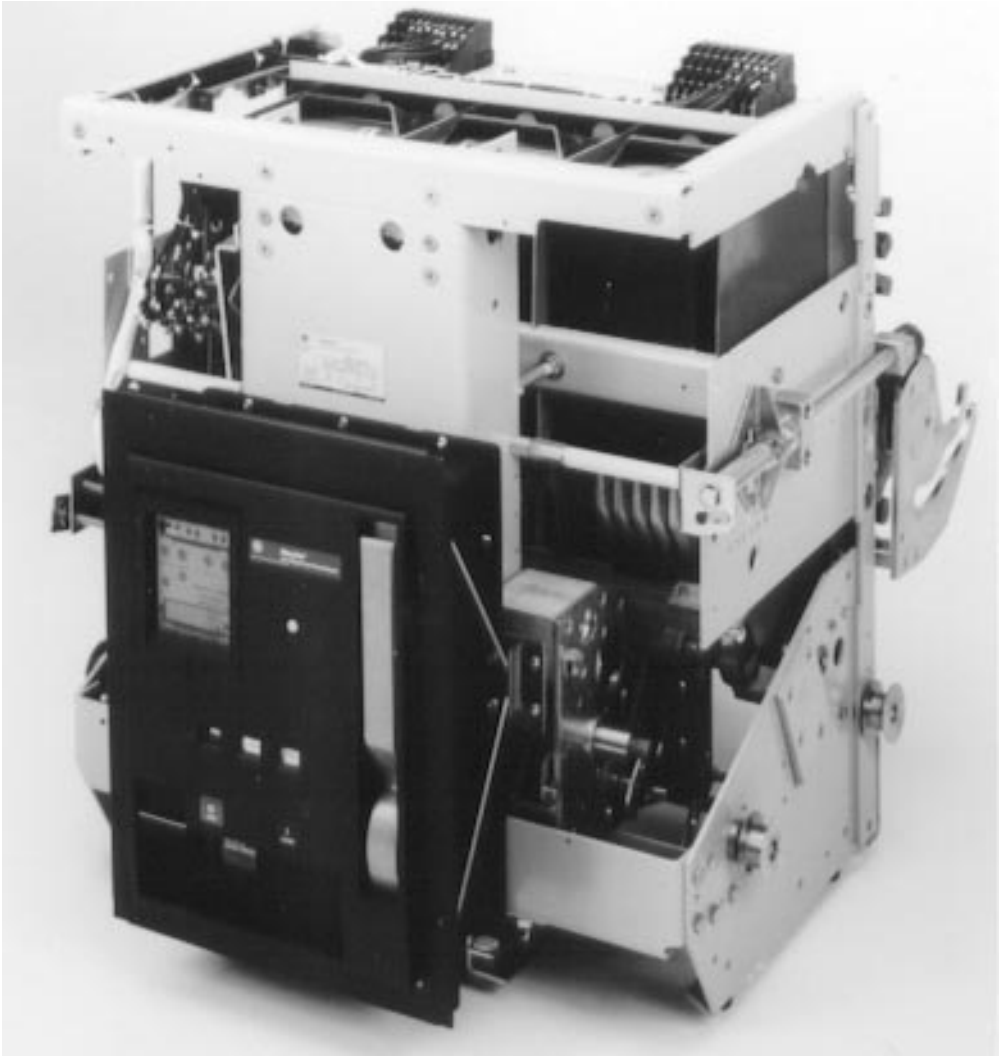
DEH–137

WavePro™ Power Circuit Breakers
3200–5000 A Frames, 240–600 Vac

Maintenance Manual



Wave Pro™
Low Voltage
Power Circuit Breakers

DEH–137

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WARNINGS

Warning notices are used in this publication to emphasize that hazardous voltages, currents, or other conditions that could cause personal injury are present in this equipment or may be associated with its use.

Warning notices are also used for situations in which inattention or lack of equipment knowledge could cause either personal injury or damage to equipment.

CAUTIONS

Caution notices are used for situations in which equipment might be damaged if care is not taken.

NOTES

Notes call attention to information that is especially significant to understanding and operating the equipment.

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1–1 Overview

These instructions describe the procedures for maintenance and operation of 3200 through 5000 ampere frame-size WavePro low-voltage power circuit breakers. Figure 1-1 is a front view of the breaker, with key features indicated.

The proper use, care, and maintenance of these breakers is important both from the safety aspect of protecting personnel and for minimizing equipment damage when faults occur. Persons who apply, use, and service these breakers should be familiar with the information presented in this publication.

WARNING: Before inspecting or beginning any maintenance work on a circuit breaker, the breaker must be in the OPEN position and disconnected from all voltage sources, both power and control.

AVERTISSEMENT: Avant d'inspecter ou de débuter tout travail de maintenance d'un disjoncteur, celui-ci dout être en position OPEN et débranché de toutes les sources de voltage, à la fois de puissance et de contrôle.

1–2 Inspection and Maintenance

Circuit breakers should be maintained under a systematic program. Take each breaker out of service periodically for inspection and maintenance to help establish high reliability in service. This policy is facilitated by keeping one or more spare breakers to install in place of breakers requiring maintenance. Keeping a stock of recommended renewal parts ensures that maintenance work can be done quickly.

The frequency at which an individual breaker should be inspected depends on the circumstances of its use. The ANSI-recommended maintenance interval is every 250 operations. WavePro breakers should be inspected after every short circuit interruption, after every 400 ON-OFF operations at any load up to the frame rating, or every two years, whichever comes first. WavePro breakers have been built and tested to operate reliably with inspections at twice the ANSI interval, thus saving time and money by reducing breaker downtime.

If a breaker is installed in an area of high humidity or a dusty atmosphere, it should be inspected more often. Monthly inspections might be warranted for a breaker operated under severe conditions.

Always inspect the breaker after a short-circuit current has been interrupted.

A standard inspection should consist of the following steps:

1. *Visual Check* – Look for dirt, grease, or other foreign material on all breaker parts. Check insulating surfaces for conditions that could degrade insulating properties, such as cracks or evidence of overheating. Check for loose hardware and components on the bottom of the breaker compartment. Check for loose or damaged control wiring and for similar problems.
2. *Operation* – Observe a few close-open operations using the operating handle.
3. *Interlocks* – During the operational check, verify that the safety interlocks are working properly, as described in Section 4–3.
4. *Arc Chutes and Contacts* – Inspect the arc chutes and contacts for excessive burning or breakage. Check the amount of contact depression or wipe when the breaker is closed. See Chapter 6.
5. *Accessories* – Verify that the various accessories are working properly as described in Chapters 7 and 8.
6. *Trip Unit* – Verify the performance of the trip unit. See the appropriate trip unit user guide for test procedures.

1–3 Renewal Parts

Many of the parts and assemblies contained in WavePro breakers are available as replacement parts. See DEF–005 for a complete listing.

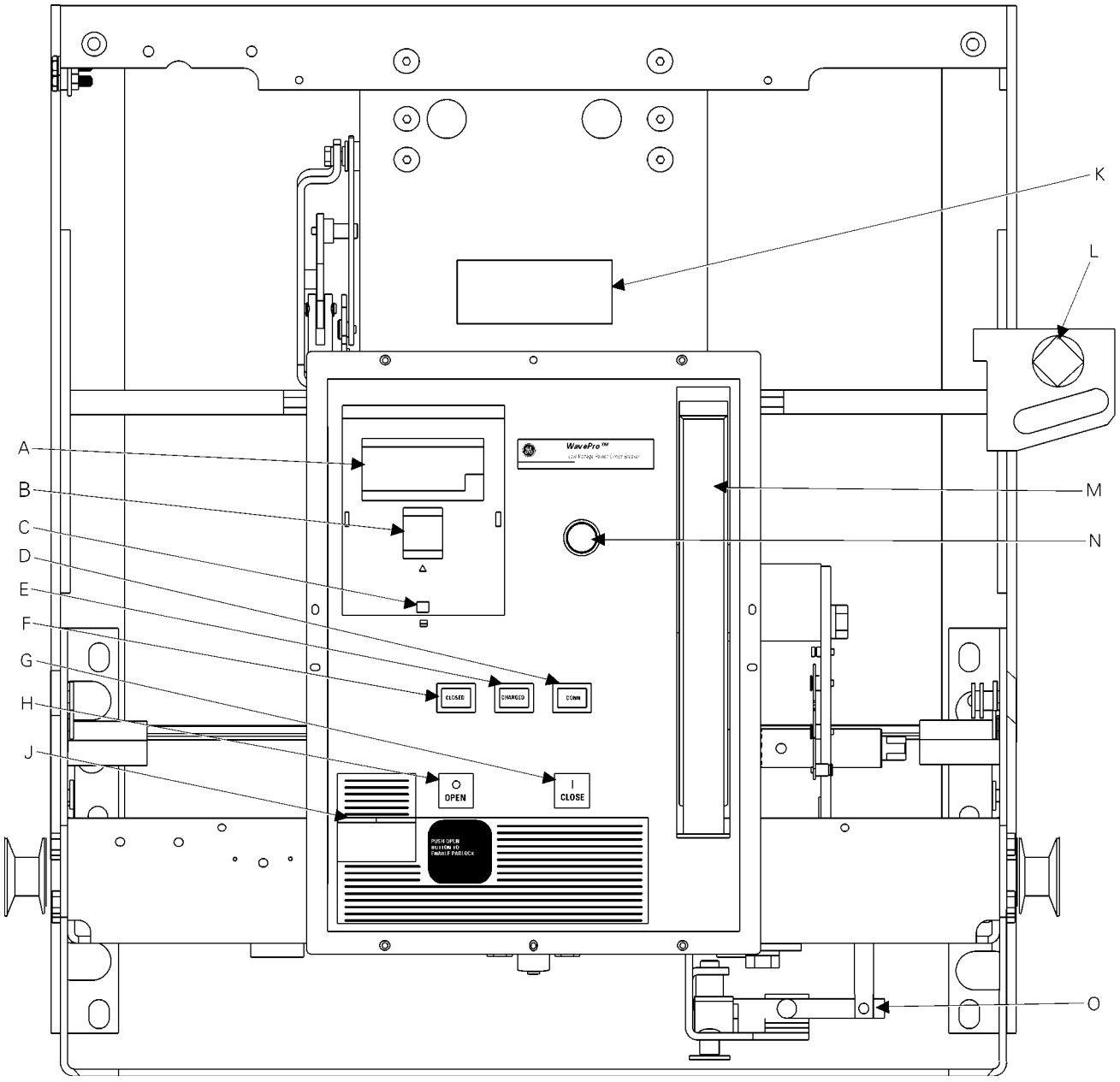


Figure 1-1. Front of the WavePro circuit breaker, showing the locations of standard and optional features.

A Trip Unit
B Rating Plug
C Sealable Trip Unit Cover
D Indicator: DISC (white)
TEST (white)
CONN (white)
E Indicator: CHARGED (yellow)
DISCHARGED (white)
F Indicator: CLOSED (red)
OPEN (green)
G CLOSE button
H OPEN button
J Padlock provision
K Nameplate
L Draw-out racking screw
M Manual charging handle
N Bell Alarm target and reset button
O Spring discharge mechanism

2–1 Introduction

WavePro low-voltage power circuit breakers control and protect power circuits up to 600 volts. They will safely switch loads and automatically clear circuits when abnormal conditions occur. These include short circuits, sustained overloads, and ground faults.

WavePro breakers contain a "quick-make, quick-break" mechanism, which stores energy in a closing spring for quick release. During closing, some energy is transferred to an opening spring to be used subsequently for fast tripping.

The four main functional components of a breaker are its mechanism, an assembly consisting of the conductive components, the interrupter, and the trip unit.

The mechanism is designed to receive energy, store it, and later deliver it to close the breaker contacts. It must be able to reverse the closing operation at any point upon activation of the trip unit (that is, it must be "trip-free"). Finally, it must also open a closed breaker quickly enough to minimize contact erosion and to effectively transfer the arc to the arc chutes.

The current-carrying components are assembled on the back frame, which provides the required mechanical support and insulating structure. The conductive components are the studs for external connections, the movable and stationary contact sets, pivots for the movable contacts, and a provision for mounting current transformers.

The interrupter components are the arcing contacts, the arc runners mounted on the back base, and the removable arc chute assemblies.

In addition to these basic components, a breaker may be equipped with a combination of accessories and interlocking devices.

2–2 Frame Sizes

The WavePro breakers covered in this manual are available in 3200 ampere, 4000 ampere, and 5000 ampere frame sizes. These values represent the maximum continuous-current rating of each frame. In addition, each breaker carries a specific rating that is determined by the current sensor ampere rating or the maximum setting of the trip unit with which it is equipped.

2–3 Operation

WavePro breakers are available with either manual or electric operation. The mechanism closing springs of manually operated breakers are charged by operating the charging handle on the front of the breaker.

Electrically operated breakers contain an electric motor that charges the closing spring. External control power is required to energize the motor and its control circuit. All breakers are equipped with a manual charging handle, so that the closing springs can be charged without motor control power. The breaker nameplate indicates the voltage required by the motor circuit and the trip and close coils.

2–4 Mounting

WavePro breakers are designed for draw-out mounting. Draw-out breakers are easily installed into or removed from their switchgear. They are equipped with a racking mechanism, which is used to insert or withdraw the breaker, and primary and secondary disconnects, which connect and part automatically.

WavePro circuit breakers are available in two configurations for installation in GE equipment and in other manufacturers' equipment using GE OEM substructures. The two types have different draw-out mechanisms and are not interchangeable

2–5 Trip Units

WavePro breakers are available with three different Trip Units. For installation and operation of MicroVersaTrip Plus™ and MicroVersaTrip PM™ Trip Units see DEH–178. Power+™ Trip Units (not available on 5000 A frame breakers) are described in DEH–179.

2–6 Interruption Ratings

Table 2-1 lists the short-circuit current that each breaker type is rated to interrupt for each maximum rated voltage.

Rated AC Voltage, Nominal (max)	Breaker Type	Short-Circuit RMS Symmetrical kA		
		Short-Time Withstand	With Inst. Trip	Without Inst. Trip
600 (635)	WPS-32	65	65	65
	WPH-32	85	85	85
	WPS-40	85	85	85
	WPS-50	85	85	85
480 (508)	WPS-32	65	65	65
	WPH-32	85	85	85
	WPS-40	85	85	85
	WPS-50	85	85	85
240 (254)	WPS-32	65	85	65
	WPH-32	85	130	85
	WPS-40	85	130	85
	WPS-50	85	130	85

Table 2-1. Breaker interruption ratings.

3–1 Storage

The breaker should be put into service immediately in its permanent location. If this is not possible, the following precautions must be taken to ensure proper storage of the breaker

- Protect the breaker against condensation, preferably by storing it in a warm, dry room, since water absorption has an adverse effect on the insulating parts. Circuit breakers installed in outdoor switchgear should be stored in the equipment only when power is available and the compartment heaters are in operation to prevent condensation.
- Store the breaker in a clean location free from corrosive gases or fumes. It is particularly important to protect the equipment from moisture and cement dust, as this combination is corrosive to many parts.

CAUTION: If the breaker is stored for any length of time, inspect it periodically to ensure that steel parts have not begun to rust and to ensure good mechanical condition. If the breaker has been stored under unfavorable atmospheric conditions, it must be cleaned and dried before being placed in service.

ATTENTION: Si le disjoncteur est remisé pour peu importe la période de temps, inspectez-le périodiquement afin de vous assurer que les pièces d'acier n'ont pas commencé à rouiller et de vous assurer de leur bonne condition mécanique. Si le disjoncteur a été remisé à des conditions atmosphériques défavorables, il doit être nettoyé et séché avant d'être mis en service.

3–2 Safety

Each facility must maintain a safety program for the protection of personnel, as well as other equipment, from the hazards associated with electrical equipment.

The following requirements are intended to augment a facility's safety program, *not* to supplant local responsibility for devising a complete safety program. The following basic industry-accepted safety requirements are applicable to all major electrical equipment, such as switchgear and switchboards. General Electric neither condones nor assumes any responsibility for practices that deviate from these requirements.

1. *All conductors must be assumed to be energized unless their potential has been measured as ground and suitable grounding conductors have been applied to prevent energizing.*
2. Although interlocks are provided to reduce some of the risks, each individual's actions are essential to prevent accidents when performing service or maintenance. Each person's knowledge, mental awareness, and planned and executed actions often determine if an accident will occur. The most important principle for avoiding accidents is that all associated personnel carefully apply a thorough understanding of the specific equipment with regard to its purpose, its construction, its operation, and situations that could be dangerous.
3. All personnel associated with installation, operation, and maintenance of electrical equipment, such as power circuit breakers and other power-handling equipment, must be thoroughly instructed, with periodic retraining, about power equipment in general and the specific equipment with which they will be working in particular. Instruction books, actual devices, and appropriate safety and maintenance procedures, such as OSHA publications, the National Electrical Safety Code (ANSI C2), the National Electrical Code, and NFPA 70B Electrical Equipment Maintenance, must be closely studied and followed. During actual work, supervisors should audit procedures to ensure conformance.
4. Excellent maintenance is essential for reliability and safety of all electrical equipment. Industry publications of recommended maintenance practices, such as ANSI/NFPA 70B, *Electrical Equipment Maintenance*, are readily available.

3–3 Maintenance

Both long- and short-term maintenance of all electrical equipment is essential for reliability and safety. Maintenance programs must be well-planned and carried out consistent with both industry experience and the manufacturer's recommendations. The local environment must always be considered in such programs, including such variables as ambient temperature, extreme moisture, number of operations, corrosive atmosphere, significant insect and small-animal problems, and any other unusual or abusive condition of the application.

One of the critical service activities, sometimes neglected, is the calibration of various control devices. These monitor conditions in the primary and secondary circuits, sometimes initiating emergency corrective action, such as opening or closing circuit breakers. In view of the vital roles of these devices, it is important to follow a periodic test program.

General Electric recognizes that the interval between periodic checks will vary, depending on the environment, the type of device, and the customer's experience. GE

recommends that, until the customer has accumulated sufficient experience to select a test interval best suited to the local requirements, all significant calibrations be checked at one- to two-year intervals.

Operation and maintenance guides supplied by manufacturers normally address components that require service or maintenance during the useful life of the equipment. However, they can not include every possible part that could require attention, particularly over a long service period or under adverse conditions. Maintenance personnel must be alert to deterioration of any part of the electrical system, taking such action as necessary to restore it to serviceable status.

If you require additional assistance in the planning and performance of maintenance, you should contact a member of the GE ED&C Factory Authorized Service Team to undertake the maintenance or to provide technical assistance, such as the latest publications.

The performance and safety of this equipment may be compromised by the modification of supplied parts or their replacement by nonidentical substitutes. All such design changes must be qualified to ANSI/IEEE Standard C37.59.

You should methodically keep written maintenance records as an aid in future service planning and equipment reliability improvement. Unusual experiences should be promptly reported to GE.

4–1 Operating Instructions

Sequence of Operations

The sequence of operations that may be performed on the circuit breaker are listed in Table 4-1.

Operation of the Breaker

Manually Charging the Mechanism Springs

Pull the charging handle down about 90° (until it stops) eight times to fully charge the springs. *This will not close the breaker contacts.* The charge indicator will show CHARGED on a yellow background.

NOTE: The breaker cannot be closed unless the springs are fully charged and the handle is stored fully in.

NOTE: Le disjoncteur ne peut être fermé à moins que les ressorts ne soient pleinement chargés et que la poignée ne soit pleinement rentrée.

Electrically Charging the Mechanism Springs

If the breaker is equipped with the (optional) charging motor, the mechanism springs may also be charged with the following method:

- Engage the charging motor by applying the rated voltage to secondary disconnect terminals A8 and A17. Power to the motor is removed automatically by a cutoff switch when the springs are fully charged.
- If power is lost during the charging cycle, finish charging the springs by cycling the charging handle until the indicator shows CHARGED on a yellow background.

The closing springs will automatically recharge after closing if control power is maintained at terminals A8 and A17.

Closing the Breaker

Close the breaker contacts with either of the following methods:

- Depress the CLOSE button on the front of the breaker.
- Energize the (optional) remote close accessory by applying the rated voltage to secondary disconnect terminals A9 and A18.

If the breaker is closed electrically and the closing voltage is maintained, an antipump device prevents a second closing operation on the breaker in the event it is tripped OPEN. The closing impulse must be released and reapplied before a second closing operation can occur.

If the closing voltage is applied while the closing springs are not fully charged, nothing will happen. The closing voltage must be removed and reapplied when the springs are fully charged to close the breaker.

A mechanical interlock prevents the closing springs from discharging if an attempt is made to close an already CLOSED breaker.

NOTE: The main breaker contacts cannot be closed if any of the following conditions apply:

- The draw-out mechanism is in any position other than TEST or CONN, as displayed on the breaker position indicator.
- The (optional) bell alarm with lockout was not reset after an overcurrent lockout.
- The (optional) undervoltage trip device or electric lockout is not energized.
- The (optional) open fuse lockout was not reset after replacement of a blown fuse.

These conditions must be corrected before the breaker can be closed. Attempts to close the breaker before these conditions are corrected may result in discharge of the closing springs without closing the main contacts.

Open/Closed Indicator	Main Breaker Contacts	Charge Indicator	Condition of Charging Springs	Next Permissible Operating Function
OPEN	Open	DISCHARGED	Discharged	Mechanism may be charged
OPEN	Open	CHARGED	Charged	Contacts may be closed
CLOSED	Closed	DISCHARGED	Discharged	Mechanism may be recharged or Contacts may be opened
CLOSED	Closed	CHARGED	Charged	Contacts may be opened
	Closed	CHARGED	Charged	Mechanism may be discharged without closing contacts by holding the OPEN button depressed while pushing CLOSE button

Table 4-1. Sequence of operations that may be performed with the WavePro circuit breaker.

NOTE: Les contacts principaux du disjoncteur ne peuvent être fermés si l'une ou l'autre des conditions suivantes s'appliquent:

- Le mécanisme de retrait du ressort est en tout autre position que: TEST ou CONN, tel que montré à la position indicatrice du disjoncteur.
- L'alarme optionnelle avec cloche n'a pas été remise en place après un blocage par surintensité de courant.
- Le mécanisme optionnel de déclenchement par sous voltage n'a pas été enclenché.
- Le mécanisme optionnel de blocage pour fusible ouvert n'a pas été remis en place après le remplacement d'un fusible éclaté.

Il faut que ces situations soient corrigées avant de procéder à la fermeture du disjoncteur. Toute tentative de fermer le disjoncteur avant que ces conditions ne soient corrigées pourra résulter en une décharge des ressorts de fermeture sans fermer les contacts principaux.

Opening the Breaker

Open the breaker contacts with either of the following methods:

- Depress the OPEN button on the front of the breaker.
- Energize (optional) shunt trip accessory or de-energize (optional) undervoltage trip device accessory.

Padlock Operation

The padlock provision prevents the breaker from closing by holding the trip latch in the tripped position. Up to three padlocks with $^{1}\square 4$" to $^{3}\square 8$" diameter shanks may be inserted at one time. To install a padlock, use the following procedure:

1. Trip the breaker (press the OPEN button).
2. While holding the OPEN button in, slide the padlock plate down and hold it in place.
3. Put the padlock into the slot in the padlock plate; this will prevent the plate from returning to its unlocked position and prevent the breaker from closing.

4–2 Control Wiring

Figure 4-1 is the wiring diagram for the breaker control circuit. Table 4-2 lists the secondary disconnect terminals and the items connected to each. The locations of the secondary disconnects are illustrated in Figure 4-2.

4–3 Breaker Interlocks

WavePro breakers are equipped with a number of safety interlocks to prevent improper operation of the breaker.

Draw-Out Interlock

The draw-out interlock prevents the breaker from being closed when the breaker is in neither the CONN nor TEST position, but is between these positions. A pin on the side of the breaker engages a ramped cam in the switchgear compartment or substructure. When the pin is lifted $^{3}\square 8$" the breaker is held trip-free.

An additional interlock holds the breaker trip-free whenever the racking handle is engaged with the draw-out mechanism racking shaft.

Contact Interlock

The contact interlock prevents the racking handle from engaging the draw-out mechanism racking screw whenever the breaker contacts are CLOSED. The racking handle (catalog number 568B731G1) has a recess that prevents it from engaging the square drive on the racking screw when the interlock is active. This prevents changes to the breaker's position with the main contacts CLOSED.

CAUTION: Use of a tool other than the GE racking handle 568B731G1 may render the contact interlock ineffective.

ATTENTION: L'utilisation d'un outil autre que le GE racking handle 568B731G1 peut rendre le mécanisme de verrouillage des contacts inefficace.

Spring Discharge Interlock

The spring discharge interlock eliminates the potential hazard of the inadvertent discharging of the closing springs during maintenance. To withdraw the breaker from the DISCONNECT position, press the spring discharge lever. This simultaneously releases the position stop pin and discharges the closing springs.

4–4 Equipment Interlocks

Additional optional interlocks may be furnished with the breaker enclosure. The key interlock prevents the breaker from closing when the interlock is engaged and requires one or more keys to operate. The door interlock prevents opening of the enclosure door when the breaker is in the CONN position. It is defeatable for authorized access.

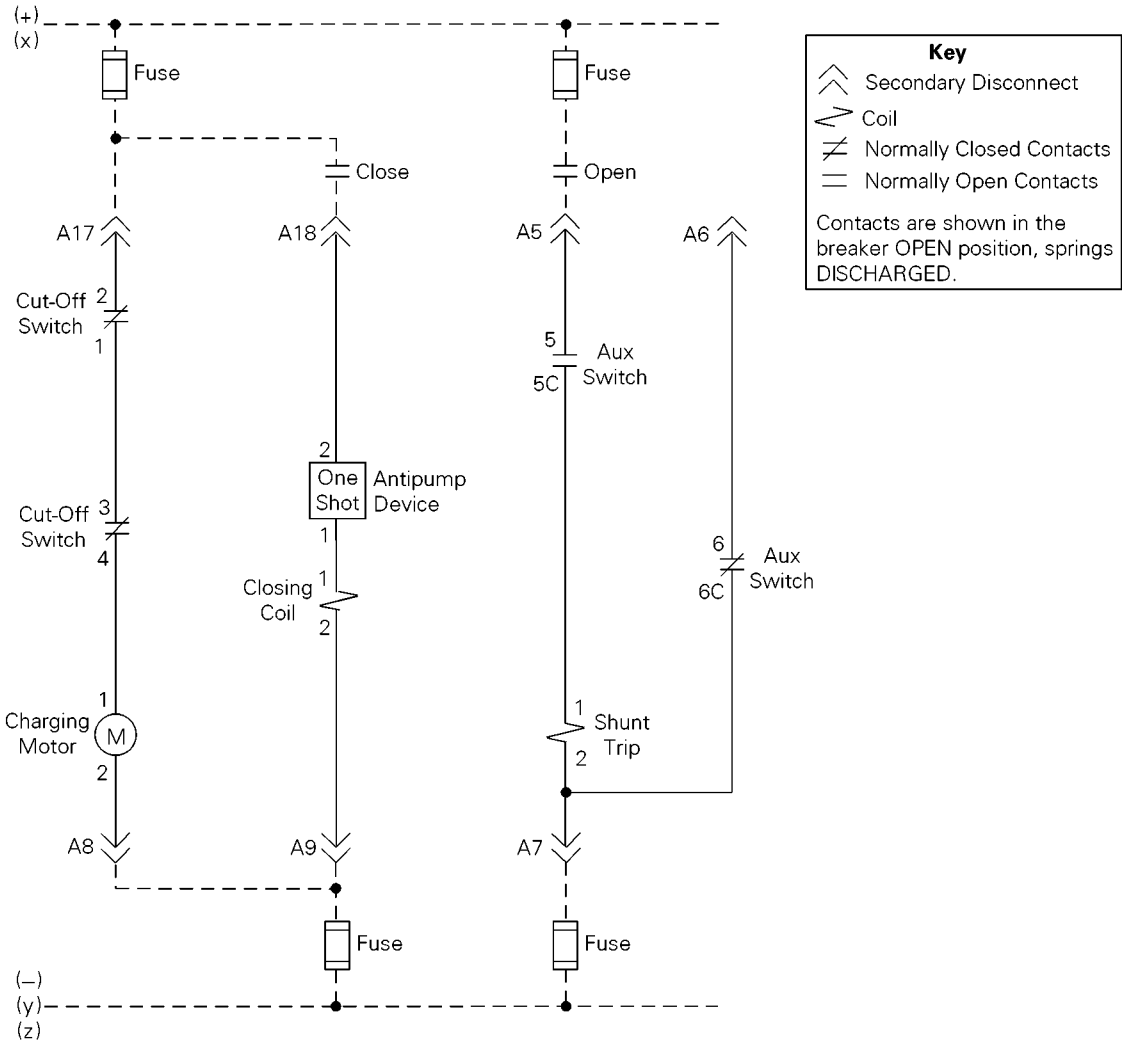


Figure 4-1. Elementary diagram of breaker control circuit.

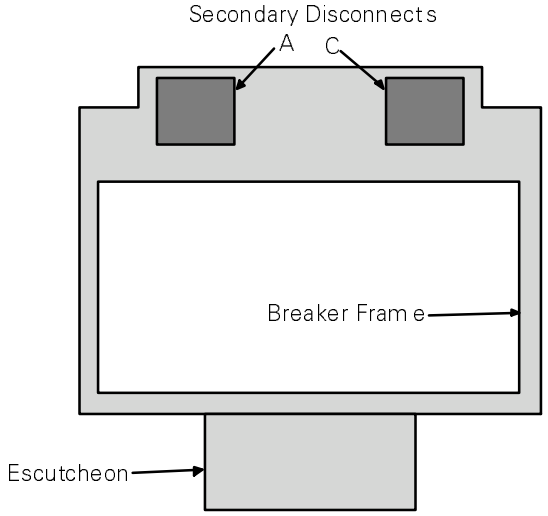
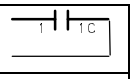
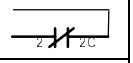
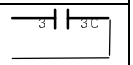
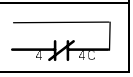
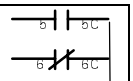
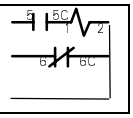
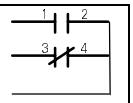
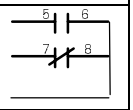
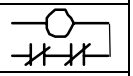
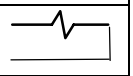
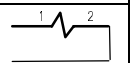
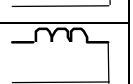
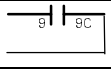
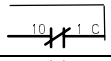
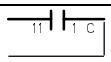
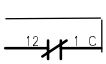
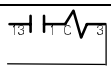
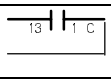
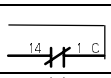
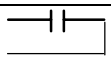
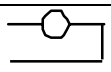
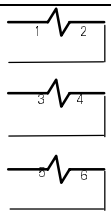


Figure 4-2. Locations of the secondary disconnects on the top view of the breaker.

A Disconnect Block (left side from front)

10 1	Aux Switch (NO contact) Aux Switch	
2 11	Aux Switch Aux Switch (NC contact)	
12 3	Aux Switch (NO contact) Aux Switch	
4 13	Aux Switch Aux Switch (NC contact)	
5 6 7	Aux Switch (NO contact) Aux Switch (NC contact) Aux Switch (common)[3]	
	OR	
5 6 7	Shunt Trip (NO contact) Shunt Trip (NC contact) Shunt Trip (common)[3]	
14 15 16	Bell Alarm (NO contact) Bell Alarm (NC contact) Bell Alarm (common)	
19 20 21	Bell Alarm (NO contact) Bell Alarm (NC contact) Bell Alarm (common)	
8 17	Closing Spring Charging Motor Closing Spring Charging Motor	
9 18	Close Circuit [1] Close Circuit [1]	
22 23	Undervoltage or Electric Lockout Undervoltage or Electric Lockout	
24 25	Neutral Sensor – tap Neutral Sensor – common	
26 27 28 29 30 31 32 33 34 35 36	Commnet+ Commnet– Zone Selective Interlock (In+) Zone Selective Interlock (In–) Zone Selective Interlock (Out+) Zone Selective Interlock (Out–) Va (voltage conditioner) Vb (voltage conditioner) Vc (voltage conditioner) Trip Unit Aux Pwr (24 Vdc+) Trip Unit Aux Pwr (24 Vdc–)	

C Disconnect Block (right side from front)

10 1	Aux Switch (N.O. contact) Aux Switch	
2 11	Aux Switch Aux Switch (NC contact)	
12 3	Aux Switch (NO contact) Aux Switch	
4 13	Aux Switch Aux Switch (NC contact)	
14 5	Second Shunt Trip Second Shunt Trip[3]	
	OR	
14 5	Aux Switch (NO contact) Aux Switch[3]	
6 15	Aux Switch Aux Switch (N.C. contact)	
8 17	Remote Charge Indicator[2] Remote Charge Indicator[2]	
16 7	WP-50 Fan Motor - 120 Vac (H) WP-50 Fan Motor - 120 Vac (N)	
9 18 19 20 21	Spare Spare Spare Spare Spare	
22 23 24 25 26 27	OFLO (phase A) OFLO (phase A) OFLO (phase B) OFLO (phase B) OFLO (phase C) OFLO (phase C)	
28 29 30 31 32 33 34 35 36	Spare Spare Spare Spare Spare Spare Spare Spare Spare	

[1] *For electrically operated breaker; Remote Close accessory on manually operated breaker.*

[2] *Remote Charge Indicator applies to electrically operated breaker only.*

[3] *Auxiliary Switch contacts are wired out if shunt Trip is not provided.*

Table 4-2. Secondary disconnect terminals with standard and optional connections.

WARNING: Before inspecting a breaker or beginning any maintenance, the breaker must be disconnected from all voltage sources, both power and control, and the breaker must be in the OFF position.

AVERTISSEMENT: Avant d'inspecter ou de débuter tout travail de maintenance d'un disjoncteur, celui-ci dout être en position OPEN et débranché de toutes les sources de voltage, à la fois de puissance et de contrôle.

5–1 Lubrication

Bearing points and sliding surfaces should be lubricated at regular inspection periods with a thin film of D6A15A2 (catalog number 183L0907P037) lubricant. First remove any hardened grease and dirt from latch, primary disconnect, and bearing surfaces with a suitable solvent. *All excess lubricant should be removed with a clean cloth to avoid accumulation of dirt or dust.*

5–2 Removing and Reinstalling the Breaker

Maintenance or inspection should be performed with the breaker removed from the compartment and placed on a workbench. Figure 5-1 illustrates these procedures.

Removing the Breaker

Use the following procedure to remove the draw-out breaker from its cubicle or substructure:

1. With the switchgear door closed and latched, open the breaker.
2. Insert the racking handle (catalog number 568B731G1) through the opening at the upper right of the door and onto the racking shaft. Rotate the handle counterclockwise until the racking shaft comes to a solid stop with the breaker in the Disconnect position, as indicated by the legend DISC on the position indicator. At this point the primary and secondary disconnects are disengaged.
3. Open the compartment door and pull out the rails. Depress the spring discharge lever, indicated in Figure 1-1, to discharge the breaker's closing springs. Continue to depress this lever while pulling the breaker out to its Withdrawn position.
4. Verify that the indicators on the front of the breaker show that the springs are DISCHARGED and the breaker is OPEN.
5. Attach the lifting bracket by locating the hooks at the cutout notches in the top frame of the breaker. Be careful to avoid damage to the control wiring behind the frame.
6. Lift the breaker off the rails.
7. Push the rails back into the compartment, then move the breaker forward until the primary disconnects clear the compartment. Lower the breaker onto a flat surface free of protrusions that could damage the breaker's internal parts. Close the compartment door.
8. If testing or maintenance is to be performed on the breaker, it may be necessary to place the draw-out mechanism in the Connect position. This will deactivate the mechanical interlocks that would otherwise prevent the breaker mechanism or contacts from closing. Engage the Racking Handle to the racking shaft and turn it clockwise until it stops, as indicated by the legend CONN on the position indicator.

Installing the Breaker

Before reinstalling the breaker in its compartment, the draw-out mechanism must be returned to the DISCONNECT position.

1. Before lifting a breaker to its intended compartment location, observe the following precautions:
   - Check the compartment to ensure that it is free of foreign objects.
   - Ensure that the breaker is OPEN.
   - Insert the racking handle and rotate it fully counterclockwise to ensure that the racking cams on the breaker are correctly positioned for initial engagement with the pins in the breaker cubicle or substructure. The position indicator on the front of the breaker should show DISC.
2. Attach the lifting bracket by locating the hooks at the cutout notches in the top frame of the breaker. Be careful to avoid damage to the control wiring behind the frame.
3. Open the compartment door. With the roll-out rails positioned inside the compartment, raise the breaker higher than the rails.
4. Pull the rails all the way out to their Withdrawn position.

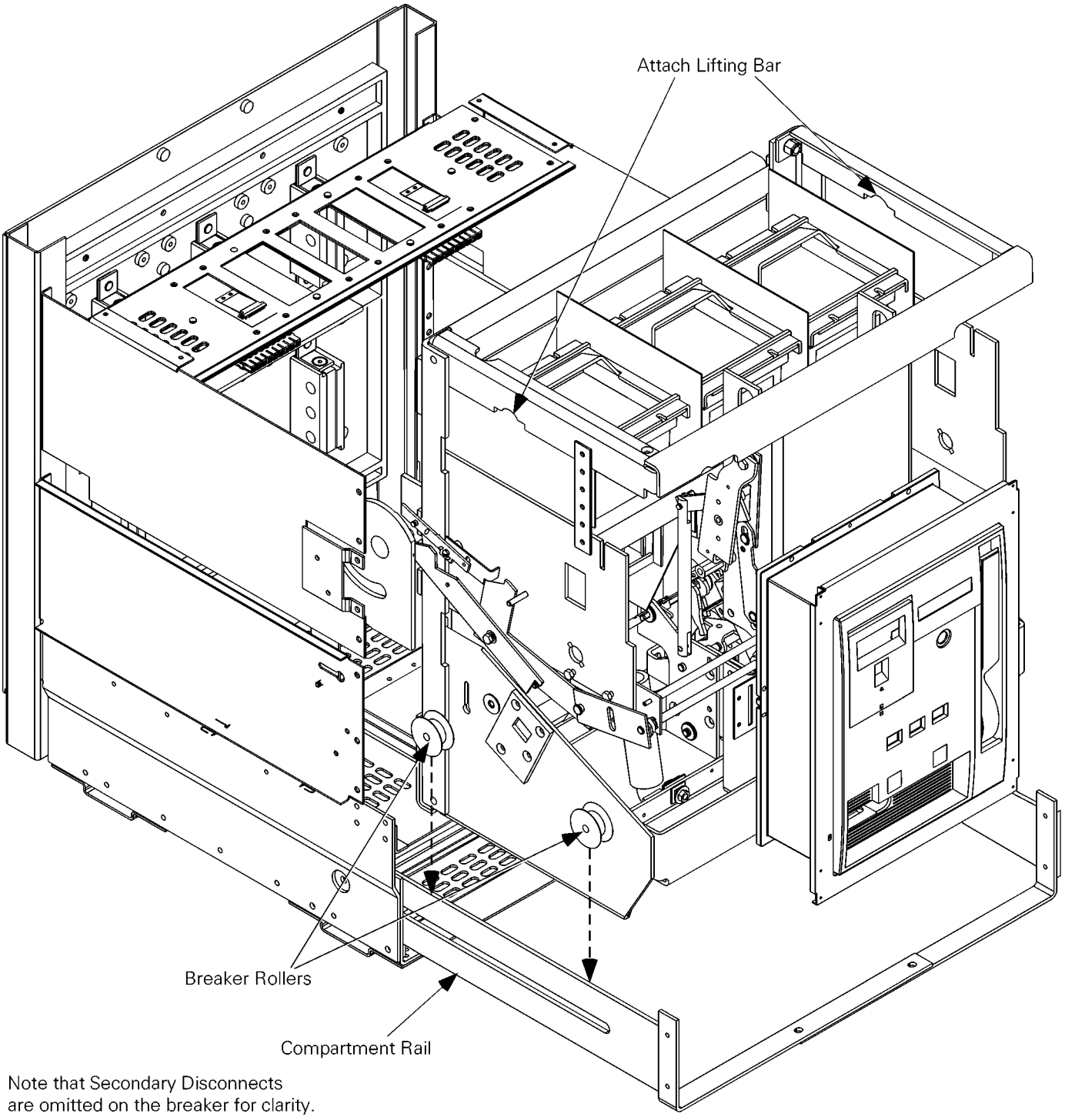


Figure 5-1. Circuit breaker during installation into or removal from its compartment.

5. Slowly lower the breaker onto the rails so that the grooves in the rollers on the side of the breaker align with the rails.
6. Push the breaker into the compartment until the spring discharge stop engages. This is the DISCONNECT position. At this point the racking cams are positioned to engage the fixed racking pins in the compartment, ready to begin the racking motion. Push the rails back into the compartment.
7. Close the compartment door. Insert the racking handle through the opening at the upper right of the door and onto the racking shaft. Rotate the handle clockwise, through the TEST position, until the racking shaft comes to a solid stop. The breaker is now in the CONNECTED position, as shown by the legend CONN on the position indicator flag. Note that a loud click will be heard as the spring-loaded secondary disconnects engage.

5–3 Slow Closing the Breaker

Closing the breaker slowly, while observing the action of the mechanism and contacts, is a good way to judge the correctness of mechanical and contact relationships. Some of the maintenance procedures described later involve slow closing the breaker. Use the following procedure to slow close the breaker:

1. Use the manual charging handle to fully charge the closing springs.
2. Remove the safety pins from their storage clips and insert them into the holes in the guide rods, as illustrated in Figure 5-2.
3. Release the prop by pressing the CLOSE button. The safety pins now take the full force of the closing springs and restrain them.
4. Rotate the breaker main shaft as needed, with the maintenance handle, to slow close the contacts.
5. To return to normal operation, recharge the closing springs with the manual charging handle.
6. Remove the safety pins from the closing spring guide rods and return them to their storage clips.

CAUTION: Do not allow the charging motor to operate while the safety pins are inserted in the closing spring guide rods.

ATTENTION: Ne laissez pas le moteur de charge opérer lorsque les tiges de sûreté sont insérées dans les tiges guides des ressorts de fermeture.

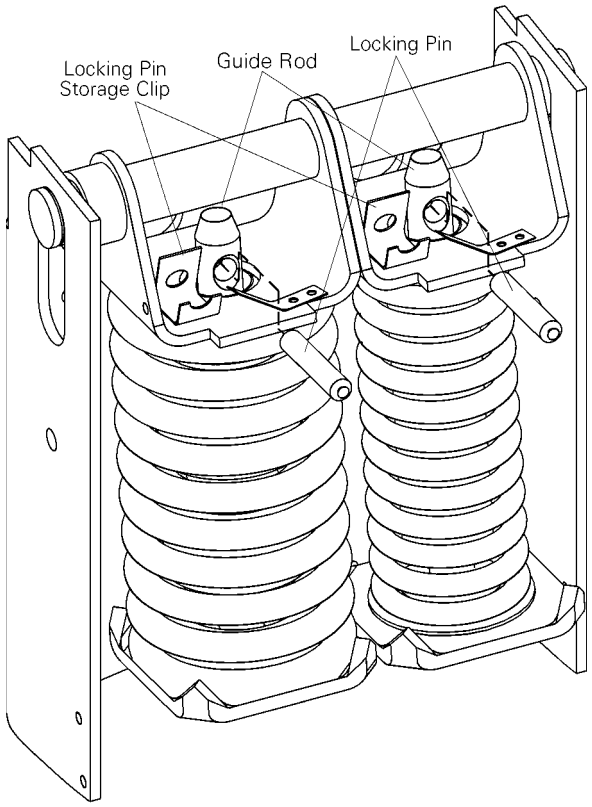


Figure 5-2. Inserting the safety pins into the closing spring guide rods.

5–4 Separation and Reconnection of Front and Back Frames

Some repair operations require separation of the front and back frames, per the following procedure. The breaker must be first removed from its compartment, as described in Section 5–2, and placed on a suitable work surface.

Separation of Front and Back Frames

1. Verify that the breaker contacts are open and the safety pins are seated in the spring guide rods, as shown in Figure 5-2.
2. Remove the two screws and standoffs securing each secondary disconnect to the mounting plate, taking care to retain the spring washer from the pin on the underside of the disconnect, as shown in Figure 5-3. Cut the wire ties securing the secondary disconnect leads to the mounting plate and to the breaker back frame. Slide the secondary disconnects off the support bracket. Secure the secondary disconnects to the front frame assembly.

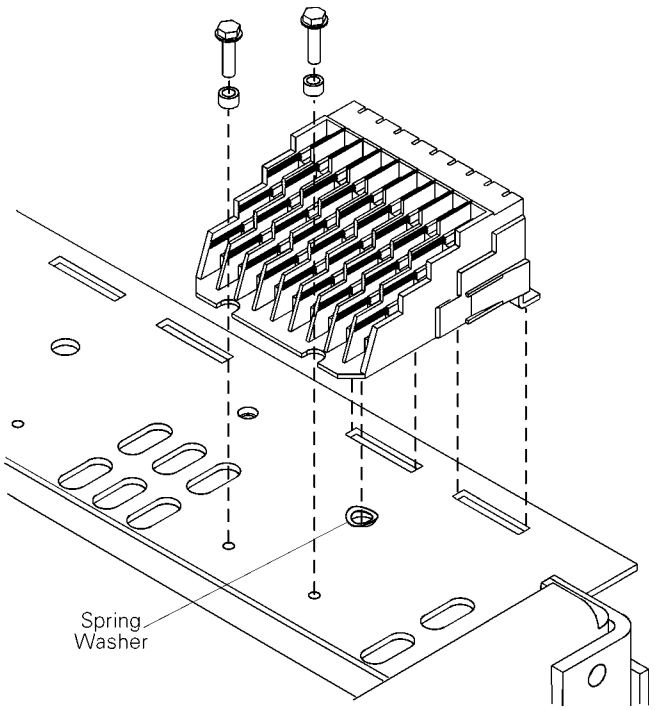


Figure 5-3. Removing the secondary disconnects.

3. Remove the six screws securing the secondary disconnect mounting plate to the back frame, then remove the mounting plate, as illustrated in Figure 5-4.
4. Remove the four screws securing the arc chute retainer bar and remove the bar, as illustrated in Figure 5-4. Lift out the four interphase barriers, then lift out the three arc chutes.
5. Compress the closing springs with the manual charging handle. Remove the safety pins from their storage clips and insert them into the holes in the guide rods, as illustrated in Figure 5-2. Push the CLOSE button to relieve the pressure on the closing springs.

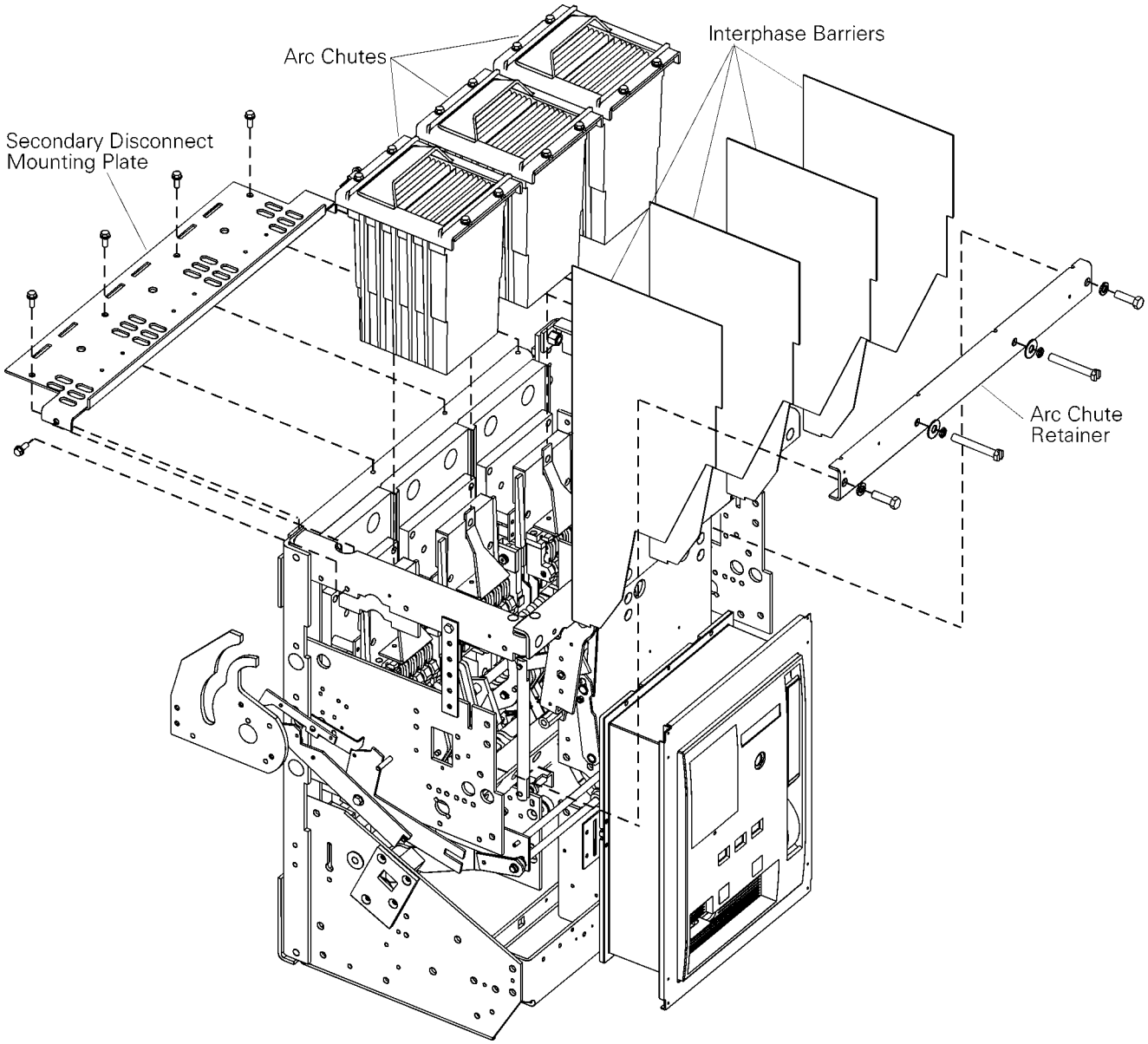


Figure 5-4. Removal of the interphase barriers, arc chutes, and secondary disconnect mounting plate.

6. Remove the two opening springs from the outside pole units on the lower part of the breaker, as illustrated in Figure 5-5.

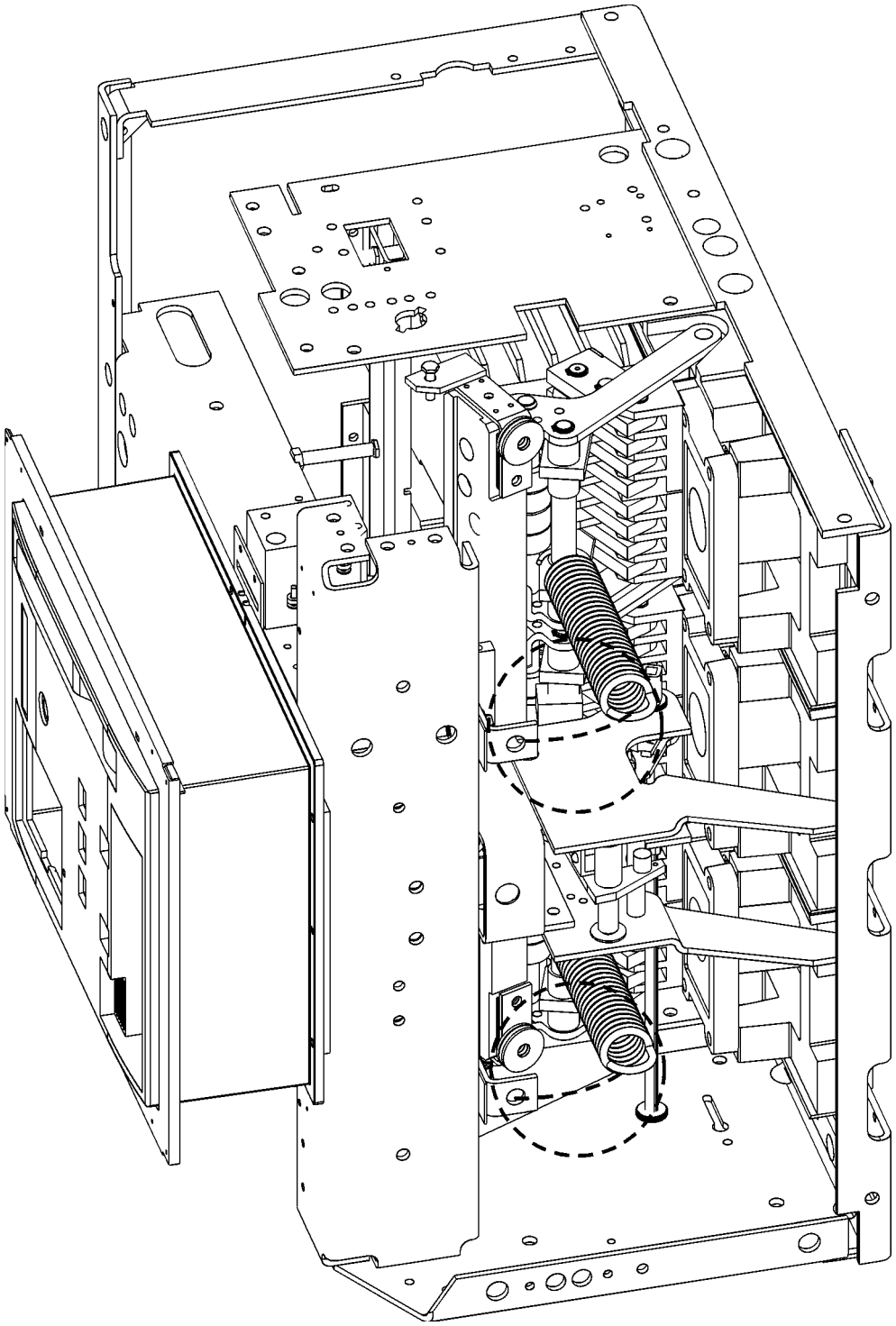


Figure 5-5. Removal of the two opening springs from the outside poles (view from the bottom of the breaker).

7. Remove one of the snap rings on the clevis pin connecting the center pole to the crossbar, then remove the pin, as illustrated in Figure 5-6.

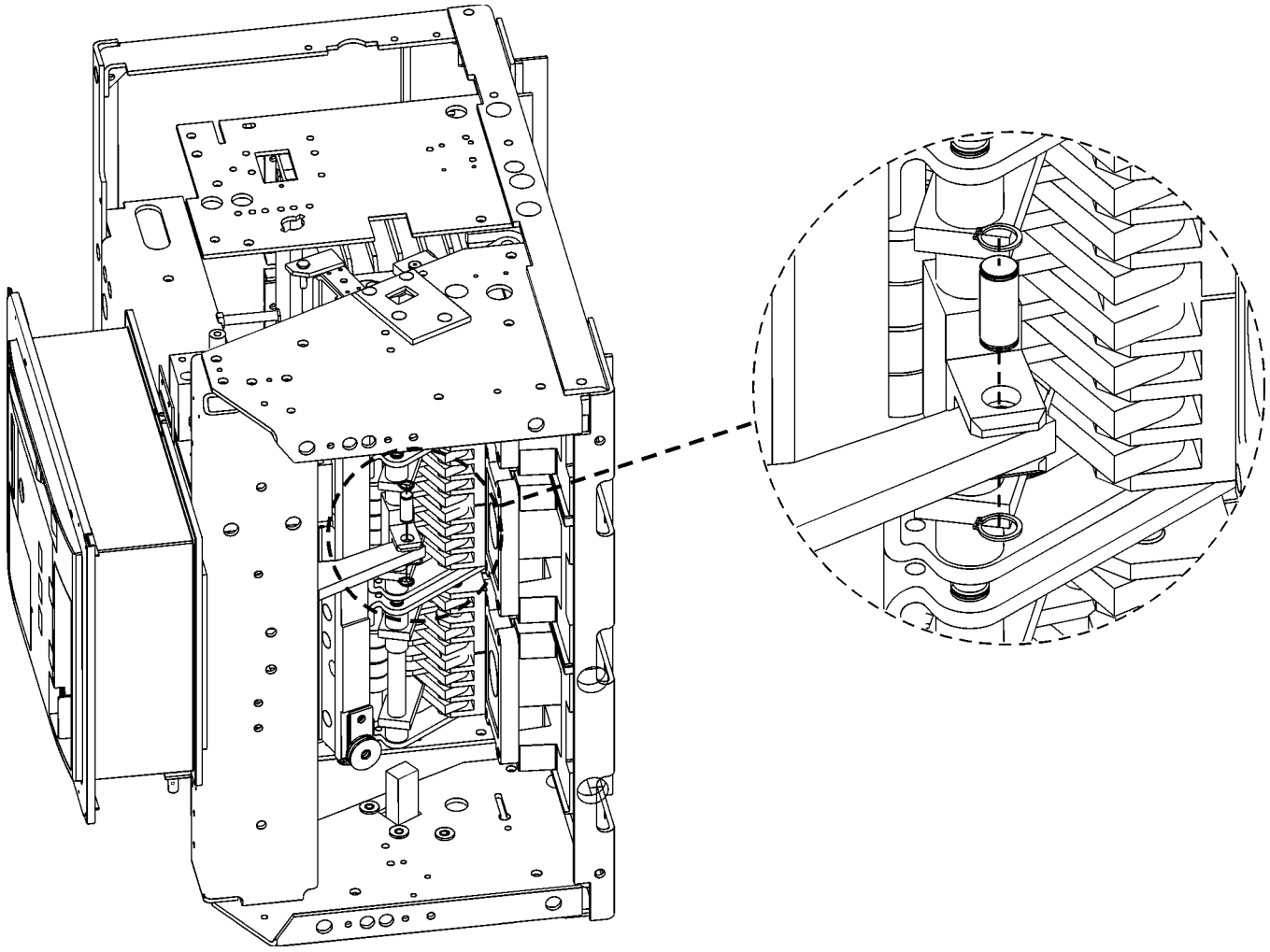


Figure 5-6. Removal of the clevis pin connecting the center pole to the crossbar.

8. Remove the snap ring and flat washer connecting the flux shifter actuator assembly to the crossbar assembly, as illustrated in Figure 5-7, then disconnect the actuator from the pin.

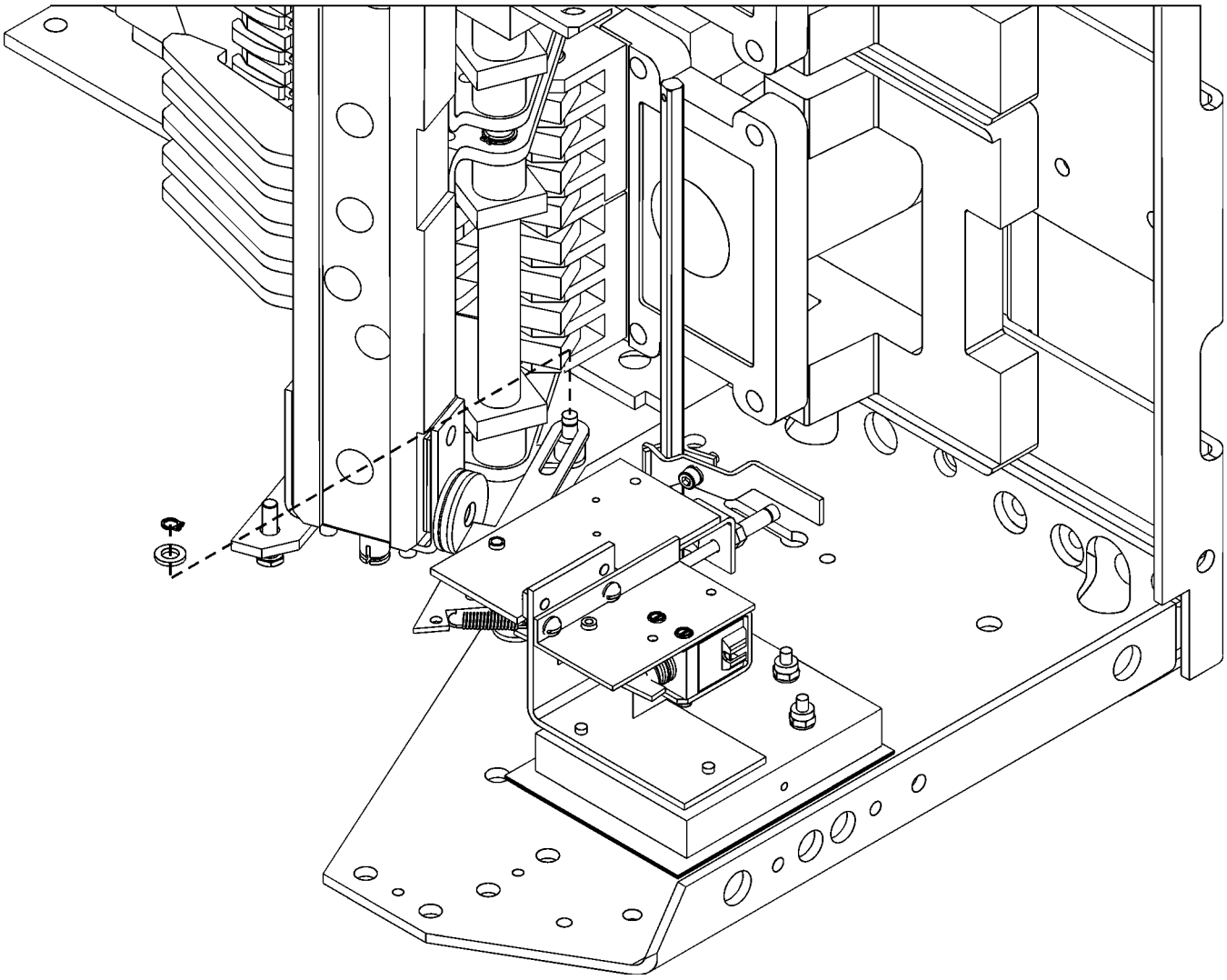


Figure 5-7. Disconnecting the flux shifter actuator from the crossbar.

9. Remove one of the snap rings from the pin connecting the auxiliary switch operating rod to the cross bar, as shown in Figure 5-8, then remove the pin to disconnect the operating rod.

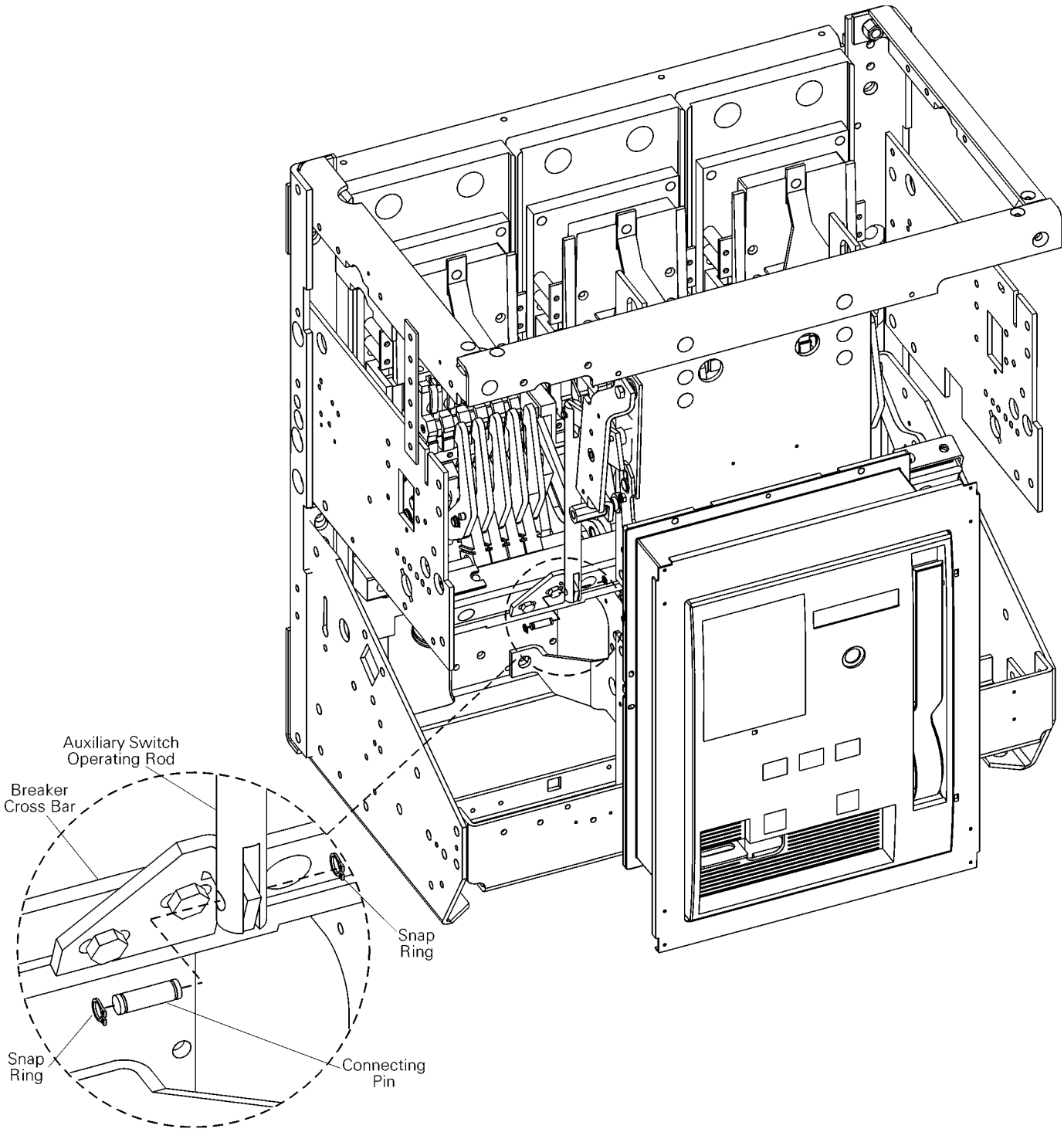


Figure 5-8. Disconnecting the auxiliary switch operating rod from the crossbar.

10. Disconnect the spring from the racking shaft interface bar. Back off the screw at the bottom end of the bar, then slide the bar up through the two sets of rollers to remove it, as illustrated in Figure 5-9.

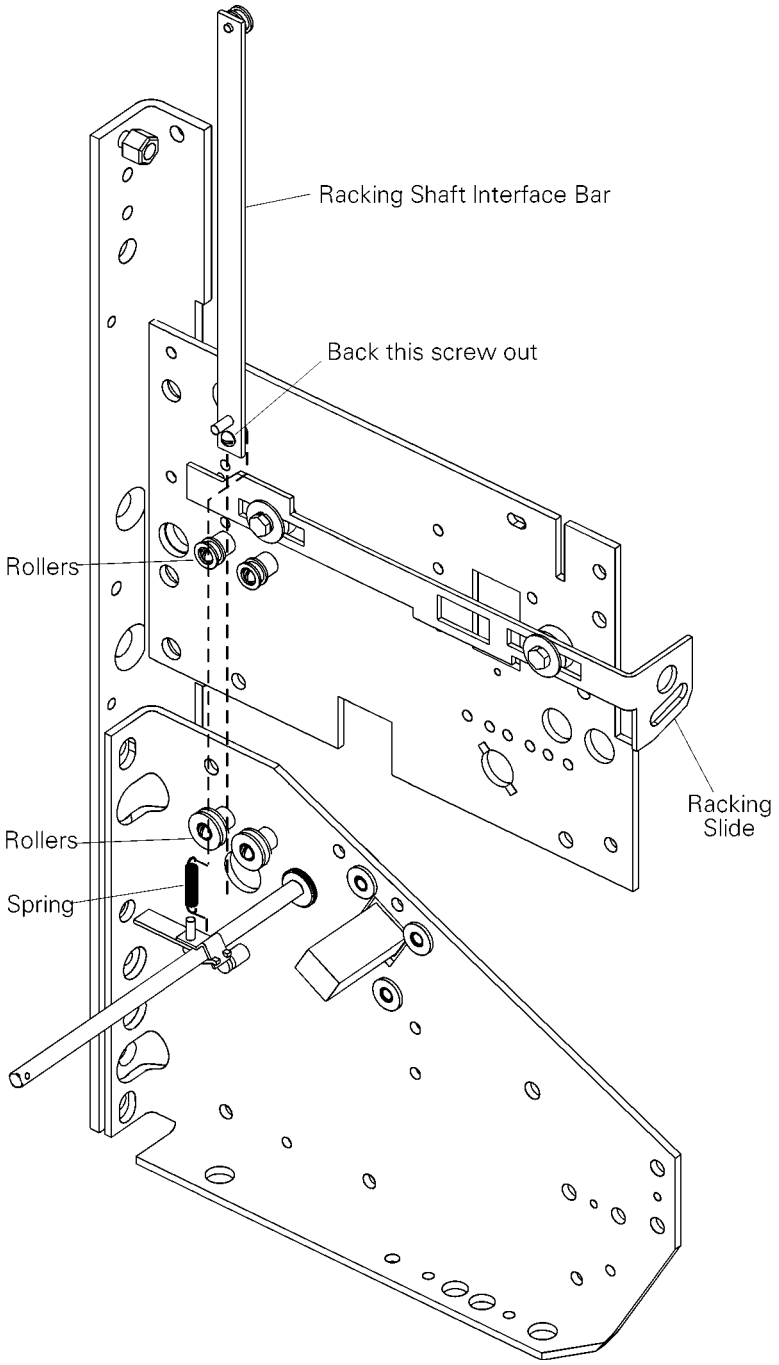


Figure 5-9. Disconnecting the racking shaft interface bar (right side view).

11. Remove the screw, lock washer, and nut attaching the harness support bracket to the back frame side plate, as illustrated in Figure 5-10.

12. Remove the long bolt, plastic tube, and two washers comprising the side supports on each side of the breaker.

13. Remove the two screws and washers connecting the trip indicator support to the back frame side plate.

14. Remove the screw, lock washer, and flat washer from the draw-out indicator connector plate and remove the plate.

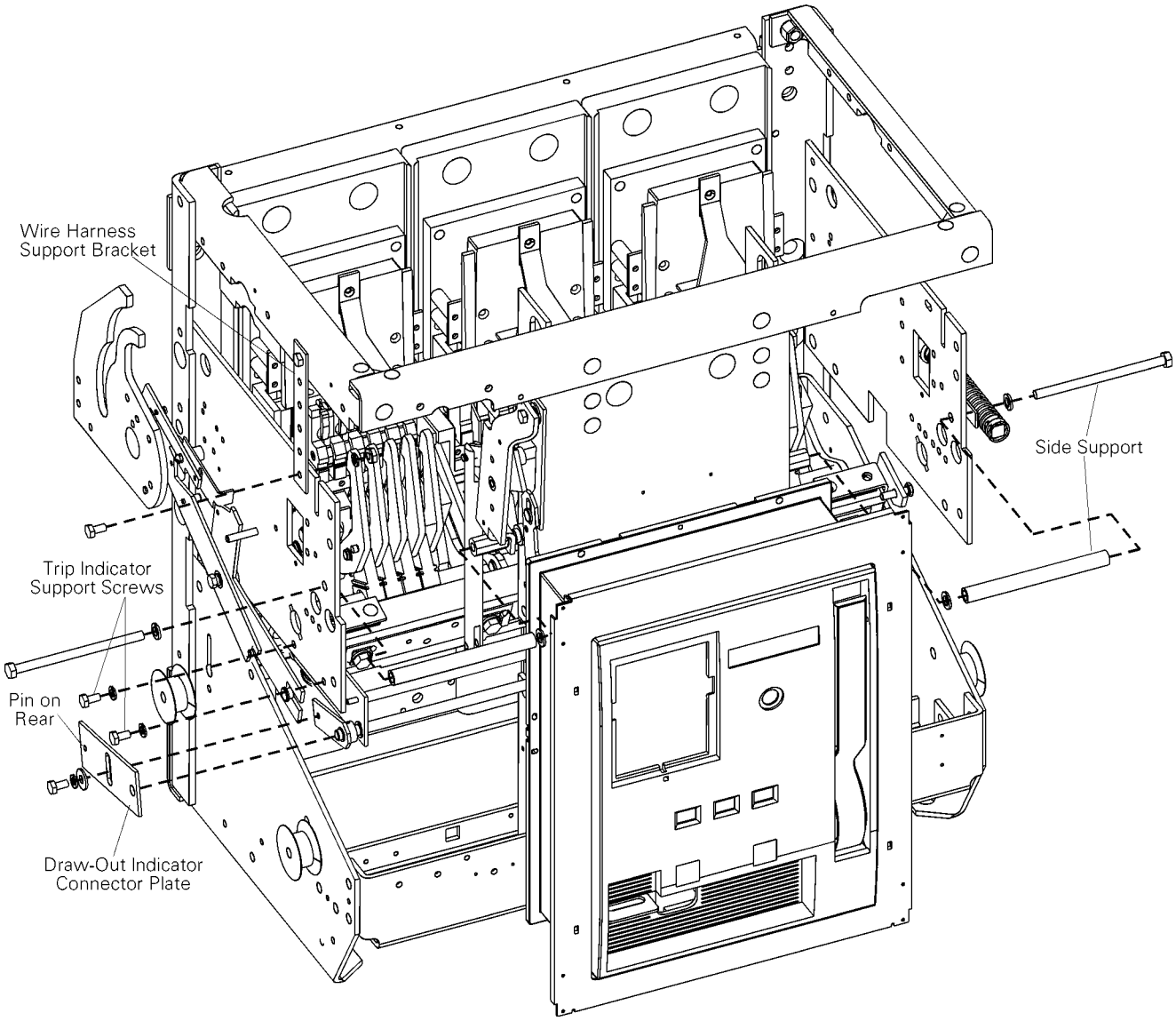


Figure 5-10. Removal of the position interlock and draw-out indicator support plate.

15. Unplug the leads from the CTs, carefully noting the polarity (black and white wires) for proper reassembly. Cut any wire ties connecting the leads to the back frame.
16. Carefully place the breaker on its back surface, resting on the primary disconnects.
17. Remove the six sets of nuts and washers connecting the front frame to the back frame, as illustrated in Figure 5-11.
18. Using a suitable lifting device, pull the front frame straight up and off the back frame to separate the two assemblies.

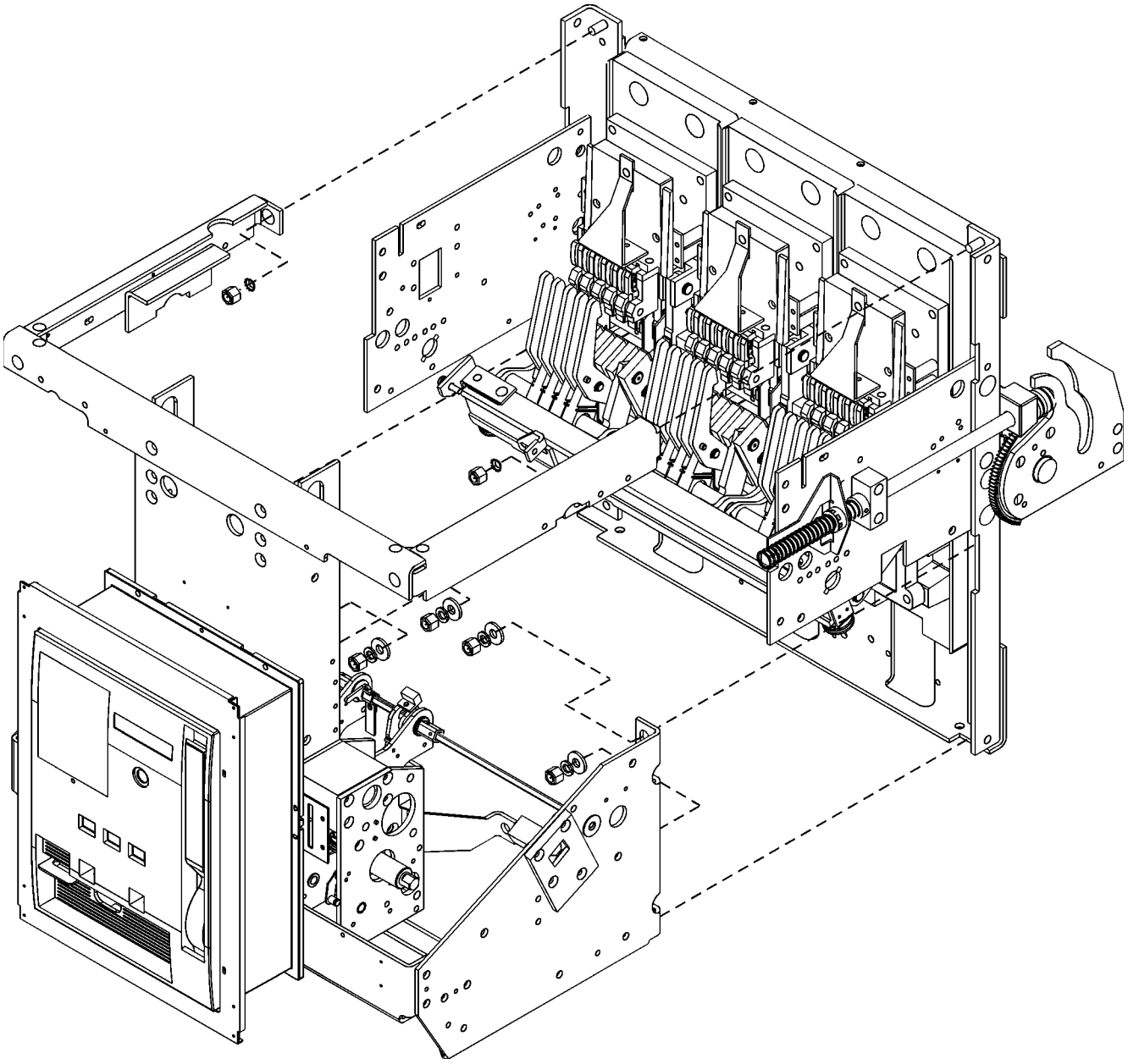


Figure 5-11. Separating the front frame from the back frame.

Reassembly of Breaker Front and Back Frames

1. Place the breaker back frame on the work surface, resting on the primary disconnects. Lower the front frame into position, lining up the corresponding holes with the six mounting studs in the back frame, as illustrated in Figure 5-11. Attach the six sets of nuts and washers to the mounting studs and tighten to 30 ft-lbs.
2. Raise the breaker to the normal position, resting on its base.
3. Reattach the wires to the CTs, observing the proper polarity. Replace the wire ties attaching the leads to the frame and the CTs.
4. Reattach the wire harness support bracket with the screw, lock washer, and nut, as illustrated in Figure 5-10.
5. Reattach the trip indicator support to the back frame side plate with the two screws and lock washers.
6. Reattach the long bolt, plastic tube, and two washers of the side support on each side of the breaker.
7. Place the pin on the rear of the draw-out indicator connector plate into the open slot in the end of the draw-out indicator. Place the hole in the plate over the pin on the end of the shaft, as indicated in Figure 5-10. Place the screw, lock washer, and flat washer through the slot in the connector plate into the tapped hole as shown. To adjust the connector plate, back the plate with the spring against the stop screw, then tighten the screw on the connector plate.
8. Slide the racking shaft interface bar through the two sets of rollers on the breaker side plate, as illustrated in Figure 5-9, and reconnect the spring onto the pin on the bar. The roller on the upper end of the bar should rest on the cam end of the trip bar. Tighten the screw previously loosened.
9. Align the holes in the auxiliary switch operating rod with the connection hole in the crossbar, then insert the connecting pin. Secure by reattaching the snap ring to the end of the pin, as illustrated in Figure 5-8.
10. Place the slot in the flux shifter actuator rod over the pin on the crossbar, then secure it with the flat washer and snap ring, as illustrated in Figure 5-7.
11. Align the hole in the bar from the center pole mechanism with the attachment point on the crossbar, then secure with the clevis pin and snap ring removed earlier, as illustrated in Figure 5-6.
12. Reconnect the two opening springs to the outer pole mechanisms, as illustrated in Figure 5-5.
13. Slow close the breaker, as described in Section 5–3, to check for proper operation and adjustment.
14. Compress the closing springs with the manual charging handle. Remove the safety pins from the charging springs and return them to their storage clips, as illustrated in Figure 5-2. Close and then trip the breaker.
15. Replace the four arc chute interphase barriers into their slots, as illustrated in Figure 5-4.
16. Slide the arc chutes into place, with the slots over the movable contact arms. Replace the arc chute retainer bar and secure it with four screws and washers, as illustrated in Figure 5-4.
17. Attach the secondary disconnect mounting plate to the breaker with its six screws, as illustrated in Figure 5-4.
18. Place the flexible washer on the molded pin on bottom of the secondary disconnect(s), then slide the two feet into the slots on the mounting plate. Secure with the two screws and standoffs, as illustrated in Figure 5-3. Replace the wire bundle into the channel on the top of the frame and secure with wire ties.
19. Check to see that no wires are interfering with breaker operation and that all bolts and nuts are tight. Operate the breaker a few times to ensure proper operation.

5–5 Breaker Mechanism Adjustments

Both electrically and manually operated breakers have the same basic mechanism, illustrated in Figure 5-12, 5-13, 5-14, and 5-15, with the drawing key in Table 5-1. All the adjustments described in this section must be made with the breaker upright and mechanism reset, as shown in Figure 5-13. Reset the mechanism by fully charging the closing springs. For safety, insert the safety pins into the guide rods, as illustrated in Figure 5-2.

1	Spring	11	Trip latch
2	Cam	12	Trip shaft
3	Link	13	Clevis pin
4	Reset spring	14	Clevis
5	Spring adjusting nuts	15	Reset latch
6	Prop	16	Roller
7	Adjusting screw	17	Prop
8	Adjusting screw stop pin	18	Bearing
9	Prop return spring	19	Latch buffer
10	Roller	20	Nut

Table 5-1. Key to the numbered parts in Figures 5-14 and 5-15.

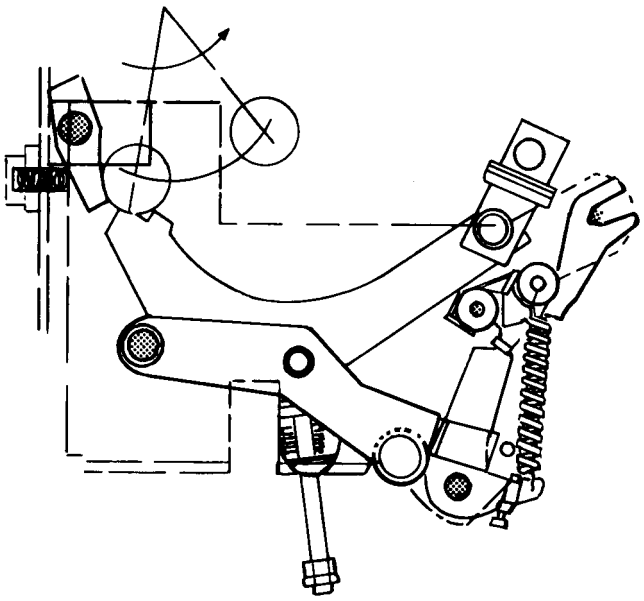


Figure 5-12. Breaker mechanism in motion before resetting.

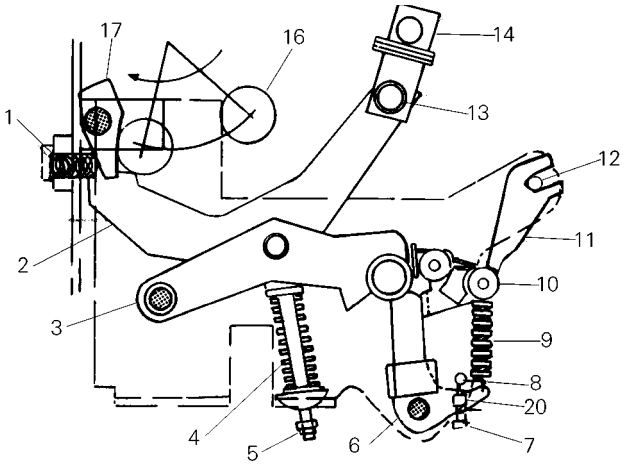


Figure 5-14. Breaker mechanism in closed position (closing spring discharged).

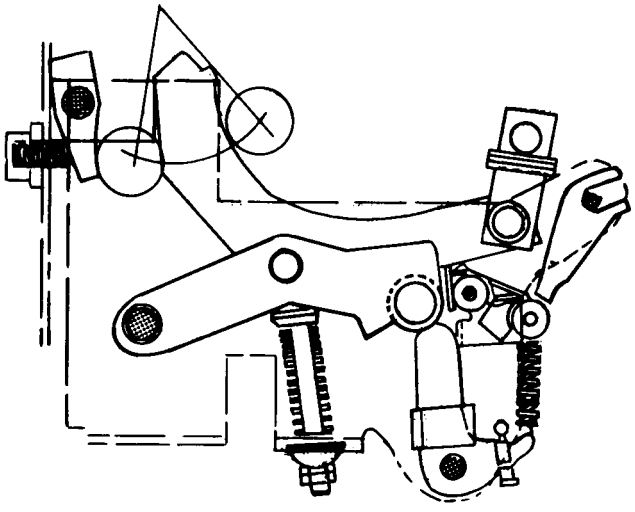


Figure 5-13. Breaker mechanism in the reset position.

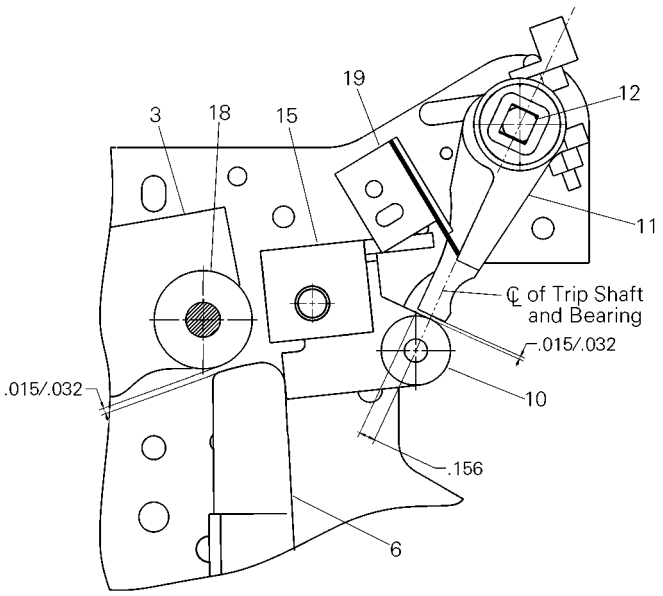


Figure 5-15. Latch, bearing, and prop adjustment.

Trip Latch Adjustment

As shown in Figure 5-15, the gap between the trip latch (11) and the roller (10) should be between 0.015 and 0.032 inch. To adjust this dimension, loosen the nut (20) and turn the Allen screw (7).

The center line of the trip latch (11) is 0.156 inch from the edge, as shown in Figure 5-15.

Latch Buffer Adjustment

As shown in Figure 5-15, the center line of the trip latch (11) should pass through the center of the roller (10). To adjust this dimension, loosen the screws retaining the latch buffer (19) to the mechanism frame, then reposition the latch with respect to the roller.

Reset Latch, Bearing, and Prop Adjustment

As shown in Figure 5-15, the gap between the bearing (18) and the prop (6) should be between 0.015 and 0.032 inch. To adjust this dimension, turn the adjusting nut (5) to expand or compress the reset spring (4).

6–1 Introduction

Breakers subjected to frequent interruption of high currents may eventually require replacement of their contacts. The general rule for determining if replacement is required is the loss of one-half or more of the mass of the contact tip material. Roughening or light pitting of the contact surface does not indicate loss of ability to carry or interrupt current.

When contacts are replaced, they must be adjusted to ensure that the proper force and contact depression is developed between the movable and stationary contacts when the breaker is closed. This is called the *wipe* adjustment. Wipe is the distance through which the stationary contacts move when the breaker closes. It is measured between the point of contact on a stationary contact when the breaker is open and the position of the same point when the breaker is closed. The actual wiping motion is greater than this measurement, since the contacts overtravel.

The wipe adjustment provides proper depression to assure full current-carrying capacity without overheating and influences proper current transfer during interruption of fault currents. Transfer of the current is the forced sequential movement from the main to the intermediate contacts, then to the arcing contacts, to the arc runner, and finally to the arc chutes, where energy is dissipated and the arc is extinguished. Contact wipe should be checked periodically during normal maintenance inspections and after any overcurrent trip.

CAUTION: Before performing any contact adjustment or replacement, disable the closing springs, as described in Section 5–3, *Slow Closing the Breaker.*

ATTENTION: Avant d'effectuer tout ajustement ou remplacement de contact, neutraliser les ressorts de fermeture, tel que décrit à la Section 5–3, *Slow Closing the Breaker.*

6–2 Arc Chute Removal and Replacement

The arc chutes should be removed and inspected at the regular inspection period. Arc chutes and interphase barriers are available as renewal parts.

The breaker must be removed from its compartment, as described in Section 5–2, and placed on a suitable work surface.

1. Verify that the breaker contacts are open and the closing springs are discharged.
2. Remove the four screws securing the arc chute retainer bar and remove the bar, as illustrated in Figure 5-4.
3. Lift out the four interphase barriers, then lift out the three arc chutes.
4. Check the arc chutes and barriers for damage and replace them, if necessary.
5. Replace the four arc chute interphase barriers into their slots
6. Slide the arc chutes into place, with the slots over the movable contact arms.
7. Replace the arc chute retainer bar and secure it with four screws and washers. Avoid over-tightening the hardware. Tighten the two outer screws until the lockwashers begin to flatten. Now tighten the two i9nner screws until their lockwashers are just flattened. Check the outer screws to make sure their lockwashers are now flattened.

CAUTION: All insulating barriers must be in place before the breaker is placed back into service.

ATTENTION: Toutes les barriéres isolatrices doivent être en place avant que le disjoncteur ne soit replacé en service.

6–3 Back Frame Assembly

The breaker back frame assembly consists of a frame to which the pole units are mounted. Each pole unit is connected to a common cross bar.. A typical back frame is shown in Figure 6-1.

The pole units consist of a molded base that supports the line and load stud assemblies, stationary and movable contact assemblies, and the actuating linkage, as illustrated in Figure 6-2. The numbers in parentheses below refer to the numbered components in Figure 6-2.

The stationary main contact assembly consists of spring-loaded contact fingers (7). The intermediate contact fingers (5) are spaced among the main contacts, with their contact surface projecting beyond that of the main contacts, so that the intermediate contacts make before and break after the main contacts.

Mating with the stationary contacts is the movable contact assembly consisting of multiple main (8) and intermediate (6) contact fingers. These movable contact fingers pivot on a stationary pin (not shown), which fastens them to the lower contact block. The insulated link (11) is attached to the movable contact assembly and gives the open and close motion to the contact arm.

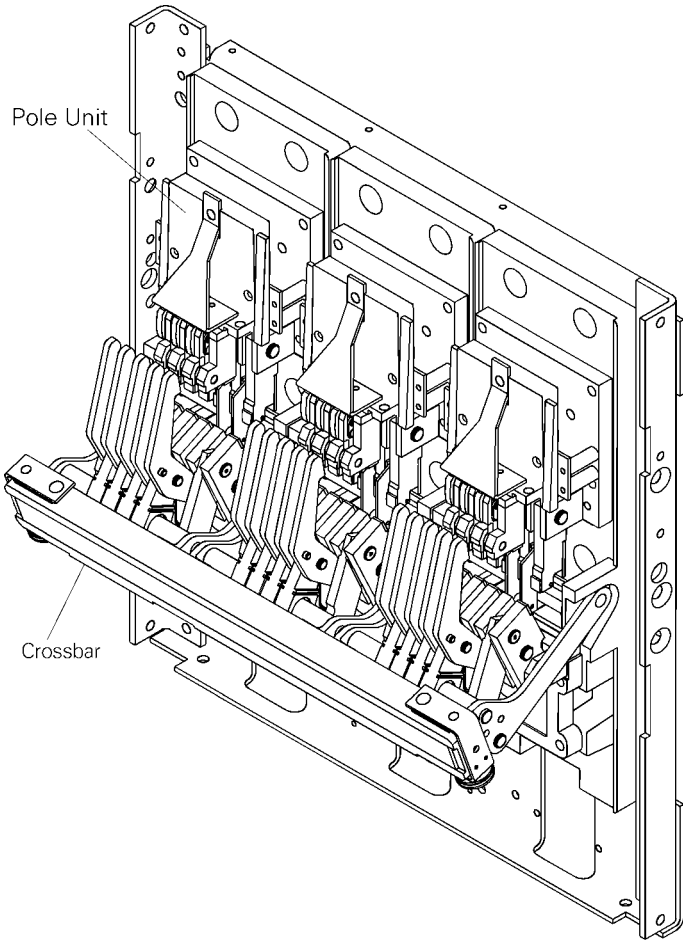


Figure 6-1. Back frame assembly.

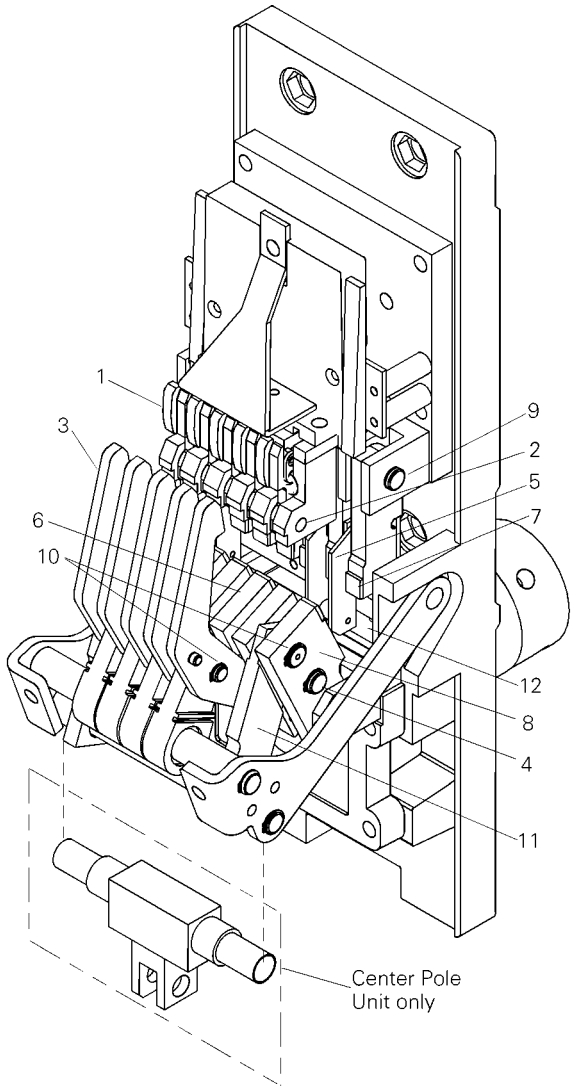
The stationary arcing contact assembly (1) is a separate set of contact fingers, pins, springs, and pivot block.

The movable arcing contact assembly consists of multiple contact arms (3) carried on two movable pins (4) and (10). The arcing contact arms are mounted among the main contacts and pivot with them about pin (4).

6–4 Replacement of Contacts

The following are the criteria for replacement of contacts:

- Arcing contacts should be replaced when eroded to a thickness of 0.08 inch.
- Intermediate contacts should be replaced when they have worn to the level of the main contacts. New intermediate contacts extend 0.06 inch beyond the main contacts.



1. Stationary arcing contact
2. Pin – stationary arcing contact
3. Movable arcing contact
4. Pin – movable arcing contact
5. Stationary intermediate contact
6. Movable intermediate contact
7. Stationary main contact
8. Movable main contact
9. Pivot pin
10. Drive pin
11. Insulated link
12. Contact stop block

Figure 6-2. Pole unit components.

- Main contacts normally need replacement only if the arcing contacts have been neglected, resulting in erosion of the main contacts so that proper contact depression can not be obtained.

The front frame does not have to be separated from the back frame to replace arcing contacts.

Replacing Stationary Arcing Contacts

Use the following procedure to replace the stationary arcing contacts, as illustrated in Figure 6-3.

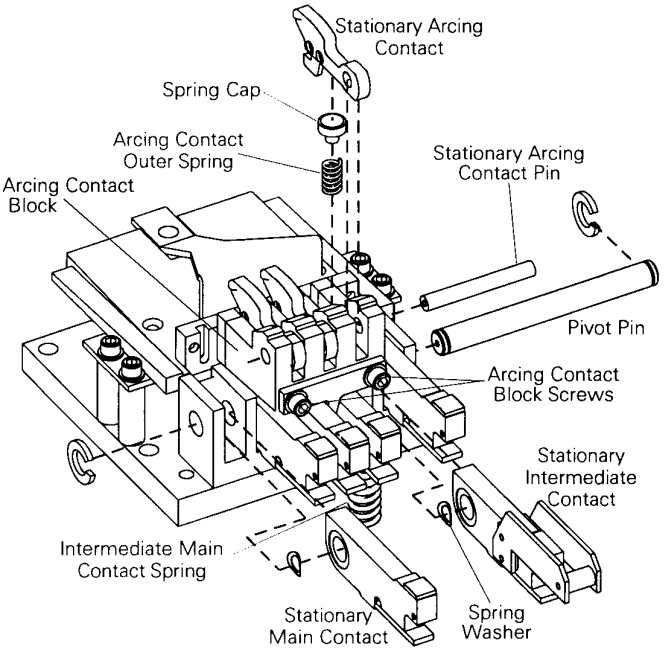


Figure 6-3. Replacing stationary contacts.

1. Slide the stationary arcing contact pin out to one side.
2. Lift off the stationary arcing contact arms. Remove the spring cap and two springs under each contact arm (there is also an inner spring not shown in Figure 6-3).
3. Install the replacement springs and spring cap for each contact arm. Replace the contact arms.
4. Replace the stationary arcing contact pin.

Replacing Stationary Intermediate and Main Contacts

Use the following procedure to replace stationary intermediate and main contacts, as illustrated in Figures 6-2 and 6-3.

1. Separate the front and back frames of the breaker, as described in Section 5–4.
2. Remove the cross bar, as described in Section 6–5.
3. Remove the allen screws holding the arcing contact block in place, then lift off the contact block.
4. Depress the main and intermediate contacts with a suitable lever to relieve the spring pressure on the contact stop bracket (12 in Figure 6-2), then remove the mounting screws. On WP40 and WP50 breakers, the outside movable main contact must be removed before the contact stop bracket mounting screws can be removed.
5. Remove the retaining ring on one end of the pivot pin, then slide out the pin.
6. Remove the stationary main and intermediate contacts, noting the spring washers on each contact pivot.
7. Place the spring washers in the counterbore on each contact arm.
8. Replace the contact arms, being careful to maintain correct right-left orientation of the main and intermediate arms.
9. Replace the pivot pin and retaining ring to secure the contact arms.
10. Depress the main and intermediate contacts to relieve the spring pressure on the bracket (12 in Figure 6-2), then tighten the screws fully before releasing the pressure.
11. Place the arcing contact block into position Depress the arcing contacts, insert the mounting screws, and tighten.
12. Replace the cross bar, as described in Section 6–5.
13. Reassemble the breaker front and back frames, as described in Section 5–4.
14. Check contact wipe, as described in Section 6–7.

Replacing Movable Arcing Contacts

Movable arcing contacts should be replaced whenever the stationary arcing contacts are replaced. See Figure 6-4.

1. Remove the retaining rings on one side of the drive pin and the movable arcing contact pin, then slide out the pins.
2. Remove the movable arcing contact arms.
3. Insert the replacement movable arcing contact arms.
4. Slide the drive pins and the movable arcing contact pin back into place, then reattach the retaining rings.

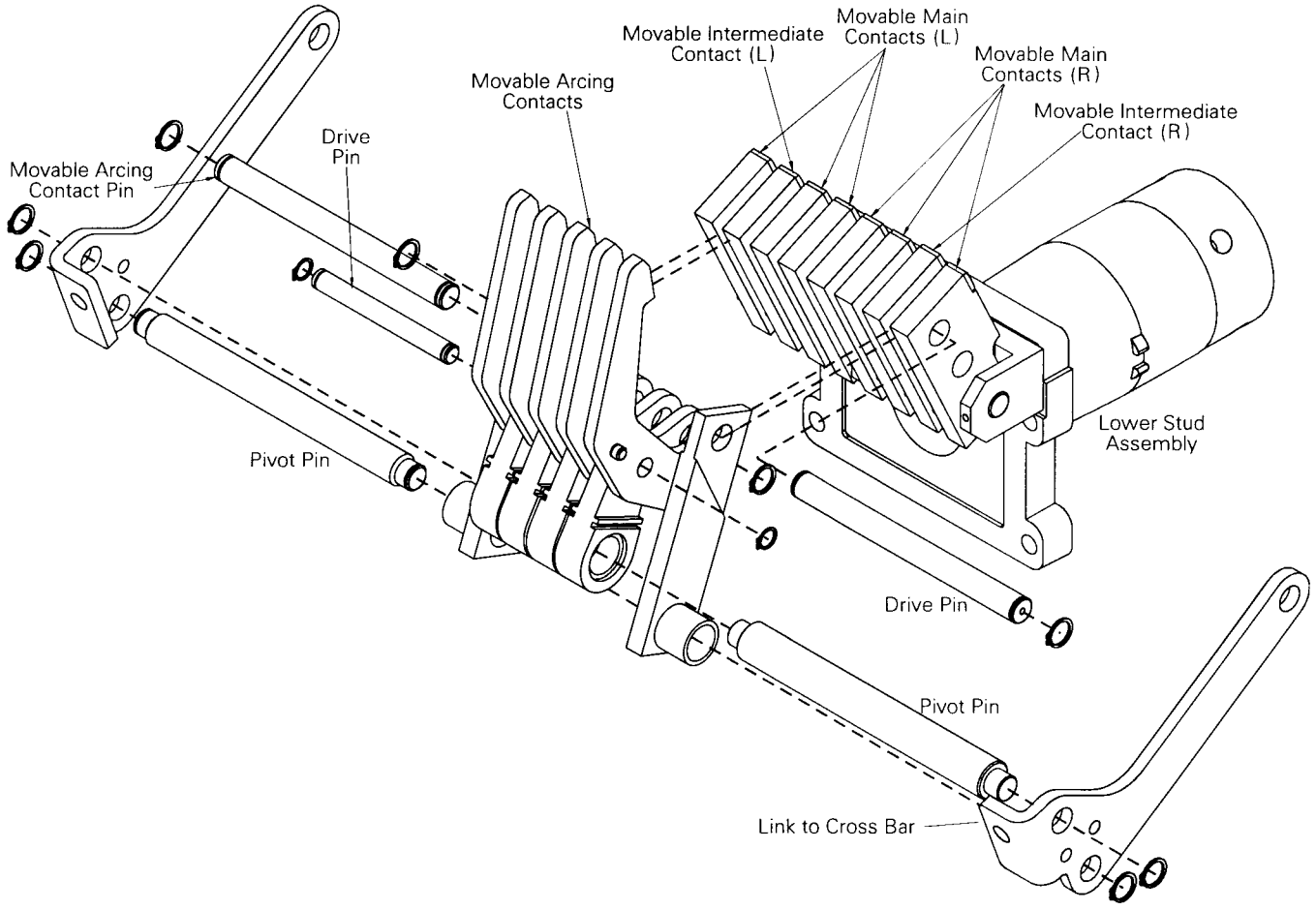


Figure 6-4. Replacement of movable contact arms.

Replacing Movable Main and Intermediate Contacts

The following procedure for replacing movable main and intermediate contact arms is illustrated in Figure 6-4.

1. Loosen the cross bar bolts, shown in Figure 6-5, so that the link can move freely.
2. Remove the retaining rings from one end of the drive pins, then slide the pins until the contact arms can be withdrawn.
3. Remove the contact arms, noting the two spring washers on each contact arm pivot.
4. Position two spring washers into the counter bore of the replacement contact arms.
5. Insert the contact arms into position, being careful to maintain correct right-left orientation of the arms.
6. Reinsert the drive pins to secure the contact arms, then attach the retaining rings.
7. Adjust the cross bar, as described in Section 6–5, then tighten the cross bar bolts.

6–5 Removal, Assembly and Adjustment of Cross Bar

For these procedures, refer to Figure 6-5.

Removal of Cross Bar

The cross bar is removed from the breaker with the following procedure:

1. Bend down the tabs on the adjustment plates securing the six screws.
2. Remove the six screws and three adjusting plates.
3. Lift off the cross bar.

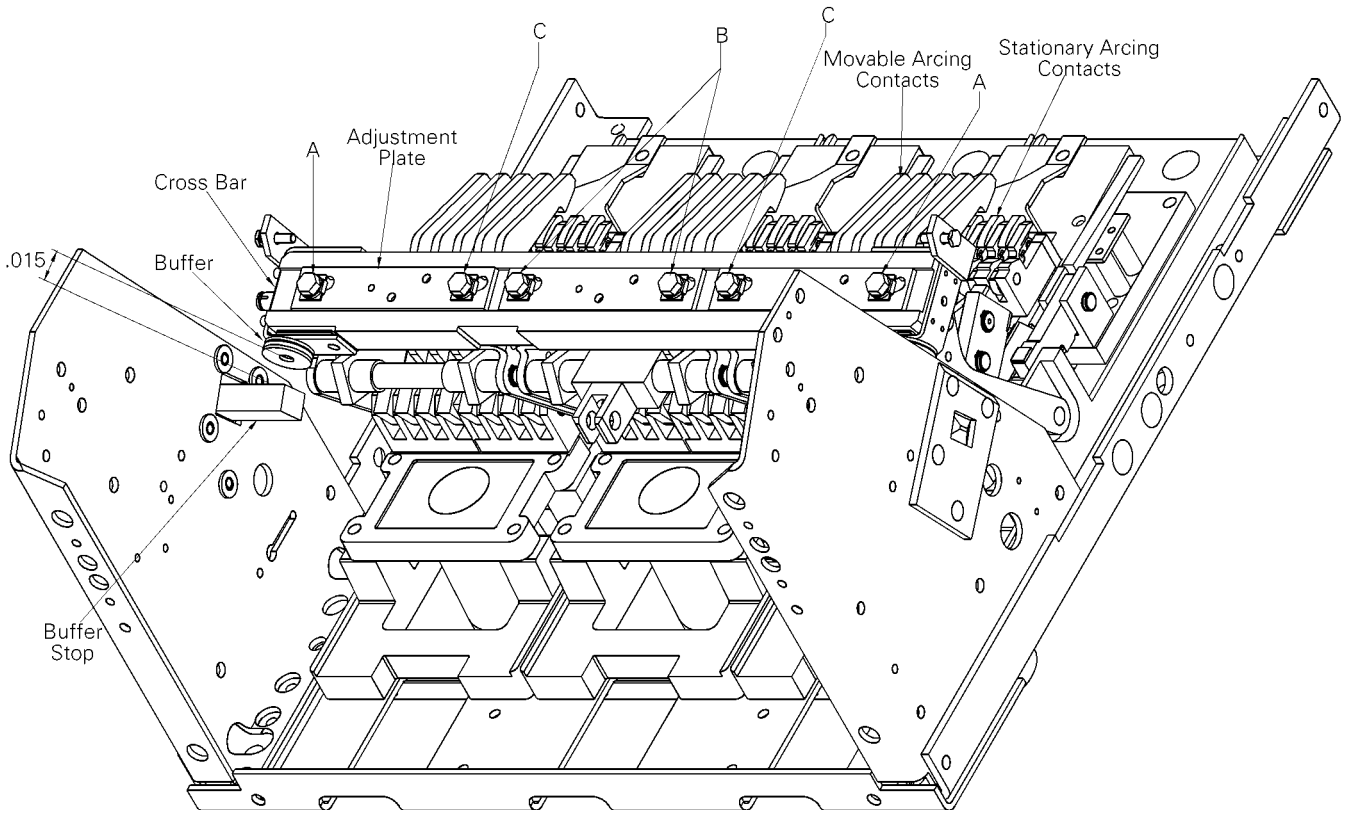


Figure 6-5. Assembly and adjustment of the cross bar.

Assembly and Adjustment of Cross Bar

The cross bar is assembled to the breaker with the following procedure:

1. Push the movable contacts of each pole back until they touch the stationary arcing contacts on the upper terminal.
2. Lay the cross bar on top of the links on the pole units.
3. Place the three adjusting plates onto the cross bar.
4. Fasten the six screws finger tight through the adjustment plates and cross bar into the tapped holes in the links on each pole assembly.
5. Set the cross bar to the 0.69 dimension shown in Figure 6-6. Check that all three poles of the movable arcing contacts are touching the stationary arcing contacts to within .03 inch.
6. Tighten the screws in the sequence A, B, then C to 400 in-lbs.
7. Check contact wipe and open gap, as described in Sections 6–7 and 6–8.
8. Bend the tabs on the adjustment plates to secure the screws.

6–6 Measuring Contact Force

Measure contact force only when contact arms are replaced. Perform the measurement while the front and back frames of the breaker are still separated during the contact replacement procedure.

Stationary Arcing Contacts

Place a push scale on the stationary arcing contact at a point 1.19 inch from the contact pivot, as illustrated in Figure 6-6, and depress the contact 0.25 inch. The load on the scale should be within the range listed in Table 6-1. If the load is not within the correct range, replace the spring under that contact assembly.

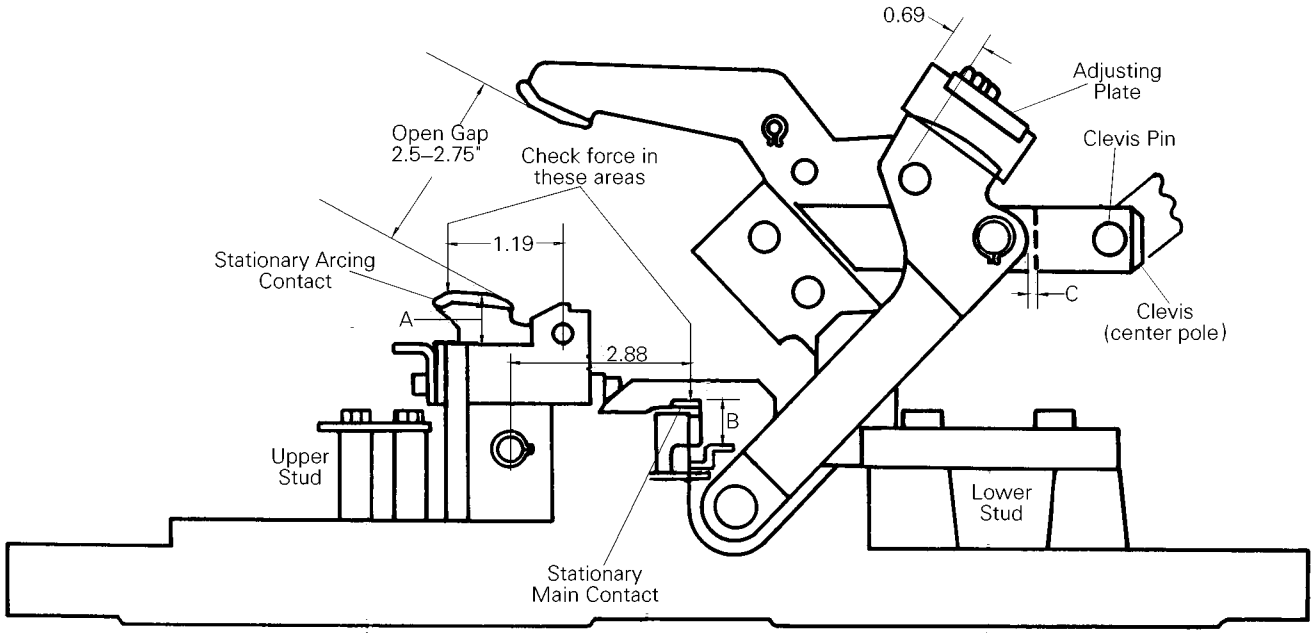


Figure 6-6. Measuring contact force and adjusting contact wipe.

Breaker Type	Main Contacts			Intermediate Contacts			Arcing Contacts		
	No. per Pole	Force, lbs	Wipe, in. (B)	No. per Pole	Force, lbs	Wipe, in. (B)	No. per Pole	Force, lbs	Wipe, in. (A)
WPS-32 WPH-32	5	25–55	0.06–0.11	1	25–55	*	3	31–43	0.16–0.28
WPS-40 WPS-50	6	25–55	0.06–0.11	2	25–55	*	5	31–43	0.16–0.28

** The intermediate contact wipe should be at least 0.06 inch greater than the main contact wipe.*

Table 6-1. Contact force and wipe specifications.

Stationary Main and Intermediate Contacts

Place a push scale on the stationary contact at a point 2.88 inch from the contact pivot, as illustrated in Figure 6-6, and depress the contact to the wipe dimension listed in Table 6-1. The load on the scale should be within the range listed in Table 6-1. If the load is not within the correct range, replace the spring under that contact assembly.

6–7 Measuring and Adjusting Contact Wipe

Use the following procedures to measure and adjust contact wipe. Refer to Figure 6-6 for dimensions and measuring points. All contact adjustments must be performed with the opening springs disconnected, as illustrated in Figure 5-5.

Measuring Contact Wipe

1. Remove the arc chutes, as described in Section 6–2.
2. With the breaker open and the opening springs disconnected, measure the distance between the edge of the stationary arcing contact and the retainer (dimension A). For main and intermediate contacts, measure the distance between the top of the contact and the contact arm retainer (dimension B).
3. Close the breaker and repeat the measurements in step 2. The difference between the two readings is the contact wipe. The correct values are listed in Table 6-1.

Adjusting Contact Wipe

The center pole is driven by the closing mechanism, which drives the cross bar, which then drives the outer poles. The adjusting plates on the cross bar have diagonal slots for the six screws that attach the cross bar to the three pole assemblies. Thus, moving the adjusting plate on the center pole changes the contact wipe on both outer poles by moving the cross bar with respect to the center pole. Moving the adjusting plate on an outer pole moves that pole assembly with respect to the cross bar and so changes the wipe only on that pole.

If adjustment is required, increase or decrease dimension C in Figure 6-6 to increase or decrease contact wipe, respectively, on the center pole.

1. Remove the clevis pin and rotate the clevis as needed to change dimension C.
2. To prevent overstressing the clevis threads, dimension C should not exceed 0.19 inch and space C should be filled with shims to within 0.005 inch of being solid.
3. When the proper center pole wipe is obtained, move the crossbar adjusting plate on the center pole to simultaneously change the wipe on both outer poles. Move the plate to the right to increase wipe, to the left to decrease wipe on both outer poles.
4. To change the wipe on either outside pole, move the cross bar adjusting plate of that pole. Move the plate to the left to increase wipe or to the right to decrease wipe on that pole.
5. When proper wipe has been established, tighten the adjustment plate screws to 400 in-lb. Bend the tabs on the adjustment plates to secure the screws.

6–8 Measuring and Adjusting Contact Open Gap

Use the following procedure to measure and adjust the gap between the movable and stationary contacts.

1. Remove the arc chutes, as described in Section 6–2.
2. Verify that the buffer assemblies on the ends of the crossbar, as illustrated in Figure 6-5, are touching. With the breaker contacts open, there should be no more than a 0.015 inch gap on one end when the buffers on the other end are touching. If necessary, adjust this dimension by adding or removing washers under one of the buffers.
3. Measure the contact open gap between the stationary and movable arcing contacts, as illustrated in Figure 6-6. This distance should be between 2.5–2.75 inches.
4. If necessary, adjust the contact open gap by repositioning the shims on the cross bar assembly. The locking nuts on the buffer bolts should be locked in position so that the buffer bolt can rotate freely.

6–9 Checking Contact Sequence

These tests can be best performed by slow closing the contacts, as described in Section 5–3.

The maximum difference in the making of the arcing contacts on the same pole must be 0.06 inch. The difference between making of the arcing contacts on different poles must also be no greater than 0.06 inch. To advance or retard the closing of the contacts on a pole, loosen the bolts holding the adjusting plate of that pole, illustrated in Figure 6-5, then slide the plate to the left to advance contact closing or to the right to retard closing. Make this adjustment on the outer poles, using the center pole as a reference.

When the arcing contacts are just touching, as illustrated in Figure 6-7, the intermediate contact gap should be at least 0.19 inch and the main contact gap at least 0.25 inch.

If it is necessary to make any adjustments in contact sequence, check and, if necessary, adjust contact wipe, as described in Section 6–7.

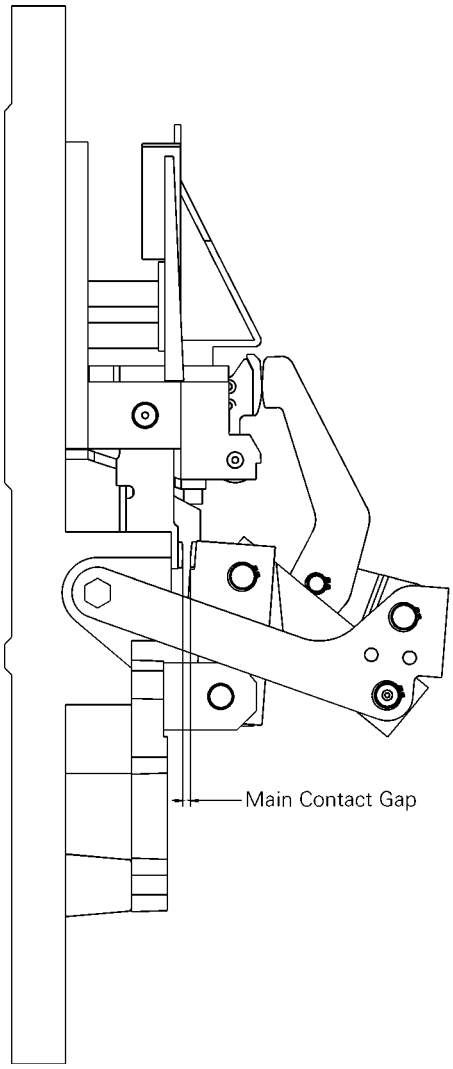


Figure 6-7. Measuring the main contact gap.

This section describes procedures for replacing the standard parts and assemblies available as renewal parts.

Before any of the operations in this chapter can be performed, the breaker must be removed from its compartment, as described in Section 5–2, and placed on a suitable work surface.

7–1 Primary Disconnects

Primary disconnects provide the flexible connection between the breaker line and load terminals and the equipment line and load terminals.

Primary disconnect assemblies are available in two configurations for the upper and lower terminals. Each pole on the lower disconnect requires two assemblies, illustrated in Figure 7-1 (one half of one pole shown). Each pole on the upper disconnect requires two assemblies and one inner heat sink, illustrated in Figure 7-2 (completed pole assembly shown) with two additional outer heat sinks on the center (B) pole.

Primary Disconnect Removal and Replacement

To replace an upper primary disconnect pole assembly, remove the four bolts and lock washers attaching the assembly to the back frame, as illustrated in Figure 7-3. Put the replacement assembly in position, then insert the four mounting bolts and lock washers and tighten to 200–250 in-lbs of torque.

To replace a lower primary disconnect pole assembly, remove the two bolts and nuts securing the two halves of the unit to the back frame. Put the replacement units in position, then insert the two mounting bolts through the disconnects and back frame pole unit. Attach the two nuts and tighten to 200–250 in-lbs of torque.

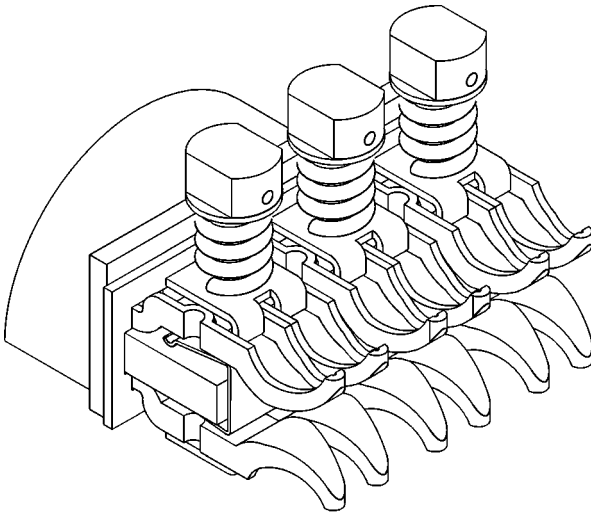


Figure 7-1 Lower primary disconnect assembly.

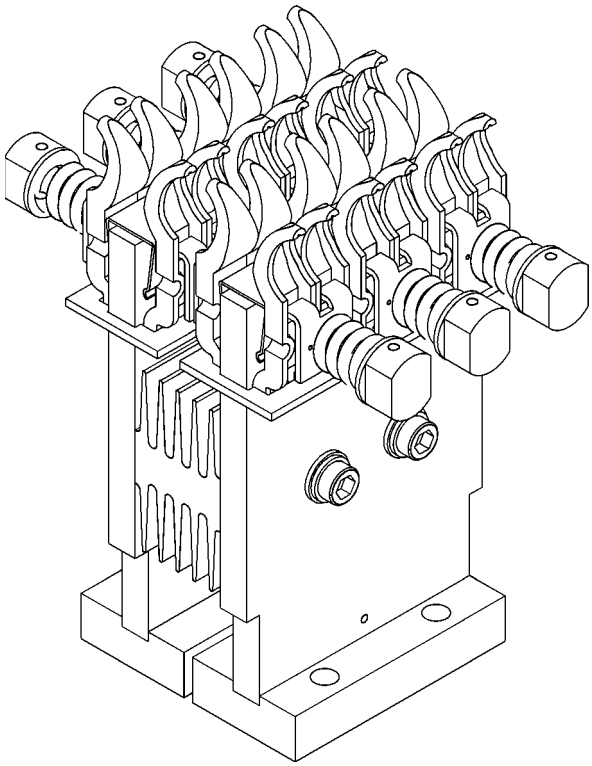


Figure 7-2. Upper primary disconnect outer pole assembly.

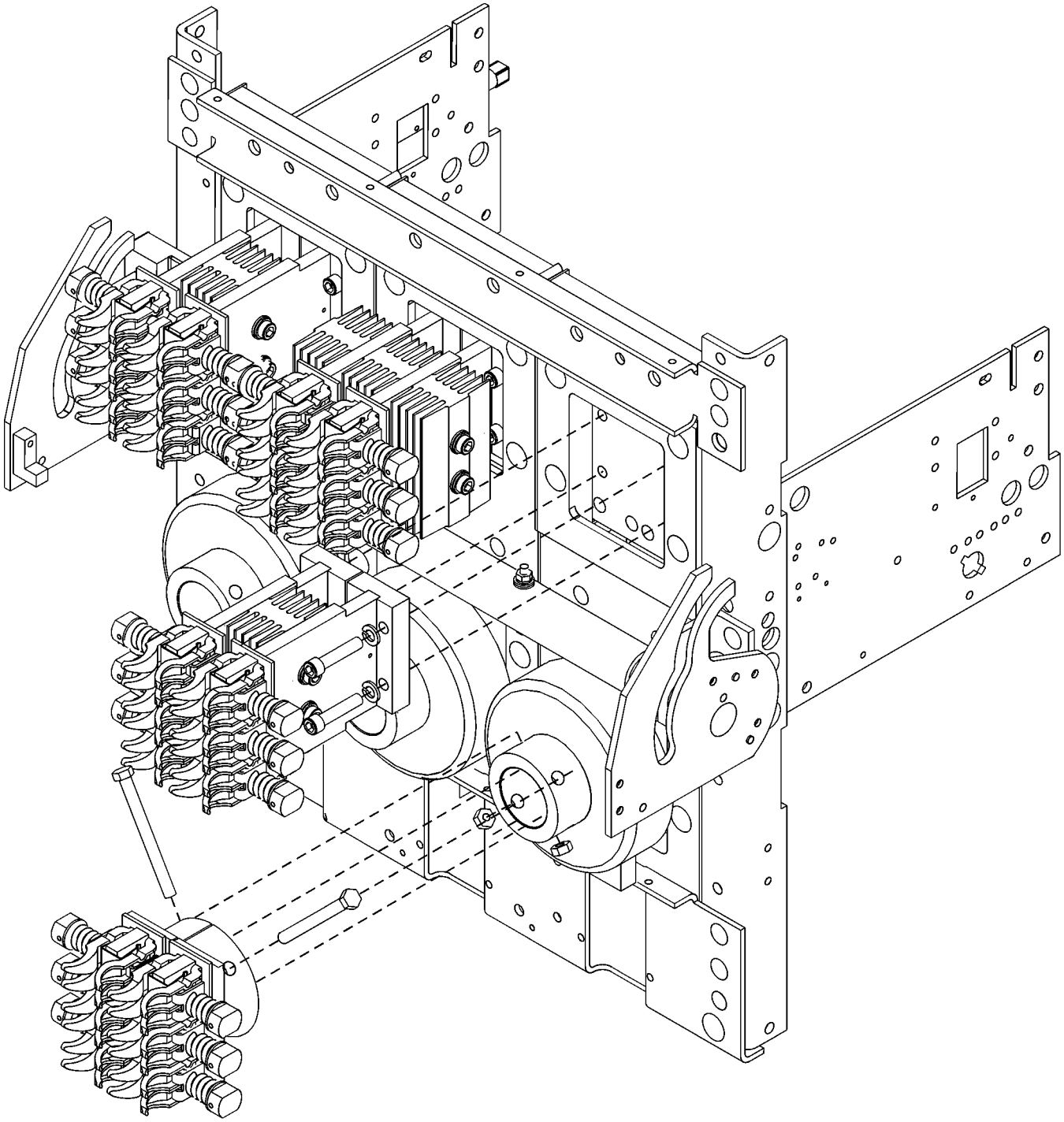


Figure 7-3. Removing or installing the primary disconnects.

7–2 Secondary Disconnects

The secondary disconnects, illustrated in Figure 7-4, serve as connections between the breaker control circuits and external circuit elements. They are attached to a mounting plate on the breaker back frame. They automatically make or break the control circuit connections as the breaker is racked in or out of its compartment. Figure 7-6 illustrates the numbering of the terminals in the secondary disconnects.

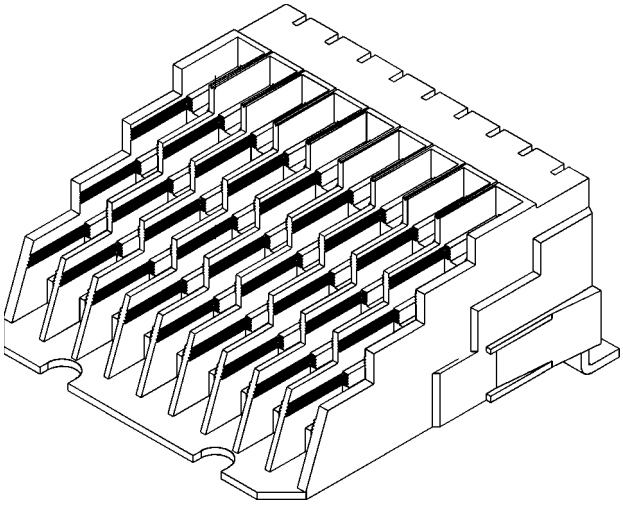


Figure 7-4. Secondary disconnect.

9	8	7	6	5	4	3	2	1
18	17	16	15	14	13	12	11	10
27	26	25	24	23	22	21	20	19
36	35	34	33	32	31	30	29	28

Figure 7-5. Secondary disconnect terminal numbering.

Secondary Disconnect Removal

To remove a secondary disconnect, use the following procedure, as illustrated in Figure 7-5:

1. Unplug all control circuit wires from the secondary disconnect, carefully marking each wire with its position number in the disconnect.
2. Remove the two screws and standoffs securing the disconnect to the mounting plate.
3. Slide the disconnect mounting feet out of the slots in the mounting plate. Remove the spring washer if it has detached from the molded pin on the underside of the disconnect.

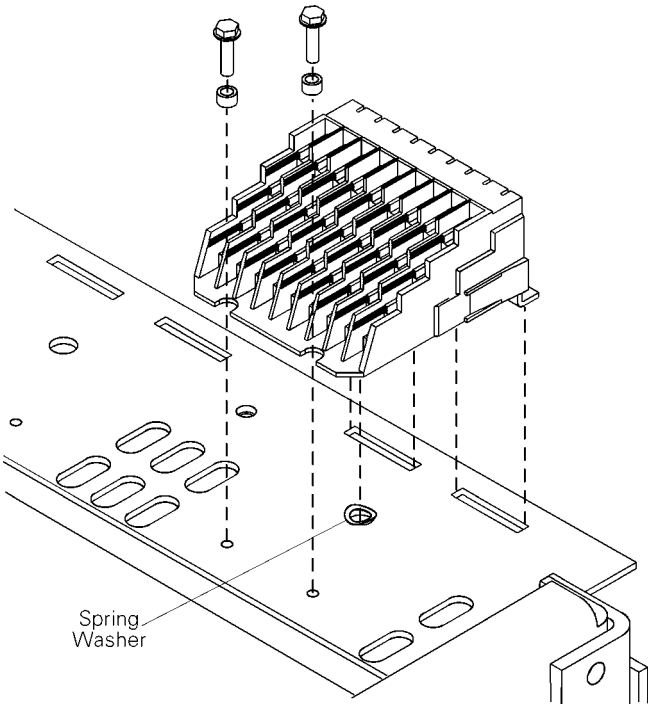


Figure 7-6. Removing or installing a secondary disconnect.

Secondary Disconnect Installation

To replace a secondary disconnect or to install an additional unit, use the following procedure:

1. Place the spring washer on the molded pin on the underside of the disconnect body and hold it in place.
2. Slide the mounting feet on the disconnect into the two slots in the secondary disconnect mounting plate.
3. Place the two screws and standoffs into the slots on the front of the disconnect and into the tapped holes in the mounting plate. Tighten to 40 in-lbs.
4. Insert the control circuit wires into the correct positions in the secondary disconnect.

7–3 Flux Shifter

The function of the flux shifter, illustrated in Figure 7-7, is to actuate the trip shaft and trip the breaker upon receiving a signal from the trip unit.

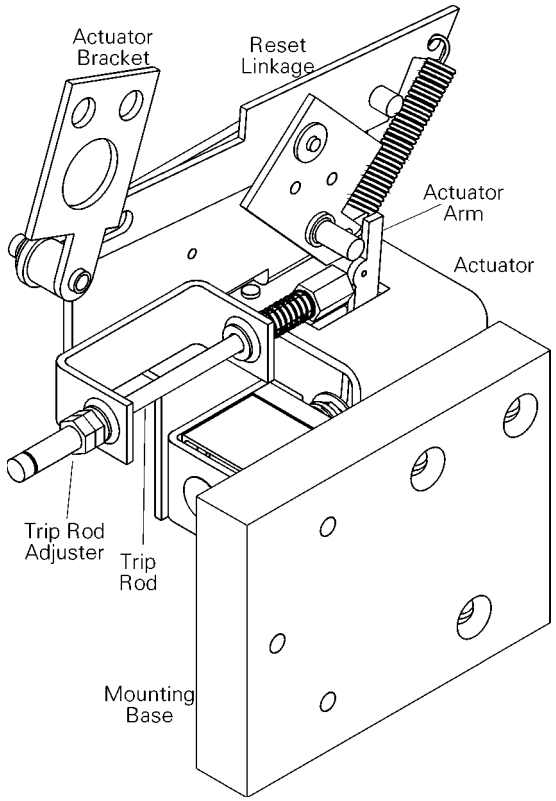


Figure 7-7. Flux shifter.

Flux Shifter Adjustment

The only adjustment required on the flux shifter is the trip rod length. As shown in Figure 7-8, the clearance between the trip rod end and the trip paddle is set to 0.11 ± 0.03 inch. To make this adjustment, open the breaker and charge the closing springs to restore the mechanism to the Reset position. Loosen the lock nut, rotate the adjuster until the proper gap is attained, then retighten the lock nut.

Removing the Flux Shifter

Use the following procedure to remove the flux shifter, as illustrated in Figure 7-9.

1. Unplug the connector at the end of the flux shifter leads.

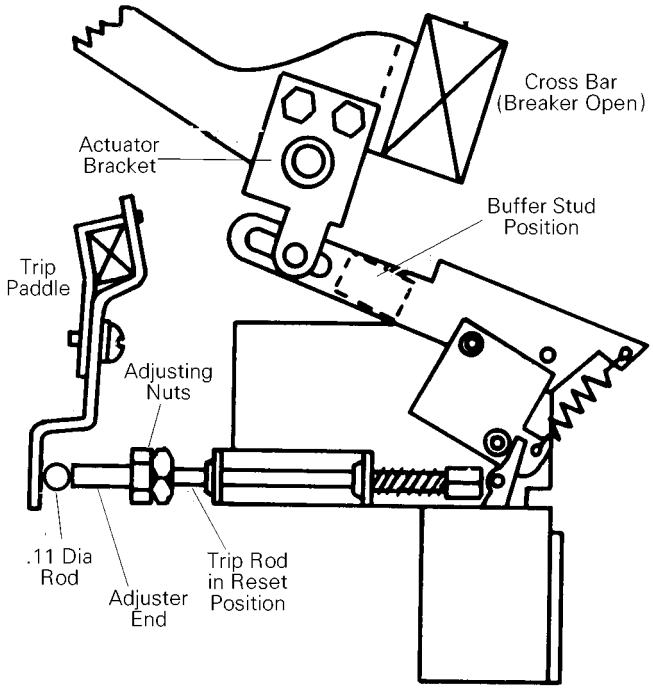


Figure 7-8. Adjusting the flux shifter trip rod length.

2. Remove the snap ring and flat washer connecting the reset linkage to the actuator bracket on the breaker main shaft.
3. Remove the three bolts, nuts, and flat washers that mount the flux shifter to the back frame side panel, then remove the flux shifter.

Installing the Flux Shifter

Use the following procedure to install a replacement flux shifter, as illustrated in Figure 7-9.

1. Mount the replacement flux shifter in position on the breaker side panel, insert the three mounting bolts, and secure with the flat washers and nuts. Tighten to 50 in-lbs.
2. Connect the flux shifter reset linkage to the actuator bracket on the main shaft and secure with the flat washer and snap ring.
3. Plug the connector on the flux shifter leads into the breaker socket.
4. Ensure that the actuator bracket will not interfere with the cross bar buffer during breaker operation. If necessary, loosen the actuator bracket mounting screws and rotate the bracket to take up the mounting hole slack. Retighten the screws.

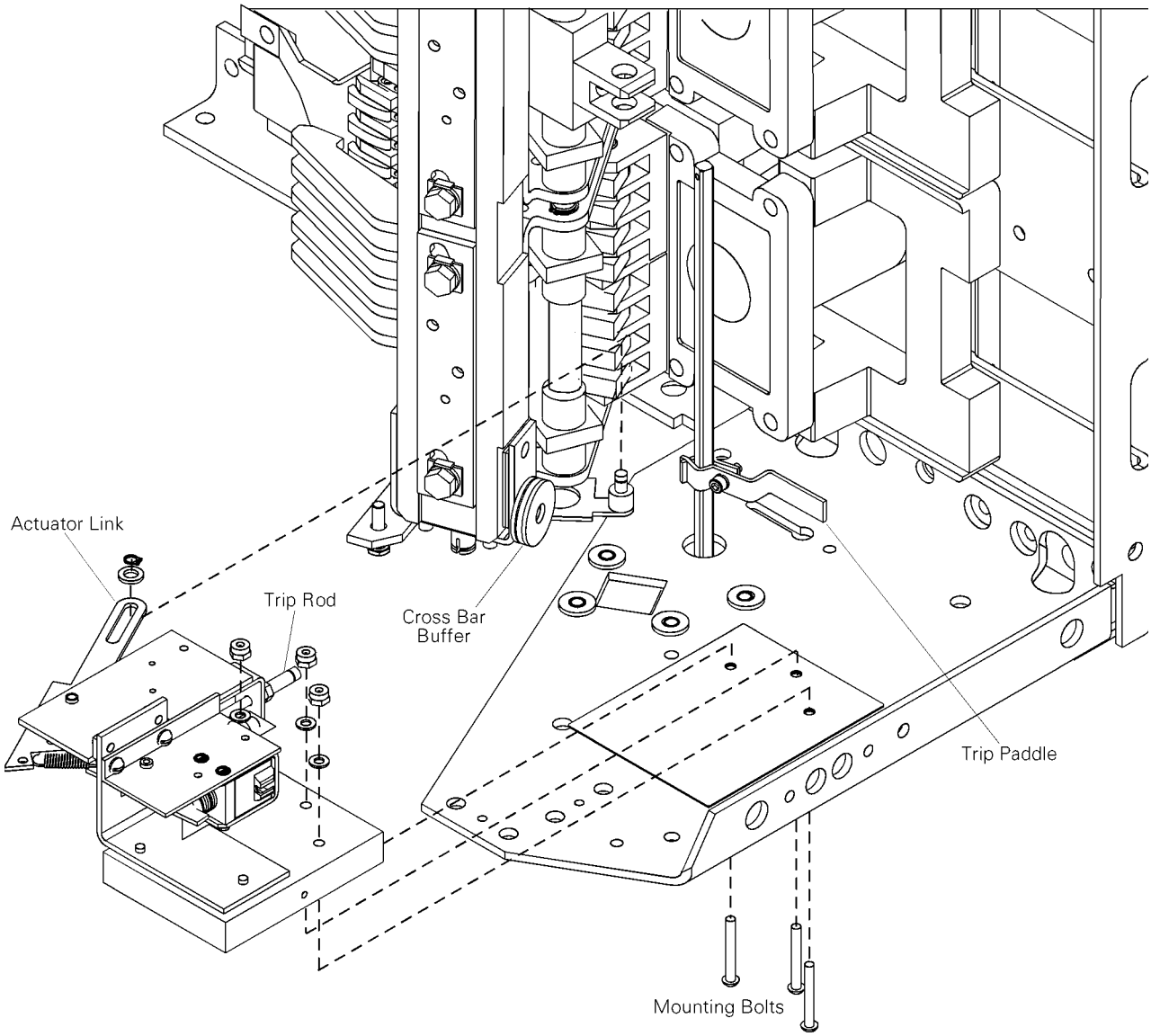


Figure 7-9. Flux shifter removal and replacement on the left side of the breaker back frame.

7–4 Current Sensors (CTs)

Current sensors provide the signals to the trip unit needed to measure the current through the breaker and initiate a trip, when appropriate. Each current sensor has two terminals for connection of control wiring to the trip unit.

Current Sensor Removal and Replacement

Use the following procedure to replace a current sensor, as illustrated in Figure 7-10.

1. Remove the two screws and nuts attaching the primary disconnect to the lower stud, as illustrated in Figure 7-3, and lift off the disconnect.
2. Detach the two leads from the connectors on the current sensor.
3. Lift the current sensor off the stud.
4. Place the replacement current sensor in position on the stud.
5. Attach the two leads to the connectors on the current sensor, maintaining proper polarity (black and white wires).
6. Place the primary disconnect in position on the stud and secure with the two screws and nuts. Tighten to 200-250 in-lbs.

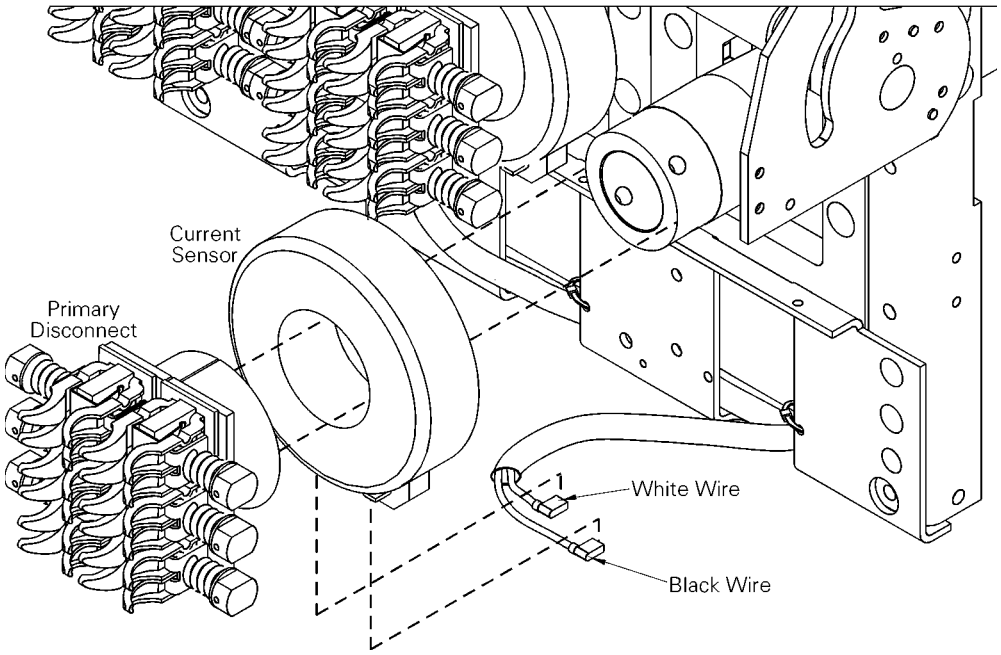


Figure 7-10. Current sensor removal and installation.

7–5 Draw-Out Mechanism

WavePro breakers are manufactured in two styles for installation in GE AKD-10 switchgear, Power Break® and AV-line switchboards or in other manufacturers' equipment using GE OEM substructures. The draw-out racking mechanism, illustrated in Figure 7-11, is available as a replacement assembly, but is not interchangeable between the two applications.

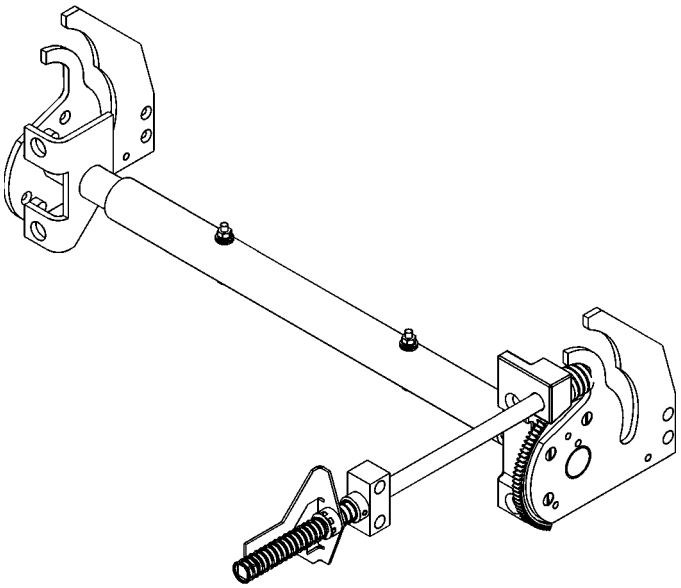


Figure 7-11. Draw-out racking mechanism.

Draw-Out Mechanism Removal

The following procedure describes the complete removal of the draw-out racking mechanism, as illustrated in Figures 7-12 and 7-13.

1. Remove the two sets of bolts, nuts, and washers attaching the shafts on the racking cams to the mounting tube. Pull the right and left racking cam assemblies out to the sides.
2. Remove the bearing from the right rear mounting bracket.
3. Remove the two pins, shown in Figure 7-13, attaching the locking collar and the spring bracket to the drive shaft.
4. Pull the driveshaft out from the rear, removing the spring, flat washer, spring bracket, and locking collar.
5. Remove the two bolts and washers securing the side bracket to the breaker and remove the bracket.
6. Remove the two bolts securing the two rear brackets to the breaker frame and remove the brackets. The bolt heads are reached from the inside of the breaker.

Draw-Out Mechanism Installation

The following procedure describes the installation of the draw-out racking mechanism, as illustrated in Figures 7-12 and 7-13.

1. Attach the two rear mounting brackets to the breaker frame with two bolts each. The bolt heads must be on the inside of the breaker frame.
2. Mount the side bracket with two bolts and washers to the tapped holes in the side of the breaker frame.
3. Insert the bearing into the right rear mounting bracket, then slide the shaft of the right racking cam assembly through the bracket.
4. Insert the shaft of the right racking cam assembly into the mounting tube. Line up the holes in the shaft and tube and secure with a screw, nut, lock washer, and two flat washers.
5. Insert the shaft of the left racking cam through the left rear bracket and into the mounting tube. Line up the mounting holes and secure with a screw, nut, lock washer, and two flat washers.
6. Insert the square end of the driveshaft into the upper hole in the right rear bracket and through the hole in the side bracket.
7. Slide the two shims, locking collar, and spring over the end and secure to the shaft with a pin through the collar and the rear hole in the shaft.
8. Slide the spring bracket over the shaft and secure it to the shaft with a pin through the hole in the bracket and the front hole in the shaft.
9. Slide the flat washer and spring over the end of the shaft. The end of the driveshaft protrudes through the hole in the end of the racking slide, shown in Figure 5-9, which secures the spring in place on the driveshaft.
10. Mesh the gear on the end of the driveshaft with the gear on the right locking plate.

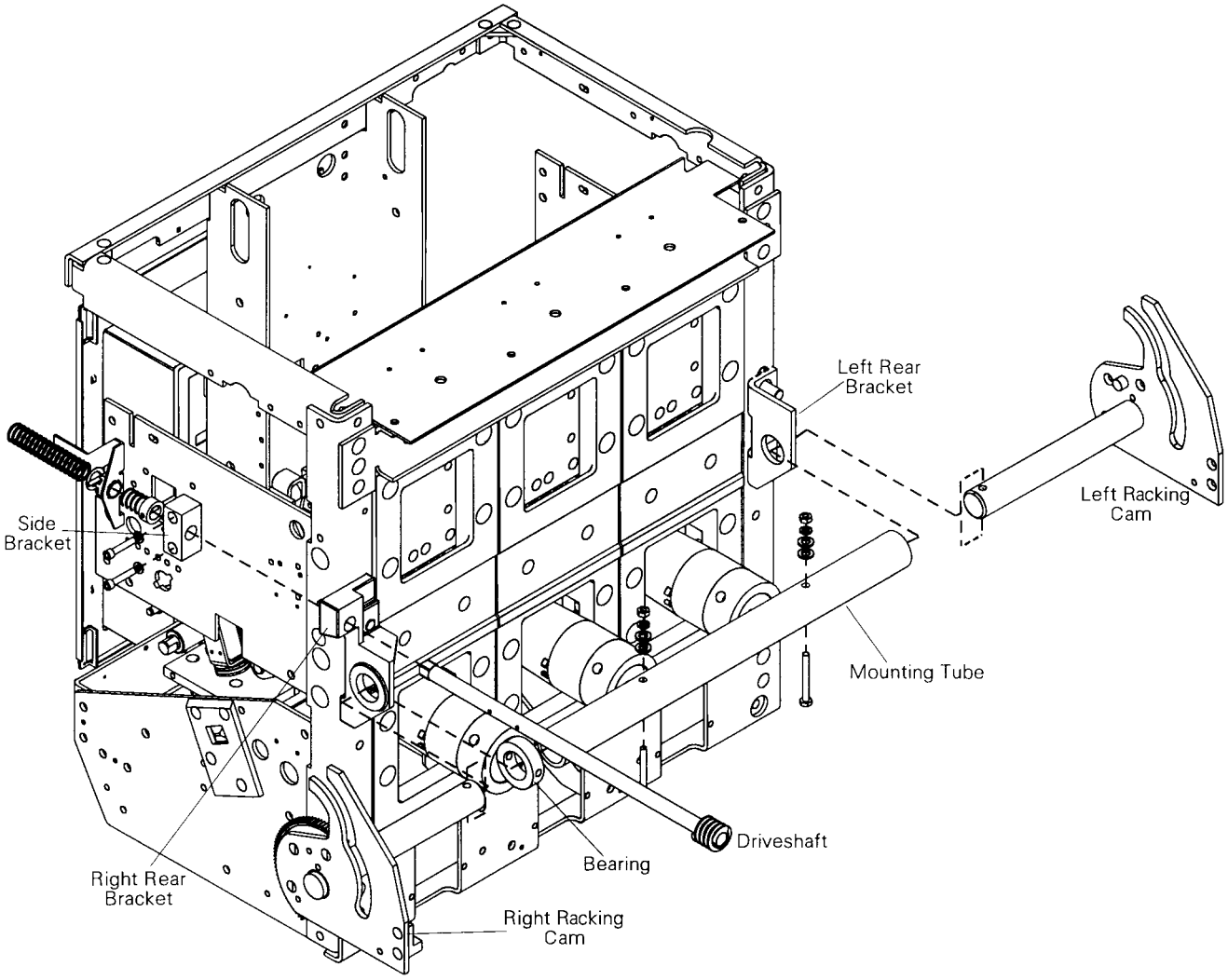


Figure 7-12. Draw-out racking mechanism removal and installation.

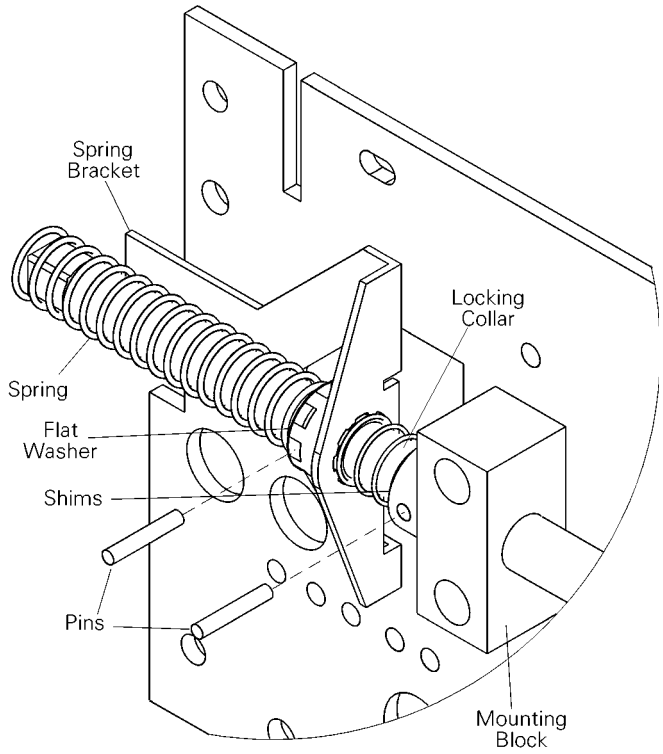


Figure 7-13. Exploded view of racking shaft assembly/disassembly.

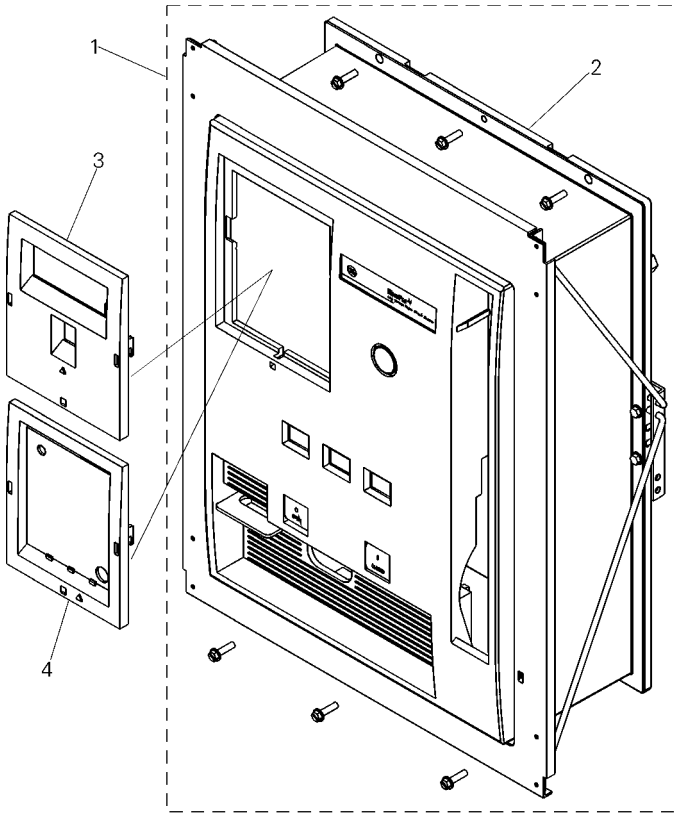
7–6 Escutcheon

The escutcheon, illustrated in Figure 7-14, is available in a complete kit including trim and mounting hardware or as the molded cover only. In addition, the trip unit doors are available separately. The manual charging handle is not included with the escutcheon.

Escutcheon Removal

Use the following procedure, illustrated in Figure 7-15, to remove the escutcheon:

1. Pull the ends of the two trim plate mounting rods out of the holes at the rear of both sides of the escutcheon, then remove the trim plate.
2. Remove the six screws securing the escutcheon to the breaker. Pull the manual charging handle out part way, then slide off the escutcheon.



1. Complete Kit
2. Escutcheon Molded Cover
3. Trip Unit Door – MicroVersaTrip Plus™ & MicroVersaTrip PM™
4. Trip Unit Door – Power+™

Figure 7-14. Escutcheon kit and related parts.

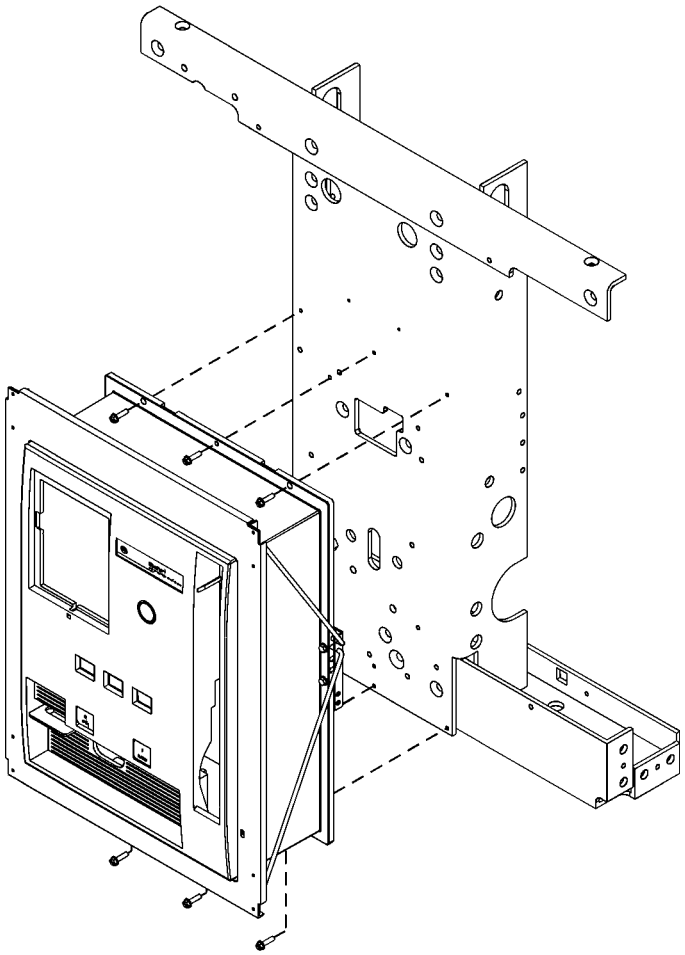


Figure 7-15. Removal and installation of the escutcheon.

Escutcheon Installation

Use the following procedure, illustrated in Figure 7-15, to install the escutcheon:

1. Pull the manual charging handle out part way, then slide the handle through the slot in the replacement escutcheon and move the escutcheon into place. Insert the six mounting screws and tighten to 14–20 in-lb.
2. Replace the trim ring around the escutcheon, with the narrow side at the bottom. Insert the trim plate mounting rods into the rear of the escutcheon.

7–7 Charging Handle and Mechanism Assembly

The charging handle and the charging mechanism assembly, illustrated in Figure 7-16, are available as renewal parts.

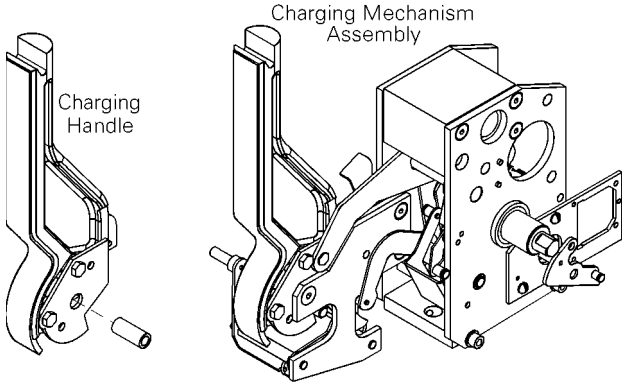


Figure 7-16. Charging handle and mechanism assembly.

Removing and Replacing the Charging Handle

Use the following procedure to replace the charging handle, as illustrated in Figure 7-17.

1. Remove the escutcheon, as described in Section 7–6.
2. Remove the two bolts, lock washers, and nuts connecting the handle to the charging linkage and to the handle mounting plate on the charging mechanism.
3. Insert the pivot pin into the replacement handle, slide the handle into position on the charging mechanism, and insert the pivot bolt through the mounting plate and handle. Secure the bolt with the lock washer and nut and tighten to 200 in-lbs.
4. Connect the charging link to the handle with the bolt, lock washer, and nut and tighten to 96 in-lbs.
5. Replace the escutcheon, as described in Section 7–6.

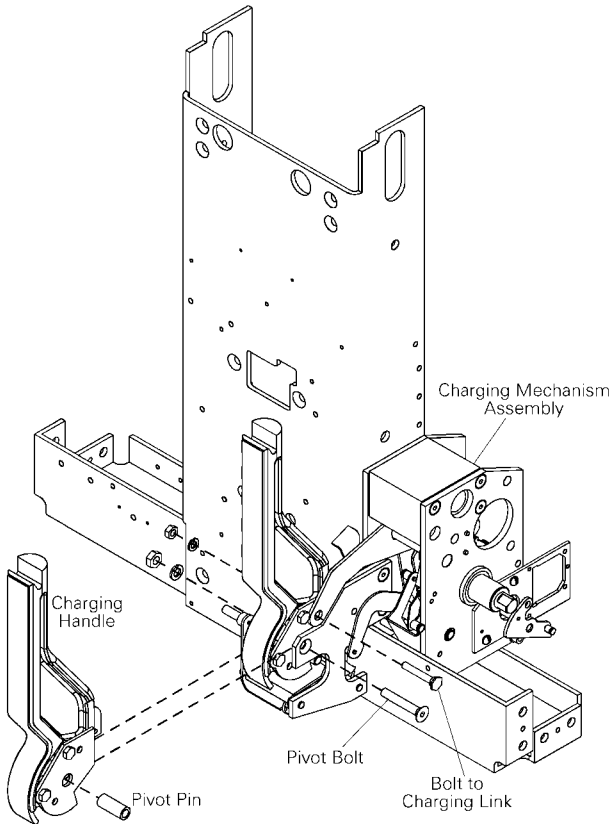


Figure 7-17. Replacing the charging handle.

Removing the Charging Mechanism Assembly

Use the following procedure to remove the charging mechanism assembly for replacement, as illustrated in Figure 7-18.

1. Remove the escutcheon, as described in Section 7–6.
2. Remove the retaining ring connecting the spring discharge interlock to the charging mechanism assembly. Save the retaining ring and washer for reinstallation.
3. Remove the bolt and lock washer from the side of the charging mechanism assembly.
4. Remove the two bolts and lock washers attaching the bottom of the charging mechanism assembly to the frame.
5. Lift off the charging mechanism assembly.
6. If present, remove the remote close, as described in Section 8–6, and the charging motor, as described in Section 8–6.

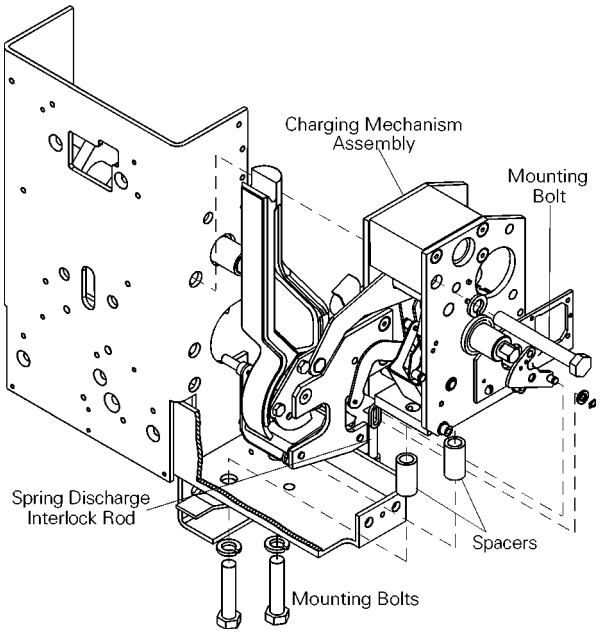


Figure 7-18. Removing or installing the charging mechanism assembly.

Installing the Charging Mechanism Assembly

Use the following procedure to install a replacement charging mechanism assembly, as illustrated in Figure 7-18.

1. Install the remote close and charging motor, if present, onto the replacement charging mechanism assembly.
2. Place the replacement charging mechanism assembly into position on the two spacers and insert the two bolts and lock washers through the bottom of the frame.
3. Insert the side mounting bolt, with lock washer, through the charging mechanism assembly and into the breaker frame.
4. Reconnect the closing link on the charging mechanism assembly to the spring discharge interlock rod with the washer and snap ring removed earlier. If necessary, adjust the length of the rod as illustrated in Figure 7-19 (this figure shows a remote close installed on the charging mechanism).
5. Replace the escutcheon, as described in Section 7–6.

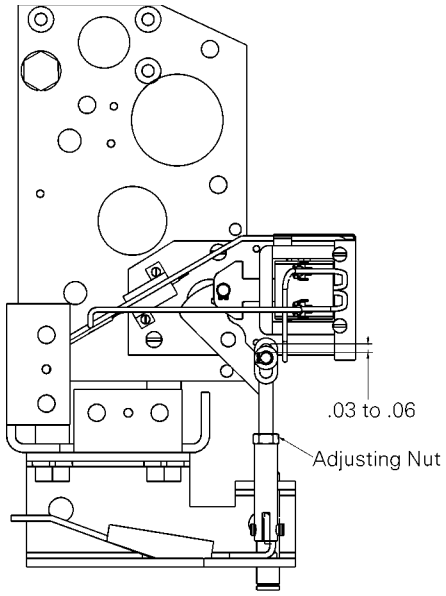


Figure 7-19. Adjusting the closing link connection to the spring discharge interlock rod.

This section describes the removal, replacement, and adjustment of the various accessories available with WavePro breakers.

Before any of the operations in this chapter can be performed, the breaker must be removed from its compartment, as described in Section 5–2, and placed on a suitable work surface.

8–1 Bell Alarm

The bell alarm provides two switches to remotely indicate that the circuit breaker has tripped because of a protection trip. It may be installed in either of two configurations. As a bell alarm with automatic reset, it resets automatically when the breaker is reclosed and can also be reset manually. As a bell alarm with lockout, it can only be reset manually by pressing the target on the breaker escutcheon.

Renewal parts for the bell alarm are a complete kit including mounting hardware, illustrated in Figure 8-1, or the module only.

Contact ratings for the bell alarm are listed in Table 8-1.

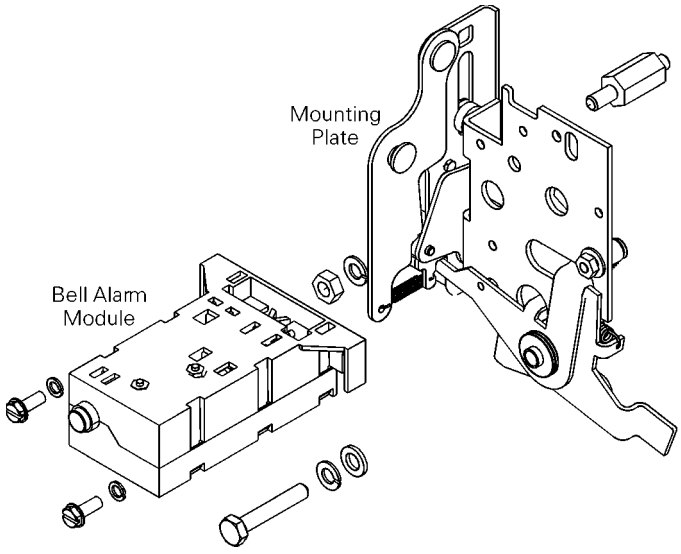


Figure 8-1. Bell alarm accessory kit.

Voltage	Contact Rating, A
125 Vdc	0.50
250 Vdc	0.25
240 Vac	6.0

Table 8-1. Bell alarm contact ratings.

Removing the Bell Alarm

Use the following procedure to remove the bell alarm module and mounting plate, as illustrated in Figure 8-2. If only the bell alarm module is to be replaced, it is not necessary to also remove the mounting plate (stop with step 4).

1. Remove the breaker escutcheon, as described in Section 7–6.
2. Detach the connector with the two wires leading to the trip unit mounting plate.
3. Remove the six bell alarm wires in the secondary disconnect A block, as listed in Table 8-2. Cut the wire ties securing the wire bundle to the breaker frame so that the six wires can be removed with the bell alarm.

Connection	Wire Color	Sec. Disc. Terminal #
Switch 1 NO	green	A14
Switch 1 NC	red	A15
Switch 1 COM	white	A16
Switch 2 NO	blue	A19
Switch 2 NC	yellow	A20
Switch 2 COM	black	A21

Table 8-2. Bell alarm wires and corresponding secondary disconnect terminals.

4. Remove the two screws and washers securing the bell alarm module to the mounting plate and remove the module.
5. Remove the long bolt with two washers that passes through the mounting plate linkage pivot into the breaker frame and the nut and washer that secure the mounting plate to the standoff.
6. Disengage the mounting plate from the breaker mechanism and remove the plate.

Installing the Bell Alarm

Use the following procedure to install the bell alarm mounting plate and module, as illustrated in Figure 8-2. If this is a new installation into a breaker that was not equipped at the factory with a bell alarm, see the installation instructions in DEH–164, supplied with the bell alarm kit. If only the module is to be replaced, begin at step 3.

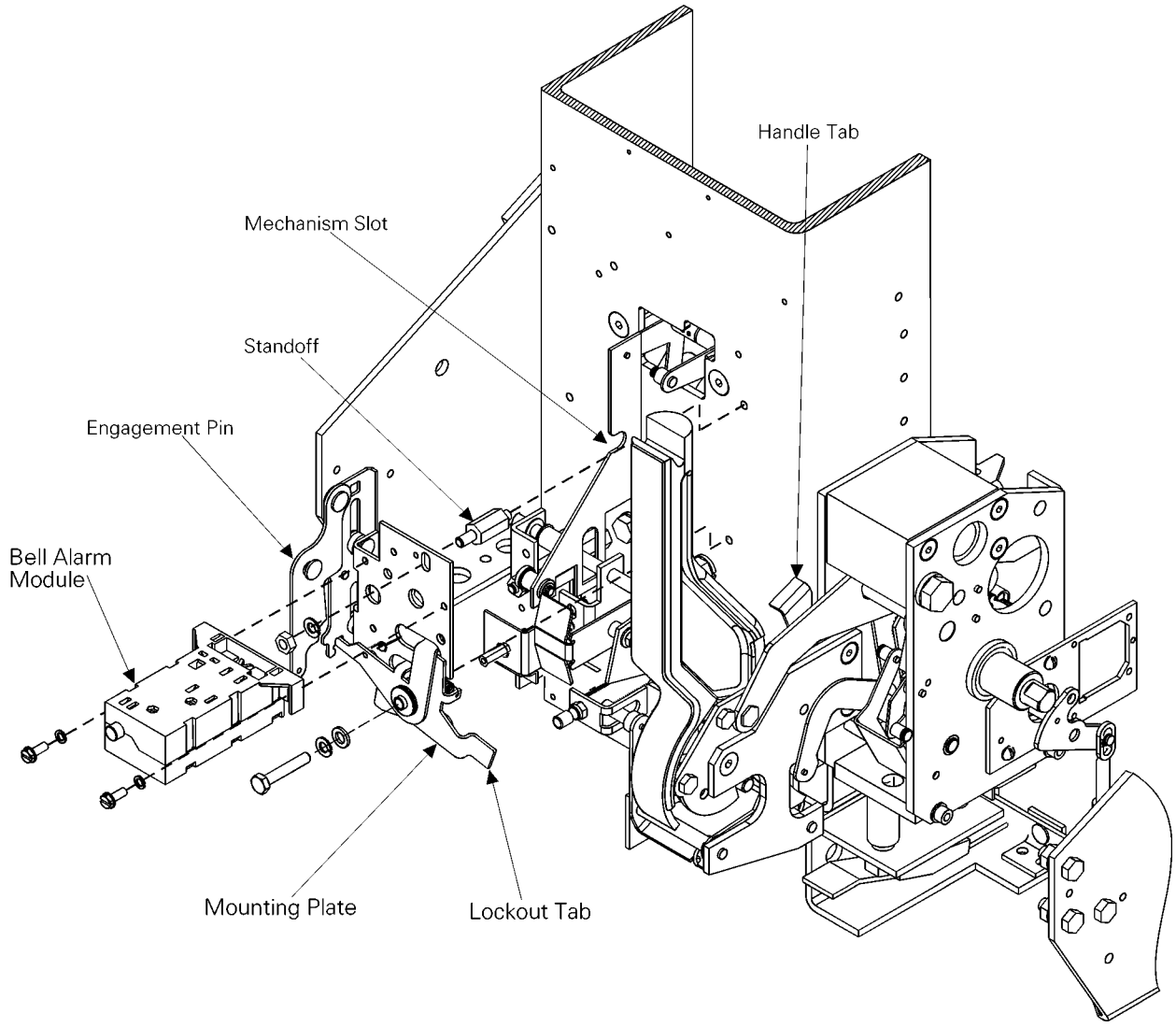


Figure 8-2. Removing and installing the bell alarm module and mounting plate (shown in the lockout position).

1. Place the bell alarm mounting plate over the standoff and secure with a washer and nut. Insert the long bolt, with two washers, through the pivot on the mounting plate and screw it into the tapped hole in the front plate of the breaker. Ensure that the engagement pin on the side of the mounting plate, also shown in the top view in Figure 8-3, fits into the slot in the breaker mechanism.
2. Ensure that the lockout tab is underneath the handle tab.

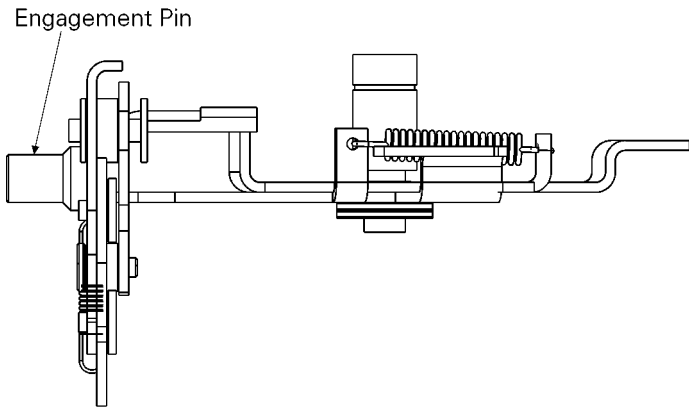


Figure 8-3. Top view of the bell alarm mounting plate, showing the breaker mechanism engagement pin.

3. Line up the Bell Alarm module on the mounting plate, as shown in Figure 8-2, so that the solenoid plunger and locating pin fit in the appropriate holes.
   a. For installation as a bell alarm with automatic reset, the label on the back of the module should appear as in Figure 8-4, with the legend ↑LF RESET horizontal. Attach the module with the two screws and washers provided.
   b. For installation as a bell alarm with lockout, the label on the end of the module should appear as in Figure 8-5, with the legend ↑LF LO horizontal.

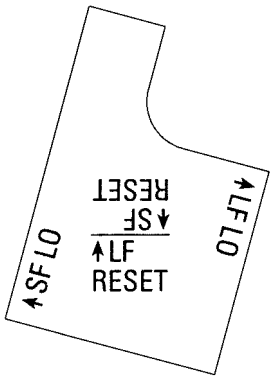


Figure 8-4. Orientation of the label on the bell alarm module for installation as a bell alarm with automatic reset.

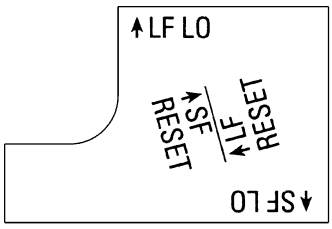


Figure 8-5. Orientation of the label on the bell alarm module for installation as a bell alarm with lockout.

4. Attach the bell alarm module to the mounting bracket with the two screws provided.
5. Attach the connector with two wires to the corresponding connector leading to the trip unit mounting plate.
6. Run the six wires from the bell alarm to the secondary disconnect A block and connect to the terminals listed in Table 8-2. Use wire ties to secure the wire bundle to the breaker frame.
7. Replace the breaker escutcheon, as described in Section 7–6.

8–2 Shunt Trip

The shunt trip allows the breaker to be tripped electrically from a remote location An "A" auxiliary switch, which is closed when the breaker is closed, is in series with the Shunt Trip coil, as illustrated in Figure 8-6. The external tripping source is connected to positions A5 and A7 on the secondary disconnect.

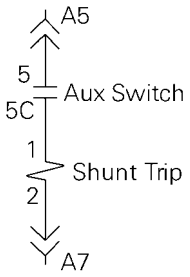


Figure 8-6. Shunt trip connections to the auxiliary switch and secondary disconnect.

Renewal parts for the shunt trip are a complete kit, illustrated in Figure 8-7, and the module only. A second shunt trip is available for 3200 and 4000 A frame breakers only.

Electrical ratings for the shunt trip are listed in Table 8.

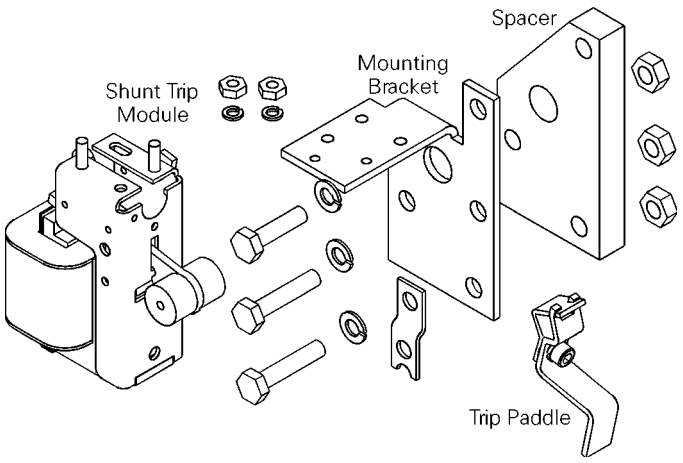


Figure 8-7. Shunt trip accessory kit.

Voltage Rating	Inrush Current, A	Sealed Current, A
70 Vac, 60 Hz	3.8	3.8
120 Vac, 60 Hz	12.3	10.8
208 Vac, 60 Hz	3.2	2.6
240 Vac, 60 Hz	3.9	3.4
120 Vac, 50 Hz	7.6	6.7
208 Vac, 50 Hz	3.8	3.1
240 Vac, 50 Hz	4.7	4.1
24 Vdc	8.3	8.3
48 Vdc	4.5	4.5
125 Vdc	2.0	2.0
250 Vdc	1.0	1.0

Table 8-3. Shunt trip electrical ratings.

Removing the Shunt Trip

Use the following procedure to remove the shunt trip module for replacement, as illustrated in Figure 8-8. The mounting bracket does not normally require replacement.

1. Position the breaker on the work surface so that the left front is accessible.
2. Disconnect the wire at the secondary disconnect A block, terminal A7. Disconnect the other wire from the auxiliary switch, terminal 5C. Bring the wires back to the shunt trip, removing wire ties as necessary.
3. Remove the two nuts and washers securing the shunt trip module to the mounting bracket, then remove the module.

Installing the Shunt Trip

Use the following procedure to install the shunt trip module as a replacement, as illustrated in Figure 8-8. If this is a new installation into a breaker that was not equipped at the factory with a shunt trip, see the installation instructions in DEH–169, supplied with the shunt trip kit.

1. Insert the two mounting studs on the top of the Shunt Trip module into the holes on the top of the mounting bracket and secure with the two lock washers and nuts supplied.

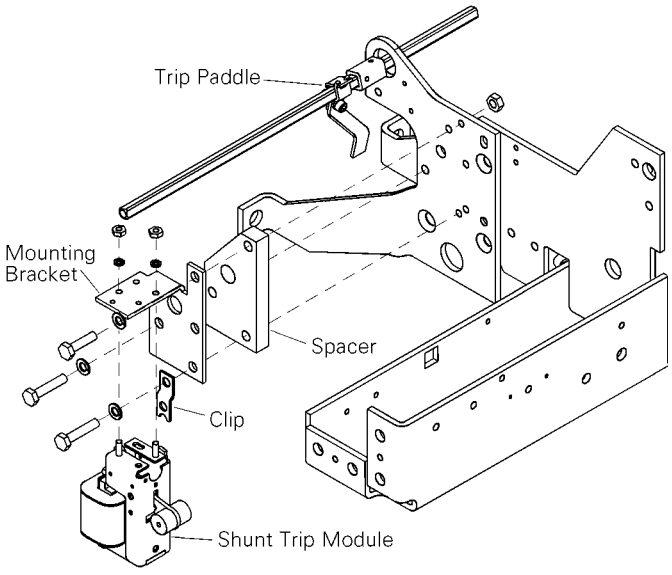


Figure 8-8. Removing and installing the shunt trip.

2. Run one wire from the shunt trip module to the auxiliary switch and connect it to terminal 5C. Run the other wire to the secondary disconnect A block, terminal 7. Cut both wires to the appropriate length and crimp on the terminals provided (the right-angle flag to the auxiliary switch, the spade terminal to the secondary disconnect).
3. Attach the wires to the breaker frame with wire ties as appropriate.
4. Figure 8-9 shows the installed shunt trip in side view. With the breaker mechanism reset, there must be clearance between the trip paddle and armature arm of 0.03 inch minimum. If adjustment is necessary, bend the trip paddle to achieve this distance.

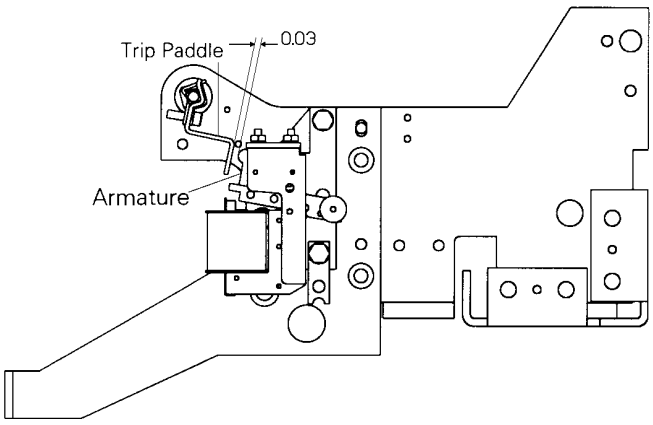


Figure 8-9. Installed shunt trip in side view.

8–3 Undervoltage Trip Device

The undervoltage trip device trips the breaker when its coil is de-energized. The coil leads are connected to terminals A22 and A23 on the secondary disconnect, as illustrated in Figure 8-10.

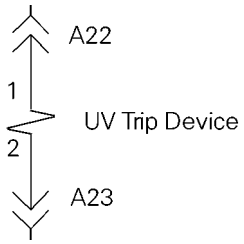


Figure 8-10. Undervoltage trip device connections to the secondary disconnect.

When the applied control voltage is above 85% of the undervoltage trip device's rated voltage, the breaker can be closed. Control voltage must be applied for one second before the breaker can be closed. When the control voltage drops to 30–60% (nonadjustable) of the rated value, the undervoltage trip device will trip the breaker.

The accessory is also available as the undervoltage trip device with time delay, consisting of an instantaneous undervoltage trip device with a separately mounted time-delay unit. The time-delay unit prevents the breaker from tripping on a momentary voltage drop in the monitored source.

Renewal parts for the undervoltage trip device are a complete kit including mounting hardware, illustrated in Figure 8-11, or the module only. The time delay unit is available separately or with the undervoltage trip device.

Electrical ratings for the undervoltage trip device are listed in Table 8-4.

Voltage Rating	Holding Current, A
120 Vac	0.15
240 Vac	0.07
24 Vdc	0.58
48 Vdc	0.32
125 Vdc	0.15
250 Vdc	0.07

Table 8-4. Electrical ratings for the undervoltage trip device.

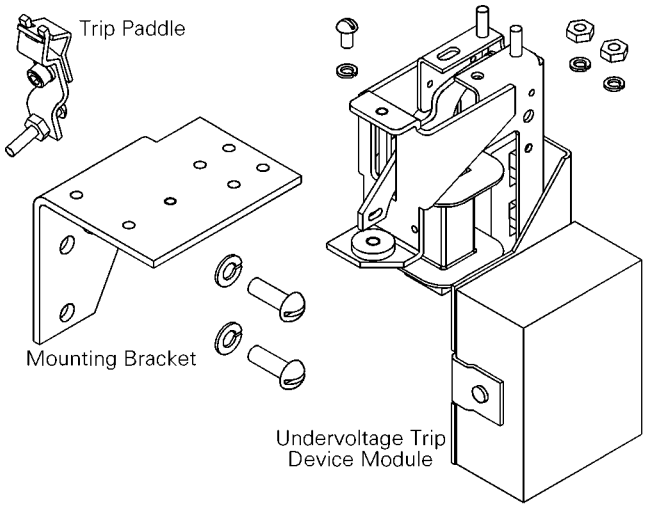


Figure 8-11. Undervoltage trip device accessory kit.

Removing the Undervoltage Trip Device

Use the following procedure to remove the undervoltage trip device for replacement, as illustrated in Figure 8-12. The mounting bracket does not normally require replacement.

1. Carefully place the breaker on a suitable working surface, resting on the primary disconnects, so that the bottom of the breaker is accessible.
2. Remove the screw and lock washer and the two nuts and lock washers from the top of the mounting bracket. Disengage the two studs in the undervoltage trip device module from the mounting bracket.
3. Disconnect the two wires leading to the secondary disconnect from the terminals in the side of the undervoltage trip device module.

Installing the Undervoltage Trip Device

Use the following procedure to install the undervoltage trip device module as a replacement, as illustrated in Figure 8-12. If this is a new installation into a breaker that was not equipped at the factory with an undervoltage trip device, see the installation instructions in DEH–166, supplied with the undervoltage trip device kit.

1. Connect the two wires leading to the secondary disconnect to the terminals in the side of the undervoltage trip device module.

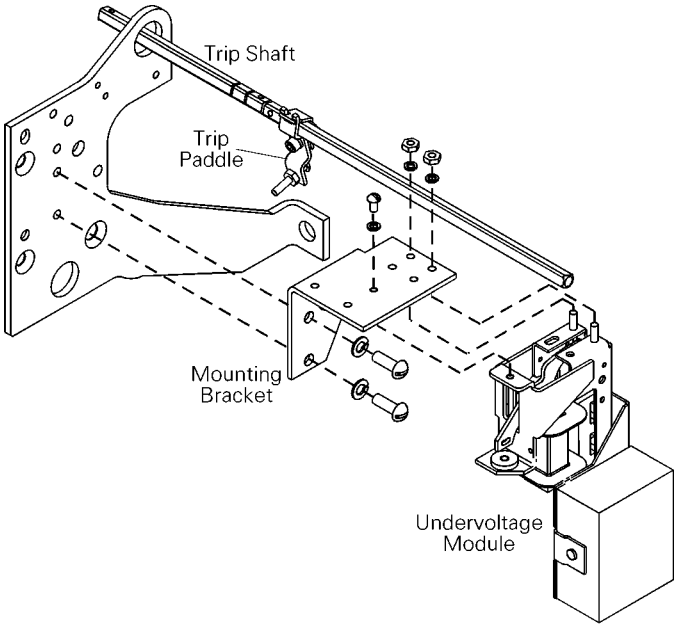


Figure 8-12. Removing or installing the undervoltage trip device.

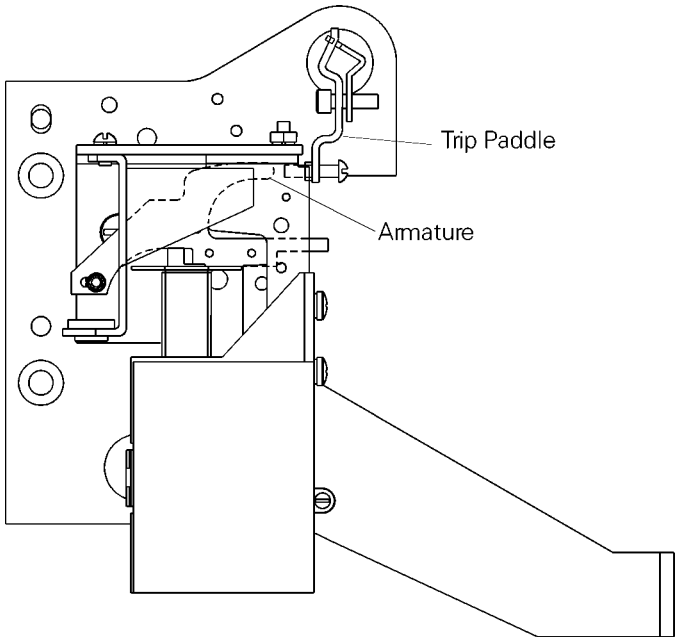


Figure 8-13. Side view of the installed undervoltage trip device.

2. Insert the two mounting studs on the top of the undervoltage trip device module into the holes in the mounting bracket and secure with the supplied lock washers and nuts. Insert and tighten the other screw and lock washer through the bracket and into the tapped hole in the module.
3. The adjusting screw in the trip paddle must line up with the undervoltage trip device armature striker plate. Figure 8-13 shows the installed undervoltage trip device in side view. If necessary, adjust the position of the trip paddle so that it is properly aligned.
4. Adjust the undervoltage trip device as follows:
   a. Manually charge the breaker closing springs and press the CLOSE button to close the breaker.
   b. Turn the adjusting screw on the trip paddle clockwise until the breaker trips.
   c. Turn the adjusting screw an additional one-half turn clockwise.

8–4 Electric Lockout

The electric lockout uses a coil similar to the undervoltage trip device to keep the breaker from closing unless the coil is energized. The breaker thus cannot be closed unless control voltage is applied; however, loss of control voltage will not trip the breaker. For example, two breakers can be interlocked so that both they cannot be closed at the same time.

The electric lockout coil is connected to terminals A22 and A23 on the secondary disconnect, as illustrated in Figure 8-14.

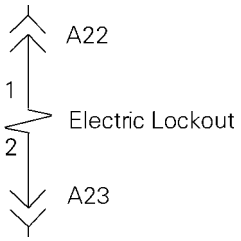


Figure 8-14. Electric lockout connections to the secondary disconnect.

When the electric lockout coil is de-energized, an open breaker is held trip free. When the breaker is closed, the breaker cam operates the lockout mechanism, holding the lockout armature closed to prevent tripping the breaker if the electric lockout coil is de-energized.

A mechanical bypass is provided to permit cold startup when control power is not available. The pull knob is located under the front of the breaker frame.

Renewal parts for the electric lockout are a complete kit including mounting hardware, illustrated in Figure 8-15, and the module only.

Electrical ratings for the electric lockout are the same as for the undervoltage trip device, listed in Table 8-4.

Removing the Electric Lockout

Use the following procedure to remove the electric lockout module for replacement, as illustrated in Figure 8-16. The mounting bracket and lockout mechanism do not normally need replacement.

1. Carefully place the breaker on a suitable working surface, resting on the primary disconnects, so that the bottom of the breaker is accessible.

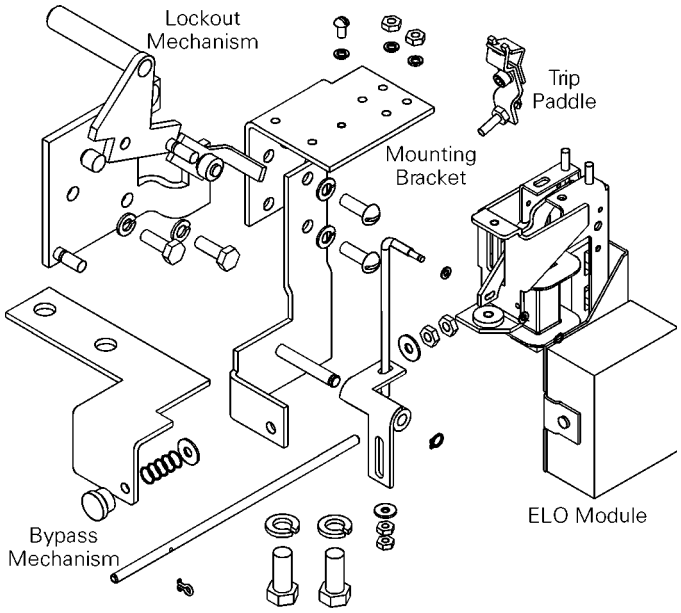


Figure 8-15. Electric lockout accessory kit.

2. Remove the spring clip and flat washer connecting the bypass actuator rod to the electric lockout module.
3. Remove the screw and lock washer and two nuts and lock washers attaching the electric lockout module to the mounting bracket. Disengage the two studs on the top of the module from the mounting bracket.
4. Disconnect the two wires leading to the secondary disconnect from the terminals in the side of the electric lockout module.

Installing the Electric Lockout

Use the following procedure to install the electric lockout module as a replacement, as illustrated in Figure 8-16. If this is a new installation into a breaker that was not equipped at the factory with an electric lockout, see the installation instructions in DEH–171, supplied with the electric lockout kit.

1. Connect the two wires leading to the secondary disconnect to the terminals in the side of the electric lockout module.
2. Insert the two mounting studs on the top of the electric lockout module into the holes in the mounting bracket and secure with the supplied lock washers and nuts. Insert and tighten the other screw and lock washer through the bracket and into the tapped hole in the module.

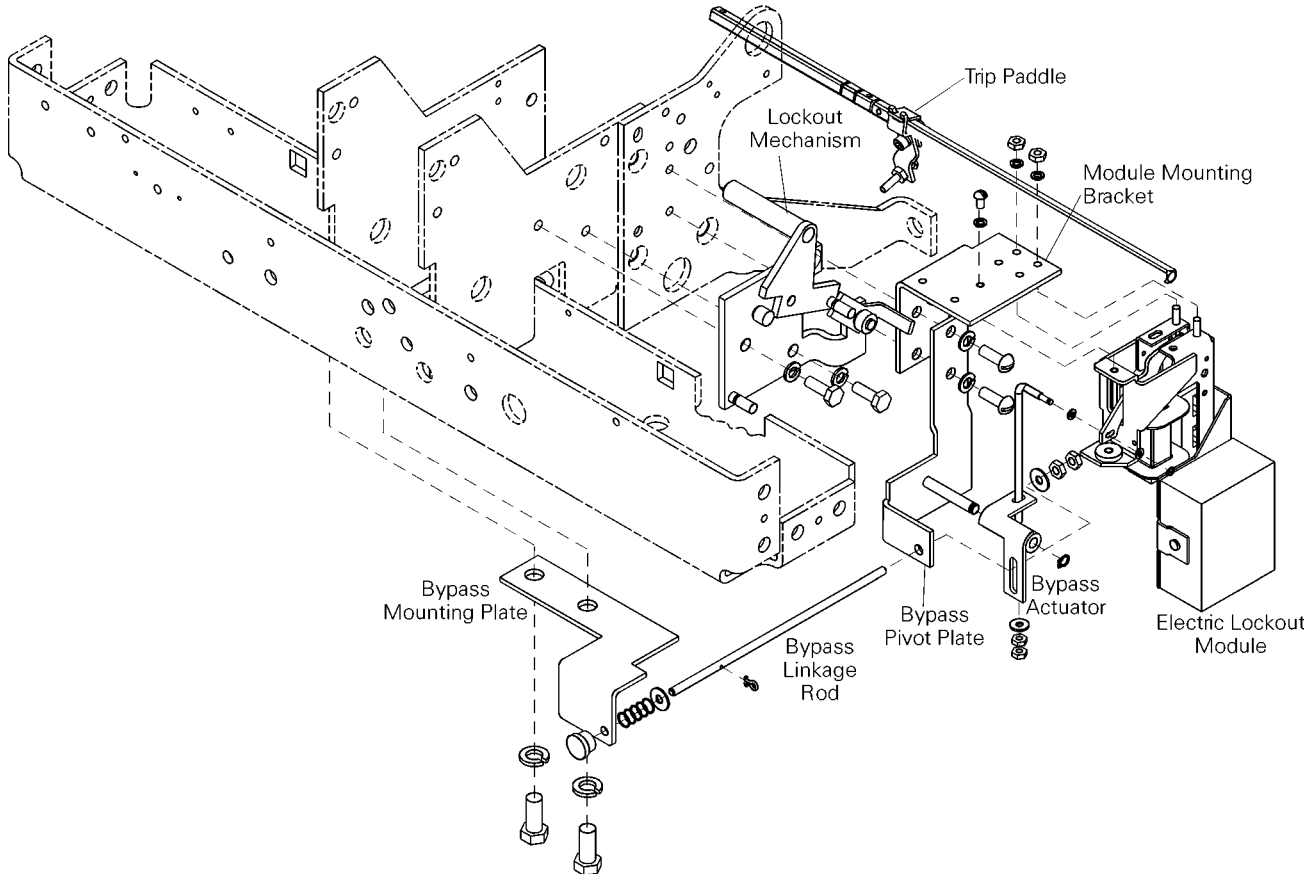


Figure 8-16. Removing or installing the electric lockout accessory.

3. Slide the end of the bypass actuator rod through the hole in the armature of the electric lockout module and secure with the two flat washers and spring clip.
4. The adjusting screw in the trip paddle must line up with the electric lockout tripping arm. Figure 8-17 shows the installed electric lockout in side view. If necessary, adjust the position of the trip paddle so that it is properly aligned.
5. Adjust the electric lockout mechanism as follows:
   a. Adjust the lock nuts on the bypass linkage and actuator rods, as shown in Figure 8-17, to obtain maximum travel of the lockout tripping arm.
   b. Pull the bypass knob out to the end of its travel. Turn the trip paddle adjusting screw for a clearance between the screw and the lockout tripping arm of 0.06 to 0.09 inch.

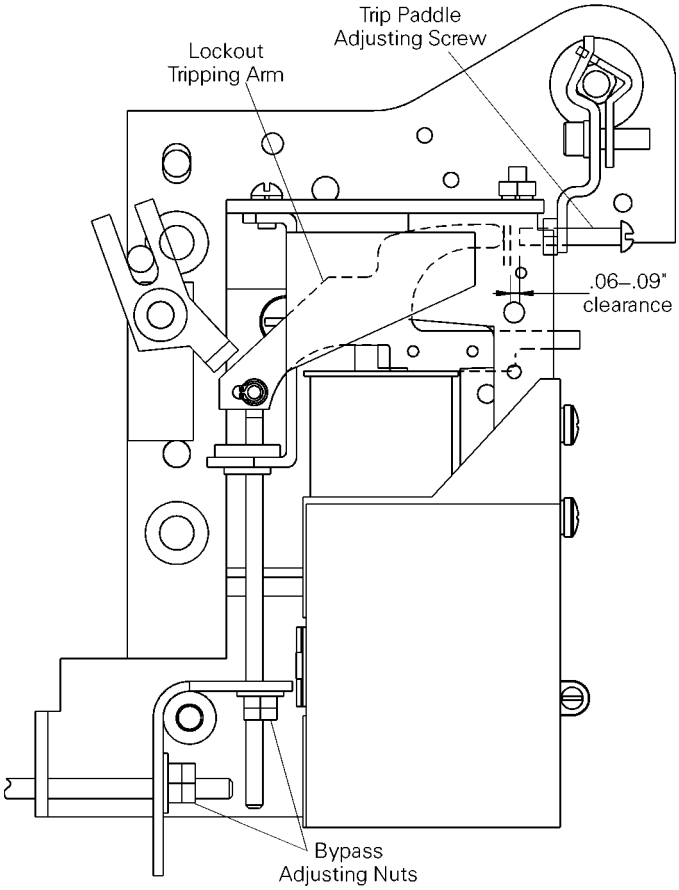


Figure 8-17. Side view of the installed electric lockout.

8–5 Charging Motor

The charging motor provides a means of electrically charging the springs that close the breaker. The charging motor is available only as a factory-installed option. A remote close accessory, auxiliary switch module, and shunt trip are always provided on a breaker equipped with a charging motor.

The circuit breaker closing springs are charged automatically when control voltage is applied to terminals A8 and A17 of the secondary disconnects. When the springs are fully charged, a cutoff switch automatically de-energizes the motor. The closing springs will recharge automatically after the breaker closes unless an external switch contact is wired into the spring charging circuit.

Renewal parts for the charging motor are the motor and the cut-off switch module, illustrated in Figure 8-18.

Electrical characteristics of the charging motor are listed in Table 8-5.

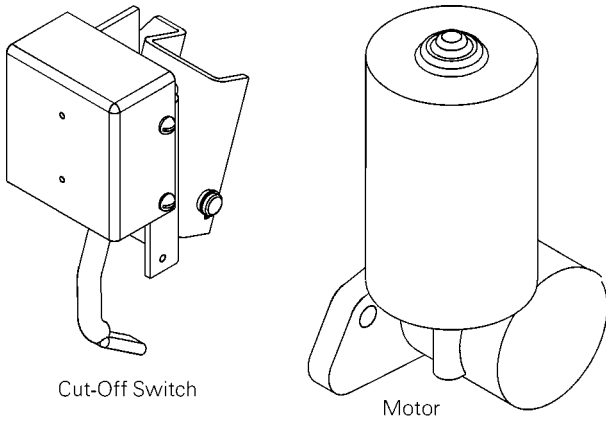


Figure 8-18. Charging motor and motor cut-off switch.

Nominal Control Voltage	Voltage Range	Inrush Current, A	Sustained Current, A
48 Vdc	38–56	22	16.5
125 Vdc	100–140	25	7
250 Vdc	200–280	13	3
120 Vac	104–127	25	8
240 Vac	208–254	12	3.5

Table 8-5. Charging motor electrical characteristics.

Removing the Charging Motor

Use the following procedure to remove the charging motor for replacement, as illustrated in Figure 8-19.

1. Position the breaker on the work surface so that the right front is accessible.
2. Remove the breaker escutcheon, as described in Section 7–6.
3. Disconnect the motor wires at the cutoff switch and secondary disconnect.
4. Remove the three mounting bolts and lock washers securing the motor to the charging mechanism.
5. Remove the motor.

Installing the Charging Motor

Use the following procedure to install a replacement motor, as illustrated in Figure 8-19.

1. Place the motor in position on the charging mechanism and insert the three mounting bolts and lock washers. Tighten the bolts to 360 in-lb.
2. Re-connect the motor wires to the cutoff switch and secondary disconnect.
3. Replace the escutcheon, as described in Section 7–6.

Removing the Motor Cut-Off Switch

Use the following procedure to remove the motor cut-off switch, as illustrated in Figure 8-19.

1. Carefully position the breaker on the work surface so that the right front is accessible.
2. Remove the breaker escutcheon, as described in Section 7–6.
3. Disconnect the wires at the screw terminals on the switch.
4. Remove the three mounting bolts and lock washers securing the switch to the right side of the breaker frame. Note that the bottom bolt is longer than the other two and is placed through a spacer.
5. Remove the cut-off switch.

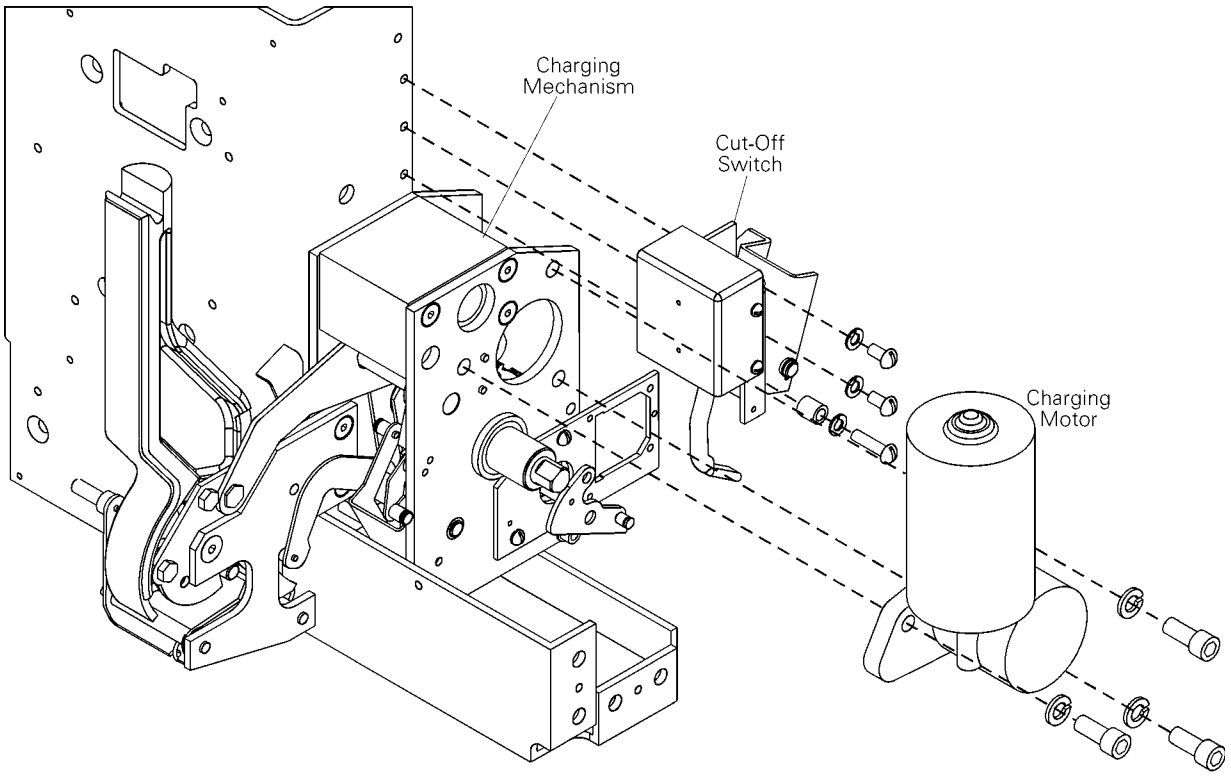


Figure 8-19. Removal and installation of the charging motor and cut-off switch.

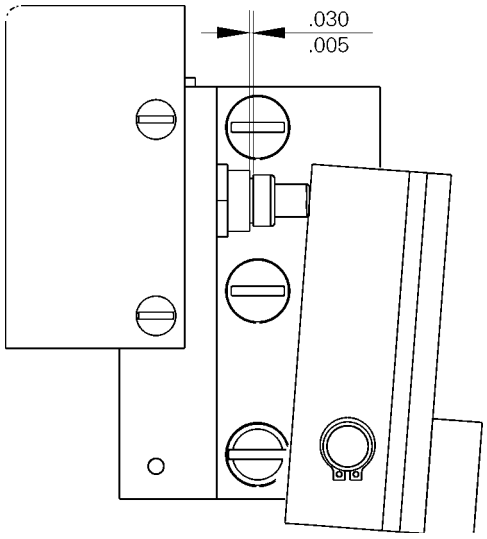


Figure 8-20. Motor cut-off switch adjustment.

Installing the Motor Cut-Off Switch

Use the following procedure to install a replacement motor cut-off switch, as illustrated in Figure 8-19.

1. Place the cut-off switch in position on the right side of the breaker frame. Insert the three bolts and lock washers. Note that the bottom bolt is longer than the other two and is inserted through a spacer. Tighten the bolts to 96 in-lb.
2. Connect the wires at the screw terminals on the switch.
3. Adjust the cut-off switch as illustrated in Figure 8-20:
   a. Charge the closing springs with the manual charging handle.
   b. The main stem of each switch should be located between 0.005 and 0.030 inch from the threaded barrel.
   c. If necessary, adjust the switch depression by loosening the switch mounting nuts and moving the switch in or out of its mounting bracket. Re-tighten the mounting nuts.
4. Replace the escutcheon, as described in Section 7–6.

8–6 Remote Close

The remote close accessory provides a means of remotely closing the circuit breaker after the closing springs have been charged. It is always provided when a charging motor is ordered, but may be installed in a manually operated breaker.

A circuit breaker equipped with the remote close accessory can be closed remotely by applying the rated control voltage to terminals A9 and A18 of the secondary disconnects.

The remote close accessory is continuously rated and has an antipump feature that prevents a motor-operated breaker from repeatedly closing if the closing signal is maintained. The closing control voltage must be removed for 1–2.5 seconds and then reapplied for each breaker closure.

Renewal parts for the remote close are the complete kit, illustrated in Figure 8-21, the circuit board, and the solenoid.

Electrical characteristics of the remote close are listed in Table 8-6.

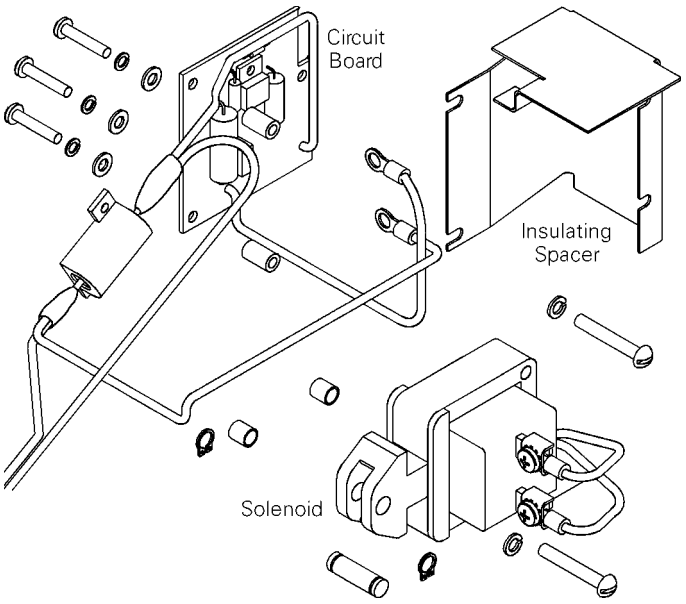


Figure 8-21. Remote close accessory kit.

Removing the Remote Close

Use the following procedure to remove the remote close solenoid and circuit board for replacement, as illustrated in Figure 8-22. If only the solenoid or circuit board is to be replaced, it is not necessary to remove both components.

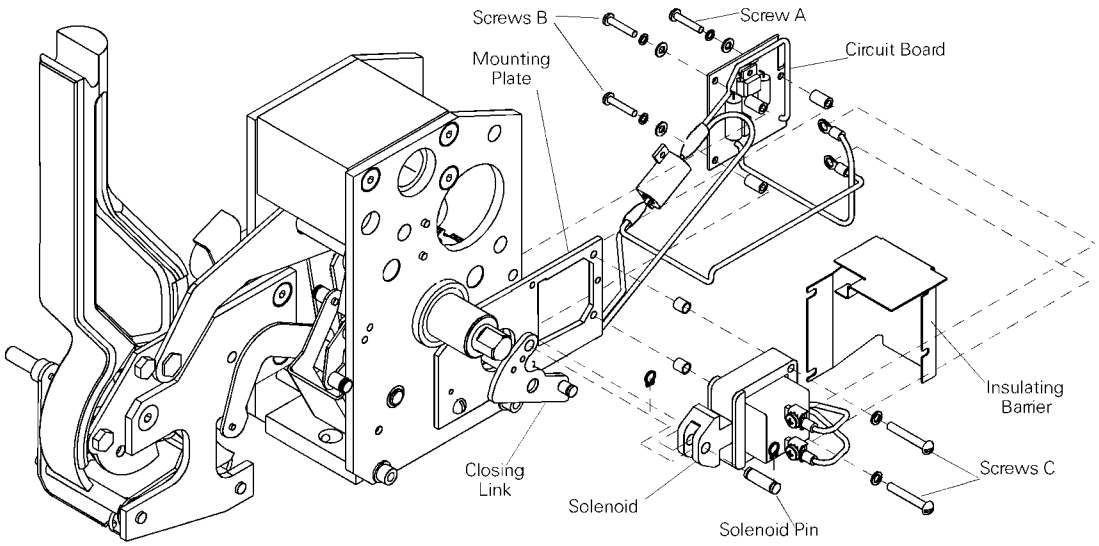


Figure 8-22. Removal or installation of the remote close accessory.

Nominal Control Voltage	Minimum Pickup Voltage	Inrush Current, A	Sealed Current, A
48 Vdc	38	2.7	2.7
125 Vdc	100	1.3	1.3
240 Vdc	200	0.68	0.68
120 Vac, 60 Hz	98	2.6	0.35
120 Vac, 50 Hz	98	2.2	0.29
240 Vac, 60 Hz	196	1.3	0.17
240 Vac, 50 Hz	196	1.1	0.15

Table 8-6. Remote close electrical characteristics.

1. Carefully place the breaker on a suitable working surface, so that the right front of the breaker is accessible.
2. If the circuit board is to be replaced, disconnect the two remote close wires at terminals 9 and 18 of the secondary disconnect A block. Cut the wire ties, as needed, so that the wires can be removed with the circuit board.
3. Remove the two screws and lock washers securing the resistor to the mounting plate, as illustrated in Figure 8-23. Two access holes in the side plate, indicated in Figure 8-24, may be useful for inserting a screw driver to loosen the screws.
4. Disconnect the two leads from the circuit board to the solenoid.
6. Remove one of the snap rings from the pin connecting the solenoid to the closing link on the charging mechanism, then slide out the pin to disconnect the solenoid from the charging mechanism.

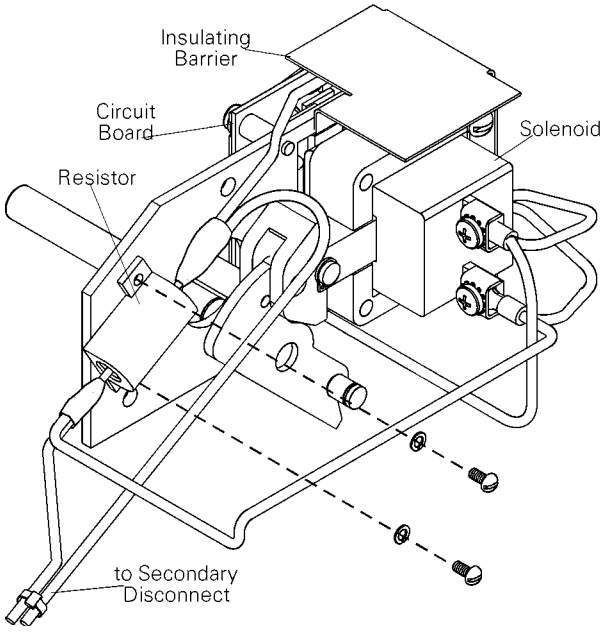


Figure 8-23. Attaching or removing the resistor.

7. Remove the two screws C, lock washers, and spacers attaching the solenoid to the mounting plate, then remove the solenoid. Two access holes in the side plate, indicated in Figure 8-24, may be useful for inserting a screw driver to loosen screws C.
8. Carefully place the breaker on its back surface, supported on the primary disconnects.
9. Disconnect and remove the opening spring from the right pole, as illustrated in Figure 5-5.

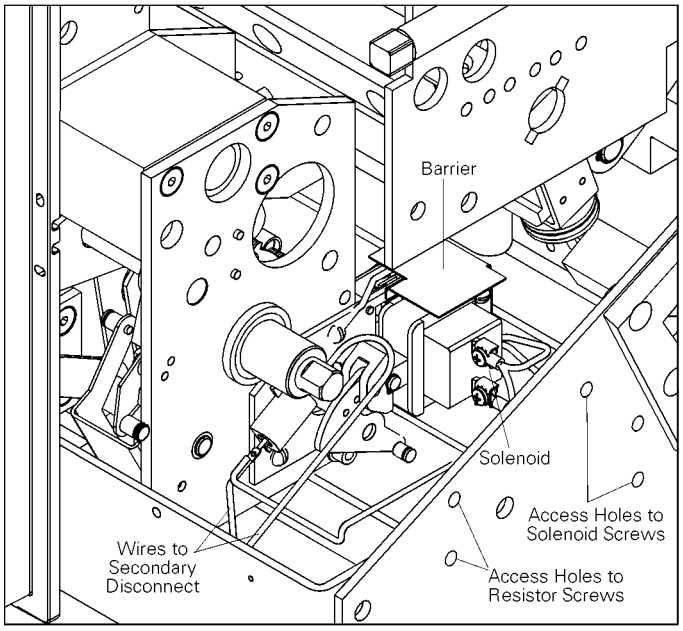


Figure 8-24. Remote close installed in the breaker, showing the locations of access holes in the breaker side plate.

10. Working from the bottom of the breaker, loosen screws B attaching the insulating spacer to the circuit board, then slide out the spacer.
11. Remove screws A and B with their lock washers, flat washers, and spacers. Remove the circuit board from the mounting plate.

Installing the Remote Close

Use the following procedure to install a replacement remote close solenoid and circuit board, as illustrated in Figure 8-22. If this is a new installation into a breaker that was not equipped at the factory with a remote close, see the installation instructions in DEH–173, supplied with the remote close kit. (The circuit breaker should be resting on the primary disconnects with the right pole opening spring removed, as in the removal procedure above.)

1. Attach the circuit board to the rear of the mounting plate with the three screws, flat washers, lock washers, and spacers. Tighten screw A, but leave screws B loose.
2. Place the insulating barrier over the circuit board so that the two slots on the edge slide underneath the heads and washers of screws B. Tighten screws B.
3. Reconnect the opening spring on the right pole and place the breaker upright on its bottom surface for the rest of the installation.
4. Slide the solenoid underneath the insulating barrier, then attach with two screws C and lock washers though the slots in the barrier, with the two spacers between the solenoid and the mounting plate. Two access holes in the side plate, indicated in Figure 8-24, may be useful for inserting a screw driver to tighten screws C. Slide the tab on top of the barrier into the window in the mounting plate.
5. Attach the resistor to the mounting plate with the two screws and lock washers provided, as shown in Figure 8-23. Two access holes in the side plate, indicated in Figure 8-24, may be useful for inserting a screw driver to tighten the two screws.
6. Slide one of the snap rings onto the solenoid pin, connect the solenoid closing mechanism to the upper hole on the closing mechanism with the pin, then attach the other snap ring.
6. Connect the two leads with circular lugs from the circuit board to the solenoid screw connectors, as shown in Figure 8-24.
7. Run the wires from the remote close to the secondary disconnect A block and attach to terminals 9 and 18. Attach the wires to the breaker frame with wire ties as needed.

8–7 Auxiliary Switch

Auxiliary switches provide remote indication of the breaker main contact position and are available in with four or seven stages. Each auxiliary switch stage provides two contacts that can be used to indicate breaker main contact position. The A contact is open or closed the same as the breaker, while the B contact is opposite to the breaker contacts. Odd-numbered switches are A type and even-numbered switches are B type.

The auxiliary switch is available as a kit including all mounting hardware, as illustrated in Figure 8-25.

The auxiliary switch contact ratings are listed in Table 8-7.

Auxiliary switch connections to the secondary disconnect are listed in Table 8-8.

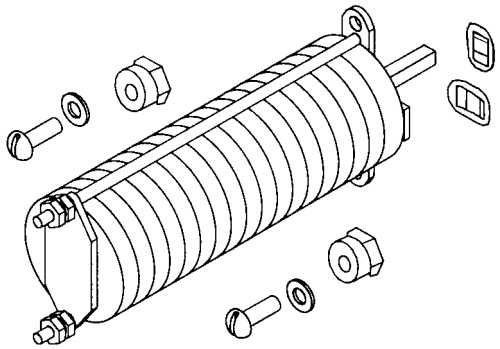


Figure 8-25 Auxiliary switch kit.

Voltage	Rating
120 Vac	15 A
240 Vac	10 A
480 Vac	5 A
125 Vdc	10 A
250 Vdc	5 A
120/240 Vac	1□2 hp

Table 8-7. Auxiliary switch contact ratings.

Removing the Auxiliary Switch

Use the following procedure to remove an auxiliary switch, as illustrated in Figure 8-26.

1. Carefully position the breaker on the work surface so that the left front is accessible.
2. Disconnect the wires at the terminals on the auxiliary switch, carefully marking them for reinstallation on the replacement switch.

Auxiliary Switch Contact	Secondary Disc. Terminal #
1 (NO)	A10
1C	A1
2 (NC)	A11
2C	A2
3 (NO)	A12
3C	A3
4 (NC)	A13
4C	A4
5 (NO)	A5
6 (NC)	A6
6C	A7
9 (NO)	C10
9C	C1
10 (NC)	C11
10C	C2
11 (NO)	C12
11C	C3
12 (NC)	C13
12C	C4
13 (NO)	C14
13C	C5
14 (NC)	C15
14C	C6

Table 8-8. Auxiliary switch connections to the secondary disconnect.

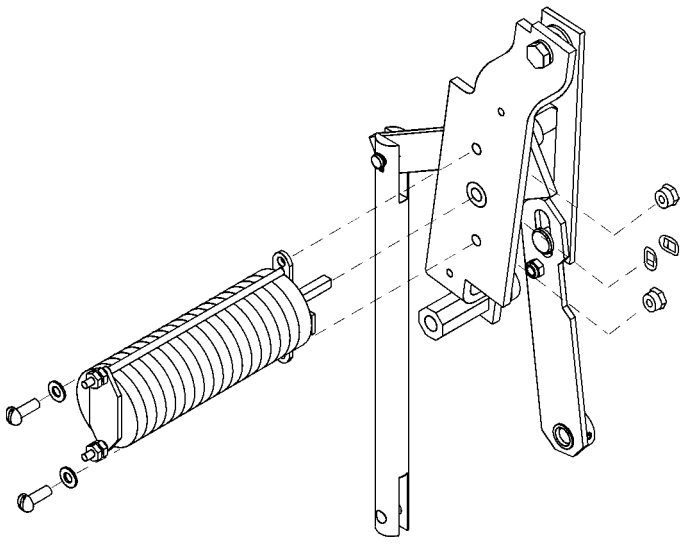


Figure 8-26. Removal or installation of the auxiliary switch.

3. Remove the two spring clips from the end of the auxiliary switch center shaft. Remove the two screws, lock washers, and nuts securing the auxiliary switch to the mounting plate and remove the switch.

Installing the Auxiliary Switch

Use the following procedure to install a replacement auxiliary switch. If this is a new installation into a breaker that was not equipped at the factory with an auxiliary switch, see the installation instructions in DEH–189, supplied with the auxiliary switch kit.

1. Insert the auxiliary switch into the breaker linkage as shown in Figure 8-26, so that the shaft forms the pivot for the linkage. The auxiliary switch must be aligned as shown in Figure 8-27, with the line scribed into the end of the shaft vertical and contacts 1 and 1C as shown. Verify that the breaker is OPEN during this alignment.
2. Attach the two spring clips over the end of the shaft. The spring clips should be installed 90° degrees from each other. Secure the auxiliary switch with the two screws, flat washers, and nuts supplied, as shown in Figure 8-26. Figure 8-28 is a view of the installed auxiliary switch from the front of the breaker.
3. Connect the wires to the new auxiliary switch, ensuring that they are connected to the proper terminals.
4. Close and trip the breaker to verify operation of the auxiliary switch. Check the status of contacts 1–1C and 2–2C with the breaker open and closed.

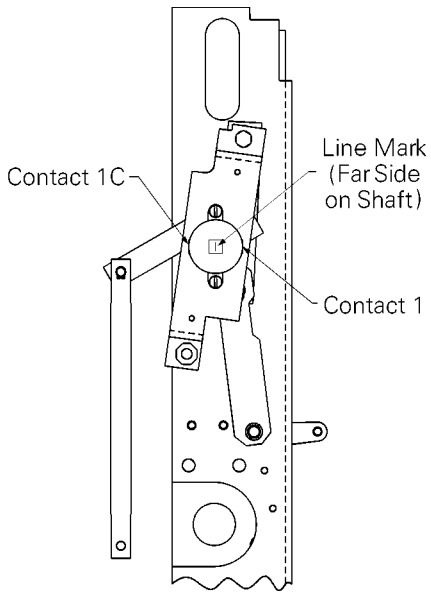


Figure 8-27. Auxiliary switch aligned and installed on the breaker.

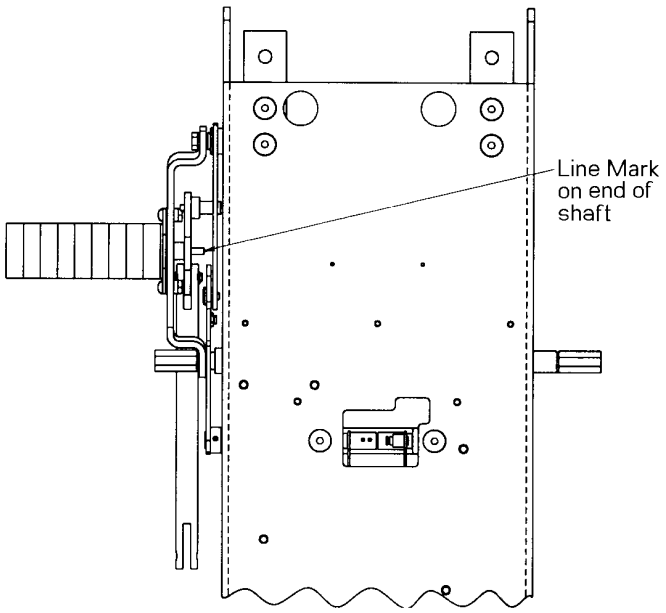


Figure 8-28. Front view of the installed auxiliary switch.

8–8 Open-Fuse Lockout

The open-fuse lockout, illustrated in Figure 8-29, is used in combination with a fuse rollout element. When any fuse blows, the open-fuse lockout trips the breaker to prevent single-phasing. This accessory is available only as a factory-installed option.

The open-fuse lockout contains an individual trip solenoid for each pole, connected directly across the fuse in that phase. When any fuse blows, its solenoid is energized through connections to the secondary disconnect, illustrated in Figure 8-30, and trips the breaker. An indicator shows which fuse has blown. The breaker cannot be reclosed until the reset button is pressed on the open-fuse lockout.

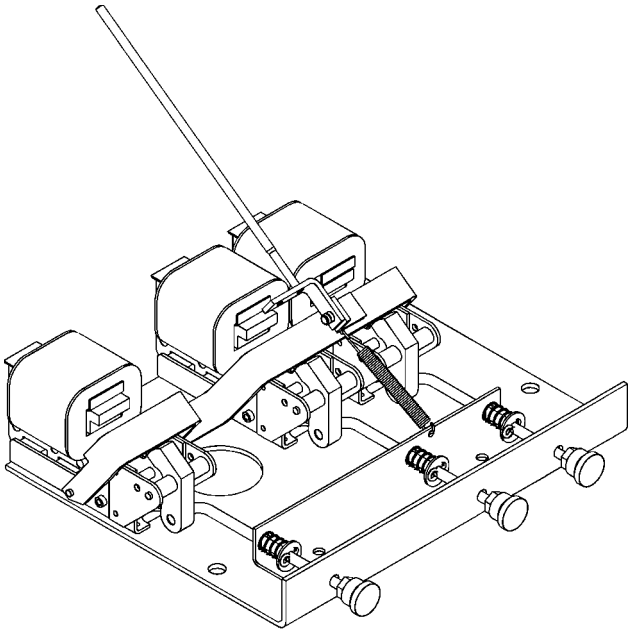


Figure 8-29. Open-fuse lockout accessory.

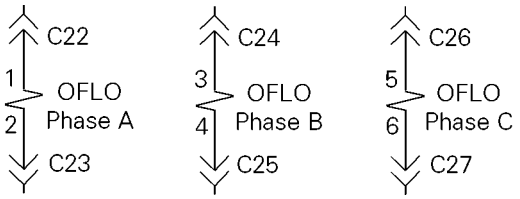


Figure 8-30. Open-fuse lockout connections to the secondary disconnect.

Removing the Open-Fuse Lockout

Use the following procedure to remove the open-fuse lockout device.

1. Disconnect the wires from the open-fuse lockout at terminals 22, 23, 24, 25, 26, and 27 of the secondary disconnect C block. Cut any wire ties, as necessary to release the wires back to the open-fuse lockout.
2. Remove the five bolts securing the open-fuse lockout to the side plate and front frame of the breaker.
3. Lower the open-fuse lockout, guiding the trip rod through the trip rod guide on the mounting bracket, as shown in Figure 8-31.

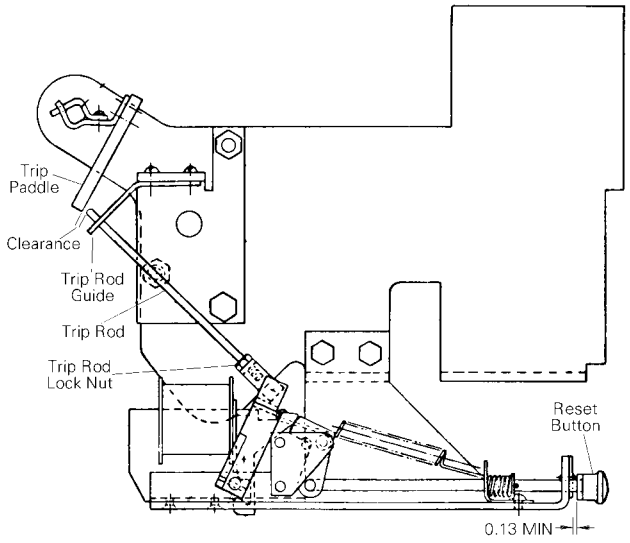


Figure 8-31. Open-fuse lockout adjustments, side view.

Installing the Open-Fuse Lockout

Use the following procedure to install a replacement open-fuse lockout.

1. Move the replacement open-fuse lockout into position, carefully guiding the trip rod through the hole in the trip rod guide on the mounting bracket.
2. Insert the five bolts to secure the open-fuse lockout to the breaker side plate and front frame. Tighten to 96 in-lb.
3. Connect the wires from the coils on the open-fuse lockout to the secondary disconnect C block as follows:
   - Phase A to terminals 22 and 23.
   - Phase B to terminals 24 and 25.
   - Phase C to terminals 26 and 27.

4. Armature overtravel of 0.03–0.06 inch is required when the breaker is tripped. Adjust armature overtravel as follows:
   a. Charge the closing springs to put the breaker in the reset position.
   b. Loosen the trip rod lock nut and turn the rod in or out to give a 0.13-inch clearance between the trip paddle and the end of the trip rod, as shown in Figure 8-31.
   c. Retighten the trip rod lock nut.
5. Clearance of 0.13 inch should be maintained at the reset knob, as shown in Figure 8-31. To adjust this clearance, loosen the lock nut at the button and turn the button in until the proper distance is achieved. Retighten the lock nut.

8–9 Remote Charge-Indication Switch

The remote charge-indication switch, illustrated in Figure 8-32, allows remote monitoring of the state of the closing springs on breakers equipped with a charging motor. When the springs are charged, terminals 8 and 17 at the C secondary disconnect are shorted and are open when the springs are discharged.

Removing the Remote Charge Indication Switch

Use the following procedure to remove the remote charge indication switch for replacement, as illustrated in Figure 8-33.

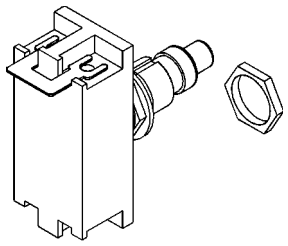


Figure 8-32. Remote charge-indication switch.

1. Carefully position the breaker on the work surface so that the right front is accessible.
2. Remove the escutcheon, as described in Section 7–6.
3. Remove the two screws and lock washers securing the cover over the remote-charge indication switch and the motor cut-off switch and lift off the cover.
4. Disconnect the two wires on the screw terminals on the remote-charge indication switch.
5. Remove the nut securing the switch to the mounting bracket and remove the switch.

Installing the Remote Charge Indication Switch

Use the following procedure to install a replacement remote charge indication switch, as illustrated in Figure 8-33.

1. Insert the button end of the switch into the hole in the mounting bracket and secure with the nut on the threaded shaft.
2. Attach the two wires to the screw terminals on the switch.
3. Adjust the switch as illustrated in Figure 8-20:
   a. Charge the closing springs with the manual charging handle.
   b. The main stem of the switch should be located

between 0.005 and 0.030 inch from the threaded barrel.

c. If necessary, adjust the switch depression by loosening the switch mounting nuts and moving the switch in or out of its mounting bracket. Re-tighten the mounting nuts.

4. Place the cover over the switches and secure to the mounting bracket with the two screws and lock washers.

5. Replace the escutcheon, as described in Section 7–6.

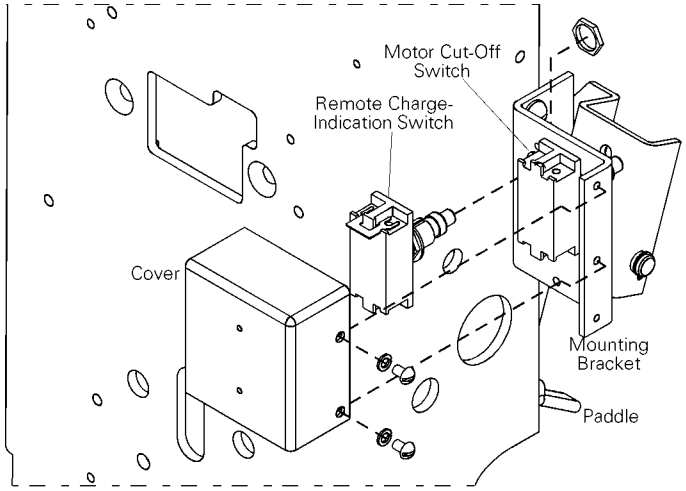


Figure 8-33. Removal or installation of the remote charge-indication switch.

A–1 Breaker Retaining Hardware

The retaining hardware items listed in Table A-1 are available in packages of 100. Order by the catalog number listed.

Shaft Size, in.	Squeeze Rings	Retaining Rings	Retaining Clip
0.187	10081394G5	10081394G9	—
0.250	10081394G3	10081394G10	—
0.312	10081394G2	—	—
0.375	10081394G1	10081394G11	—
0.438	10081394G7	—	—
0.500	10081394G6	10081394G12	—
0.625	10081394G4	—	—
0.875	—	10081394G13	—
1.000	—	10081394G14	—
1.250	—	10081394G15	—
Aux Switch	—	—	10081394G8

Table A-1. Catalog numbers of retaining hardware available for WavePro breakers.



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