Lecture-9

duties of switch gear, automatic switch, air circuit breaker

Topic Covered

- Classification of Circuit Breakers
- Air Circuit Breakers
- Air Blast Circuit Breakers
- Applications
- Advantage and Disadvantage

Requirements of Circuit Breaker

The power associated with the circuit breakers is large and it forms the link between the consumers and suppliers. The necessary requirements of circuit breakers are as follows,

1. The normal working current and the short circuit current must be safely interrupted by the circuit breaker.
2. The faulty section of the system must be isolated by circuit breaker as quickly as possible keeping minimum delay.
3. It should not operate with flow of overcurrent during healthy conditions.
4. The faulty circuit only must be isolated without affecting the healthy one.

Classification of Circuit Breakers

The circuit breakers are classified by various ways. The different criteria for classification of circuit breakers are as follows,

i) Interrupting medium
ii) According to service
iii) Way of operation
iv) Action
v) Method of control
vi) Way of mounting
vii) Tank construction
viii) Contacts

According to the interrupting medium the circuit breakers are classified as air circuit breaker, air blast circuit breaker, oil circuit breaker and magnetic blast circuit breaker.

According to service there are two types of circuit breakers viz indoor circuit breaker and outdoor circuit breaker.

Depending on the operation, the types of circuit breakers are gravity opened, gravity closed and horizontal break circuit breaker.

On the basis of action, the circuit breakers are classified as automatic and non-automatic circuit breaker.

According to method of control, the circuit breaker may be controlled directly or it may be operated remotely. The remote control may be manual, pneumatic or electrical.

The way of mounting classifies the circuit breakers into panel mounted, rear of panel or remote from panel type.

Depending on the tank construction, the circuit breakers are classified as separate tank for each pole type or one tank for all poles type.

On the basis of contacts, the different types of circuit breakers are Butt, Wedge, Laminated flat contact, Explosion chamber etc.

Out of the various ways of classification of circuit breakers the general way of classification is on the basis of medium used for arc extinction which is normally oil, air, Sulphur Hexa Flouride (SF_6) or vacuum.

Each type of circuit breaker is associated with its own advnatages and disadvantages. We will now consider some types of circuit breakers in detail.

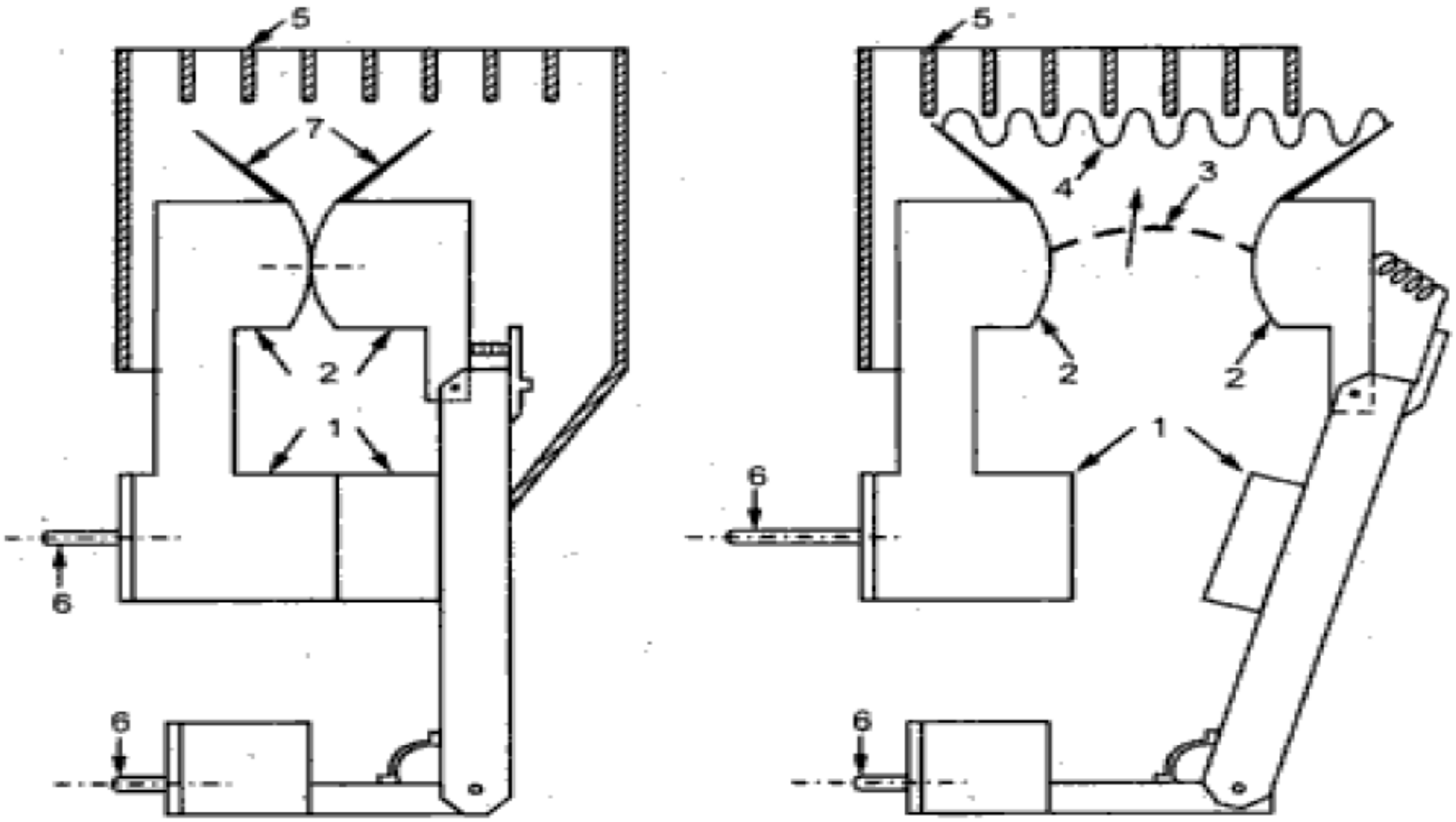
Air Circuit Breakers

1.In this Circuit Breaker the arc is elongated using arc runners and arc splitters so as to increase the resistance of the arc.

3.This increases the voltage required to maintain the arc and if the available voltage cannot sustain the arc ,the arc gets extinguished.

2.At current zero ,the recovery voltage across the contacts becomes less than the arc voltage and the arc gets extinguished.

4. The energy in the system inductance at current zero is zero .Hence arc interruption is easier.



(I) Contact closed **(II) Contacts open**

Principle of air-break circuit-breaker

1. Main contacts
2. Arcing contacts
3. Arc rising in the direction of the arrow
4. Arc getting split
5. Arc splitter plates
6. Current carrying terminals
7. Arc runners

Air Circuit Breakers

1.Used For low voltage levels and current levels

2.As voltage level increases, the size of breaker becomes large so not convenient for higher voltage and current levels.

3.Air is used as medium to extinguish the arc which have inferior extinguishing properties compared to SF6 or Vacuum circuit breakers

4.Operating control is manual as well as automatic.

5.It is used up to 6.6kV with a breaking capacity of 15MVA.

6.Suitable for repeated operation because medium of arc extinction is air . So commonly used in Industrial Switchgears . Auxiliary switchgear Generating Stations

Air Blast Circuit Breakers

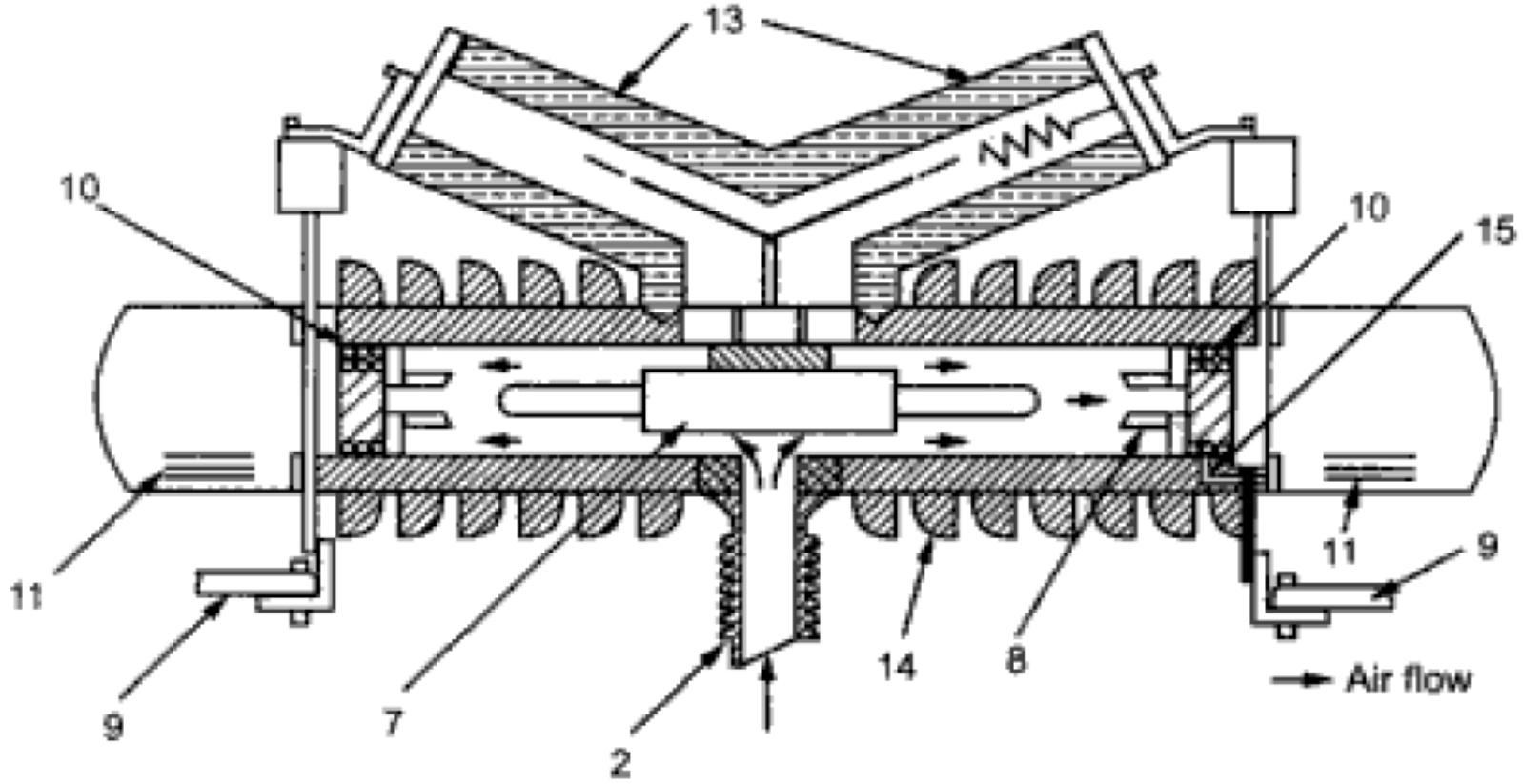
In this breaker, a high pressure air blast is used as an arc quenching medium.

The contacts are opened and a flow of air blast is maintained by opening the blast valve.

The air blast cools the arc and takes away the arcing products to atmosphere .

This rapidly increases the dielectric strength of the medium between the contacts and the arc is extinguished and the flow of current is interrupted.

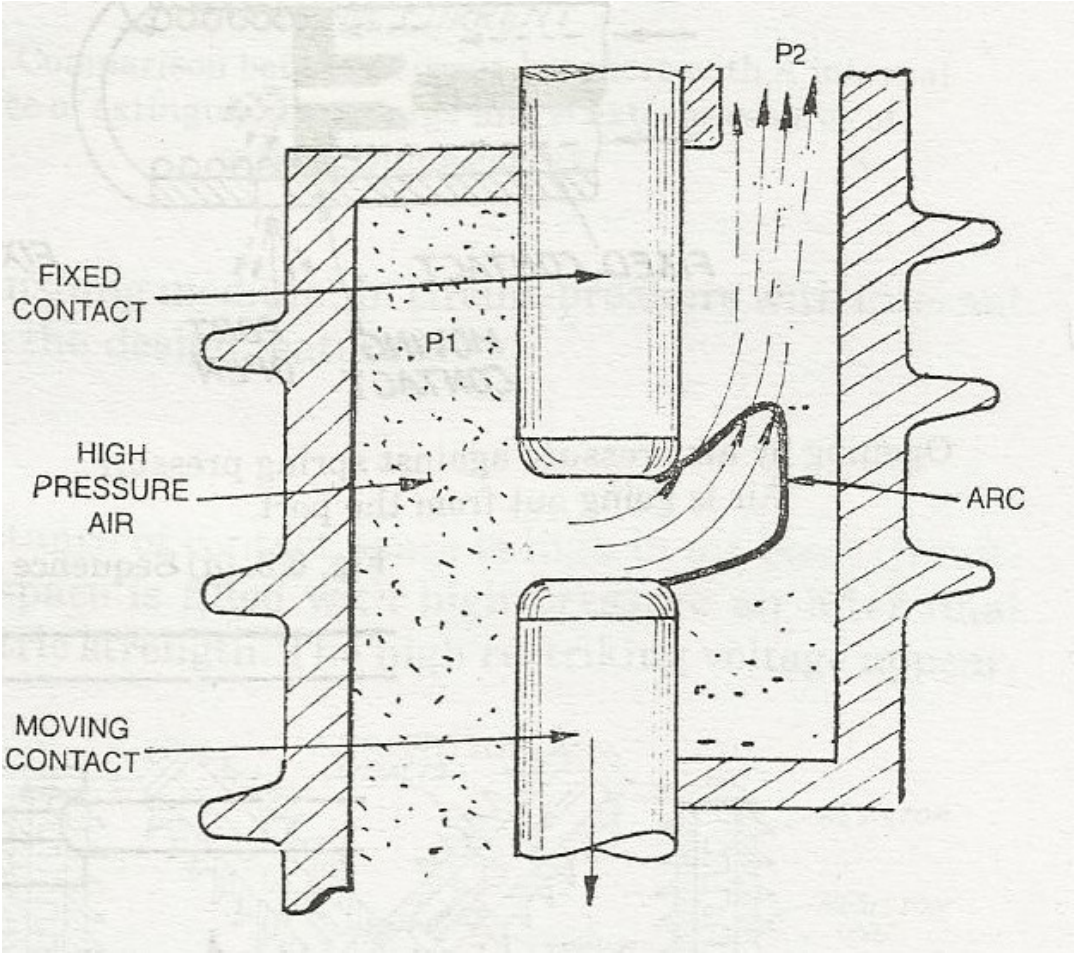
One pole of an extra high voltage air blast circuit-breaker



Details of double arc extinction chamber

1. Tank air reservior (receiver)
2. Hollow insulator assembly
3. Double arc extinction chamber
4. Pneumatic operating mechanism
5. Operating rod
6. Pneumatic value
7. Fixed contact (in 3)
8. Moving contact (in 3)
9. Connection for current
10. Compression springs
11. Openings for air outler
12. Arcing horns Optional
13. Resistance switching unit
14. Enclosure
15. Port

Air Blast Circuit Breaker(Radial Flow)



Advantages and Disadvantages

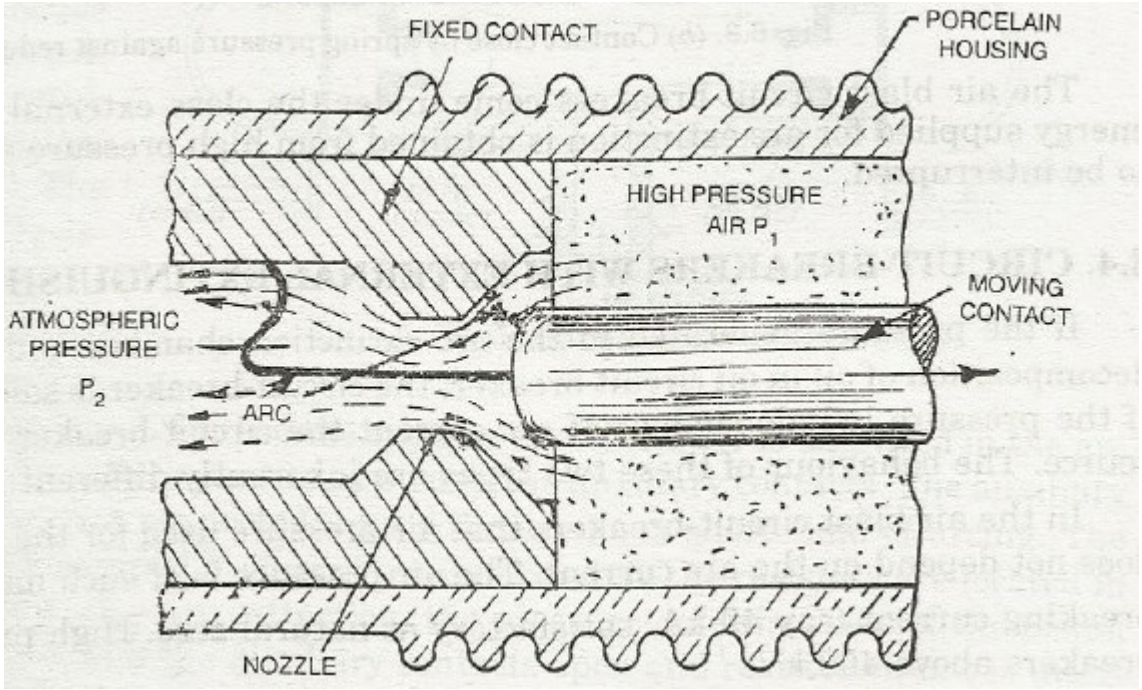
Advantages

- High speed of operation
- Short arcing time
- High speed reclosing
- Less weigh as compared to oil circuit breakers
- Very less maintenance
- No possibility of explosion

Disadvantages

- Cost is more
- For complete compress air installation is required
- These breakers are more sensitive to RRRV.
- For operation and maintenance ,highly skilled persons are required

Air Blast Circuit Breakers (Axial Flow)



Axial Blast ABCB

Air is admitted in the arc extinction chamber it pushes the moving contact. This air blast takes away the ionized gases along with it. Afterwards the arc gets extinguished. High pressure air has higher dielectric strength.

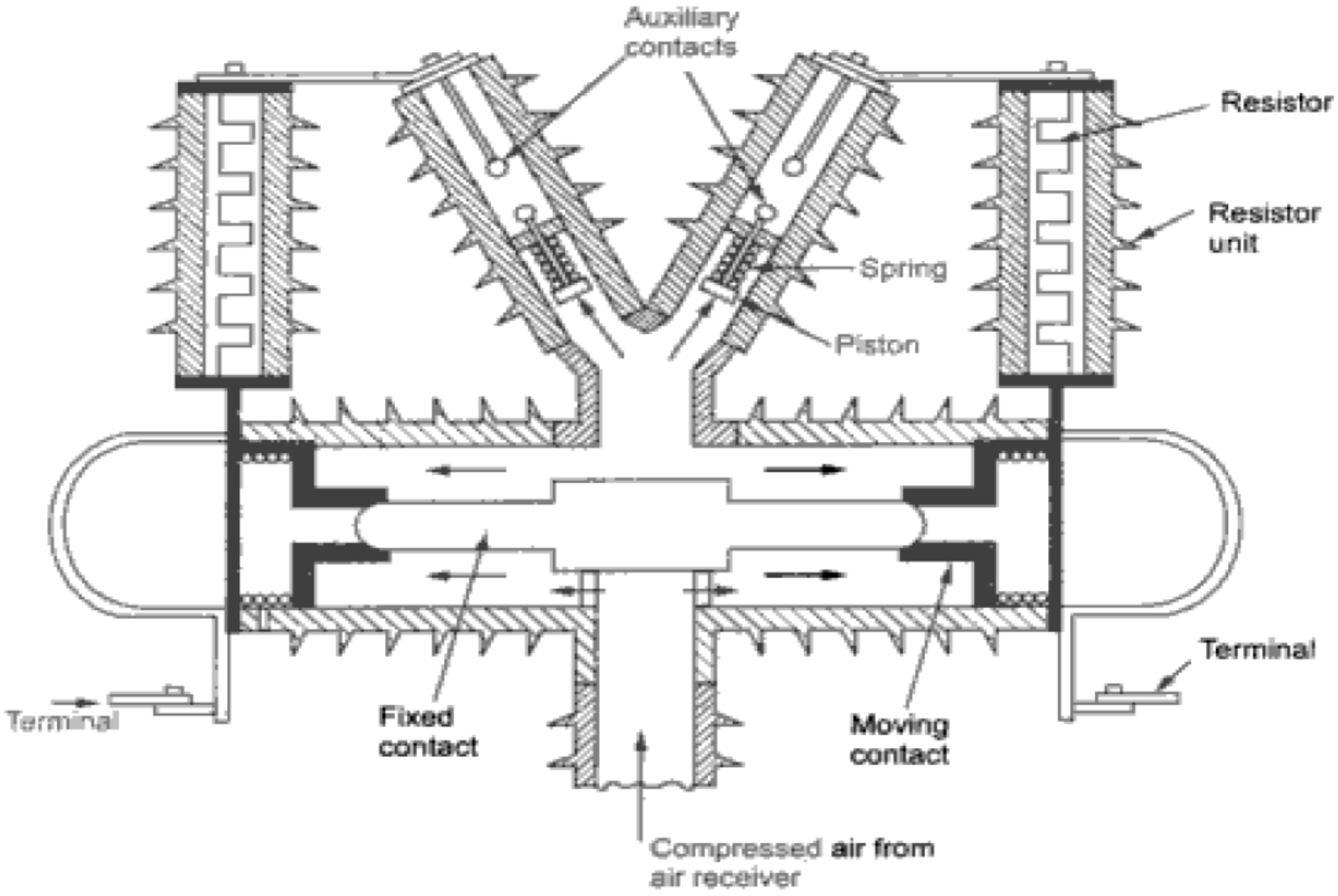
The design is such that the air expands into the low pressure (atmospheric pressure zone).The air at high speed removes heat from the arc, thus arc is quenched. Diameter of arc is reduced.

Uses

1.Arc Furnaces

2.Traction Syetems

Modification of Air Blast Circuit Breakers



Advantages of Air Blast Circuit Breaker

The various advantages of air blast circuit breakers are,

i) No fire hazards are possible with this type of circuit breaker.

ii) The high speed operation is achieved.

iii) The time for which arc persists is short. Thus the arc gets extinguished early.

iv) As arc duration is short and consistent, the amount of heat released is less and the contact points are burnt to a less extent. So life of circuit breaker is increased.

v) The extinguishing medium in this type of circuit breaker is compressed air which is supplied fresh at each operation. The arc energy at each operation is less than that compared with oil circuit breaker. So air blast circuit breaker is most suitable where frequent operation is required.

vi) This type of circuit breaker is almost maintenance free.

vii) It provides facility of high speed reclosure.

viii) The stability of the system can be well maintained.

Applications of Air Blast Circuit Breakers

The air blast circuit breakers are preferred for arc furnace duty and traction system because they are suitable for repeated duty. These type of circuit breakers are finding their best application in systems operating in range of 132 kV to 400 kV with breaking capacities upto 7000 MVA.

Disadvantages of Air Blast Circuit Breakers

The various disadvantages of air blast circuit breakers are,

i) If air blast circuit breaker is to be used for frequent operation it is necessary to have a compressor with sufficient capacity of high pressure air.

ii) The maintenance of compressor and other related equipments is required.

iii) There is possibility of air leakages at the pipe fittings.

iv) It is very sensitive to restriking voltage. Thus current chopping may occur which may be avoided by employing resistance switching.