

Installation

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Introduction

Qualified Persons

WARNING

Only qualified persons knowledgeable in the installation, operation, and maintenance of overhead and underground electric transmission and distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of special precautionary techniques, personal protective equipment, insulated and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read This Instruction Sheet

NOTICE

Thoroughly and carefully read this instruction sheet and all materials included in the product's instruction handbook before installing the Mark V Circuit-Switcher. Become familiar with the Safety Information on pages 3 through 4 and Safety Precautions on page 5. The latest version of this publication is available online in PDF format at sandc.com/en/contact-us/product-literature/.

Retain This Instruction Sheet

This instruction sheet is a permanent part of the Mark V Circuit-Switcher. Designate a location where users can easily retrieve and refer to this publication.

Proper Application

WARNING

The equipment in this publication is only intended for specific applications. The applications must be within the ratings furnished for the equipment. Application and ratings information for the Mark V Circuit-Switcher are listed in Specification Bulletin 711-31. The ratings are also on the nameplate affixed to the product.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to the product. Become familiar with these types of messages and the importance of these signal words:

⚠ DANGER
“DANGER” identifies the most serious and immediate hazards that will likely result in serious personal injury or death if instructions, including recommended precautions, are not followed.


⚠ WARNING
“WARNING” identifies hazards or unsafe practices that can result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION
“CAUTION” identifies hazards or unsafe practices that can result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE
“NOTICE” identifies important procedures or requirements that can result in product or property damage if instructions are not followed.

Following Safety Instructions

If any portion of this instruction sheet is unclear and assistance is needed, contact the nearest S&C Sales Office or S&C Authorized Distributor, or call the S&C Global Support and Monitoring Center at 1-888-762-1100. Telephone numbers are also listed on S&C’s website, sandc.com.

NOTICE	
Read this instruction sheet thoroughly and carefully before installing the Mark V Circuit-Switcher.	

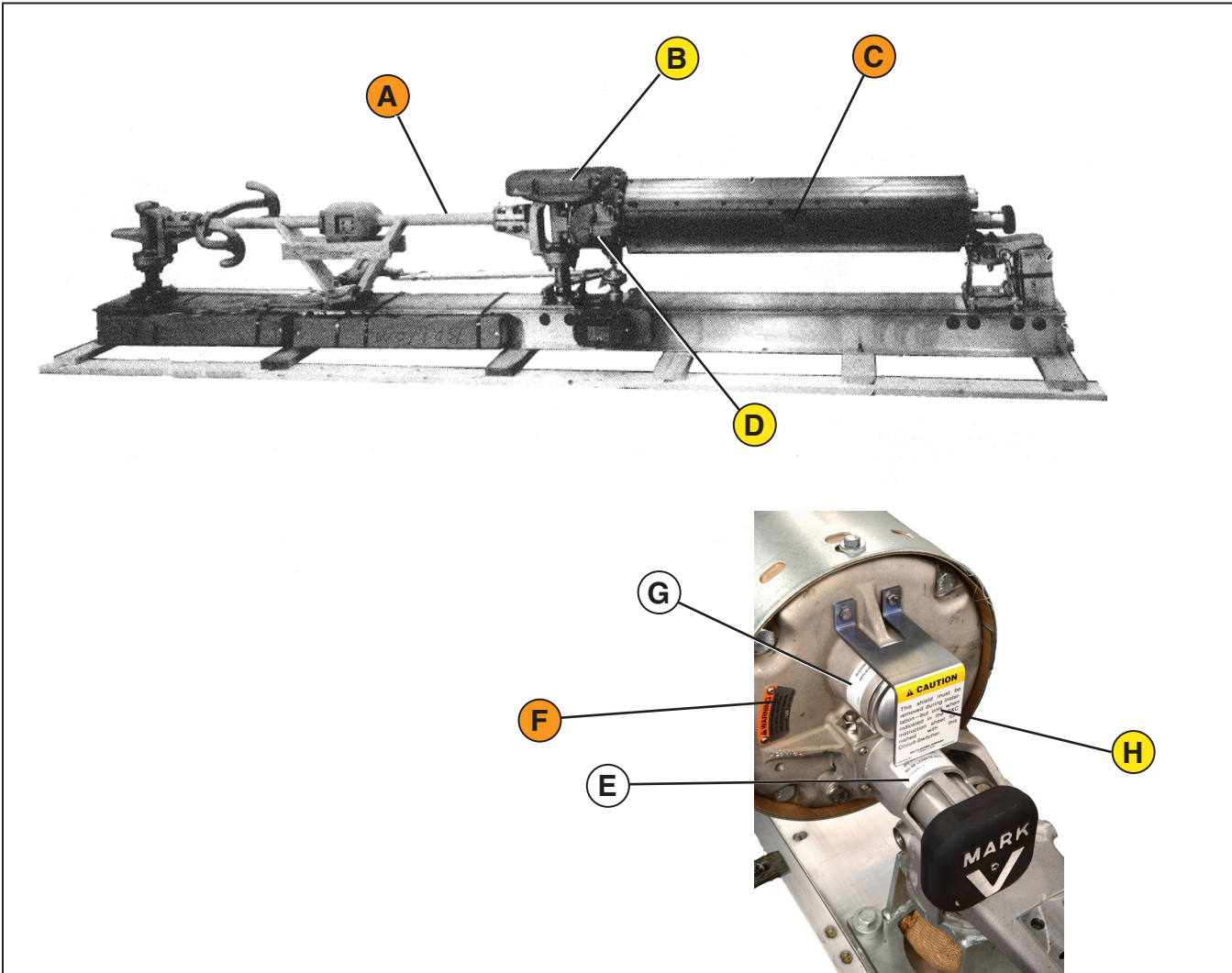
Replacement Instructions and Labels

If additional copies of this instruction sheet are required, contact the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting the nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Safety Information

Location of Safety Labels



Reorder Information for Safety Labels

Location	Safety Alert Message	Description	Part Number
A	⚠ WARNING	Do not lift the brain and interrupting unit by attaching slings to the disconnect blade.	G-4093●
B	⚠ CAUTION	Before putting the switch into service, the interrupters must be closed...	G-4512■
C	⚠ WARNING	DO NOT remove steel outer wrapper until installation is complete.	G-5993
D	⚠ CAUTION	After the shunt-trip insulated operating shaft has been installed...	G-4602■
E	INSTRUCTION	Do not lift here.	G-3824
F	⚠ WARNING	Interrupter pressurized to 85 PSI. Install protective shields prior to removal.	G-9680
G	INSTRUCTION	Interrupter Part Number. Replace with catalog number...	G-6376
H	⚠ CAUTION	This shield must be removed during installation—but only when indicated...	G-6043●

● Temporary tag. Remove after installation.

■ For shunt-trip option only.

⚠ DANGER



Mark V Circuit-Switchers operate at high voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. QUALIFIED PERSONS. Access to Mark V Circuit-Switchers must be restricted only to qualified persons. See the "Qualified Persons" section on page 2. 2. SAFETY PROCEDURES. Always follow safe operating procedures and rules. 3. PERSONAL PROTECTIVE EQUIPMENT. Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flash clothing, in accordance with safe operating procedures and rules.. 4. SAFETY LABELS. Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "NOTICE" labels. 5. OPERATING MECHANISM AND BASE. Mark V Circuit-Switchers contain fast moving parts that can severely injure fingers. Do not remove or disassemble operating mechanisms or remove access panels unless directed by S&C Electric Company. 6. ENERGIZED COMPONENTS. Always consider all parts live until de-energized, tested, and grounded. Voltage levels can be as high as the peak line-to-ground voltage last applied to the circuit-switcher. | <p>Circuit-switchers that have been installed near energized lines should be considered live until tested and grounded.</p> <ol style="list-style-type: none"> 7. GROUNDING. The Mark V Circuit-Switcher must be connected to a suitable earth ground at the base of the utility pole, substation ground system, or to a suitable building ground for testing, before energizing the switch and at all times when energized.
The ground wire(s) must be bonded to a system neutral, if present. If the system neutral is not present, proper precautions must be taken to ensure the local earth ground, or building ground, cannot be severed or removed. 8. SWITCH POSITION. Always confirm the Open/Close position of each switch. <ul style="list-style-type: none"> ○ Switches and terminal pads may be energized from either side. ○ Switches and terminal pads may be energized with the switches in any position. 9. MAINTAINING PROPER CLEARANCE. Always maintain proper clearance from energized components. |
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Shipping and Handling

Inspection

Examine the shipment for external evidence of damage as soon after receipt as possible, preferably before removal from the carrier's conveyance. Check the bill of lading to make sure all listed shipping skids, crates, cartons, and containers are present.

If there is visible loss and/or damage:

1. Notify the delivering carrier immediately.
2. Ask for a carrier inspection.
3. Note the condition of shipment on all copies of the delivery receipt.
4. File a claim with the carrier.

If concealed damaged is discovered:

1. Notify the delivering carrier within 15 days of receipt of shipment.
2. Ask for a carrier inspection.
3. File a claim with the carrier.

Also, notify S&C Electric Company in all instances of loss or damage.

Packing

An S&C erection drawing will be found in a water-resistant envelope attached to the interrupter container on one of the three circuit-switcher pole-units. Study the erection drawing carefully and check the bill of material to make sure all parts are at hand.

The circuit-switcher shipment should include the following items, as shown in Figure 1 on page 7:

1. Three pole-units, each mounted on a skid. The live parts-which are attached directly to the insulator mounting flanges-are factory-assembled and adjusted and should not be interchanged during their removal for installation of the insulators.
2. A crate which contains miscellaneous power-train components, interphase couplings, mounting hardware, and a temporary adapter for hand operation of the individual pole-units-all individually identified.
3. The vertical operating shaft, interphase shafts, and connecting shaft, which are bundled and shipped uncrated. These shafts are cut to length if specified. Otherwise, the correct number of shaft sections

are shipped for field cutting in accordance with the dimensions specified on the erection drawing.

- a. Interphase shafts and connecting shafts of 2½-inch IPS pipe are furnished if the distance from the gearbox to the farthest pole-unit is 25 feet (7.62 m) or less. If this distance exceeds 25 feet, interphase shafts and connecting shafts of 3-inch IPS pipe are supplied.
 - b. Vertical shafts of 2½-inch IPS pipe are furnished if the gearbox mounting height is over 25 feet or less. If the gearbox mounting height is over 25 feet, vertical shafts of 3-inch IPS pipe are furnished.
4. Insulators, which are shipped in separate crates.
 5. A specially prepared gauge pipe, identified by a red band, shipped attached to one of the pole-unit skids. This gauge pipe is an alignment tool and should be handled with reasonable care to avoid deforming it.
 6. A Type CS-1A Switch Operator (as specified). Instructions for installing the switch operation are found in S&C Instruction Sheet 719-500.
 7. Any accessories specified, such as shunt-trip device, bypass accessory, grounding switch, manual operating handle, or pre-insertion inductor.

Note: Interrupter Target. Circuit-Switchers are usually shipped with the interrupters in the **Open** position. Therefore, if the interrupter target, located on the side of each brain housing will appear yellow. See Figure 2 on page 7. During the step-by-step instructions in this instruction sheet, the disconnect blades will be moved to the fully **Open** position. This will close the interrupter and charge and latch the stored-energy source within the brain, and the target will appear gray (normal).

Note: Gas-Pressure. Circuit-Switchers have sealed interrupters containing gas under pressure. Loss of gas pressure from damage during shipping or handling may result in improper interrupting action. Low gas pressure is signaled by a red target in the gas-pressure indicator at the terminal end of each interrupter. A gray target indicates normal pressure. See Figure 3 on page 7.

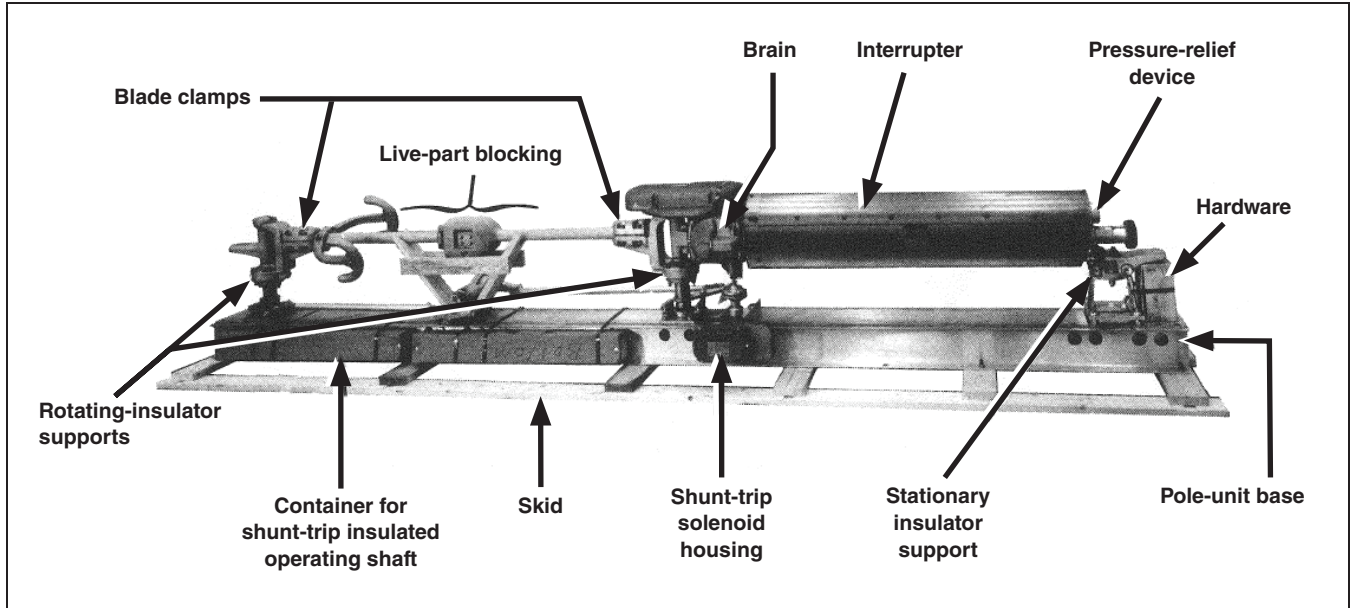


Figure 1. Center-Break Mark V Circuit-Switcher on shipping skid.

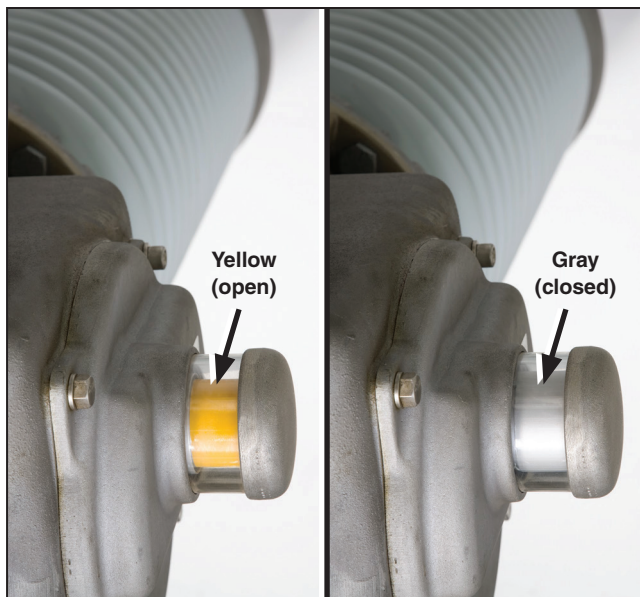


Figure 2. Interrupter target.

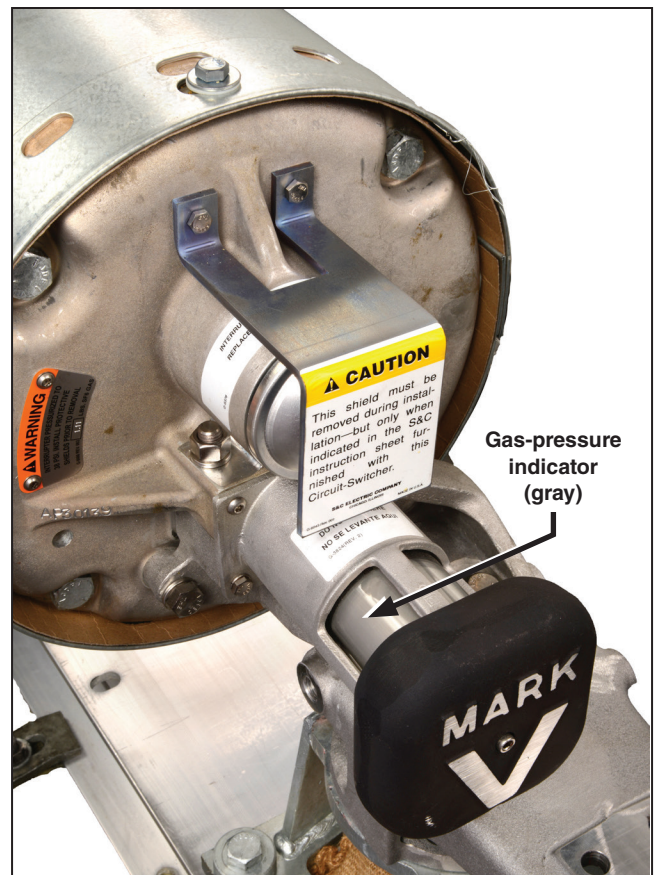


Figure 3. Gas-pressure target indicator.

Options and Accessories

Shunt-Trip Device

High-Speed tripping of power-operated Mark V Circuit-Switchers is furnished by the S&C Shunt-Trip Device. This optional accessory (circuit-switcher catalog number suffix “-T1” or “-T2”) provides high speed (8-cycle) circuit interruption. The Type CS-1A Switch Operator is required if the shunt-trip device is specified.

If the optional shunt-trip device has been specified, a shunt-trip solenoid housing will be attached to the side of each pole-unit base near the center insulator support, and a shunt-trip linkage will be attached to the brain. The cartons containing these insulator units should be opened to inspect for shipping damage, but the units should be left in the boxes until installation to prevent damage at the job site.

Installation of the shunt-trip insulated operating shafts should be performed as described in “Connecting the Optional Shunt-Trip Device” on page 21 before adjusting the pole-units as described in “Adjusting the Pole-Units” on page 21. Conduit and control wiring from the switch operator to the shunt-trip solenoid housings—to be furnished by the user—may be installed any time after the circuit-switcher pole-units have been permanently mounted in place. Conduit size should be one inch (25 mm) minimum. Control wiring for the shunt-trip solenoids should be left disconnected at the switch operator end until the section “Checking the Operation” on page 25 has been completed. Refer to S&C Instruction Sheet 711-600 for recommended wire sizes for the control wiring.

Mounting Pedestals

The high operating speed, which makes possible many of the Mark V Circuit Switcher’s superior performance features when power-operated, brings about high acceleration and deceleration rates, resulting in high dynamic forces. S&C Mounting Pedestals were specifically designed for these forces, and are therefore highly recommended. Alternately, circuit-switchers can be installed on a user’s steel pedestal or supporting structure, which must meet specific static and dynamic deflection limits shown in S&C Information Bulletin 711-301, so the dynamic forces will be absorbed by the pedestal and not transferred to the adjoining bus, other apparatus, and the bushings. Install S&C mounting pedestals per the included dimensional drawing.

Handling

NOTICE

Do not intermix components from different installations

S&C maintains an historical record, by serial number, of every circuit-switcher produced. This record lists information pertinent to each installation, such as application, date of shipment, and any service performed by S&C factory service specialists. This record is invaluable when questions arise relative to modifications or replacements. It is important, therefore, components belonging to a specific circuit-switcher installation not be intermixed with components belonging to a different installation.

For this reason, each circuit-switcher is serially numbered. This serial number is stamped on the nameplate affixed to the mounting-frame weldment and also on the nameplate affixed to the switch operator (or the manual geared operating handle if the circuit-switcher is manually operated).

To facilitate identification during erection, the serial number, the sales-order number, and the erection-drawing (ED) number are marked on the circuit-switcher mounting-frame weldment and on the switch operator shipping crate, and on all crates, boxes, and bundles for the other components associated with the installation. In addition, each circuit-switcher pole-unit base, as well as the pole-unit skid, is marked “Pole 1,” “Pole 2,” or “Pole 3,” corresponding to the mounting position of the pole-unit on the erection drawing. These pole-unit numbers are not necessarily phase designations.

WARNING

Do not remove the protective shields around the interrupters until the installation is complete. Interrupters are pressurized to 85 PSIG. **Failure to keep the shields in place during installation may cause equipment damage or serious personal injury.**

Before Starting

Without removing the circuit-switcher pole-units from their skids, arrange them in the position and order in which they will be raised onto their mounting pedestals or structure as shown on the erection drawing. Each pole-unit base is numbered, corresponding to its position as indicated on the erection drawing. (The pole-unit numbers are not necessarily phase designations.) Moreover, the three pole-units carry the same serial number located on the nameplate of each pole-unit base. In the event more than three pole-units are available, care should be taken to be sure the serial numbers are matched for each circuit-switcher installation. The switch operator also carries the circuit-switcher serial number on its nameplate to aid in making certain the operator is used with the correct circuit-switcher.

Each skid should rest firmly and be reasonably level. Shoring under the skids may be necessary if the ground is uneven. Sufficient space must be provided to permit full blade opening of each pole-unit without interference with the adjacent pole-unit or pedestal. The blades will open to the left, as viewed from the interrupter end.

Assembly of Individual Pole-Units

Repeat Step 1 through Step 26 on page 20 for each of the three circuit-switcher pole-units:

- STEP 1.** Carefully remove the outer crate (if provided), but leave the skid attached to the pole-unit base. Remove any packaging supporting the live parts during shipping. See Figure 1 on page 7. Inspect for any obvious shipping damage before continuing installation.
- STEP 2.** Attach the temporary hand-operation adapter, which is provided, to the drive-shaft crank on the side opposite the direction of blade opening as shown in Figure 4. (Use this same temporary hand-operation adapter when checking and adjusting the other two pole-units.)

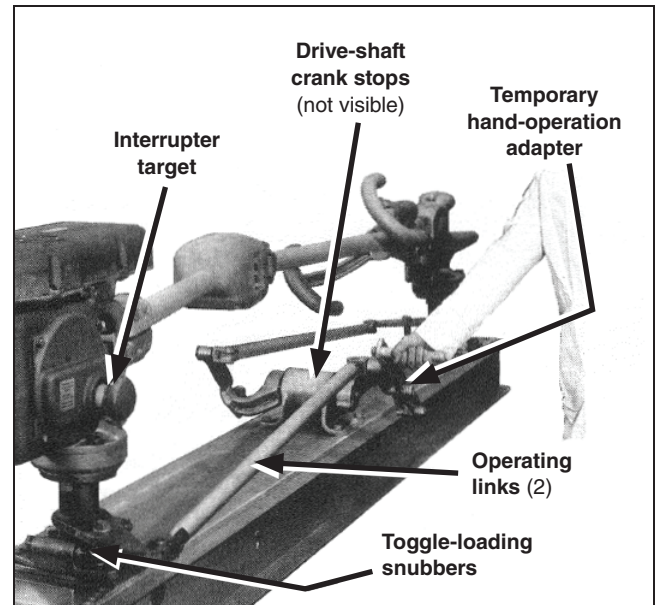


Figure 4. The base-integrated power train being operated with the temporary hand-operation adapter.

Installation

STEP 3. With the hand-operation adapter, open and close the pole-unit several times to obtain the “feel,” and observe the operation of circuit-switcher as adjusted by the factory. Note the following operational parameters:

- (a) During the opening operation, an initial peaking of effort is required as the drive-shaft crank leaves its **Closed** toggle position. Rotation should progress smoothly but with a noticeable increase in effort as the blade passes beyond its **Half-open** position. At this position the stored-energy source within the brain begins to charge as the interrupter closes.

As opening continues, the stored-energy source charges and latches, and a final peaking of effort again is required as the drive-shaft crank goes into toggle against the Open stop. Both blades will not be in the fully **Open** position at an angle slightly greater than 90 degrees and the interrupter will be in the **Closed** position, as indicated by the gray interrupter target on the side of the brain.

- (b) During the opening sequence, the interrupter target on the side of the brain housing changes from gray to yellow when the interrupter is opened, then back to gray, indicating the normally **Closed** position of the interrupter. In addition, the interrupter target remains gray when the circuit-switcher is closed, indicating the interrupter is in the **Closed** position.
- (c) As the circuit-switcher moves toward the **Closed** position, rotation should progress smoothly with the fault-closing tongue contact in proper mesh with the fault-closing jaw contact and with the current-carrying tongue contact entering the current-carrying jaw contact evenly. See Figure 5. The same engagement should be attained after the live parts have been removed and reassembled on the insulator stacks.

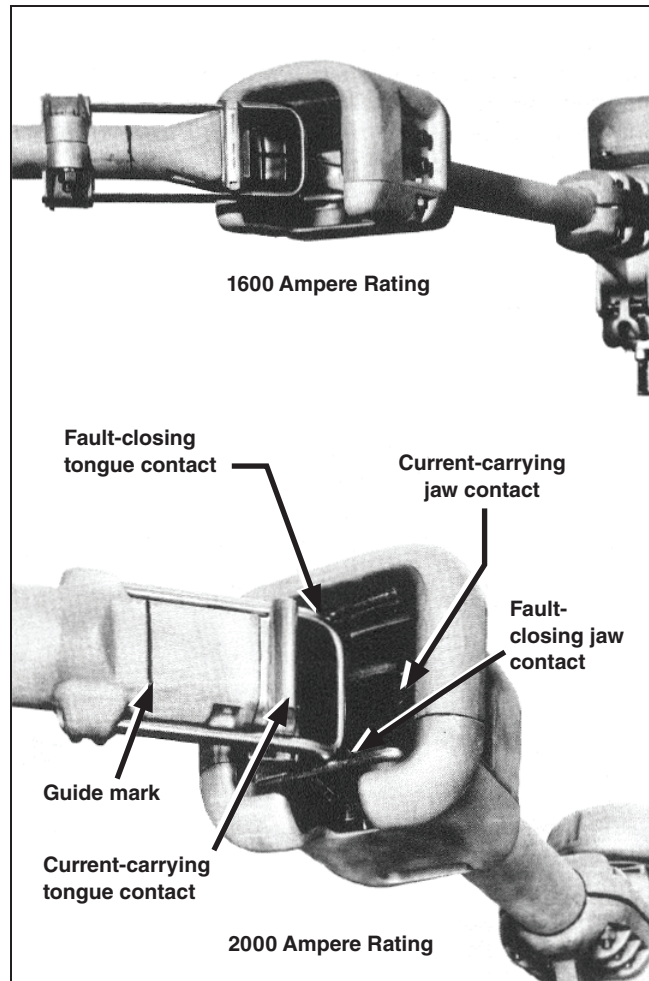


Figure 5. Blade-contact detail.

- (d) As the circuit-switcher reaches either the fully **Open** or fully **Closed** position, the drive-shaft crank will be felt to strike firmly against an internal driveshaft crank stop (not visible) in the drive-shaft assembly. See Figure 4 on page 9. The toggle-loading snubbers (located on the pole-unit base adjacent to the rotating-insulator supports) maintain positive toggle locking at each end of the operating stroke. Both the internal drive-shaft crank stops in the drive-shaft assembly and the toggle-loading snubbers have been carefully adjusted at the factory and readjustment should not be attempted.

STEP 4. Loosen the disconnect-blade clamps and carefully remove both blade assemblies intact. This operation can be performed with the circuit-switcher pole-unit in either the fully closed or fully **Open** position. However, after removal of the blade assemblies, make sure the pole-unit is placed in the fully **Closed** position to establish a point of reference and to facilitate reassembly.

Note: As live parts are disassembled, use care to set them aside on a clean surface. Dirt adhering to the current-transfer surfaces could result in poor electrical contact.

Note: A corona shield is furnished, to be attached to the tongue-contact blade assembly as shown in Figure 18 on page 20. As shipped, however, the corona shield is clamped near the hinge end of the tongue-contact blade, as shown in Figure 4 on page 9, to prevent interference with the drive-shaft crank. Do not move the corona shield to its normal position until so directed in Step 21 on page 19.

STEP 5. Remove the brain-and-interrupter assembly from the insulator-mounting supports, using the following procedure:

- (a) Attach lifting slings in the manner shown in Figure 6. Make sure the slings do not interfere with the interrupter target on the side of the brain, the gas-pressure indicator, the pressure-relief device, or the shunt-trip operating shaft (if applicable).

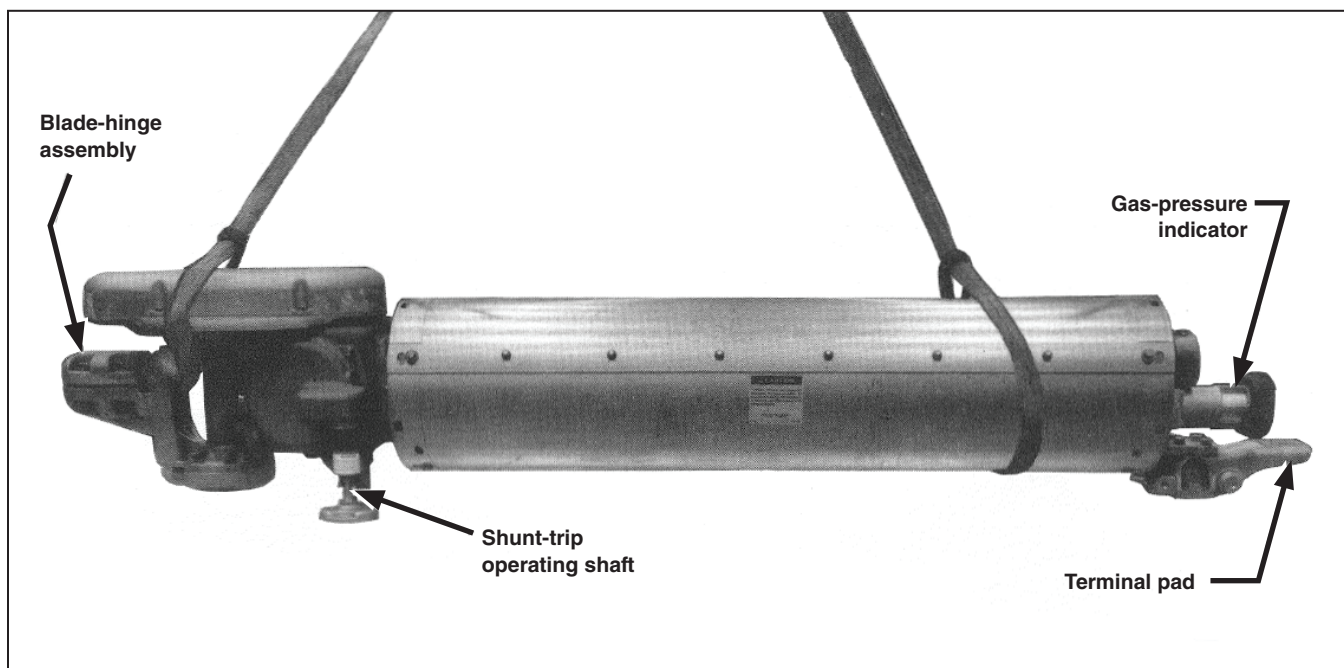


Figure 6. Lifting the brain and interrupter assembly.

Installation

- (b) Loosen the adjusting screws at both blade-adjustment discs. See Figure 7 for an illustration of the terminal-end blade adjusting screws.
- (c) Remove the cap screws fastening the blade-hinge assembly to the blade-adjustment disc on the center insulator support, and the cap screws fastening the interrupter terminal pad to the stationary insulator support.
- (d) Hoist the brain-and-interrupter assembly and set it aside on a clean surface. Do not permit the assembly to rest on the shunt-trip shaft extending from the brain (if applicable).

Retain the stainless steel hardware for reuse; discard the galvanized cap screws

used to fasten the terminal pad to the insulator support.

- STEP 6.** Remove the remaining live parts from the rotating insulator supports. First, remove the blade-hinge assembly at the terminal-end rotating insulator support; retain the stainless steel cap screws for reuse. Then remove both blade-adjustment discs; discard the galvanized cap screws.
- STEP 7.** Assemble the insulator stacks, with rain shields (where applicable) installed in accordance with the instruction sheet furnished with the insulators directly on their insulator mounting flanges using the galvanized hardware specified in Figure 8 on page 13.

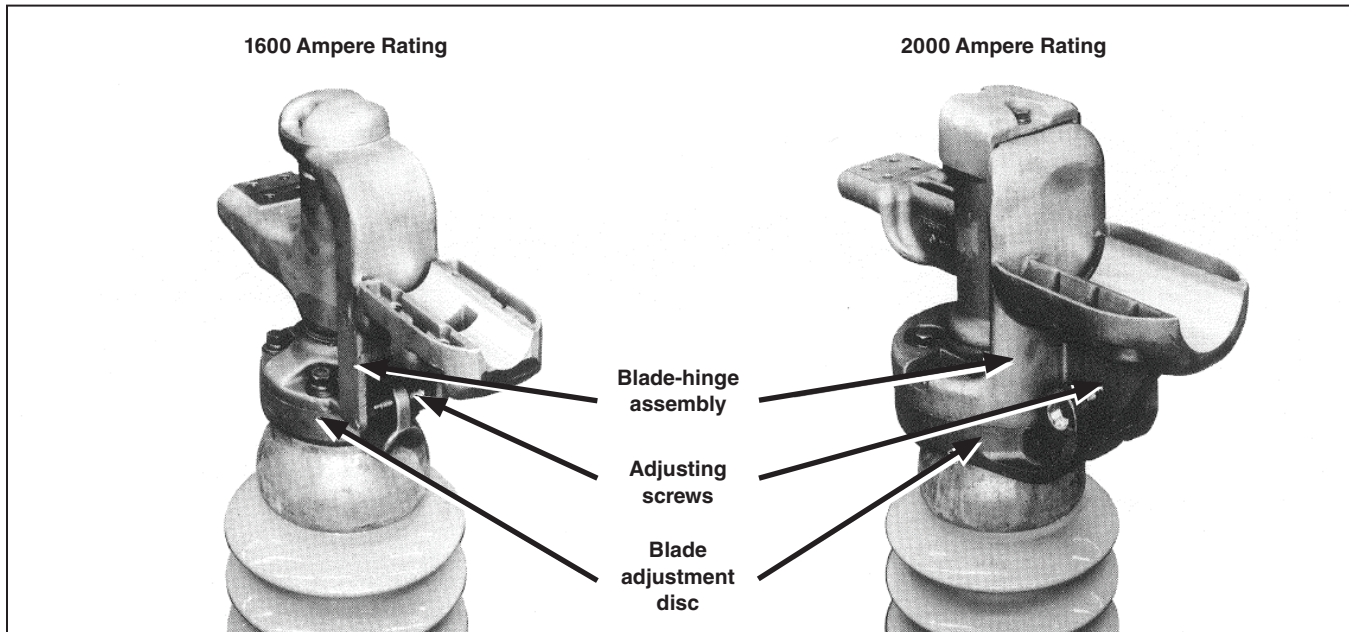


Figure 7. The blade adjusting screws.

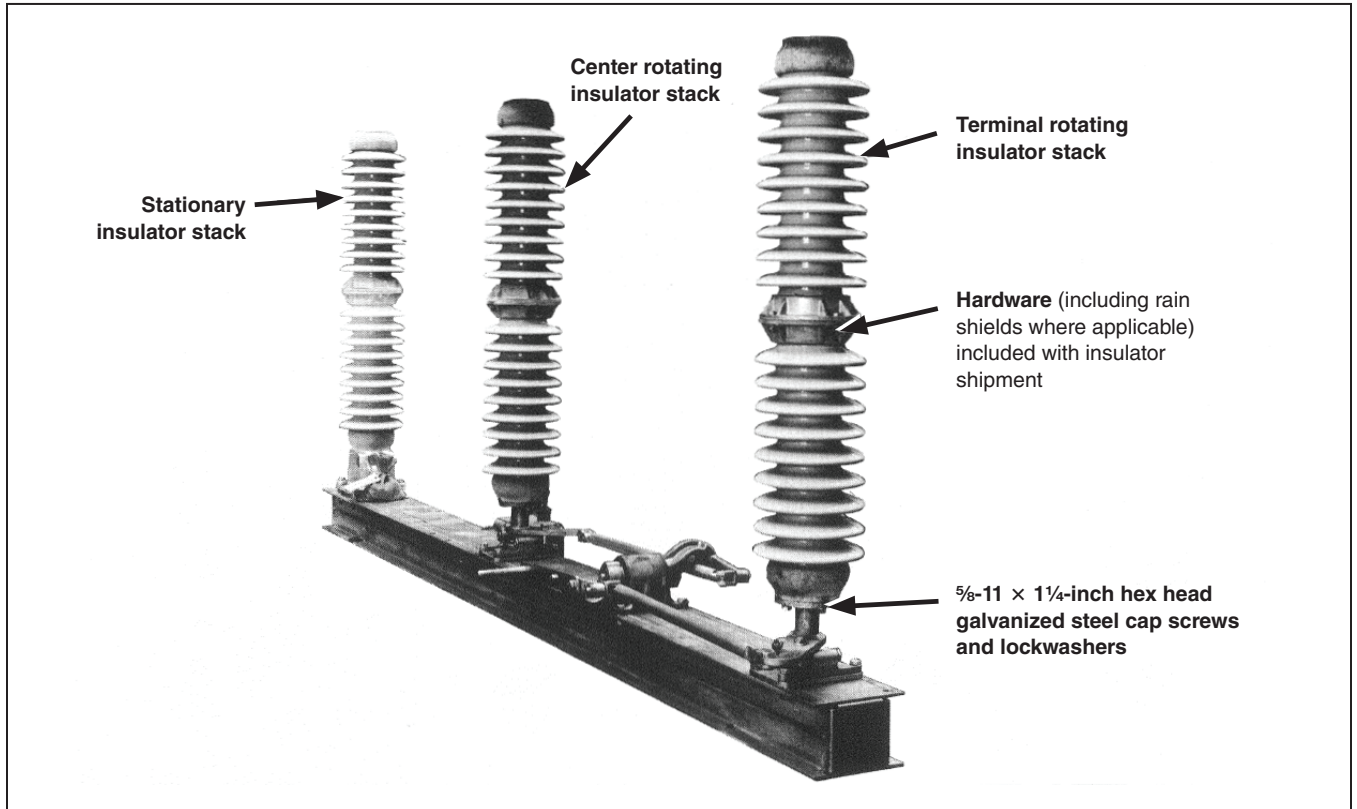


Figure 8. Insulator stacks assembled on pole-unit.

Installation

STEP 8. Check each rotating insulator stack for eccentricity as follows:

- (a) Locate the centerpoint of each insulator stack by accurately drawing, on the top of the insulator cap, temporary lines that bisect and connect opposite bolt holes. See Figure 9.
- (b) Stretch a cord taut across the top of the insulator caps so it crosses the centerpoint on the rotating insulator stack. (At this time the cord need not cross the centerpoint of the other two insulator caps.)
- (c) Make a mark on the cord at the point where it crosses the centerpoint of the rotating insulator stack. (Alternately, for use as a reference, any fixed object may be extended over the centerpoint of the rotating insulator stack. The fixed object

may be supported, for example, by attachment of a vertical length of wood or pipe the height of the insulator stack, clamped to the pole-unit base.)

- (d) Operate the temporary hand-operation adapter and check to see the mark on the cord remains within $\frac{1}{8}$ -inch (3 mm) of the centerpoint of the rotating insulator cap as the insulator stack turns. Any eccentricity in excess of this value must be corrected by placing shims between the insulator stack and its support. See Figure 9. Shimming material is included with the insulator hardware in a package attached to the pole-unit base.
- (e) Torque to final tightness all insulator-stack cap screws, including those fastening the insulator stacks to the insulator supports.

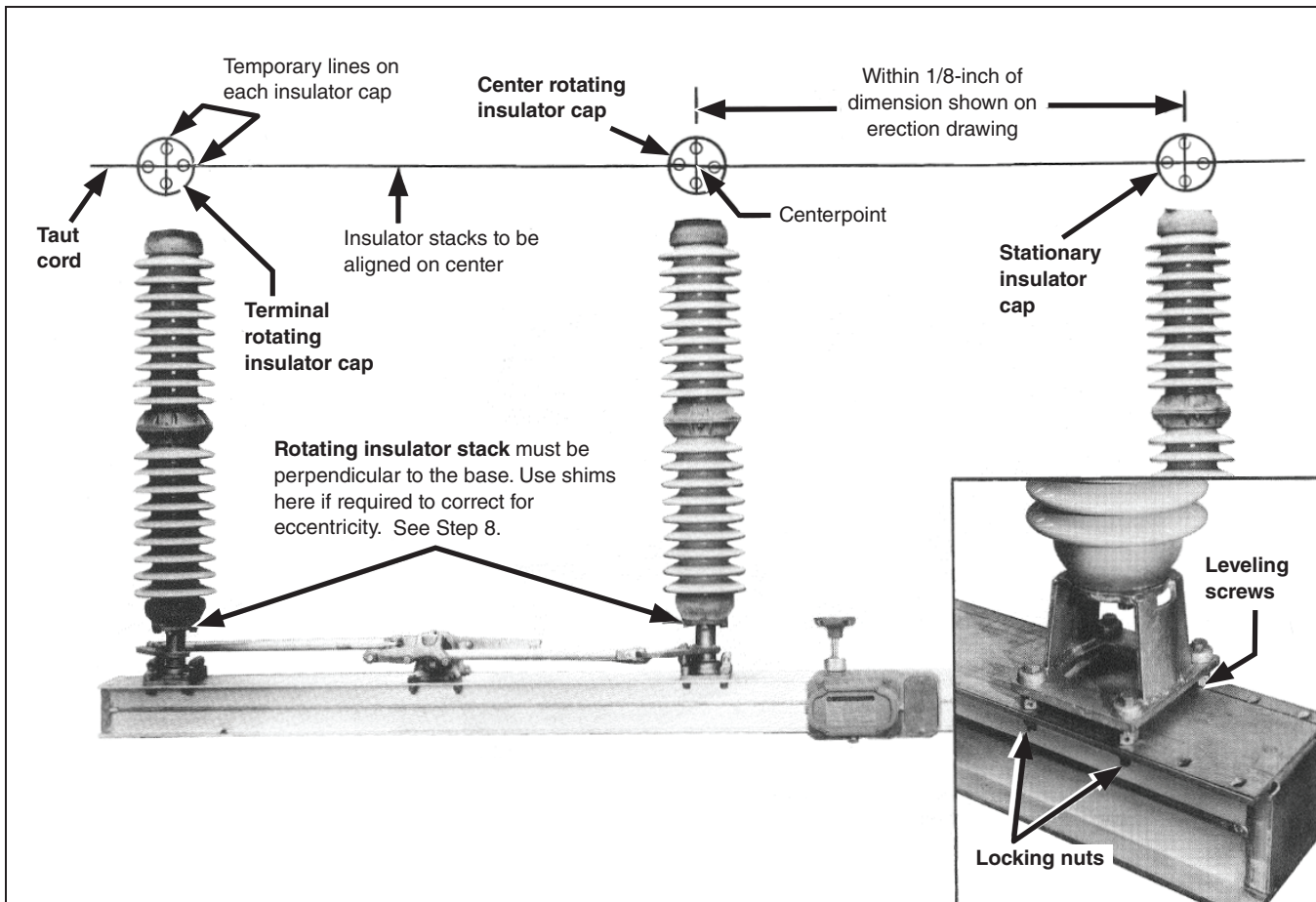


Figure 9. Obtaining critical dimension and alignment with shims and leveling screws.

When adjustments have been made to eliminate eccentricity, the perpendicularity of the rotating insulator stacks with respect to the base will be within acceptable limits.

STEP 9. The stationary insulator stack should be checked for alignment with the rotating insulator stacks by stretching a cord taut across the top of the insulator caps so it crosses the centerpoint of all three insulator stacks. Then measure the center-to-center distance between the stationary insulator stack and the center rotating insulator stack. See Figure 9 on page 14. This distance must be within $\frac{1}{8}$ -inch (3 mm) of the dimension shown on the erection drawing.

STEP 10. Adjust for the necessary centerline distance and the stack alignment, as described in Step 9, as follows:

- (a) Using the access holes in the sides of the base, hold the four locking nuts and turn the leveling screws located under the stationary insulator support. See Figure 9 on page 14. (The leveling screws are threaded into the insulator support flange.) To avoid changing the effective height of the insulator stack, do not adjust more than three of the four leveling screws.
- (b) Retighten the locking nuts.

Note: Alignment of the insulator stacks as directed in Step 8, Step 9, and Step 10 is essential to obtain correct latching of the brains and to obtain close interphase simultaneity during opening.

STEP 11. To install the live parts in their proper relationship to the rotating insulator stacks, establish a point of reference by placing the pole-unit power train in the fully **Closed** position (see the erection drawing to verify the applicable direction of rotation.)

STEP 12. Mount a blade-adjustment disc on each rotating insulator stack using hex-head galvanized steel cap screws as shown in Figure 10 (see also Figure 11).

The cap screws for mounting the blade-adjustment discs must be torqued to final tightness. This is important because access to the cap screws will be restricted later.

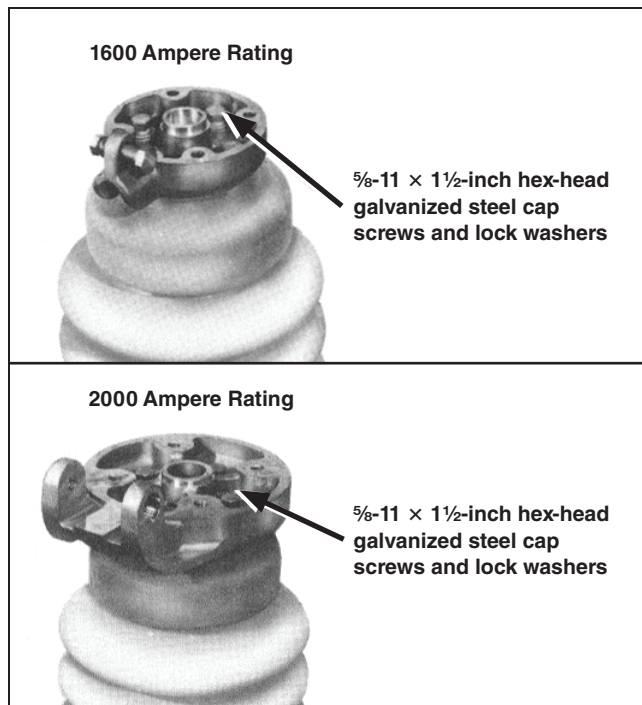


Figure 10. Blade adjustment discs.

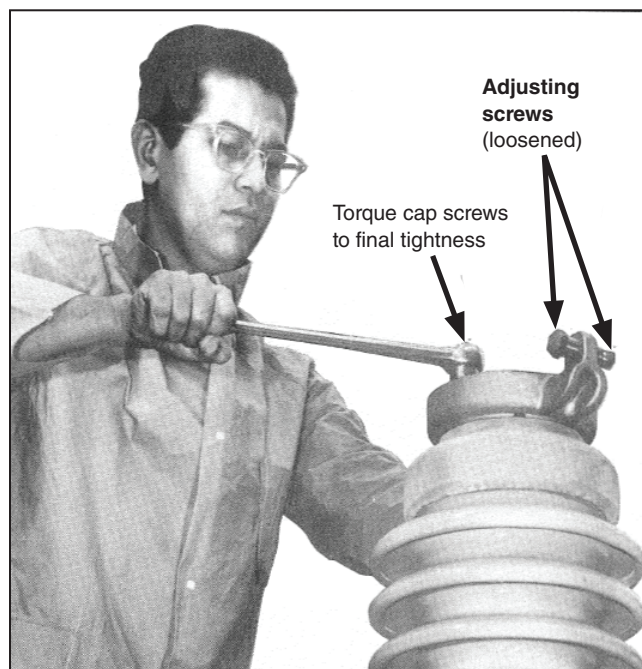


Figure 11. Mounting blade adjustment discs (one on each insulator stack.) 1600 ampere rating shown.

Installation

Make sure the cap screws are the correct length. Screws longer than those specified may bottom in the mounting holes in the insulator caps without effectively tightening against the blade-adjustment discs.

STEP 13. Mount the brain-and-interrupter assembly with the same handling care cautioned for its removal. See Figure 12. Be sure to place the brain-and-interrupter assembly on the same pole-unit from which it was removed. The cap screws at the terminal end of the brain-and-interrupter assembly should be torqued to final tightness; the stainless steel cap screws in the slotted holes of the blade-hinge assembly

should be left loose enough for adjustment. See Figure 12 for hardware sizes.

Extreme care should be exercised to prevent damage to the interrupter target, gas-pressure indicator, and pressure-relief device with the lifting sling or fall lines, and to prevent their contact with other objects during lifting. See Figure 12.

STEP 14. Mount the terminal-end blade-hinge assembly on its rotating insulator stack in a manner similar to that described in Step 13 on page 16, with the stainless steel cap screws snug but loose enough for the slot adjustment. See Figure 13 on page 17.

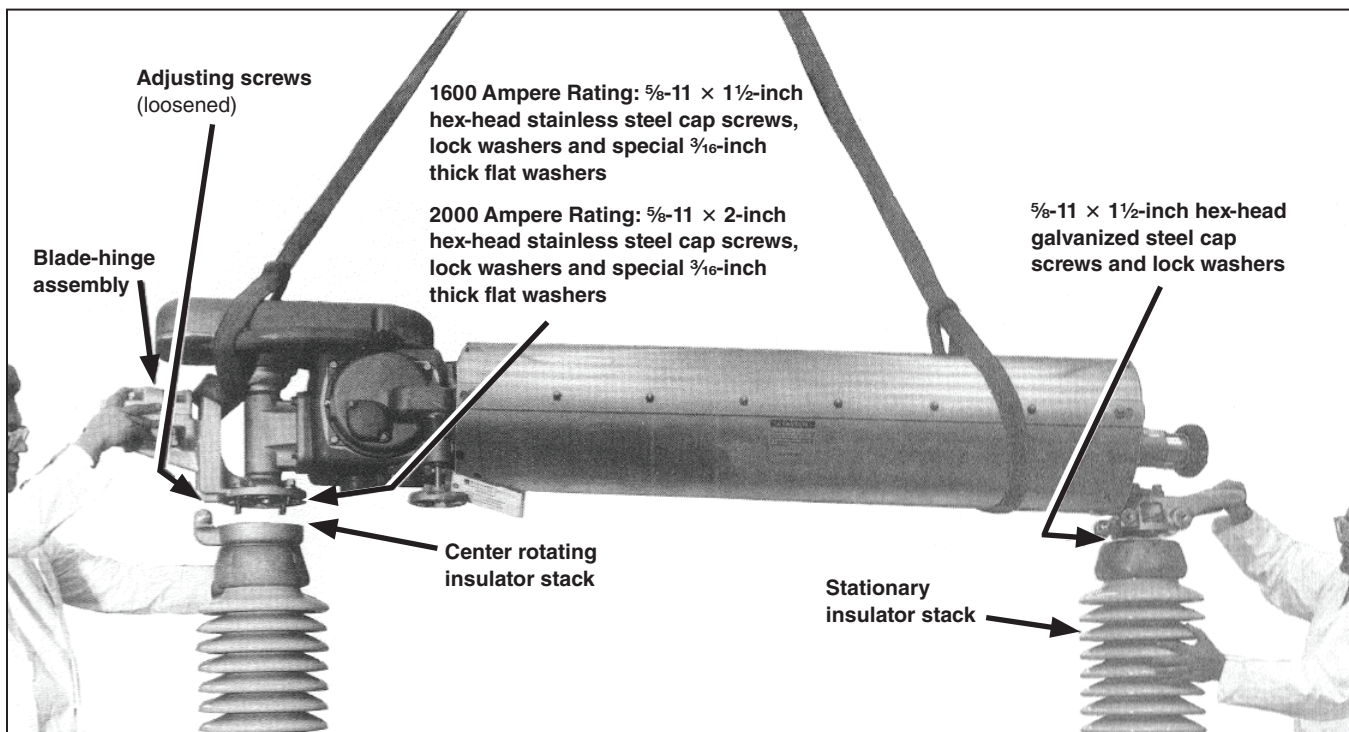


Figure 12. Lifting the brain-and-interrupter assembly into place on the insulator stacks.

STEP 15. Remove the top sections of the blade clamps on both blade-hinge assemblies and lay the gauge pipe across the hinge assemblies as shown in Figure 14.

Loosen the adjusting screws on both blade adjustment discs to provide ample freedom of movement to align the blade-hinge assemblies with the gauge pipe.

STEP 16. Replace the top sections of the blade clamps and clamp the gauge pipe securely in place. Next, with the drive-shaft crank held firmly against its closed stop by means of the temporary hand operation adapter, torque the cap screws of both blade-hinge assemblies to final tightness.

Then, tighten the adjusting screws at both blade adjustment discs. See Figure 14.

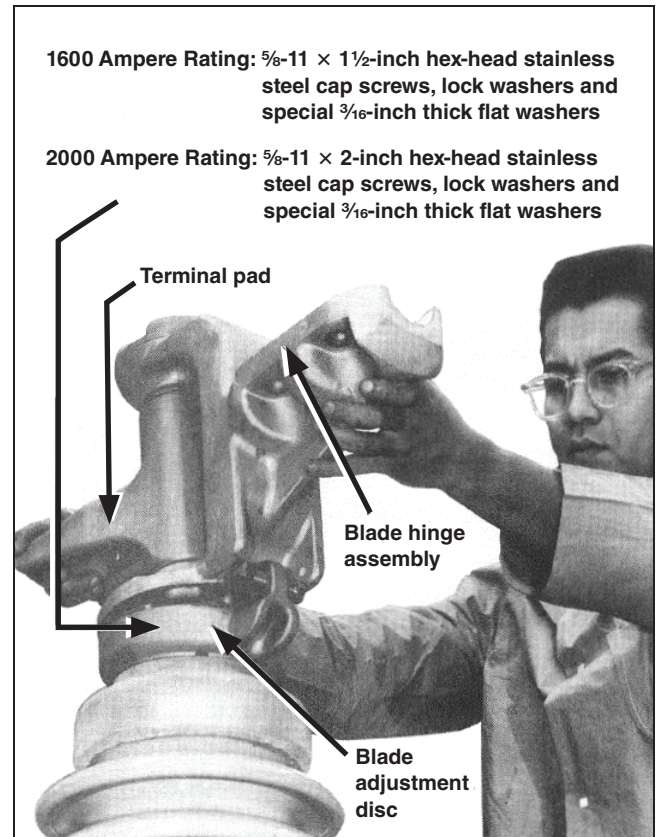


Figure 13. Mounting a terminal-end blade-hinge assembly (1600 amperes shown.)

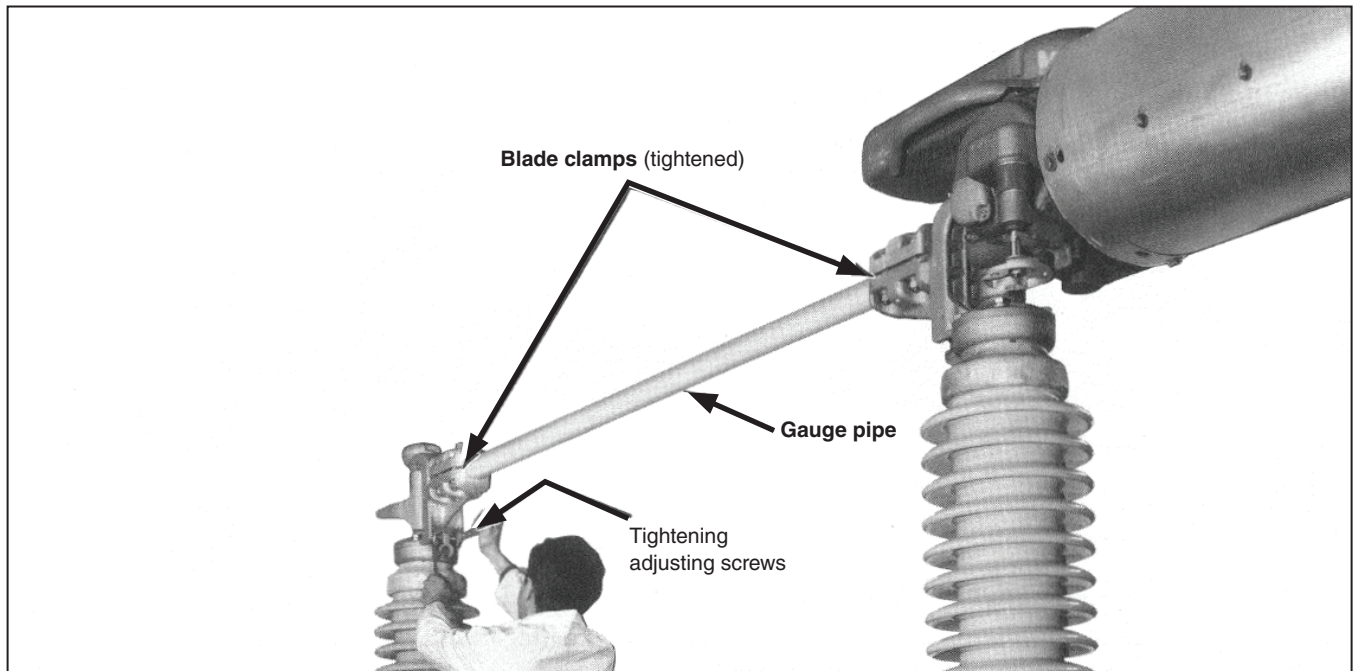


Figure 14. Blade-hinge alignment (1600 ampere rating shown.)

Installation

STEP 17. Remove the gauge pipe by removing the blade clamps. Replace these blade clamps, and then replace the jaw-contact blade assembly in the brain-end blade-hinge assembly from which it was removed. Insert the blade assembly into the blade clamp until the leading edge of the guide mark is in line with the end of the blade clamp. Tighten the clamp securely. See Figure 15.

STEP 18. Open the circuit-switcher pole-unit and insert the tongue-contact blade assembly in the terminal-end blade-hinge assembly. Rotate the blade assembly to position it so the curvature of the fault-closing tongue contact is in the direction of blade travel during closing. See Figure 16 on

page 19 and Figure 17 on page 19. Tighten the blade clamp securely.

STEP 19. Close the circuit-switcher pole-unit and note the guide mark on the tongue-contact blade. See Figure 17 on page 19. This mark should be in line with the edge of the jaw-contact housing to ensure proper blade engagement. If the guide mark does not line up with the edge of the jaw-contact housing, loosen the blade clamp holding the tongue-contact blade assembly and move the blade assembly in or out as required. Torque all blade-clamp bolts to final tightness.

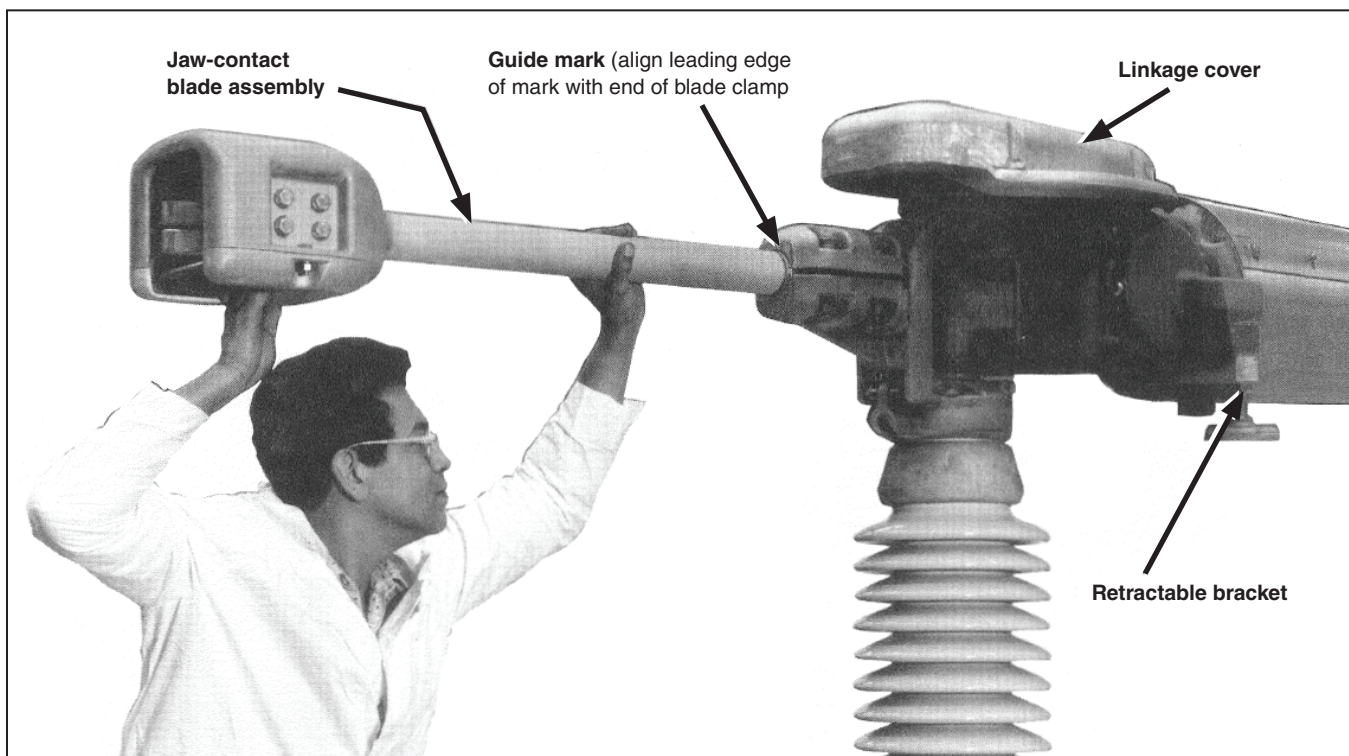


Figure 15. Inserting the jaw-contact blade assembly at brain end (1600 ampere rating shown.)

For Circuit-Switchers rated 1600

amperes: Adjust the position of the tip of the fault-closing tongue contact for $\frac{1}{8}$ -inch to $\frac{3}{16}$ -inch clearance (3-mm to 5-mm) from the jaw-contact housing, as shown in Figure 17, by loosening the fault-closing tongue-contact support and sliding it along the blade. The bottom cover of the jaw-contact housing must be removed to check this measurement.

STEP 20. Open and close the circuit-switcher pole-unit to check blade entry. The current-carrying tongue contacts should enter the current-carrying jaw contacts evenly with no tendency to clash against either side. See Figure 5 on page 10.

Should adjustment be necessary, it may be accomplished with the blade-adjustment disc at the terminal-end rotating stack only. Do not disturb the blade-adjustment disc of the center rotating stack because this can impair the latching and tripping action of the brain.

Note: Under no circumstances or conditions should adjustment be attempted on the power train on the pole-unit base.

STEP 21. Loosen the corona-shield clamping bolts and slide the corona shield to its correct position (with rod ends of the fault-closing tongue contact indexed to holes in the corona shield) against the fault-closing tongue contact support, as shown in the inset of Figure 18 on page 20. Tighten the clamping bolts.

STEP 22. After all three pole-units have been adjusted and individual pole-unit operation has been determined to be satisfactory, place all three pole-units in the fully **Closed** position. Verify all insulator-stack cap screws and cap screws securing the live parts are torqued to final tightness.

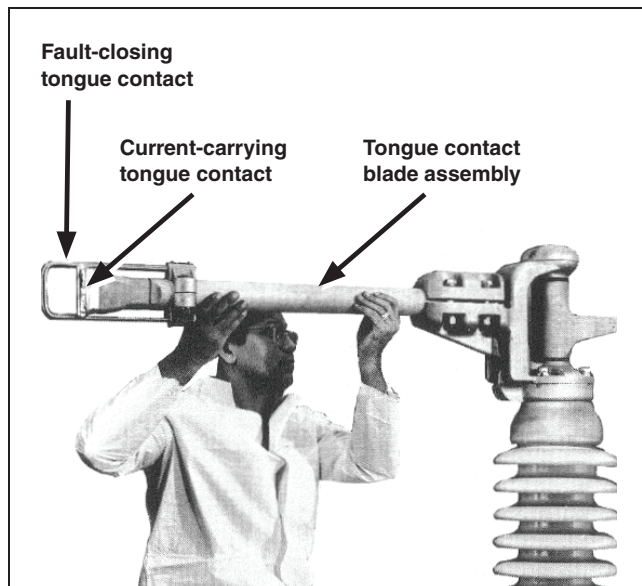


Figure 16. Inserting tongue-contact blade assembly at terminal end (1600 ampere rating shown.)

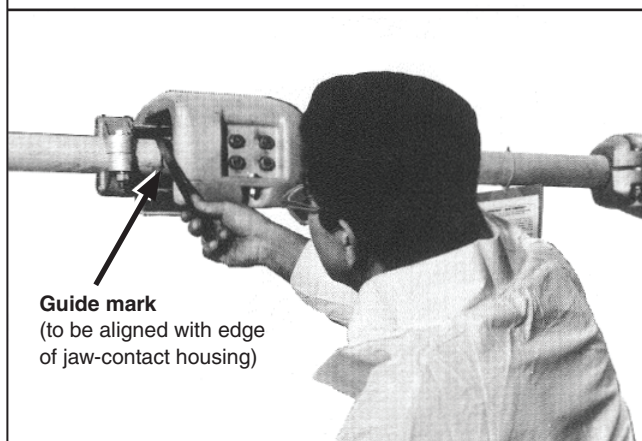
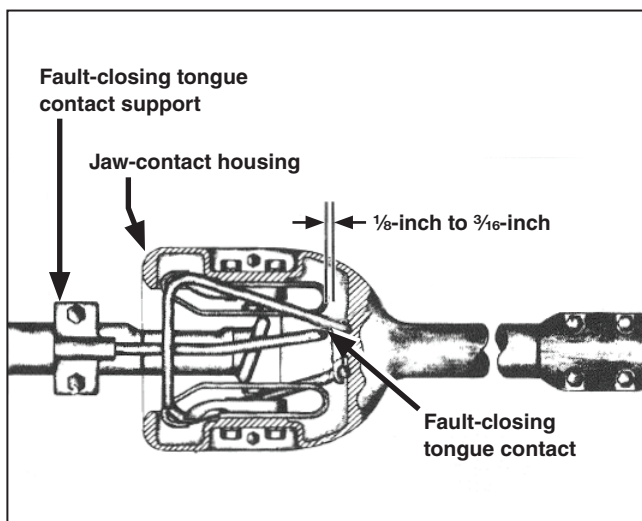


Figure 17. Checking for proper blade engagement.

Installation

- STEP 23.** Check the mounting pedestals or structure for plumb, level, and alignment and make corrections if necessary.
- STEP 24.** With the blades in the fully **Closed** position, unbolt the skids and, by lifting from the base, raise each circuit-switcher pole-unit to the mounting elevation in the order indicated on the erection drawing. Make sure the rigging does not stress the interrupter or the brain. Furthermore, extreme care should be exercised to prevent fouling the interrupter target, the gas-pressure indicator, or the pressure-relief device with the lifting sling or fall lines during erection, and to prevent contact with other objects during lifting.

WARNING

Do not lift a complete circuit-switcher pole-unit by the disconnect blade and/or the interrupter. Lift by the base **ONLY**. The disconnect blade and interrupter cannot carry the weight of the completed pole-unit. **Lifting from anywhere but the base may cause equipment damage or serious personal injury.**

- STEP 26.** Bolt the circuit-switcher pole-units in place using $\frac{5}{8}$ -inch galvanized bolts, flat washers, lockwashers, and nuts (furnished only if so specified on order). The pole-unit bases should be shimmed as required if the mounting surface is sufficiently irregular to distort the bases.

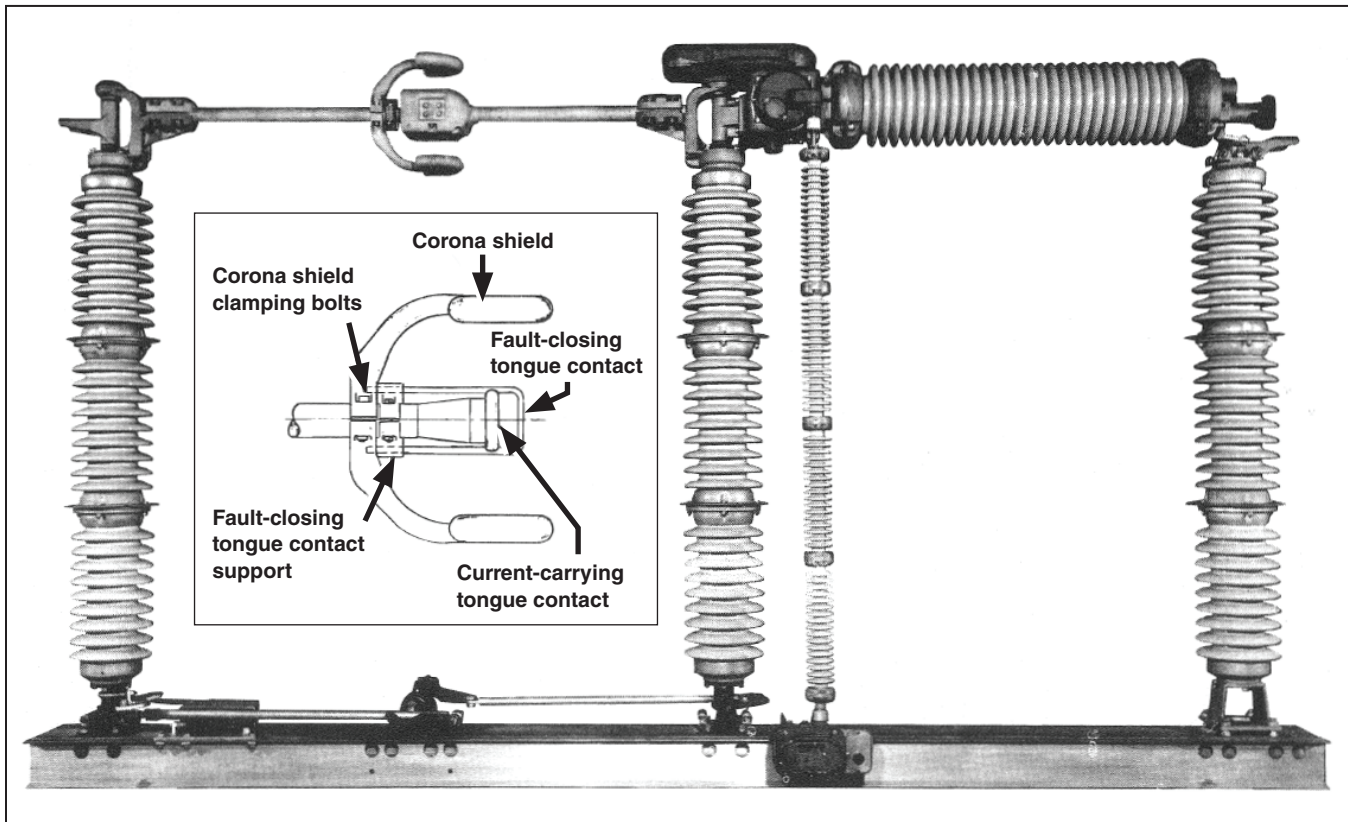


Figure 18. Pole-unit of a 230 kV circuit-switcher showing corona shield in its normal position.

Connecting the Optional Shunt-Trip Device

If the optional shunt-trip device has been specified, the insulated operating shafts should be installed at this time. The necessary conduit with control wiring of recommended size-should be in place, although the control wiring for the shunt-trip solenoids should be left disconnected at the switch operator end until the section “Checking the Operation” on page 25 has been completed. Refer to S&C Instruction Sheet 711-600 for instructions on insulated operating shaft installation.

After the insulated operating shaft has been installed, fully disengage the retractable bracket which secures the shunt-trip operating shaft extending from each brain, as shown in Figure 15 on page 18.

Adjusting the Pole-Units

To adjust the pole-units, complete the following steps:

- STEP 1.** After all three pole-units have been bolted to the structure in accordance with the erection drawing, operate each circuit-switcher pole-unit alternately to its fully **Open** and fully **Closed** positions using the hand-crank operation adapter.

In each position the drive-shaft crank, as it goes into toggle, should be felt to strike firmly against an internal drive-shaft crank stop (not visible) in the drive-shaft assembly. See Figure 4 on page 9. The toggle-loading snubbers (located on the pole-unit base adjacent to the rotating-insulator supports) should maintain positive-toggle locking at each end of the operating stroke. Both the internal drive-shaft crank stops in the drive-shaft assembly and the toggle-loading snubbers have been carefully adjusted at the factory, and readjustment should not be attempted.

In each position (fully **Open** and fully **Closed**) examine the blade crank-arm at the top of the brain to verify it rests against its respective stop. See Figure 19 on page 22. Do not attempt to adjust these stops. The stops are factory-set to provide the travel necessary to achieve full latching of the brain as well as tripping simultaneity. The blade crank-arm may be viewed through the window in the top of the linkage cover.

WARNING

Do not remove the brain linkage cover. The circuit-switcher brain linkage contains fast moving parts which can seriously injure fingers.

Do not remove the linkage cover itself. If the blade crank-arm at the top of the brain fails to meet its stop, in either the fully **Open** or fully **Closed** position, the most likely cause is misalignment of the stationary insulator stack. Adjust the stationary insulator stack as follows:

- (a) Loosen the cap screws that fasten the interrupter at the terminal end and, with the power train held securely against the drive-shaft crank stop, move the interrupter sideways (within the confines of the mounting holes) until the blade crank-arm stop makes firm contact with the blade crank-arm. See Figure 19.

Torque to final tightness the cap screws which fasten the interrupter at the terminal end.

- (b) If the above method does not provide sufficient movement, adjustment of the stationary insulator stack is required. Loosen the cap screws that fasten the interrupter to the terminal end (to relieve the strain) and adjust the stationary stack to align it with the rotating stacks. See Step 10 on page 15. Then repeat the adjustment described in (a).

- STEP 2.** After each pole-unit has been checked and adjusted as described in this section, return it to the fully **Open** (or fully **Closed**) position and remove the temporary hand-operation adapter.

Installing the Power Train

To install the gearbox and power train, complete the following steps:

- STEP 1.** Install the gearbox in the position shown on the erection drawing.

Note: To ensure proper installation, the alignment arrow on the gearbox should be positioned as indicated on the erection drawing.

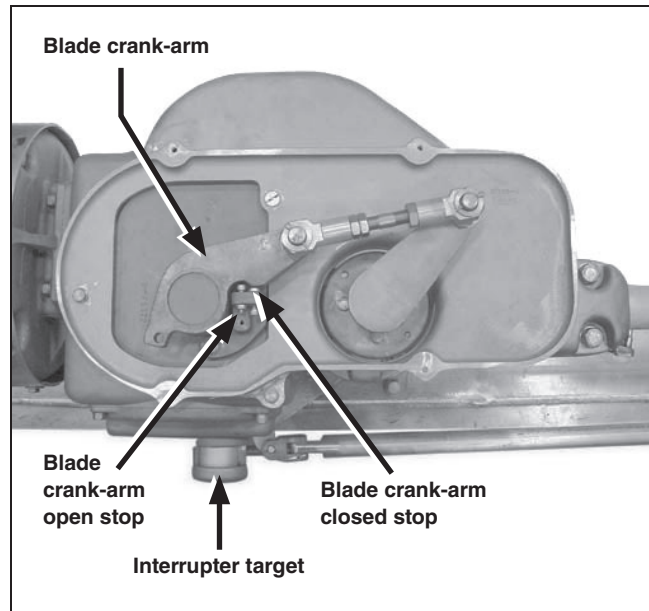


Figure 19. Brain linkage detail. Linkage cover removed for visibility. Do not remove linkage cover.

STEP 2. Attach the coupling assemblies for the interphase and connecting shafts to the switch pole-units and gearbox as shown on the erection drawing. See Figure 20. Thread the flexible-coupling attachment bolts through the flexible-coupling plate and through the coupling flange. Tighten the bolts to draw the flexible plate flush against the flange; this will deform the threads in the flexible plate, resulting in a binding, nonslip connection. Install and tighten the self-locking nuts. Do not use lockwashers with the flexible-coupling attachment bolts.

STEP 3. Install the interphase and connecting shafts as shown on the erection drawing. When performing this operation. Make sure the cutting tips of the piercing set screws do not protrude through the body of any coupling. Tighten the clamp bolts equally so the clamp pulls down evenly. Take care during this procedure each pole-unit remains in its fully **Open** (or fully **Closed**), **Positive-toggle** position. Then, tighten the associated piercing set screws, piercing the shaft, and continue turning until a firm resistance is felt.

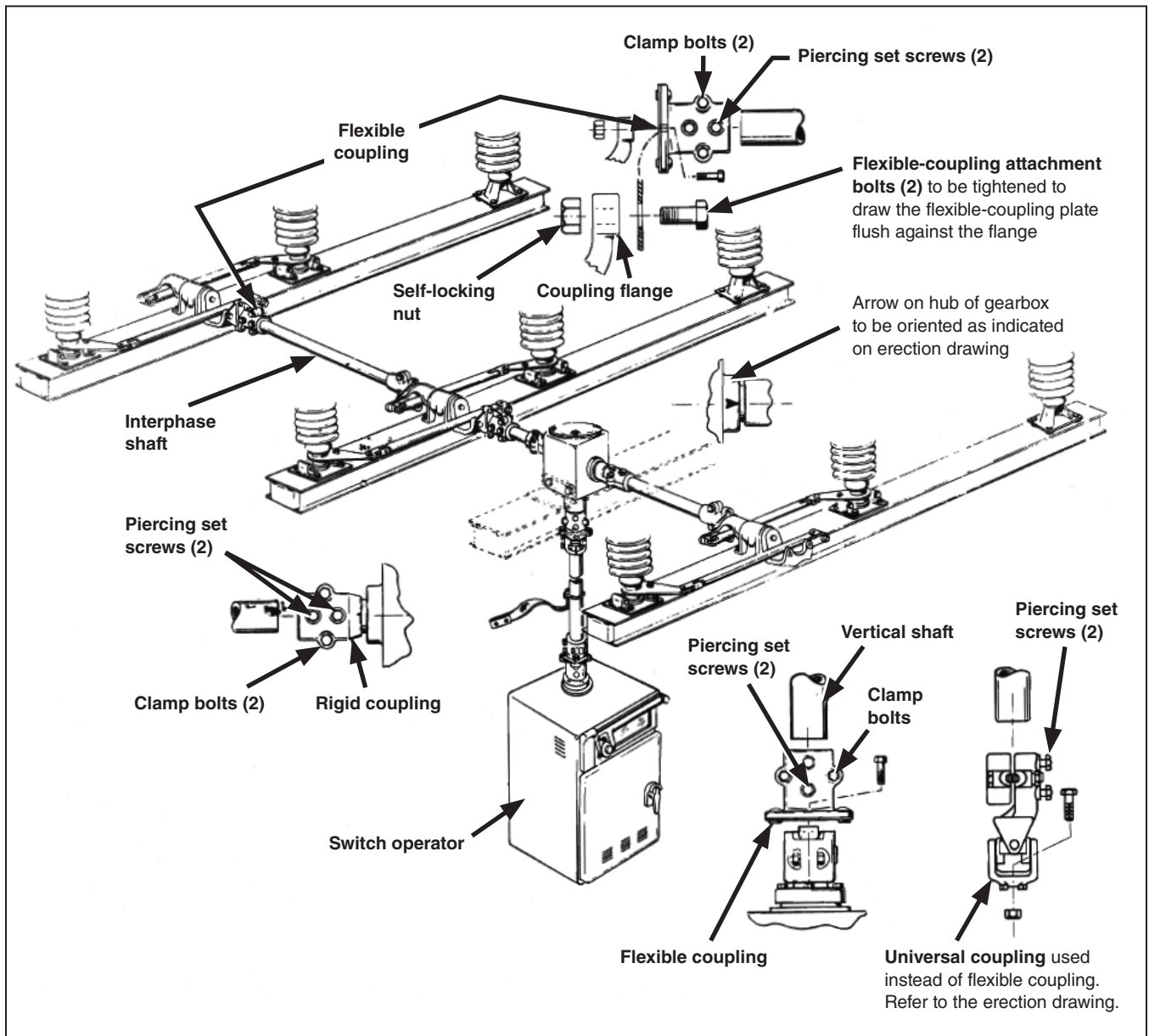


Figure 20. Power train detail.

Installing the Type CS-1A Switch Operator

NOTICE

To avoid damage to the circuit-switcher and switch operator, electrical operation of the switch operator should not be attempted until its travel-limit discs have been properly adjusted as described in S&C Instruction Sheet 719-500.

To install the Type CS-1A Switch Operator, complete the steps here and in S&C Instruction Sheet 719-500:

STEP 1. Mount the switch operator as indicated on the erection drawing. ●

If the erection drawing indicates universal couplings in the vertical shaft, bolt one to the switch operator output shaft and one to the shaft extending downward from the gearbox.

Alternately, if the erection drawing indicates flexible couplings in the vertical shaft, bolt one to the switch-operator output shaft and one to the shaft extending downward from the gearbox.

Thread the flexible-coupling attachment bolts through the flexible-coupling plate and through the coupling flange. Tighten the bolts to draw the flexible plate flush against the flange; this will deform the threads in the flexible plate, resulting in a binding, nonslip connection. Install and tighten the self-locking nuts. Do not use lockwashers with the flexible-coupling attachment bolts.

STEP 2. At the gearbox end of the vertical shaft, make sure the cutting tips of the piercing set screws do not protrude through the body of the universal or flexible coupling. See Figure 20 on page 23. Install the vertical shaft. Tighten the clamp bolts equally so the clamp pulls down evenly. Then, tighten the associated piercing set screws, piercing the shaft and continue turning until a firm resistance is felt.

STEP 3. Couple the lower end of the vertical shaft to the switch operator, but do not tighten the clamp bolts or pierce the shaft at this time.

STEP 4. Fasten the free end of the grounding strap to the vertical shaft a few inches above the universal or flexible coupling attached to the switch operator using the grounding connector provided. Then, fasten the other end of the grounding strap to a suitable earth ground.

STEP 5. Refer to the Type CS-1A Switch Operator Instruction Sheet 719-500, which is in the door of the switch operator, and proceed as outlined therein.

STEP 6. Manually operate the switch operator to bring it to the same position (fully **Open** or fully **Closed**) as the circuit-switcher. Make sure the cutting tips of the piercing set screws do not protrude through the body of the universal or flexible coupling attached to the output shaft of the switch-operator. Tighten the clamp bolts equally so the clamp pulls down evenly. Then, tighten the associated piercing set screws, piercing the shaft, and continue turning until a firm resistance is felt.

Connecting High-Voltage Conductors

Connect the high-voltage conductors to their respective circuit-switcher terminal pads.

⚠ WARNING

Before connecting the conductors to the Mark V Circuit-Switcher, conductors must be de-energized and grounded in accordance with standard system operating practice. Then, proceed with the final checks and adjustments described in the following steps.

Working on an energized circuit-switcher may lead to equipment damage, personal injury, or death.

● If more than one switch operator is available, be sure to select the one intended for the circuit-switcher installation being made. Make certain the circuit-switcher serial number, located on the circuit-switcher nameplate on the switch operator, agrees with the serial number on the nameplate of each pole-unit.

Checking the Operation

To check the operation of the circuit-switcher, complete the following steps:

- STEP 1.** Using the manual operating handle on the switch operator, open and close the circuit-switcher to check the three-pole group operation. The feeling of toggle action and the increase in opening effort as the stored-energy sources within the brains are charged will be similar to that experienced with single-pole operation.
- STEP 2.** Check interrupter action by observing the target on the side of each brain. During the opening sequence, each target changes from gray to yellow when the interrupter opens, then back to gray, indicating the normally **Closed** position of the interrupter. In addition, the interrupter targets remain gray when the circuit-switcher is closed, indicating the interrupters are in the **Closed** position.
- STEP 3.** Adjust the switch operator for electrical operation, as described in S&C Instruction Sheet 719-500.
- STEP 4.** Operate the circuit-switcher several times with the switch operator and observe the action. Operation should appear smooth, in both the opening and closing direction, with the drive-shaft crank of each pole-unit coming to rest in a **Positive-toggle** position.

Checking the Optional Shunt-Trip Device

When the optional shunt-trip device is specified, the control wiring for the shunt-trip solenoids should be connected to the terminal block in the switch operator at this time. See S&C Instruction Sheet 711-600. Then, complete the following checks:

- STEP 1.** Opening of the three pole-unit interrupters by the switch operator should be simultaneous within 1.0 cycle (0.016 second).
 - (a) Check for simultaneity by slowly opening the circuit-switcher (by manually cranking the switch operator). Listen for the tripping action of the individual interrupters, and observe the interrupter targets.
 - (b) Note the point at which the first interrupter trips. From this point, no more than 40 degrees of rotation of the manual operating handle should be required before the other two interrupters trip. When this condition exists, the desired simultaneity has been attained.
- STEP 2.** If simultaneity within the limits specified in Step 1 is not attained, recheck the blade crank-arm at the top of each brain with circuit-switcher both the fully **Open** and fully **Closed** positions. If any blade crank-arm fails to meet its respective stop in either position, adjust as directed in the section “Adjusting the Pole-Units” on page 21. In the event the blade crank arms are correctly adjusted and the specified simultaneity is not attained, instructions for corrective adjustment will be provided by an S&C factory service specialist.

Installation

Before Energizing the Circuit-Switcher

Remove the container and shield from each interrupter as follows:

- STEP 1.** Remove and discard the $\frac{3}{8}$ -16 zinc-plated serrated hex nuts which run the length of the container. See Figure 21. Remove and discard the $\frac{3}{8}$ -16 \times $\frac{7}{8}$ -inch and two $\frac{3}{8}$ -16 \times 1-inch zinc-plated hex-head cap screws and flat washers which attach the upper container-half to the coupling end casting of the interrupter. Also remove and discard the $\frac{3}{8}$ -16 \times $\frac{7}{8}$ -inch and two $\frac{3}{8}$ -16 \times 1-inch zinc-plated hex-head cap screws and flat washers which attach the upper container-half to the indicator end casting of the interrupter.
- STEP 2.** Pry the container-halves apart with a screwdriver. The upper container-half can now be removed and discarded. Slotted holes are provided so a rope or lifting sling can be attached and the container-half and conveniently lowered to the ground.
- STEP 3.** Remove and discard the $\frac{3}{8}$ -16 \times $\frac{7}{8}$ -inch hex-head cap screw and flat washer which attach the lower container-half to the coupling end-casting of the interrupter, and the $\frac{3}{8}$ -16 \times $\frac{7}{8}$ -inch hex head cap screw and flat washer which attach the lower container-half to the indicator end casting of the interrupter, and discard this container-half.
- STEP 4.** Remove and discard the inner packaging wrapped around the interrupter.
- STEP 5.** Remove and discard the shield for the pressure-relief device. See Figure 22.

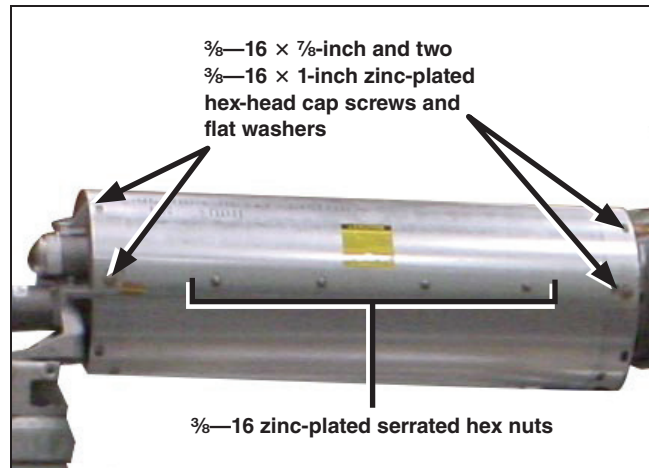


Figure 21. Removing the interrupter container.

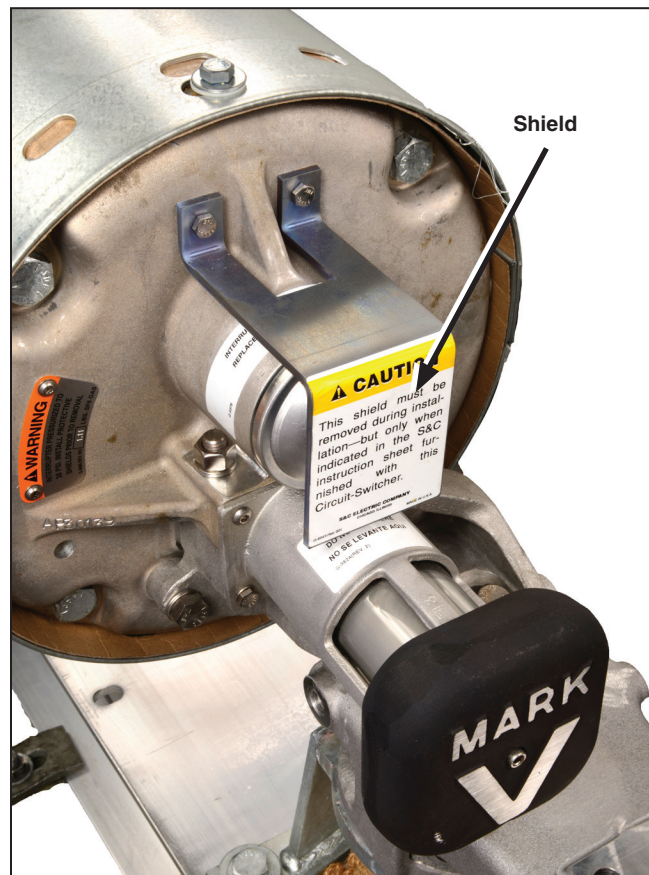


Figure 22. Removing the pressure relief device shield.

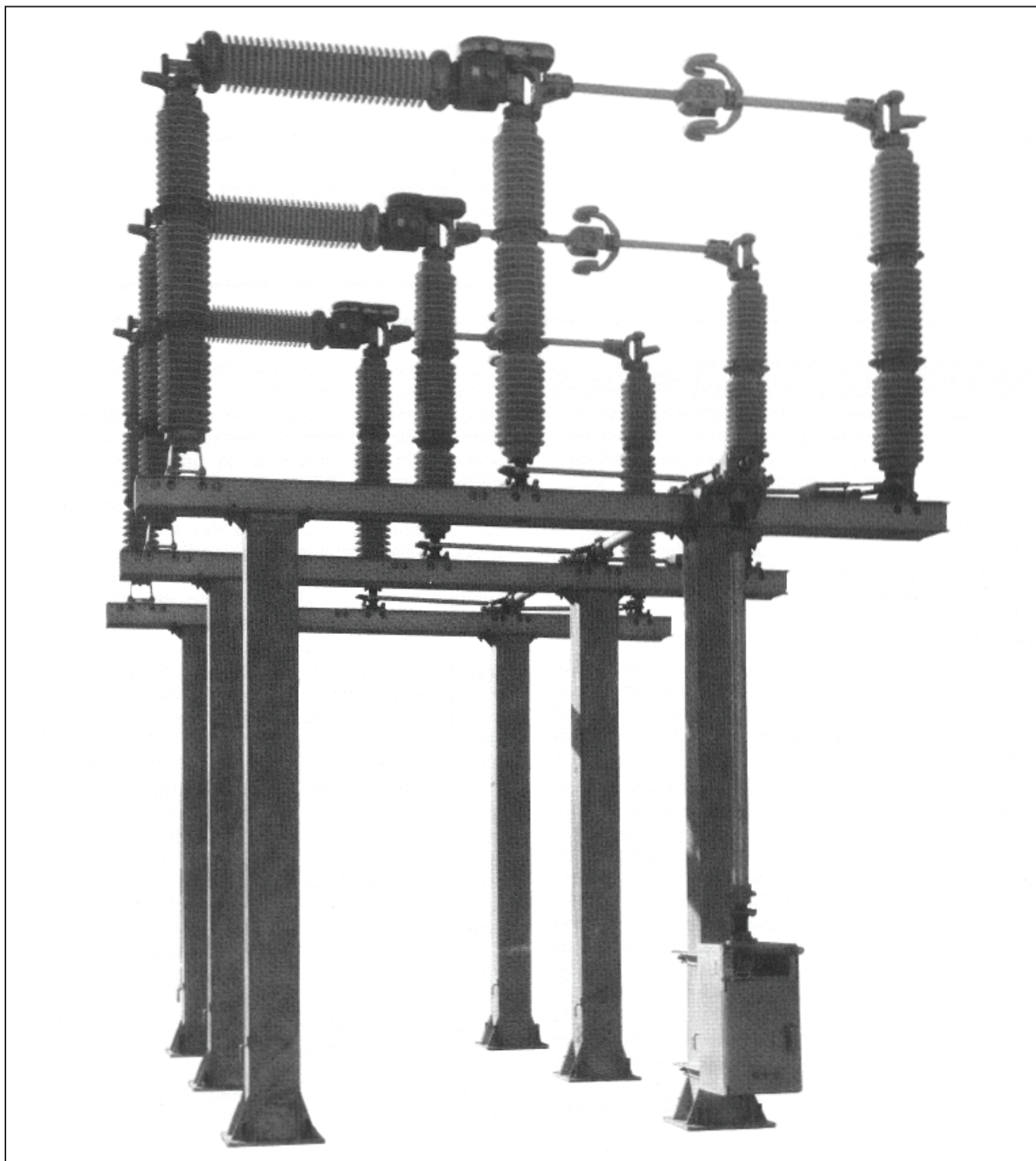


Figure 23. Completed circuit-switcher installation.