Westinghouse

SWITCHBOARD TEMPERATURE INDICATOR WITH RESISTANCE COIL DETECTOR

INSTRUCTIONS*

This Instruction Leaflet covers the application of permanent magnet moving coil switchboard instruments for the measurement of temperatures in electrical machinery or other apparatus operating in temperature ranges between 0C and 250°C.

Instructions for the instrument proper are those associated with the type designations of the instruments.

GENERAL

These temperature indicators operate on the resistance coil detector principle, the detecting coil forming one branch of a Wheatstone Bridge, which is energized by D.C. or rectified A.C. control circuit. The detecting coils are usually embedded in the machinery windings and are wound with copper wire to an exact resistance of 10 ohms at 25°C. Usually five to nine detecting coils are provided with each machine and are so located as to measure the temperature at "hot spot" locations. A selector switch allows the indicator to be connected to any coil desired.

When the detector coil is at a predetermined temperature the bridge is in balance and no potential exists on the instrument. This point is called the balance temperature and is selected depending upon the scale range of the instrument.

At any other temperature the resistance of the detector coil changes and therefore there will be an unbalance of the bridge. This results in a potential difference which deflects the pointer of the instrument. This potential difference is directly proportional to the resistance of the coil and thus the scale can be calibrated in temperature of the coil.

The balance point is selected at the temperature at which the greatest accuracy is desired. At this temperature the indications will be independent of control circuit voltage. This point is marked by a red line on the indicator scale.

At other temperatures the error due to incorrect voltage will be the difference between the actual temperature and the balance temperature, multiplied by deviation in control voltage. This error is small and can be neglected for ordinary variations in voltage, as the balance point is chosen near ordinary operating temperatures, and the error near the balance point is very small. For any reading and any incorrect control voltage the true reading, if desired, can be found as follows:

B = Balance point temperature
T_1 = Observed temperature
E = Rated control voltage
E_1 = Actual control voltage
T = True Temperature

$$T = B - \frac{E}{E_1}(B - T_1)$$

For Example if:

Balance point temperature = 100°
Observed temperature = 80°
Rated control voltage = 125 Volts
Actual control voltage = 115 Volts

$$T = 100° \frac{125}{115} (100° - 80°)$$

$T = 100° - 21.75°$
$T = 78.25°$ an error of 1.75°

This error can usually be neglected for ordinary variations in control voltage. Unless a fairly steady d.c. circuit is available the Wheatstone bridge circuit is preferably fed from a "Rectox trickle charger" and an a.c. lighting circuit.

INSTALLATION

The complete outfit includes the indicator proper, leads, bridge box, terminal block (on machine), selector switch, test resistor, calibrating rheostat and trickle charger or other auxiliary circuit.

For best results the wiring and selector switches shown by Fig. 1 should be used. A type W selector switch is required for each machine or group of six search coils. If calibrated leads are furnished with the outfit they should be connected between the indicator and the bridge box.

The leads to the search coils may be several hundred feet in length, but their resistance should be kept below .2 ohm for best results, and it is important that the resistance of lead 2 from bridge box to search coil be equal to resistance of any lead 4 from bridge box, through switch, to search coil.

Alternate wiring is shown in Figs. 2 and 3. This plan uses one selector switch for each group of six search coils.

Best accuracy is obtained when three leads are brought out from each search coil, and connected as shown.

NOTES

1. The diagrams, Figs. 1, 2 and 3 show the connections for use with rectox units and a.c. control. Connections for d.c. control are similar except that the d.c. control takes the place of

*SUPERSEDES I.L. 948 AND I.L. 2245.

the output terminals of the trickle charger as marked + and -. The control circuit for which the indicator is intended is marked on the dial.

2. If other types of selector switches than those indicated on the diagrams are used, special wiring diagrams to suit such switches will be required.

ZERO ADJUSTMENT

The pointer of the indicator should rest at the red mark or "balance point" on the scale when no voltage is applied to the circuit.

CALIBRATION

With the circuit set up as in Fig. 1, 2 or 3, turn the selector switch to test coil position and apply control circuit. The indicator should show 0° C. If the indicator reads too high, it will be necessary to reduce the series control resistance in the bridge box. Final adjustment can be made with the calibrating rheostat mounted on the panel. The latter can be used for correcting control voltage at any time before readings are taken.

The test resistor is desirable whenever control voltage is subject to variations or when recalibrating the instrument. It can be eliminated if control voltage is known to be always steady at the value for which the indicator is calibrated.

The test resistor has a constant resistance of 9.037 ohms which is equivalent to the resistance of a 10-ohm exploring coil at 0 degrees Centigrade. Thus with the test resistor connected in place of the exploring coils, the instrument should read zero on the scale.

The panel mounted rheostat is desirable when direct current varies or when great accuracy with ease of adjustment is required. Otherwise, voltage variations can be corrected by means of the rheostat on the trickle charger. The trickle charger rheostat may not be as accessible as the panel mounted rheostat.

CALIBRATION DATA

The following table gives the resistance of the search coils for which this instrument is calibrated, at various temperatures.

Temperature °C	Resistance Ohms
0	9.037
25	10
50	10.962
100	12.887
150	14.812

The detector coil balances the bridge circuit at the temperature indicated by the red line on the scale of the instrument.

REPAIRS

When ordering repair parts give name of the part wanted, and the style and serial numbers of the indicator.

Ordinary repairs can readily be made by workers skilled in instrument practice. However instruments will be promptly and satisfactorily repaired if returned to our factory. Before the instrument is returned to the factory apply to the nearest Sales Office for "Returned Material Tag" so that apparatus will be properly identified when received.

ACCESSORIES

Rectox trickle charger 115 volts, 60 cycles a-c 24 volts d-c with rheostat adjustment. S#1 224 719

Type W Selector switch as per Fig. 1.....*
Type W selector switch as per Fig. 2.....*
Type W selector switches as per Fig. 3...*
Test Resistor.....S#724 093

*Choice of style Nos. given on figures.

Panel mounting rheostat
for 20 volt control..... S#839 963
Panel mounting rheostat
for 125 volt control.....S#1 001 806
Panel mounting rheostat
for 250 volt control.....S#1 001 807

ADDENDUM

How to change D.C. Control Temperature Indicators to A.C. Control.

A.-C. Lighting circuits being generally steadier in voltage than battery or other direct current control sources, it is sometimes desired to change an instrument from d-c. control to a-c. control.

Assuming that the temperature indicator is calibrated and in good condition, the following new items will be required to change to 120 volt 60 cycle control.

1 - RESISTANCE SPOOL 180 ohms, S#563855
1 - RECTOX "TRICKLE CHARGER" S#1224719
1 - TEST RESISTOR S#724093
1 - ADJUSTING RHEOSTAT S#839963
1 - TYPE W SELECTOR SWITCH STYLE PER Fig. 1, 2 or 3

Resistance Spool -- If the temperature indicator is already calibrated for 20 or 24 volts d-c. control circuit no change in the bridge box resistor S#563855 is required. If the indicator is calibrated for other d-c. voltages above 24 volts it will be necessary to reduce the series resistance connected to terminal #1 inside the bridge box assembly to about 180 ohms by means of resistor spool #563855.

Rectox -- The Trickle Charger should be connected as shown in figures 1, 2, or 3.

Test Resistor--The connections for the test resistor are also shown in figures 1, 2, or 3.

Adjusting Rheostat--This rheostat may be available if the previously used control circuit was 20 or 24 volts. The connections are shown in the diagrams.

Selector Switch--To bring an installation entirely up to date install new selector switches styles as per figures 1, 2, or 3, according to whether complete lead compensation or approximate lead compensation is used, and whether one indicator and selector switch per machine is used. Or whether one indicator serves separate machines through separate selector switches.

If other style selector switches as previously installed are to be retained with existing wiring a comparison of the old diagram with figures 1, 2, or 3 should be made to make sure that no other changes are needed in addition to those indicated above.

Note: For Thermocouple temperature indicator see I.L. 43-206.1. For resistance type temperature indicator operated from oil temperature in Transformers, see I.L. 43-206.2

DIAGRAM INFORMATION

TEMPERATURE INDICATOR 20 V. D.C. (5) EXPLORING COIL TYPE WITH RECTOX AND TYPE W SELECTOR SWITCH

COMPLETE LEAD COMPENSATION

SELECTOR SWITCH

FOR INDIVIDUAL INDICATOR APPLICATION (ONE SW. PER IND.) WITH FIXED MODERNISTIC KEY, 1/8" MTG. _____ S #1176902

POSITION TABULATION

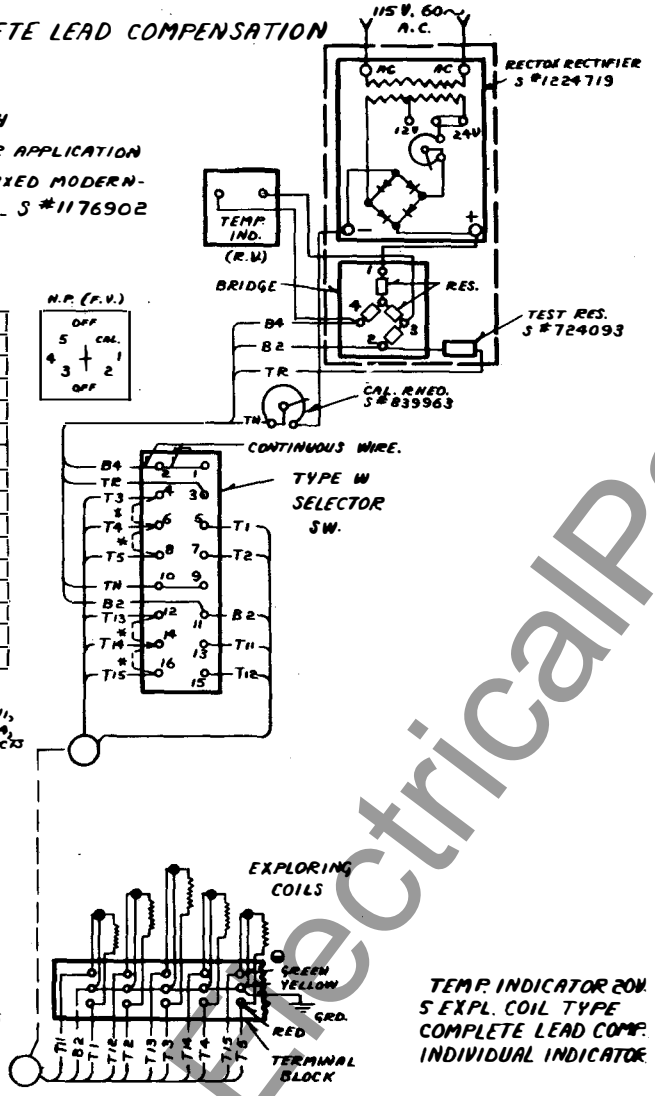
CONTACT	POSITION							
	OFF	CAL	1	2	OFF	3	4	5
2-1	X	X	X	X	X	X	X	X
2-3		X						
2-5			X					
2-7				X				
2-4						X		
2-6							X	
2-8								X
10-9	X	X	X	X	X	X	X	X
10-11		X						
10-13			X					
10-15				X				
10-12						X		
10-14							X	
10-16								X

X = CONTACTS CLOSED.

CONTACT 2-3 MAKES BEFORE 10-11, CONTACTS 2-3, 2-5, 2-7 AND 2-4, 2-6, 2-8 ARE OVERLAPPING CONTACTS TO PREVENT OPENING OF BRIDGE DURING TRANSITION.

*IF LESS THAN 5 EXPLORING COILS ARE USED, CONNECT THE BLANK STUDS TO ONE OF THE EXPLORING COILS AS INDICATED BY THE DOTTED JUMPERS.

⊖ ON ALL DRAWINGS WHERE THIS TERMINAL BLOCK IS SHOWN THE COLOR CODE OF EXPLORING COILS AS SHOWN HERE IS TO BE INDICATED.



TEMP. INDICATOR 20 V. 5 EXPL. COIL TYPE COMPLETE LEAD COMP. INDIVIDUAL INDICATOR

Fig. 1
Wiring Diagram with Separate Indicator and Type W Selector Switch for Each Machine, for Complete Lead Resistance Compensation.

DIAGRAM INFORMATION

TEMPERATURE INDICATOR 20 V. D.C. (5) EXPLORING COIL TYPE WITH RECTOX AND TYPE W SELECTOR SWITCH

APPROXIMATE LEAD COMPENSATION

SELECTOR SWITCH

FOR INDIVIDUAL INDICATOR APPLICATION (ONE SW. PER IND.) WITH FIXED MODERNISTIC KEY, 1/8" MTG. _____ S# 1176899

FOR COMMON INDICATOR APPLICATOR (SEVERAL SWITCHES PER INDICATOR) WITHOUT KEY _____ S# 1176900

KEY, MODERNISTIC 1/8" MTG. _____ S# 1176901

POSITION TABULATION

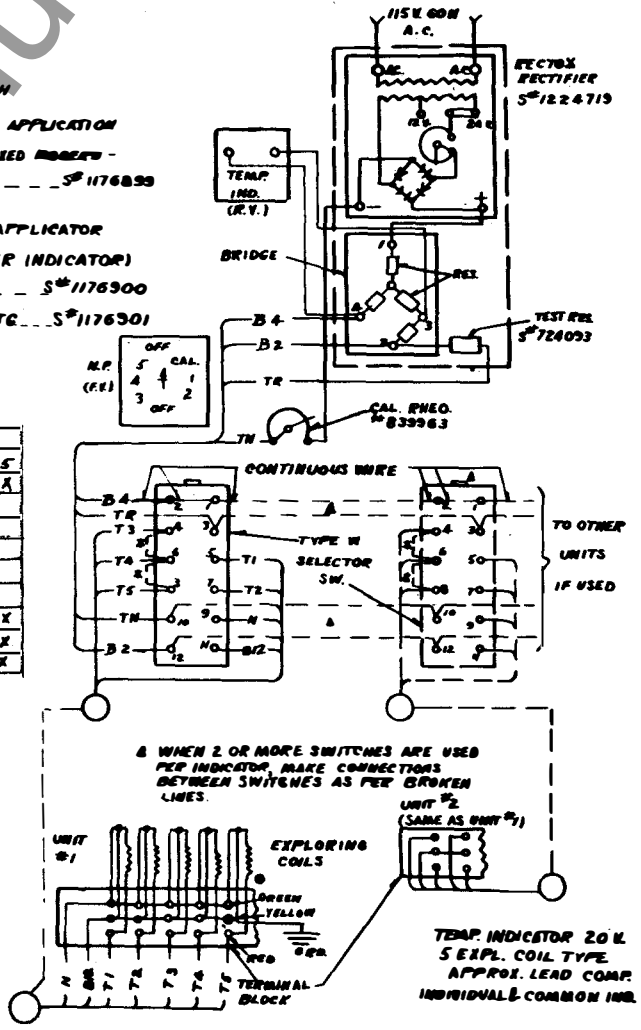
CONTACT	POSITION							
	OFF	CAL	1	2	OFF	3	4	5
2-1	X	X	X	X	X	X	X	X
2-3		X						
2-5			X					
2-7				X				
2-4						X		
2-6							X	
2-8								X
9-10	X	X	X	X		X	X	X
11-12	X	X	X			X	X	X

CONTACTS 2-3, 2-4, 11-12 MAKE BEFORE 9-10 MAKES. CONTACTS 2-3, 2-5, 2-7 AND 2-4, 2-6, 2-8 OVERLAP TO PREVENT OPENING OF BRIDGE DURING POSITION X= CONTACTS CLOSED

* IF LESS THAN 5 EXPLORING COILS ARE USED, CONNECT THE BLANK STUBS TO ONE OF THE EXPLORING COILS AS INDICATED BY THE DOTTED JUMPERS.

⊖ ON ALL DIAGRAMS WHERE THIS TERMINAL BLOCK IS SHOWN THE COLOR CODE OF EXPLORING COILS AS SHOWN HERE IS TO BE INDICATED.

& WHEN 2 OR MORE SWITCHES ARE USED PER INDICATOR, MAKE CONNECTIONS BETWEEN SWITCHES AS PER BROKEN LINES.



TEMP. INDICATOR 20 V. 5 EXPL. COIL TYPE APPROX. LEAD COMP. INDIVIDUAL & COMMON IND.

Fig. 2
Wiring Diagram with separate Indicator and Type W Selector Switch for Each Machine for Approximate Lead Resistance Compensation.

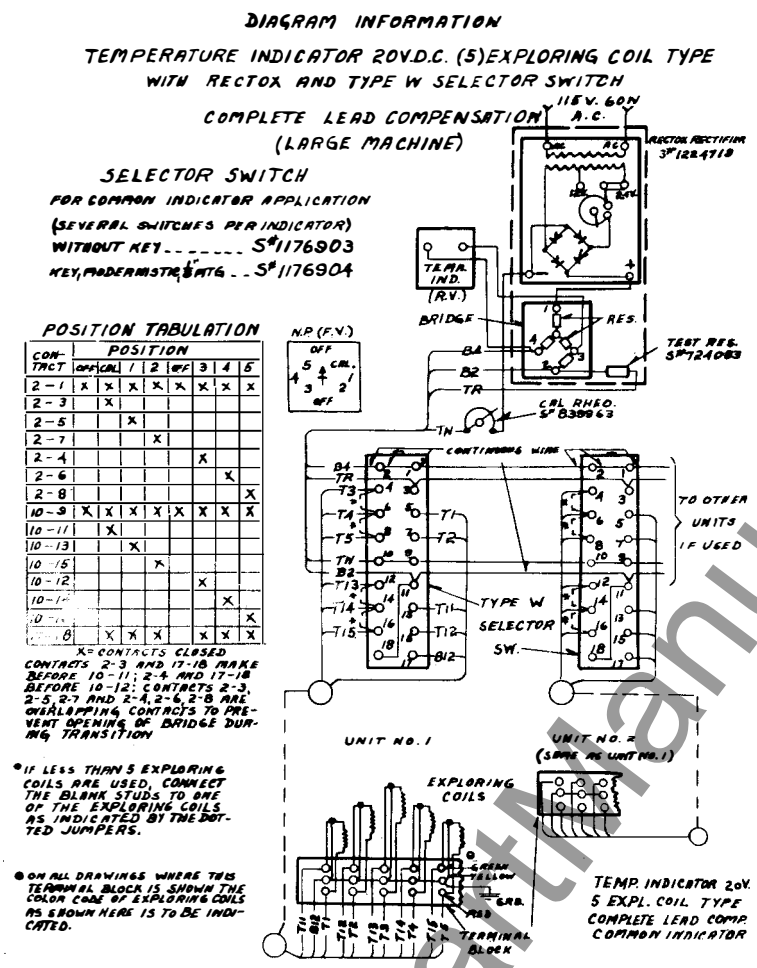


Fig. 3
Wiring Diagram with One Indicator for Several Machines and Separate Type W Selector Switches for Each Machine, for Approximate Lead Resistance Compensation.

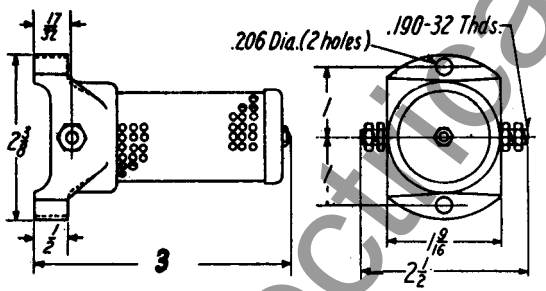


Fig. 4
Test Resistor Style No. 724 093

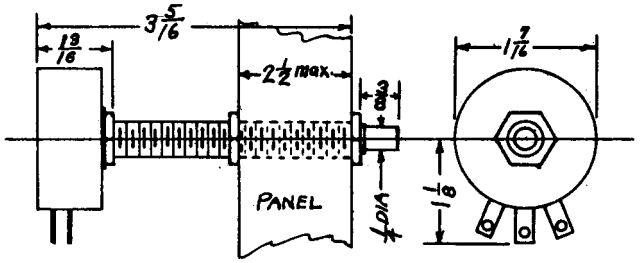


Fig. 5
Panel Rheostat Style No. 839 963

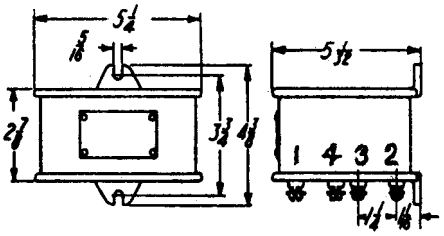


Fig. 6
Bridge Box for All Exploring Coil Temperature Indicators.