Signal Training Bulletin

COMMITTEE G: Education & Training
Communication & Signal Division, AAR

C-6 Thermal Relays

Approved November 1978

Definition: A timing relay whose contacts are actuated by the heating effect of current flowing through its controlling element.

Symbol:

Description: A thermal relay does not operate on the electro-magnetic principle as do most other relays. A thermal relay is equipped with one heel and a front contact or a dependent front-back contact arrangement. The back contact is used as a checking contact and the front contact is externally adjustable to vary the time interval. The heel consists of a bi-metallic strip, consisting of two different metals around which resistance wire has been wound to form a heater. The heating coil is insulated from the bi-metallic strip.

The basic operation of the thermal relay takes advantage of the difference in the thermal expansion of two metals. When electric current flows through the heater, the heat generated causes the two metals to expand unequally, setting up forces that bend the strip toward the front contact and away from the back or checking contact. The amount of time delay is dependent upon the space between the back and front contacts. The greater the space is the longer the delay. Figure 1 shows an adjustable thermal relay.

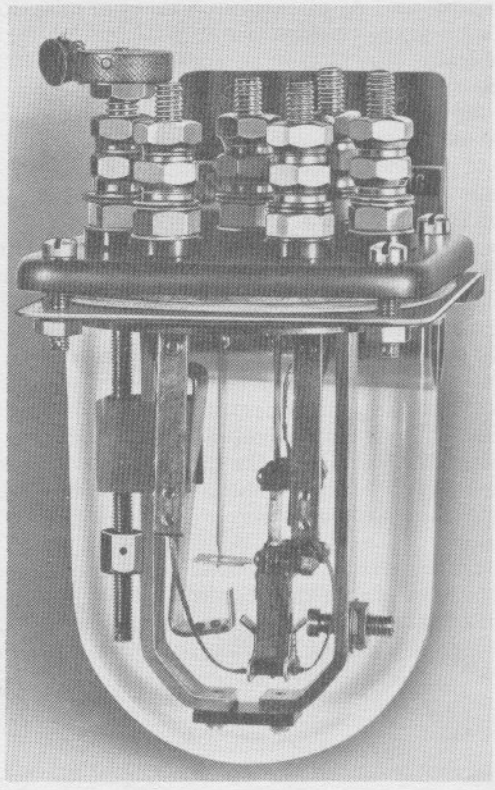

Figure 1

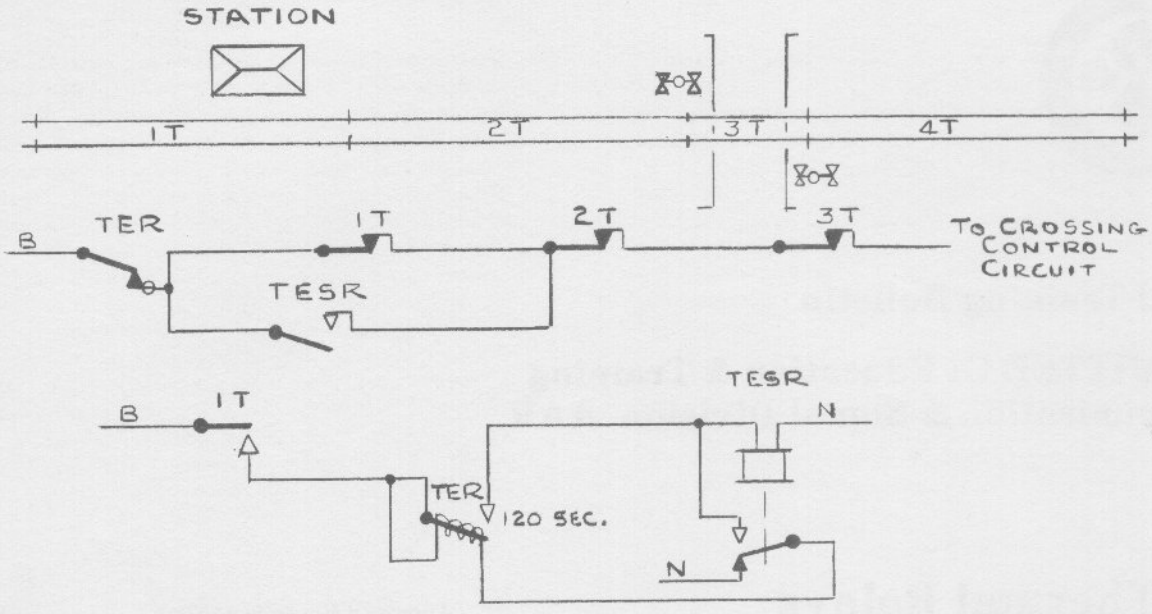

Figure 2

Purpose and Application: A thermal relay may be used with grade crossing warning devices at locations where trains may stop in an approach track circuit for an extended period of time.

To reduce delays to highway traffic, a thermal relay can be used to stop the warning devices if the train is not going to proceed immediately over the highway crossing.

Figure 2 illustrates a typical layout where the timing feature may be applied.

The circuits are designed so that a train entering 1T circuit starts the warning devices. At this same time the thermal relay is energized and starts to heat. If the timing contact makes before the train occupies 2T, relay TESR controlled by the thermal is energized. This permits the thermal relay check contact to return to normal and stop the warning devices. The warning devices will not be activated again until the train occupies 2T. Note that the check contact is in the warning device control circuit, which checks that the thermal relay returns to its normal position after each operation.

A time delay relay is also used to protect against loss of shunt. Loss of shunt is a condition which results when a train on a track circuit momentarily loses its connection between the rails allowing the track relay to pick up. If the track circuits picks up with a train on the circuit it could be possible for opposing signals to display a proceed aspect onto the occupied track section. Since the shunt will normally be re-established within seconds, this condition may be minimized by use of a second relay (TPSR-Track Repeater Stick Relay), controlled by a thermal relay. The TPSR contacts are inserted in the control circuits. In the example circuit Figure 3, when the track relay drops, it drops the TPSR. Should the TR pick up with a train occupying the track the TPSR will stay down until the thermal heats (after 5 or 10 seconds have elapsed); the TPSR will not pick up, and the vital circuits will have been protected during the loss of shunt duration.

Figure 4 shows an adjustable thermal relay, with the various parts identified.

General Information: Thermal relays must be inspected, adjusted, and sealed in accordance with the railroad's requirements.

Detailed Operation: One type of thermal relay circuit is shown in Figure 3. It has a fixed time delay which is from the time between the electric current being applied and the closing of its one stationary contact. The

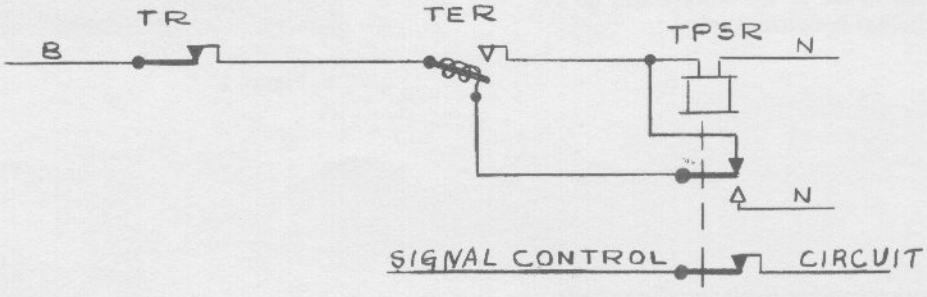

Figure 3

most common time range is 5 to 15 seconds for loss of shunt circuits.

In the thermal relay Figure 4, the bi-metallic strip acts as a heel for the two contacts. The contacts are referred to as the checking contact and the front contact rather than the normal terms of back and front. The checking contact back is normally closed and is open any time the relay is heating or cooling after having been heated. The checking contact is used in signal circuits where a time delay is required and whenever open indicates that the relay is operating. Closing of the checking contact indicates the relay has returned to the normal position. When the thermal relay is energized, the bi-metallic strip (heel) bends away from the checking contact and after a time lapse, governed by the distance between the two contacts, makes with the hot contact, or front. The front contact when made with the heel is used in a circuit to energize a repeater relay which, when energized, removes the energy from the thermal heating coil allowing the bi-metallic strip to cool back to the checking contact. The time lapse from the time the heel leaves the checking contact, makes connection with the hot contact and cools back to the checking contact is considered the full operating time of this thermal relay.

The relay shown in Figure 4 is adjustable. The time may be adjusted by turning the adjusting screw. This action mechanically moves the front contact closer to or farther from the bi-metallic strip contact which decreases or increases the time required to bridge the contact gap when the heater coil is energized.

Relays of the type illustrated in Figure 4 have adjustment ranges for time, the two most common time ranges being 15 to 45 seconds and 45 to 120 seconds. When adjustments are necessary, they should be made in accordance with the circuit requirements.

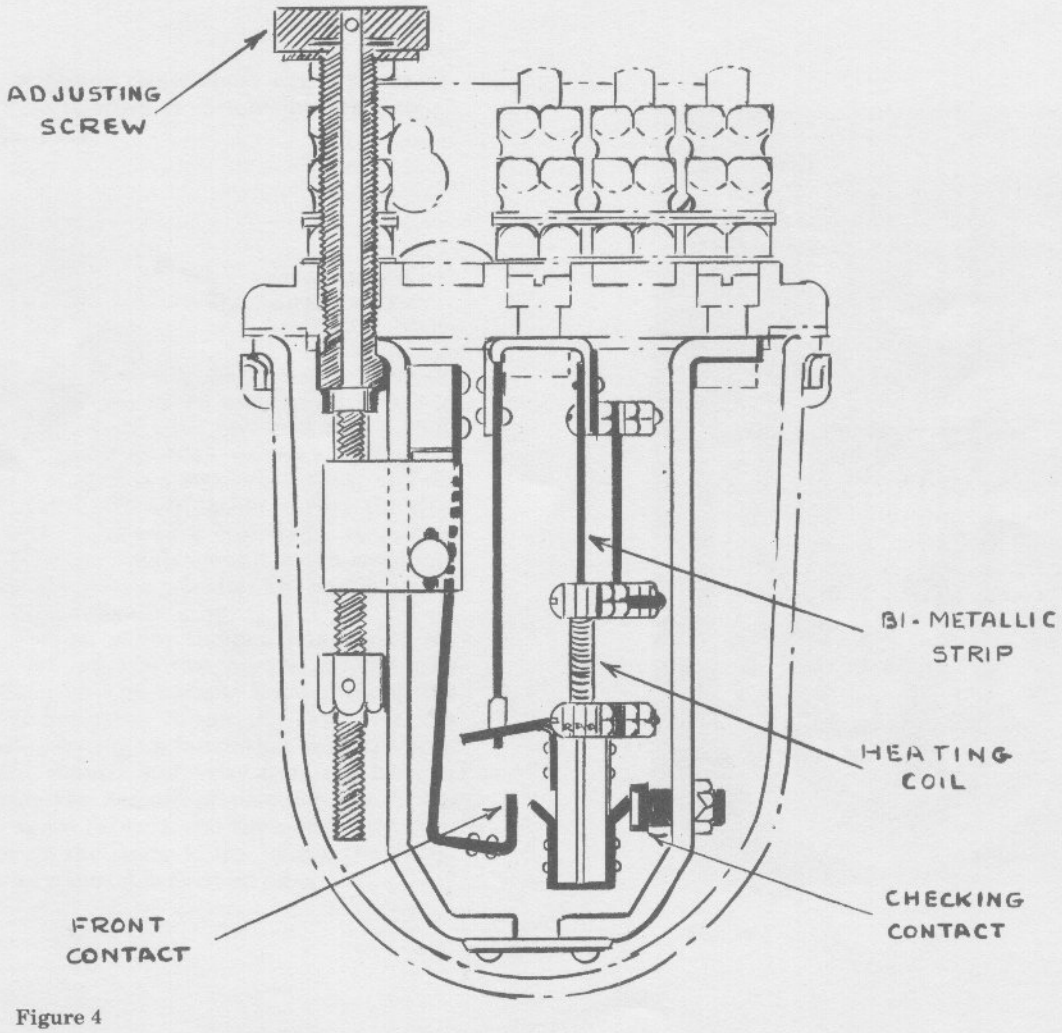

Figure 4