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Circuitbreakers

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Abstract

Circuit Breaker a mechanical switching device designed to carry current in normal operation and protection of the equipment and wiring in the event of overload or short circuit.

In this essay refers to the main nodes of circuit breakers, classification, what kinds of releases are their design and operation.

Introduction

Circuit breakers are electrical switching devices designed to carry current circuit in normal mode and for the protection of electrical networks and equipment from the emergency operation (short circuit, overcurrent, and others), as well as for infrequent switching rated currents (6-30 times night).

Due to the simplicity, convenience, safety and reliability of service protection against short circuit currents, these devices are widely used in electrical installations of low and high power.

Circuit breakers are switching devices of manual control, but many types have a solenoid or motor drive, allowing you to control them from a distance.

Function and principle of operation

Machines are switched off usually by hand, and in violation of normal operation (the appearance of an overcurrent or undervoltage) – automatically. In addition, each machine is equipped with overcurrent release, and in some types of undervoltage.

By function protection circuit breakers are divided into the following types:

- overcurrent.
- undervoltage.
- reversepower.

Machines are used for overcurrent automatic disconnection of electric energy in case of short-circuits and as overload protection in an event occurring beyond a safe limit.

Classification

Circuit breakers are divided into:

- installation circuit breakers – they have a protective insulation (plastic) body and can be installed in public places ;
- universal – do not have this body and are designed for installation in switchgear;
- fast (own response time is less than 5 ms);
- low-speed (10 to 100 ms); from 10 to 100 milliseconds.

Response is provided for rapid quenching of the electric arc.

- selective with adjustable response time in the area of short circuit currents ;
- automatic reverse current, triggered only in case of changing direction of the current in the protected circuit ;
- Polarized machines break a circuit only when the current rise occurs in the forward direction, unpolarized – in either direction of the current.

Design

Design features and operation of the machine are determined by its purpose and scope.

Turning on and off the machine can be done manually or by means of operating motorized electromagnetic drive.

Hand drive used at rated currents up to 1000 A and provides a guaranteed limit switching capacity regardless of speed including handle (the operator must perform switching operation manually).

Electromagnetic and electric motor drives are powered by voltage sources. Drive control circuit must be protected from reclosing on a short circuit, while the process of turning the machine to limit short-circuit currents must stop at a supply voltage of 85 – 110 % of nominal.

With overload and short-circuit currents circuit breaker is made regardless of whether the control lever is held in the closed position.

An important part of the machine is a release that controls the specified parameter of the protected circuit and affects the tripping device, which disables automatic. In addition, the release allows remote shutdown of the machine.

Basic components of the circuit breaker

- the contact system.
- arc system.
- releases.
- governance mechanism.
- trip-free mechanism.

Contact system consists of fixed contacts, fixed in the housing and a movable contact pivotally planted on a half- arm control mechanism and provides, usually, a single open circuit.

Interrupter device is installed at each pole of the breaker, and is intended to localize the electric arc to a limited extent.

Freewheel decoupling is articulated 3 – or 4 -pole mechanism that ensures tripping on and off as the contact system in both automatic and manual control.

Electromagnetic overcurrent release is an electromagnet with armature provides automatic circuit breaker at short circuit currents above the setpoint current. Magnetic trip device current with hydraulic slow response has inverse- time delay for overcurrent protection.

Maximum heat release is thermal bimetallic plate. At overload currents deformation and efforts of this plate provide automatic shutdown of the switch. Exposure time decreases with increasing current.

Semiconductor releases consist of a measuring element, the semiconductor relay unit and the output of electromagnet acting on a trip-free mechanism for the machine. As a measuring element the current transformer (on alternating current) or the throttle magnetic amplifier (on a direct current) is used.

Widespread releases of the following types

- electromagnetic protection against short-circuit currents ;
- thermal overload protection;
- combined;
- semiconductor having high stability and ease of operation parameters to configure.

For switching circuit without current or rare switching rated current machines can be used without releases.

Commercial series circuit breakers are designed for use in various climatic zones, placement in locations with various operating conditions, to work in an environment of different mechanical stress and explosion protection, and have varying degrees of shock protection from external influences.

Information on specific types of devices, their standard performance and sizes refer to the regulatory and technical documents. Typically, this document is technical specification (TS) of the plant. In some cases, in order to unify the products having wide application and manufactured at different plants, the document level increases (sometimes to the level of the State Standard).

Conclusion

In conclusion, I would like to say that the circuit breakers play a huge role in the electric power industry. This device is very important in our lives, so it protects the electrical network from short circuits and from various emergency conditions. Accidents can occur everywhere, such as in homes so industrial facilities.

References:

1. <http://electronics.howstuffworks.com/circuit-breaker.htm>.
2. <http://electralschool.info/spravochnik/apparaty/23-avtomaticheskie-vykljuchateli.html>.
3. http://en.wikipedia.org/wiki/Circuit_breaker.

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Wind power benefits

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I've read in the Internet, that [1]"Canadian company Magenn Power tried the unusual type of the generator in the form of the revolving dirigible, which is able to get the wind from the big height. Flying wind-turbine is called MARS(Magenn Power Air Rotor System). Under the influence of the air stream its balloon revolves on its horizontal axis, to which generators are attached, and ropes, maintaining the dirigible at the one place and conveying the received electricity to the ground." I was interested, in what condition is the energetic problem nowadays and what is its solution. This is how the theme of my project "Wind power benefits" arose.

Practical part:

- 1) To make a calculation of the capacities of the ideal model of the wind-powered generator.
- 2) To make a calculation of the capacities of the ideal model of the wind-powered generator with all the losses.
- 3) To define the coefficient of the efficiency of the wind-powered generator and make a calculation of money saving depending on the number of windy days.
- 4) Make a conclusion about a rationality of the usage of the wind-powered generator.

There is a serious problem how to provide enough quantity of the electric power, fuel and raw materials. Fuel and energy resources constantly run out and in some hundreds years can totally disappear.

The principle part of energy, being consumed by mankind, we get from black coal, oil and gas, i.e. from materials which are called fossil fuel. This type of energy is called non-renewable energy because it cannot be used twice. Fossil fuel cause pollution of the environment, and, more than that, its reserves are limited. However, people's necessity in energy is so high that they continue to use this type of fuel.