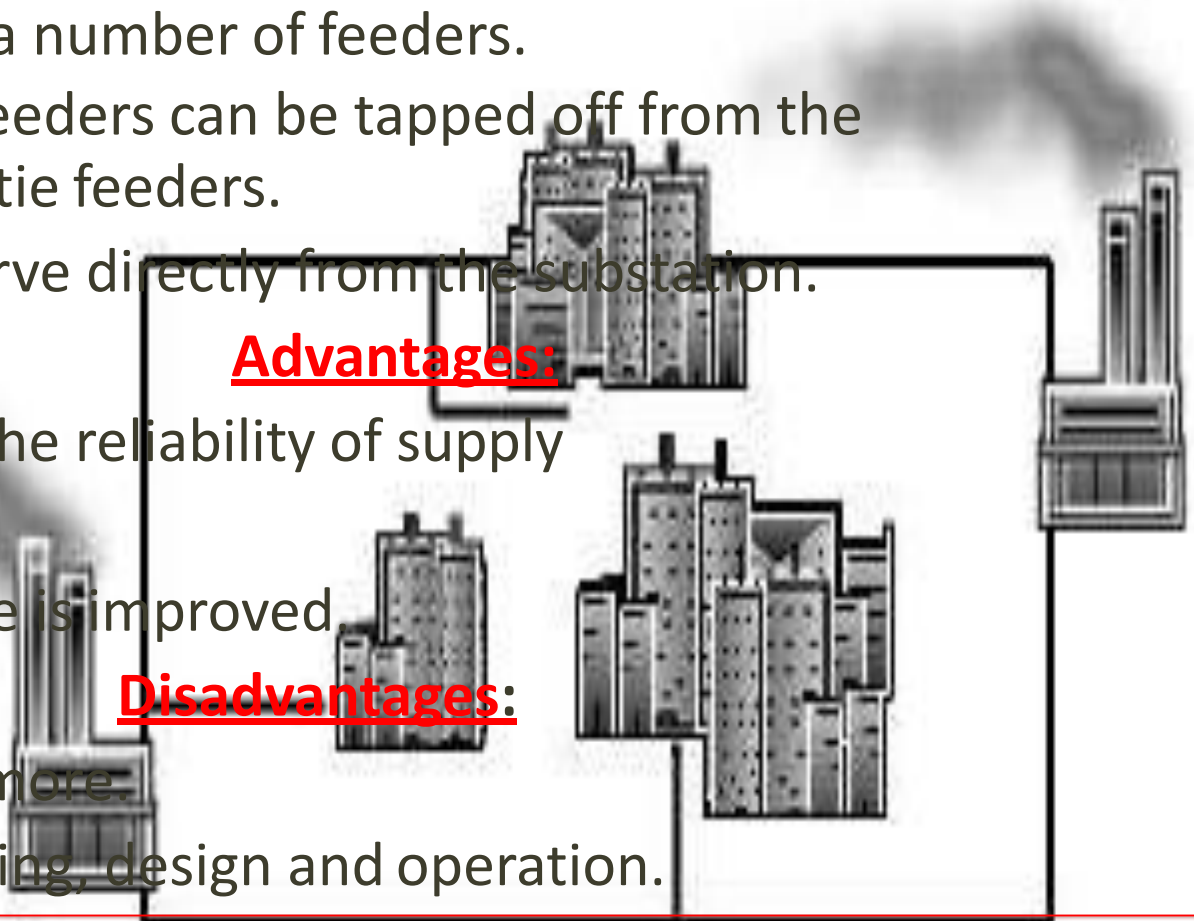
- It is supplied by a number of feeders.
- Radial primary feeders can be tapped off from the interconnecting tie feeders.
- They can also serve directly from the substation.

## Advantages:

- Increases the reliability of supply
- Losses are less
- Quality of service is improved

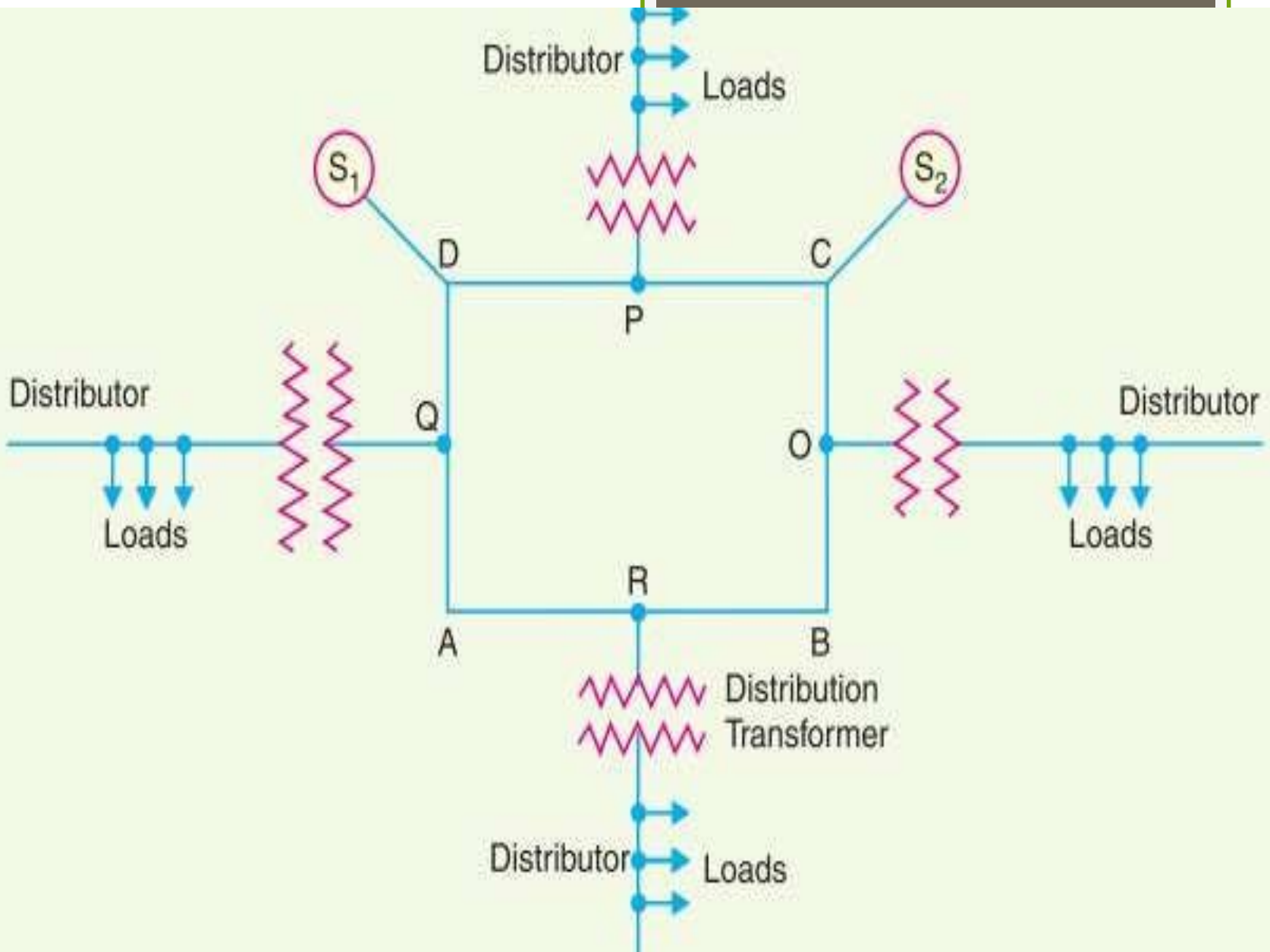
## Disadvantages:

- Its initial cost is more.
- Difficult in planning, design and operation.



• Difficult in planning, design and operation.

• Its initial cost is more.



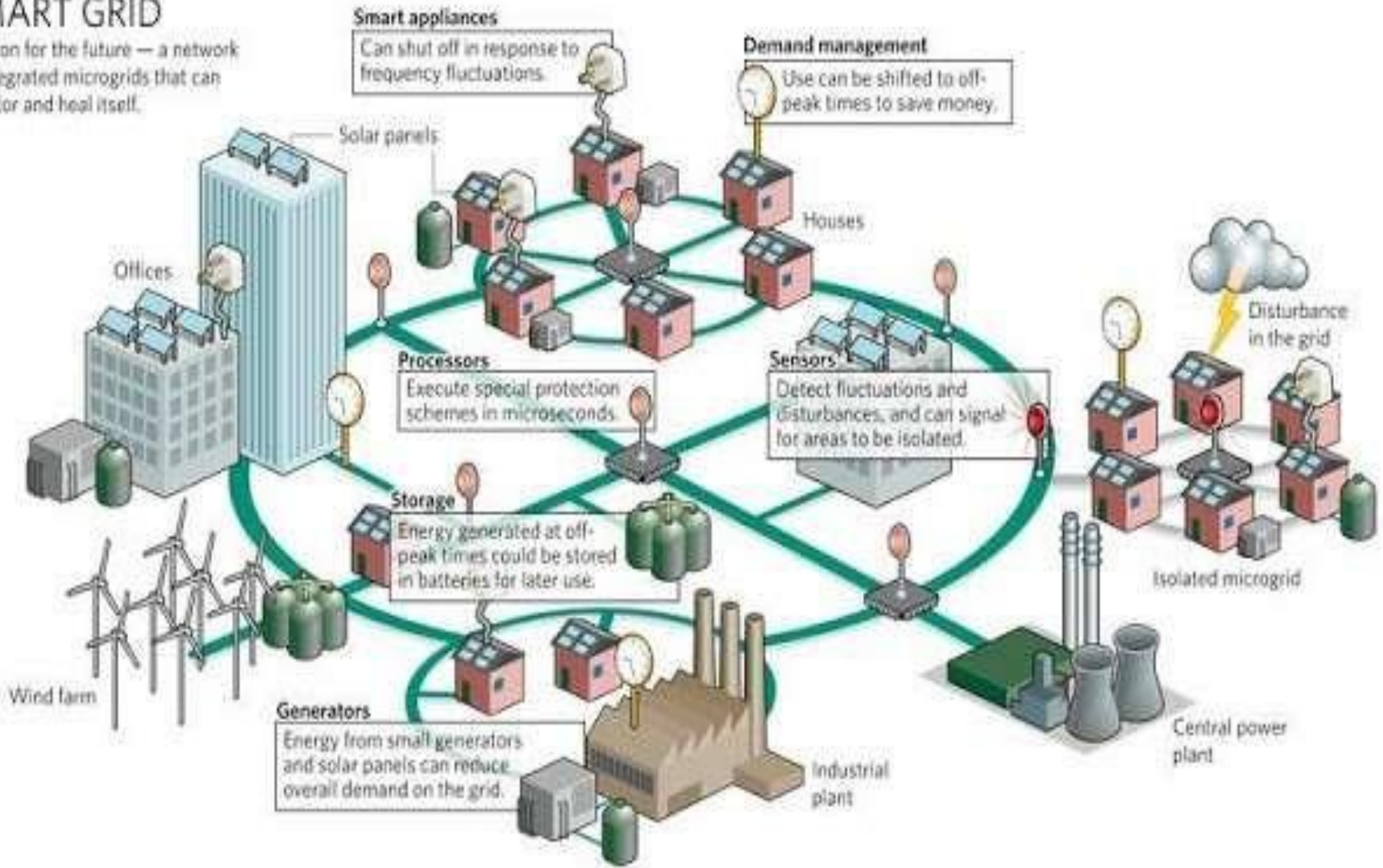




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# SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



# D.C. Distribution

- D.c. supply is required for the operation of variable speed machinery ( *i.e.*, d.c. motors),
- for electro-chemical work and for congested areas where storage battery reserves are necessary.
- For this purpose, a.c. power is converted into d.c. power at the substation by using converting machinery *e.g.*, mercury arc rectifiers, rotary converters and motor-generator sets. The d.c. supply from the substation may be obtained in the form of

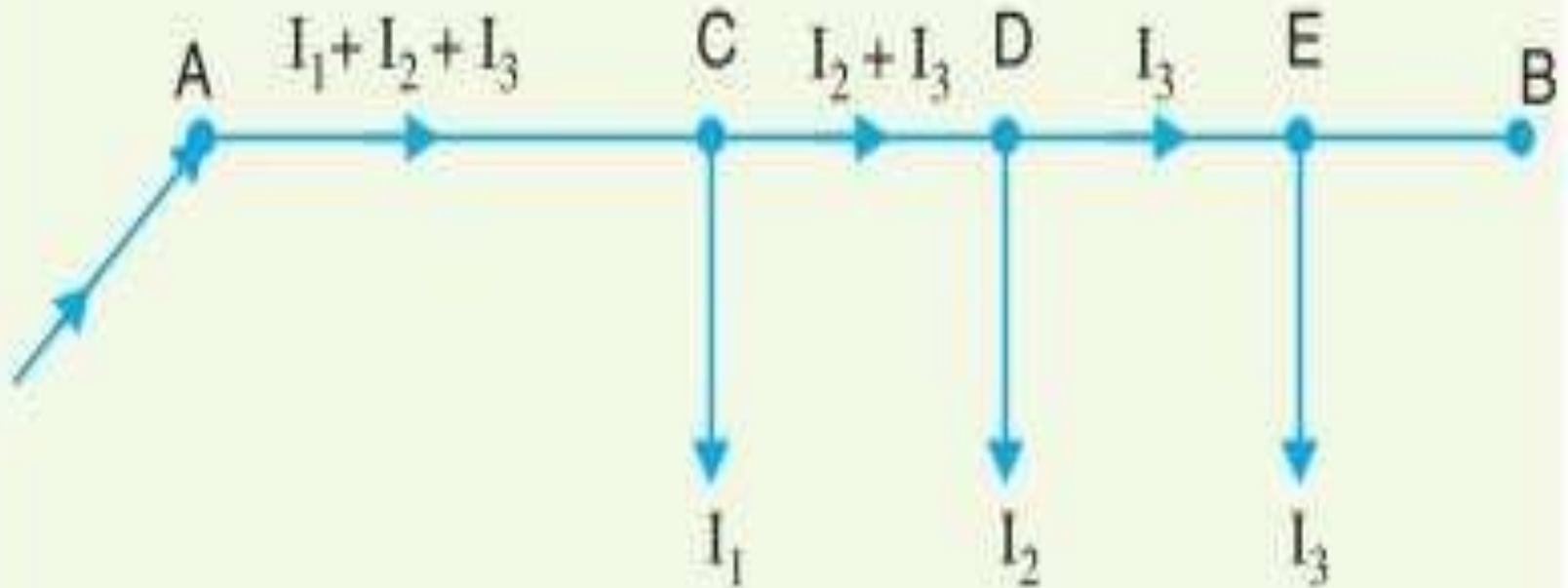
# DC Distribution:

- Voltage drop along distributor is considered as a main factor while designing a distributor.
- It depends upon the nature of load and also on feeding, whether it is fed at one or both ends.

According to loading, a distributor can be classified as:

- i. Fed at one end.
- ii. Fed at both ends. a). With equal voltages.  
b). With unequal voltages.
- iii. Fed at centre.  
Ring mains.

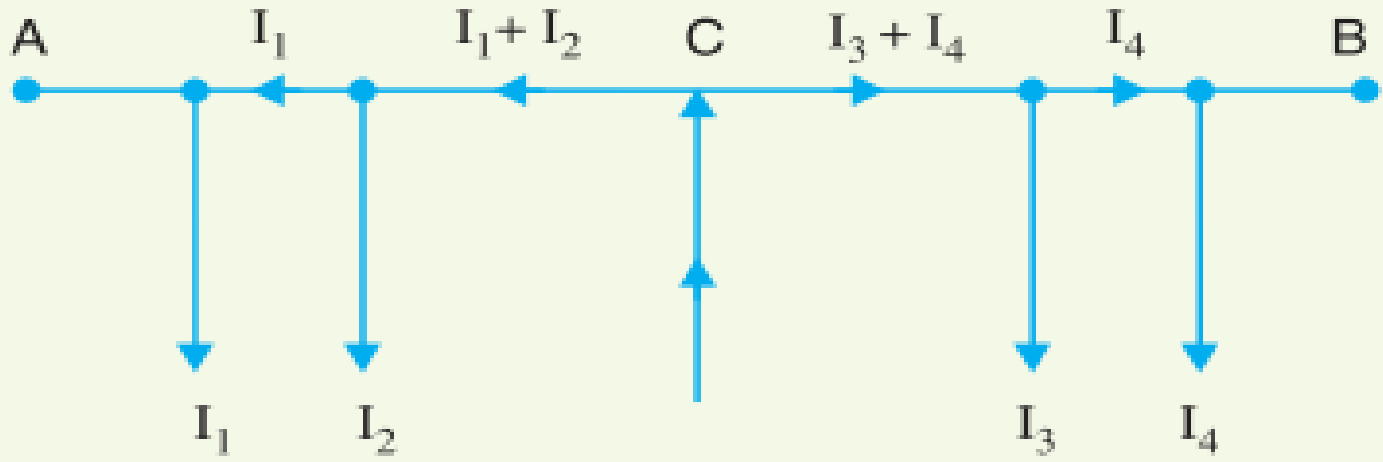
# DC Distribution Feed at one end



**Fig. 13.1**

- **a)** The current in the various sections of the distributor away from feeding point goes on decreasing. Thus current in section *AC* is more than the current in section *CD* and current in section *CD* is more than the current in section *DE*.
- **(b)** The voltage across the loads away from the feeding point goes on decreasing. Thus in Fig. 13.1, the minimum voltage occurs at the load point *E*.
- **(c)** In case a fault occurs on any section of the distributor, the whole distributor will have to be disconnected from the supply mains. Therefore, continuity of supply is interrupted

# Distributor fed at center





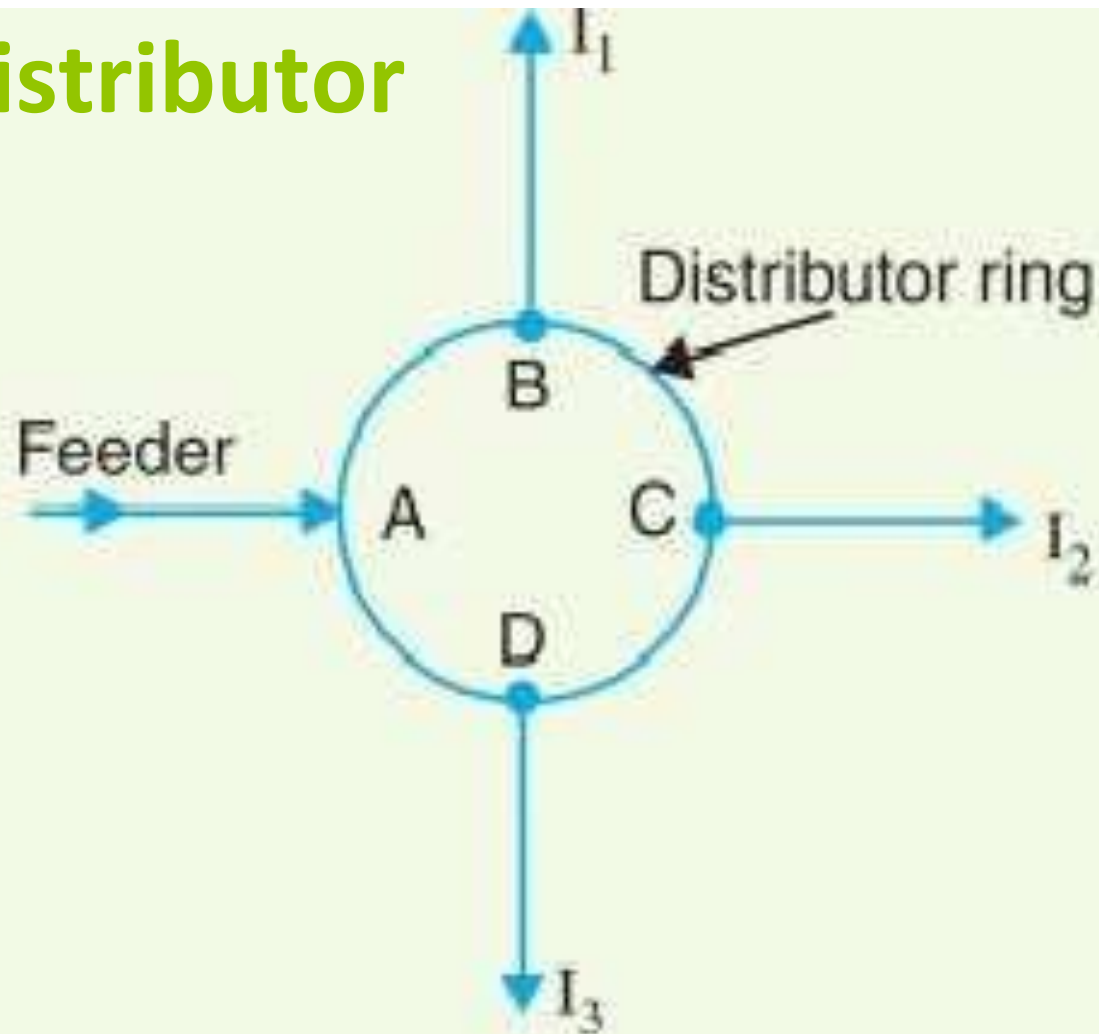
- In this type of feeding, the distributor is connected to the supply mains at both ends and loads are tapped off at different points along the length of the distributor.
- The voltage at the feeding points may or may not be equal. distributor  $A B$  fed at the ends  $A$  and  $B$  and loads of  $I_1$ ,  $I_2$  and  $I_3$  tapped off at points  $C$  respectively.
- Here, the load voltage goes on decreasing as we move away from one feeding point say  $A$ , reaches minimum value and then again starts rising and reaches maximum value when we reach the other feeding point  $B$ .
- The minimum voltage occurs at some load point and is never fixed. It is shifted with the variation of load on different sections of the distributor.



# Advantages

- (a) If a fault occurs on any feeding point of the distributor, the continuity of supply is maintained from the other feeding point.
- (b) In case of fault on any section of the distributor, the continuity of supply is maintained from the other feeding point.
- (c) The area of X-section required for a doubly fed distributor is much less than that of a singly fed distributor.

# Ring Distributor



- In this type of feeding, the centre of the distributor is connected to the supply mains as shown in Fig.
- It is equivalent to two singly fed distributors, each distributor having a common feeding point and length equal to half of the total length