Installation

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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 or operating 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. Store a copy in the Type CS-1A Switch Operator's instruction book holder, or 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 application must be within the ratings furnished for the equipment. Ratings for the Mark V Circuit-Switcher, vertical-break style are listed in the ratings table 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

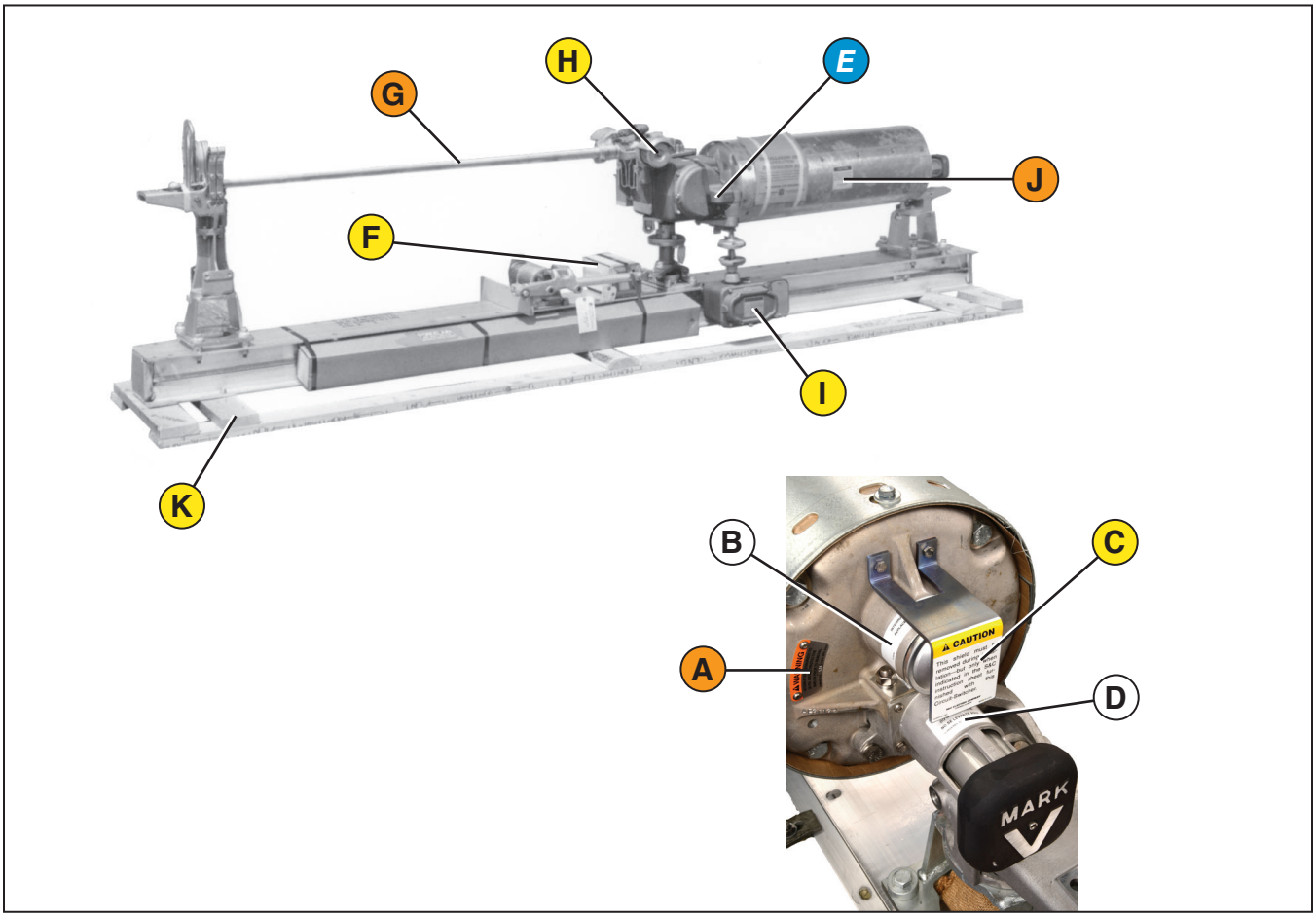
Read this instruction sheet thoroughly and carefully before installing the Mark V Circuit-Switcher.

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.

Location of Safety Labels



Reorder Information for Safety Labels

Location	Safety Alert Message	Description	Part Number
A	⚠ WARNING	Interrupter pressurized to 38 PSI. Install protective shields prior to removal.	G-9686
B	INSTRUCTION	Interrupter Part Number. Replace with catalog number...	G-6376
C	⚠ CAUTION	This shield must be removed during installation-- but only when indicated...	G-6043●
D	INSTRUCTION	Do not lift here.	G-3824
E	*NOTICE*	After the shunt-trip insulated operating shaft has been installed...	G-4602■
F	⚠ CAUTION	This insulator mounting flange position bolt contained in this bag must be used...	G-4766●
G	⚠ WARNING	Do not lift the brain and interrupting unit by attaching slings to the disconnect blade.	G-4093●
H	⚠ CAUTION	Before putting the switch into service, the interrupters must be closed...	G-4512●
I	⚠ CAUTION	The high-energy solenoid in this housing is designed for intermittent duty...	G-4947■
J	⚠ WARNING	DO NOT remove steel outer wrapper until installation is complete.	G-5993
K	⚠ CAUTION	Instructions for lifting 161-kV Circuit-Switcher pole-unit skid...	G-5990R1▲

● Temporary tag. Remove after installation.
■ Shunt-trip option only.
▲ For 161 kV Circuit-Switchers 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.

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 unit. Units that have been energized or installed near energized lines should be considered live until tested and grounded.
7. **GROUNDING.** The Mark V Circuit-Switcher must be connected to a suitable earth ground at the base of the utility pole, 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 the 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.
   - 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.

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 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. For ratings of 69 kV and above, the live parts, which are attached 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 individually identified miscellaneous power-train components, interphase couplings, mounting hardware, and a temporary adapter for hand operation of the individual pole-units.
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 2 ½-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 for switches rated 69 kV and higher.
5. Mounting pedestals (if specified) consisting of a set of two, of square steel tube construction, complete with a circuit-switcher support frame.
6. An S&C Type CS-1A Switch Operator (if specified)
7. Any accessories specified, such as shunt-trip device, grounding switch, pre-insertion inductors, bypass accessory, or manual operating handle.

Note: Interrupter Target. Circuit-switchers are usually shipped with the interrupters in the **Open** position. Therefore, 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.

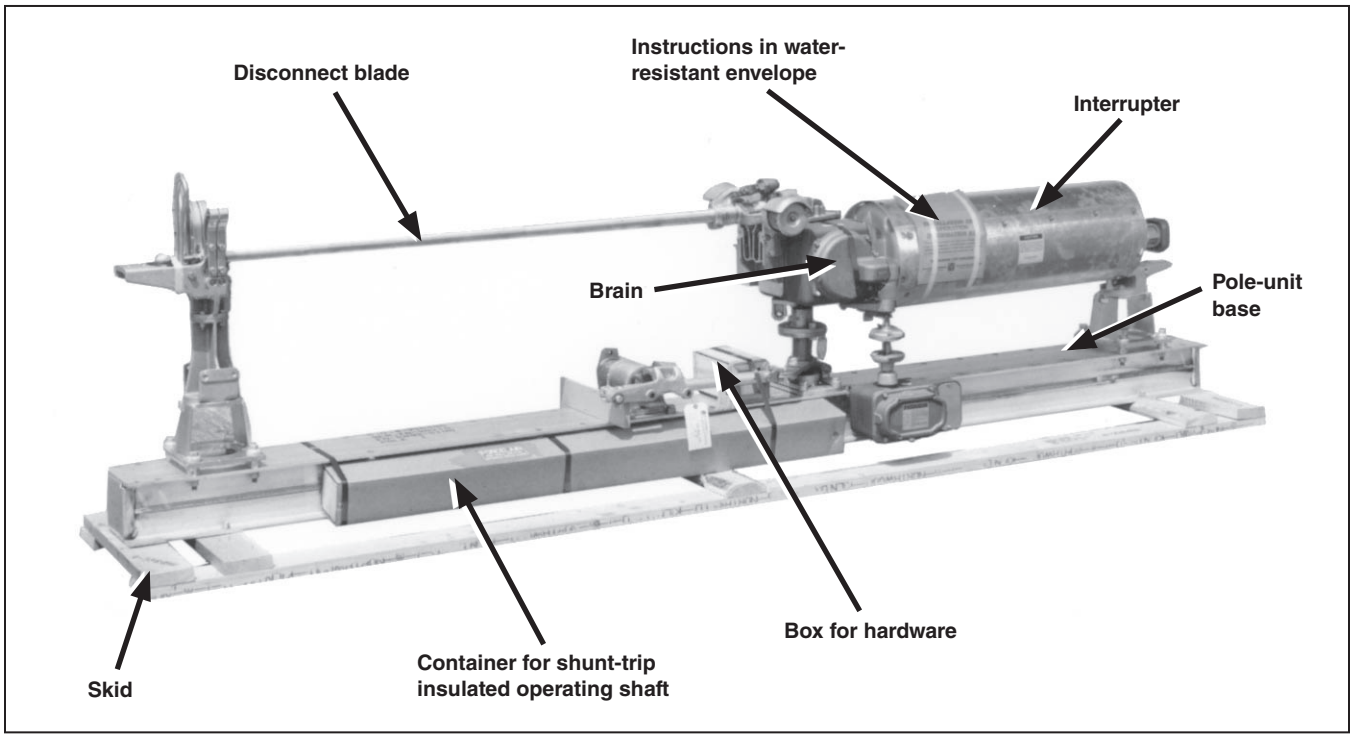


Figure 1. Pole-unit on skid.

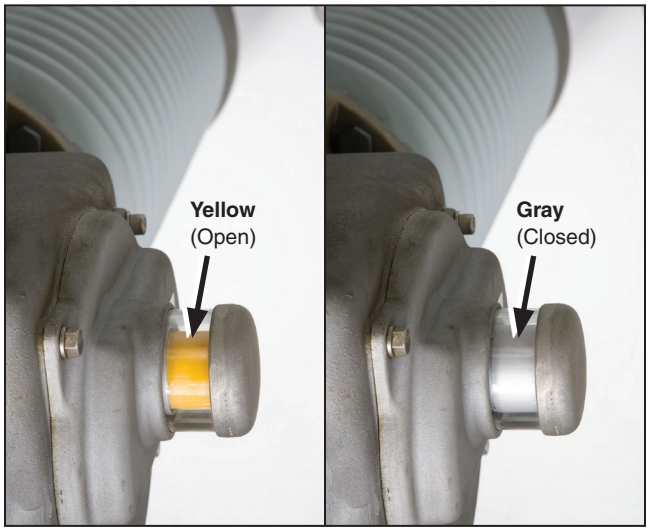


Figure 2. Interrupter target.

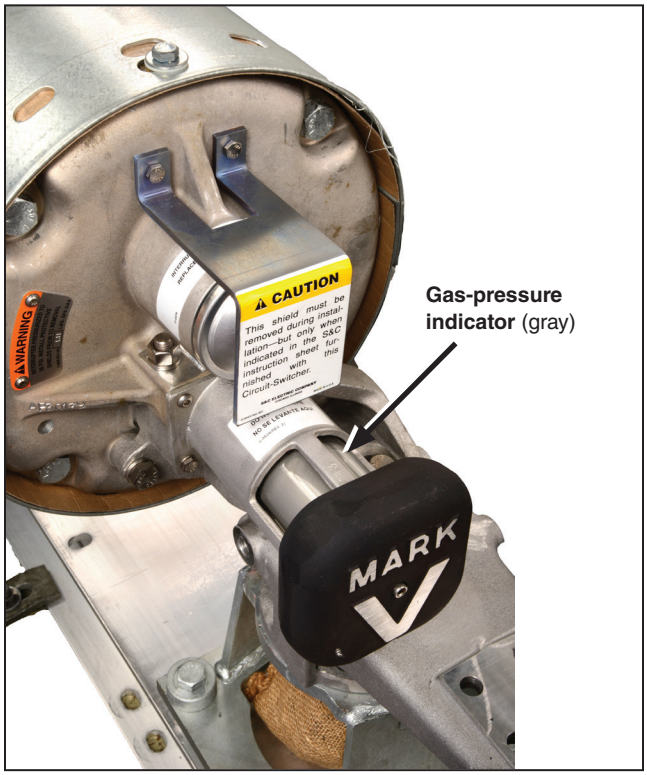


Figure 3. Gas-pressure target indicator.

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 rotating-insulator support, and a shunt-trip linkage will be attached to the brain. For circuit-switchers rated 69 kV and above, the shipment will also include, in separate cartons, insulator units and hardware for the three shunt-trip insulated operating shafts. 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 17. 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 "Checking the Optional Shunt-Trip Device" on page 25. 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, produces 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 711-300, 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 that various 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.

⚠ WARNING

Do not remove the protective shields around the interrupters until the installation is complete. Interrupters are pressurized to 75 PSIG. **Failure to keep the shields in place during installation may cause equipment damage or serious personal injury.**

Before Starting

⚠ WARNING

The foundations for the S&C Mounting Pedestal or user-furnished structure must be designed to meet the loading limits specified in S&C Information Bulletin 711-300. **Failure to meet these loading limits can result in equipment damage and personal injury.**

Without removing the circuit-switcher pole-units from their skids, arrange them in the position and order in which they will be raised onto the 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.) The three pole-units have 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 ensure the serial numbers are matched for each circuit-switcher installation. The switch operator also has the circuit-switcher serial number on its nameplate so 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.

Assembly of Individual Pole-Units

Repeat the following Step 1 through Step 15 for each of the three circuit-switcher pole-units. Assemble the pole-units as follows:

Note: Step 5 through Step 13 apply only to circuit-switchers rated 69 kV and up, for which the insulators are shipped separately. If the pole-units are shipped assembled, skip to Step 14 on page 16. after Step 5 on page 12.

STEP 1. Carefully remove the outer crate (if provided), but leave the skid attached to the pole-unit base. Inspect for any obvious shipping damage before continuing installation.

STEP 2. Attach the temporary hand-operation adapter, to the drive-shaft crank. See Figure 4 on page 10.

STEP 3. With the hand-operation adapter, open and close the pole-unit several times to obtain the "feel," and observe the operation of the circuit-switcher as adjusted by the factory. Observe 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.

(b) 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. The blade will now be in the fully **Open** position and the interrupter will be in the **Closed** position, as indicated by the gray interrupter target on the side of the brain. See Figure 2 on page 7.

(c) 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.

(d) As the circuit-switcher moves toward the **Closed** position, the current-carrying tongue contacts enter the current-carrying jaw contacts with equal clearance on each side. See "Adjusting the Pole-Units" on page 18 and Figure 12 on page 18. For circuit-switchers rated 69 kV and up, this same engagement should be attained after the live parts have been removed and reassembled on the insulator stacks.

(e) The blade crank-arm at the top of the brain rests against the blade crank-arm stop in the fully **Open** position. See Figure 15 on page 19.

No more than a 1/32-inch (0.8-mm) gap exists between the blade crank-arm and its associated blade crank-arm stop in the **Closed** position. See Figure 16 on page 20.

(f) 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 drive-shaft crank stop (not visible) in the drive-shaft assembly. See Figure 4 on page 10. The toggle-loading snubbers, located on the pole-unit base adjacent to the rotating-insulator support, (See Figure 14 on page 19) 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.

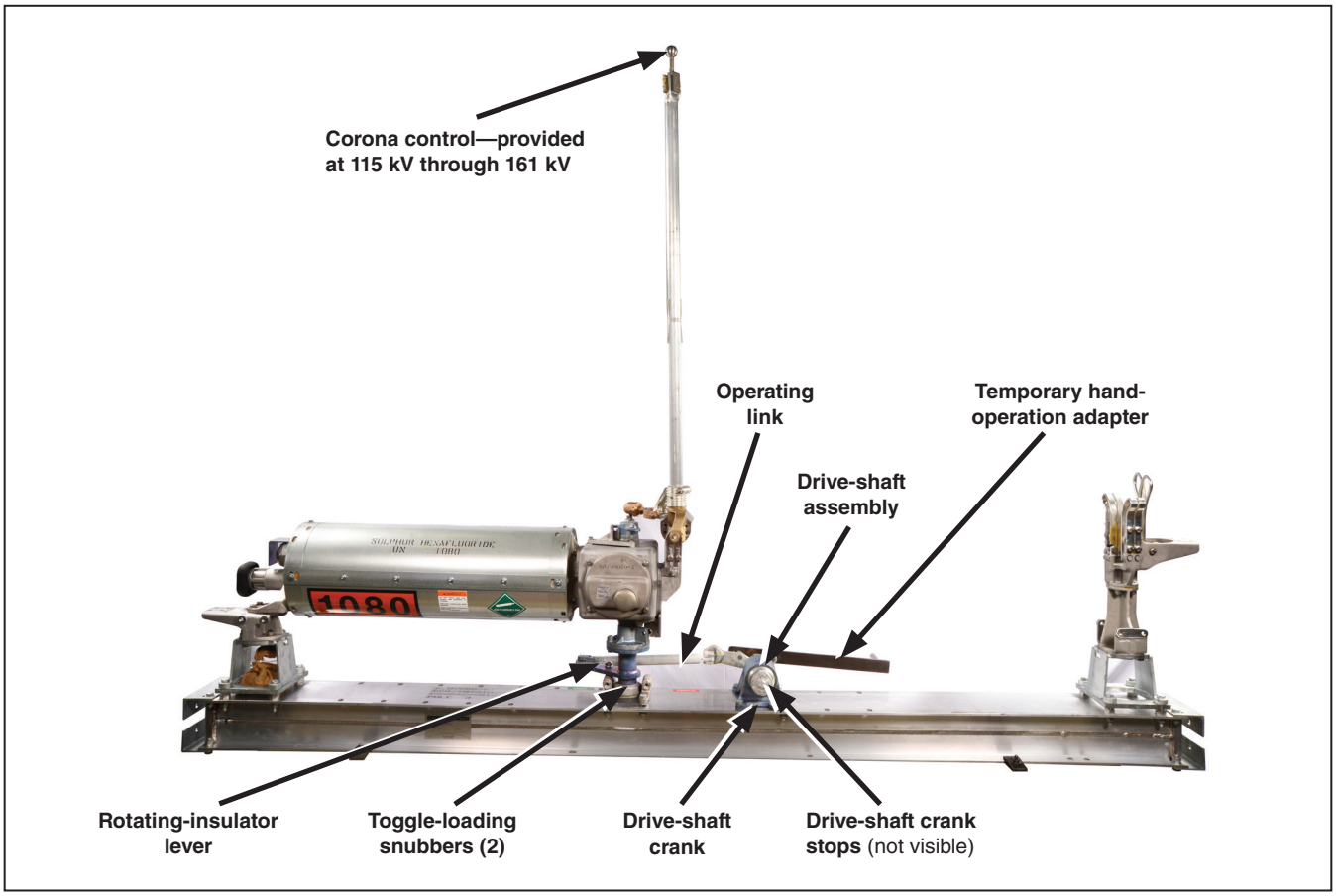


Figure 4. Overview of parts of Mark V Circuit-Switcher pole-unit and attaching the temporary hand-operation adapter.

STEP 4. Each circuit-switcher pole-unit brain, with its associated base-integrated power train, is factory-adjusted to provide the sequence control necessary to ensure positive latching of the stored-energy source within the brain and precisely timed opening of the interrupters. To maintain this essential factory-adjusted brain-and-power-train relationship during removal and later reassembly of live parts, a brain adjustment-holding device is provided. See Figure 5.

The adjustment-holding device consists of a stop bushing, factory-set in the bracket attached to the underside of the brain, plus a tab on the brain operating shaft. When the pole-unit is opened, the tab rotates to within 1/16-inch (1.6 mm) of the stop bushing. A ½–13 × 2¾-inch positioning bolt with flat washer and nut is furnished (in a cloth bag attached to the operating-shaft tab) for insertion through the stop bushing and the tab. Install the positioning bolt as follows:

(a) Make sure the pole-unit is in the fully **Open** position.

(b) At the brain mounting flange, loosen, but do not remove, the cap screws which fasten the brain to the rotating-insulator support See Figure 5.

(c) Insert the positioning bolt through the tab and stop bushing and secure it with the flat washer and nut. Torque the nut tightly so the two mating surfaces are drawn together. See Figure 6.

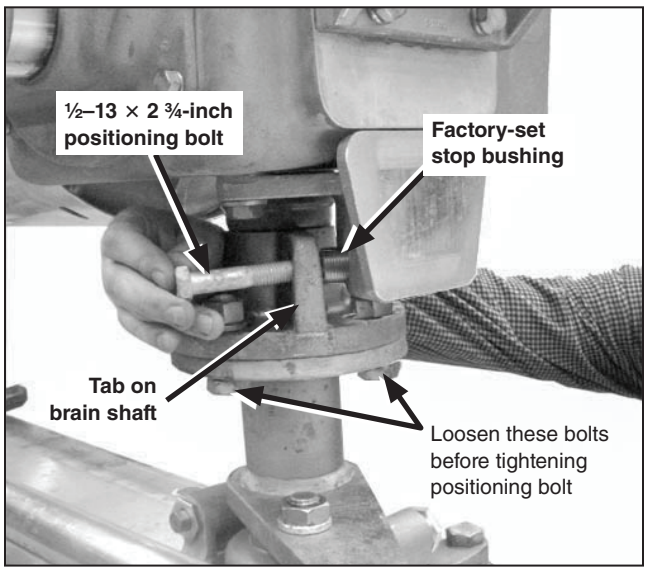


Figure 5. Installing the positioning bolt.

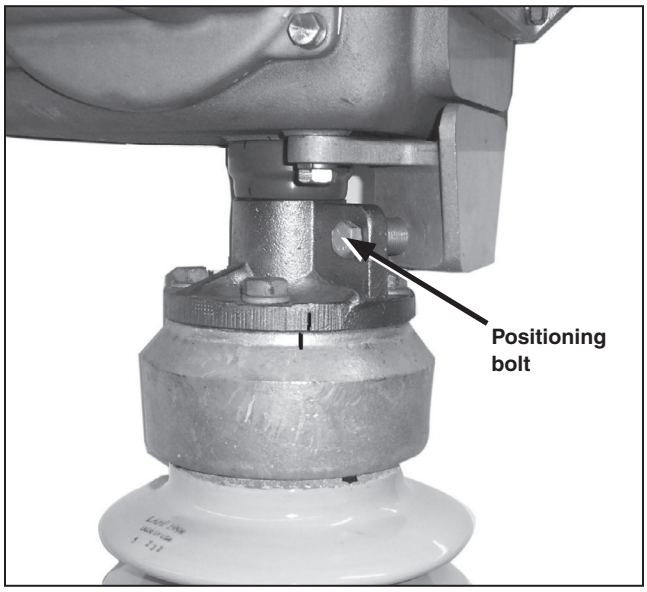


Figure 6. Positioning bolt after installation.

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

(a) Attach lifting slings in the manner shown in Figure 7. Be 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).

(b) Remove the cap screws fastening the brain to the rotating-insulator support and the cap screws fastening the interrupter to the rear insulator support.

(c) 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).

STEP 6. Unbolt and remove the jaw-contact assembly and terminal adapter, as a unit, from the front insulator support. See Figure 7.

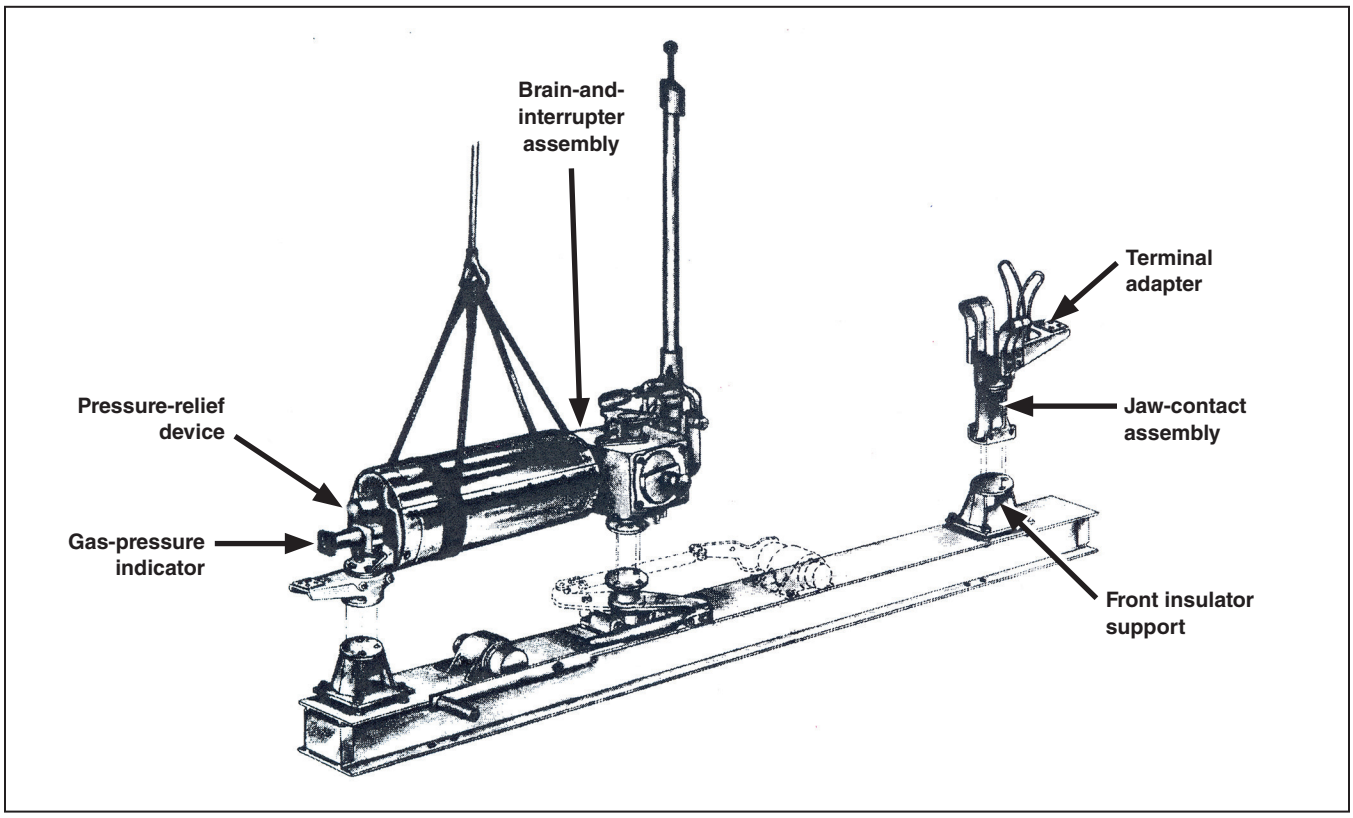


Figure 7. Removing brain-and-interrupter assembly and the jaw-contact assembly.

STEP 7. Assemble the insulator stacks directly on their insulator supports, using the galvanized hardware specified in Figure 8.

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

(a) Locate the center point of each insulator stack by accurately drawing, on the top of the insulator cap, temporary lines which bisect and connect opposite bolt holes. See Figure 9 on page 14.

(b) Stretch a cord taut across the top of the insulator caps so it crosses the center point on the rotating-insulator stack. (At this time the cord need not cross the center point of the front and rear insulator caps.)

(c) Make a mark on the cord at the point where it crosses the center point of the rotating-insulator stack.

(d) Operate the temporary hand-operation adapter and check to see the mark on the cord remains within ⅛-inch of the center point 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 8. Shimming material is included with the insulator hardware in a cloth sack 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.

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

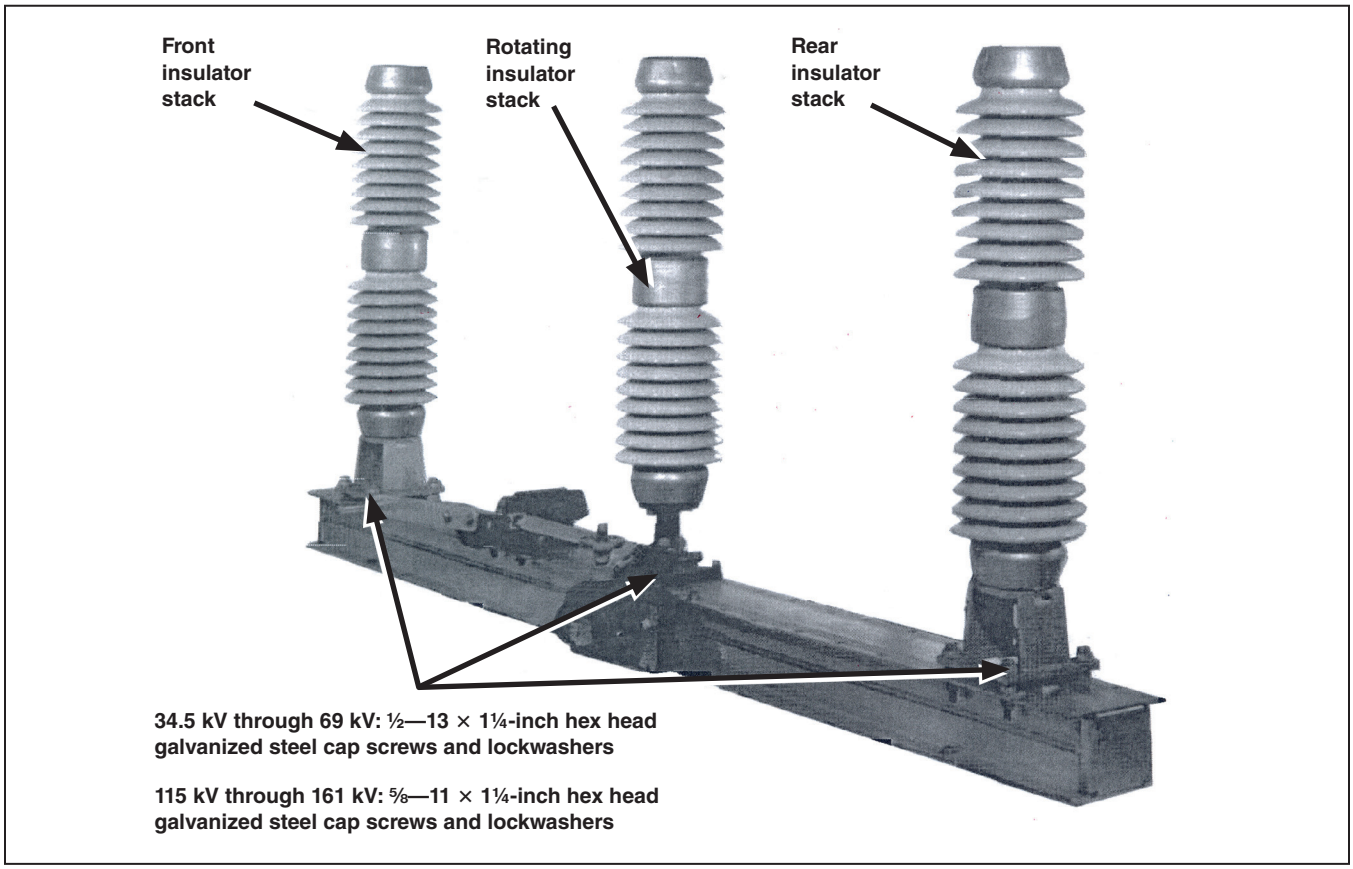


Figure 8. Insulator stacks assembled on pole-unit.

STEP 9. The rear insulator stack should be checked for alignment with the rotating insulator stack as follows:

(a) Stand behind the rear insulator stack and sight down the length of the pole-unit base. The rear insulator stack should not be canted. It should be perpendicular to the base and in alignment with the rotating insulator stack.

(b) Measure the centerline distance across the top from the centerpoint of the rotating insulator stack to the centerpoint of the rear insulator stack. This measurement must be within ⅛-inch of the dimension shown on the erection drawing. See Figure 9.

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

(a) Loosen the four locking nuts and adjust the leveling screws located under the stationary insulator support. See Figure 9. (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 four locking nuts.

STEP 11. Check the alignment of the front-insulator stack by means of a cord stretched taut across the top of the insulator stacks. The cord should cross the center points of all three insulator stacks and the front insulator stack should not be tilted. If adjustment of the front-insulator stack is necessary, follow the procedure described in Step 10.

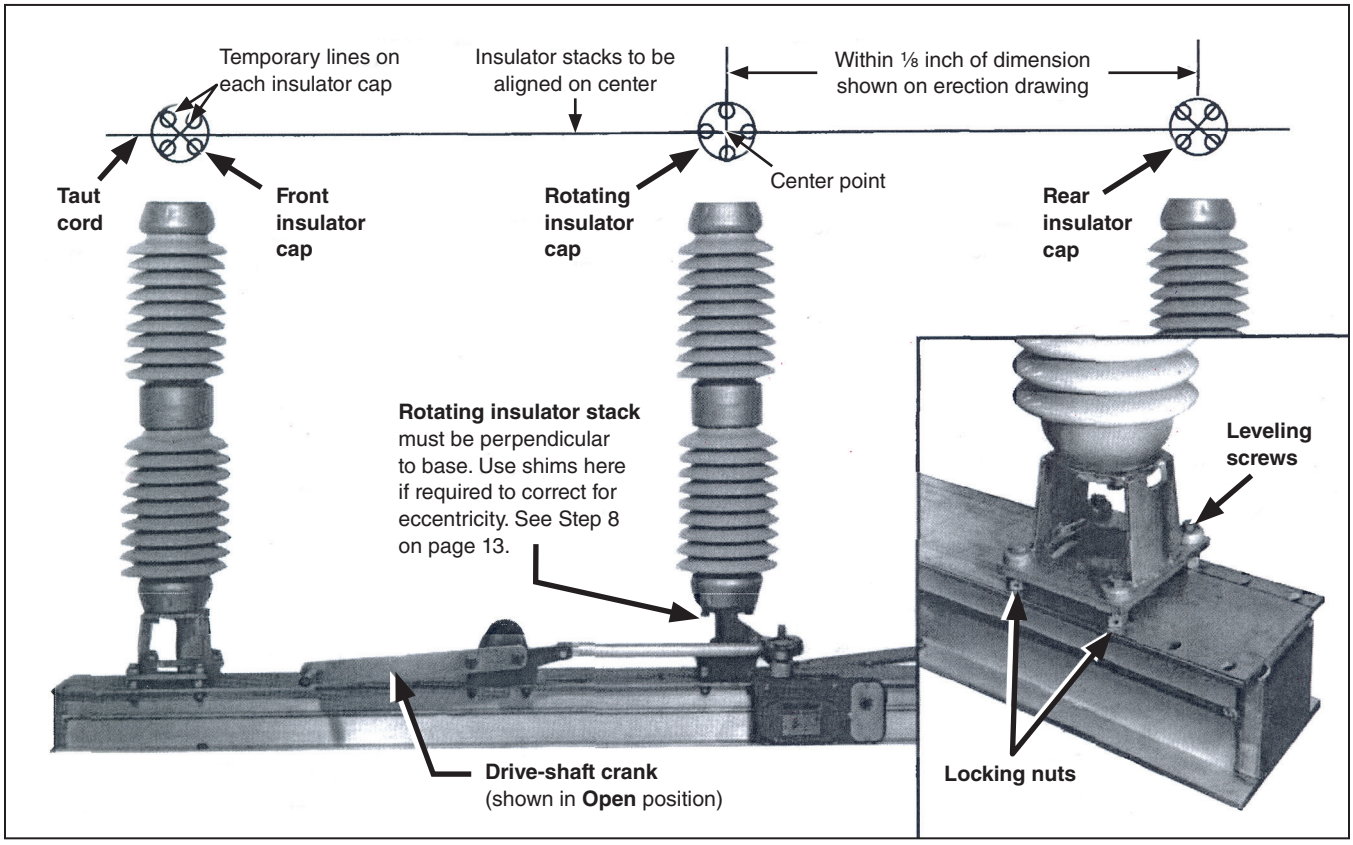


Figure 9. Obtaining critical dimension and alignment with shims and leveling screws.

STEP 12. Mount the brain-and-interrupter assembly as follows:

(a) Place the drive-shaft crank in the fully **Open** position (rotating-insulator stack rotated counterclockwise).

(b) Lift the brain-and-interrupter assembly into position on its respective insulator stacks, using the same handling care that was cautioned for its removal. See Figure 10. Be sure to place the brain-and-interrupter assembly on the same pole-unit from which it was removed.

(c) Install the cap screws (with lock-washers) finger tight at both ends of the brain-and-interrupter assembly. If necessary, loosen the cap screws at the rotating-insulator support. 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. See Figure 10. Then, torque to final tightness, in order, the interrupter cap screws at the terminal end, the cap screws at the top of the rotating-insulator stack, and finally, any rotating-insulator cap screws previously loosened.

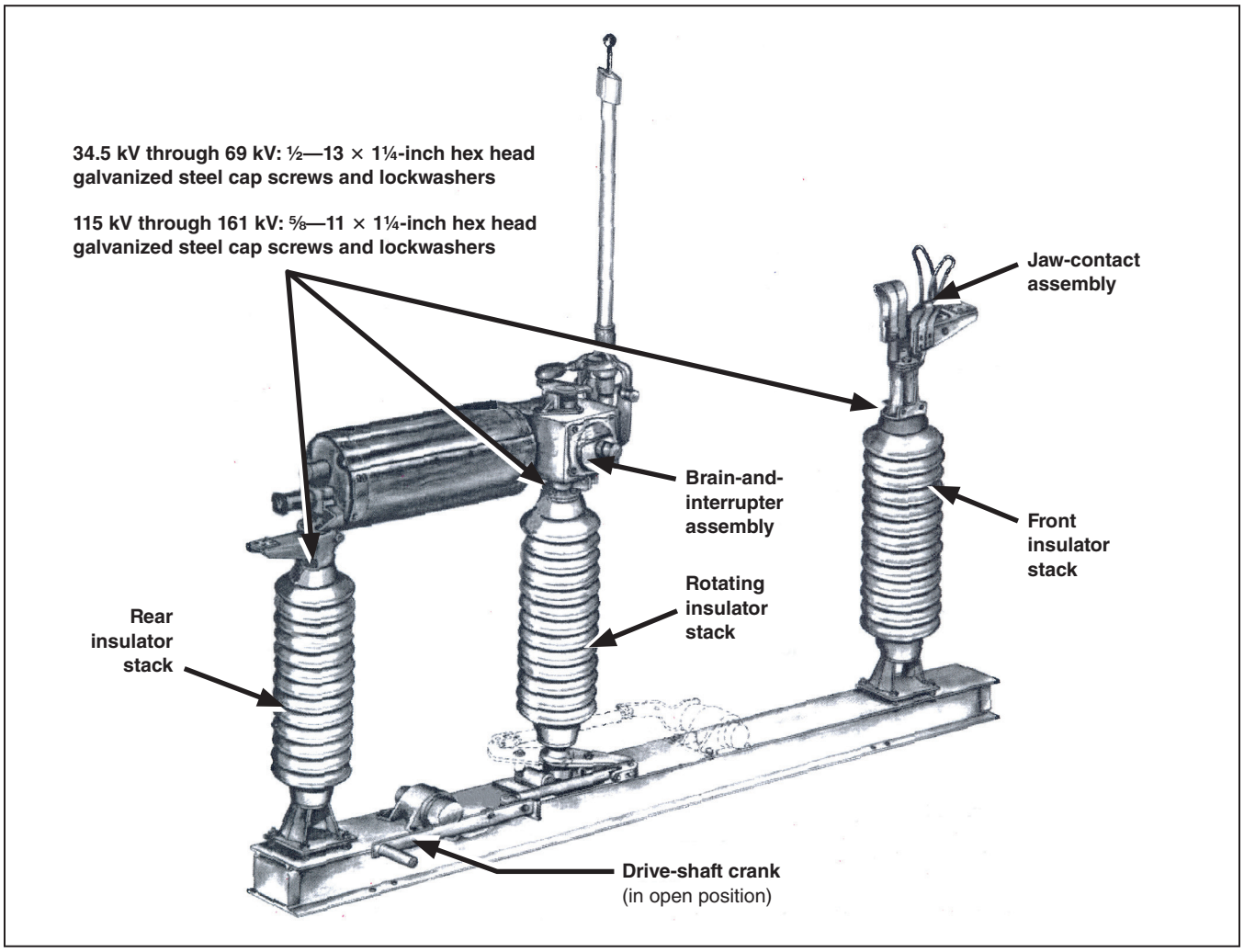


Figure 10. Braln-and-interrupter assembly and jaw-contact assembly mounted on insulator stacks.

(d) Remove, from the adjustment-holding device under the brain, the ½–13 × 2¾-inch (positioning bolt installed in Step 4 on page 11. (A visible gap between mating parts is normal when the bolt is removed.)

Do not attempt to operate the circuit-switcher pole-unit before removing the positioning bolt.

STEP 13. Mount the jaw-contact assembly and terminal adapter as a unit on the front-insulator stack using the galvanized hardware specified in Figure 10 on page 15. Align the jaw-contact assembly with the blade by shifting the terminal adapter as required. (Optimal alignment of the jaw-contact assembly with the blade may require adjustment of the front-insulator-support leveling screw. This final adjustment should be made only after the pole-unit has been mounted in place and bolted to the pedestals or structure.)

STEP 14. 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 by the erection drawing. Make sure the rigging does not stress the interrupter or the brain.

Extreme care should be exercised to prevent damaging the interrupter target, the gas-pressure indicator, or the pressure-relief device with the lifting slings 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. The blade and/or the interrupter cannot support the full weight of the pole-unit. **Failure to lift from the base may cause property damage and/or serious injury.**

STEP 15. Bolt the circuit-switcher pole-units in place using ⅝-inch (16-mm) galvanized bolts, flat washers, lockwashers, and nuts (furnished only if so specified on the order). The pole-unit bases should be shimmed as required if the mounting surface is sufficiently irregular to distort the bases.

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 on circuit-switchers rated 69 kV and up. 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 Step 6 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 11.

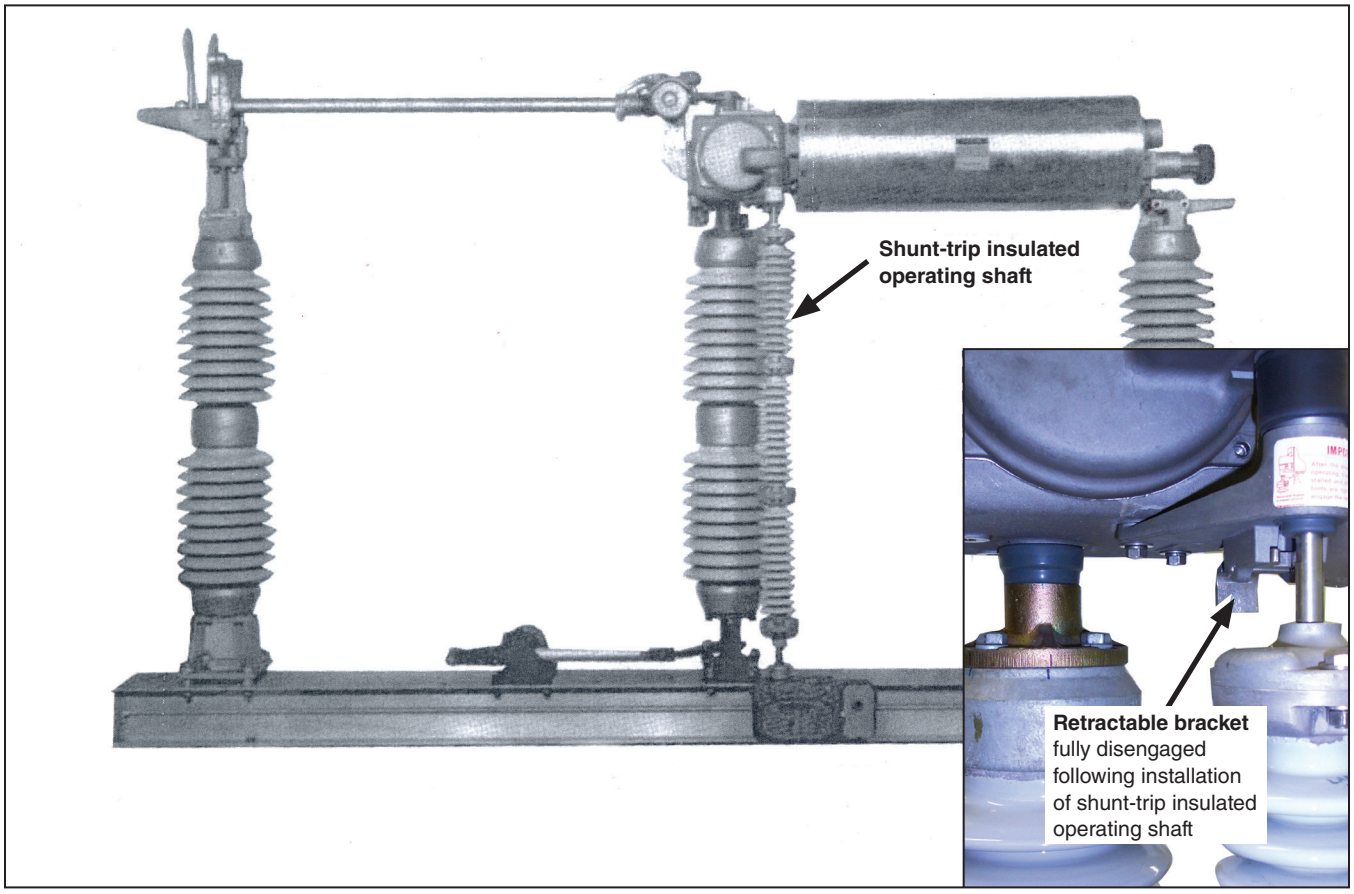


Figure 11. Complete pole-unit, with shunt-trip device, after mounting on structure.

Adjusting the Pole-Units

STEP 1. Make a final check of each circuit-switcher pole-unit for adjustment and alignment of the blade with the jaw-contact assembly. As each circuit-switcher blade is closed, the fault-closing tongue contact should engage each of the fault-closing jaw contacts with equal pressure and the current-carrying tongue contacts should enter the current-carrying jaw contacts with equal clearance on each side. The silver-surfaced area of the current-carrying tongue contacts should center laterally with the silver-surfaced current-carrying jaw contacts, and the blade should rotate with slight pressure against the blade bumper stop and come to rest either on the stop or slightly above it. See Figure 12.

If adjustment of the position of the jaw-contact assembly is necessary to obtain the described alignment, the insulator mounting-flange bolts should be loosened and the insulator shifted as required. It may also be necessary to adjust the front-insulator-support leveling screws.

To maintain the correct effective height of each individual insulator stack, it is important only three of the four leveling nuts on any one insulator support be adjusted. One leveling nut should always remain in its original (factory-set) position to avoid changing the effective height of the insulator. See Figure 13 on page 19.

STEP 2. With the hand-operation adapter, operate each circuit-switcher pole-unit to its fully **Open** 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. The toggle-loading snubber (located on the pole-unit base adjacent to the rotating-insulator support, see Figure 14 on page 19) should maintain positive-toggle locking. 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.

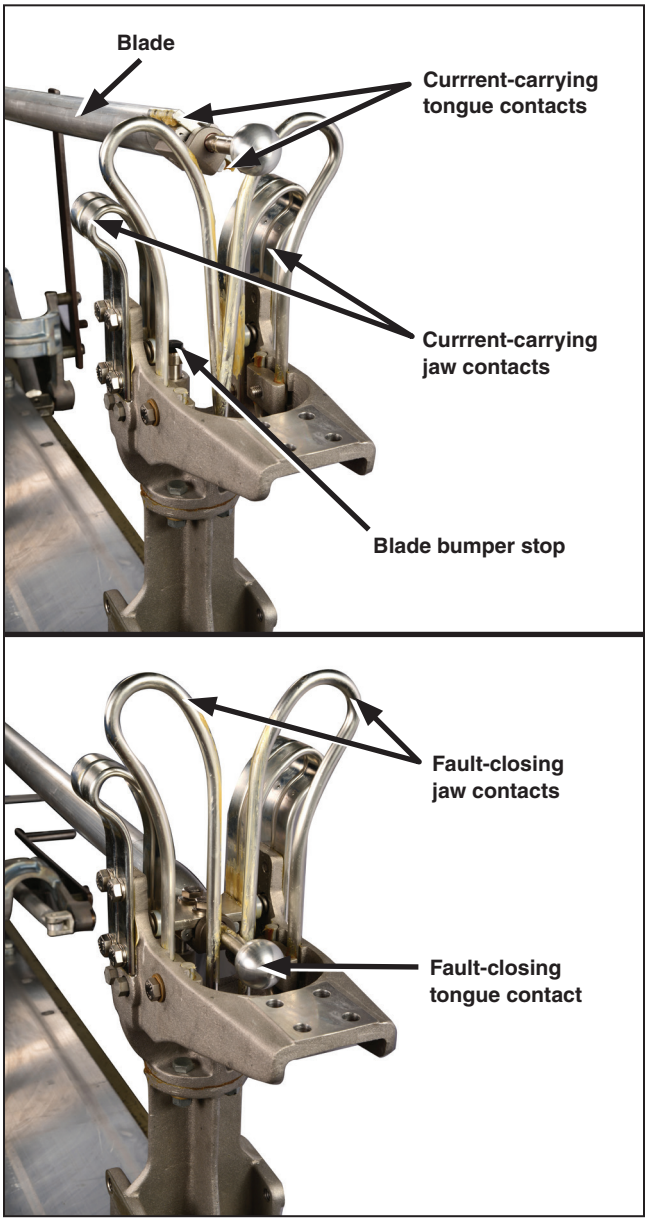


Figure 12. Tongue-contact and jaw-contact assemblies shown in partially Closed and fully Closed positions.

With the drive-shaft crank in the fully **Open** toggle position described, the blade crank-arm at the top of the brain should rest against its open stop, thus assuring a positive **Closed and Latched** position of the interrupter. See Figure 15. Do not attempt to adjust this stop. The stop is factory-set to provide the travel necessary to achieve positive latching of the brain as well as tripping simultaneity.

Should the blade crank-arm fail to meet its open stop, readjust as follows:

(a) Loosen the four cap screws fastening the brain to the rotating insulator.

(b) Install the ½–13 × 2 ¾-inch positioning bolt, flat washer, and nut in the adjustment-holding device under the brain, as shown in Figure 5 on page 11. Tighten the nut securely so the two mating surfaces are drawn together.

(c) Securely tighten the four cap screws fastening the brain to the rotating insulator.

(d) Remove the positioning bolt installed in (b).

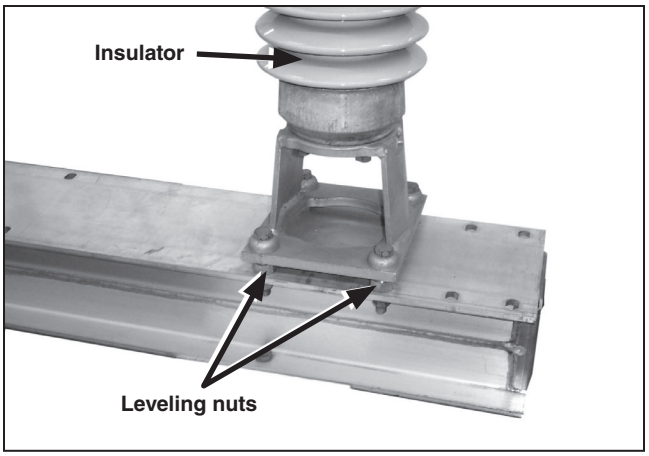


Figure 13. Leveling nuts on base of jaw-contact insulator.

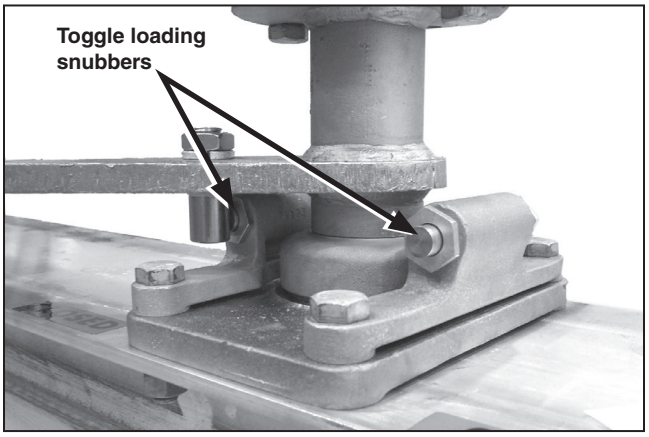


Figure 14. Toggle loading snubbers, closed position.

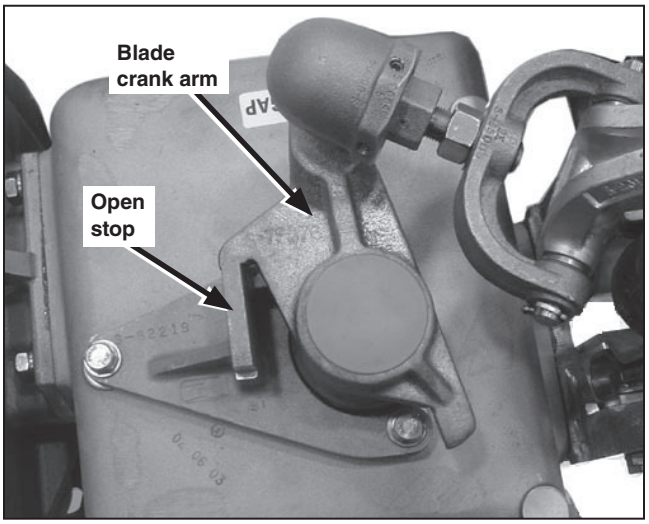


Figure 15. Top of brain, blade crank arm stop. Open position.

STEP 3. With the hand-operation adapter, operate each circuit-switcher pole-unit to its fully **Closed** position. See Figure 16. The drive-shaft crank should rest firmly in a toggle position against an internal drive-shaft crank stop in the drive-shaft assembly. As in the **Open** position, a positive-toggle position of the drive-shaft crank should be maintained by the force exerted on the rotating-insulator lever by the toggle-loading snubber and transmitted by the operating link.

Although it is desirable the blade crank-arm rest against its closed stop in the fully **Closed** position, a gap not greater than 1/32 inch (0.8 mm) can be tolerated in the **Closed** position only.

STEP 4. Become familiar with the parts of the blade mechanism as seen in Figure 17. Check each circuit-switcher pole-unit for adequate penetration of the blade into the jaw contact during completion of the closing stroke. See Figure 12 on page 18. The blade should exert a slight pressure against the blade bumper stop before the start of the "wiping in" rotation. After the current-carrying tongue contacts are completely rotated into the jaw contacts, the blade pressure against the bumper stop will tend to be relaxed, and a 1/8-inch (3.2-mm) maximum gap is permissible between the blade and the blade bumper stop.

Should a blade-penetration adjustment be required, proceed as follows:

(a) With the blade in a partially **Open** position, loosen the rotating-yoke lock nut. Figure 18 on page 21.

(b) Remove one of the cotter pins from the rotating-yoke coupling pin. Then, remove the coupling pin itself.

(c) Turn the rotating yoke in or out on its threaded stud to decrease or increase blade penetration. Half-turn adjustment increments are suggested between tryouts.

(d) Replace the rotating-yoke coupling pin and, if no further adjustment is required, also replace the cotter pin.

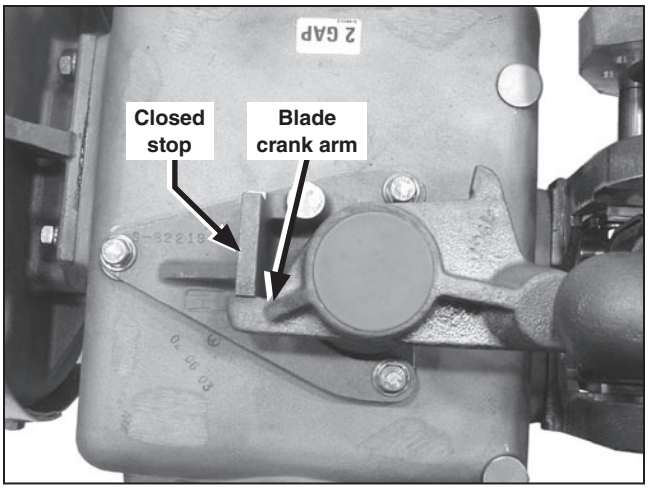


Figure 16. Top of brain, blade crank arm stop. Closed position.

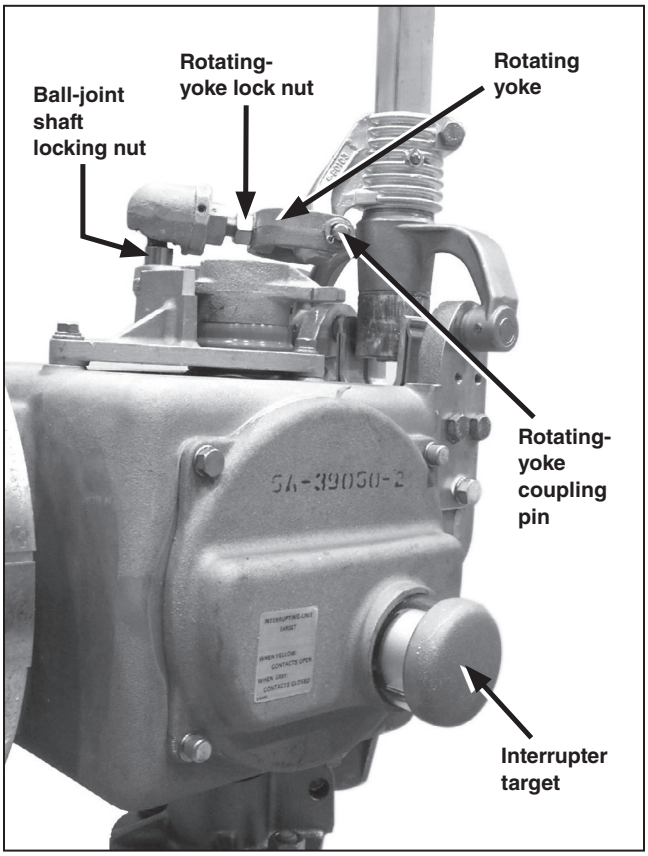


Figure 17. Blade mechanism overview

(e) Before tightening the rotating-yoke lock nut, observe the action of the ball joint during opening and closing operations. Note the "window" of the ball-joint socket should permit the socket to roll freely with the motion of the blade without binding against the ball-joint shaft.

Then, with the blade in the fully **Closed** position and while holding the ball-joint socket so the edge of its window nearest the interrupter target is close to the ball-joint shaft, tighten the rotating-yoke lock nut.

STEP 5. After each pole-unit has been checked and adjusted as described above, return it to the fully **Open** position. Then, remove the temporary hand-operation adapter.

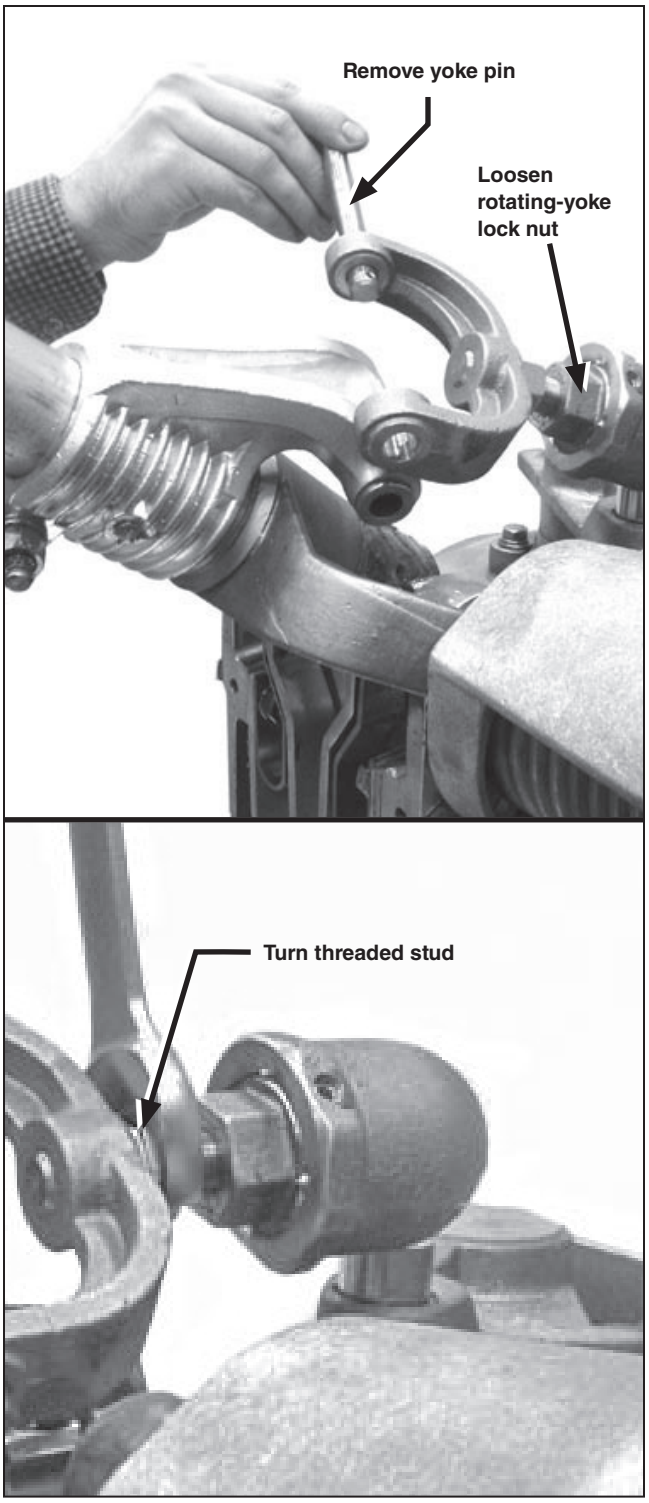


Figure 18. Blade penetration adjustment.

Installing the Power Train

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.

NOTICE

To ensure the integrity of the operating mechanism, it is imperative careful attention be given to the correct installation of the piercing set screws provided on the operating-shaft couplings. See Figure 19 and Figure 20. Before installing an operating shaft in any coupling, make certain the cutting tips of the piercing set screws do not protrude through the body of the coupling. Tighten each piercing set screw as directed in the step-by-step instructions that follow, but in each case, only after the associated clamp bolts have been torqued to final tightness.

STEP 1. 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 21 on page 23. 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. Install the interphase and connecting shafts as shown on the erection drawing. When performing this operation make certain 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. Then, tighten the associated piercing set screws, piercing the shaft, and continue turning until a firm resistance is felt. See Figure 19 and Figure 20.

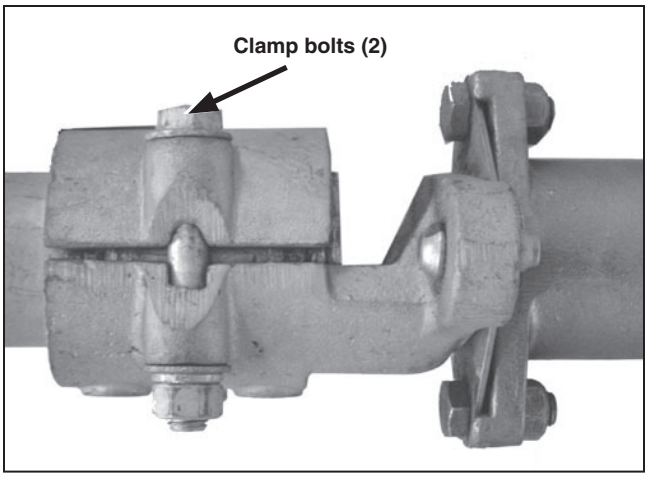


Figure 19. Coupling showing clamp bolt. There are two clamp bolts per coupling.

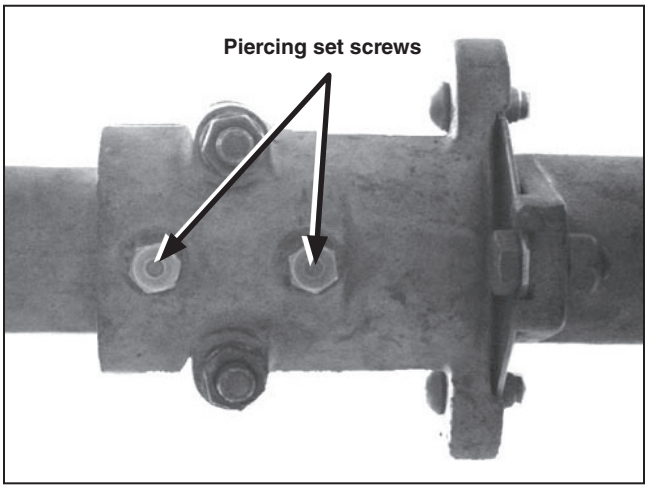


Figure 20. Coupling showing piercing set screws.

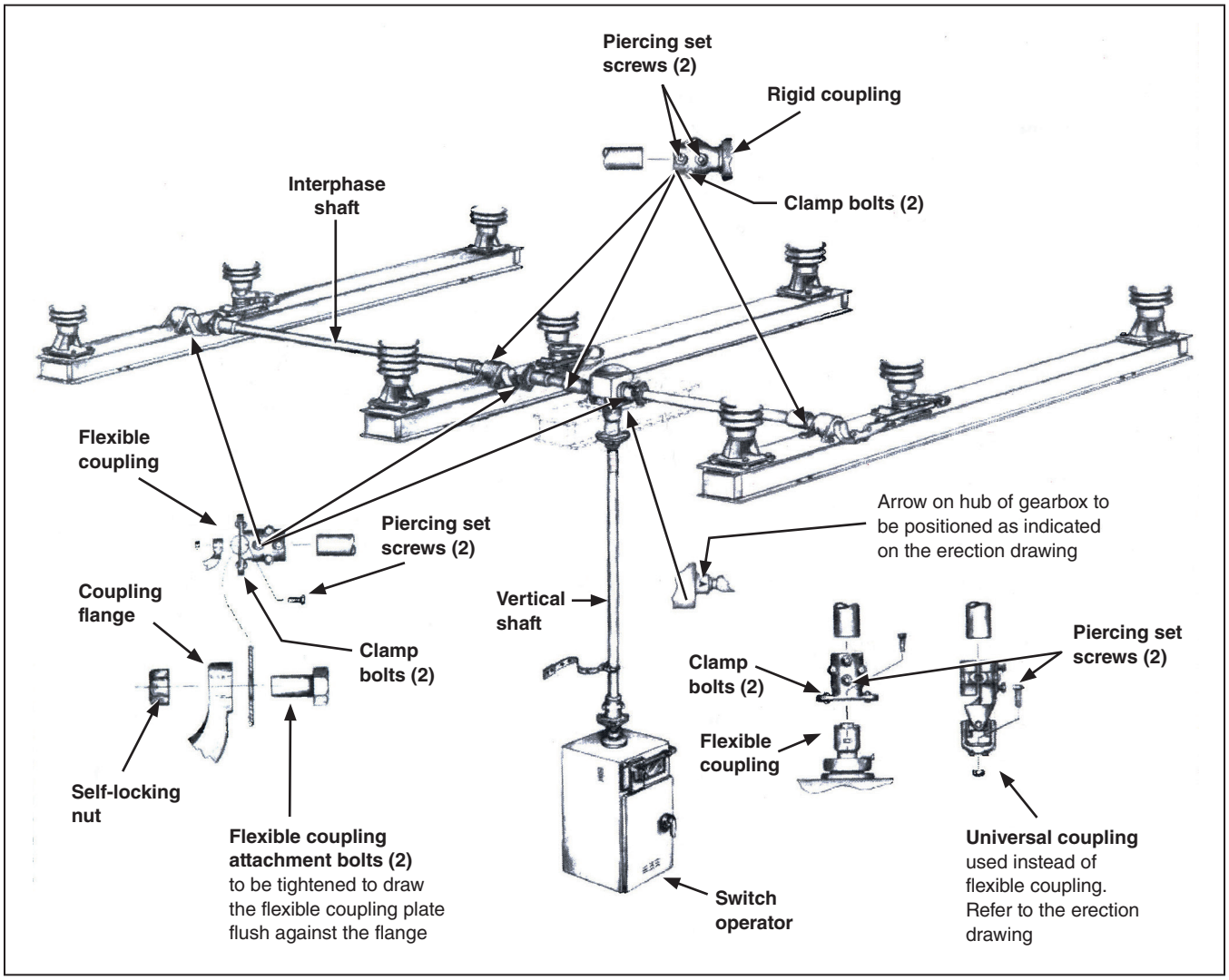


Figure 21. Power train.

Installing the Type CS-1A Switch Operator

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

When 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, matches the serial number on the nameplate of each pole-unit.

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 certain the cutting tips of the piercing set screws do not protrude through the body of the universal or flexible coupling. See Figure 19 on page 22 through Figure 21 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 S&C Type CS-1A Switch Operator Instruction Sheet 719-500, which is located inside the door of the switch operator, and proceed as outlined therein.

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.

STEP 6. Manually operate the switch operator to bring it to the same position (fully **Open** or fully **Closed**) as the circuit-switcher. Make certain 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.**

Checking the Operation

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. Check for simultaneous closing of the three pole-units by visually determining engagement of the fault-closing contacts. Check each pole-unit for proper blade penetration and readjust if necessary, as described in Step 4 on page 20.

STEP 4. While it is not critical, the normal blade opening is 90 degrees. It may be desirable from an appearance standpoint, for all three pole-unit blades to achieve an equal stance when in the fully **Open** position. If adjustment is required. Loosen the ball-joint shaft locking nut. Turn the shaft (which is an eccentric) to achieve a satisfactory blade position. See Figure 10 on page 15. Retighten the locking nut. Note it is not necessary to loosen the socket-head screw (in the blade crank-arm) to make this adjustment. It is not a lock screw.

Repositioning the ball-joint shaft will affect the depth of blade penetration into the jaw contact during completion of the closing stroke. The difference in penetration will range from very slight (at lower voltage ratings) to significant (at higher voltage ratings).

When the adjustment described above is performed, recheck for proper blade penetration and readjust if necessary (as in Step 4 on page 20).

STEP 5. After satisfactory group operation has been attained manually, adjust the switch operator for electrical operation as described in the "Adjusting the Switch Operator" section of S&C Instruction Sheet 719-500.

STEP 6. 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.

Opening of the three pole-unit interrupters by the switch operator should be simultaneous within 1.0 cycle (0.016 second).

STEP 1. 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.

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 is not attained, recheck the blade crank-arm at the top of each brain with the circuit-switcher in the fully **Open** position. (See Figure 15 on page 19.) If any blade crank-arm fails to meet its Open stop, it will be necessary to isolate the pole-unit(s) affected by loosening the clamps at both ends of the applicable interphase and/or connecting shafts. Then proceed as follows:

(a) At the applicable pole-unit(s), loosen the four bolts fastening the brain to the rotating insulator, and install the ½–13 × 2 ¾-inch positioning bolt, flat washer, and nut as shown in Figure 5 on page 11. Tighten the nut securely so the two mating surfaces of the tabs are drawn together as shown in Figure 6 on page 11.

(b) Securely tighten the four bolts fastening the brain(s) to the rotating insulator.

(c) At each end of the previously loosened interphase and/or connecting shafts make certain the piercing set screws do not protrude through the body of any coupling. Rotate the shafts about 90 degrees (to provide a fresh piercing surface). At each coupling 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.

(d) Remove the positioning bolt(s) installed in (a) on page 25.

In the event the blade crank-arms are correctly adjusted and the specified simultaneity cannot be attained, contact your local S&C Sales Office.

Before Energizing the Circuit-Switcher

Remove the container from each interrupter as follows:

STEP 1. Remove and discard the ⅜–16 zinc-plated serrated hex nuts which run the length of the container. See Figure 22. Remove and discard the ⅜–16 × ⅞-inch and two ⅜–16 × 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 ⅜–16 × ⅞-inch and two ⅜–16 × 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 conveniently lowered to the ground.

STEP 3. Now remove and discard the ⅜–16 × ⅞-inch hex-head cap screw and flat washer which attach the lower container-half to the coupling end casting of the interrupter, and the ⅜–16 × ⅞-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. Finally, remove and discard the inner packaging wrapped around the interrupter.

STEP 5. Remove and discard the shield for the pressure-relief device. See Figure 23.

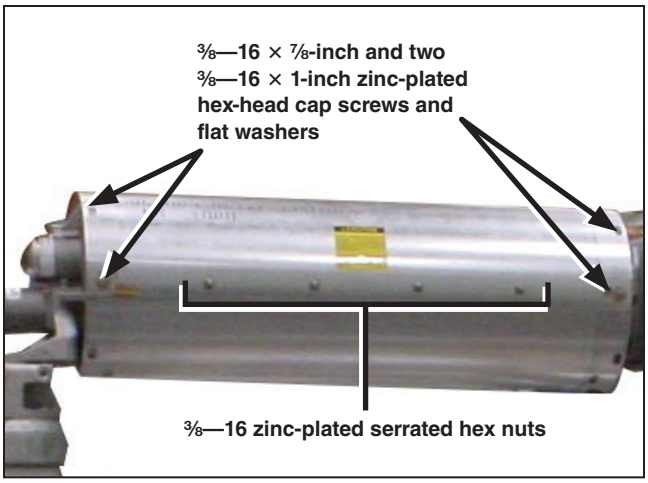


Figure 22. Removing the interrupter container.

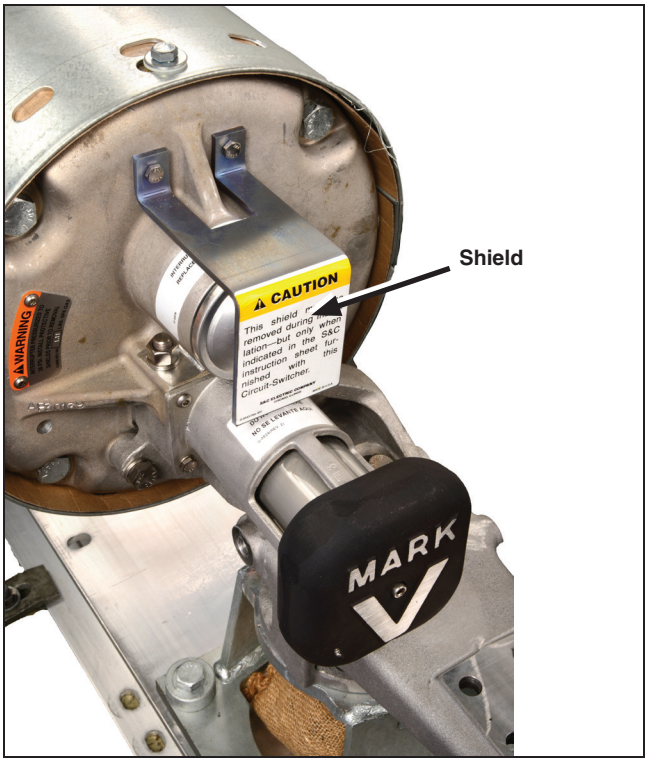


Figure 23. Removing the pressure relief device shield.