TYPE "TRC" THERMAL RELAY

INSTRUCTIONS

GENERAL

The Westinghouse type "TRC" thermal control relay is used on power transformers to provide operation by copper temperature. It can be used on all ratings for standard power service from the smallest up to the largest transformers which may be designed. This relay uses a bimetal thermal element which is heated both by the top oil in the transformer and by the current, supplied from a current transformer, which flows through it and is proportional to the line current. It is accurately coordinated with the actual copper temperature of the transformer winding.

The deflection of the bimetal element with increasing temperature, trips a latch to close contacts in a warning light circuit to indicate that the maximum safe value of thermal load for the transformer has been reached. On further increase in temperature the increased deflection of the bimetal element trips a second latch which operates contacts to trip the load circuit breaker and thus disconnects the transformer from its load.

A solenoid operated resetting mechanism mounted inside of the case of the relay, when energized, simultaneously resets both latches. The warning light (one is provided for each relay when more than one relay is used on a transformer) indicates, when lighted, that the first latch of the relay has been tripped, and when extinguished, that both latches of the relay have been reset.

The resetting switch and the indicating lamp are mounted at a convenient location on the control panel of the load circuit breaker. This may be in a compartment on the side of the transformer tank, as in the case of a CSP power transformer, or the resetting switch and lamp may be mounted at some convenient point removed from the transformer. Where it is desirable, an additional circuit opening or circuit closing contact may be provided on the breaker tripping latch for operating auxiliary alarm or signal devices. All leads from the TRC thermal relay, including the connections necessary for checking the operation of the relay, are brought to a small junction box on the cover of the transformer.

CONSTRUCTION

The relay mechanism is of rugged construction throughout. The assembly is enclosed in a heavy pressed steel case which is rigidly bolted to a supporting framework within the transformer case. The latches which are tripped by the bimetal element are of ground and hardened steel. These latches are mounted in the relay case in such a way that they may be easily and accurately adjusted to match the characteristics of the transformer in which they are to be used. The relays are installed in the transformer and carefully adjusted at the factory and require no attention or servicing in in field.

The reset mechanism is so designed that when its coil is energized the pick-up arm engages both latches and pulls them counterclockwise (see Fig. 4) until they are engaged by the catch. Only one latch is shown in Fig. 4 for the sake of clarity. The second latch is the same shape as the first except slightly longer so that the catch must move farther in the direction of the arrow to release this latch. Tension springs pull the latches clockwise and close the contacts as the latches are released.

The contacts are of non-corrosive arc resisting materials and are ample for normal tripping and indicating circuits.

The reset switch is shown in Fig. 5. It is designed to simplify the operation of resetting the TRC relay and in addition provide a positive safeguard against the possibility of improper operation on the part of the attendant. It consists of two elements:—a pair of contacts closed by a spring-return thumb operated handle; and a thermal release device for the protection of the relay reset coil. This device opens its contacts when it operates and they remain open until the operator releases the handle and then operates the handle again. If a high temperature exists at the relay, it will not reset. Holding the handle in closed position, therefore, cannot harm the resetting coil.

OPERATION

When the gradient between the bimetal and the oil plus the oil temperature equals the temperature for which the bimetal is adjusted, the bimetal trips its latch to operate the corresponding contact. Since the gradient depends on the current, this operation coordinates the relay operation with actual winding temperatures.

Fig. 1 and Fig. 2 show schematically the usual connections for the relay. Fig. 1 is used on power transformers where through type current transformers are normally used with the relay. The through type current transformers are usually provided with taps which are used at the factory to adjust the bimetal current to coordinate the tripping of the relay with the winding temperature. The usual connections for CSP or unit substation transformers is shown in Fig. 2. In this scheme the relay is usually required to be coordinated with other tripping devices such as overcurrent relays.

Standard-ratio wound-type current transformers with 5 ampere secondaries are used with these connections and a small multi-ratio saturating type current transformer is mounted on the relay case to give the required thermal characteristics in the TRC relay. Fig. 3 shows the relay with a saturating type current transformer mounted on it.

As the load increases, the bimetal will deflect upward (Fig. 4) due to increased oil temperature and heat from the current from the secondary of the current transformer connected in the load circuit. The bimetal carries with it an insulating block and "catch". At a definite deflection the "catch" is raised above the "latch" for operating the lamp "contacts" when the latch will turn due to tension of the latch spring and thus close the lamp contact.

If the temperature of the bimetal continues to increase, the bimetal deflects further to release a second latch which closes the trip contacts to operate the disconnecting breaker for the transformer.

The reset switch should always be operated by a firm pressure to insure that the latches are completely reset. A slight tap on the reset switch may result in latches being only part-way returned to operating position. In this case the latches may trip on the first slight movement of the bimetal.

TYPE "TRC" THERMAL RELAY—Continued

The relay is readily reset, when the lamp latch has tripped or when both latches have tripped, by means of the spring-return thumb operated switch shown in the schematic diagram (Fig. 4) and illustrated in Fig. 5.

Installation

The type TRC relay is usually mounted on an insulating base supported by a steel frame work in the hot oil of the transformer. The signal light may be mounted on a control panel at the transformer or it may be mounted on the switch board panel. Usually the resetting switch is located adjacent to the lamp. No adjustments to the relay are required as these are made at the factory and should not be disturbed.

Maintenance

No maintenance of the "TRC" thermal control relay is required. It is ruggedly constructed out of heavy and accurately made parts and does not have gears or clock work of any kind. It is completely immersed in transformer oil and will not deteriorate in service. Its calibration is not impaired nor affected by any normal operating hazards to which any transformer is subject. It is not necessary to inspect the contacts of the relay. The operation of the relay can be easily checked at any time the transformer is out of service by means of the connections which are provided in a junction box on the transformer cover.

Field Checking the Relay

The following data is furnished to permit a field check on the operation of the relay and a rough check on the relay calibration. The data furnished is correct for most applications but in every case where the customer requires reliable data, on the relay calibration, the manufacturer should be consulted.

Refer to the wiring diagram furnished with the transformer for connections to be made for testing the relay.

Apply, to the test terminals, the current corresponding to the oil temperature and the latch being tested as given in the following tables. It is important that the oil temperature be measured accurately on tests for relay calibration. It is also important that the current be held constant throughout the test. Where very low voltages are not available a suitable impedance should be included in the test circuit to limit the current.

For best results the current should be preset before applying to the test circuit for the relay. The impedance of the bimetal circuit is very low and only a very slight change in the current adjustment is required when the bimetal is put into the circuit.

Use Table I for Inertaire or Sealdaire equipped transformers.

Use Table II for transformers equipped with expansion tanks.

TABLE I

Current Required

Oil Temp.	Trip Contact	Lamp Contact
15°C.	61.6 Amp.	56.8 Amp.
20°C.	59.2 Amp.	54.8 Amp.
25°C.	57.4 Amp.	52.8 Amp.
30°C.	55.6 Amp.	50.8 Amp.
35°C.	53.8 Amp.	48.7 Amp.
40°C.	51.9 Amp.	46.7 Amp.
Time Limits	7 to 20 Sec.	7 to 21 Sec.

TABLE II

Current Required

Oil Temp.	Trip Contact	Lamp Contact
15°C.	56.8 Amp.	53.0 Amp.
20°C.	54.8 Amp.	50.9 Amp.
25°C.	52.8 Amp.	48.8 Amp.
30°C.	50.8 Amp.	46.7 Amp.
35°C.	48.7 Amp.	45.5 Amp.
40°C.	46.7 Amp.	42.3 Amp.
Time Limits	7 to 21 Sec.	6 to 24 Sec.

Interpolate current magnitude for oil temperatures between the values given in the tables.

TYPE "TRC" THERMAL RELAY—Continued

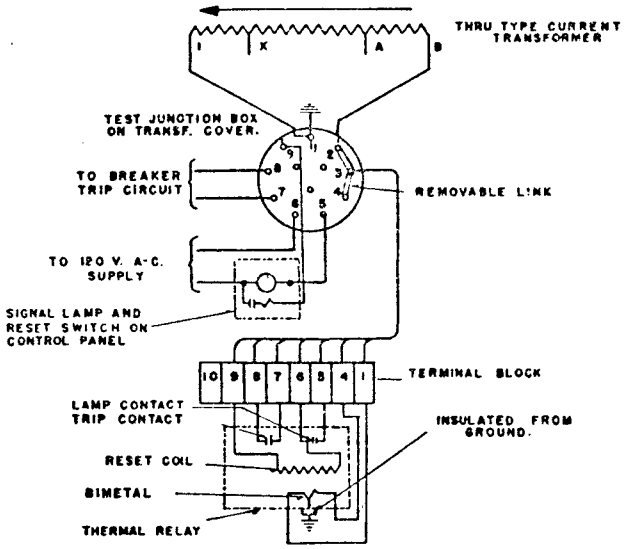


FIG. 1

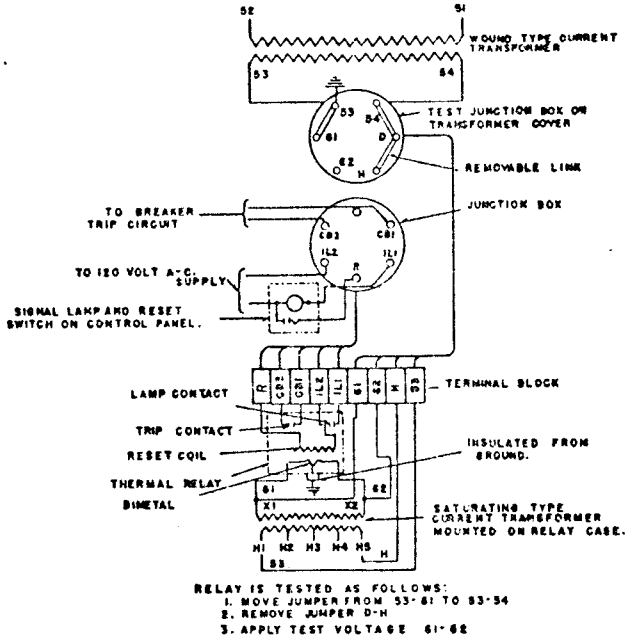


FIG. 2

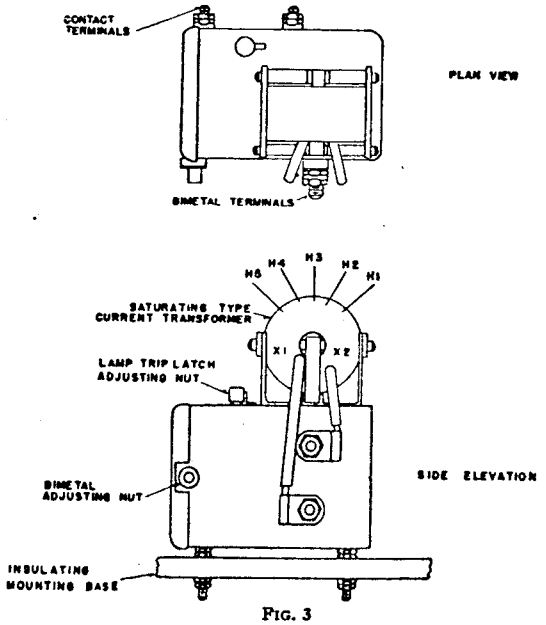
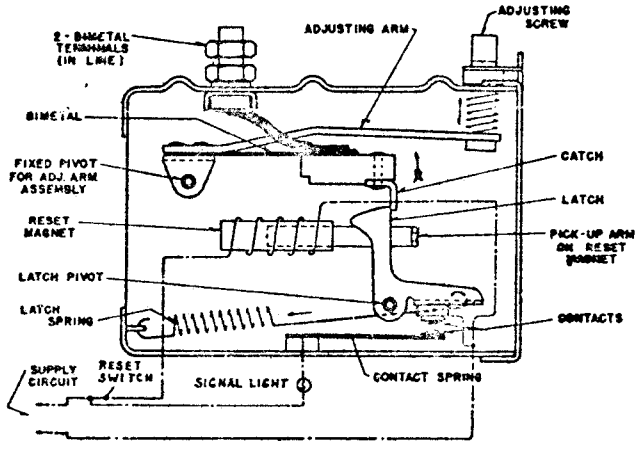


FIG. 3



TYPE "TRC" RELAY

SHOWING BIMETAL TRIP MECHANISM, ONE LATCH, AND (DIAGRAMMATICALLY) RESET MAGNET.

NOTE: CIRCUIT TO HEAT BIMETAL CONNECTED THROUGH TERMINALS AT TOP.. CIRCUIT TO CONTACTS AND RESET MAGNET SHOWN THUS —·—·—

OPERATION

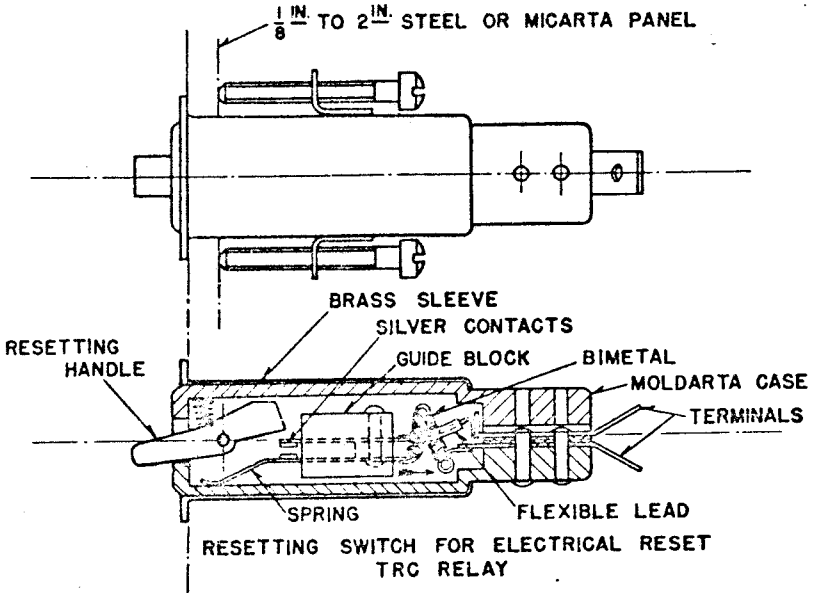
1.-ON RISING TEMPERATURE, BIMETAL DEFLECTS IN DIRECTION OF ARROW UNTIL LATCH IS RELEASED.

2.-LATCH SPRING ROTATES THE LATCH CLOCKWISE TO CLOSE CONTACTS AND LIGHT THE SIGNAL LIGHT.

3.-TO RESET, SWITCH IS CLOSED, AND RESET MAGNET IS ACTUATED TO PULL THE LATCH BACK INTO ENGAGEMENT WITH CATCH ON BIMETAL.

FIG. 4

TYPE "TRC" THERMAL RELAY—Continued



OPERATION

1. RESETTING HANDLE IS PUSHED UP TO CLOSE SILVER CONTACTS
2. CURRENT FLOWS IN BIMETAL AND CONTACTS.
3. HEATING OF BIMETAL CAUSES BLOCK TO BE DRAWN IN THE DIRECTION OF THE ARROW AND CONTACTS ARE PULLED FROM UNDER SWITCH LEVER. CONTACTS OPEN QUICKLY TO INTERRUPT CIRCUIT.
4. BIMETAL COOLS AND CONTACTS MOVE BACK UNDER RESET LEVER WHEN HANDLE IS RELEASED.

FIG. 5

Westinghouse Press
Printed in U.S.A. (Rep. 6-40)

Curve 249308-B Signature L. Ewalt February 11, 1947

MAR 21 19[illegible] Curve 249309-B

CALIBRATION CURVE - "TRC" RELAY

Bimetal S#1185164
Relay Trip 83°C
Normal Trip Time at 25°C 12.5 Seconds
Switch Setting 50:5 C.T. Fig. A

Q-Curve No. 287888

Preset = $(83-T_A) \times .048$

Oil Temp.	Amp.	Ammeter Reading	Preset	Limits Calibrating		Checking	
				10 to 16		9 to 19	
15	52.6	5.26	3.26	10	16	9	19
16	52.2	5.22	3.22	10	16	9	19
17	51.8	5.18	3.17	10	16	9	19
18	51.4	5.14	3.12	10	16	9	19
19	51.0	5.10	3.07	10	16	9	19
20	50.6	5.06	3.02	10	16	8	19
21	50.1	5.01	2.98	10	16	8	20
22	49.7	4.97	2.93	10	16	8	20
23	49.3	4.93	2.88	10	16	8	20
24	48.9	4.89	2.83				
25	48.5	4.85	2.78	10	16	8	20
26	48.0	4.80	2.74	10	16	8	20
27	47.6	4.76	2.69	9	16	8	21
28	47.2	4.72	2.64	9	16	8	21
29	46.8	4.68	2.59	9	16	8	21
30	46.4	4.64	2.54	9	17	8	21
31	45.9	4.59	2.50	9	17	8	22
32	45.5	4.55	2.45	9	17	8	22
33	45.1	4.51	2.40	9	17	8	23
34	44.6	4.46	2.35	9	17	8	23
35	44.2	4.42	2.30	9	17	8	24
36	43.7	4.37	2.26	9	17	8	25
37	43.2	4.32	2.21	9	18	8	26
38	42.8	4.28	2.16	9	18	7	27
39	42.3	4.23	2.11	9	18	7	28
40	41.9	4.19	2.06	9	18	7	30

Curve 249309-B Signature L. Ewalt February 11, 1947

SKETCH SHEET FOR PRINTS

CALIBRA

Bimetal S#1185164
Relay Trip 93°C
Normal Trip Time at 25
Switch Setting 50:5 C

Oil Temp.	Amp.	Ammeter Reading
15	56.5	5.65
16	56.1	5.61
17	55.7	5.57
18	55.3	5.53
19	54.9	5.49
20	54.5	5.45
21	54.1	5.41
22	53.7	5.37
23	53.3	5.33
24	52.9	5.29
25	52.5	5.25
26	52.1	5.21
27	51.7	5.17
28	51.3	5.13
29	50.9	5.09
30	50.5	5.05
31	50.1	5.01
32	49.7	4.97
33	49.3	4.93
34	48.9	4.89
35	48.5	4.85
36	48.0	4.80
37	47.6	4.76
38	47.2	4.72
39	46.8	4.68
40	46.4	4.64

Curve 249307-B S

TYPE "UR" - TEP REGULATOR
VARIATION OF
5SES
AND
CURRENT

Curve 249308-B Signature L. Ewalt February 11, 1947

MAR 21 19[illegible] Curve 249309-B

CALIBRATION CURVE - "TRC" RELAY

Bimetal S#1185164
Relay Trip 63°C
Normal Trip Time at 25°C 12.5 Seconds
Switch Setting 50:5 C.T. Fig. A

Q-Curve No. 287888

Preset = $(83-T_A) \times .048$

Oil Temp.	Amp.	Ammeter Reading	Preset	Limits Calibrating		Checking	
15	52.6	5.26	3.26	10 to 16		9 to 19	
16	52.2	5.22	3.22	10	16	9	19
17	51.8	5.18	3.17	10	16	9	19
18	51.4	5.14	3.12	10	16	9	19
19	51.0	5.10	3.07	10	16	9	19
20	50.6	5.06	3.02	10	16	8	19
21	50.1	5.01	2.98	10	16	8	20
22	49.7	4.97	2.93	10	16	8	20
23	49.3	4.93	2.88	10	16	8	20
24	48.9	4.89	2.83	10	16	8	20
25	48.5	4.85	2.78	10	16	8	20
26	48.0	4.80	2.74	9	16	8	21
27	47.6	4.76	2.69	9	16	8	21
28	47.2	4.72	2.64	9	16	8	21
29	46.8	4.68	2.59	9	17	8	21
30	46.4	4.64	2.54	9	17	8	22
31	45.9	4.59	2.50	9	17	8	22
32	45.5	4.55	2.45	9	17	8	23
33	45.1	4.51	2.40	9	17	8	23
34	44.6	4.46	2.35	9	17	8	24
35	44.2	4.42	2.30	9	17	8	25
36	43.7	4.37	2.26	9	18	8	26
37	43.2	4.32	2.21	9	18	7	27
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Oil Temp.	Amp.	Ammeter Reading
15	56.5	5.65
16	56.1	5.61
17	55.7	5.57
18	55.3	5.53
19	54.9	5.49
20	54.5	5.45
21	54.1	5.41
22	53.7	5.37
23	53.3	5.33
24	52.9	5.29
25	52.5	5.25
26	52.1	5.21
27	51.7	5.17
28	51.3	5.13
29	50.9	5.09
30	50.5	5.05
31	50.1	5.01
32	49.7	4.97
33	49.3	4.93
34	48.9	4.89
35	48.5	4.85
36	48.0	4.80
37	47.6	4.76
38	47.2	4.72
39	46.8	4.68
40	46.4	4.64

Curve 249307-B S

TYPE "URT" STEP REGULATOR
VARIATION
AND
CURRENT
SSES