CIRCUIT BREAKERS

KS-15910

REQUIREMENTS AND ADJUSTING PROCEDURES

1. GENERAL

1.01 This section covers KS-15910 circuit breakers used in the J86623, 120- and 170-KW engine-driven reserve alternator plants.

1.02 Reference shall be made to Section 020-010-711 covering general requirements and definitions for additional information necessary for the proper applications of the requirements listed herein.

1.03 ***Phi (ϕ):*** Requirements are marked with a phi when they are not required to be checked before turnover.

1.04 ***Asterisk (*):*** Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus, or would affect the adjustment involved, or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

1.05 The circuit breakers covered by this section are of the 3-pole, single-throw type and may be either manually or electrically operated. The series overload coils are rated at either 500 or 600 amperes and are designed to trip the breaker at either 100 $\pm$10 per cent or 120 $\pm$10 per cent of these values respectively depending on which list number is specified. Electrically operated breakers are provided with a closing solenoid control system and a shunt tripping device for remotely opening and closing the breaker. Manually operated breakers can be opened and closed only at the breaker.

1.06 When any inspection or maintenance work is to be done, be sure that all power from the associated circuits has been shut off.

1.07 A complete inspection of the main contacts and arc quenchers should be made after the breaker has opened due to a short circuit in the load.

2. REQUIREMENTS

2.01 ***Operation of Breakers***

(a) ***Manual Closing:*** KS-15910, L3 and L4 breakers shall be closed by rotating the operating handle 90 degrees counterclockwise and then clockwise 90 degrees back to its normal vertical position. KS-15910, L1 and L2 breakers are closed when the handle is rotated 90 degrees counterclockwise. No reset stroke is necessary as in the case of manual breakers.

Note: In closing a manual breaker on a load, it is desirable to make the handle movement with a reasonably fast, snapping action.

(b) ***Electrical Closing:*** KS-15910, L1 and L2 electrically operated breakers shall be closed by means of a closing solenoid and associate control system. The control system consists of a closing switch, a closing contactor, an antipump relay and a cut-off switch. The sequence of operation is as follows.

(1) When the closing switch push button located on the front of the breaker is depressed the coil of the contactor becomes energized.

(2) The contacts of the contactor make, sealing its coil in and also energizing the solenoid closing coil. This causes the upward movement of the solenoid armature which initiates the mechanical closing action.

(3) As the breaker mechanism moves from the open to the closed position, the cut-

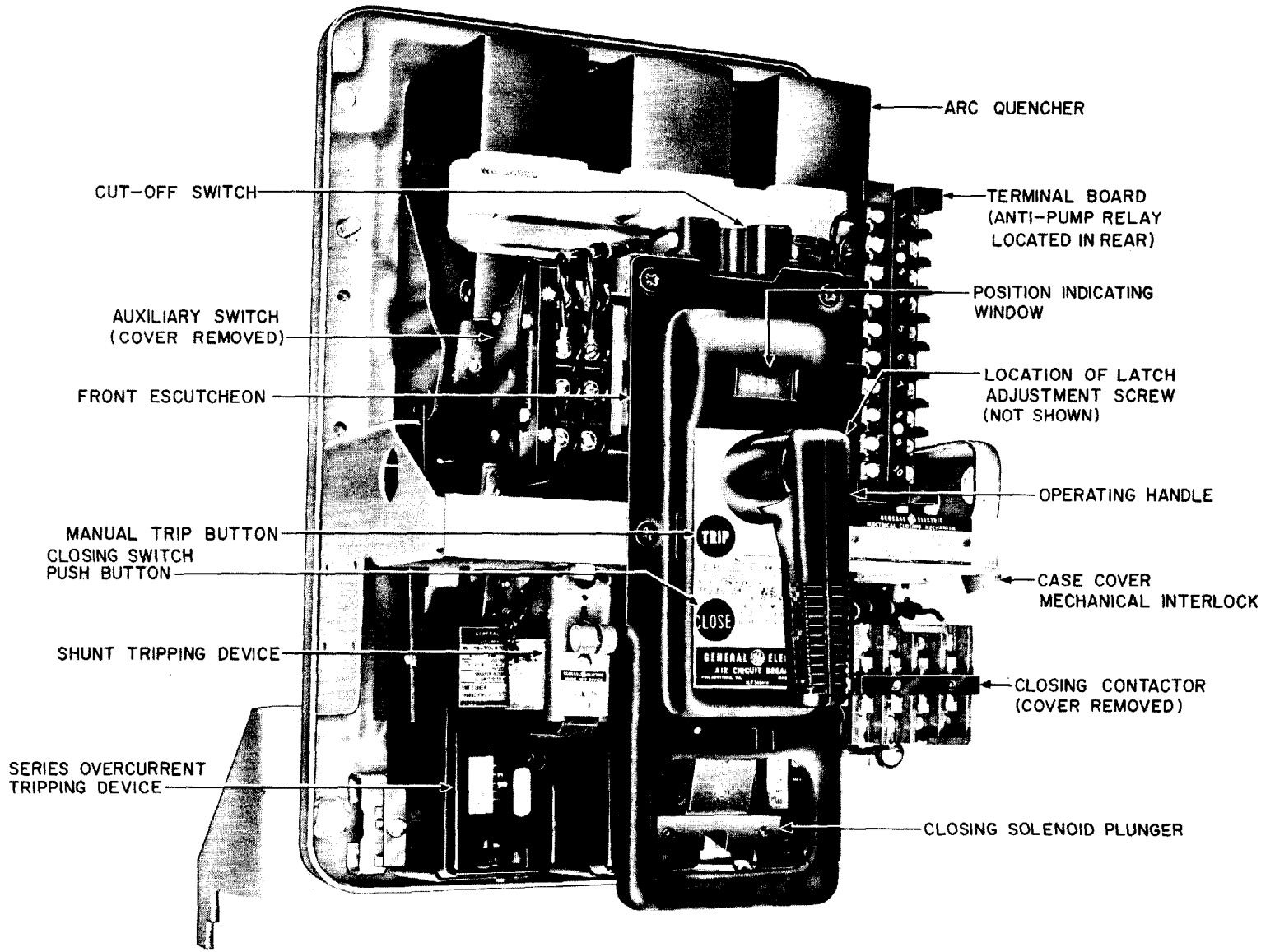


Fig. 1 – Front View of KS-15910, L2 Electrically Operated Breaker

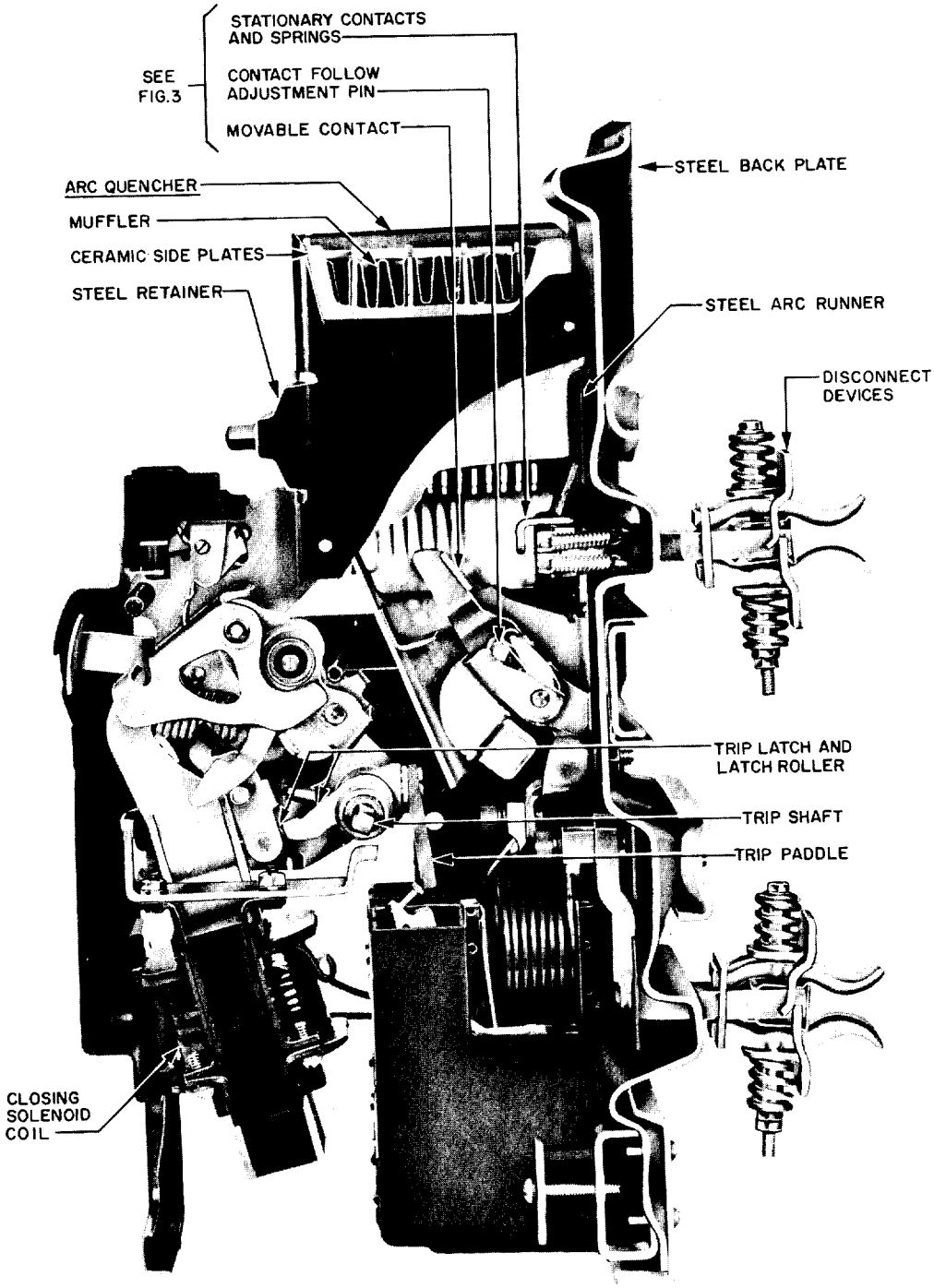


Fig. 2 – Cut-Away View of Electrically Operated Breakers — Reset Position (Pistol-Grip Handle Not Shown)

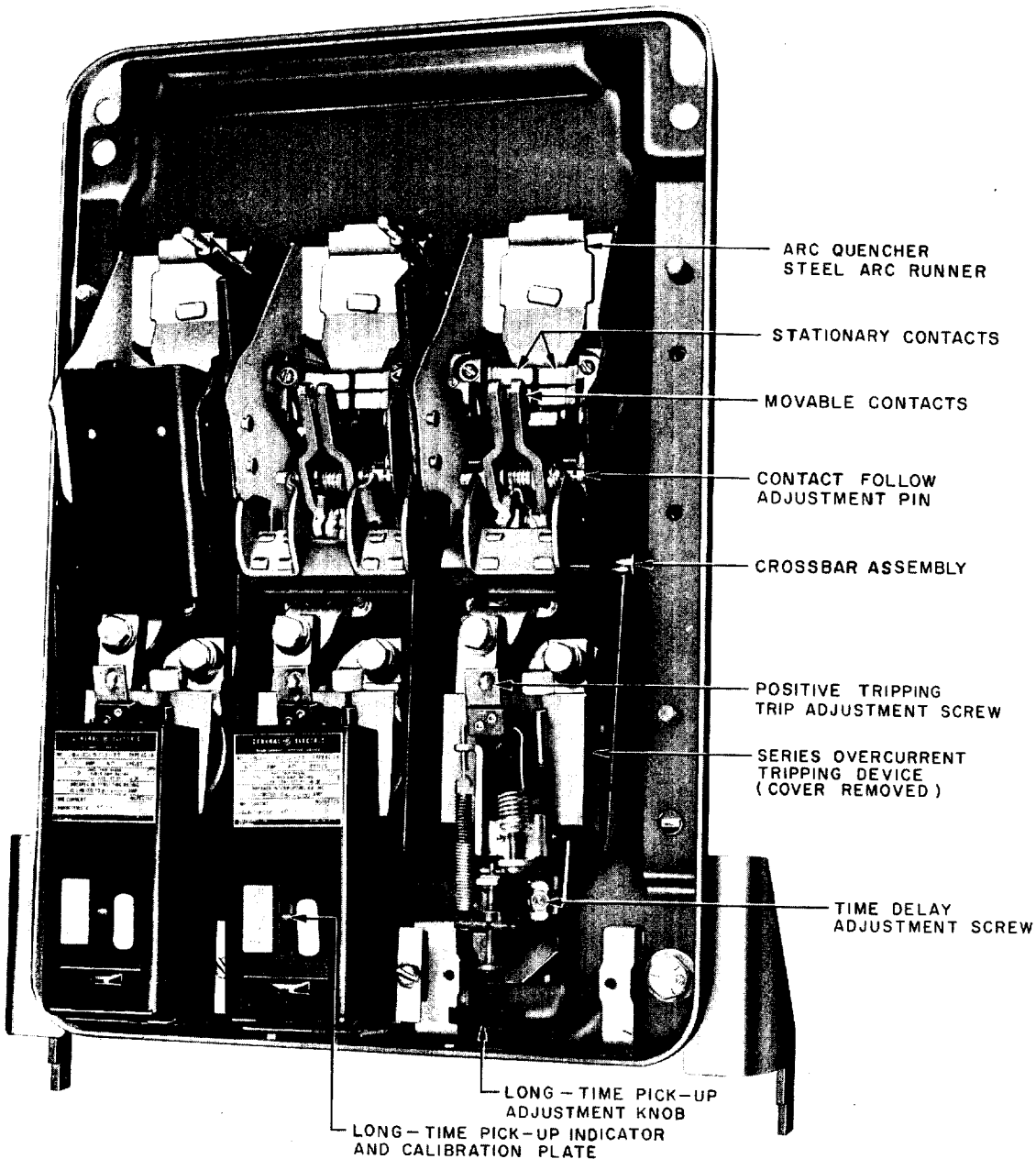


Fig. 3 – Back Frame of Breakers

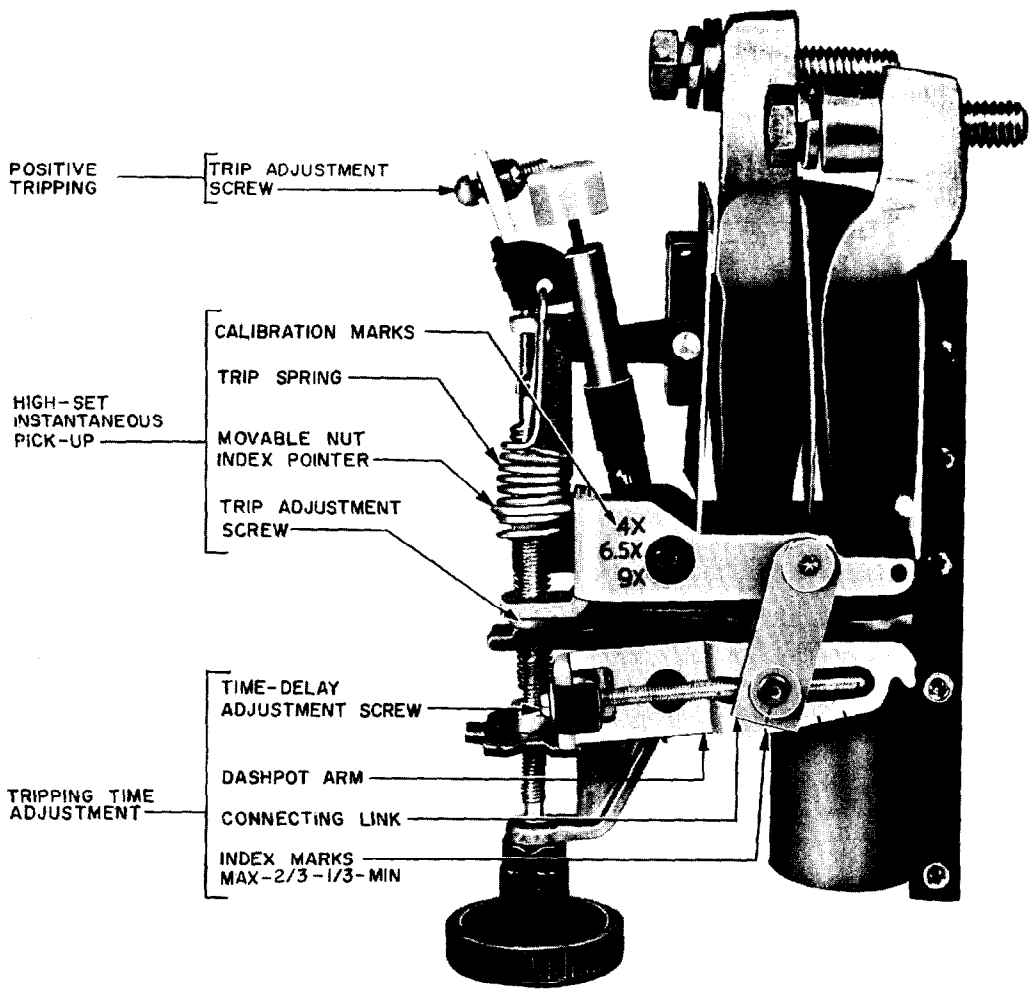


Fig. 4 – Side View of Series Overcurrent Tripping Device (Cover Removed)

off switch de-energizes the contactor coil and energizes the relay coil.

(4) The relay together with the cut-off switch provide an antipump feature which allows only one closure of the breaker for a single operation of the closing switch no matter how long the switch may be held closed.

(c) ***Manual Tripping:*** The breakers can be manually tripped by depressing the manual trip button. This action pushes a rod against a trip shaft, rotating it and causing the mechanical trip latch to be displaced.

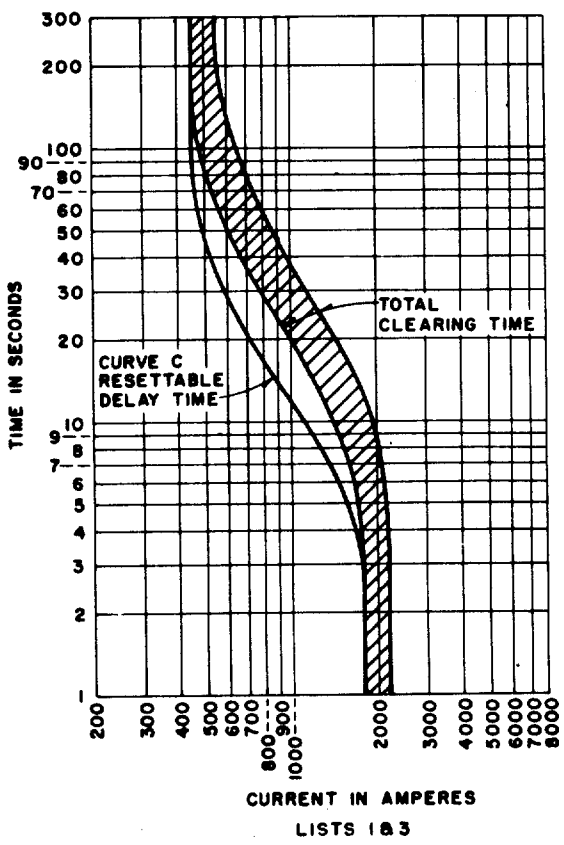
Caution: If the breaker is tripped manually while the operating handle is in the reset position, the handle should be lowered by the right hand while operating the trip button with the left hand.

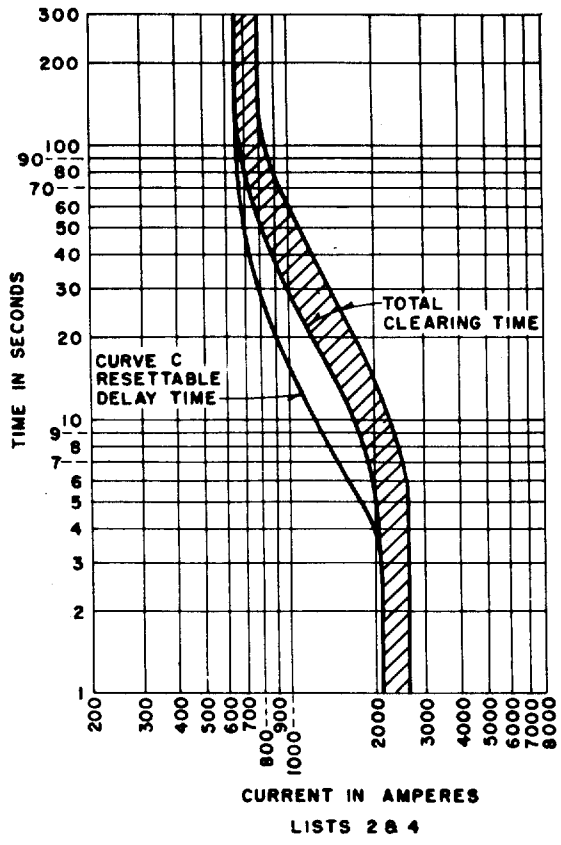
(d) ***Electrical Tripping:*** The breakers can be tripped automatically by the following tripping devices.

(1) Series overcurrent tripping devices

(2) Shunt tripping device

These devices affect tripping by displacing the trip latch of the mechanism. The trip latch is rigidly attached to a trip shaft which runs horizontally from left to right through the breaker. The tripping devices are provided with striker arms which displace the mechanism trip latch





NOTE:
CURVE C INDICATES THE MAXIMUM TIME ANY OVERCURRENT CAN EXIST WITHOUT TRIPPING THE BREAKER PROVIDED THAT AFTER THE INDICATED TIME THE CURRENT IS REDUCED TO 80% OF THE SERIES TRIP COIL SETTING.

Fig. 5 – Time-Current Characteristic of Series Overcurrent Tripping Devices

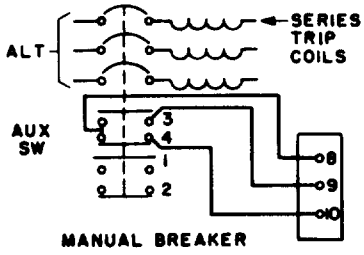


Fig. 6 — KS-15910, L3 and L4 Schematic

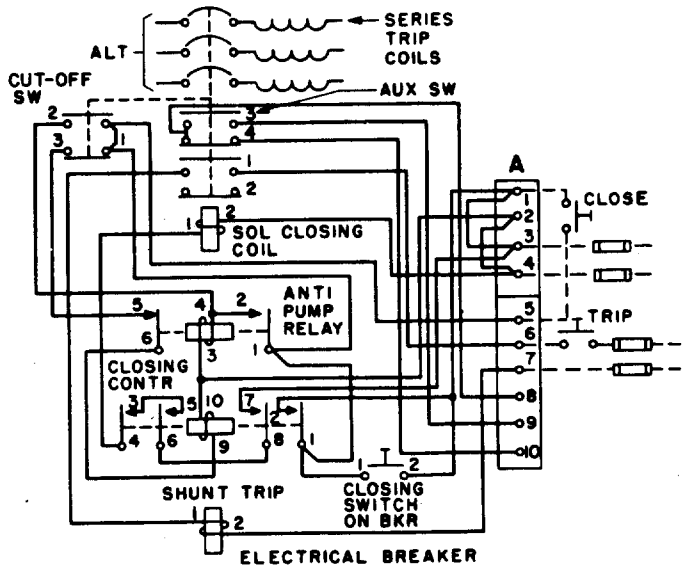


Fig. 7 — KS-15910 L1 and L2 Schematic

by moving against trip paddles fastened on the trip shaft. Looking at the breaker from the right, counterclockwise rotation of the trip shaft causes the breaker to trip; clockwise movement resets the mechanism latch.

ϕ**2.02** ***Lubrication:*** Bearing points and sliding surfaces shall be lubricated annually with petrolatum.

2.03 ***Mounting and Terminals:*** The breaker shall be firmly secured in its case so that the disconnect devices properly engage the studs of the connector unit.

2.04 ***Mechanical Interlock:*** The mechanical interlock shall trip open the breaker upon removal of the case cover.

ϕ**2.05** ***Arc Quenchers:*** The arc quenchers shall be inspected annually for corrosion or burning of parts, or after tripping due to a short circuit in the load.

ϕ**2.06** ***Main Contacts:*** The main contacts shall be inspected annually or after tripping due to a short circuit in the load. The main contacts shall meet requirements 2.07, 2.08, and 2.09.

ϕ**2.07** ***Contact Surfaces:*** Contact surfaces shall be clean and free from build-ups which might interfere with reliable contact.

Gauge by eye.

ϕ**2.08** ***Contact Follow:*** The amount of contact follow, which may be described as the distance the movable and stationary contacts move while they are touching one another in the process of breaker closing shall be

Min 3/32 inch

Max 5/32 inch

Use the R-8550 scale.

ϕ**2.09** ***Contact Pressure:*** The pressure or force required to begin movement of a single stationary contact from its static position shall be

MIN		MAX	
Pounds	Grams	Pounds	Grams
5	2270	9	4080

Use the 79F gram gauge.

2.10** ***Latch Engagement: The amount of engagement between the latch and latch roller shall be such that the breaker shall function properly.

2.11 ***Series Overcurrent Trip Devices***

ϕ (a) The breaker shall trip within 1 hour on the specified long-time trip current and immediately at the instantaneous trip current. The breakers shall also trip in accordance with the performance curve shown in Fig. 5 for other overcurrents.

KS-15910 LIST	LONG-TIME TRIP AMPERE	INSTANTANEOUS TRIP AMPERE
1 & 3	500	2000
2 & 4	720	2400

(b) The long-time pick-up setting shall be set at 100 per cent for KS-15910, L1 and L3 and at 120 per cent for KS-15910, L2 and L4. The instantaneous pick-up setting shall be set at 4X for KS-15910, L1 to L4.

2.12 ***Closing Solenoid and Controls (Electrically Operated Breakers Only)***

(a) When actuated by the closing switch, the closing solenoid shall promptly close the breaker. When the breaker closes, the contacts of the control system shall de-energize the closing solenoid.

2.13 ***Shunt Tripping Device (Electrically Operated Breakers Only)***

(a) When actuated by the associated remote control switch, the shunt trip shall trip open the breaker.

2.14** ***Temperature: The rise in temperature the breaker parts in any convenient ambient temperature between the limits of 10 C and 40 C shall not exceed the following values.

	MAXIMUM RISE ABOVE AMBIENT
Main contacts	85 C (185F)

Use a thermometer.

All measurements shall be taken with the in place. If the temperature is thought to be excessive, check as follows. Hold the bulb of the mometer against the hottest spot in que

covering the part of the bulb not in contact with the part being measured by a piece of felt. Observe the highest temperature indicated after it has stabilized.

3. ADJUSTING PROCEDURES

3.001 *List of Tools, Gauges, and Materials*

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
276	1/4-inch Hex. Single-end Socket Wrench
373D	Contact Burnisher Holder
374A	Burnisher Blade
417A	1/4- and 3/8-inch Hex. Open Double-end Flat Wrench
KS-6015	Duckbill Pliers
KS-6320	Orange Stick
KS-6367	7/16- and 5/8-inch Hex. Open Double-end Flat Wrench
KS-6854	Screwdriver
KS-14208 (2 reqd)	Brush
R-1542	6-inch Adjustable Wrench
—	Long-Nose Pliers
—	4- and 5-inch F Screwdrivers
—	B Screwdrivers, No. 1, 2, and 3
GAUGES	
79F	0-6000 Gram Push-Pull Tension Gauge
R-1032, Detail 1	—5° to 150 C Thermometer
R-8550	6-inch Steel Scale
MATERIALS	
KS-8372	Stabilized Trichloroethylene
KS-14666	Cleaning Cloth
—	150 Grade Abrasive Cloth
—	1-ounce Bottle
—	Felt Pad
—	Petrolatum

3.002 It is recommended that any individually enclosed units on the breaker, such as the series overcurrent tripping devices, shunt tripping device, closing solenoid, solenoid control device, or auxiliary switch, be replaced if out of adjustment or defective, as it would be impractical to make internal repairs or adjustments other than those specified in the following paragraphs. See Section 026-315-801 for replacement procedures.

3.01 *Operation of Breakers* (Reqt 2.01)

(1) The following checks should be made if the breaker fails to function properly.

(a) Manually operate the breaker several times, checking for obstruction or excessive friction.

(b) Electrically operate the breaker several times (see 2.12) to ascertain whether the electrical attachments are functioning properly.

(c) Remove and inspect the arc quenchers as covered in 3.05.

(d) Check the main contact for contact surfaces, contact follow, and contact pressure as covered in 3.07, 3.08, and 3.09, respectively.

(e) Check the latch engagement as covered in 3.10.

(f) Check operation of tripping devices including the overcurrent trip devices, making sure all have positive tripping action. Refer to 3.11 and 3.13.

3.02 *Lubrication* (Reqt 2.02)

(1) Clean and lubricate accessible rubbing surfaces, such as the tripping paddles, when the breaker is inspected or disassembled for maintenance, but not more frequently than once a year. It should not be necessary to lubricate any parts inside the individually covered units such as the series overcurrent tripping devices.

(2) Remove hardened grease and dirt from latch and bearing surfaces with a clean KS-14666 cloth moistened with KS-8372 trichlo-

roethylene. If necessary use a KS-6320 orange stick to loosen hardened grease. Apply a thin film of petrolatum on bearing surfaces, taking care to remove any excess petrolatum from insulating surfaces.

Note: Latch surfaces should be left clean and should not be lubricated.

3.03 ***Mounting and Terminals*** (Reqt 2.03)

(1) Tighten all holding screws and bolts as necessary.

3.04 ***Mechanical Interlock*** (Reqt 2.04)

(1) The interlock device consists of a trip rod with a spring mounted on a bracket on the side of the breaker and a trip paddle mounted on the breaker trip shaft. When the cover is removed, the spring causes the trip rod to move forward engaging the trip paddle, thereby tripping the breaker. The breaker remains tripped until the cover is replaced. If this device does not trip the breaker when the cover is removed, check for freedom of moving parts or bend the tripping paddles which it engages, as required.

3.05 ***Arc Quenchers*** (Reqt 2.05)

(1) To inspect the arc quenchers, remove the steel retainer using the KS-6367 wrench and lift the arc-quencher assembly up and out. The upper edge of the steel arc runner, fastened to the back plate of the breaker, fits into a recess in the back portion of the arc quencher and locates it in its proper position upon replacement. Make sure the steel retainer is replaced and fastened firmly to its mounting studs.

(2) The muffler at the top of the arc-quencher assembly is a serpentine shaped strip of perforated copper plated steel. It is important that the perforations of the muffler be kept open and free from dirt. The arc-quencher unit should be replaced if any extensive burning or corrosion is noted, or if there are any breaks or cracks in the ceramic material.

3.06 ***Main Contacts*** (Reqt 2.06)

(1) To gain access to the main contacts, remove the arc quenchers as covered in 3.05. Before reassembling, inspect the arc quenchers as covered in 3.05.

3.07 ***Contact Surfaces*** (Reqt 2.07)

(1) The main contacts may become pitted or burned after the breaker has opened several times due to short circuits. Clean, smooth, or replace contacts, as required.

(2) ***Cleaning Contacts:*** To remove dirt and gummy substance, clean the contacts with KS-8372 trichloroethylene as follows.

(a) Pour a small quantity of the trichloroethylene into a 1-ounce bottle. It is important to avoid the use of contaminated trichloroethylene in cleaning the contacts. Therefore, discard the trichloroethylene as soon as it appears slightly dirty.

(b) Dip the hairs of a clean KS-14208 brush their full length in the trichloroethylene. Remove excess fluid by wiping the brush on the edge of the bottle. Then, with the pair of contacts open, brush the entire surface of the contact to be cleaned with the moist brush.

(c) Brush the contacts with a dry, clean KS-14208 brush.

(3) ***Removing Build-ups:*** There shall be as little smoothing of contacts as is consistent with satisfactory operation. Contacts should be smoothed while closed, where practicable. To remove build-ups on main contacts, use a strip of 150 grade abrasive cloth. For auxiliary contacts [see 3.12(2)], use the No. 374A burnisher blade held in the No. 373D contact burnisher holder. Insert the blade or abrasive cloth between the contacts and move it back and forth until build-ups are reduced enough to insure reliable contact. Exercise care to avoid reducing the height of the contact. After burnishing, brush the contacts with a dry KS-14208 brush.

(4) Replace any contacts which are badly pitted or worn from repeated smoothing. Main contacts should be replaced if there is less than one-half of the original 1/8-inch thickness

of the contact tip material. Replace contacts as covered in Section 026-315-801.

3.08 ***Contact Follow*** (Reqt 2.08)

(1) Adjustment for contact follow is made by means of an adjustment pin (see Fig. 3) which passes through the center of the movable contact assembly. Two cantilever springs, which bear on each end of the pin, lock the pin in place and provide index stops for the process of adjustment. The right-hand hexagon-shaped end of the pin is numbered from 1 to 6.

(2) The procedure for contact follow adjustment is as follows.

(a) With the breaker in the open position, set each pin in the same position using the numbers on the pin as a reference point. In many cases the number 3 is a good beginning point. Note that the numbers on the pin are not in numerical sequence as the pin is rotated. Use the No. 417A wrench to rotate the pin.

(b) With the breaker still open, measure and establish the position of the front surfaces of the stationary contacts with reference to the steel arc runners above and behind the stationary contacts. Close the breaker and remeasure the distance.

(c) If any set of contacts lead or lag the other, open the breaker and advance or retard the adjustment pin to the next higher or lower number. Moving the adjustment pin to a higher number will increase the contact follow and moving to a lower number will decrease the contact follow.

Note: No attempt should be made to move the adjusting pin when the breaker is closed. Besides being more difficult, the additional force required to move the pin will tend to round off the flats of the hex. section of the pin.

3.09 ***Contact Pressure*** (Reqt 2.09)

(1) To measure the contact pressure of the main stationary contacts, apply the No. 79F push-pull tension gauge at the point at which the movable contact touches the stationary contact. If these pressures are not obtained, replace the stationary contact springs as covered in Section 026-315-801.

3.10 ***Latch Engagement*** (Reqt 2.10)

General

(1) If the breaker functions properly through several repeated operations, it is best to assume that the latch engagement is satisfactory. If the breaker mechanism does not function properly, check requirements 2.05 to 2.09 before making a latch adjustment.

(2) Before making a latch adjustment, check to make sure that the buffer paddle which stops against the end of the latch adjustment screw is rigidly fastened to the trip shaft. Hold the trip shaft steady and attempt to move the buffer paddle. If any relative movement between the two is noted, tighten the fasteners holding the buffer paddle to the trip shaft.

(3) The latch adjustment screw is located on the lower, outer side of the mechanism side frame. (See Fig. 1 for approximate location.) This screw is threaded through a nylon insert locknut which in turn is welded to a projecting bracket on the side frame.

(4) If the mechanism continues to function improperly after the proper latch engagement has been set and the other requirements of this section have been met, it is recommended that the breaker be returned to the supplier for repairs or replacements. No attempt should be made to repair the mechanism interior.

Latch Adjustment — Manual Breakers

(5) Rotate the closing handle 90 degrees counterclockwise, setting the closing mechanism in the reset position. With the 4-inch E screwdriver, turn the adjusting screw into the locknut until the closing mechanism trips open, the closing handle returning to its normal vertical position.

Caution: Keep hands clear of the closing handle when making this adjustment.

(6) Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn. Observe whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, the position of the adjusting screw where the latch and latch roller begin to engage has been established. Note the position of the slot in the head of the adjusting screw.

(7) Withdraw the adjusting screw three and one-half turns from the position noted in (6). This sets the proper amount of latch engagement.

Latch Adjustment — Electrical Breakers

(8) With the breaker in the open position, turn the adjustment screw into the locknut one complete turn at a time, closing the breaker after each complete turn of the adjusting screw until the breaker will not close.

(9) Withdraw the adjusting screw from the locknut 1/4 turn at a time, attempting to close the breaker after each 1/4 turn. Observe whether the contacts move toward closing before tripping occurs. If the contacts move before tripping occurs, the position of the adjusting screw where the latch and latch roller begin to engage has been established. Note the position of the slot in the head of the adjusting screw.

(10) Withdraw the adjusting screw three and one-half turns from the position noted in (6). This sets the proper amount of latch engagement.

3.11 *Series Overcurrent Trip Devices* (Reqt 2.11)

General

(1) The overcurrent devices are equipped with adjustable long-time and instantaneous pick-up settings and adjustable time settings. In addition the devices can be adjusted for positive tripping.

(2) Although these devices are adjusted at the factory, a check may be made on the long-time and instantaneous tripping adjustments. These adjustments involve the use of extra ammeter and special artificial load equipment and need not be checked unless required by job information or local supervision.

(3) The positive tripping adjustment is made at the factory on new breakers, but must be made in the field when the overcurrent trip devices have been replaced.

Long-Time Pick-up Setting (See Fig. 3)

(4) The current pick-up point can be varied from 80 to 160 per cent of the series coil rating by manipulation of the adjustment knob. An indicator and calibrated plate is provided on the front of the device cover.

Instantaneous Pick-up Setting (See Fig. 4)

(5) The high-set instantaneous pick-up value is adjustable over a range of from 4 to 9 times the coil rating. The setting may be varied by turning the instantaneous pick-up trip adjusting screw using the No. 2, B screwdriver. As the instantaneous trip spring is tightened, the pick-up point is increased. The top edge of the associate movable nut serves as an index pointer to the calibration marks (4X — 6.5X — 9X) stamped on the operating arm. The pointer should line up with the center of the desired calibration mark to obtain the proper instantaneous trip setting.

Tripping Time Adjustment (See Fig. 3 and 4)

(6) The tripping time may be varied within the limits shown on the time-current characteristic curve (see Fig. 5) by turning the time-delay adjustment screw using the No. 1, B screwdriver. Turning the screw in a clockwise direction increases the tripping time and counterclockwise decreases it.

(7) The turning of the time-delay adjustment screw changes the effective length of the dashpot arm. The dashpot arm is indexed at four points (Max — 2/3 — 1/3 — Min), as indicated in Fig. 4, when the connecting link lines up with a mark on the dashpot arm, the approximate tripping time as shown by the characteristic curve is indicated.

Note: Forcing the time adjustment screw to either extreme position may cause binding of the device and should be avoided.

(8) If it is desired to relate the linkage setting to the index marks, it will be necessary to remove the cover of the device. This may be done by removing the two mounting screws, one on each side of the case, without disturbing the trip unit itself. Remove the screws from the steel clamps using the 4-inch E screwdriver.

Note: The center pole case must be taken off first on breakers equipped with a shunt trip.

Positive Tripping Adjustment (See Fig. 3 and 4)

(9) Positive tripping is achieved when the trip adjustment screw is in such a position that it will always carry the trip paddle on the trip shaft beyond the point of tripping the mechanism when the armature closes against the magnet.

(10) In order to make the adjustment, first unscrew the trip adjustment screw using the No. 276 wrench, until it will not trip the breaker even though the armature is pushed against the magnet. Then, holding the armature in the closed position, advance the screw until it just trips the breaker. After this point has been reached, advance the screw two additional full turns. This will give an overtravel of 1/16 inch and will make sure that activation of the device will always trip the breaker.

(11) In order to gain access to the adjustment screw on the center pole, it will be necessary to remove the nameplate from the front escutcheon of the breaker. Use the KS-6854 screwdriver to remove the nameplate. Removal of the nameplate will reveal a hole centrally located in the escutcheon, by means of which the No. 276 wrench can engage the adjustment screw.

3.12 *Closing Solenoid and Controls* (Reqt 2.12)

(1) The control system consists of a closing switch, closing contactor, a permissive relay, and cut-off switch. For sequence of operation, refer to 2.01.

(2) Contacts of the closing switch and closing contactor should require no attention other than an occasional cleaning. Clean contacts as covered in 3.07(1) and as specified in 3.07(2) for auxiliary contacts. To gain access to the closing switch, remove the front escutcheon and handle assembly by removing the four Phillips head screws from the flange of the escutcheon using the No. 3, B screwdriver. To gain access to the contactor, remove the contactor cover.

(3) If the closing solenoid releases before the breaker is fully closed or if the closing solenoid does not release when the breaker is fully closed, check the closing solenoid and control system for binding or defective parts and replace the individual units (see 3.002) as covered in Section 026-315-801.

3.13 *Shunt Trip Device* (Reqt 2.13)

(1) If this device, when operated, does not engage the main shaft paddle sufficiently to trip the breaker, bend or shape the paddle as required. Hold the main shaft in a fixed position with the R-1542 adjustable wrench while bending the paddle with the KS-6015 pliers.

(2) In order to avoid unnecessary heating of the coil, two contacts of the auxiliary switch are wired in series with the shunt trip coil. This prevents the energization of the coil if the breaker is open. These auxiliary switch contacts are open when the breaker contacts are open.

(3) Check the operation of the auxiliary switch and replace a defective switch as covered in Section 026-315-801.

3.14 *Temperature* (Reqt 2.14)

(1) If the temperature exceeds the specified limits and requirements 2.05 to 2.09 are met refer the matter to the supervisor.