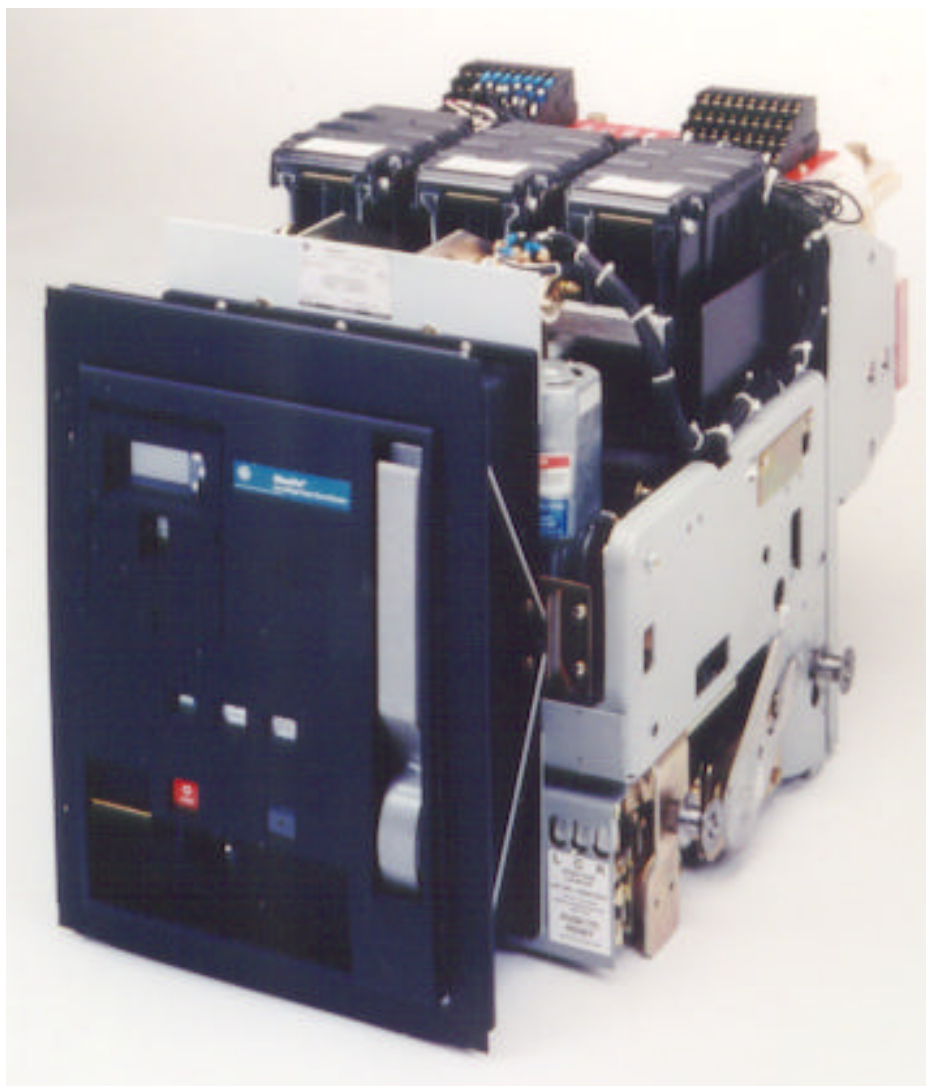


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# WavePro™ Power Circuit Breakers 800–2000 A Frames, 240–600 Vac

## Maintenance Manual





## DEH-136

# WARNINGS, CAUTIONS, AND NOTES AS USED IN THIS PUBLICATION

### 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 800- through 2000-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 débiter tout travail de maintenance d'un disjoncteur, celui-ci doit 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. Table 1-1 lists the ANSI-recommended service interval with the GE-recommended interval for WavePro breakers. WavePro breakers should be inspected after every short circuit interruption, after every number of ON-OFF operations given in Table 1-1, 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.

Source of Recommendation	800 A Frame	1600 and 2000 A Frames
ANSI	1750	500
WavePro, no load	3500	1000
Wave Pro, at frame rating	2800	800

Table 1-1. Recommended service intervals, in number of ON-OFF operations, for WavePro breakers.

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 foreign objects 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. If a breaker is seldom operated, such that it remains open or closed for six months or more, open and close the breaker several times in succession.
3. *Interlocks* – During the operational check, verify that the safety interlocks are working properly.
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.
5. *Accessories* – Verify that the various accessories are working properly.
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-004 for a complete listing.

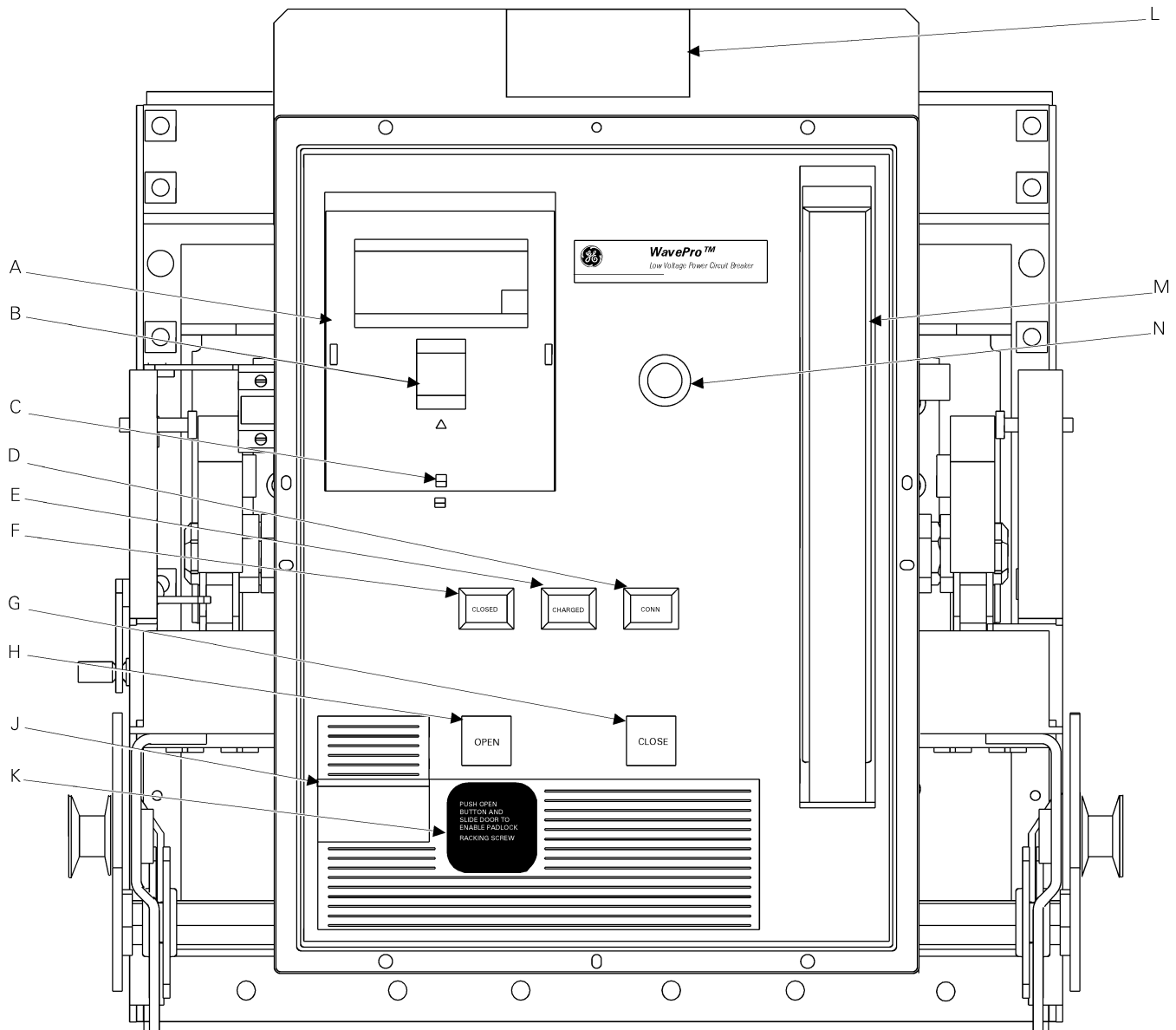


Figure 1-1. Front of the WavePro circuit breaker, showing the locations of key features.

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

## 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 800 ampere, 1600 ampere, and 2000 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. Nameplates indicate the voltage required by the motor circuit and the trip and close coils.

## 2–4 Fused Models

Internally fused breakers are available in 800- and 1600-ampere frame sizes. They are not interchangeable with nonfused breakers, since fused breakers require deeper compartments to accommodate the fuses.

## 2–5 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.

## 2–6 Trip Units

WavePro breakers are available with three different Trip Units. For installation and operation of Power+™ Trip Units see DEH–179. MicroVersaTrip Plus™ and MicroVersaTrip PM™ Trip Units are described in DEH–178.

## 2–7 Interruption Ratings

Table 21 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-08	30	30	30
	WPH-08	42	42	42
	WPX-08	50	50	50
	WPS-16	42	42	42
	WPH-16	65	65	65
	WPS-20	65	65	65
480 (508)	WPS-08	30	30	30
	WPH-08	42	42	42
	WPX-08	65	65	65
	WPS-16	50	50	50
	WPH-16	65	65	65
	WPS-20	65	65	65
240 (254)	WPS-08	30	42	30
	WPH-08	42	50	42
	WPX-08	65	65	65
	WPS-16	50	65	50
	WPH-16	65	65	65
	WPS-20	65	65	65

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.

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.

### 3–2 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.* Many accidents have been caused by back feeds from various sources.

### 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 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,

## Chapter 3. Storage, Safety, and Maintenance

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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 supplied switchgear, 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 or supplied parts or their replacement by non-identical substitutes. All such design changes must be qualified to ANSI/IEEE Standard C37.59.

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



## 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 operating handle down about 90° (until it stops) six times to fully charge the closing 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 re-applied 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 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
OPEN	Open	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.

## Chapter 4. Breaker Operation

**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 DISC, 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.

### Opening the Breaker

Open the breaker contacts with either of the following methods:

- Depress the OPEN button on the front of the breaker.
- Energize the (optional) shunt trip accessory or de-energize the (optional) undervoltage trip device accessory.
- Initiate a trip through the TVRMS2 Test Kit connected to the trip unit.

### Padlock Operation

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

1. Trip the breaker (press the OPEN button).
2. While holding the OPEN button in, slide the racking door to the right. 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 or 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  $\frac{3}{8}$ " the breaker is held trip-free.

An additional interlock holds the breaker trip-free whenever the access door to the racking mechanism is open.

### Contact Interlock

The contact interlock keeps the door to the draw-out mechanism racking screw closed whenever the breaker contacts are CLOSED. This prevents changes to the breaker's position with the main contacts CLOSED.

### Spring Discharge Interlock

The spring discharge interlock automatically discharges the closing springs when the breaker is racked from the TEST position to the DISC position. This eliminates the potential hazard of the closing springs inadvertently discharging during maintenance. The contacts will not close because the trip latch is held trip-free by other interlocks.

## 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.

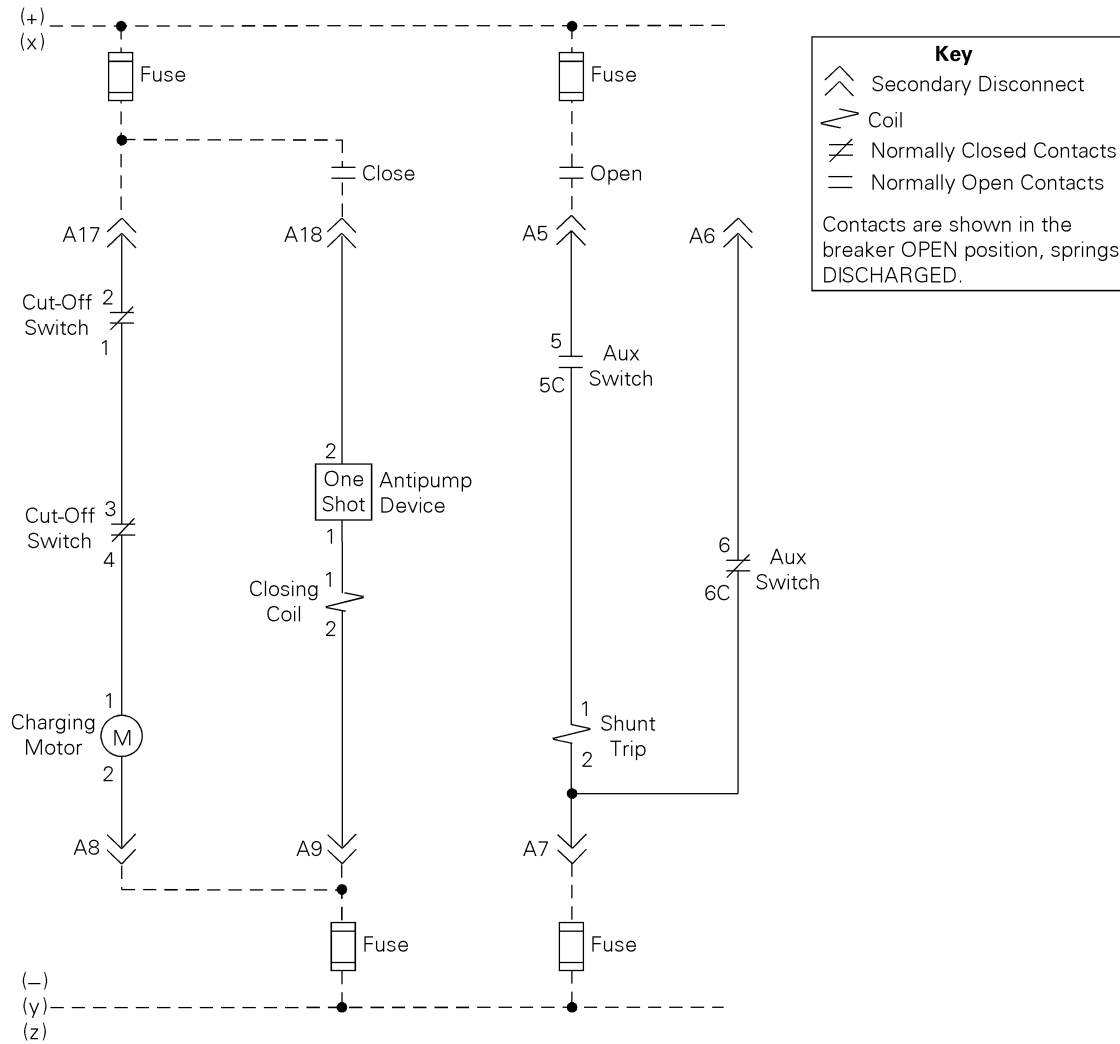


Figure 4-1. Elementary diagram of the breaker control circuit.

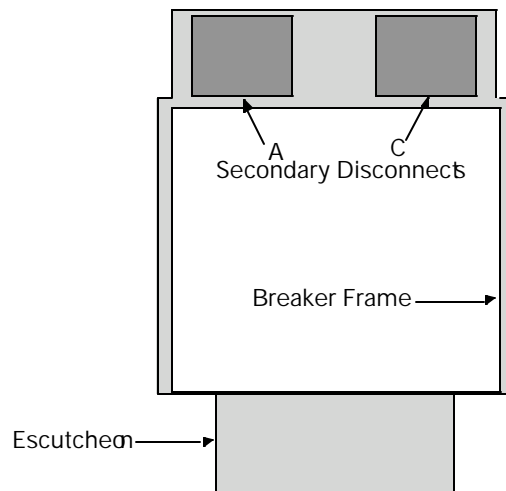


Figure 4-2. Locations of the secondary disconnects on the top view of the breaker.

## Chapter 4. Breaker Operation

**A Disconnect Block (left side from front)**

10	Aux Switch (NO contact)	
1	Aux Switch	
2	Aux Switch	
11	Aux Switch (NC contact)	
12	Aux Switch (NO contact)	
3	Aux Switch	
4	Aux Switch	
13	Aux Switch (NC contact)	

5	Aux Switch (NO contact)	
6	Aux Switch (NC contact)	
7	Aux Switch (common) <sup>3</sup>	

**OR**

5	Shunt Trip (NO contact)	
6	Shunt Trip (NC contact)	
7	Shunt Trip (common) <sup>3</sup>	

14	Bell Alarm (NO contact)	
15	Bell Alarm (NC contact)	
16	Bell Alarm (common)	
19	Bell Alarm (NO contact)	
20	Bell Alarm (NC contact)	
21	Bell Alarm (common)	
8	Closing Spring Charging Motor	
17	Closing Spring Charging Motor	
9	Close Circuit <sup>1</sup>	
18	Close Circuit <sup>1</sup>	
22	Undervoltage or Electric Lockout	
23	Undervoltage or Electric Lockout	
24	Neutral Sensor – tap	
25	Neutral Sensor – common	
26	Commnet+	
27	Commnet–	
28	Zone Selective Interlock (In+)	
29	Zone Selective Interlock (In–)	
30	Zone Selective Interlock (Out+)	
31	Zone Selective Interlock (Out–)	
32	Va (voltage conditioner)	
33	Vb (voltage conditioner)	
34	Vc (voltage conditioner)	
35	Trip Unit Aux Pwr (24 Vdc+)	
36	Trip Unit Aux Pwr (24 Vdc–)	

**C Disconnect Block (right side from front)**

10	Aux Switch (N.O. contact)	
1	Aux Switch	
2	Aux Switch	
11	Aux Switch (NC contact)	
12	Aux Switch (NO contact)	
3	Aux Switch	
4	Aux Switch	
13	Aux Switch (NC contact)	

14	Second Shunt Trip	
5	Second Shunt Trip <sup>3</sup>	

**OR**

14	Aux Switch (NO contact)	
5	Aux Switch <sup>3</sup>	

6	Aux Switch	
15	Aux Switch (N.C. contact)	
8	Remote Charge Indicator <sup>2</sup>	
17	Remote Charge Indicator <sup>2</sup>	
16	Spare	
7	Spare	
9	Spare	
18	Spare	
19	Spare	
20	Spare	
21	Spare	
22	OFLO (phase A)	
23	OFLO (phase A)	
24	OFLO (phase B)	
25	OFLO (phase B)	
26	OFLO (phase C)	
27	OFLO (phase C)	
28	Spare	
29	Spare	
30	Spare	
31	Spare	
32	Spare	
33	Spare	
34	Spare	
35	Spare	
36	Spare	

<sup>1</sup> For electrically operated breaker; remote close accessory on manual breaker.<sup>2</sup> Remote charge indicator applies to electrically operated breaker only.<sup>3</sup> 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 OPEN position.

**AVERTISSEMENT:** Avant d'inspecter ou de débuter tout travail de maintenance d'un disjoncteur, celui-ci doit 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

1. With the compartment door closed and latched, trip the breaker.
2. Push the OPEN button and slide the racking door to the right, exposing the racking screw. Insert the racking handle (catalog number 568B731G1) onto the racking screw. Rotate the handle counterclockwise until the breaker travels from the Connected position through the Test position (as indicated by the legends CONN and TEST, respectively, on the draw-out position indicator) until the racking screw comes to a solid stop in the Disconnected 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. Pull out the rails, then pull the breaker out to the withdrawn position at the track travel limit.
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 (catalog number 0324B4551G1) by locating the hooks in the slots on the side of the breaker and on the closing spring

anchor pin. Raise the breaker until its mounting wheels clear the rails.

6. 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.

### Installing the Breaker

Use the following procedure to install the draw-out breaker into its compartment.

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.
  - Verify that the breaker is the correct type for that compartment.
  - Ensure that the breaker is OPEN.
  - Apply a thin coat of lubricant D6A15A2 (catalog number 183L0907P037) lubricant to the breaker's primary disconnects.
  - 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 in the slots on the side of the breaker and on the closing spring anchor pin.
3. Pull the rails all the way out to their withdrawn position.
4. Slowly lower the breaker onto the rails so that the grooves in the rollers on the side of the breaker align with the rails.

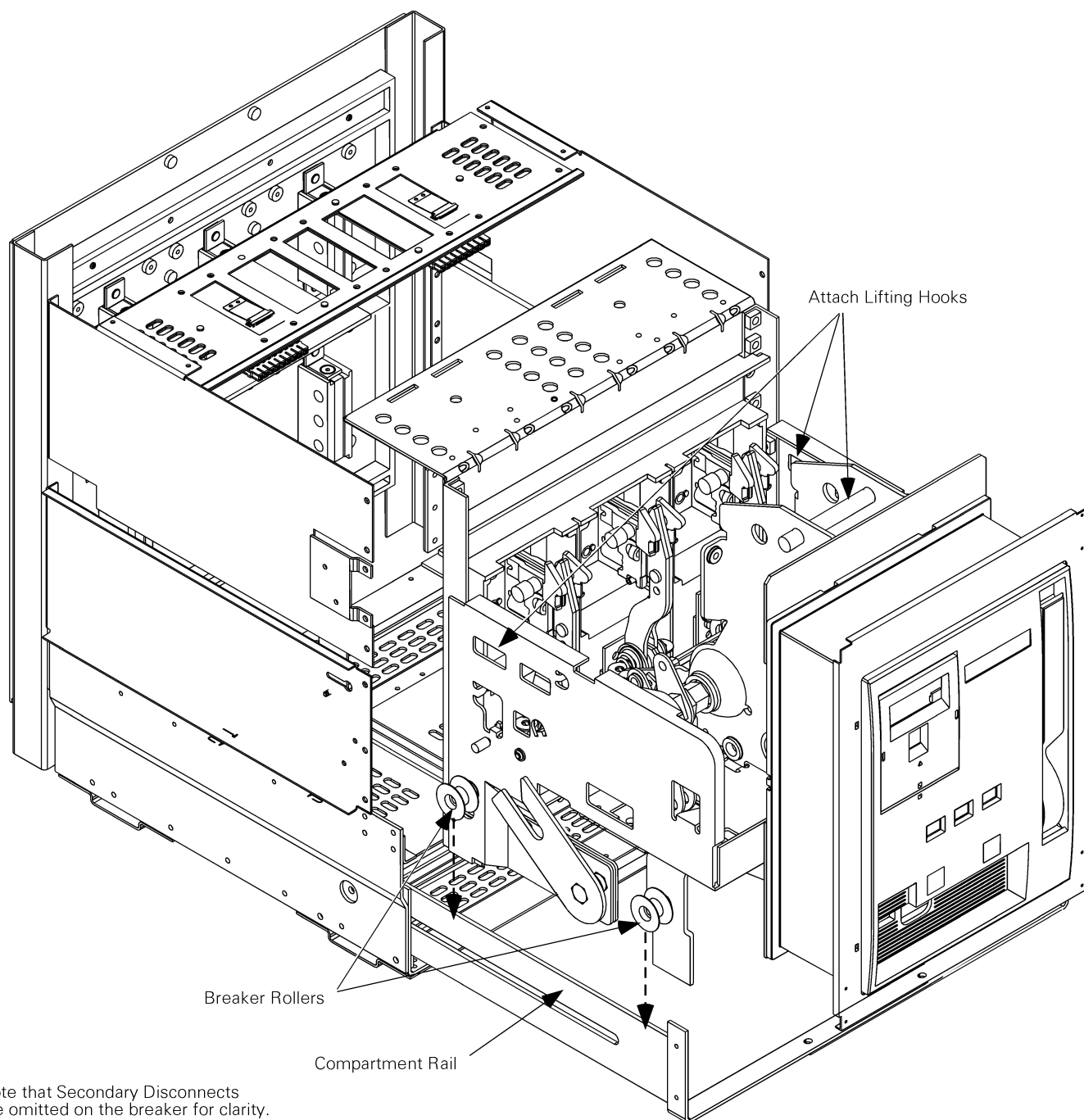


Figure 5-1. Installing the breaker into the compartment.

5. Push the breaker into the compartment until it reaches the stops. This is the Disconnect position (as shown by the legend DISC on the draw-out position indicator). At this point the racking arms are positioned to engage the fixed racking pins in the compartment and are ready to begin the racking motion. Push the rails back into the compartment.
6. Close the compartment door. Insert the racking handle into the racking screw opening in the breaker escutcheon. 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. The closing spring must be isolated from the mechanism camshaft. Make sure that the breaker mechanism is DISCHARGED and the spring is at minimum extension, then remove the hex-head bolt shown in Figure 52 to disconnect the lower spring assembly from the mating camshaft linkage.
2. After the bolt is removed, use the maintenance handle to rotate the ratchet assembly roller onto the closing prop.
3. Remove the closing prop by either pushing the CLOSE button or by pushing the solenoid armature of the remote close.
4. Continue turning the camshaft until the contacts and mechanism are in the fully closed position. The cam then supports the cam roller and the contacts develop maximum depression.
5. Push the TRIP button to release the mechanism and open the contacts.

**CAUTION:** The mechanism and contacts will open with normal speed and force.

**ATTENTION:** Le mécanisme et les contacts s'ouvriront à une vitesse et une force normales.

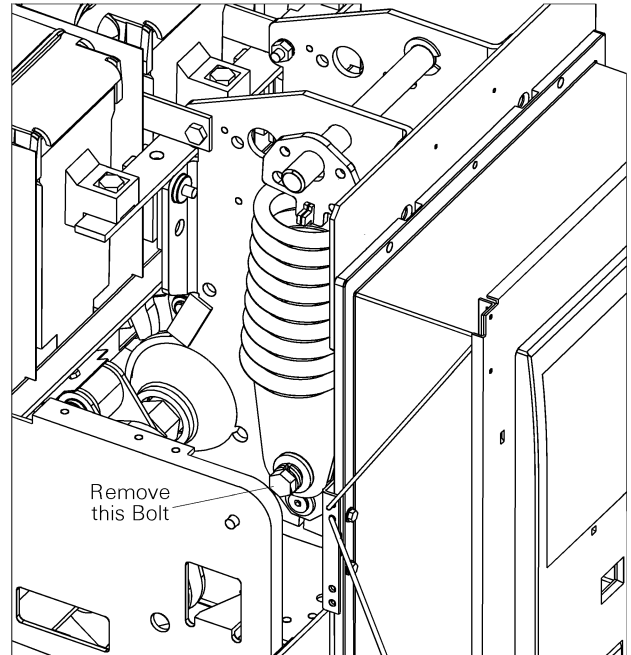


Figure 5-2. Disconnecting the closing spring assembly.

When replacing the hex-head bolt, turn the camshaft with the charging handle to align the mating holes in the lower spring assembly and camshaft linkage. Tighten the bolt to 360 lb-in.

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

#### Separation of Front and Back Frames for WPS08, WPF08, WPH08

The following procedure is illustrated in Figure 5-5.

1. Verify that the breaker contacts are open and that the closing springs are discharged.
2. Remove the mounting bolt securing each of the arc chutes and lift out the arc chutes. Remove the four interphase barriers.
3. 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 illustrated 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

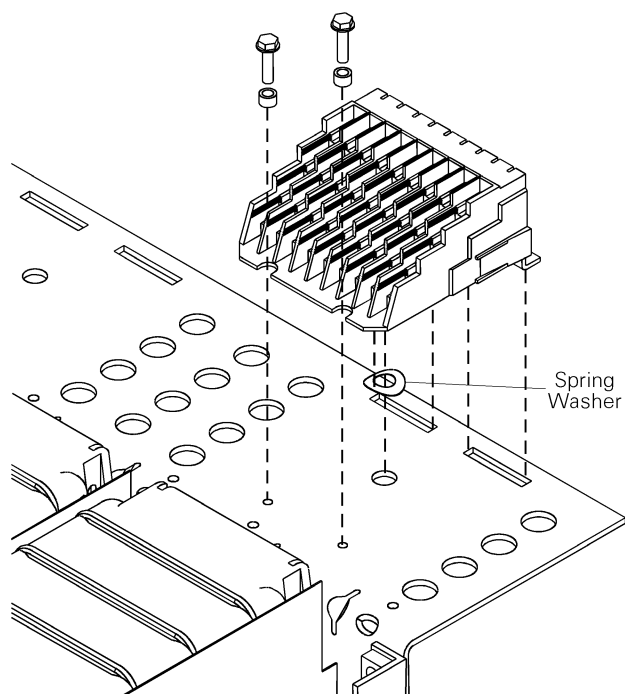


Figure 5-3. Removing or installing the secondary disconnects.

off the support bracket. Secure the secondary disconnects to the front frame assembly.

4. Remove the bolt, lock washer, and nut connecting each tie bar to the front frame. Lift off the tie bars.
5. Remove the four bolts, washers, and nuts that attach the secondary disconnect mounting plate to the back frame. Remove the mounting plate.
6. Remove one of the snap rings and slide out the pin connecting each of the movable contact assemblies to the breaker main shaft, as illustrated in Figure 5-4.
7. Remove the wires on the current sensors. Be sure to note the proper polarity, as indicated by the black and white insulation on the wires.
8. Carefully place the breaker on its back, resting on the primary disconnects.
9. Remove the six bolts and lock washers attaching the front and back frames on the side panels.
10. Lift the front frame straight off the back frame.

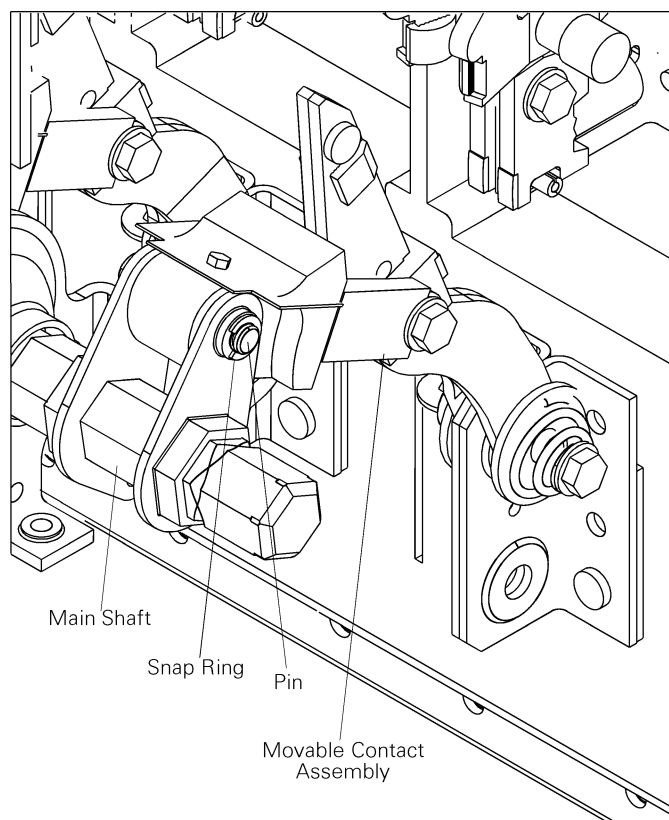


Figure 5-4. Movable contact connection to the breaker main shaft on WPS08, WPF08, and WPH08 breakers.

### Reconnection of Front and Back Frames for WPS08, WPF08, WPH08

The following procedure is illustrated in Figure 5-5.

1. Carefully place the back frame on a suitable work surface, resting on the primary disconnects.
2. Place the front frame assembly onto the back frame, being careful to line up the mounting holes in the side panels. Insert the six bolts and lock washers and tighten them to 200 in-lb.
3. Carefully place the breaker upright, resting on its bottom surface.
4. Reconnect the wires to the current sensors, observing the proper polarity (white wire on the upper terminal, black on the lower).
5. Reconnect the movable contact assemblies to the breaker main shaft by inserting the connecting pin and reattaching the snap ring, as illustrated in Figure 5-4.
6. Place the secondary disconnect mounting plate in position and secure with the four bolts, washers, and nuts.



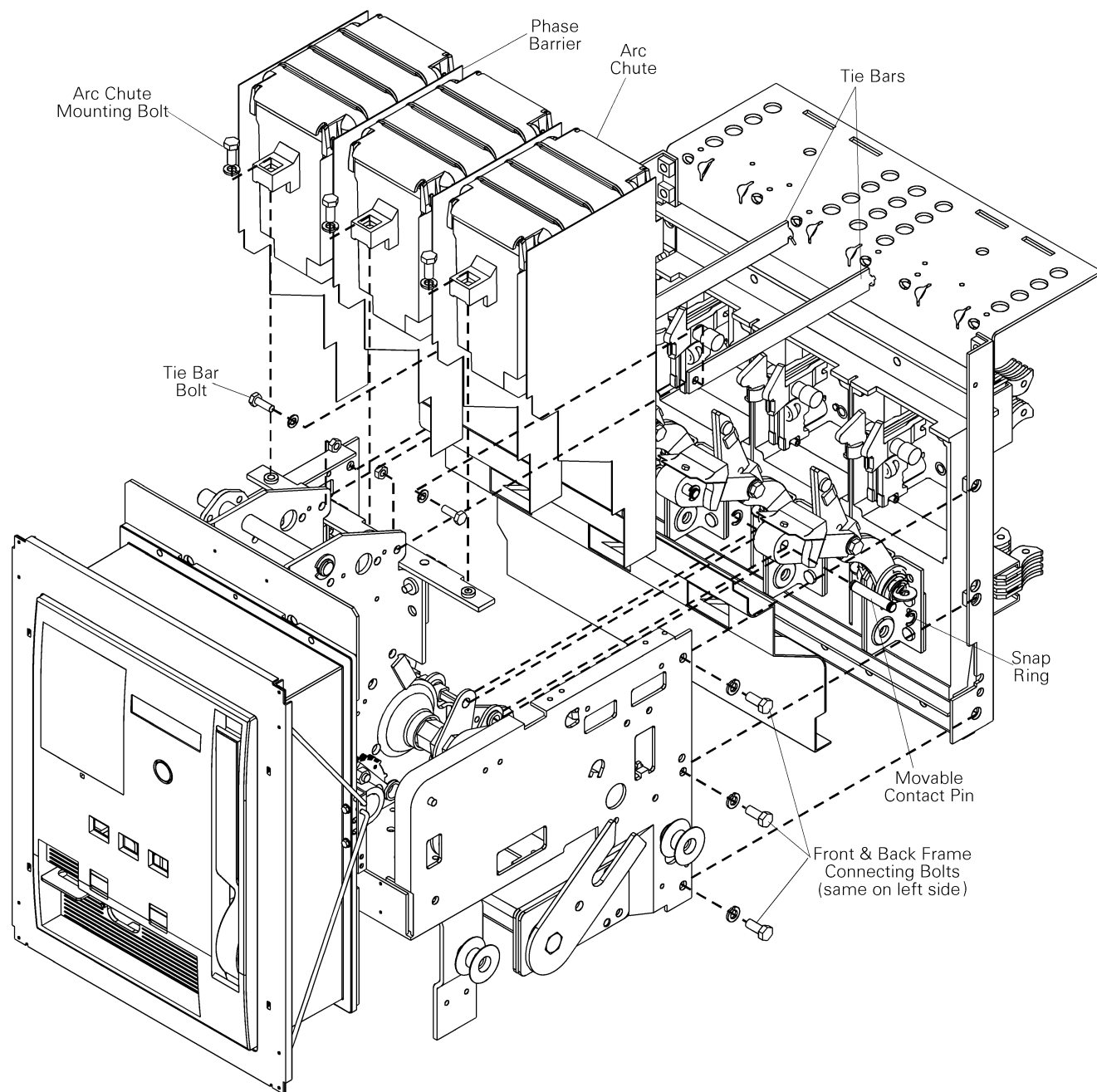


Figure 5-5. Separating the front and back frames on WPS08, WPF08, and WPH08 breakers.

## Chapter 5. Breaker Maintenance

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7. Connect the ends of the tie bars to the secondary disconnect mounting plate and attach the other ends to the front frame with the bolt, lock washer, and nut removed earlier. Tighten to 96 in-lb.
8. Place the flexible washer on the molded pin on the bottom of the secondary disconnects, then slide the two feet into the slots on the mounting plate. Secure with the two screws and standoffs, as illustrated in Figure 6. Replace the wire bundle into the channel on the top of the frame and secure with wire ties.
9. Insert the four interphase barriers into their mounting slots.
10. Slide the arc chutes into position, with the slots over the movable contact arms. Secure with the bolts and lock washers removed on disassembly.
11. Check that no wires are interfering with breaker operation and that all bolts and nuts are tight. Operate the breaker a few times to verify proper operation.

### Separation of Front and Back Frames for WPX08, WPS16, WPF16, WPH16, and WPS20

The following procedure is illustrated in Figure 5-7.

1. Verify that the breaker contacts are open and that the closing springs are discharged.
2. Remove the two bolts and lock washers that attach the arc chute retainer to the front frame and remove the retainer. Slide out the arc chutes and interphase barriers. Note that there are three distinct types of phase barriers: right, two inner, and left.
3. 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 illustrated 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.
4. Remove the three screws and washers that attach the secondary disconnect mounting plate to the back frame. Remove the mounting plate.
5. Remove one of the snap rings and slide out the pin connecting each of the movable contact assemblies to the breaker main shaft, as illustrated in Figure 5-6. On the two outer poles, first remove the bolt and cover over the outer end of the pin.
6. Remove the wires on the current sensors. Be sure to note the proper polarity, as indicated by the black and white insulation on the wires.
7. Carefully place the breaker on its back, resting on the primary disconnects.
8. Remove the two nuts and lock washers attaching the tie bars to the front frame.
9. Remove the six nuts and lock washers (the top connections also have spacers) connecting the front and back frames.
10. Lift the front frame straight off the back frame.

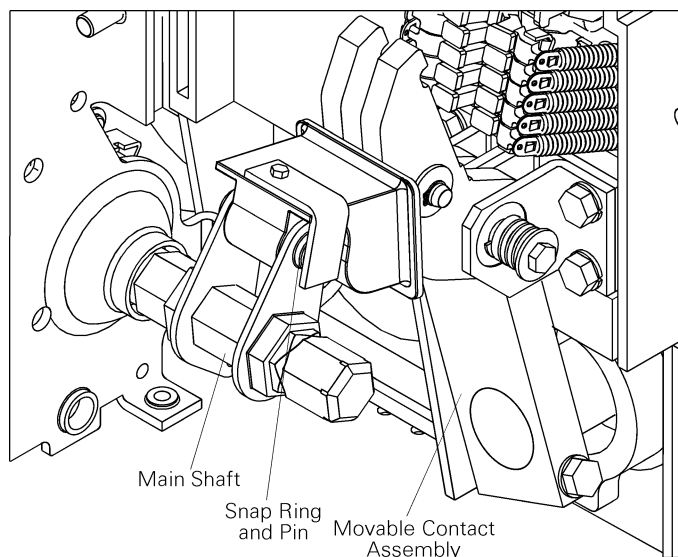


Figure 5-6. Movable contact connection to the breaker main shaft on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

9. Insert the four interphase barriers into position, noting the proper locations for the three different types.
10. Slide the arc chutes into position. Place the arc chute retainer in position and secure with the two bolts and lock washers to the front frame. Tighten securely.
11. Check that no wires are interfering with breaker operation and that all bolts and nuts are tight. Operate the breaker a few times to verify proper operation.

### Reconnection of Front and Back Frames for WPX08, WPS16, WPF16, WPH16, and WPS20

The following procedure is illustrated in Figure 5-7.

1. Carefully place the back frame on a suitable work surface, resting on the primary disconnects.
2. Carefully lower the front frame onto the back frame, lining up the six studs in the sides of the back frame with the corresponding holes in the front frame. Attach the six nuts and lock washers, with the two spacers on the top studs, and tighten to 250 in-lb.
3. Attach the two nuts and lock washers to secure the tie bars to the front frame. Tighten to 250 in-lb.
4. Carefully place the breaker upright, resting on its bottom surface.
5. Reconnect the wires to the current sensors, observing the proper polarity.
6. Reconnect the movable contact assemblies to the breaker main shaft by inserting the connecting pin and reattaching the snap ring, as illustrated in Figure 5-6. Reattach the cover and bolt on the two outer poles.
7. Reattach the secondary disconnect mounting plate with three screws and washers to the back frame.
8. Place the flexible washer on the molded pin on the bottom of the secondary disconnects, 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.

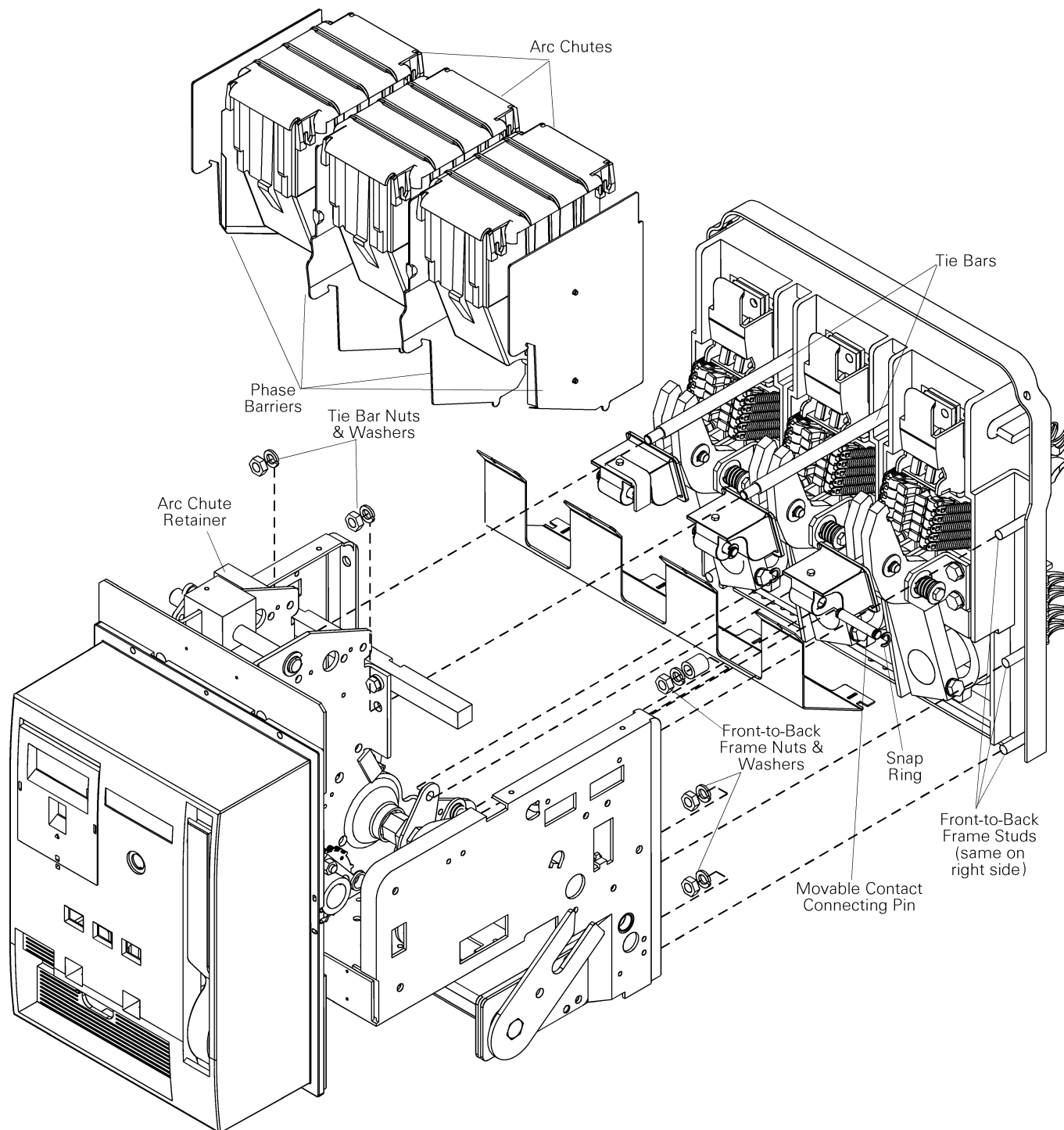


Figure 5-7. Separating the front and back frames on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers (WPS20 illustrated).

## 5–5 Breaker Mechanism Operation and Adjustment

Figures 5-8, 5-9, and 5-10 show the mechanism components in the CLOSED, TRIPPED, and RESET conditions, respectively. Numbers in parentheses refer to the indicated items in the figures listed in Table 5-1. The closing spring is in the charged position for all of these details.

**Closed Position** – The movable contacts are pushed against the stationary contacts by the toggle linkage, as illustrated in Figure 5-8. The toggle linkage is held in position through the engagement of its cam roller (4), with the prop (1), the secondary latch/roller (5), the secondary latch (10), and the trip latch (7).

**Tripped Position** – The mechanism goes from the CLOSED position to the TRIPPED position, illustrated in Figure 5-9, when the trip shaft (6) is rotated by either the manual trip button or one of the other trip devices. The trip latch (7) is assembled to the trip shaft. When the trip shaft rotates, the trip latch disengages from the secondary latch roller (5). The secondary latch pivots, resulting in the collapse of the toggle linkage. This collapse, along with the opening spring (11), shown in Figure 5-10, causes the breaker contacts to open.

**Reset Position** – The closing cam (2), assembled to the cam shaft (3), is rotated by the charging motor, manual charging handle, or maintenance handle. The cam engages the cam roller and partially extends the toggle linkage. This allows the secondary latch (10) to pivot against the front frame, as illustrated in Figure 5-10, leaving a gap between the trip latch (7) and secondary latch roller (5). The secondary latch is now in a position to engage both the trip latch and cam roller (4).

The breaker closes when the closing spring discharges and rotates the cam (2) against the cam roller (4). The toggle linkage is fully extended, pivoting the secondary latch (10) from the front frame and engaging it with the trip latch (7) and cam roller (4), as shown in Figure 5-8.

When the breaker is closed and the closing spring discharged, the upper cam roller (4) is supported by the cam (2) rather than the prop (1). The mechanism must be in this position to check contact adjustment, as described in Chapter 6.

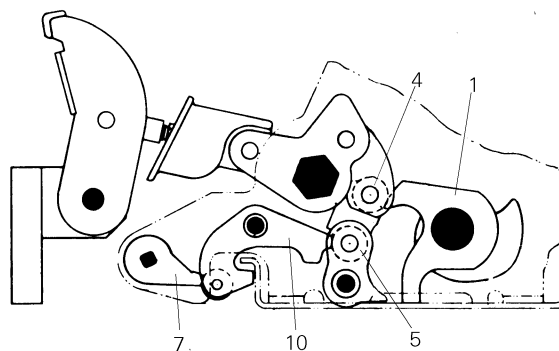


Figure 5-8. Breaker mechanism in the CLOSED position.

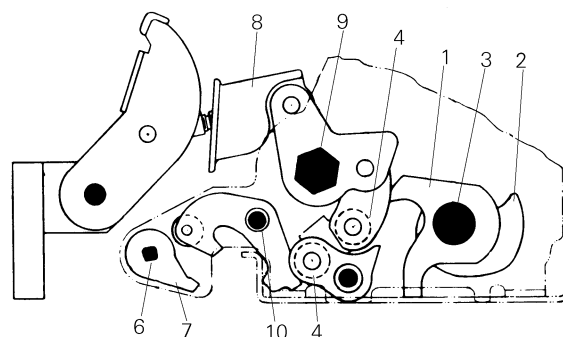


Figure 5-9. Breaker mechanism in the TRIPPED position.

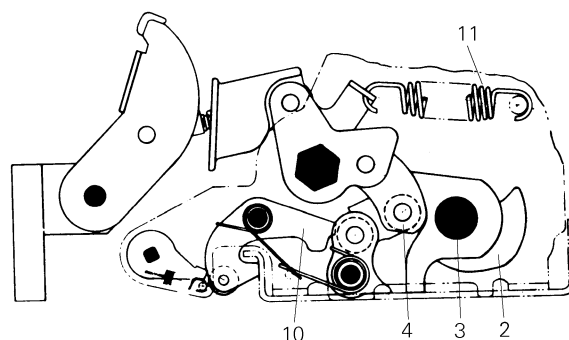


Figure 5-10. Breaker mechanism in the RESET position.

1 Prop	7 Trip latch
2 Cam	8 Insulated coupling
3 Camshaft	9 Main shaft
4 Cam roller	10 Secondary latch
5 Secondary latch roller	11 Opening spring
6 Trip shaft	

Table 5-1. Key to numbered parts in Figures 5-8, 5-9, and 5-10.

### Trip Latch Adjustment

Use the following procedure to adjust the trip latch, as illustrated in Figure 5-11.

1. Remove the breaker from its compartment and place it on a suitable work surface.
2. Remove the arc chutes and phase barriers, as described in Section 6–2.
3. Charge the closing springs with the manual charging handle and close the breaker.
4. Turn the trip latch adjustment screw in (clockwise) until the breaker trips. Withdraw the screw (counter-clockwise) 4 1/2 turns.

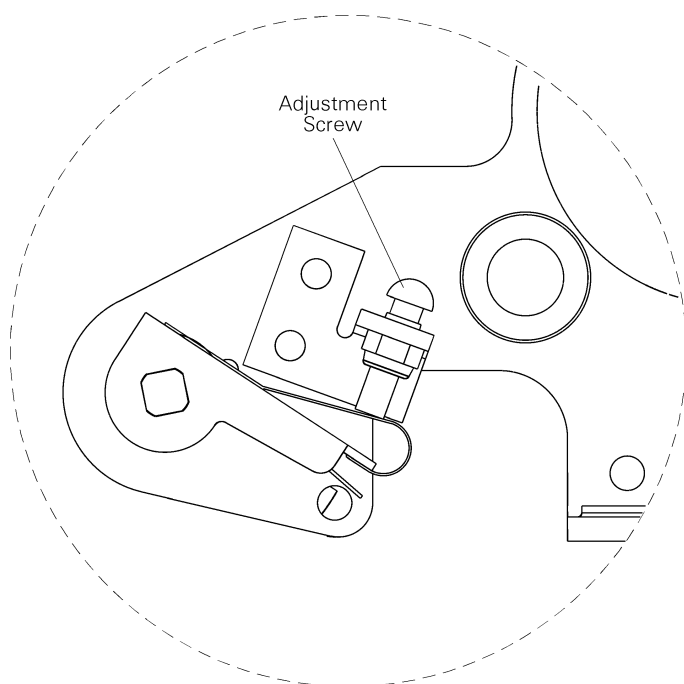


Figure 5-11. Adjusting the trip latch.,

## 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.

There are two types of arc chutes used in these breakers, depending on frame size.

### Arc Chutes in WPS08, WPF08, and WPH08 Breakers

Use the following procedure to remove and replace the arc chutes, as illustrated in Figure 5-5.

1. Verify that the breaker contacts are open and the closing springs are discharged.
2. Remove the mounting bolt and lock washer securing each of the arc chutes and lift out the arc chutes. Remove the four interphase barriers.
3. Check the arc chutes and barriers for damage and replace them, if necessary.
4. Replace the four interphase barriers into their slots.
5. Slide the arc chutes into place, with the slots over the movable contact arms.
6. Replace the mounting bolt and lock washer securing each arc chute to the breaker frame.

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

**ATTENTION:** Toutes les barrières isolatrices doivent être en place avant que le disjoncteur ne soit remplacé en service.

### Arc Chutes in WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

Use the following procedure to remove and replace the arc chutes, as illustrated in Figure 5-7.

1. Verify that the breaker contacts are open and the closing springs are discharged.
2. Remove the two bolts and lock washers that attach the arc chute retainer to the front frame and remove the retainer.
3. Slide out the arc chutes and interphase barriers. Note that there are three distinct types of phase barriers: right, two inner, and left.
4. Check the arc chutes and barriers for damage and replace them, if necessary.
5. Replace the four interphase barriers into their correct 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 two bolts and lock washers.

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

**ATTENTION:** Toutes les barrières 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 the breaker main shaft. Typical examples of the two styles of back frame are shown in Figures 6-1 and 6-2. Complete back frame assemblies are available as renewal parts.

Each pole consists of a separately mounted upper (stationary) and lower (movable) contact assembly, including the line and load mounting studs.

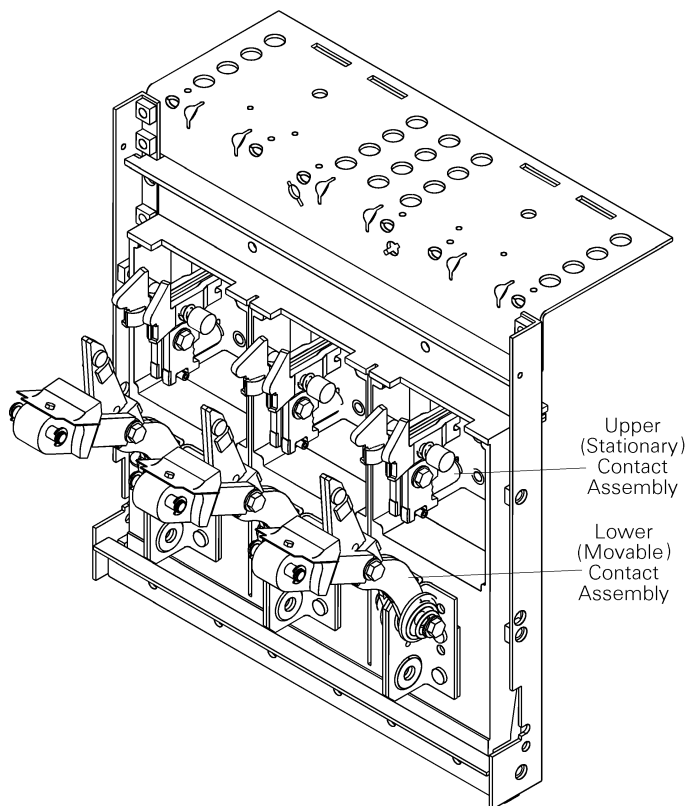


Figure 6-1. Typical back frame assembly, WPS08, WPF08, and WPH08.

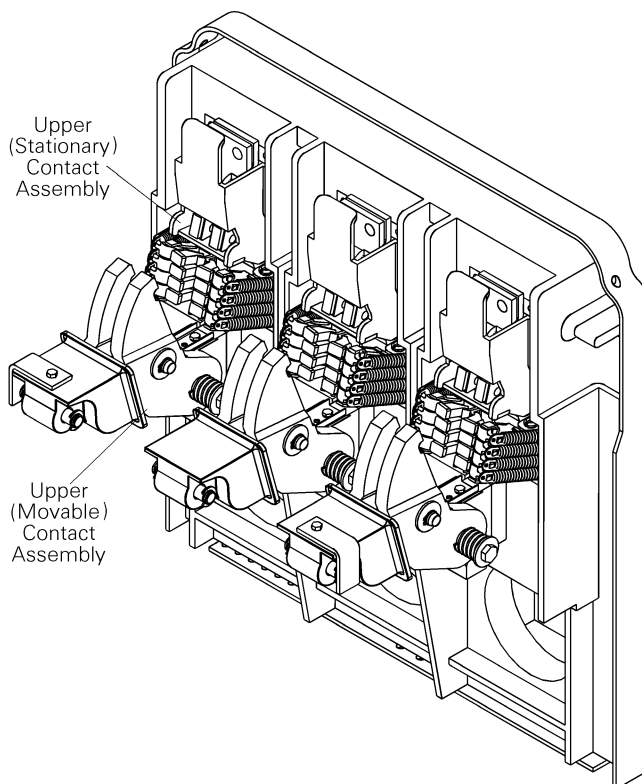


Figure 6-2. Typical back frame assembly, WPX08, WPS16, WPF16, WPH16, and WPS20.

### 6–4 Replacement of Contacts

Contact assemblies are different between the WPS08, WPF08, and WPH08 frames and the WPX08, WPS16, WPF16, WPH16, and WPS20 frames. The procedures for contact replacement for each type follow.

#### Contact Replacement on WPS08, WPF08, and WPH08 Breakers

Complete upper and lower contact assemblies are available as renewal parts, as illustrated in Figures 6-3 and 6-4. In addition, arcing and main contact springs are available for the upper contact assemblies. The insulator link assembly and movable contact springs are available for the lower contact assemblies.

Use the following procedure to replace a contact assembly, as illustrated in Figure 6-5. It is not necessary to separate the front and back frames.

1. Remove the breaker from its compartment and place it on a suitable work surface.
2. Remove the primary disconnect from the pole on which the contact assembly is to be changed, as described in Section 7–1.



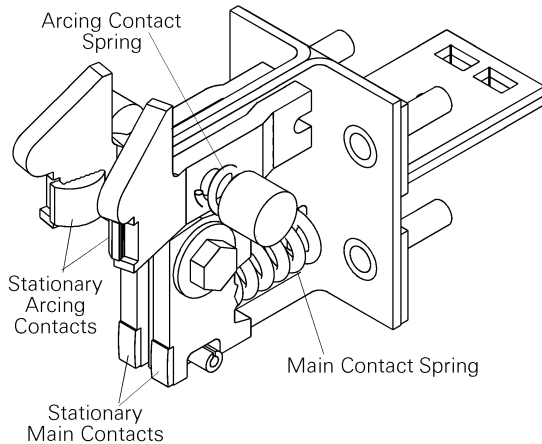


Figure 6-3. Upper (stationary) contact assembly for WPS08, WPF08, and WPH08 breakers (WPH08 has two additional main contacts).

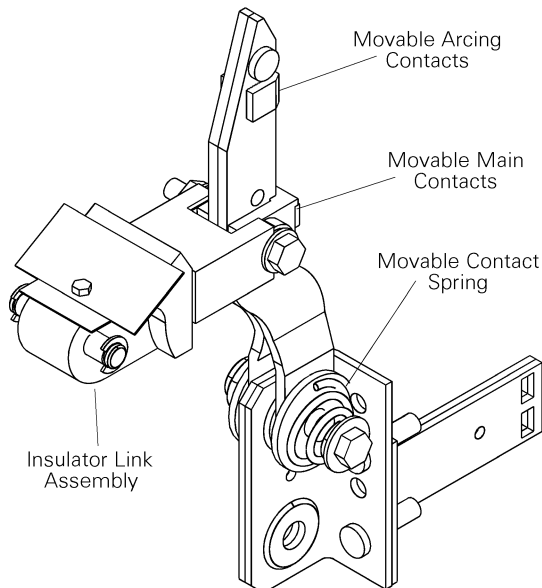


Figure 6-4. Lower (movable) contact assembly for WPS08, WPF08, and WPH08 breakers (WPH08 has two additional main contacts).

3. If a lower contact assembly is to be replaced, remove the current sensor (CT), as described in Section 7–4.
4. Remove the arc chutes and interphase barriers, as described in Section 6–2.
5. For a lower contact assembly, remove one of the snap rings from the pin connecting the contact arm to the breaker main shaft, then slide out the pin.
6. Remove the nut, lock washer, and flat washer from each of the four studs attaching the contact assembly to the breaker back frame.

7. Slide the contact assembly forward, then lift out through the top of the breaker.
8. To replace only the stationary contact springs, use the following procedure:
  - a. Remove the insulating caps over the bolt head and nut securing the arcing contacts. Remove the nut, two flat washers, two springs, and bolt. Remove the arcing contacts.
  - b. Remove the bolt, flat washer, nut, and lock washer securing the main contacts to the assembly. Remove the main contacts and springs.
  - c. Insert the new main contact springs and the existing main contacts into position on the contact assembly. Replace the bolt, nut, and washers to secure the main contacts.
  - d. Place one of the new arcing contact springs and a flat washer onto the bolt removed in **b**. Place the arcing contacts in position, slide the bolt through the holes, and place the other new spring and a flat washer and nut onto the bolt. Replace the insulating caps on the bolt head and nut.
9. To replace only the movable contact springs and insulator link assembly, use the following procedure:
  - a. Remove the bolt, flat washer, lock washer, nut, and two bushings securing the insulator link assembly and movable main contacts to the contact arm and remove the link assembly and main contacts.
  - b. Remove the bolt, nut, two small flat washers, two springs, and two large flat washers from the movable contact arm pivot.
  - c. Place a small flat washer, replacement spring, and large flat washer onto the bolt removed in **b**.; slide the bolt through the contact arm pivot; and place a large flat washer, replacement spring, small flat washer, and nut onto the bolt.
  - d. Place a flat washer and bushing onto the bolt removed in **a**.; slide the bolt through the replacement insulator link assembly, movable main contacts, and contact arm; and place a bushing, flat washer, and nut on the bolt.
10. Place the contact assembly back into position, with the four studs through the appropriate holes in the back frame. Replace the nuts, flat washers, and lock washers on the studs.

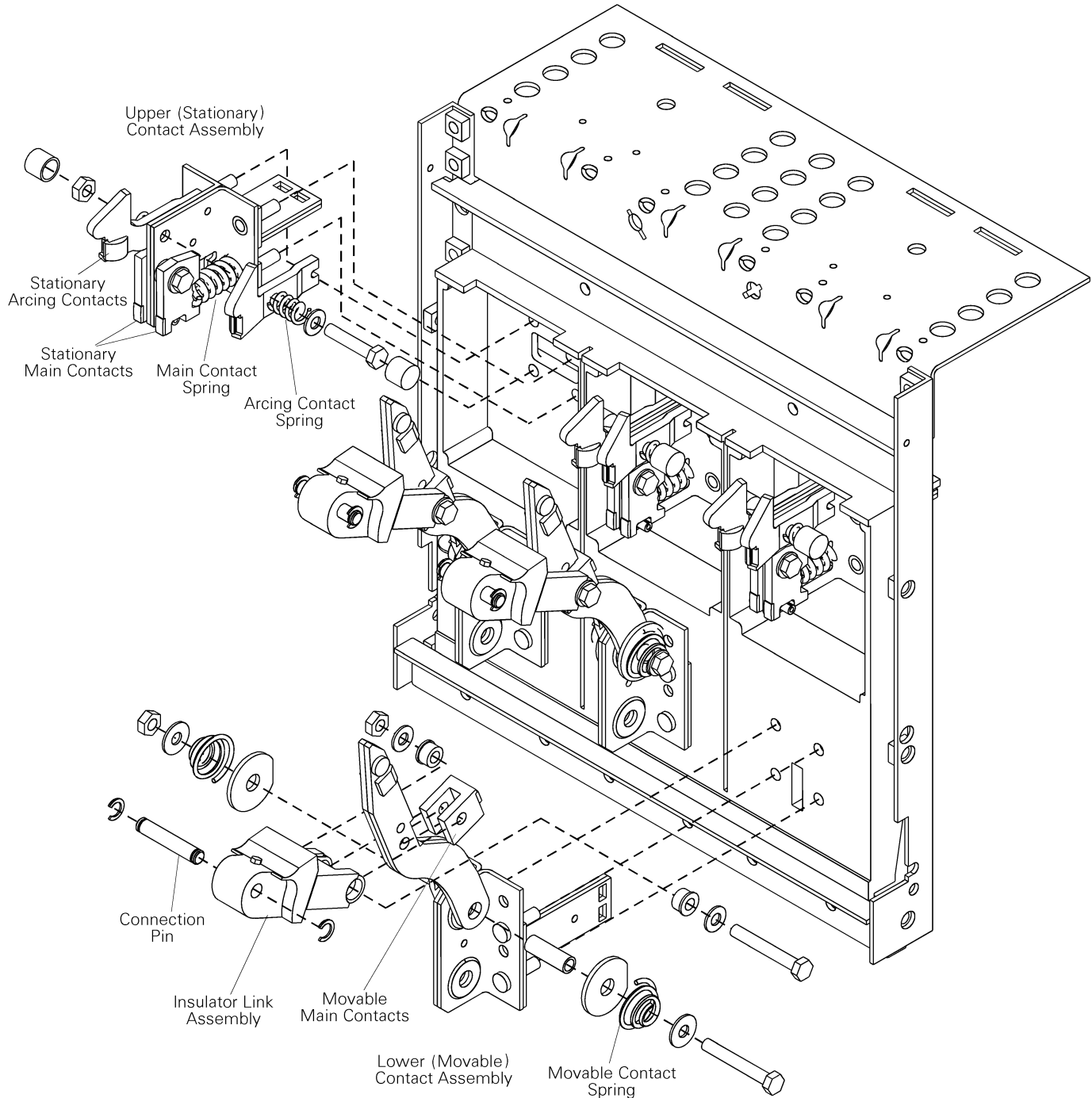


Figure 6-5. Removal and installation of contact assemblies on WPS08, WPF08, and WPH08 breakers.

11. For a lower contact assembly replace the pin attaching the insulator link assembly to the breaker main shaft and secure with the snap ring removed earlier.
12. Adjust the contacts as described in Section 6–5.
13. Replace the arc chutes and interphase barriers.
14. Replace the current sensor, if a lower contact assembly was replaced.
15. Replace the primary disconnect.

### Contact Replacement on WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

For the following procedures, illustrated in Figure 6-6, the breaker must be removed from its compartment and placed on a suitable working surface. Remove the arc chutes and interphase barriers, as described in Section 6-2.

#### Stationary Contacts

Use the following procedure to replace the stationary contacts.

1. Remove the four screws holding the arc runner in place and remove the arc runner. Take care not to damage or lose the insulating washer underneath the lock washer and flat washer on the two lower screws.
2. For replacement of stationary main and intermediate contacts:

- a. Release each contact spring by holding the corresponding intermediate or main contact, extending the spring, and removing the spring from the contact. The end pieces of each spring have a small hole for inserting a spring puller.
- b. Remove each contact as its spring is disengaged. Clean off the existing lubricant on the pivot area. Replace with a small amount of GE Lubricant D6A15A2 (catalog number 183L0907P037).
- c. Insert each replacement main and intermediate contact and secure with its contact spring. Note that main and intermediate contacts are differentiated by the number of chamfers on the corners of the contact surfaces, as illustrated in Figure 6-7. It is important that this distinction be observed when replacing the contacts.

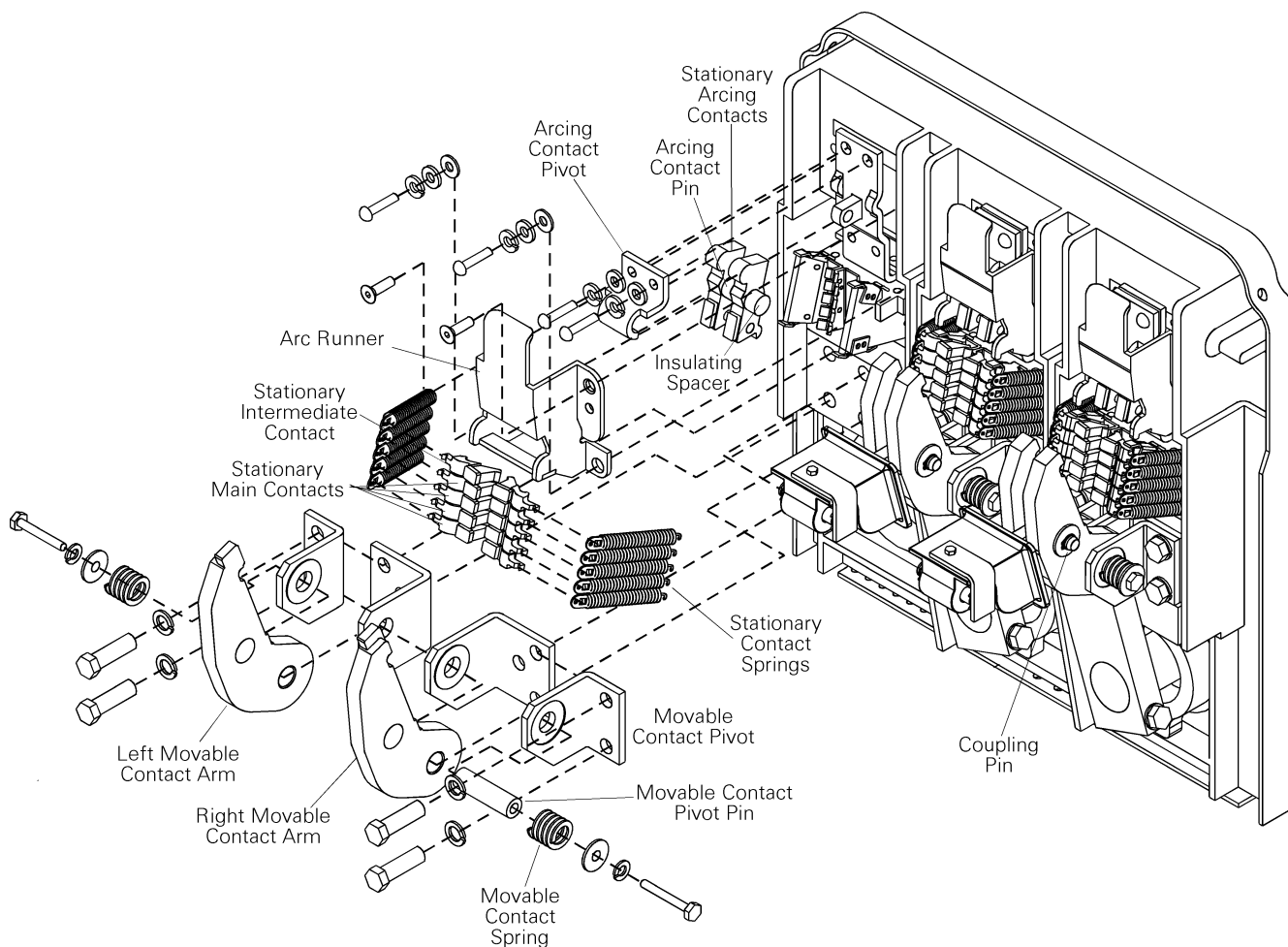


Figure 6-6. Removal and installation of contact assemblies on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

## Chapter 6. Contact Maintenance

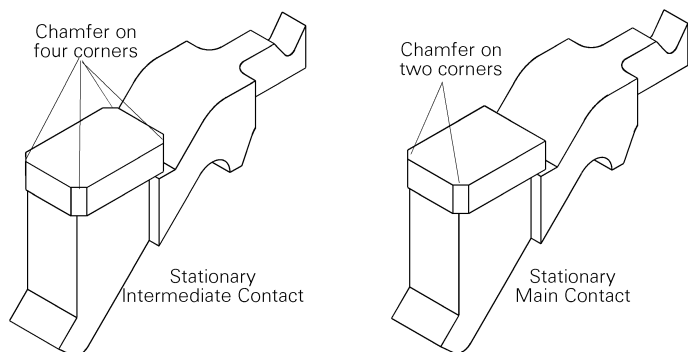


Figure 6-7. Stationary main and intermediate contact styles.

3. For replacement of stationary arcing contacts, as illustrated in Figure 6-8:
  - a. Remove the two screws and lock washers securing the arcing contact pivot to the assembly and remove the pivot.
  - b. Remove the insulating spacers, contact pin, and arcing contacts.
  - c. Insert the replacement arcing contacts, the contact pin, and insulating spacers.
  - d. Place the arcing contact pivot in position and secure with its two screws and lock washers.

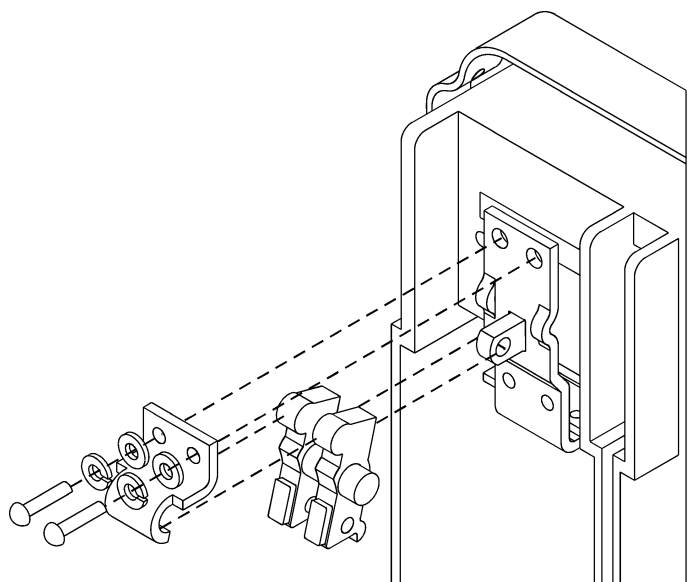


Figure 6-8. Replacement of stationary arcing contacts.

4. Place the arc runner in position and secure with its four screws. Ensure that the insulating washers are in place on the lower screws. Tighten the screws to 45 in-lb.

### Movable Contacts

Use the following procedure to replace the movable contacts.

1. Remove the snap ring from the coupling pin and slide out the pin.
2. Remove the screw, washer, and spring from one side of the pivot pin. Carefully remove the pivot pin.
3. Slip out the contact arms.
4. Clean any existing lubricant from the pivot pin. Place a small amount of GE Lubricant D6A15A2 (catalog number 183L0907P037) on the pivot pin and the pivot surfaces of the new contact arms.
5. Install the new arm, insert the pivot pin, and replace the pivot spring, washer, and screw. Tighten to 90 in-lb.
6. Install the coupling pin and secure with the snap ring.
7. Adjust the contacts as described in Section 6–5.

## 6–5 Adjusting the Contacts

Adjust the contact depression whenever contacts are replaced. In addition, check and adjust, as necessary, at the normal maintenance interval.

### Contact Adjustment on WPS08, WPF08, and WPH08 Breakers

The following procedure is illustrated in Figure 6-9.

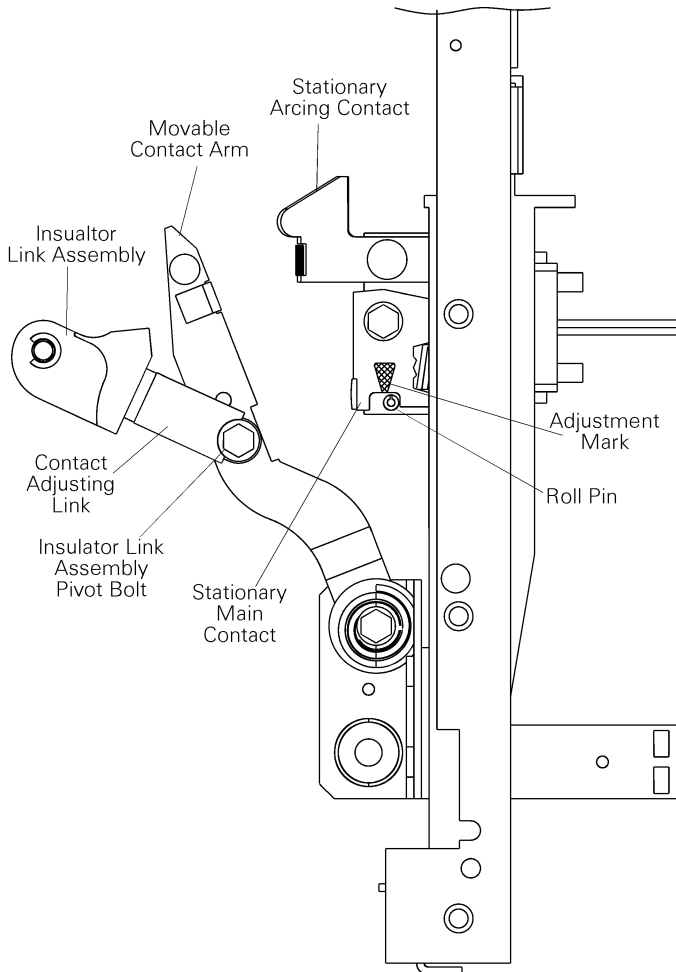


Figure 6-9. Contact adjustment on WPS08, WPF08, and WPH08 breakers.

1. Contact depression is correct if the center of the roll pin falls within the two sides of the scribed

adjustment mark on the side of the stationary main contact.

2. If adjustment is necessary, remove the nut, washer, and bushing from the end of the pivot bolt securing the insulator link assembly to the movable contact arm, then remove the bolt and other washer and bushing.
3. Turn the contact adjusting link in full 360° increments in or out of the insulator link assembly. Increase its length to increase contact depression and shorten the link to decrease contact depression.
4. Reassemble the insulator link assembly to the contact arm with the pivot bolt, nut, two washers, and two bushings.

### Contact Adjustment on WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

The following procedure is illustrated in Figure 6-10.

1. Remove the arc chutes and phase barriers, as described in Section 6–2.
2. To establish a reference for measurement, fasten the aluminum arc chute retainer to the breaker mechanism frame with small C clamps, as shown. Ensure that the C clamps do not interfere with any moving parts.
3. Measure dimension 'A' with the contacts open and again with the contacts closed. Note that the measurement is made from the second contact spring end (first stationary main contact). The difference in the measurements should be 0.06–0.10 inch, which provides 0.05–0.08 inch main contact depression.
4. To adjust contact depression, do the following:
  - a. Remove the retaining ring from one side of the pin connecting the drive link to the movable contact arms and remove the pin.
  - b. Adjust the depression by turning the link in one-half-turn increments. Note that the link has left-hand threads. One-half turn changes dimension A by about 0.03 inch, which is equivalent to about 0.02 inch in contact depression.
5. Repeat for all poles.

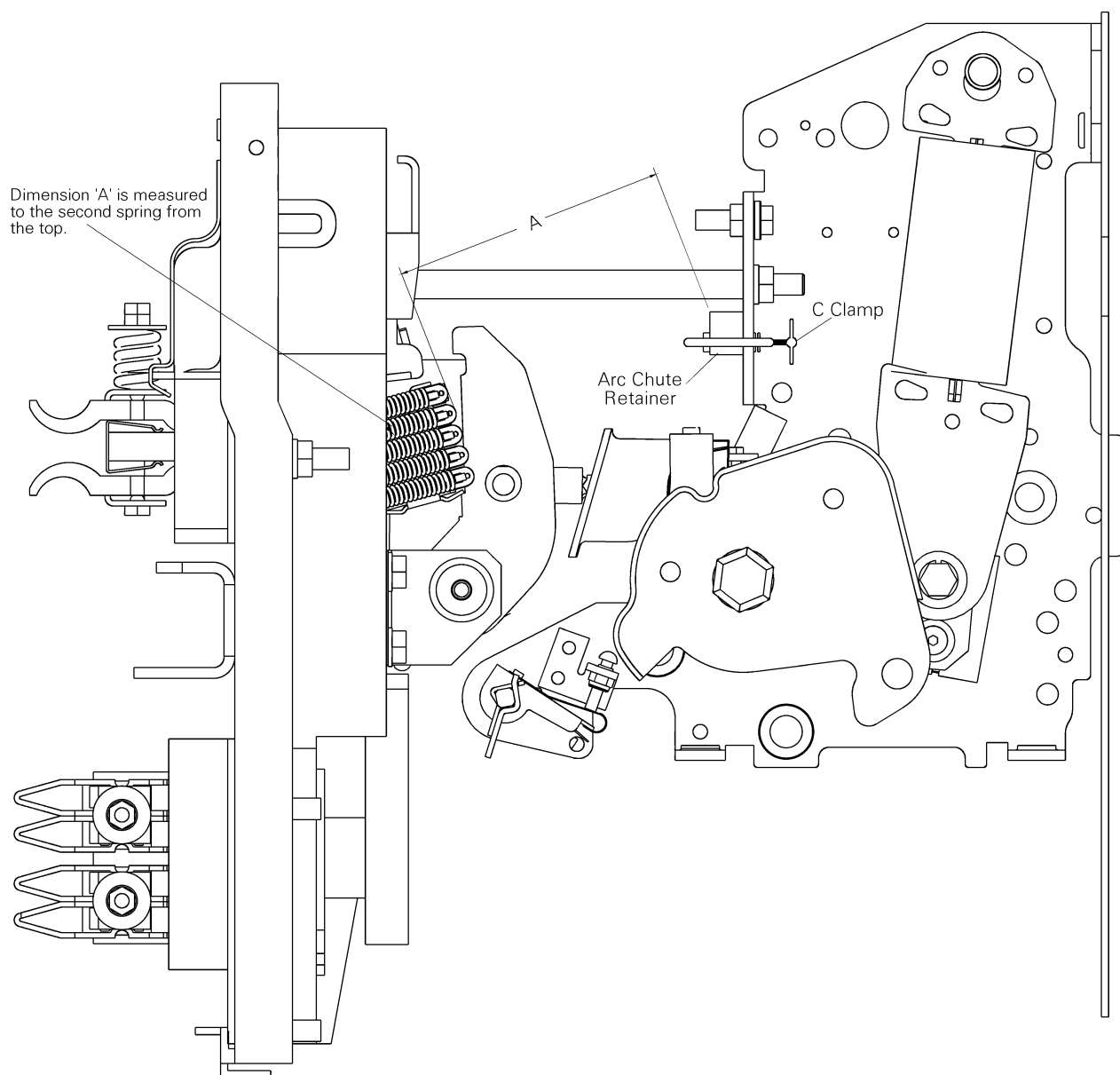


Figure 6-10. Contact adjustment on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

## Chapter 7. Maintenance of Standard Parts and Assemblies

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 different between the WPS08, WPF08, and WPH08 frames, as illustrated in Figure 7-1, and the WPX08, WPS16, WPF16, WPH16, and WPS20 frames, as illustrated in Figure 7-2. The procedures for removal and installation of the two types are described below.

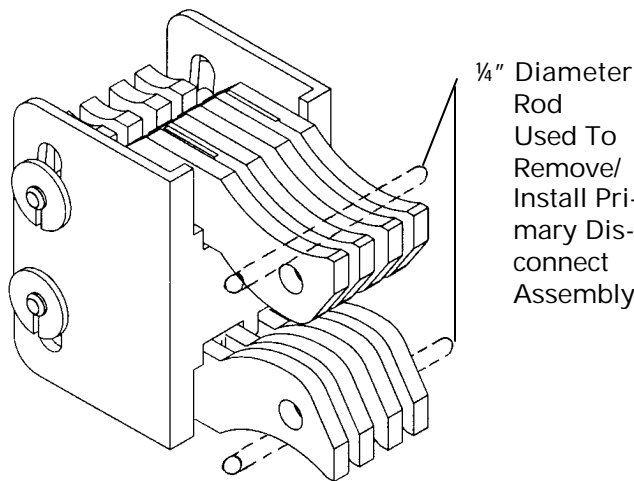


Figure 7-1. Primary disconnect assembly for WPS08, WPF08, and WPH08 breakers.

### Primary Disconnect Replacement on WPS08, WPF08, and WPH08 Breakers

The following procedure is illustrated in Figure 7-3.

To remove a primary disconnect assembly, squeeze the disconnect fingers together with a suitable tool until the assembly releases from the stud, then slide it off.

To install a primary disconnect assembly, squeeze the disconnect fingers together with a suitable tool, slide the assembly over the stud, then reduce the pressure on the fingers until they close into the slots on the stud.

A pair of channe-lock type pliers and two (2) 1/4" diameter rods or bolts can be used to remove the primary disconnect assembly. Place the rods on the top and bottom of the finger assembly and then squeeze the rods with a pair of pliers. The rods help prevent damage to the fingers and also allows all the fingers to be released simultaneously.

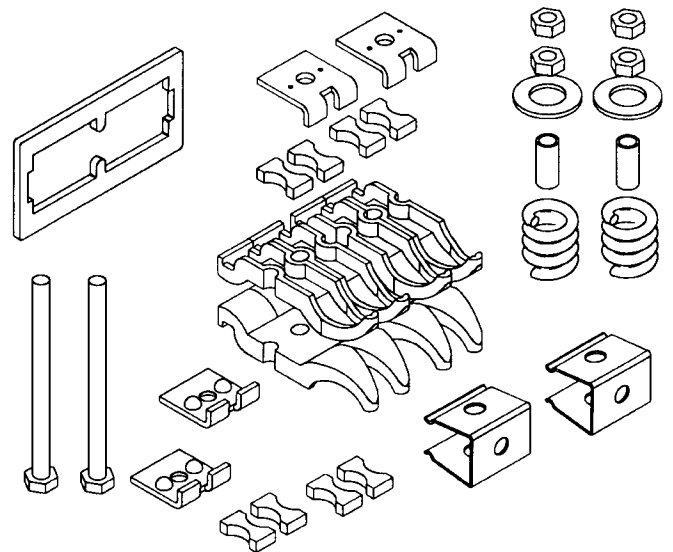


Figure 7-2. Primary disconnect assembly for WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

### Primary Disconnect Removal on WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

The following procedure is illustrated in Figure 7-4.

1. Remove the two nuts from one of the long bolts holding the primary disconnect assembly together.
2. Carefully slide out the bolt while removing the flat washer, spring, bushing, upper retainer, bow-tie spacers, and disconnect fingers from the top and the bow-tie spacers, lower retainer, and fingers from the bottom of the assembly.
3. Repeat for the other assembly bolt and components.
4. Slide off the spring clips
5. Remove the main retainer from the stud.

### Primary Disconnect Replacement on WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

1. Slide the main retainer over the stud.
2. Position spring clips on the stud.

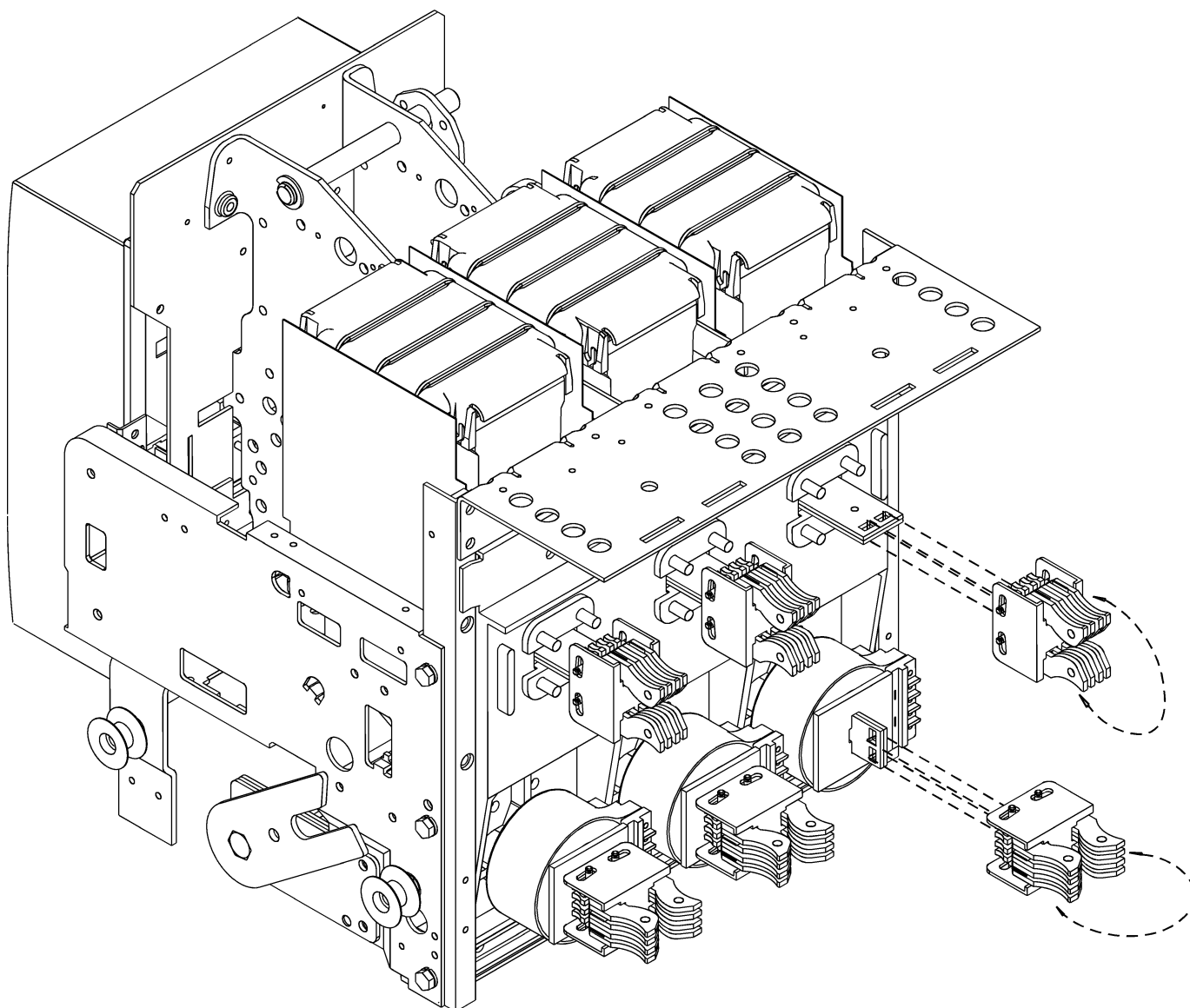


Figure 7-3. Primary disconnect removal and installation on WPS08, WPF08, and WPH08 breakers.

3. Set a pair of bow-tie spacers into one of the fingers, place a retainer over the spacers to hold them in position, then turn the subassembly over. Slide a long bolt through the hole in the retainer and finger, then through the clip and stud spacer. Hold the bottom finger subassembly in place.
4. Place a finger over the bolt from the top, then place two bow-tie spacers in the finger and hold them in position with a retainer.
5. Place a spring, bushing, and flat washer over the bolt, then secure with the two nuts.
6. Repeat steps 3–5 for the other half of the pole.
7. The primary disconnect assembly on new breakers is adjusted in the factory for a force of 85–105 pounds on a 1/2-inch-thick copper bar between the fingers. This force range can be obtained after installation of a new primary disconnect assembly by adjusting the finger spacing as shown in Figure 75. Loosen the lock nuts to obtain a spacing of 0.766–0.797 inch between the top of the upper retainer and the bottom of the flat washer. Tighten the lock nuts.



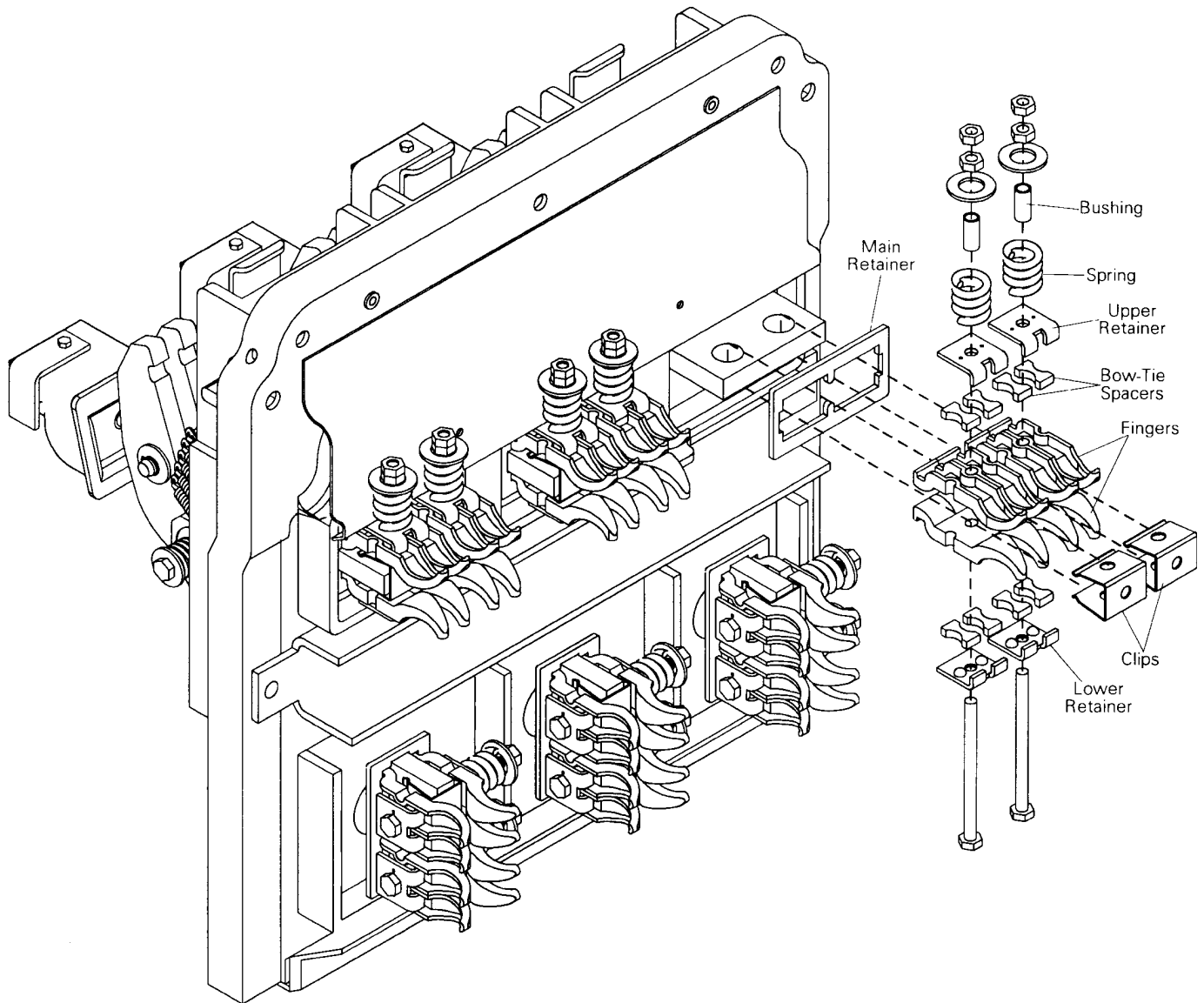


Figure 7-4 Primary disconnect removal and installation on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

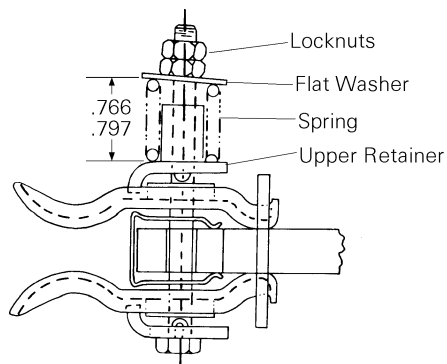


Figure 7-5. Primary disconnect adjustment on WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

## 7–2 Secondary Disconnects

The secondary disconnects, illustrated in Figure 7-6, provide 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 7-7 illustrates the numbering of the terminals in the secondary disconnects.

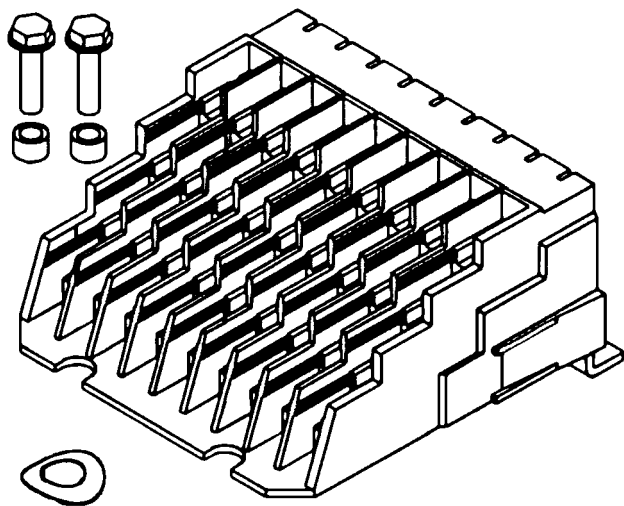


Figure 7-6. Secondary disconnect.

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 7-7. Secondary disconnect terminal numbering.

### Secondary Disconnect Removal

To remove a secondary disconnect, use the following procedure, as illustrated in Figure 7-8.

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.

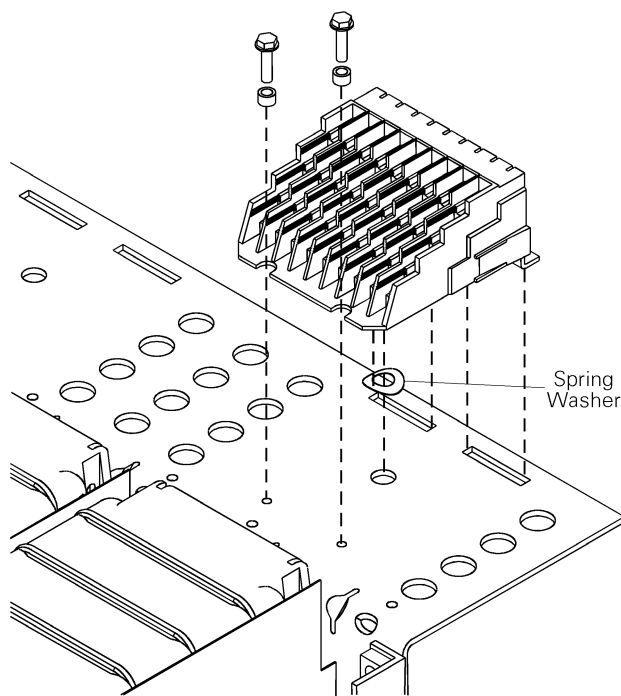


Figure 7-8. Removing or installing the secondary disconnect.

### Secondary Disconnect Installation

To replace a secondary disconnect or to install an additional unit, use the following procedure, as illustrated in Figure 7-8.

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-lb.
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 7-9, is to actuate the trip shaft and trip the breaker upon receiving a signal from the trip unit.

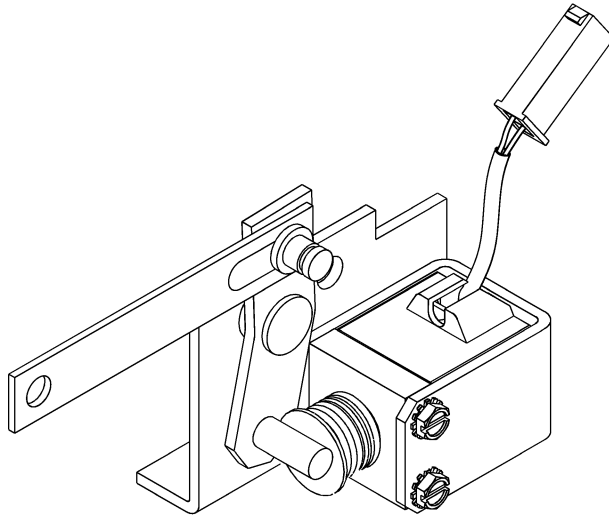


Figure 7-9. Flux shifter.

#### Flux Shifter Adjustment

The only adjustment required to the flux shifter mechanism is the trip rod length. As shown in Figure 7-10, the clearance between the trip rod end and the trip paddle is set to  $0.11 \pm 0.03$  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 on the trip rod, rotate the adjuster until the proper gap is attained, then retighten the lock nut.

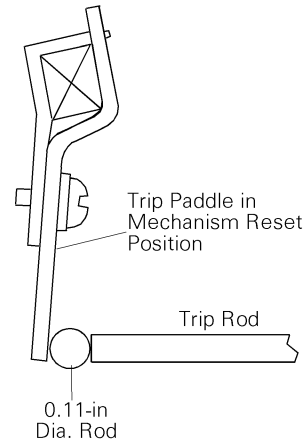


Figure 7-10. Flux shifter adjustment.

#### Removing the Flux Shifter

The following procedure is illustrated in Figure 7-11.

1. Remove the snap ring connecting the reset arm to the main shaft and slide the arm off its mounting point.
2. Disconnect the leads to the trip unit.
3. Remove the two mounting bolts and lock washers from underneath the breaker base, then lift off the flux shifter.

#### Installing the Flux Shifter

The following procedure is illustrated in Figure 7-11.

1. Put the replacement flux shifter into position, lining up the solenoid plunger with the end of the trip rod and the operations counter link (if present) with the end of the reset arm. Insert the two bolts and lock washers from beneath the bottom plate of the breaker and tighten to 32 in-lb.
2. Slide the end of the reset arm onto the connection on the breaker main shaft and secure with the snap ring.
3. Connect the leads to the trip unit.

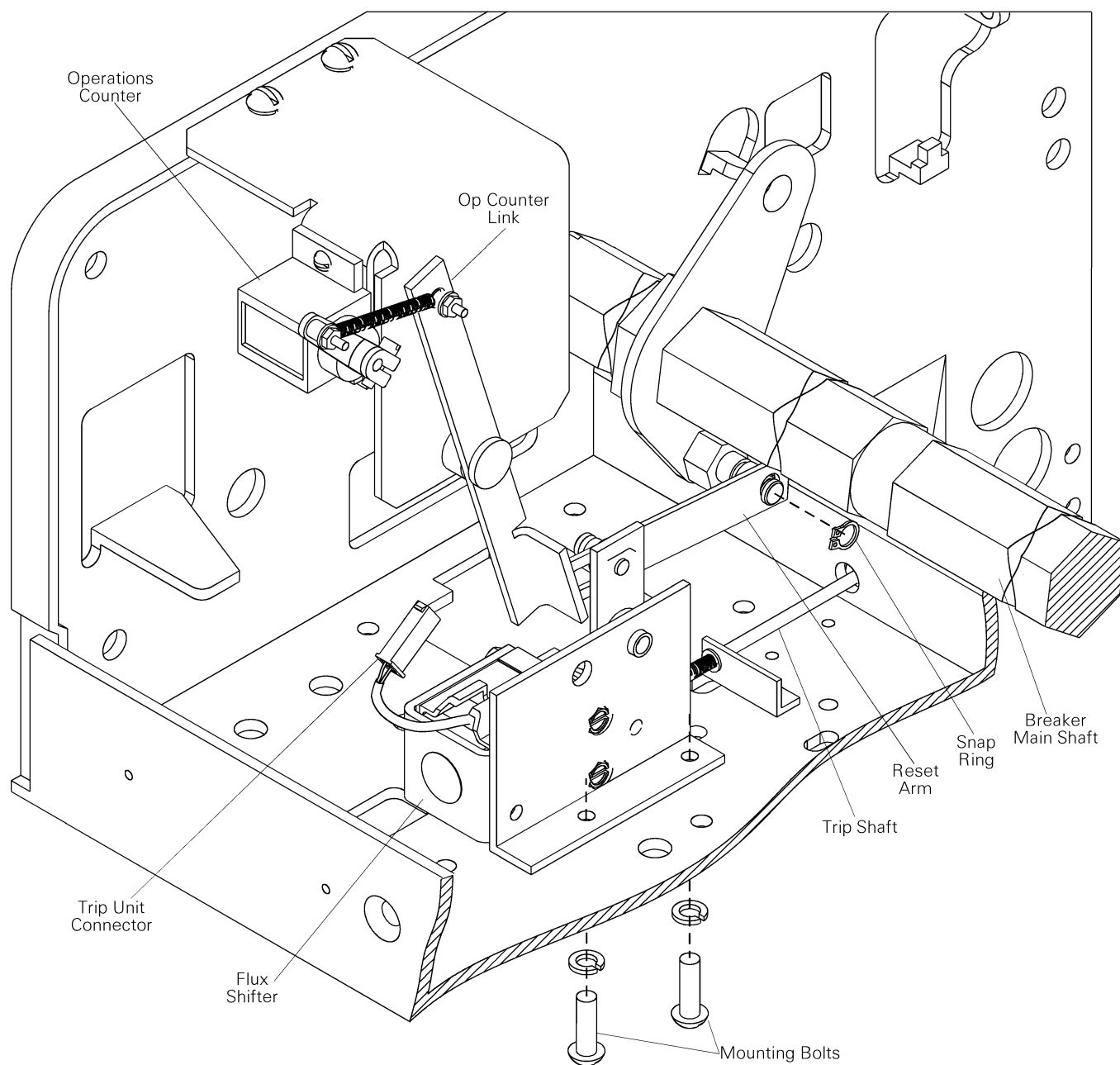


Figure 7-11. Removal or installation of a flux shifter.

### 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 on WPS08, WPF08, and WPH08 Breakers

Use the following procedure to replace a current sensor, as illustrated in Figure 7-12. Current sensors are mounted on the rear of the breaker underneath the primary disconnects on the load studs.

1. Squeeze the primary disconnect fingers together until the assembly releases from the stud, then slide it off.

(Refer to Primary Disconnect Replacement Instructions in 7-1.)

2. Remove the shield from the stud.
3. Disconnect the two wires connecting the current sensor to the trip unit.
4. Slide off the current sensor.
5. Place the replacement current sensor over the stud.
6. Connect the leads as shown in Figure 712, maintaining proper polarity (black and white wires.)
7. Slide the shield over the current sensor.
8. Squeeze the primary disconnect fingers together and slide the assembly over the stud, then reduce the pressure on the fingers until they close into the slots on the stud. (Refer to Primary Disconnect Replacement Instructions in 7-1.)

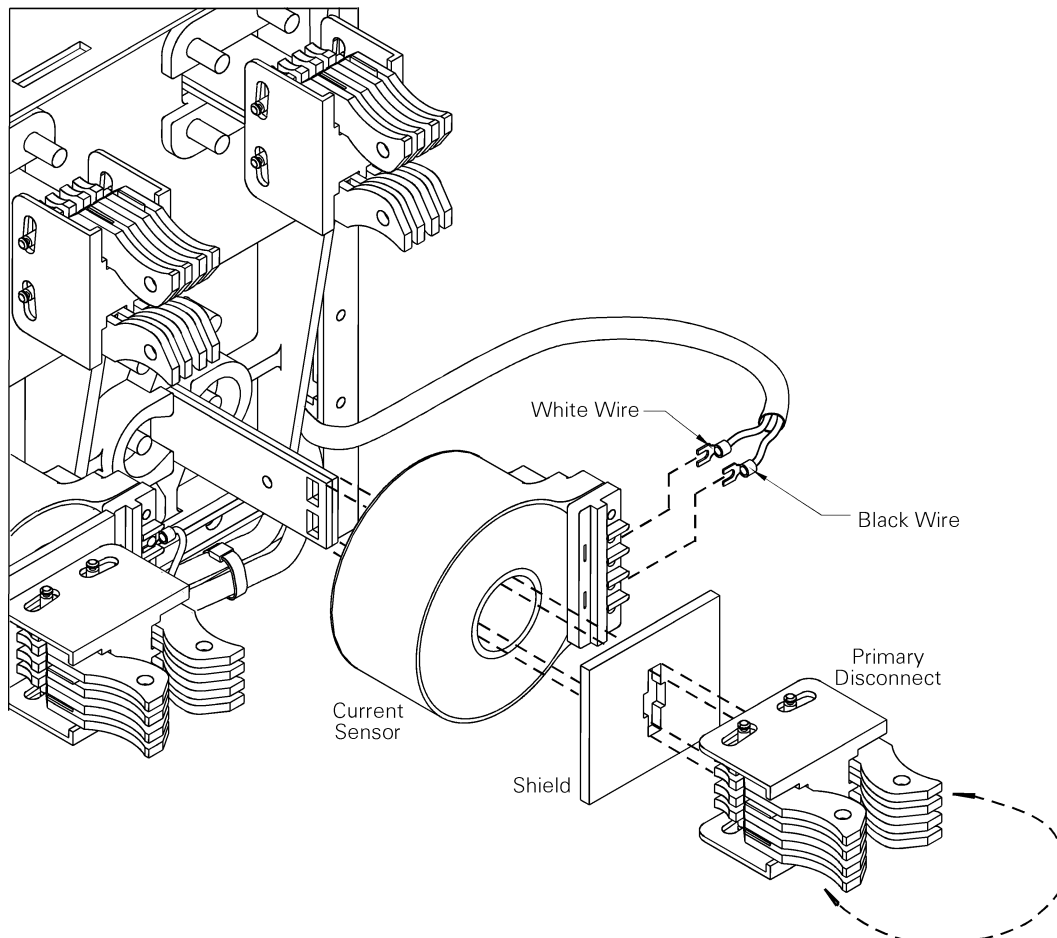


Figure 7-12. Current sensor removal and installation for WPS08, WPF08, and WPH08 breakers.

### Current Sensor Removal and Replacement on WPX08, WPS16, WPF16, WPH16, and WPS20 Breakers

Use the following procedure to replace a current sensor, as illustrated in Figure 7-13. The current sensors are mounted on the inside of the breaker back frame, on the studs connecting to the load-side primary disconnects.

1. Disconnect the two wires from the current sensor, noting the correct terminals for the white and black wires.
2. Remove the clamp bolt, lock washer, and nut securing the stud connector to the stud on which the current sensor is mounted.
3. From the back of the breaker frame, remove the two Allen-head bolts and lock washers securing the stud connector.
4. Slide the stud connector and the current sensor off the stud.
5. Put the replacement current sensor in position on the pole.
6. Place the stud connector in position on the stud and secure it with the two mounting bolts and lock washers through the back of the frame. Tighten the bolts to 360 in-lb.
7. Insert the clamp bolt and lock washer into the hole in the stud connector, attach the nut, and tighten to 360 in-lb.
8. Attach the two leads from the trip unit to the current sensor, observing the proper polarity (white and black wires).

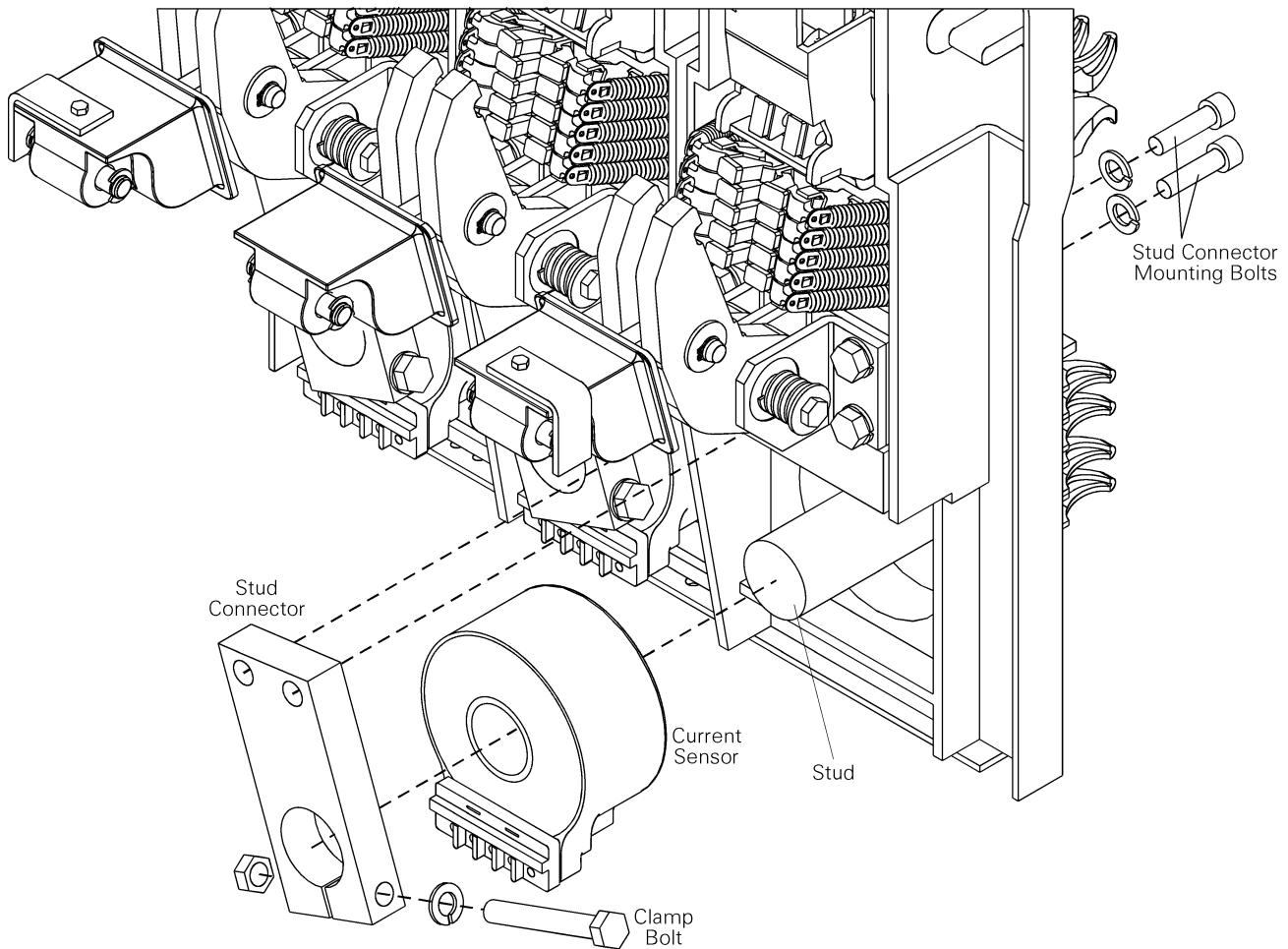


Figure 7-13. Current sensor removal and installation for WPX08, WPS16, WPF16, WPH16, and WPS20 breakers.

### 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 7-14, is available as a replacement assembly, but is not interchangeable between the two applications.

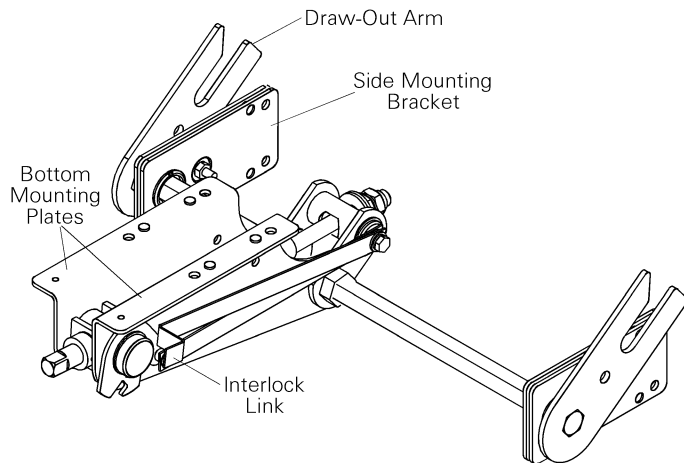


Figure 7-14. Draw-out racking mechanism.

### Draw-out Mechanism Removal

The following procedure describes the removal of the draw-out mechanism, as illustrated in Figure 7-16.

1. Position the breaker on a suitable work surface so that its underside is accessible.
2. Remove the snap ring connecting the interlock link to the breaker mechanism.
3. Remove the two bolts, lock washers, and nuts connecting each side mounting bracket to the sides of the breaker.

4. Remove the four bolts and lock washers connecting the bottom mounting brackets to the tapped holes in the bottom plate of the breaker and lift off the mechanism.

### Draw-out Mechanism Installation

The following procedure describes the installation of the draw-out mechanism, as illustrated in Figure 7-16.

1. Put the replacement mechanism in position on the bottom of the breaker, then insert the four bolts and lock washers through the bottom mounting brackets into the tapped holes in the bottom plate of the breaker. Tighten to 96 in-lb.
2. Attach the two side mounting brackets to the sides of the breaker with two bolts, lock washers, and nuts each. Tighten to 96 in-lb.
3. Position the interlock link on the mounting pin of the breaker mechanism and secure with the snap ring.

### Draw-out Mechanism Adjustment

After installation of a replacement draw-out mechanism, adjust the draw-out mechanism

1. With the trunnion against the jamb nut washers, check that the distance between the edge of the washers and the collar is 9.19 inch, as illustrated in Figure 7-15. To adjust this dimension, loosen and rotate the jamb nuts appropriately, then retighten the nuts.
2. The length of the sleeve is adjusted to stop the trunnion when the distance between the ends of the equipment and breaker studs in 0.03 to 0.22 inch. To adjust this dimension, loosen the set screw in the collar, turn the sleeve to increase or decrease its length appropriately, then retighten the set screw.

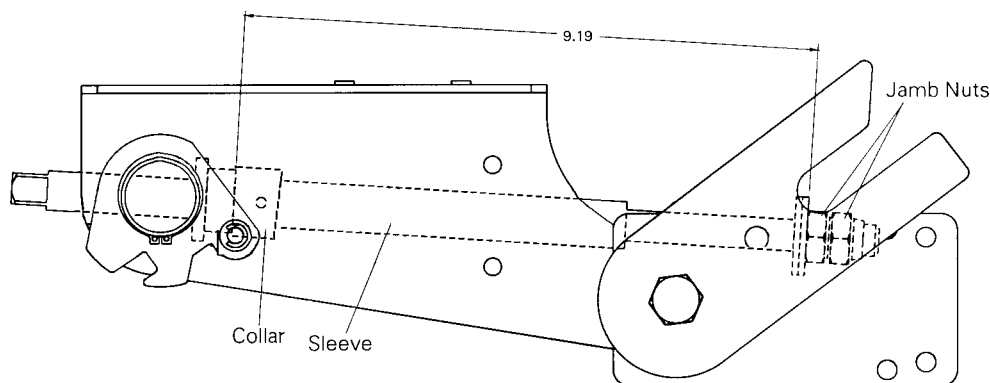


Figure 7-15. Draw-out mechanism adjustment.

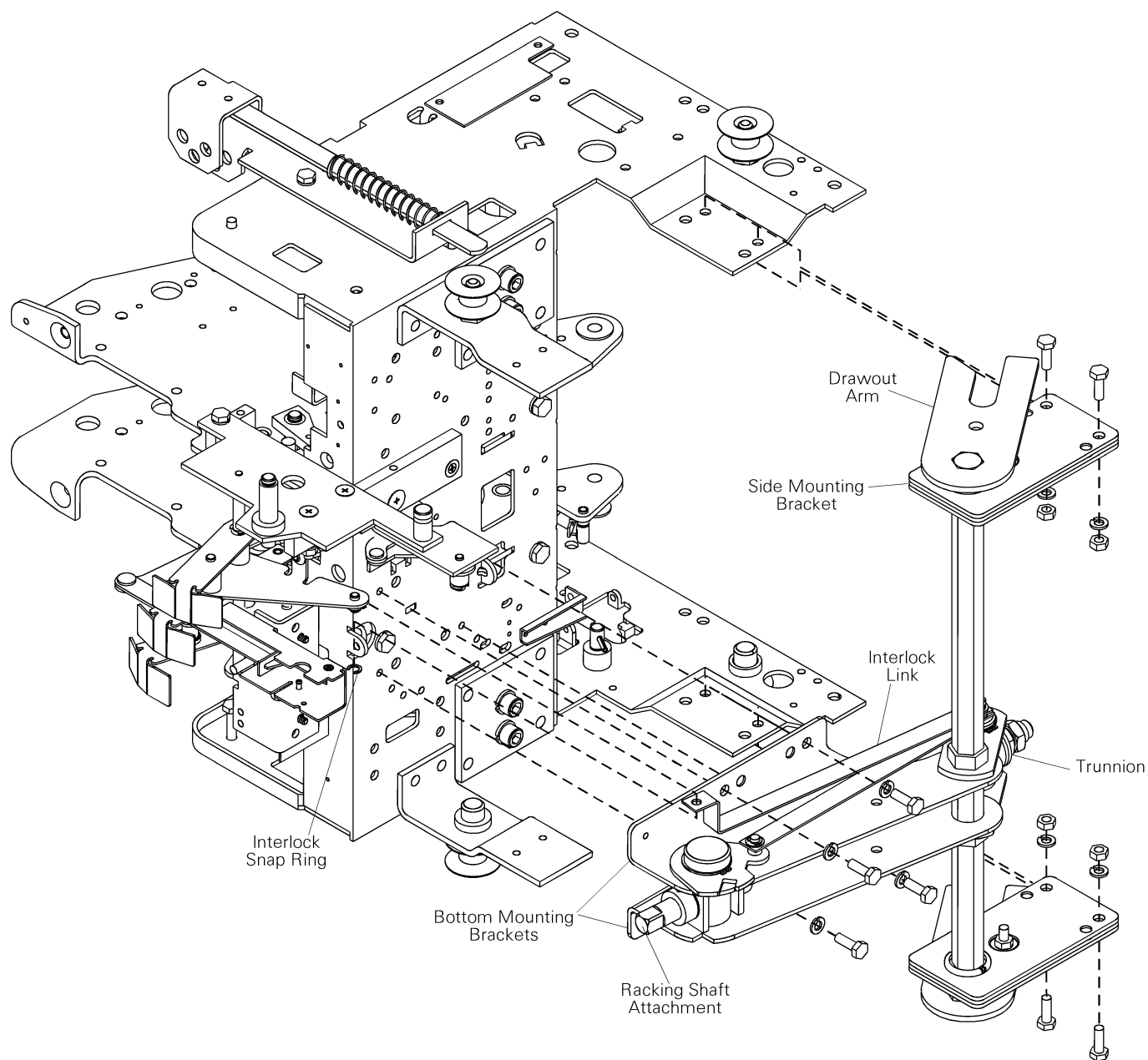
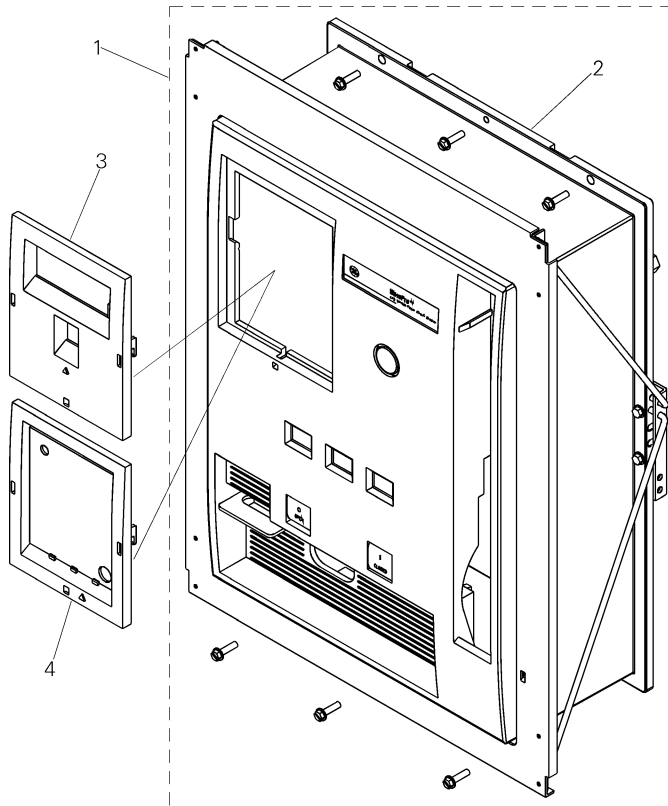


Figure 7-16. Draw-out racking mechanism removal and installation.



## 7–6 Escutcheon

The escutcheon, illustrated in Figure 7-17, 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.



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

Figure 7-17. Escutcheon kit and related parts.

### Escutcheon Removal

Use the following procedure 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.

### Escutcheon Installation

Use the following procedure to install the escutcheon:

1. Use the racking handle to move the draw-out arms to the TEST position. Remove the racking handle and place the racking door in its CLOSED position.
2. 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.
3. 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.
4. Use the racking handle to move the draw-out arms back to the DISCONNECT position.

### 7-7 Charging Handle

The charging handle, illustrated in Figure 7-18, is available as a renewal part.

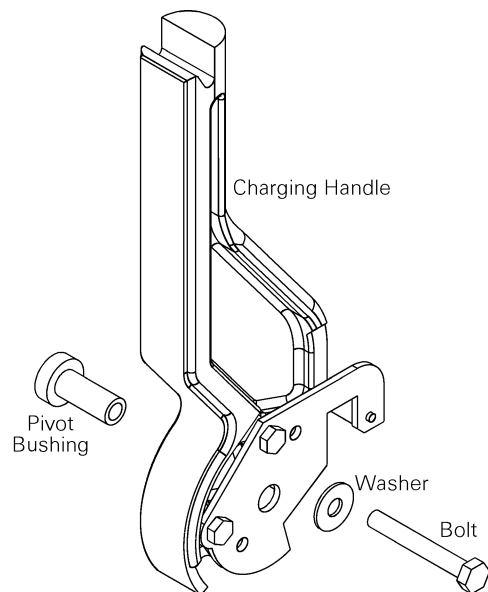


Figure 7-18. Charging handle.

#### Removing the Charging Handle

Use the following procedure to remove the charging handle, as illustrated in Figures 7-19 and 7-20.

1. Remove the escutcheon, as described in Section 7-6.
2. Disconnect the handle return spring from the link on the rear of the handle.
3. Remove the nut and lock washer from the bolt connecting the handle to the charging mechanism, then slide out the bolt and flat washer.
4. Remove the nut and lock washer from the mounting bolt, then slide out the bolt and flat washer. Remove the handle from the breaker.

#### Installing the Charging Handle

Use the following procedure to install the charging handle, as illustrated in Figures 7-19 and 7-20.

1. Insert the pivot bushing into the replacement handle, then place the handle in position on the charging mechanism. Insert the mounting bolt with flat washer and secure it with the lock washer and nut. Tighten to 200 in-lb.

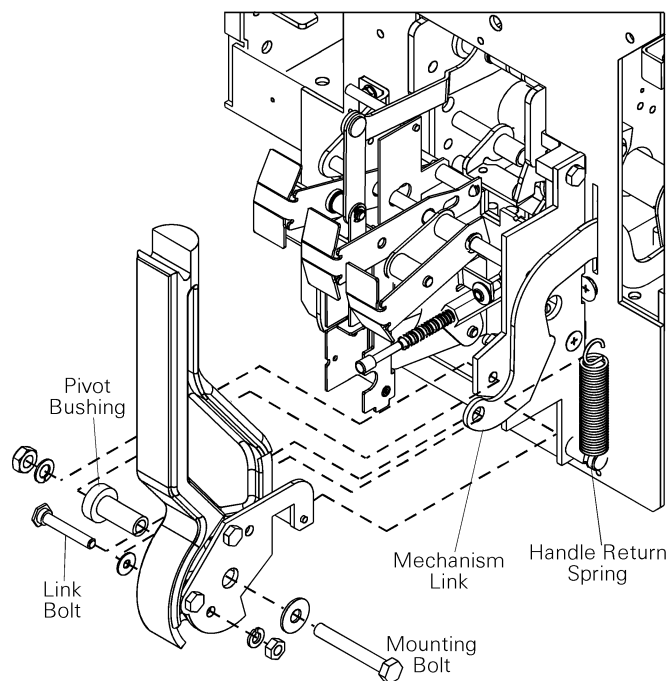


Figure 7-19. Charging handle removal and installation.

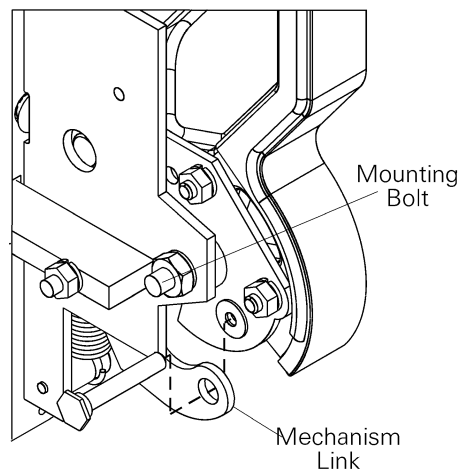


Figure 7-20. Charging handle mounting detail.

2. Slide the other bolt through the mechanism link, flat washer, and handle, then secure it with the lock washer and nut. Tighten to 96 in-lb.
3. Connect the handle return spring to the link on the rear of the handle.
4. Replace the escutcheon, as described in Section 7-6.

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. The bell alarm provides normally open and normally closed outputs available at the secondary disconnects, as illustrated in Figure 8-1.

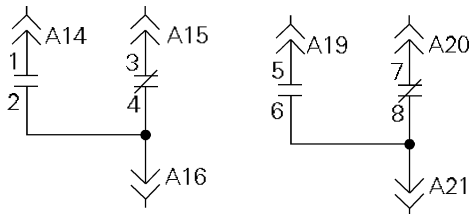


Figure 8-1. Bell alarm connections on the secondary disconnect. The contacts are shown in the reset state.

The bell alarm 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 8-2, or the module only.

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

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

Table 8-1. Bell alarm contact ratings.

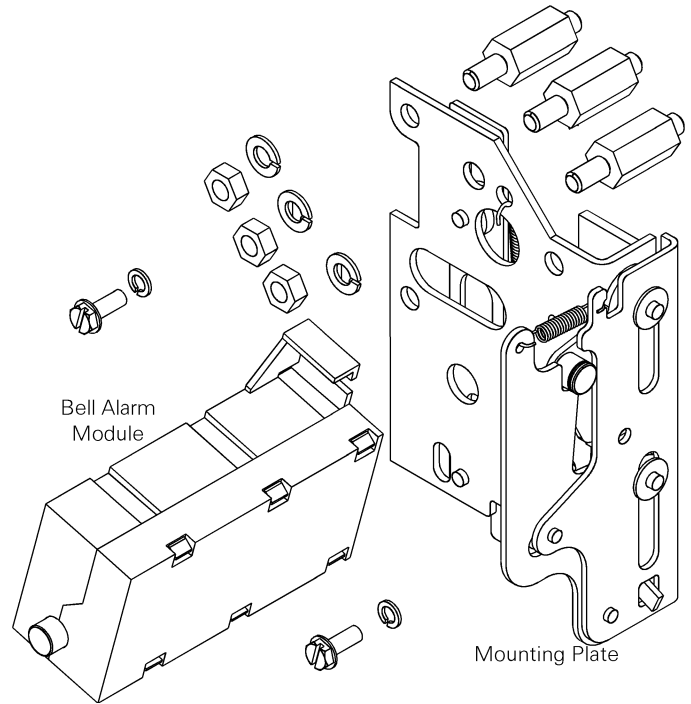


Figure 8-2. Bell alarm accessory kit.

## Removing the Bell Alarm

Use the following procedure to remove the bell alarm module and mounting plate, as illustrated in Figure 8-3. 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.
4. Remove the two screws and washers securing the bell alarm module to the mounting plate and remove the module.
5. Remove the three nuts and lock washers securing the mounting plate to the breaker frame.
6. Disengage the mounting plate from the breaker mechanism and remove the plate.

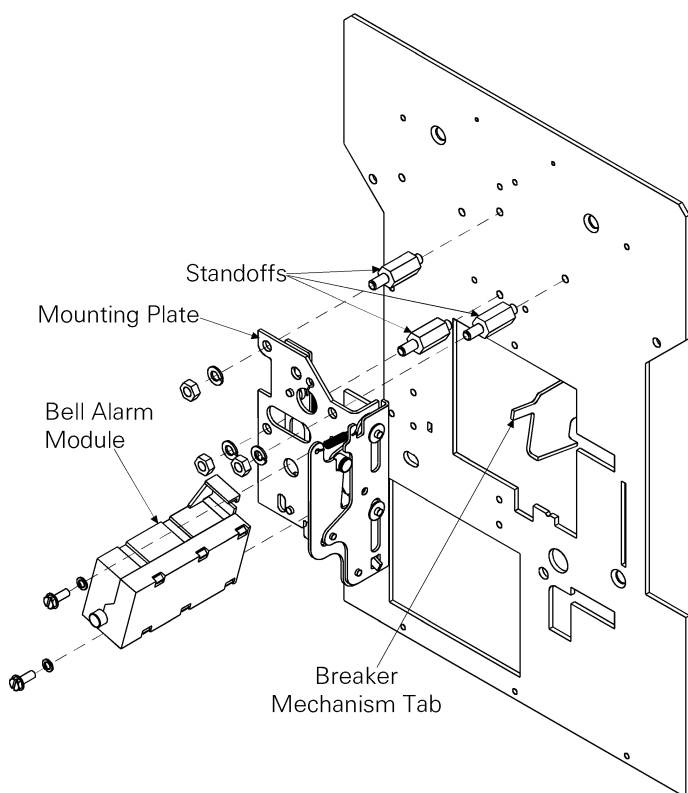


Figure 8-3. Bell alarm installation or removal (shown as bell alarm with lockout).

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.

### Installing the Bell Alarm

Use the following procedure to install the bell alarm mounting plate and module. 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-163, supplied with the bell alarm kit. If only the module is to be replaced, begin at step 3.

1. Place the bell alarm mounting plate over the three standoffs on the breaker front frame and secure with three lock washers and nuts. Ensure that the actuating tab from the breaker mechanism engages the slot in the bottom of the mounting plate, as illustrated in the front view in Figure 8-4.

2. Ensure that the actuating tab from the breaker mechanism engages the slot in the bottom of the mounting plate, as illustrated in the front view in Figure 8-3.
3. Line up the bell alarm module on the mounting plate, as shown in Figure 8-3, 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 8-5, with the legend ↑ SF 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 8-6, with the legend ↑ SF LO horizontal.
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.

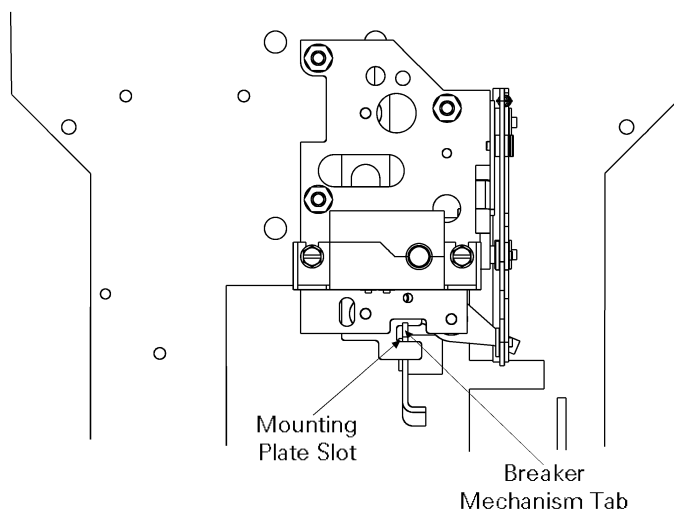


Figure 8-4. Front view of the bell alarm installation, showing the breaker mechanism tab engaging the mounting plate slot.

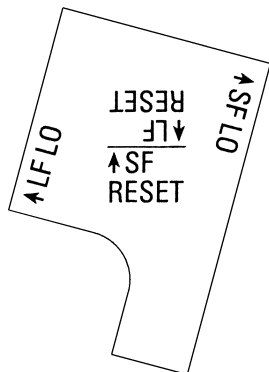


Figure 8-5. Orientation of the label on the bell alarm module for installation as a bell alarm with automatic reset.

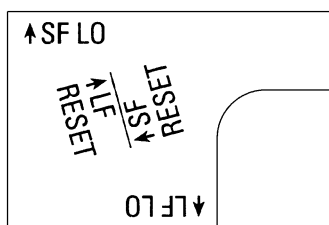


Figure 8-6. Orientation of the label on the bell alarm module for installation as a bell alarm with lockout.

## 8–2 Shunt Trip

The shunt trip accessory allows the breaker to be tripped electrically from a remote location. The shunt trip causes the circuit breaker to trip when its coil is energized. An “A” auxiliary switch, which is closed when the breaker is closed, is in series with the shunt trip coil, as illustrated in Figure 87. The external tripping source is connected to positions A5 and A7 on the secondary disconnect.

Renewal parts for the shunt trip are a complete kit, illustrated in Figure 88, and the module only. Electrical ratings for the shunt trip are listed in Table 8-3.

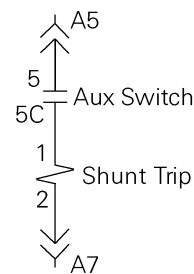


Figure 8-7. Shunt trip connections to the auxiliary switch and secondary disconnect.

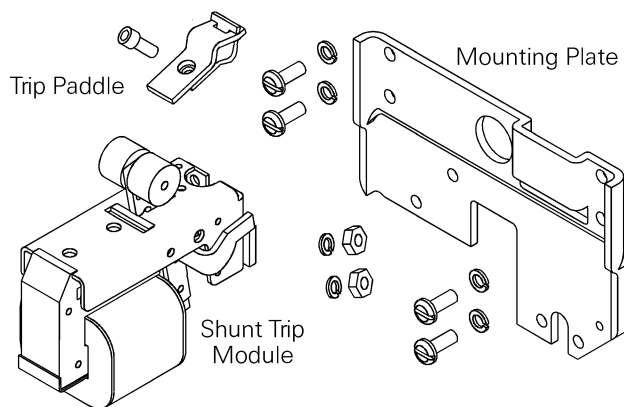


Figure 8-8. Shunt trip accessory kit.

## Removing the Shunt Trip

Use the following procedure to remove the shunt trip module for replacement, as illustrated in Figure 89. 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.

## Chapter 8. Accessory Maintenance

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.

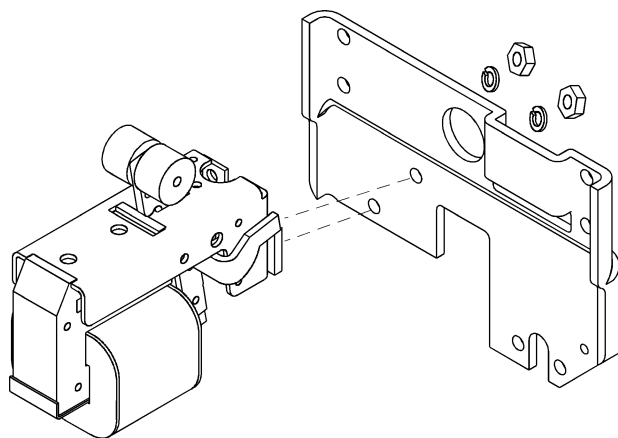


Figure 8-9. Shunt trip module removal and installation.

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. To verify that the shunt trip will trip the breaker, place a 0.03-inch shim between the armature and magnet of the shunt trip and manually operate the armature to trip the breaker.
5. If the breaker does not trip in this test, verify that the mounting fasteners are tight. If they are, bend the trip paddle on the trip shaft to slightly reduce the distance between the trip arm of the shunt trip and the trip paddle and recheck for positive trip. Verify that there is a 0.03–0.05-inch gap between the trip arm and the trip paddle with the breaker closed. A gap greater than 0.05 inch is allowable and may sometimes be necessary to prevent nuisance tripping.

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 8-9. 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-168, 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.
2. Run one wire from the shunt trip module to the auxiliary switch and connect it to terminal 5C. Run

### 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.

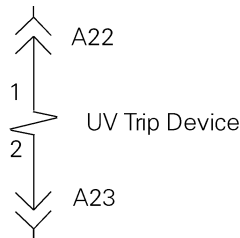


Figure 8-10. Undervoltage trip device connections to the secondary disconnect.

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.

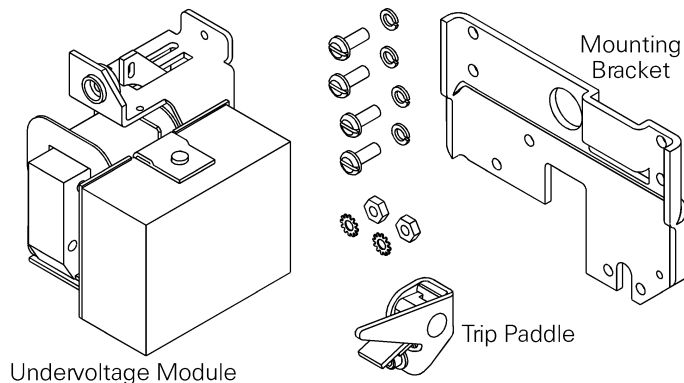


Figure 8-11. Undervoltage trip device accessory kit.

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.

#### 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.

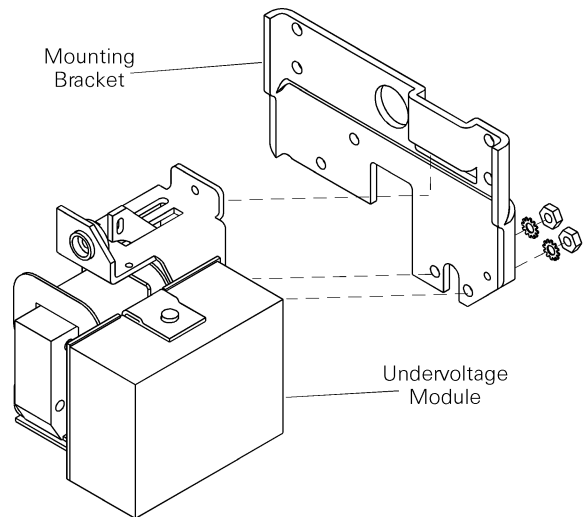


Figure 8-12. Removing or installing the undervoltage trip device.

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 two nuts and lock washers from the back of the mounting bracket attached to the studs on the undervoltage trip device module. Slide the module down to remove the tab from its slot on the 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-165, 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.
2. Slide the tab on the top of the undervoltage module into the slot in the mounting bracket. Insert the two studs on the module into the mounting holes on the bracket. Secure with the nuts and lock washers on the rear of the bracket.
3. The trip paddle must line up with the device armature through the slot in the module, but not touch the sides of the slot; otherwise, nuisance tripping could result. Adjust the position of the trip paddle on the trip shaft as necessary.
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.

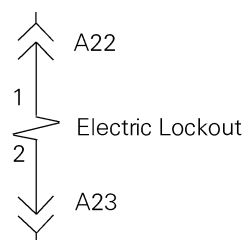


Figure 8-13. Electric lockout connections to the secondary disconnect.

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.

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 8-15. The mounting bracket, bypass mechanism, 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.



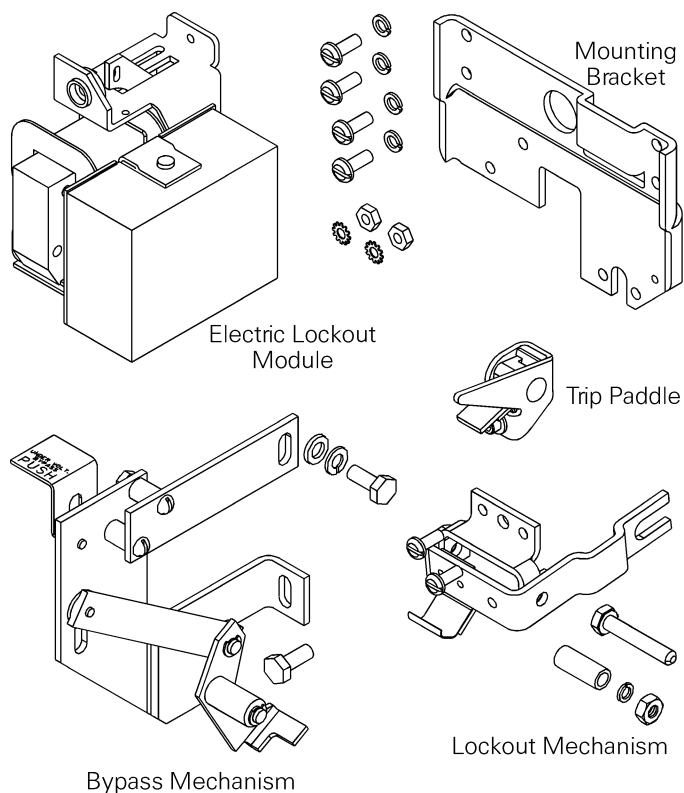


Figure 8-14. Electric lockout accessory kit.

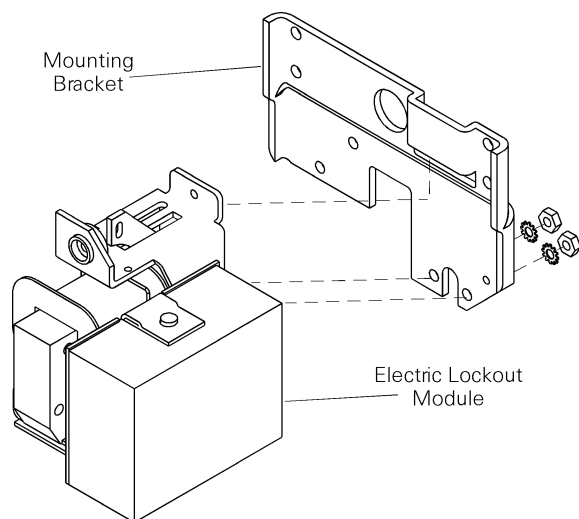


Figure 8-15. Electric lockout module removal and installation.

### Installing the Electric Lockout

Use the following procedure to install the electric lockout module as a replacement, as illustrated in Figure 8-15. 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-170, 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. Slide the tab on the top of the electric lockout module into the slot on the mounting bracket. Insert the two studs on the module into the mounting holes in the bracket. Secure with the nuts and lock washers on the rear of the bracket.
3. The trip paddle must line up with the device armature through the slot in the module, but not touch the sides of the slot; otherwise, nuisance tripping could result. Adjust the position of the trip paddle on the trip shaft as necessary.
4. Adjust the electric lockout 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.

2. Remove the two nuts and lock washers from the back of the mounting bracket attached to the studs on the electric lockout module. Slide the module down to remove the tab from its slot on the bracket.
3. Disconnect the two wires leading to the secondary disconnect from the terminals in the side of the electric lockout module.

## 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, illustrated in Figure 8-16.

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

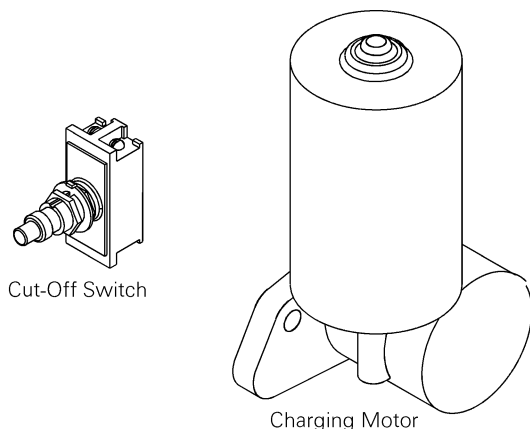


Figure 8-16. Charging motor and cut-off switch.

Nominal Control Voltage	Voltage Range	Inrush Current, A	Sustained Current, A
48 Vdc	38–56	40	10
125 Vdc	100–140	27	5
250 Vdc	200–280	13	3
120 Vac	104–127	25	5
240 Vac	208–254	12	3

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 8-17.

1. Carefully place the breaker on a suitable working surface, so that the right front of the breaker is accessible.
2. Disconnect the motor wires from the secondary disconnect and the motor cut-off switch.
3. Remove the three bolts and lock washers securing the motor to the breaker mechanism.
4. Remove the motor and the three mounting spacers.

## Installing the Charging Motor

Use the following procedure to install a replacement charging motor, as illustrated in Figure 8-17.

1. Place the motor in position with the three mounting spacers on the breaker mechanism and insert the three mounting bolts and lock washers. Tighten the bolts to 110 in-lb.
2. Connect the motor wires to the secondary disconnect and the motor cut-off switch.

## Removing the Motor Cut-Off Switch

Use the following procedure to remove the motor cut-off switch, as illustrated in Figure 8-17.

1. Carefully place the breaker on a suitable working surface, so that the right front of the breaker 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 nut from the switch stem under the hole in the mounting bracket.
5. Remove the cut-off switch.

## Installing the Motor Cut-Off Switch

Use the following procedure to install the replacement motor cut-off switch, as illustrated in Figure 8-17.

1. Screw one of the locking nuts onto the switch barrel and place the flat washer over the nut.
2. Place the cut-off switch in position with the switch stem through the hole in the mounting bracket. Attach the mounting nut and secure the switch.
3. Connect the wires at the screw terminals on the switch.

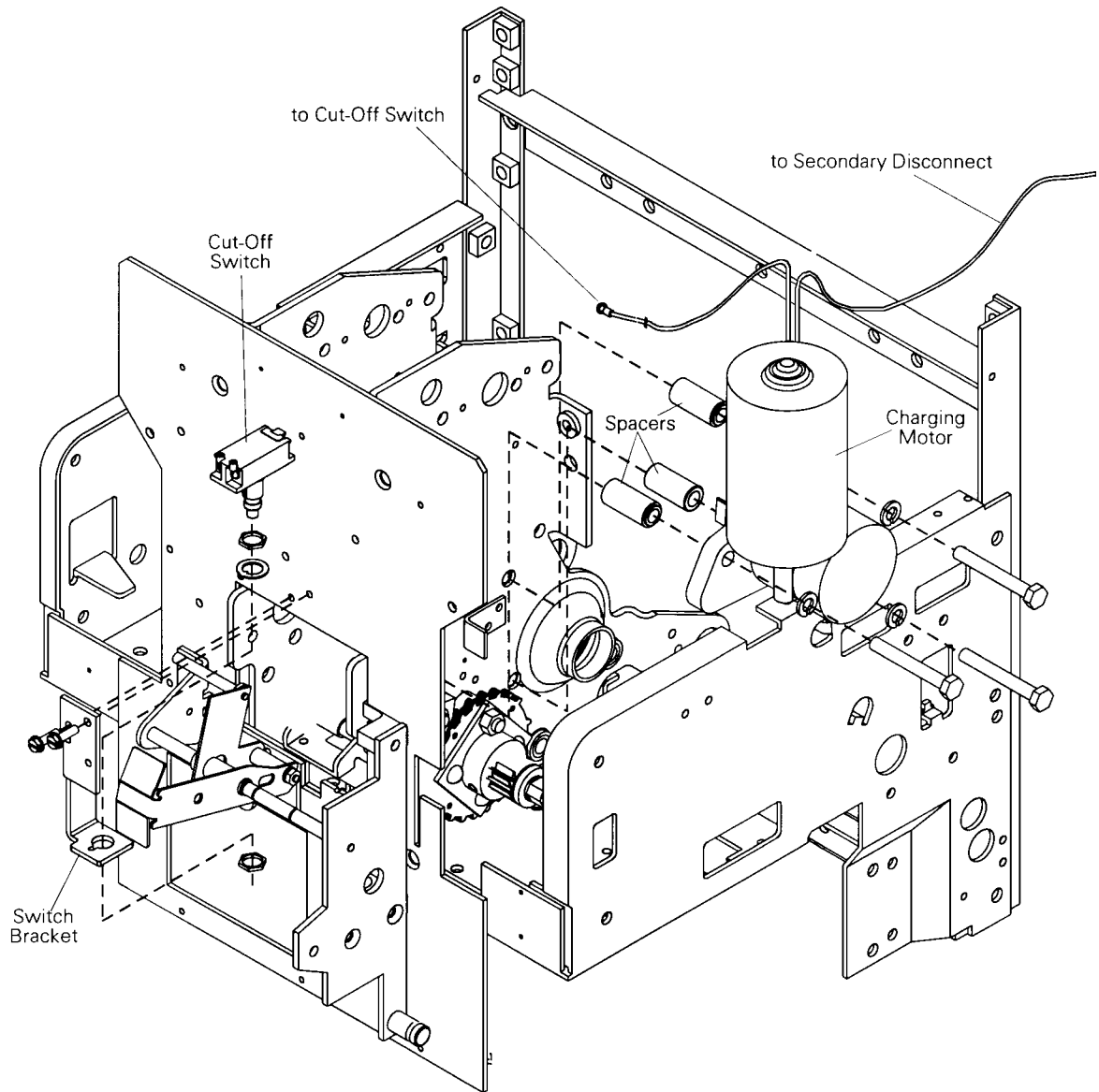


Figure 8-17. Removal and installation of the charging motor and cut-off switch.

### Adjusting the Motor Cut-Off Switch

Adjust the cut-off switch as illustrated in Figure 8-18:

1. Charge the closing springs with the manual charging handle.
2. The main stem of the switch should be located between 0.005 and 0.030 inch from the barrel.
3. If necessary, adjust switch depression by loosening the switch mounting nuts and moving the switch up or down in its mounting bracket. Re-tighten the mounting nuts.

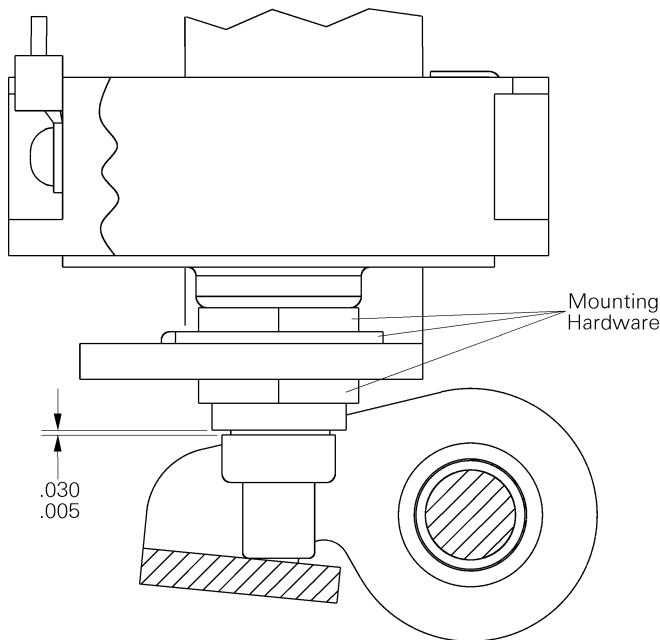


Figure 8-18. Cut-off switch adjustment.

### 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 8-19, the circuit board, and the solenoid.

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

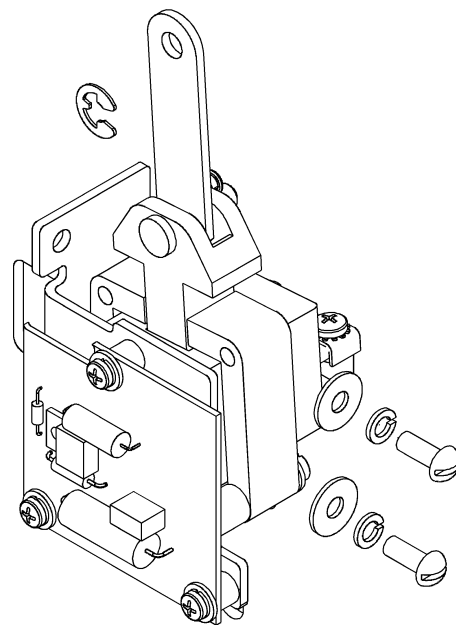


Figure 8-19. Remote close accessory kit.

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.

### Removing the Remote Close

Use the following procedure to remove the remote close for replacement, as illustrated in Figure 8-20.

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. 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 remote close.
3. Remove the two screws, lock washers, and flat washers connecting the remote close module to the breaker frame.
4. Remove the snap ring connecting the remote close actuator to the pin on the charging mechanism and remove the module.
5. The remote close solenoid or circuit board can now be separately replaced on the module.

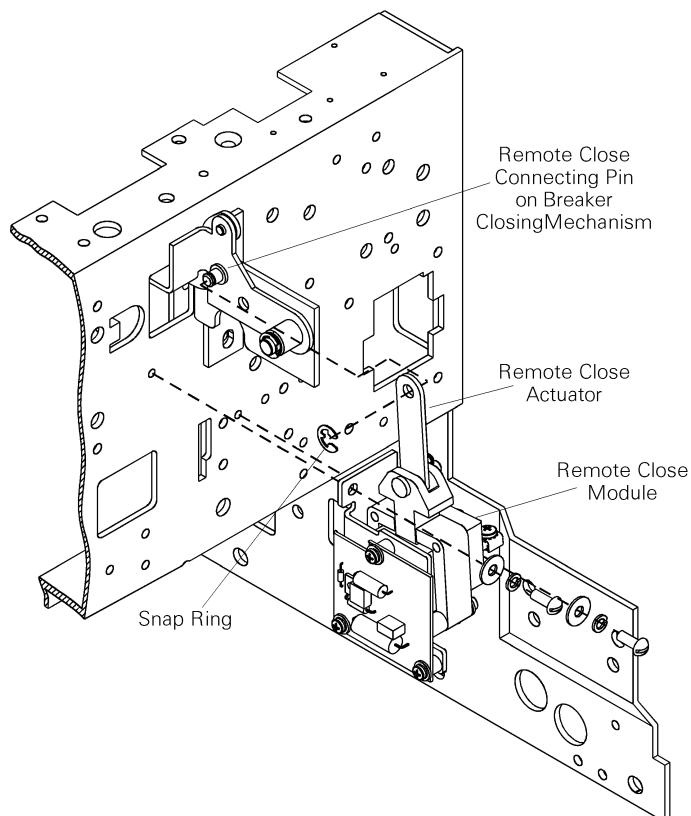


Figure 8-20. Remote close installation and removal.

### Installing the Remote Close

Use the following procedure to install the replacement remote close, as illustrated in Figure 8-20.

1. Insert the connecting pin on the breaker closing mechanism through the hole in the end of the remote close actuator and secure with the snap ring.
2. Line up the mounting holes in the remote close module with the two tapped holes in the bottom of the breaker frame. Insert a screw with lock washer and flat washer into each hole and tighten.
3. Run the wires from the remote close module to the secondary disconnect A block and connect the wires to terminals 9 and 18. Attach the wires to the breaker frame with wire ties as needed.

## Chapter 8. Accessory Maintenance

## 8–7 Auxiliary Switch

Auxiliary switches provide remote indication of the breaker main contact position and are available 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 8-21, with either four or seven switches on the module.

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

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

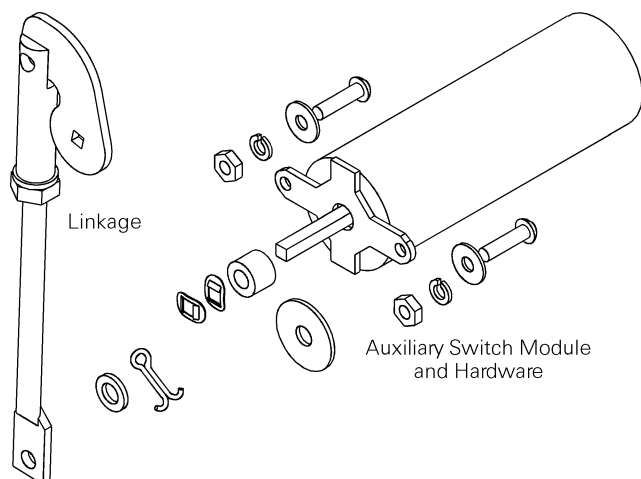


Figure 8-21. Auxiliary switch kit.

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.

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.

## Removing the Auxiliary Switch

Use the following procedure to remove an auxiliary switch module for replacement, as illustrated in Figure 8-22. The linkage does not normally need replacement.

1. Remove the mounting bolts securing the center and right arc chutes and lift out the arc chutes.
2. Disconnect the wires on the terminals at the auxiliary switch module, carefully marking them for reinstallation on the replacement switch module.
3. Remove the two spring clips from the end of the auxiliary switch center shaft. Remove the two screws, flat washers, lock washers, and nuts securing the switch module to the mounting plate and remove the switch. Note that there is a spacer and flat washer on the switch center shaft.

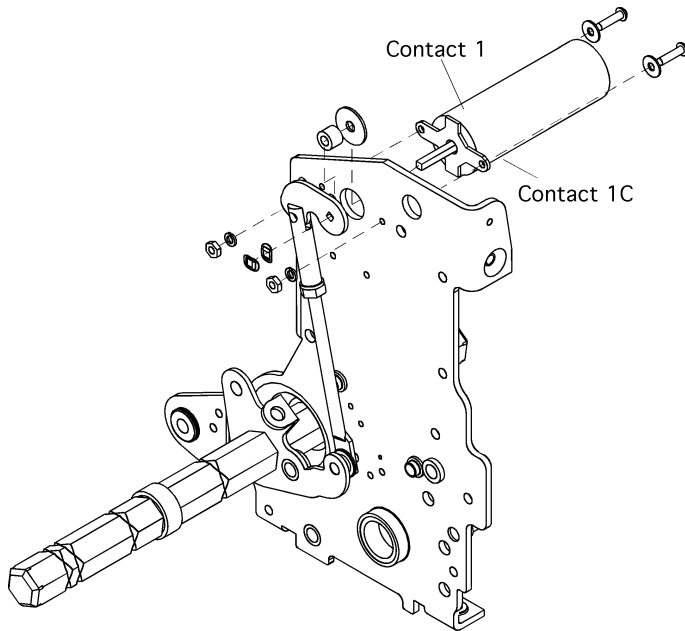


Figure 8-22 Removal and installation of the auxiliary switch module.

### 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-188, supplied with the auxiliary switch kit.

1. Insert the shaft of the auxiliary switch module through the hole in the breaker frame, so that the scribed line on the end of the shaft is horizontal. Contact 1 must be on the top of the module and contact 1C on the bottom, as indicated in Figure 8-22. Verify that the breaker is OPEN during this alignment.
2. Place the large flat washer and spacer over the module shaft. Slide the module shaft through the hole in the linkage and attach with the two spring clips 90° from each other. Secure the module to the breaker frame with two screws, flat washers, lock washers, and nuts, as shown.
3. Connect the wires to the new auxiliary switch module, ensuring that they are connected to the proper terminals.
4. Check that the length between the pivots on the linkage is 6.50 inch, as shown in Figure 8-23.
5. 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.
6. Replace the center and right arc chutes and secure with the bolts and lock washers removed earlier.

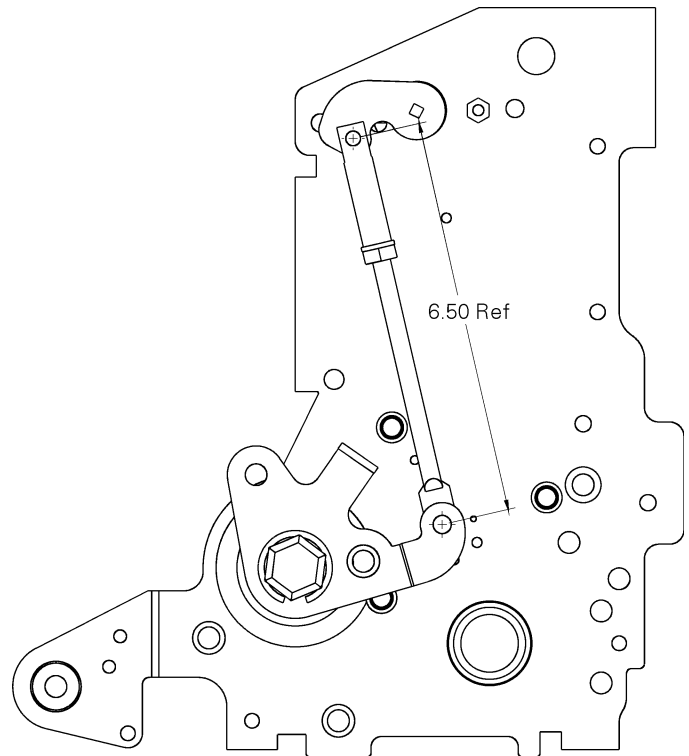


Figure 8-23. Adjusting the auxiliary switch linkage.

## Chapter 8. Accessory Maintenance

## 8–8 Open-Fuse Lockout

The open-fuse lockout, illustrated in Figure 8-24, is used in combination with either integral fuses or 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 and trips the breaker. 800 & 1600A frame breakers are integrally fused while the 2000A frame breaker utilizes a fuse rollout element. The open fuse lockout is wired directly to the fuses on 800 & 1600A frame breakers. On 2000A frame breakers, the open fuse lockout is wired to the fuse rollout element through the secondary disconnect as shown in Figure 8-25. An indicator shows which fuse has blown. The breaker cannot be reclosed until the reset button is pressed on the open-fuse lockout.

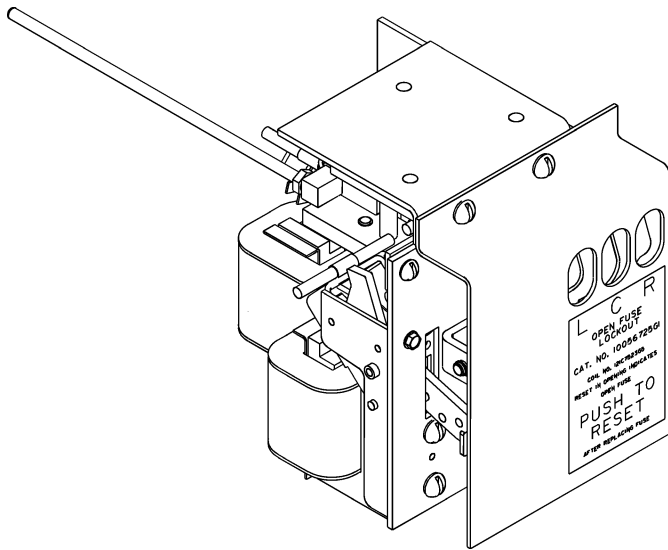


Figure 8-24. Open-fuse lockout accessory.

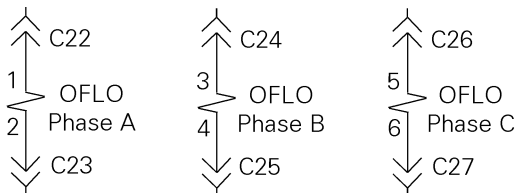


Figure 8-25. Open-fuse lockout connections to the secondary disconnect (2000A frame breakers only).

## Removing the Open-Fuse Lockout

Use the following procedure, illustrated in Figure 8-26, to remove the open-fuse lockout for replacement.

1. Disconnect the wires from the open-fuse lockout at terminals 22, 23, 24, 25, 26, and 27 of the secondary disconnect C block on 2000A frame breakers or from the fuses for 800 & 1600A frame breakers. Cut any wire ties, as necessary to release the wires back to the open-fuse lockout.

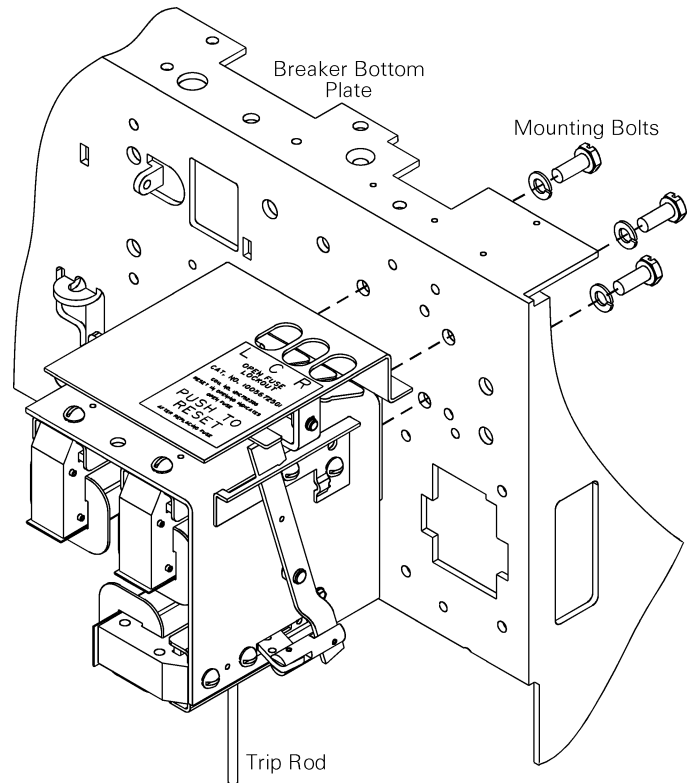


Figure 8-26. Open-fuse lockout installation and removal.

2. Remove the three mounting bolts and lock washers securing the open-fuse lockout to the bottom plate of the breaker.
3. Remove the open-fuse lockout straight out from the front of the breaker.

## Installing the Open-Fuse Lockout

Use the following procedure, illustrated in Figure 8-26, to install a replacement open-fuse lockout.

1. Place the replacement open-fuse lockout in position, carefully guiding the trip rod through the hole in the trip rod guide.
2. Insert the three bolts and lock washers from the top of the breaker bottom plate into the tapped holes in the open-fuse lockout mounting bracket. Tighten to 96 in-lb.



3. Connect the wires from the coils on the open-fuse lockout directly across each fuse or 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. Adjust the open-fuse lockout as follows:
  - a. Charge the closing springs with the manual charging handle and close the breaker.
  - b. The dimension between the end of the trip rod and the trip paddle should be 0.10–0.14 inch. If necessary, loosen the trip rod lock nut and turn the rod in or out to attain the proper clearance.
  - c. With the open-fuse lockout energized, the breaker must TRIP and the RESET button must move forward to the front plate. In this condition, the breaker must be held trip free.

### 8–9 Remote Charge-Indication Switch

The remote charge-indication switch, illustrated in Figure 8-27, 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.

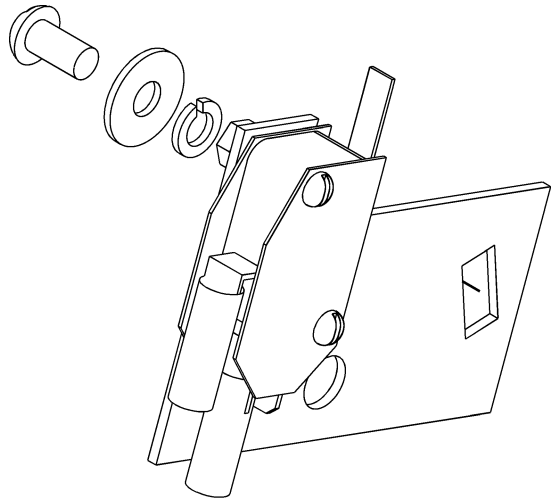


Figure 8-27. Remote charge-indication switch.

### Removing the Remote Charge-Indication Switch

Use the following procedure to remove the remote charge-indication switch for replacement, as illustrated in Figure 8-28.

1. Remove the breaker escutcheon, as described in Section 7–6.
2. Disconnect the two wires from terminals 8 and 17 of the secondary disconnect C block and bring them back to the switch.
3. Remove the bolt, lock washer, and flat washer attaching the switch to the flag shaft support plate, then slide off the switch.

## Chapter 8. Accessory Maintenance

### Installing the Remote Charge-Indication Switch

Use the following procedure to install the replacement remote charge-indication switch, as illustrated in Figure 8-28.

1. Place the replacement switch in position on the flag shaft. Insert the mounting bolt, lock washer, and flat washer through the rectangular hole in the switch and into the tapped hole in the flag shaft support plate. Do not tighten the bolt.
2. Adjust the switch position as follows:
  - a. Charge the breaker closing springs with the manual charging handle.
  - b. Rotate the switch until the switch trigger is fully depressed against the trigger pin, as illustrated in Figure 8-29.
  - c. Tighten the switch mounting bolt to 32 in-lb.
  - d. Close and trip the breaker.
3. Run the two wires from the switch to the secondary disconnect C block and connect them to terminals 8 and 17.
4. Replace the breaker escutcheon, as described in Section 7–6.

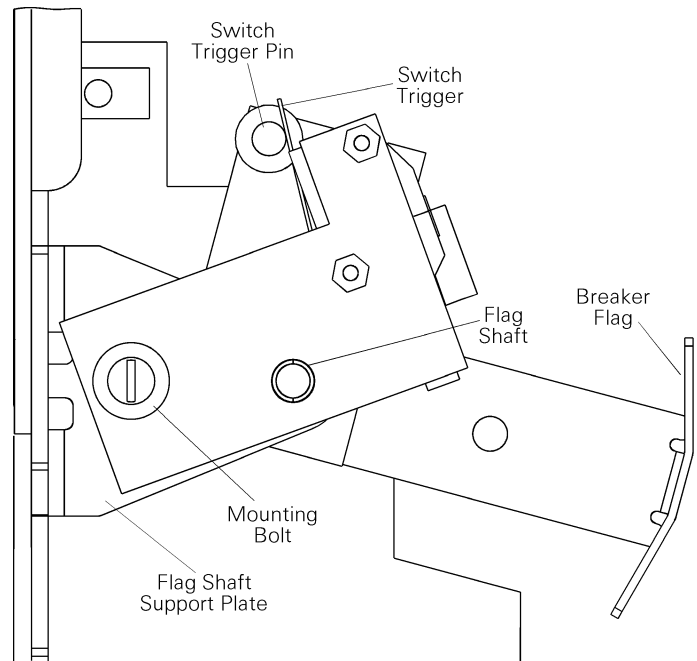


Figure 8-29. Remote charge-indication switch side view.

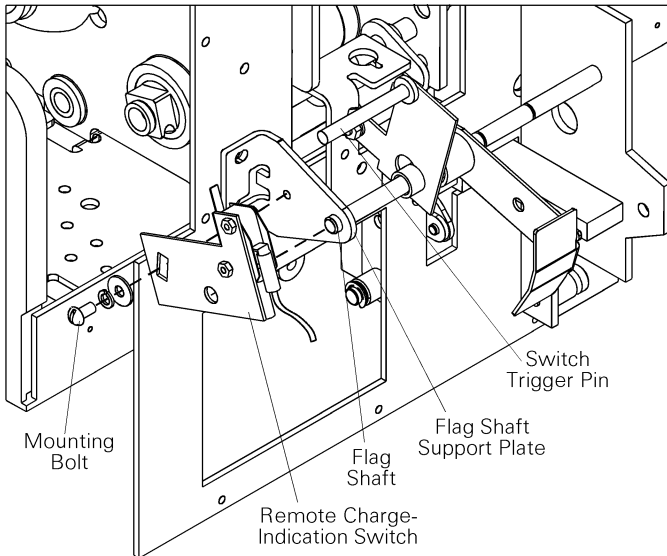


Figure 8-28. Remote charge-indication switch removal and installation.

## 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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GE Electrical Distribution & Control