Westinghouse

Types HR and HRC Relays

INSTRUCTIONS

Caution

Before putting protective relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

Description

Types HR and HRC relays are directional instantaneous overcurrent relays, designed to obtain high-speed directional line and ground protection. They consist of a high-speed inductor loop type directional element, and an instantaneous overcurrent element.

Type HRC relays are like HR relays except the directional element is current polarized instead of voltage polarized. The conventional voltage coil is replaced by a current coil which is energized from the current transformer in the grounded neutral of the power transformer.

Application

Parallel Line

For the balanced protection of parallel lines the HR and HRC relays have their overcurrent windings connected in the differential circuit of cross-connected current transformers and provide high-speed balanced protection during parallel line operation. For single line operation additional relays with appropriate time characteristics are required. The external diagram, Fig. 7, shows connections for both parallel and single-line operation using HR relays for high-speed balanced phase and ground protection and CR relays for single-line operation. The SV relays prevent incorrect breaker tripping during switching.

Single Line

HR and HRC relays are suitable for the following single-line protection applications:

1- Those cases where there is no question of selection with succeeding sections, as on loop systems having power supply at but one point on the loop. On these single-source, loop systems, HR and HRC relays are applicable at points most remote from the source electrically in the direction in which the relay trips, that is, on the distant ends of sections adjacent to the source.

2- Those cases where the fault-current magnitude is a fair measure of distance irrespective of source capacity, as on the lines whose impedance is high compared to the system impedance back of the line. For these applications, the HR or HRC relay, overcurrent-element pickup must be just above the maximum instantaneous asymmetrical fault current for a fault at the next bus with maximum connected capacity. Faults closer to the relay give currents above the pickup point of the overcurrent element and cause instantaneous operation. If the system impedance does not increase appreciably in changing from maximum to minimum capacity, a large portion of the line will be provided with high-speed relay operation. Protection for the remainder of the line section as well as backup protection for the next line section must be obtained with additional relays having suitable timing characteristics.

Construction

HR Relay - The overcurrent element consists of a solenoid coil and plunger to which the contacts are fastened. The coil, which is wound on a micarta spool, has a tap lead at a point equal to approximately 2/3 of the full winding. See Fig. 4. Normally, the tap lead is dead ended. To use the tap on the coil, remove the lead from terminal #4 and replace with the tap lead.

The directional element is of the induction dynamometer type. The rectangular loop of aluminum to which the moving contacts are fastened forms a short-circuited secondary of a small transformer. The primary consists of the voltage coil. The loop is in the field produced by the current coils. Torque is caused by the interaction of the current flowing in the loop and the current flux threading the loop.

HRC Relay - The HRC relay is similar to the HR except the voltage coil on the directional element is replaced by a current coil, thus polarizing the directional element on current alone. One current coil utilizes the neutral current of the power transformer while the other uses the residual current of the line.

Both relays are provided with a universal operation indicator and a contactor switch. The latter is provided with three contacts, two of which short out the relay trip contacts after the relay has operated to close the trip circuit. The third contact is provided for a bell alarm circuit. The indicator is adjusted to trip at 0.9 amperes d-c. and the contactor switch to pick up at 2 amperes. For positive operation, at least four amperes should flow in the trip circuit. The relay trip circuit resistance is approximately 0.4 ohms.

The main relay contacts will safely close 50 amperes at 125 volts d-c. and the contactor switch contacts will carry this current until the trip circuit is interrupted by the auxiliary switch on the breaker.

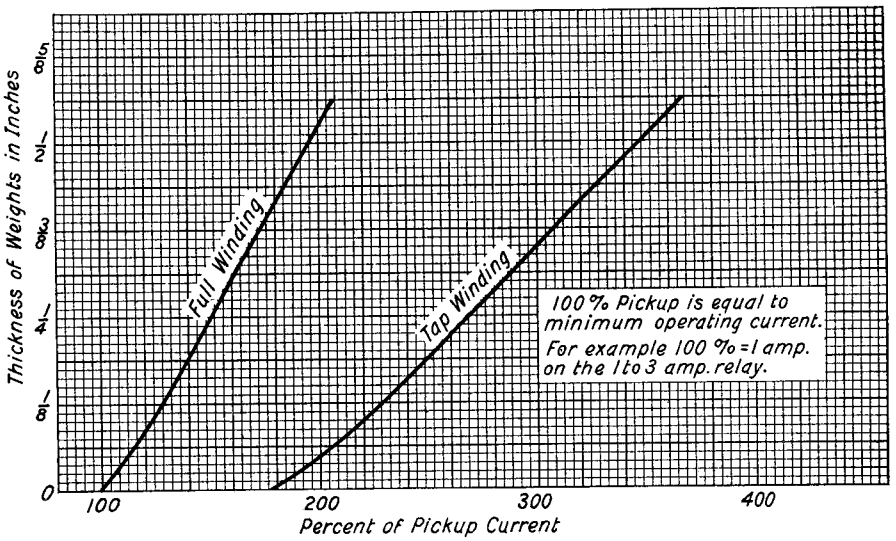

FIG. 1-PICKUP CURVES AT 60 CYCLES FOR TYPES HR AND HRC RELAYS

Operation

The overcurrent element operates in 1 cycle or less and the operating point is varied by changing weights on the plunger and also by taps on the coil. See Fig. 1. The characteristics of the overcurrent element are shown in Fig. 2.

The directional element operates on 4 amperes, 2 volts in phase.

The directional element of the HRC will operate on a minimum of 1.5 amperes in each winding when the currents through both windings are in phase.

Coil Ratings

The overcurrent element of the HR and HRC are available in the ranges shown in the table below, or the coil in the relay can be replaced by the proper coil to give any one of these ranges.

The volt-ampere burden of the directional element current coil of the HR or HRC that is in series with the overcurrent element is a 4 volt-amperes at 5 amperes. Power factor: 86%.

The volt-ampere burden of the voltage coil of the HR at 125 volts, 60 cycles is 4. Power factor: 90%.

The volt-ampere burden of the current coil of the HRC that is connected in the secondary of a current transformer in the neutral of the power transformer bank is 4 volt-amperes at 5 amperes. Power factor: 90%.

COIL RATINGS

			Overcurrent Element				
			Burden at 5 Amperes, 60 Cycles.				
Range, Amperes	Continuous Rating Full Winding Amperes	Continuous Rating Tap Winding Amperes	Full Winding Volt-Amps.	Watts	Tap Winding Volt-Amps.	Watts	Style No. Coil
0.5-1.5	0.75	1	500	350	200	140	704 734
1-3	1.5	2	160	88	55	35	680 682
2-6	3	4	40	22	14	8.8	680 341
4-12	6	8	10	5.5	3.5	2.2	703 601
8-24	12	16	2.5	1.4	0.9	0.6	680 683

Installation and Connections

The relay should be mounted on a switchboard panel free from excessive vibration. After mounting, remove the blocking from the moving elements.

External connections for the HR and HRC relays are shown in Figs. 6 and 7 respectively. Connections using a combination of HR, CR, and SV relays for parallel and single-line protection are shown in Fig. 7.

Adjustments

Overcurrent Element

The pickup current adjustment is made by adding weights to the plunger. The required number of weights are slipped on the threaded shaft carrying the plunger and then clamped in place by a nut and lockwasher. The pickup and dropout curve is shown in Fig. 2.

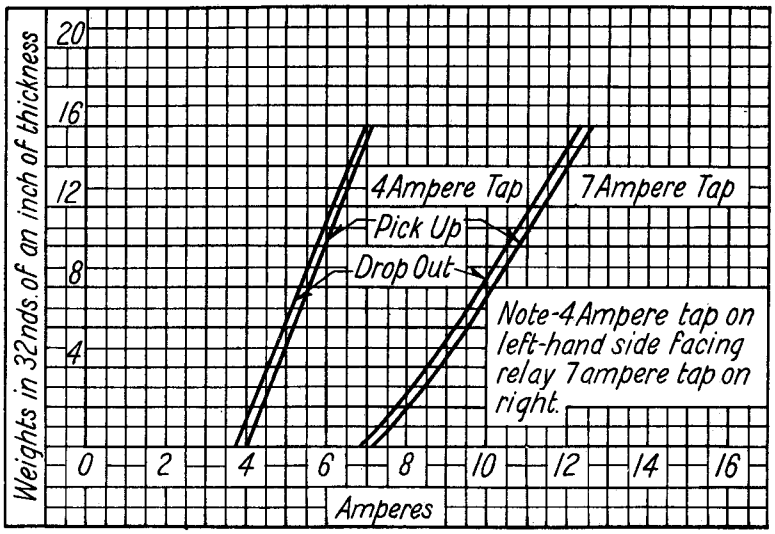

FIG. 2-OPERATING CHARACTERISTIC CURVE FOR TYPES HR AND HRC RELAYS

OUTLINE DIMENSIONS IN INCHES

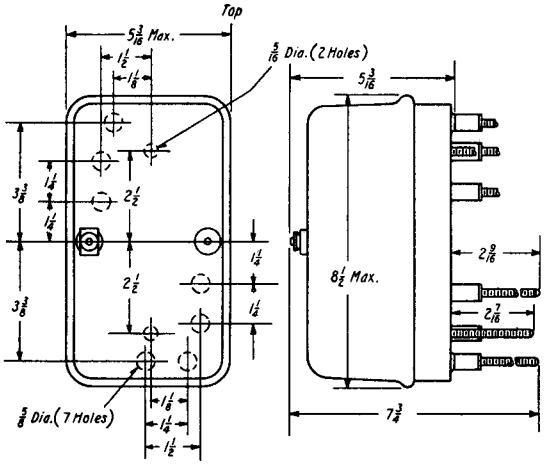

FIG. 3 - OUTLINE AND DRILLING PLAN FOR TYPES HR AND HRC RELAYS

INTERNAL WIRING DIAGRAM

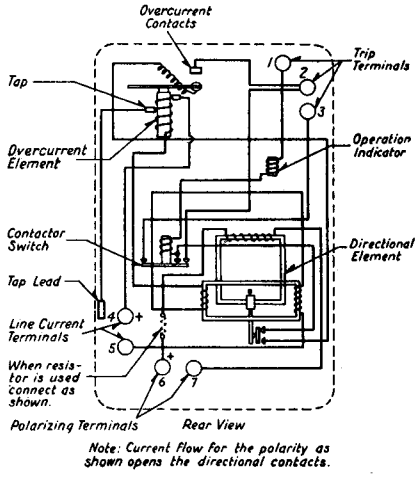

FIG. 4 - INTERNAL WIRING DIAGRAM OF TYPES HR AND HRC RELAYS

Dimensions are for reference only. For official dimensions, apply to the nearest district office.

EXTERNAL WIRING DIAGRAMS

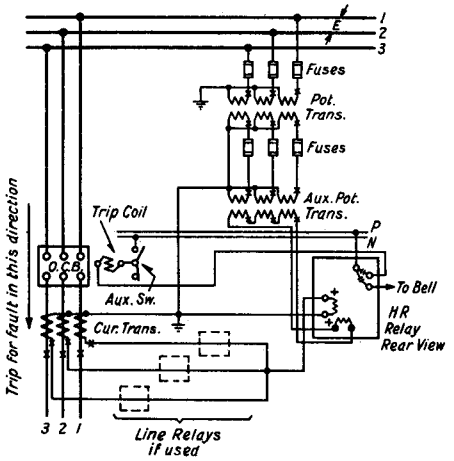

FIG. 5 - DIRECTIONAL GROUND PROTECTION USING THE TYPE HR RELAY

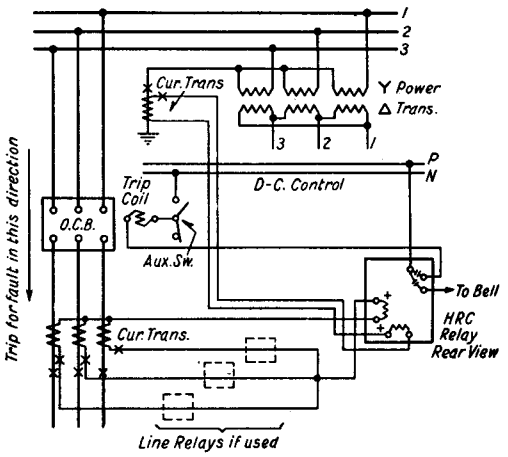

FIG. 6 - DIRECTIONAL GROUND PROTECTION USING THE TYPE HRC RELAY

Directional Element

Check the free movement of the directional element loop. The loop should assume approximately a vertical position with contacts open when the element is completely de-energized.

The movement of the loop is limited in the contact opening direction by a stop screw which strikes the lower part of the loop. This screw is located on the left-hand side of the element to the rear of the current coil. The back stop screw should be screwed forward until it just touches the loop when it is in its natural de-energized position.

The contact clearance between the silver bridge on the loop and the rear stationary contact should be approximately .025". The silver bridge should be made to touch both contacts simultaneously and deflect the springs about .006" before the contacts strike the back-stop screws.

Apply 4 amperes, 3.0 volts in phase to the directional element and make sure that a good contact is made. It may be necessary to adjust slightly the stationary contact in order to obtain a good steady contact. Reverse polarity to open contacts and apply 110 volts 5 amperes and make sure that the contacts will not bounce closed when the voltage is suddenly interrupted.

When the directional element is energized on voltage alone, there may be a small torque which may hold contacts either open or closed. This torque is small and shows up only at high voltages and entire absence of current. At voltages high enough to make this torque discernible, it will be found that only a fraction of an ampere in the current coils will produce plenty of true wattmeter torque to insure positive action. This is mentioned because the slight torque shown on voltage alone has no significance in actual service and has no practical effect on the directional element operation.

Contactor Switch

Adjust for 1/16" between disc and contacts. Contactor switch should close at 2.0 amperes and not seal in after 30 amperes d-c. have been applied.

Operation Indicator

Adjust the indicator to operate at 1.0 ampere d-c. gradually increased. Test for sticking after 30 amperes d-c. have been applied.

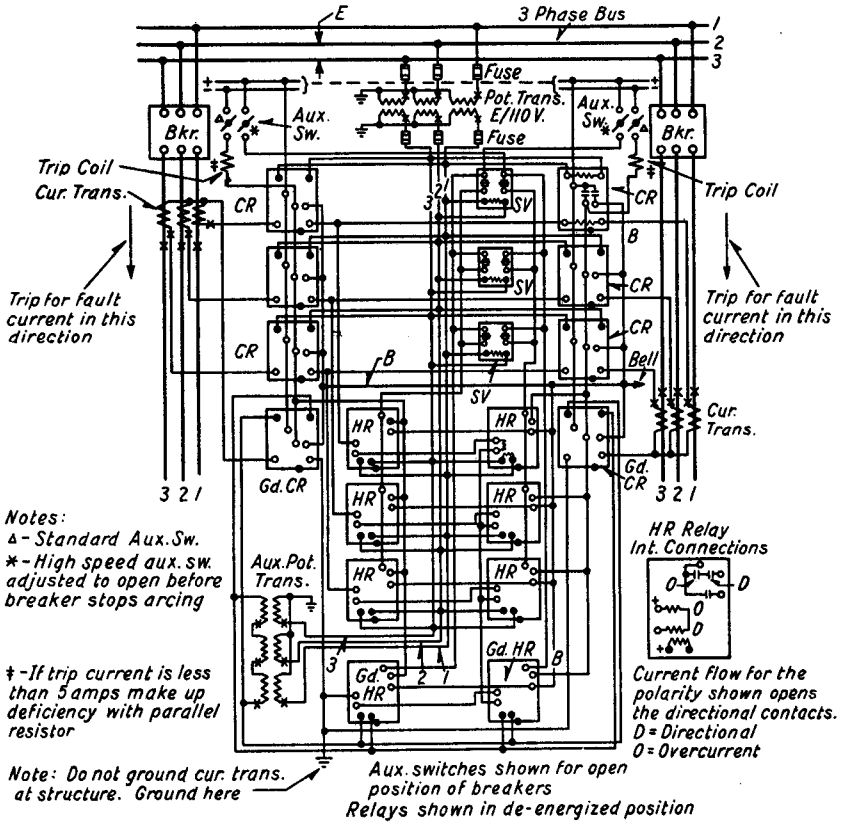

FIG. 7-PARALLEL AND SINGLE-LINE PROTECTION WITH TYPE HR RELAYS FOR THE PARALLEL-LINE OPERATION AND TYPE CR RELAYS FOR THE SINGLE-LINE OPERATION. CONNECTIONS ARE 30-DEGREE. PHASE POTATION IS 1-2-3. TYPE SV RELAYS MAY BE USED WHERE THE LINE IMPEDANCE DOES NOT EXCEED THE SYSTEM IMPEDANCE TO THE STATION BUS

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