I.T.E. CIRCUIT BREAKERS
REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers manually operated types UX, J, EL, W and LL and solenoid operated types W and LL, I.T.E. plain overload, plain reverse current, or overload and reverse current circuit breakers in accordance with specifications KS-5105, KS-5105-01, KS-5181 and KS-5181-01.

1.02 This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

1.03 Reference shall be made to Section 020-010-711 covering General Requirements and Definitions for additional information necessary for the proper application of the requirements listed herein.

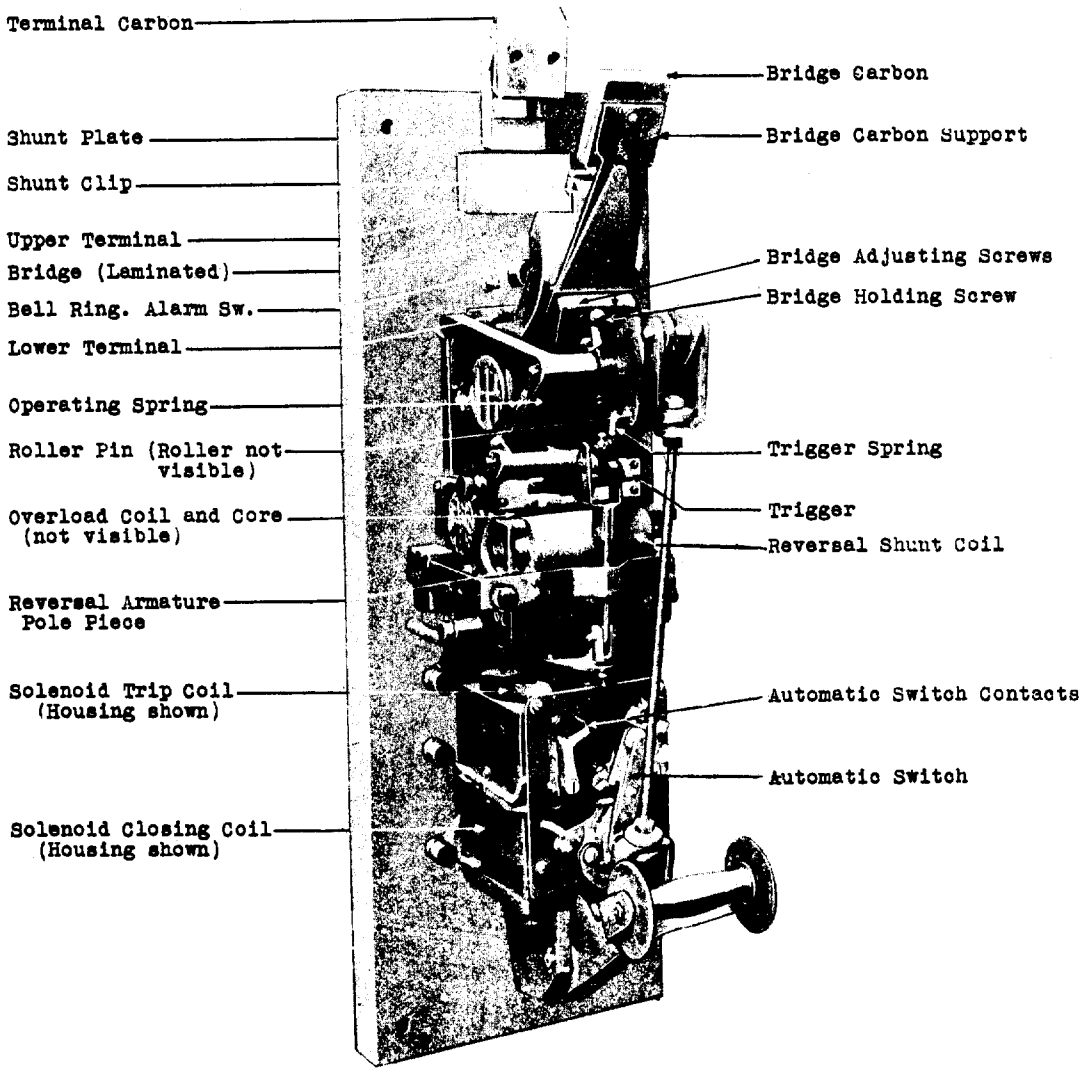

Fig. 1 – Type LL Breaker — Solenoid Operated

2. REQUIREMENTS

2.01 ***Heating:*** When carrying full rated load, the temperature rise above an ambient temperature not over 40° C. shall not exceed the following values when measured by a thermometer against the hottest accessible spot holding the bulb against the metal with a minimum amount of felt or putty.

Coils	50° C
All other parts	20° C

Use Centrigrade Thermometer.

> ***Note:*** This requirement need be checked for only when it is felt that the heating is excessive.

2.02 ***Sequence of Operation:*** When closing the contacts shall make in the following sequence:

(1) carbons,
(2) shunt clips,
(3) laminated bridge.

When opening this order shall be reversed.

Gauge by eye.

2.03 ***Trigger:*** When the holding trigger (latch) moves into position it shall hold the circuit breaker closed until the breaker is opened either electrically or manually.

2.04 ***Contact:*** The contact pressure and area shall be such that the voltage drop across the main bridge contacts with the breaker carrying full rated current shall not exceed 20 millivolts when measured between the main contact blocks. Use millivoltmeter.

> ***Note:*** If no regular millivoltmeter is available, this test may be made with the standard switchboard ammeter by removing the ammeter leads from the external shunt and using the meter with its leads as the test instrument. These meters give full scale deflection with 50 millivolts impressed on the lead terminals and therefore 2/5 of full scale represents 20 millivolts.

2.05 ***Overload Feature:*** The circuit breaker shall trip when the current flowing through the circuit reaches a predetermined value for the particular application, usually.

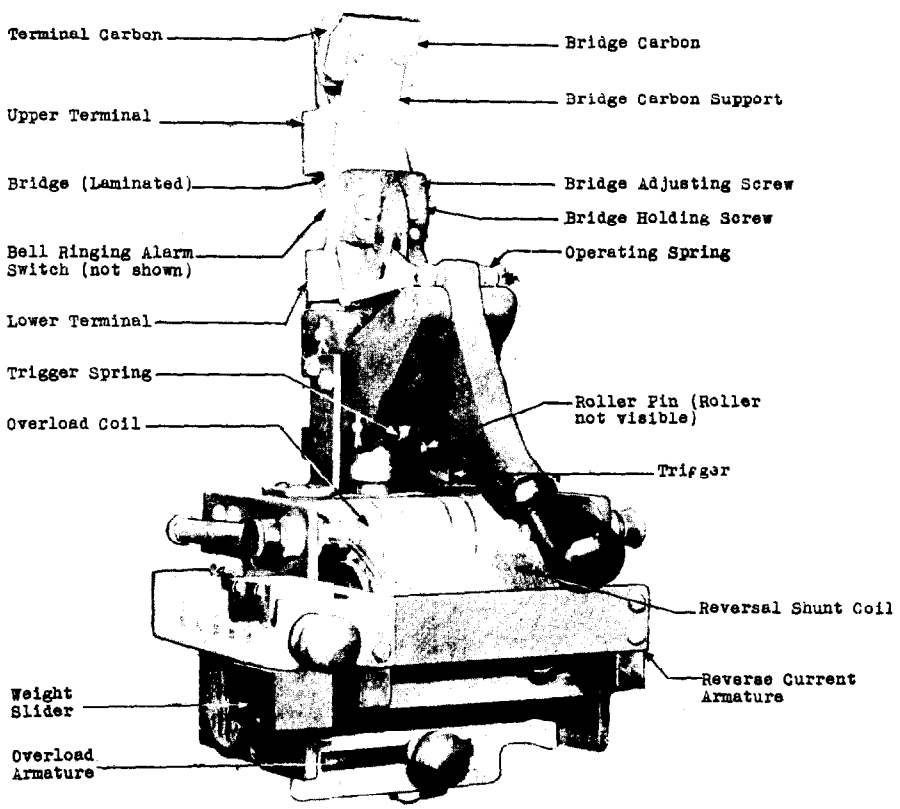

Fig. 2 – Type EL Breaker — Overload and Reverse Current

110% to 125% of the capacity of the circuit or generator protected by the breaker. Use power board ammeter.

Note: Circuit breakers protecting generators controlled by centrifugal type voltage regulators do not use the overload feature.

2.06 ***Reverse Current Feature***

(a) With the circuit breaker closed but carrying no load (generator switch open) ***slowly*** raise the armature of the reverse current feature, manually, by applying slight upward pressure to under side of armature (either at the front or rear corner depending upon the type of breaker). When armature reaches mid position, or slightly above, the magnetic pull of the shunt coil at normal operating voltage shall be sufficient to cause the armature to complete its upward movement and release the mechanical latch permitting the circuit breaker to open. This requirement does not apply to UX and J breakers.

(b) With circuit breaker closed and associated generator delivering as large a percentage of its rated capacity as circuit conditions permit open the circuit supplying power to the motor driving the generator. Reverse current resulting from the motorizing of the generator shall trip the circuit breaker. A time lag of 5 seconds maximum shall be allowed between the opening of the motor circuit and the tripping of the circuit breaker.

(c) An alternate method which may be employed if desired consists of slowly reversing the current in the generator armature, manually, by operating the associated field rheostat. The circuit breaker shall trip before the reverse current reaches 15% of rated generator amperes.

2.07 ***Bell Ringing Attachment***

(a) The bell ringing switch shall be closed when the circuit breaker is open and open when the breaker is closed.

(b) Types W, EL and LL breakers are also equipped with a shunt coil switch used to connect the shunt coil of the reverse current feature in the circuit and actuated by the same mechanism as the bell ringing attachment. This switch shall be closed when the circuit breaker is closed and open when the circuit breaker is open.

2.08 ***Solenoid Operation:*** The breaker shall close when the solenoid closing coil is energized by having normal voltage impressed upon it. The breaker shall open when the trip coil is similarly energized.

2.09 ***Automatic Solenoid Switch***

(a) The automatic switch on the solenoid operated breakers shall open the circuit through the closing coil and close the circuit through the tripping coil when the breaker is closed either manually or electrically.

(b) It shall open the circuit through the tripping coil and close the circuit through the closing coil when the tripping coil is energized and trips the breaker.

(c) Tripping of the circuit breaker by the overload or reverse current features shall not cause the auomatic switch to function.

3. ADJUSTING PROCEDURES

3.001 ***List of Tools, Materials and Test Apparatus***

Tools

File, flat, 10" smooth. R-1776.

Pliers, P long nose, 6-1/2", A.T.&T. Co. standard specification 6267.

Screw-drivers as required.

Wrenches, open end, flat, as required.

Materials

Abrasive Cloth or paper 100 grade or equivalent.

Cloth, Twill Jean, KS-2423 or equivalent.

Carbon paper.

Test Apparatus

Millivoltmeter, Weston, Model 280, 0-100 scale or equivalent.

Thermometer, R-1032, Detail 1.

Watch, ordinary, with second hand.

3.01 ***Heating*** (Reqt 2.01)

(1) Overheating coils shall be replaced. Any other parts that overheat should be inspected to be sure that the current carrying connections to those parts are clean and secure. If the connections are satisfactory, check the requirements given under "Contact".

3.02 ***Sequence of Operation*** (Reqt 2.02)

(1) If the carbons do not close in the proper sequence and are not excessively worn, form the member carrying the removable tip to secure the proper sequence, or replace the member. Worn carbons shall be replaced.

(2) If the shunt clip contacts do not close in proper sequence, form the spring carrying these contacts, or replace the member. In type UX and J breakers the outer spring of the laminated bridge serves as the shunt clip contact and makes contact before the remainder of the bridge. For breakers of this type the bridge and shunt clip must be removed before reforming the shunt clip to make proper contact.

3.03 ***Trigger*** (Reqt 2.03)

(1) If the trigger fails to hold when in the latching position, it shall be adjusted by means of its associated adjusting screw or replaced.

3.04 ***Contact*** (Reqt 2.04)

(1) To clean silvered contact blocks and bridges, wipe with a dry cloth. Never use abrasive of any kind.

(2) To clean copper contacts, wipe with a dry cloth; remove corrosion by rubbing lightly with a piece of abrasive cloth wrapped around a small block of wood. To remove burrs, file carefully being sure not to remove any metal except that interfering with the proper seating of the parts.

(3) The area of contact is determined by inserting a piece of carbon paper against a thin piece of plain white paper (tissue paper preferred) between the contacts and then closing the breaker. The impression on the paper shows the area of contact which should be at least 75% of the available area.

(4) The area of contact is adjusted by moving the bridge contact which is mounted to its arm by six screws, the two center ones holding the bridge in place and the other four serving to adjust its position. By turning in the adjusting screw on the side where the contact is least and turning out the corresponding screw on the side where contact is greatest, the area of contact can be equalized. On the later design of type W breakers, shim plates are used behind the bridge instead of adjusting screws.

(5) To make minor adjustments in the bridge contact pressure turn both upper or both lower adjusting screws in the same direction. Turning in increases pressure and turning out decreases it. Pressure is correct when the inner lamination of the bridge on types W and LL deflects about 1/32" from the inner washer plate on closing. On type EL breakers the inner lamination should slide along the contact blocks approximately 1/32 inch when closing. Excess pressure will cause outer laminations to lift off of block.

(6) To make major adjustments in the bridge contact pressure, loosen the two holding screws and the 4 adjusting screws until the bridge is loosely held to the arm. Close the breaker, being sure that the bridge is in its proper position just before the pressure is applied. Tighten all 4 adjusting screws until the four corners of the inner lamination have the proper deflection. Tighten the two holding screws and retest as outlined above.

3.05 ***Overload Feature*** (Reqt 2.05)

(1) ***Types UX and J Breakers:*** The overload device is equipped with a calibrated scale and the adjustment is made by turning the knurled knob under the scale after first releasing the knurled lock nut. The setting is indicated by the top of the armature which serves as a pointer. Turning to move the pointer toward the higher scale values will permit a higher current to flow before the breaker will trip. Turning in the opposite direction will cause the breaker to trip at a lower current value. After changing the adjustment, tighten the lock nut and cause the breaker to open several times on overload to determine whether the proper adjustment has been given. If not, change the adjustment again and repeat the test.

(2) ***All Other Types of Breakers:*** The overload device is equipped with a calibrated scale and the adjustment is made by moving a slider along the scale. The knob on the front of the slider which acts as a handle for convenience in making adjustments is threaded and when screwed in tightly holds the slider firmly in place. Moving the slider toward the higher calibration will permit a higher current to flow before the circuit breaker trips and moving in the opposite direction will cause the breaker to trip at a lower current. After the adjustment has been changed, screw the knob in tightly and cause the breaker to open several times on overload to determine whether the proper adjustment has been given. If not, change the adjustment and repeat the test.

3.06 ***Reverse Current Feature*** (Reqt 2.06)

Types UX and J Breakers

(1) If the breaker does not trip within the specified time on reverse current examine the shunt coil circuit of the reverse feature and see that all connections are firm, that the contacts are clean and the armature moves freely.

(2) Adjust the stop screw at the lower end of the reversal armature until the breaker operates on reverse current or the airgap at the top end of the reversal armature is a minimum of one quarter that of the airgap at the bottom of the reversal armature. If the breaker still does not trip within the specified time on reverse current replace the reverse current shunt coils or the breaker.

All Other Types

(3) If armature of reverse current feature does not follow through and trip breaker ascertain that breaker is in good mechanical condition and that the latch load is not picked up until after reverse current armature gets beyond its mid position. If the latch mechanism is engaged before the armature reaches its mid position, replace the latch mechanism or the cross member of the armature which engages the latch mechanism. Examine the shunt coil circuit to see that all connections are firm, contacts clean, and that reversal armature does not bind and is centered in its frame. If binding is apparent check to insure that the cylindrical iron core does not scrape inside of the series current coil. The armature may be centered by adjusting the pivot screws. Replace any defective coils.

(4) On breakers which have been marked locally by means of a painted mark on the reverse current scale to indicate the proper position of the associated weight, move the slider one quarter the distance toward the next higher scale marking if the painted mark is opposite the lowest scale division, or one half a scale division if the painted mark is opposite any other scale reading. Pass approximately rated current if practicable, but not less than 30% rated current, through the breaker in the forward direction for a few seconds to magnetize the armature and then trip the motor of the associated charging generator. If the breaker trips on reverse current as the generator motorizes its operation may be considered satisfactory and the slider weight should then be moved back to its original position opposite the painted mark. If the breaker does not operate try the standard setting outlined in the following paragraphs.

(5) On breakers which do not have the position of the reverse current slider indicated by a painted line, set the slider on the lowest scale marking and see that the breaker does not trip out on potential when the potential of the associated generator is raised to 40 volts for 24 volt generators, 80 volts for 48 volt generators or 200 volts for 130 volt generators. To obtain this operation the reversal armature may be adjusted as follows.

(6) Open the circuit at some point other than the breaker contacts, as at the generator switch, so that voltage will be on but no current will flow through the breaker, then close the breaker. The reverse current armature stop screws are threaded through the holding pole-pieces. On type LL breakers they are accessible from beneath and secured in place by a lock nut. On types EL and W breakers they are secured in place by set screws in the near side of the holding pole-pieces. Raise or lower the stop screws to obtain operation of the armature at the desired potential.

(7) When types EL and W breakers have an overcurrent trip armature combined with the reverse current trip, it is necessary to remove the overload armature in order to adjust and lock the stop screws of the reverse current trip. To remove the overcurrent trip armature take out the two flat-headed screws in the lower part of each side plate, releasing the current scale and adjustment slider. Back out the overload armature pivot screws and remove the armature. Reassemble before the final check. The weight may be moved slightly for final adjustment.

(8) Next, pass approximately rated current, if practicable, but not less than 30% rated current thru the breaker, in the forward direction for a few seconds and then trip the motor of the associated charging generator. If the breaker trips on reverse current move the slider one quarter the distance towards the next higher scale marking and repeat. If the breaker trips on reverse current with this setting the breaker may be considered to be in satisfactory operating condition and the slider should then be set on the lowest scale marking and left in that position.

Special Setting for Types LL, EL and W Breakers

(9) If the breaker does not operate on reverse current under the conditions outlined above the breaker may be given a special setting. Move the weight on the reverse current armature to the 15% reversal position on type LL breakers or to the 10% reversal position on the types EL and W breakers. Adjust the reversal armature by means of the associated stop screws as described above until the armature trips with 31.5 ± 0.5 volts for 24 volt service, 63.0 ± 2.0 volts for 48 volt service or 165.0 ± 5.0 volts for 130 volt service applied to the shunt coils. Scribe a temporary line on the scale at the weight point. Apply approximately rated current, if practicable, but not less than 30% rated current thru the breaker, in the forward direction and trip the power service to the motor driving the associated generator. See that the breaker trips positively on reverse current. Move the slider one half a scale division toward the next higher mark and repeat. If the breaker operates satisfactorily reset to the new temporary scribe line and make it permanent.

(10) In the majority of cases it will be possible to obtain a satisfactory adjustment of the circuit breaker by one of the two methods outlined above. It is expected that no difficulty will be met in applying the above adjustments to type W breakers, either hand or solenoid operated, or to types EL or LL breakers having solenoid operation. Some difficulty may be experienced in the field on some manually operated types EL or LL breakers, particularly the older LL breakers with 33 or 30 volt coils. The trouble is frequently due to too much residual magnetism in the iron of the reverse current series magnetic circuit. In such cases as cause trouble the matter should be referred to the supervisor who may wish to order new iron for the series magnetic circuit. The replacing of the iron is a simple matter and the procedures to be followed are readily apparent. If the breaker can be taken out of service for a time, or can be kept under supervision when required to be operated so reverse-current protection can be dispensed with, the old iron parts may be returned to the manufacturer for reannealing, instead of ordering new parts.

3.07 ***Bell Ringing Attachment*** (Reqt 2.07)

(1) ***Types UX and J:*** The bell ringing attachment consists of a fixed contact resting against a push rod of insulating material. When the breaker is closed, the push rod is pushed in and opens the contacts. When the breaker is opened the spring contact pushes the rod back again and closes the contact. If the contacts are dirty, clean with abrasive cloth or fine sandpaper. If they do not make contact form them with pliers being sure that the spring tension is sufficient to close the contact when the breaker is opened.

(2) ***Types W and LL:*** The bell ringing attachment consists of two pairs of springs between which contact is made by two blocks carried on a push rod. The pair of springs nearer the panel carries the bell ringing contacts and the pair farther from the panel carries the shunt coil contacts. If the contacts are dirty, clean with abrasive cloth or fine sandpaper. If the contacts fail to make, form the springs with a pair of pliers. When forming the contacts, be sure that the contact pres-

sure is not so heavy that it prevents the spring from returning the push rod to its normal position when the circuit breaker is opened.

(3) ***Type EL:*** The bell ringing attachment consists of two pairs of fixed contacts and a lever type movable contact held in the closed position by a helical spring and operated by a push rod of insulating material projecting thru the panel. The whole switch is mounted on one of the main studs. The pair of springs nearer the panel carries the shunt coil contacts and the pair farther from the panel carries the bell ringing contacts. If the contacts are dirty, clean with abrasive cloth or fine sandpaper. If the contacts fail to make, form the springs with a pair of pliers. When forming the contacts be sure that the contact pressure is not so heavy that it prevents the spring from returning the push rod to its normal position when the circuit breaker is opened.

3.08 ***Solenoid Operation*** (Reqt 2.08)

(1) If the closing rod does not permit the trigger to move freely into the locking position close the breaker manually until the solenoid plunger stops against the top of its chamber and adjust the closing rod length so that the latch engages the roller freely and the breaker arm is just clear of its final stop. The length of the automatic solenoid switch operating rod should be adjusted so that the switch snaps over into the opposite position just at the end of the movement on slow manual closing.

Old Style

To change the closing rod adjustment, remove the pin in the upper clevis and loosen the lock nuts at both ends of the rod. Do not disturb the insulating joint in the middle of the rod. The thread at one end of the rod is coarse and at the other end fine so that a very fine adjustment can be obtained by turning the rod and the clevis. After changing the adjustment reassemble the upper clevis and operate the circuit breaker manually. When the adjustment is satisfactory tighten the lock nuts.

New Style

To change the closing rod adjustment, loosen the nut above the clevis at the lower end of the rod. Turn the nut on the end of the rod to change the adjustment and operate the breaker manually. When the adjustment is satisfactory tighten the nut above the clevis, being careful not to disturb the one on the end of the rod by which the adjustment was made.

(2) If operation of the trip rod does not trip the circuit breaker, the rod should be shortened. If the rod does not allow the trigger to hold the breaker in the closed position, the rod should be lengthened.

Old Style

To change the trip rod adjustment, remove the pin in the lower clevis and loosen the lock nut at the upper end of the rod. Do not disturb the insulating joint in the middle of the rod. Screw the trip rod into or out of the upper support as required and reassemble the parts. After changing the adjustment trip the circuit breaker by means of the tripping coil. When the adjustment is satisfactory, tighten the lock nut.

New Style

To change the trip rod adjustment, remove the pin in the lower clevis and loosen the lock nut below the clevis. Screw the clevis in or out as required and reassemble the rod. After changing the adjustment, trip the circuit breaker by means of the tripping coil. When the adjustment is satisfactory, tighten the lock nut.

3.09 ***Automatic Solenoid Switch*** (Reqt 2.09)

(1) Dirty contacts shall be cleaned by rubbing lightly with abrasive cloth or fine sandpaper.