INSTRUCTIONS

HIGH-SPEED CIRCUIT BREAKERS

TYPE JR

GENERAL ELECTRIC
SCHENECTADY, N.Y.

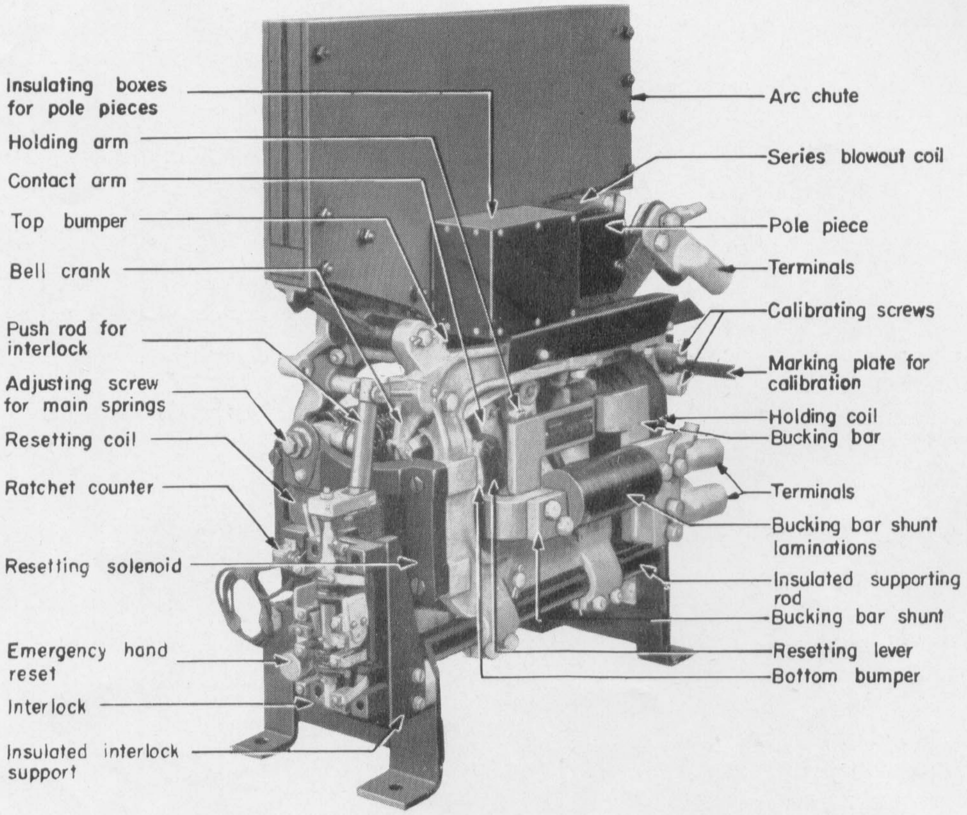


Fig. 1. Typical Type JR high-speed circuit breaker

HIGH-SPEED CIRCUIT BREAKERS

TYPE JR

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

The Type JR breaker is for the protection of synchronous converters, mercury-arc rectifiers, generators, motor-generator sets, motors and feeders from damage due to short circuit or heavy overload conditions. The breaker is arranged for remote control from the switchboard panel, for both closing and tripping operations.

INSTALLATION

The breaker may be installed on the floor of a substation, in the gallery of a station, or may be mounted on substantial framework. The feet of the breaker may be bolted to a concrete floor or mounted directly on framework without additional insulation. In selecting a location, take care to have sufficient clearance above the arc chute to prevent the arc connecting to any grounded metal; these clearances vary with the voltage and are given in the outline drawing furnished with the breaker.

The following points should be observed in selecting a location for the breaker:

(a) The location must be free from severe dampness.

(b) Provide sufficient clearance for inspection and removal of the arc chute, and space for closing the breaker manually with the reset handle.

(c) Dust and metal particles must not be permitted to fall into the arc chute.

(d) Provision must be made to protect operators from contact with live parts of the breaker, including the frame.

For generator or synchronous-converter negative breakers it is recommended that the breaker be installed adjacent to the machine on the floor of the station; this permits placing the breaker in the generator circuit with the minimum amount of wiring.

For feeder or generator positive breakers the breaker may be installed in a gallery erected above the d-c switchboard panel; in this construction the disconnecting switches may be located in a concrete cell and the breaker directly above, making it convenient to connect to the disconnecting switches with busbars; this arrangement is especially recommended for high-voltage installations.

The breaker may also be mounted on top of the switchboard framework or, if it is clean and dry, in the basement in a place adjacent to the switchboard panel.

Load-limiting Resistor

The load-limiting resistor is connected to the two small terminals on the breaker, and should be located as close as possible to the breaker. This is usually done by mounting the resistor on the ceiling of the room immediately under the breaker. The resistor should be insulated from its supports by porcelain bolt insulators.

Control Apparatus

The control apparatus required in a manually operated station for control potentials of 750 volts or less includes the following:

1. A control fuse for protection of the control circuits.

2. A single-pole, single-throw, pull-button opening switch for de-energizing the holding coil to open the breaker.

3. A single-pole, single-throw, pull-button closing switch for energizing the resetting contactor.

4. A red lamp and a green lamp, connected through interlocks on the breaker to indicate when the breaker is closed and open, respectively.

5. A resistor to be connected in series with the indicating lamps where the control potential of

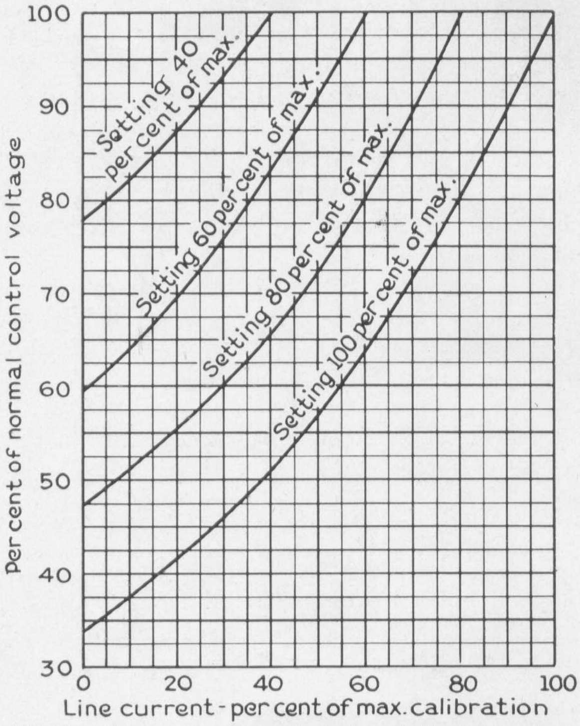


Fig. 2. Curves showing effect of variation of control voltage on tripping point of breaker

the indicating lamp circuit is greater than 125 volts.

6. A resistor to be connected in series with the holding coil across which the resetting contactor coil is usually operated.

Items 1, 5, and 6 should be mounted on the back of the generator or feeder panel, and the pull-button switches and indicating lamps on the front of the panel.

In case the control voltage is variable there will be required in the holding circuit an ammeter and a regulating rheostat which can be mounted on the panel of the generator or feeder with which the breaker is used.

If several breakers in one station are to be operated from a variable source of control voltage, a regulated control bus is usually used, the voltage of this bus being held constant by means of a regulating rheostat. This arrangement is usually used with a storage battery where, during the overcharge period, the control voltage might be raised 25 or 30 per cent above normal. The rheostat and voltmeter can be located on the battery-charging panel so that adjustment of the voltage of the battery-charging motor-generator set and the voltage of the regulated bus can be made at the same time.

CONNECTIONS

All necessary external connections should be made in accordance with the wiring diagram furnished with the breaker.

The main frame of the breaker is in the main current circuit and is not grounded; therefore, it must be considered to be at the potential of the circuit and should not be touched unless the breaker is disconnected from the circuit.

Terminals are usually furnished for the outgoing cables, but busbar connections can be furnished if desired.

Exercise care in making connections to see that the direction of current flow through the main circuit and the connections to the holding coil are as shown in the wiring diagram.

When the breaker is installed in the negative side of the generator circuit, see that the breaker is connected to the armature or commutating field so that when two or more generators in a station are operated in parallel the breaker will be connected between the equalizer switch and the armature; otherwise the resistance would be cut in series with the series field and not with the armature. On 3000-volt installations the breaker should be connected in the circuit next to the armature in order to prevent high-voltage strains between the field winding and the frame of the generator when the breaker opens up on overload. On 1500-, 1200-, and 600-volt generators and synchronous converters it is recommended that the breaker be connected between the armature and commutating fields; however, in some cases on these lower voltage generators it may be necessary to make the connection between the commutating field and the series fields because of the arrangement of cables to the armature and fields.

When the breaker is used in feeder circuits of 1200 volts and above, it is good practice to install a disconnecting switch on each side of the breaker to isolate it for inspection or repairs. On 600-volt circuits at least one switch should be installed to disconnect the breaker from the bus.

ADJUSTMENT

Calibrating Screws

Changes in the current required to trip the breaker are obtained by means of the two screws inserted in the magnetic circuit at the end of the holding coil. By turning these screws out of the steel bar the reluctance of the holding magnetic circuit is increased, thus decreasing the magnetic flux holding the armature closed and allowing a lower main current to trip the breaker. The breaker is calibrated by marking the trip current for a number of different positions of the calibrating screws on the adjacent brass plate. On breakers with square-head calibrating screws, the bottoms of the heads are the reference points for the markings on the plates.

Effect of Voltage Fluctuation on Calibration

When the holding coil of the breaker is excited from a source subject to considerable fluctuation in voltage, the magnetic flux in the holding-coil circuit will vary with the voltage, thus changing the calibration of the breaker. This change is more noticeable at the lower tripping points, as shown in Fig. 2. These curves show the effect of changes in control voltage on the tripping point of the breaker when set to trip at different values.

Where the voltage to the holding coil is variable, as from a storage battery during the overcharge period, the current in the holding coil should be held constant at a specified value by means of an adjusting rheostat, using an ammeter in the circuit to read the current. If several breakers are installed in a station, a single rheostat may be used to hold a potential constant on an auxiliary bus from which all of the holding coils are energized, and a voltmeter should be used to read the potential of the regulated bus.

Spring Adjustment

The springs are set to give about 285-lb tension with the breaker closed. This tension may be checked approximately by attaching a spring balance to the end of the manual reset handle, 14 in. from the boss on the closing lever, against which the handle rests. The spring balance should indicate a pressure of 110 lb when just forcing the holding arm against the pole piece with the holding coil de-energized.

If the breaker is to be disassembled, measure the distance between the projection of the reset coil casting used as an anchor for the springs and the cross piece to which the stationary ends of the springs are attached. This distance should be measured accurately, and when the breaker is reassembled the springs should be replaced in their position by means of this measurement.

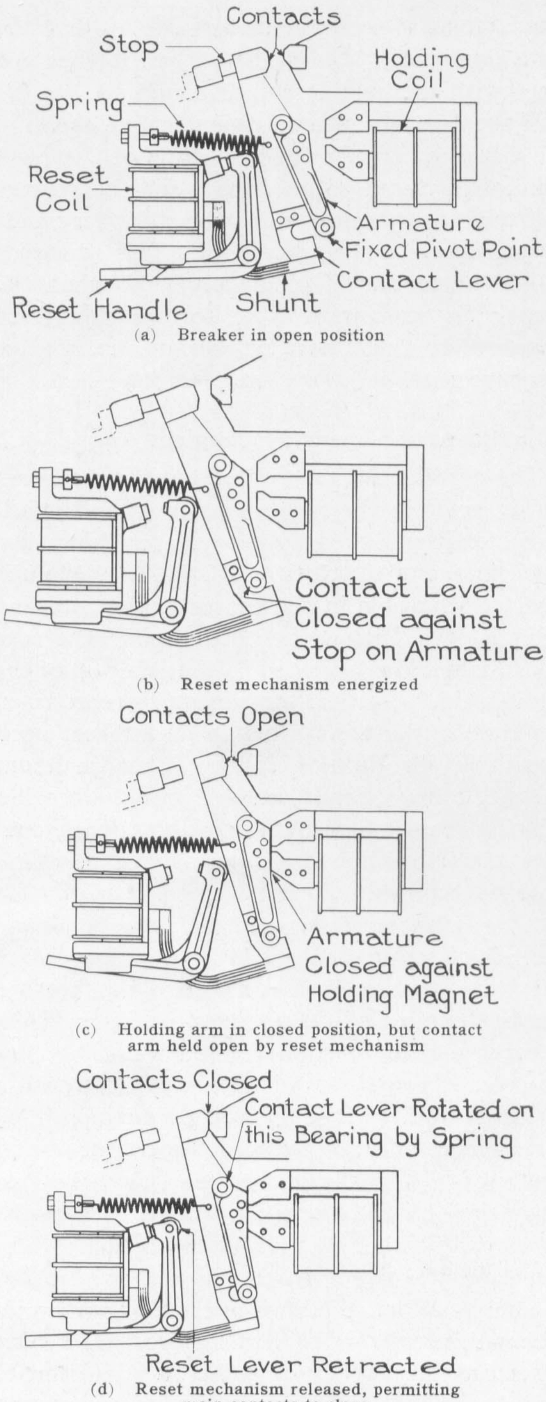
Adjustment of Closing Mechanism

The core in the top of the resetting magnet coil is made in the form of a screw, and is adjustable. It is locked by a small punching that fits into one of the slots cut in the top. A pin is inserted in a hole in the center of the core and extends ¼ in. below the bottom end. The core of the solenoid is adjusted so that the top of the pin is ⅛ in. below the top edge of the core when the resetting lever is lifted to its farthest position in the direction of closing. This adjustment should be made carefully whenever the breaker is being reassembled. Any tendency of the contact arms to rebound in closing can be eliminated as follows:

Alternately raise the resetting magnet core and reset the breaker electrically with no load, until the core position is found where the breaker starts "pumping." Mark this position. Then lower the core in similar manner until a low position is found at which the breaker again starts pumping. Mark this second position, then set the core midway between the two positions. The upper and lower positions may be distinguished by the manner in which the breaker "pumps." With core too high the breaker closes too hard, the tips slam closed, and the breaker rebounds. When the core is too low, the reset mechanism strikes the core before the breaker armature can seal shut and the breaker immediately opens.

Trip-free Reclosure

The breaker may be closed on a circuit under load without impairing its usefulness, and it is



(a) Breaker in open position

(b) Reset mechanism energized

(c) Holding arm in closed position, but contact arm held open by reset mechanism

(d) Reset mechanism released, permitting main contacts to close

NOTE: It is seen that the reset mechanism must be retracted before the main circuit can be closed, thus permitting the breaker to trip immediately in case of overload or short circuit.

Fig. 3. Leverage arrangement used to obtain trip-free action

therefore unnecessary to provide a line switch in series with the breaker that recloses the circuit.

The arrangement that permits this trip-free action is shown in Fig. 3. The holding arm that carries the armature is pivoted at the bottom to the main breaker frame and at the top to the contact arm that carries the moving tip. When the breaker is closed the reset mechanism acts through the reset lever and revolves both arms around the lower pivot of the holding arm until the armature is in contact with the holding magnet. However, the main contacts are held apart until the reset lever drops back. Spring tension causes the contact arm to rotate around the top pivot of the holding arm and the main contacts to close. Thus, the breaker is in readiness to trip when the main contact is made.

Contact Tips

The contact tips should be replaced when they are worn to the limits shown in Fig. 4. When inspecting or replacing contacts, the arc chutes may be removed, or they may be turned back by unfastening one end. If desired, the pole pieces may be removed by taking out two screws, one of which supports each of the insulating blocks and boxes covering the ends of the pole pieces; remove the two nuts, one on each end of the core of the series blowout coil, and then remove the supporting screws by inserting a screw driver in the hole in the top of the insulating boxes.

The stationary tip is held by three screws, and the moving tip is held by four bolts that extend through the arm. The surface on the contact arm against which the movable contact clamps will oxidize when it is exposed to the air; this oxide must be removed and the surface polished and coated with petroleum jelly before replacing the contact tip.

INSPECTION PRIOR TO PLACING IN SERVICE

Before placing the breaker in service, check the wiring with diagram furnished and see that none of the low-voltage control wiring is con-

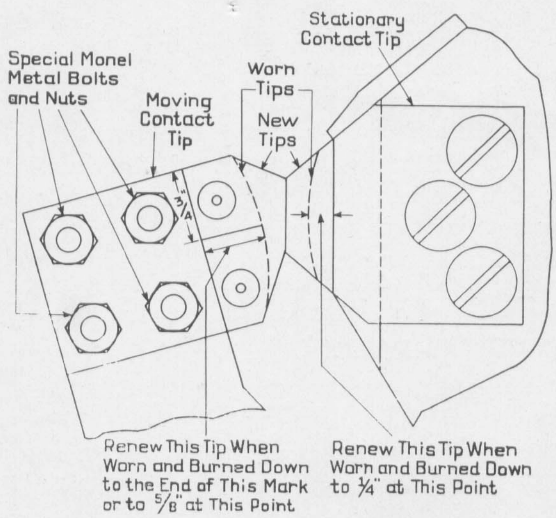


Fig. 4. Contact-tip wear limits

nected to or is close to the high-voltage parts of the breaker.

See that the calibration screws are set to the proper value for the circuits to be protected.

Operate the breaker by means of the hand lever to see that the parts are free from binding.

Blow out with compressed air any accumulated dust or dirt from the contacts and operating parts of the breaker.

It is very necessary that the pole face and face of armature be clean and smooth.

Inspect the grids of the load-limiting resistor to see that none are broken and that all the terminals are tight and well soldered.

Energize the holding coil circuit with the proper control voltage; then close the pull-button "closing" switch which will energize the coil of the resetting contactor and cause the breaker to close and remain closed. Open the pull-button "opening" switch to see that the breaker opens properly, and observe that the red light is showing only when the breaker is closed and the green one is lighted only when the breaker is open.

Close the negative JR breaker and then the generator positive breaker with the generator shut down and the disconnecting switches open. Trip the negative JR breaker with the pull-button "opening" switch and see that the generator positive breaker opens immediately after the negative JR breaker, thus checking the connections to the undervoltage release or shunt trip.

When closing the JR breaker the pull-button "closing" switch should be held closed only long enough for the breaker to close fully.

When the generator is connected to the bus, arrangements should be made to obtain sufficient load through the breaker to see that the breaker trips properly, and that the connections are correct. If the breaker fails to trip at approximately the current for which it is set it will probably be found that the direction of current through the main circuit or through the holding coil is reversed.

OPERATION

For Generators or Converters in Manually Operated Stations

Close the JR breaker, and then close the positive breaker or switch. Be sure to close the JR breaker first; otherwise, current will be put through the load-limiting resistor, and since this is for very short time duty only it may be burned out.

When shutting down the generator, open the negative JR breaker by means of the pull-button "opening" switch. The opening of the JR breaker will trip the positive breaker to cut the generator off the bus.

For Feeders in Manually Operated Stations

Close the disconnecting switches, and then close the JR breaker with the pull-button "closing" switch. If there is a short circuit on the line the JR breaker will open immediately.

When cutting off a feeder, open the JR breaker with the pull-button "opening" switch.

Inductive Shunt

Many JR breakers are equipped with an inductive shunt around the bucking bar. The inductance of this shunt is usually adjusted to give a lower tripping point for rapidly rising currents than for steady currents. Thus, when a short circuit occurs the current rises at a very rapid rate, and the breaker starts to open at a lower value than would be the case with a steady load. If the breaker is found to be too sensitive, particularly when closing on non-inductive loads near the trip point, the inductive ratio may be reduced by removing some of the washers from the bucking-bar shunt. The total length of iron on the bucking-bar shunt should not be less than 1½ in., for under this condition the trip point is the same for both rapidly rising currents and for steady overloads.

SEMI-ANNUAL INSPECTION

The breaker should be inspected thoroughly every six months, or more often if operating conditions warrant. The following points should be observed.

1. Examine the main contact tips, and if they are pitted file them smooth with a fine file.

2. Remove metallic fouling from the inside area of the arc chute.

3. Clean the faces of the holding magnet and armature and apply a coat of light grease.

4. Check the adjustment of the interlock mechanism and be sure that the interlock rod is not jammed when the breaker is closed. Replace the contacts if necessary.

5. Check for loose nuts or worn parts.

RENEWAL PARTS

Renewal parts may be ordered by Cat. No. if a Renewal Parts Bulletin is available. Otherwise, give a complete description of the part wanted and all data that appear on the nameplate of the apparatus. Order parts from the nearest Sales Office of the General Electric Company.

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