

Northern India institute of technology

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A SEMINAR REPORT PRESENT ON

AIR BLAST CIRCUIT BREAKER

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submitted to:-

Acknowledgement

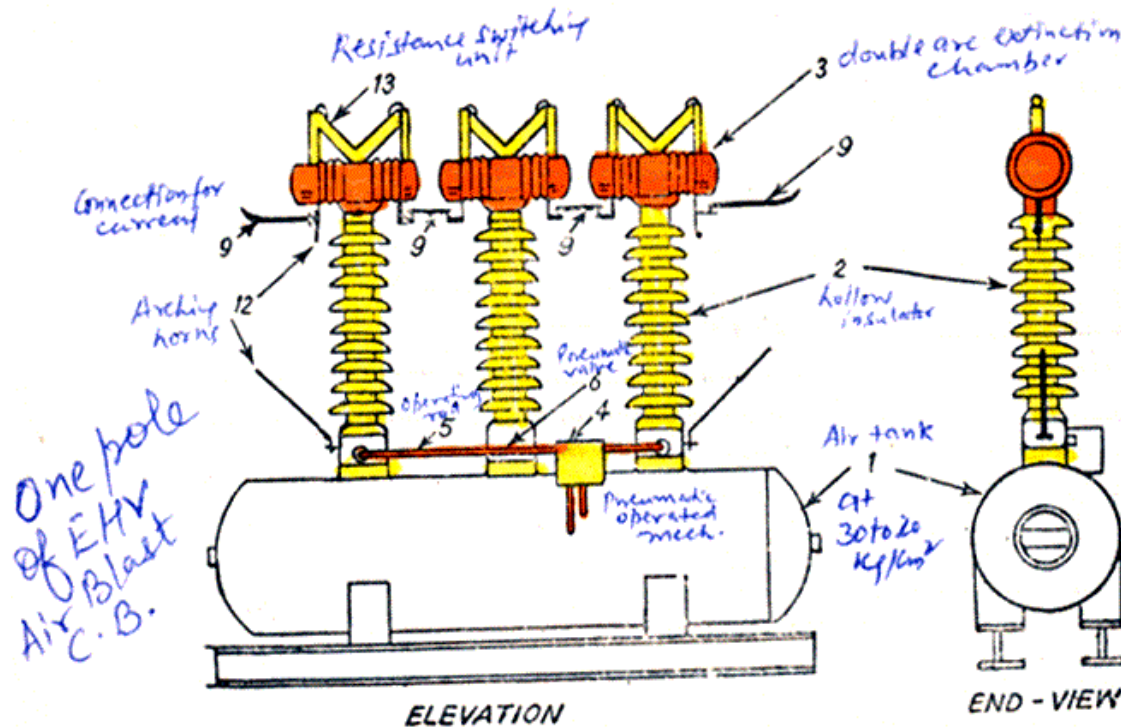
content

Topic	Page no.
Air blast circuit breaker	04
Principle of arc quenching in air blast circuit breaker	09
Resistance switching	14
Advantages and disadvantages	17
conclusion	18

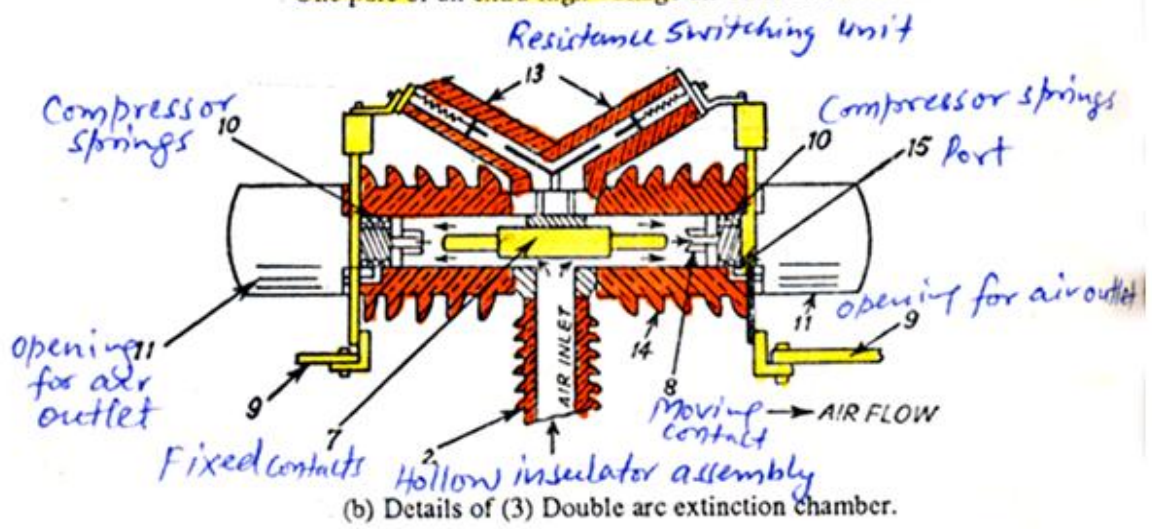
Air blast circuit breaker

Fast operations, suitability for repeated operation, auto reclosure, unit type multi break constructions, simple assembly, modest maintenance are some of the main features of air blast circuit breakers. A compressors plant necessary to maintain high air pressure in the air receiver. The air blast circuit breakers are especially suitable for railways and arc furnaces, where the breaker operates repeatedly. Air blast circuit breakers is used for interconnected lines and important lines where rapid operation is desired.

High pressure air at a pressure between 20 to 30 kg/ cm² stored in the air reservoir. Air is taken from the compressed air system. Three hollow insulator columns are mounted on the reservoir with valves at their basis. The double arc extinguished chambers are mounted on the top of the hollow insulator chambers. The current carrying parts connect the three arc extinction chambers to each other in series and the pole to the neighbouring equipment. Since there exists a very high voltage between the conductor and the air reservoir, the entire arc extinction chambers assembly is mounted on insulators



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



Since there are three double arc extinction poles in series, there are six breaks per pole. Each arc extinction chamber consists of one twin fixed contact. There are two moving contacts. The moving can move axially so as to open or close. Its position open or close depends on air pressure and spring pressure.

The operating mechanism operates the rod when it gets a pneumatic or electrical signal. The valves open so as to send the high pressure air in the hollow of the insulator. The high pressure air rapidly enters the double arc extinction chamber. As the air enters into the arc extinction the pressure on the moving contacts becomes more than spring pressure and contacts open.

The contacts travel through a short distance against the spring pressure. At the end of the contact travel the port for outgoing air is closed by the moving and the entire arc extinction

chamber is filled with high pressure air as the air is not allowed to go out. However, during the arcing period the air goes out through the openings and take away the ionized air of the arc.

While closing, the valve is turned so as to close connection between the hollow of the insulator the reservoir. The valve lets the air from the hollow insulator to the atmosphere. As a result of the pressure of air in the arc extinction chamber is dropped down to the atmospheric pressure and the moving contacts close over the fixed contacts by virtue of the spring pressure.

The opening is fast because the air takes a negligible time to travel from the reservoir to the moving contact. The arc is extinguished within a cycle.

Therefore, air blast circuit breaker is very fast in breaking the current.

Closing is also fast because the pressure in the arc extinction chamber drops immediately as the valve operates and the contacts close by virtue of the spring pressure.

WE CAN ALSO UNDERSTAND

AIR BLAST CIRCUIT BREAKERS AS :-

Circuit breakers are mechanical devices designed to close or open contact members, thus closing or opening of an electrical circuit under normal or abnormal conditions. Air blast circuit breakers are using compressed air or gas as the circuit breaking or interrupting medium. Gases such as nitrogen, carbon dioxide, hydrogen or Freon can be used as arc interrupting medium. But compressed air is the most accepted arc interrupting medium. The reasons are, nitrogen has circuit breaking properties similar to compressed air and there is no advantage of using it. Carbon dioxide has a draw back as it is difficult to control owing to freezing at valves and other restricted passages. Hydrogen has increased breaking capacity but it's costlier.

Freon has high dielectric strength and good arc extinguishing properties, but it is expensive and it is decomposed by the arc into acid forming elements.

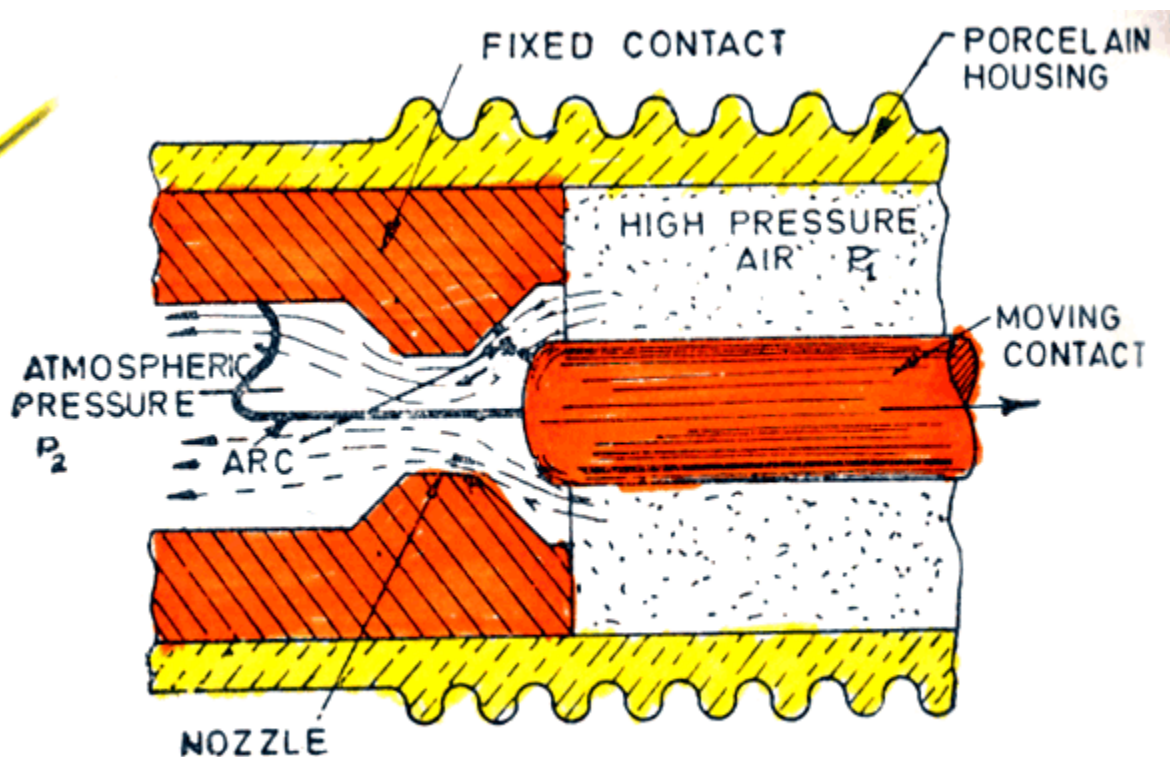
Desirable features of air blast circuit breakers are High speed operation, which is very necessary on large inter connected networks in order that system stability can be maintained and in the air blast circuit breaker this is achieved because the time interval between the receipt of a tripping impulse and contact separation is very short. Suitability for frequent operation, repeated switching by an air blast circuit breaker is possible simply because of absence of oil, which rapidly carbonizes with frequent operation, and because there is an insignificant amount of wear and tear at the current carrying contact surfaces. High speed reclosure by automatic means is an advantage on hv inter connected networks to assist and maintain system stability during the clearance of transient faults, a type of fault which is perhaps in majority on over head line. Negligible maintenance, the ability of the air blast circuit breaker to cope with repeated switching also means that negligible maintenance is required. Elimination of fire hazard, because of the absence of oil the risk of fire is eliminated.

Reduced size, the growth of dielectric strength is so rapid in air blast circuit breakers that final gap required for arc extinction is very small. This reduces the size of the device.

The air blast circuit breaker requires an auxiliary compressed air system which supplies air to the breaker air receiver. When opening is required compressed air is admitted to the arc extinction chamber. It pushes away the moving contacts. In doing so the contacts are separated and the air blast takes away the ionized gases along with it and assist arc extinction.

Principle of Arc quenching in Air Blast Circuit Breaker (ABCB)

It needs an auxiliary compressed air system which supplies air to the air receiver of the breaker. For opening operation, the air is admitted in the arc extinction chamber. It pushes away the moving contacts. In doing so, the contacts are separated and the air blast takes away the ionized gases along with it and assists in extinction. After a few cycles the arc is extinguished by the air blast and the arc extinction chamber is filled with high pressure air (30 kg/cm²). The high pressure air has higher dielectric strength than that of atmospheric pressure. Hence a small contact gap of few centimeters is enough.



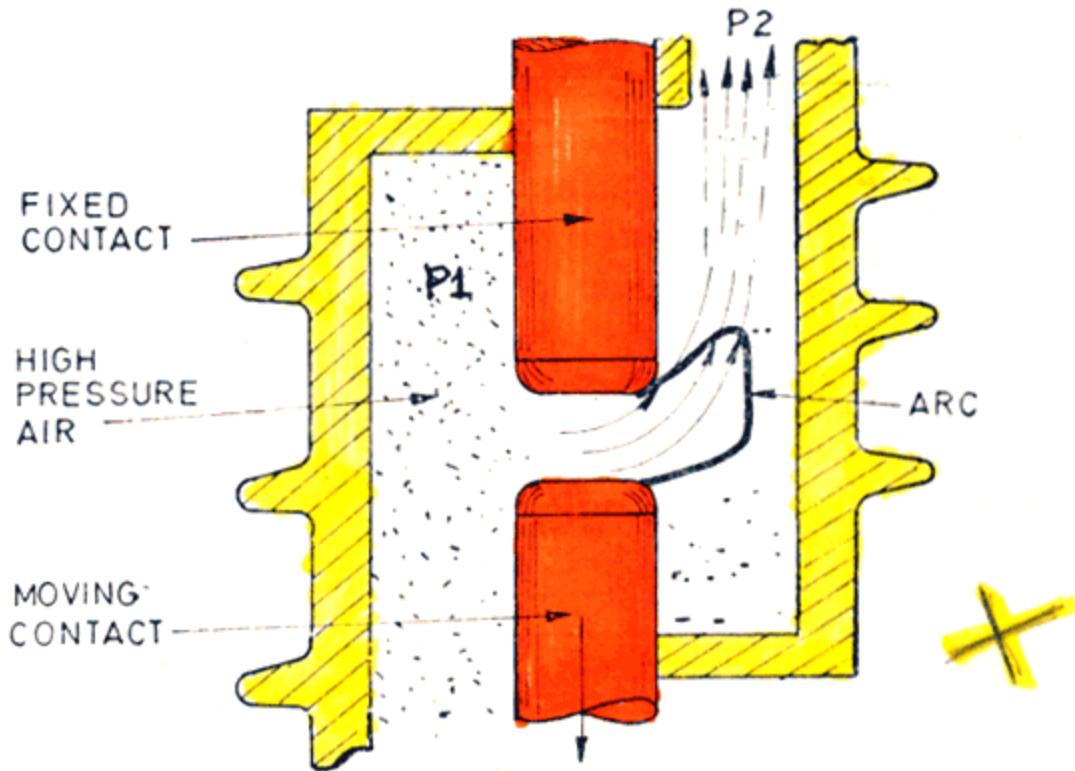
(a) Axial flow.

In axial blast type air flow, the air flows from high pressure reservoir to the atmospheric through a convergent divergent nozzle. The difference in pressure and the design of the nozzle is such that the air expands into the low pressure zone, it attains almost supersonic velocity.

The mass flow of air through the nozzle is governed by the parameters like pressure ratio, area of throat, nozzle throat diameter and is influenced by the diameter of the arc itself.

The air flowing at a high speed axially along the arc causes the removal of heat from the periphery of the arc and the diameter of the arc reduces to a low value at current zero. At this instant the arc is interrupted and the contact space is flushed with fresh air flowing through the nozzle.

The flow of fresh air through the contact space ensures removal of hot gases and rapid building up of dielectric strength.

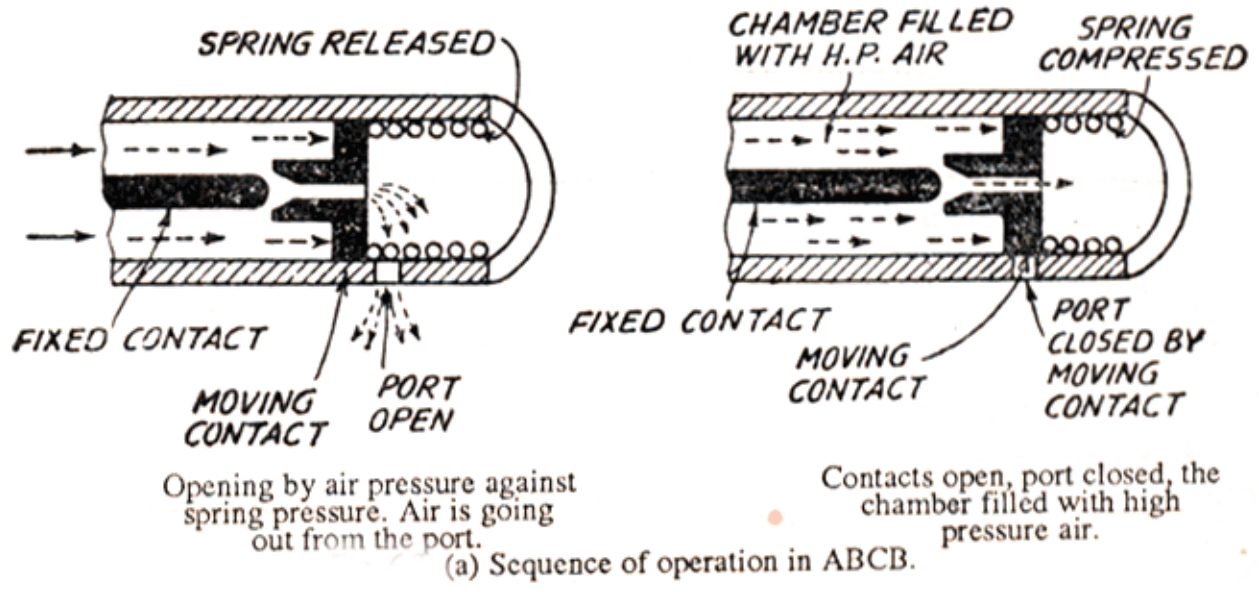


(b) Cross flow in ABCB—(Not used).

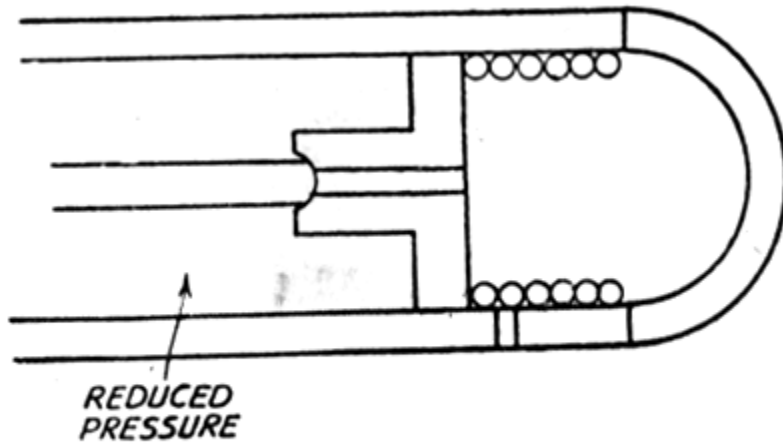
The principle of operation of cross blast flow is, the air flows around the arc and the diameter of arc is likely to remain stable for higher values of current.

During the period of arc extinction, the air continues to flow through the nozzle to the atmosphere. The mass flow rate can be increased by increasing the pressure of high pressure system. The increase in the mass flow results in the increased breaking capacity.

The air blast circuit breakers come under the class external extinguishing energy type. The energy supplied for arc extinction is obtained from high pressure air and is independent of current to be interrupted.



After the brief duration of air flow, the interrupter is filled with high pressure air. The dielectric strength of air increases with pressure. Hence the fresh high pressure air in the contact space is capable of withstanding the transient recovery voltage.



(b) Contact close by spring pressure against reduced air pressure.

After the arc extinction the interrupter chamber is filled with high pressure air. For closing operation, the air from this chamber is let out to the atmosphere.

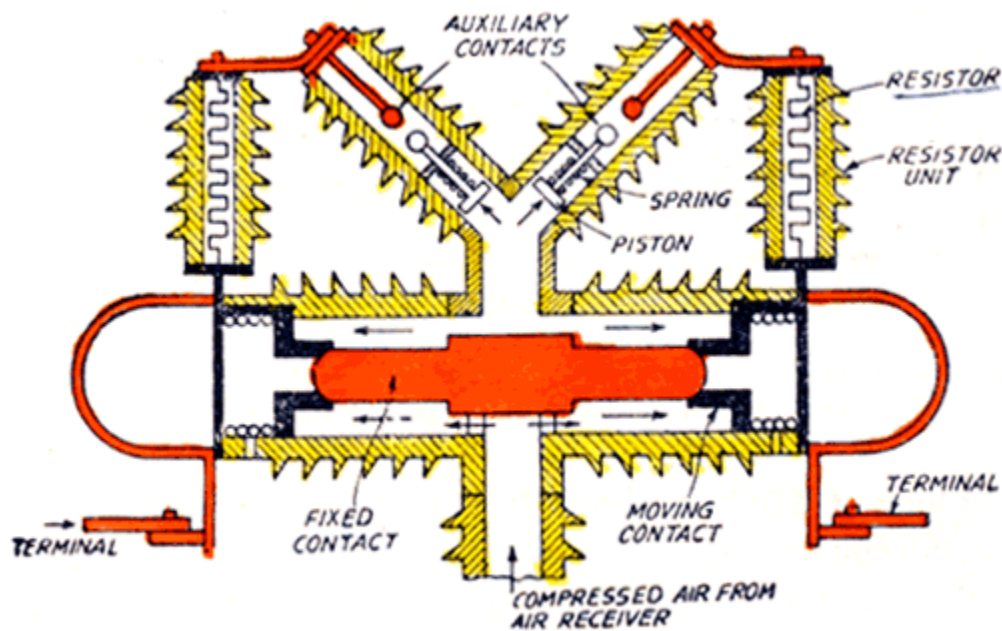
Thereby the pressure on the moving contacts from one side is reduced and the moving contacts close rapidly by the spring pressure.

Resistance Switching

The post zero resistance of contact space is high in air blast circuit breakers. This is because the contact clearance space is filled with high pressure air after final current zero and high pressure air has high dielectric strength. The high restriking voltage appears across the contacts does not damp out through the gap because of the high post zero resistance.

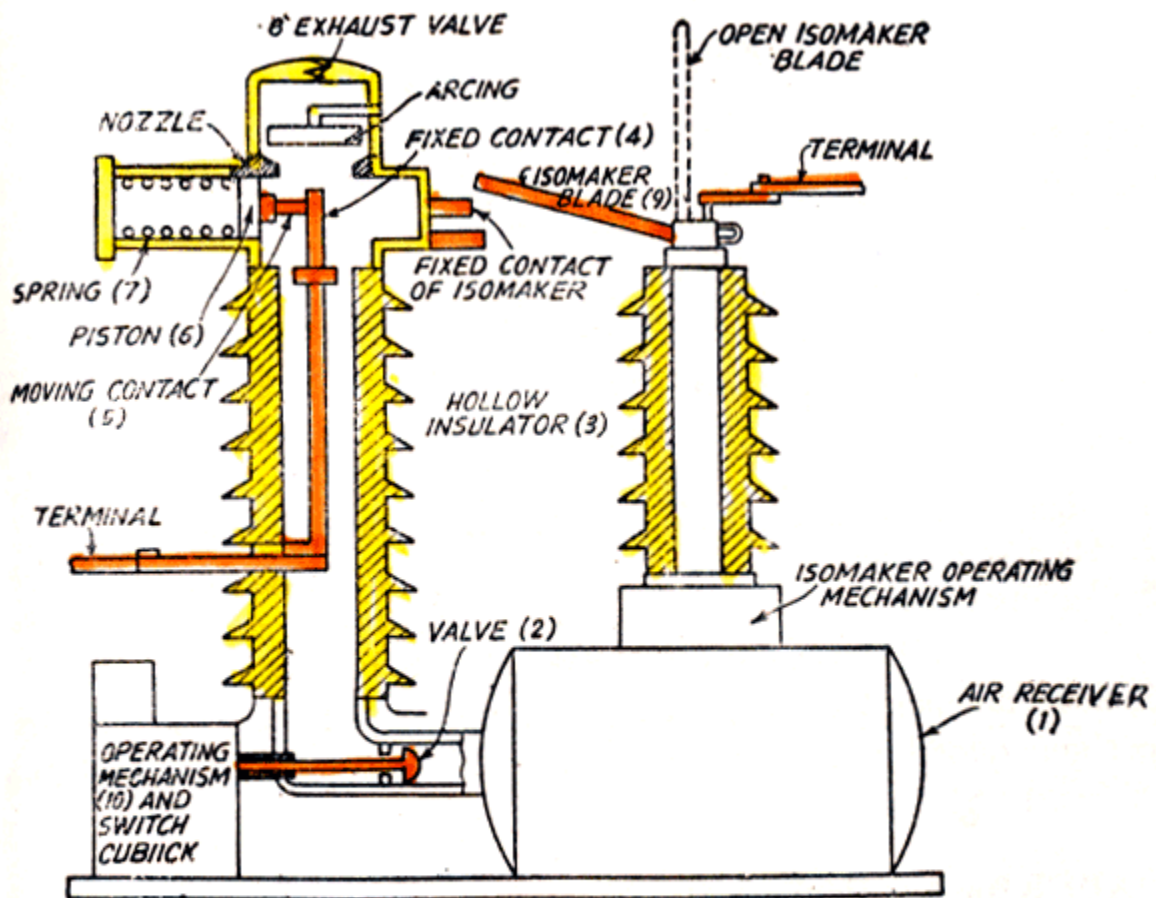
Further, voltages of the order of several times the normal voltage appear across the contacts because of current chopping. If these voltages are not allowed to discharge, they may cause break down of insulation of the circuit breaker or the neighboring equipment. To overcome this difficulty resistance switching is adopted. The usual procedure is to connect a resistance in shunt with the arc.

During the opening operation, air is admitted in the arc extinguishing chamber. It separates the main contacts and pushes the auxiliary contacts. The auxiliary contacts close, thereby the resistors are connected across the arc for a short time of arcing. The auxiliary contacts are located in the inclined V shaped insulators while the resistors are located in the vertical insulators. Immediately after the arc extinction the pressure on either side of the piston of auxiliary contacts gets so adjusted that the auxiliary contacts open and resistor circuit is interrupted. Ceramic resistances of non linear characteristics, similar to those used in the lightning arresters are used for resistance switching.



Configuration of switching resistors.

These consist of silicone carbide, bound by inorganic binders subjected to heat treatment. During high current, non linear resistor offers low resistance. Thus the main arc current is partly diverted through resistor unit. As current reduces, the resistance offered by non linear resistors increases causing a greater drop across the resistor units. Thereby the voltage available for arc between auxiliary contacts is no more sufficient and arc between auxiliary contacts is automatically extinguished.



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|--------------------------|--------------------|----------------------|
| 1. Air receiver, | 2. Valve, | 3. Hollow insulator. |
| 4. Fixed contact, | 5. Moving contact, | 6. Piston. |
| 7. Spring, | 8. Exhaust valve, | 9. Isomaker, |
| 10. Operating mechanism. | | |

25 kV Single Phase Air Circuit Breaker.

ADVANTAGES

1)The risk of fire is eliminated.

2)The arcing products are completely removed by the blast whereas the oil deteriorates with successive operations, the expense of regular oil is replacement is avoided.

3) Due to lesser arc energy, air blast circuit breakers are very suitable for conditions where frequent operation is required.

4)the energy supplied for arc extinction is obtained from high pressure air and is independent of the current to be interrupted.

DISADVANTAGES

1)Air has relatively inferior arc extinguishing properties.

2)Air blast circuit breakers are very sensitive to the variations in the rate of re-striking voltage.

3)Considerable maintenance is required for the compressor plant which supplies the air blast.

Conclusion:

Conclusion In near future, air blast circuit breaker is going to rule the breaker circuit class in almost all the fields and circuits regardless of low voltage or high voltage.

Types of breakers	Arc extinguished by	Medium of arc quenching	remarks
Air	Arc contact and arcing horns operating in air	Air	Used in ngd for voltages up to and including 13.6 kv.
Air blast	A blast of compressed air	Air	Used in ngd for high voltages 115kv, 230kv and 500kv.
oil	Oil	Oil	Used in ngd at 115kv and 230 kv.
Vacuum	Vacuum	Vacuum	Used at 3 hwp at 2.4 kv.
Sulpher hexa fluroids(sf6)	Sf6	Sf6	Gaining acceptance by oh. Available in range of voltage upto 500kv.