Westinghouse

TYPE CT TEMPERATURE-OVERLOAD RELAY

INSTRUCTIONS

CAUTION

Before putting 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.

APPLICATION

The Type CT relay is an induction type relay operating from exploring coils imbedded in or attached to the equipment being protected, and from a line current transformer. The relay is used to protect a-c. equipment from overheating resulting from overloads, open phase, or insulation failure when the line current may be insufficient to operate short circuit protective devices. In order for the relay to operate, the temperature of the windings of the apparatus and the current flowing in the apparatus must be above values for which the relay is set, and these two conditions must have existed for a certain period of time because of the inherent time-delay of the induction-type element. Thus the danger of disconnecting the apparatus upon transient overloads is eliminated.

This relay is manufactured and set at the factory for each application and cannot be changed after shipment. In order to make the application, the following information is necessary:

1. Frequency of the connected system.
2. Power rating of the apparatus being protected.
3. Full Load phase current.
4. Current transformer ratio. This should be chosen so that the full load secondary current is between 3.5 to 5.0 amperes. When using a 3.0 ohm exploring coil it is desirable to have the full load secondary current as near to 5 amperes as possible. This provides the relay plenty of current for operation and permits the use of a relatively stiff spring to cause a definite and quick reset.
5. Maximum safe operating temperature at which the relay must trip if full load current or more is present.
6. The metal used in the exploring coefficient of resistance at 25° Centigrade.
7. Resistance of each exploring coil at 25° Centigrade.
8. Ambient temperature (if appreciably different from 25°C.)
9. Resistance of the leads from the exploring coils to the relay terminals.

CONSTRUCTION

The Type CT relay consists of an operating, element, two fixed resistor lags of the Wheatstone Bridge, a Contactor Switch, and Operation Indicator.

Operating Element

This element is the induction-disc type. The induction disc is mounted on a vertical shaft. A pin is inserted in the disc to prevent the contact from opening more than approx. 1/4 of an inch. The shaft is supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and on the upper end by a stainless steel pin.

The moving contact is a small silver hemisphere fastened on the end of an arm. The other end of this arm is clamped to an insulated section of the disc shaft. The electrical connection is made from the moving contact thru the arm and spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of a leaf spring. This spring is fastened to a Micarta block and mounted on the element frame. A small set screw permits the adjustment of contact follow.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front. The upper and lower pole windings are brought out to separate terminals as shown in figure 1. The upper pole windings are connected as the galvanometer leg of a Wheatstone Bridge circuit, and the lower pole winding in parallel with the Bridge as shown in figure 2. The lower pole winding and the bridge are energized from a current transformer connected to carry the load current of the apparatus being protected. Since the impedance of the bridge is largely resistance, and that of the lower winding almost entirely reactance, there is sufficient phase displacement between the currents in the two relay windings to give a positive rotating

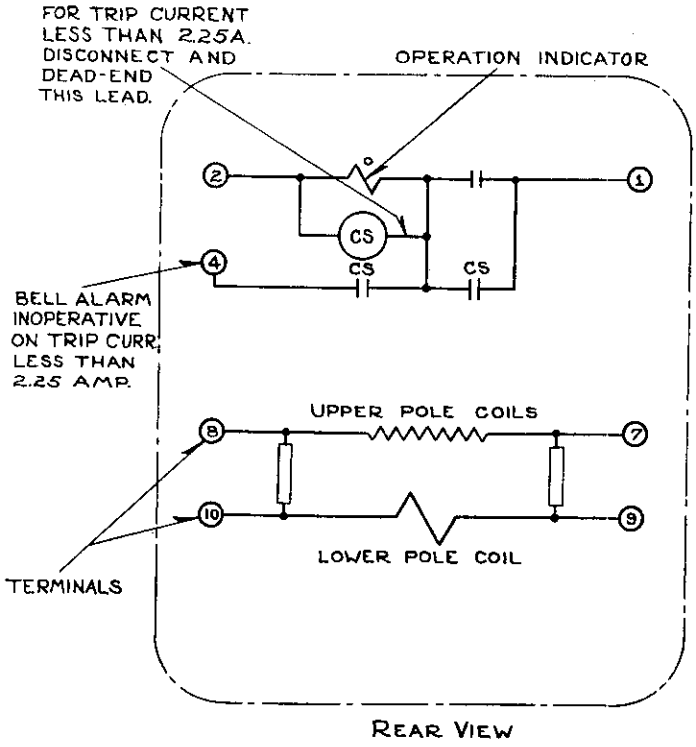


Figure 1
Internal Connections of the Type CT Relay.

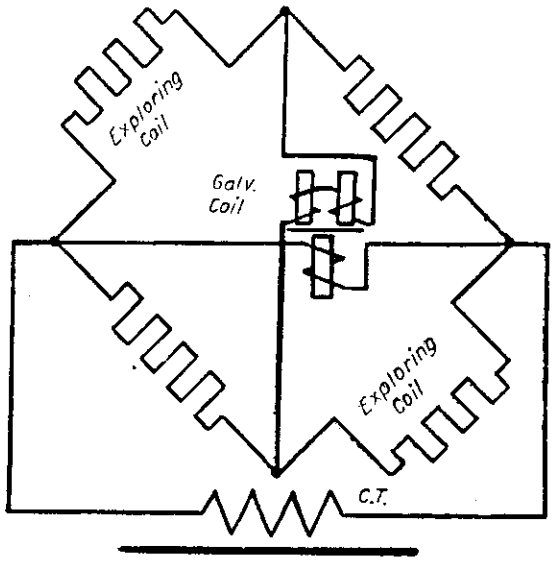


Figure 2
Schematic Diagram of the Wheatstone Bridge Circuit.

Contactor Switch

The d-c. contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker. The contactor switch is equipped with a third point which is connected to a terminal on the relay to operate a bell alarm.

Operation Indicator

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod in the cover stud.

OPERATION

The operation of the relay is as follows with reference to figure 2. When the resistance of the exploring coils is increased by the rising temperature of the apparatus to equal the resistance of the fixed sides of the bridge, no current will flow thru the upper pole of the relay and there will be no torque. The relay is normally set at the factory so that the bridge circuit is balanced at either 5° or 10° Centigrade below the operating temperature which the customer sets as being the limit which he does not want to exceed. The relay is connected so that when the resistances of the exploring coils are higher than the critical resistance the torque is in the contact closing direction, and when less, the torque is in the contact opening direction. Thus the relay will not trip on any load current as long as the temperature of the machine is indicated by the change in resistance of the exploring coil is within the safe limits. If the temperature rises above the safe limit, and the full load current is exceeded, the relay contacts will close.

CHARACTERISTICS

The closing torque of the Type CT relay is approximately proportional to the product of the current and temperature difference from the balance point. With the rise of these values above the operating limits, the relay contacts close with a rapidly increasing force. The limited travel of the disc permits a very short operating time. When the operating limits are exceeded considerably.

There are two types of exploring coils normally used with the relay. The first type is known as the "Rope Coil". It is a flat loop or skein of wire wound around two pegs set 9'6" apart. It is then insulated with a tape winding and varnish dipped and baked. Two strands of enameled copper wire are wound in parallel and four leads are brought out, making the two exploring coil sides of the bridge in the one winding. This type of exploring coil is used when the relay is applied to the protection of any motor or generator which is already built and in operation. The flexible coil is wound and laced to the end connection of the windings. It is not so efficient as the other type of coil, which can be located in the slot next to the working coils, but is the best substitute where the machines are already built.

The second type of exploring coil is a short flat structure which is intended to be placed in the slots of a large machine next to the working windings. This coil is used when the relay is applied to a machine which has exploring coils or is being manufactured.

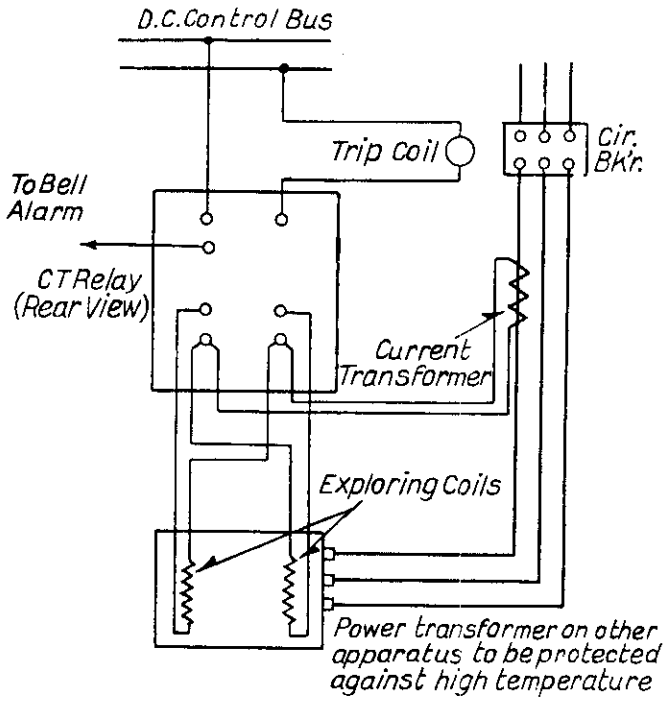


Figure 3
External Connections for the Type CT Relay.

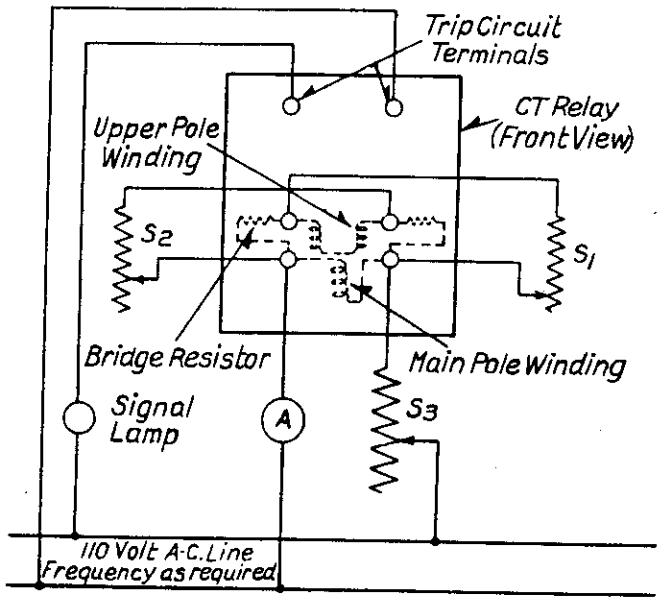
INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs. Either of these studs may be utilized for grounding the relay base. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

The external connections are shown in figure 3. The main contacts will safely close 30 amperes at 250v. d-c, and the switch contacts will safely carry this current long enough to trip a breaker.

The relay is shipped with the operation indicator and the contactor switch connected in parallel. This circuit has a resistance of approximately 0.25 ohms and is suitable for all trip currents above 2.25 amperes d-c. If the trip current is less than 2.25 amperes, there is no need for the contactor switch and it should be disconnected. To disconnect the coil, remove the short lead to the coil on the front stationary contact of the contactor switch. This lead should be fastened (dead ended) under the small filister-head screw located in the Micarta base of the contactor switch. The operation indicator will operate for trip currents above 0.2 amperes d-c. The resistance of its coil is approximately 2.8 ohms.

When using the contactor switch, it is necessary to use an auxiliary switch on the circuit breaker so that when the circuit breaker is tripped, the tripping circuit will be opened by this switch.



A - 5-10 Amp. A-C Ammeter

S_1-S_2 - Non-inductive slide resistors adjustable from 10 to approx. 15 ohms in steps of approx. .05 ohms or less. Slide must have negligible contact resistance.

S_3 - Variable resistance giving from 3 to 10 amperes and with 5 amperes continuous rating. Currents between 3 and 5 amperes should be adjustable in steps of about .05 amperes.

Figure 4
Diagram of Test Connections for The Type CT Relay.

ADJUSTMENT AND MAINTENANCE

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

Operating Coil

To check the operating coils, connect the relay per figure 4. The relay should trip at "A" amperes and "T" degrees C. as marked on its nameplate. The temperature may be represented by increasing the resistance of the exploring coil sides of the bridge by means of slide wire resistances, to the values corresponding as shown in the following table:*

Resistance	Temperature	Resistance	Temperature
10.00 ohms	25°C.	12.89	100
10.96	50	13.28	110
11.35	60	13.66	120
11.73	70	14.05	130
12.12	80	14.43	140
12.50	90	14.82	150

*NOTE - This table applies only to coper wire coils having 10 ohms resistance at 25°C.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core when the switch is picked up. This can be most conveniently done by turning the relay up-side-down. Screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving core stops rotating. This indicates the point where the play in the moving contact assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the stationary core screw one turn beyond this point and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32 inch by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 1 amperes d-c. Test for sticking after 30 amperes d-c. have been passed thru the coil. The coil resistance is approximately 1.0 ohms.

Operation Indicator

Adjust the indicator to operate at 0.2 ampere d-c. gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs, they should be weakened slightly by stretching to obtain the 0.2 ampere calibration. The coil resistance is approximately 2.8 ohms.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

ENERGY REQUIREMENTS

The 60 cycle burden of the relay on the current transformer is 15.0 voltamperes at 5 amperes, 49° lag Power Factor. The continuous rating of the winding is 5 amperes, (10 ohms exploring coil) and the one second rating 150 amperes, 60 cycles.

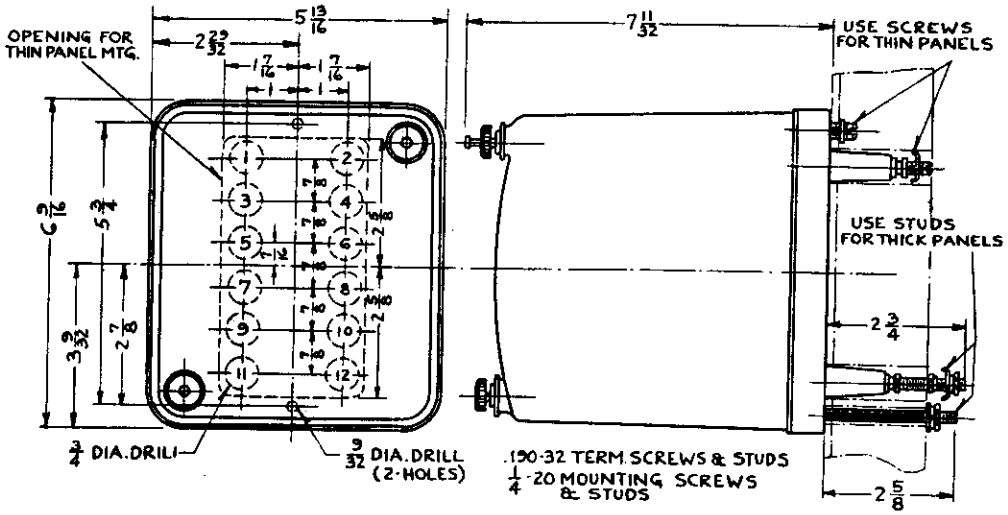


Figure 5
Outline and Drilling Plan for the Standard Projection Type Case. (See Internal Connections for Terminals Supplied.)

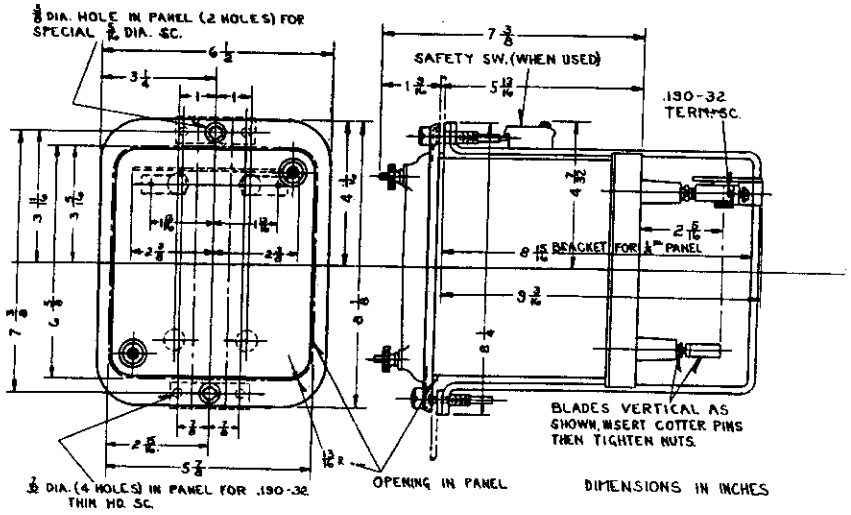


Figure 6
Outline and Drilling Plan for the Standard Detachable Type Case for 1/8" Panel Mounting.