INSTRUCTIONS

For Field Assembly and Installation

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INTRODUCTION

⚠ CAUTION

The equipment covered by this publication must be selected for a specific application and it must be installed, operated, and maintained by qualified persons who are thoroughly trained and who understand any hazards that may be involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

General

The following instructions are for field assembly (erection) and installation of S&C Mark IV Center-Break Style Circuit-Switchers, with aluminum-sheathed steel weldment bases, in ratings of 345 kv, 1600 amperes and 2000 amperes continuous; and 500 kv, 2000 amperes continuous, with six interrupting gaps per pole-unit. See Figure 1 and Figure 2. (Circuit-Switchers having six interrupting gaps per pole-unit use a siamese brain between *two* interrupters for each pole-unit.)

The S&C Mark IV Circuit-Switcher employs in-series circuit-breaking interrupters and a circuit-making and isolating disconnect, making it especially suited for switching and protection of transformers, lines, cables, capacitor banks, and line-connected or tertiary-connected shunt reactors. The Mark IV Circuit-Switcher is suitable for frequent operation over a long period of time with minimal maintenance; is capable of closing, carrying, and interrupting fault currents as well as load currents; and utilizes interrupters economically tailored for specific applications by employing the precise number of interrupting gaps required.

Maintenance of Mark IV interrupters is neither necessary nor possible; however, Mark IV Circuit-Switchers must be properly adjusted during installation and inspected periodically to minimize the possibility of malfunction wherein the disconnect blades are closed with the interrupters open. Such malfunction of an energized Mark IV Circuit-Switcher might result in operation of the interrupter pressure-relief devices, since these interrupters employ voltage-grading resistors not designed to withstand system voltage continuously.

Each pole-unit of the S&C Mark IV Circuit-Switcher includes a brain which provides built-in positive sequence control . . . and a fully enclosed stored-energy source dedicated solely to operation of the interrupters which are in the circuit at all times. Close-and-trip mechanisms are fully enclosed and protected, too. There are no external linkages, lever arms, cams, shunts, etc. that must be coordinated with a disconnect blade to accomplish circuit interruption. Positively sequenced operation is assured regardless of severe weather conditions such as high winds, rain, sleet, or snow.

The fault-closing contacts utilized on Center-Break Style Mark IV Circuit-Switchers consist of a rugged stainless-steel tongue contact and a tempered silicon-bronze jaw contact. This contact arrangement assures long operating life and contributes to Center-Break Style Mark IV Circuit-Switcher's high fault-closing capability. Dissimilar metals prevent contact welding.

The current-carrying contacts utilized on Center-Break Style Mark IV Circuit-Switchers consist of a multi-finger, spring-loaded, silver-plated, hard-drawn copper, reverse-loop jaw contact that grips hard (but only when needed during short-circuit current surges) against a silver-inlaid, high-conductivity cast copper tongue

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contact. Confining all arcing to the fault-closing contacts, plus the built-in blade-wiping action, assures clean current-carrying contacts, low-resistance current path.

Mark IV Circuit-Switcher features a base-integrated power train with drive-shaft mechanism that efficiently transmits and controls energy at high operating speed . . . and permanently maintains close interphase simultaneity. The drive train utilizes 186-degree vertical-shaft rotation to provide full toggle action at both ends of closing and opening strokes for smooth, shock-free acceleration and deceleration. Peak mechanical advantage is developed at stroke ends for power opening and closing without hesitation under 1½-inch ice formation, as discussed below under "Power Operation."

Power Operation

High-speed, high-torque power operation of 345-kv Mark IV Center-Break Style Circuit-Switchers is required to provide a two-time duty-cycle fault-closing rating of 40,000 amperes rms three-phase symmetrical, 102,000 amperes peak (see "Basis of Fault-Closing Ratings" on page 4).

Power operation of Mark IV Center-Break Style Circuit-Switchers also provides opening and closing without hesitation under 1½-inch ice formation; close interphase simultaneity; long life of fault-closing contacts under normal operating duties; and avoidance of excessive switching transients due to prolonged or unstable prestrike arcing. Mark IV Circuit-Switchers are provided with high-speed, high-torque power operation by means of S&C Switch Operators—Type CS-2A.

High-speed tripping of power-operated Mark IV Circuit-Switchers is furnished by the S&C Shunt-Trip Device. This optional accessory (Circuit-Switcher Catalog Number Suffix "-T2") provides high-speed (8-cycle) circuit interruption. The S&C Switch Operator—Type CS-2A is required if the shunt-trip device is specified.

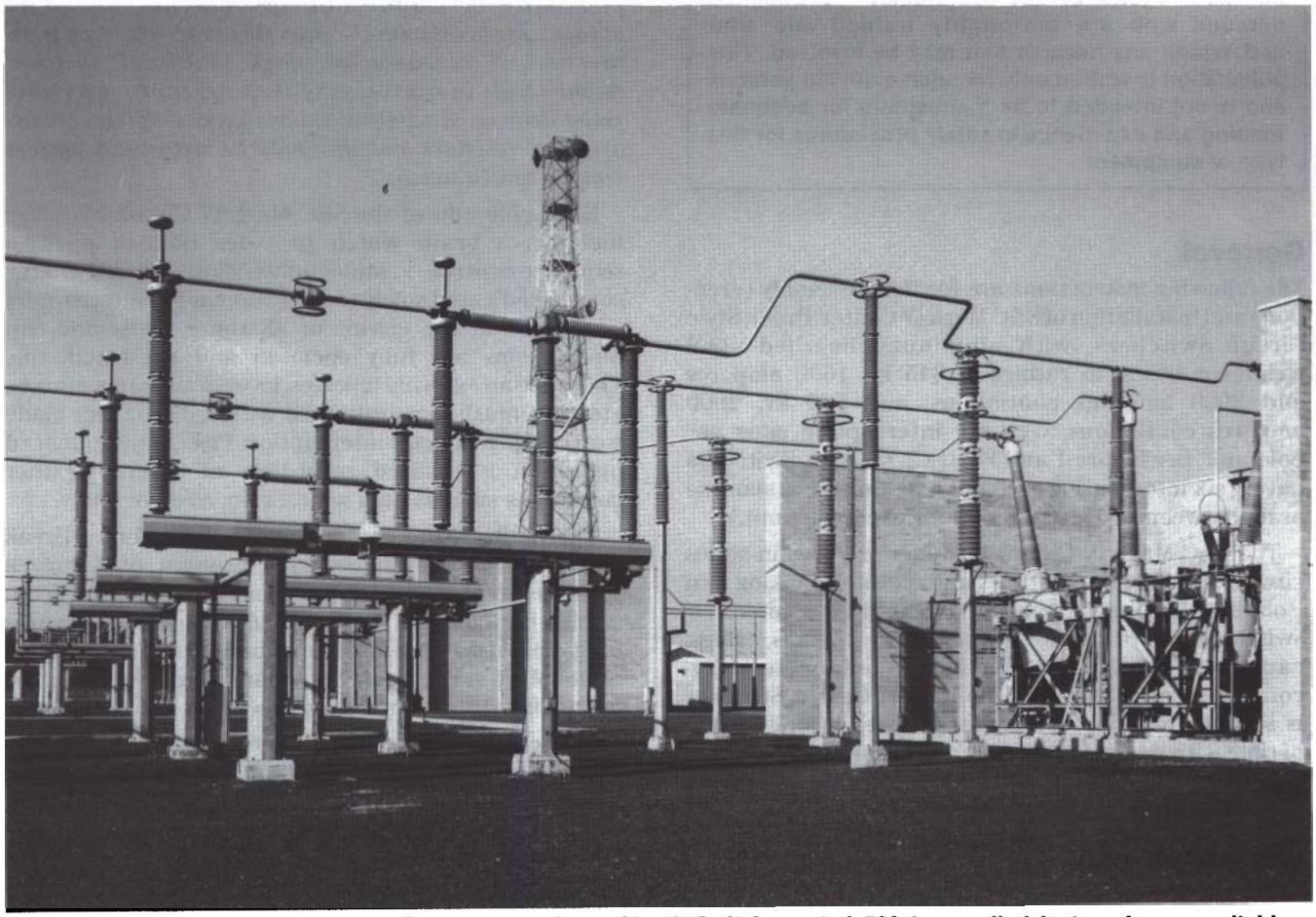


Figure 1. S&C Mark IV Three-Pole Center-Break Style Circuit-Switcher rated 500 kv, applied in transformer-switching application.

Figure 2. S&C Mark IV Three-Pole Center-Break Style Circuit-Switcher rated 345 kv, 1600 amperes continuous.

Basis of Fault-Closing Ratings

The two-time duty-cycle fault-closing rating set forth above applies to 345-kv Center-Break Style Mark IV Circuit-Switchers when powered by S&C Switch Operators—Type CS-2A, and is based on performance as follows:

1. The Circuit-Switcher is capable of two fault-closing operations consisting of closing against and carrying for 10 cycles its rated fault-closing current, after which it can carry and interrupt its rated continuous current and is capable of power operation—either opening or closing.
2. After each occasion consisting of either one or two fault-closing operations at its rated fault-closing current, the Circuit-Switcher must be inspected and any necessary repair or replacement of the fault-closing contacts made to restore the device to its original condition.

Mounting of Circuit-Switchers

The high operating speed which makes possible many of the Mark IV Circuit-Switcher's superior performance features when power operated brings about high acceleration and deceleration rates, resulting in high dynamic forces—for which S&C Mounting Pedestals were specifically designed, and are thus highly recommended. Alternately, Circuit-Switchers can be installed on the user's steel pedestals or supporting structures—which must meet specific static and dynamic deflection limits shown in an S&C data sheet so that the dynamic forces will be absorbed by the pedestals and not transferred to adjoining bus or other apparatus (e.g., bushings).

Use of flexible-conductor connections at Circuit-Switcher's terminal pads will compensate for inherent insulator-column deflection. The weight of the bus plus any associated ice load exerts a vertical force on the Circuit-Switcher terminal pads. This vertical force must not exceed 400 pounds on the terminal pad at the interrupter end, or 300 pounds on the terminal pad at the disconnect-blade end. Furthermore, bus connections to the terminal pads on the disconnect-blade end must be sufficiently rigid to preclude wind-induced oscillation of the terminal pads.

Seismic Withstand Capability

S&C Mark IV Circuit-Switchers, when installed with the recommended S&C Mounting Pedestals and anchor bolts, are capable of withstanding seismic loading of 0.2 g ground acceleration in any direction, as well as performing as intended during such loading and afterward. Higher seismic withstand capabilities can be furnished on special application.

Inspection Schedule and Procedures

To assure Circuit-Switcher's continued proper performance, it should be inspected in accordance with S&C's recommended schedule and procedures contained in S&C Instruction Sheet 715-590.

Since the Type CS-2A Switch Operator is provided with a convenient means for decoupling it from the Circuit-Switcher, elective exercising of the operator may be performed at any time without requiring an outage or switching to an alternate source. Moreover, when the switch operator is in the decoupled position, the shunt-trip device—when this option is furnished—is rendered inoperative, thereby permitting checkout of the system protective scheme.

Checking the Shipment

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 be sure all parts are at hand.

The Circuit-Switcher shipment should include the following items, as shown in Figure 3.

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, temporary insulator-lifting bar (500 kv only), and a temporary adapter for hand operation of the individual pole-units—all individually identified.
3. The vertical operating shaft and flanged interphase shafts, which are bundled and shipped uncrated. Perforated panels, to enclose the underside of the pole-unit bases after the installation has been completed, are shipped in a separate crate.
4. Insulators, if furnished, shipped in separate crates.
5. S&C Mounting Pedestals (if specified) consisting of a set of six, of square steel tube construction.
6. An S&C Switch Operator—Type CS-1A (as specified).
7. Any accessories specified, such as shunt-trip device or pre-insertion inductors.

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 (see Figure 5), will appear yellow. During the step-by-step instructions which follow, the disconnect blades will be moved to the fully open position. This will close the interrupters and charge and latch the stored-energy source within the brain, and the target will appear gray (normal).

⚠ CAUTION

When in service, Circuit-Switcher interrupters should *never* be open when the blades are in the closed position. To close the interrupters, Circuit-Switcher must be completely opened and then reclosed.

Gas-Pressure Indicator

Circuit-Switchers have sealed interrupters containing gas under pressure. Loss of gas pressure 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.

BEFORE STARTING INSTALLATION — Continued

SHUNT-TRIP DEVICE

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 insulator support associated with the brain, and a shunt-trip linkage will be attached to the brain. The Circuit-Switcher 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 their boxes until installation* to prevent damage at the job site.

Installation of the shunt-trip insulated operating shafts should be performed following Step 29. 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 minimum. Control wiring for the shunt-trip solenoids should be left disconnected at the switch operator end until Step 34 has been completed. Refer to S&C Instruction Sheet 711-600 for recommended wire sizes for the control wiring.

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, that the 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 each individual pole-unit base and also on the nameplate affixed to the switch operator.

To facilitate identification during erection, the serial number, the sales-order number, and the erection-drawing (ED) number are marked on each Circuit-Switcher pole-unit base; 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.

⚠ CAUTION

Do not remove the interrupter containers until the installation has been completed.

Although the erection drawing illustrates the installation in the "switch closed" position in accordance with what may be regarded as accepted practice, the installation instructions which follow initiate all adjustments from the "switch open" position, in order to use the fixed relationship of the drive-shaft crank and the temporary brain adjustment-holding device as a reference. See Step 5. Since the basic open-position adjustments are also shown on the erection drawing, there should be no confusion.

Note: 345-kv Circuit-Switchers for reactor applications and 500-kv Circuit-Switchers for reactor or transformer applications must be installed with the disconnect blades toward the source and the interrupters toward the load.

Step 1

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, 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 that more than three pole-units are available, care should be taken to be sure that 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 that the operator is used with the correct Circuit-Switcher.

Each skid should rest firmly and be reasonably level. See Figure 3. 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. Determine from the erection drawing the side of the base toward which the open blades will extend.

Repeat Steps 2 through 10 for each of the three Circuit-Switcher pole-units.

Step 2

Leaving the skid attached to the pole-unit base, remove the blocking members which support the live parts during shipping. Remove also from the base any component parts, such as corona shields or shunt-trip insulated operating shafts (if applicable). See Figure 3. *Do not remove the wooden block fastened to the casting supporting the interrupter at the middle of the pole-unit until the live parts have been attached to their supporting insulators. This block is intended to prevent a freely swinging blade from damaging the adjacent interrupter's gas-pressure indicator or pressure-relief device during hoisting.* Inspect for any obvious shipping damage before continuing installation.

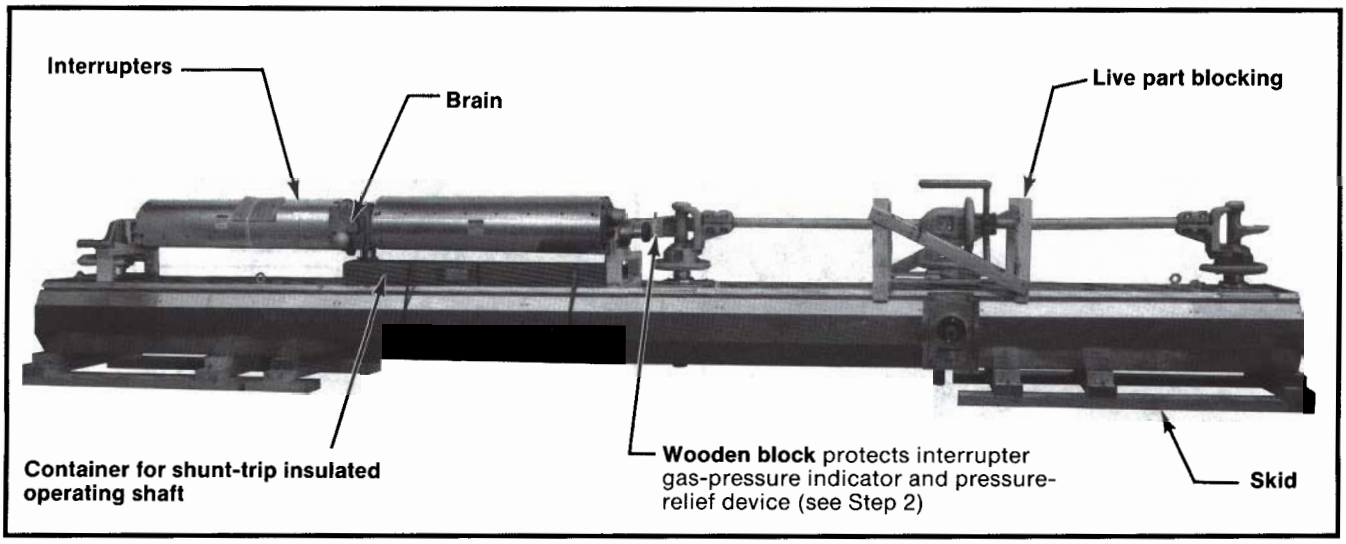


Figure 3. Pole-unit as shipped (345-kv, 1600-ampere rating shown).

INSTALLATION — Continued

Step 3

Attach one of the interphase couplings to the hexagonal drive-shaft hub. Then bolt the temporary hand-operation adapter to the coupling in a manner so as to permit 186-degree rotation of the adapter. See Figure 4. (Use this same temporary hand-operation adapter and interphase coupling when checking and adjusting the other two pole-units.)

Step 4

Using the hand-operation adapter, rotate the drive shaft until the drive-shaft crank goes into toggle against its open stop. As a matter of information, considerable effort will be required as the drive shaft passes beyond the half-open position. It is at this position that the stored-energy source within the brain begins to charge as the interrupters close. As the opening rotation continues, this stored-energy source charges and latches, and a final peaking of effort again will be required as the drive-shaft crank goes into toggle against its open stop. With the drive-shaft crank in its fully open position the interrupters will be closed, as indicated by the gray interrupter target on the side of the brain. See Figure 5.

Step 5

Each Circuit-Switcher pole-unit brain, conjointly 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 Figures 5 and 6.

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 of the stop bushing. A ½″—13×2¾″ positioning bolt with flat washer and nut is furnished (in a cloth bag attached to the operating-shaft tab) for insertion through the tab and the stop bushing. Install the positioning bolt as follows:

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

(b) At the brain mounting flange, remove the two mounting bolts associated with the eccentric locking spacers. See Figure 6. Then loosen, but do not remove, the other two mounting bolts. Retain the eccentric locking spacers and the special serrated stainless-steel washers for later reassembly.

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

Step 6

Remove, as a complete assembly, the brain and the two interrupters, along with the associated disconnect blade, from the insulator-mounting supports, following

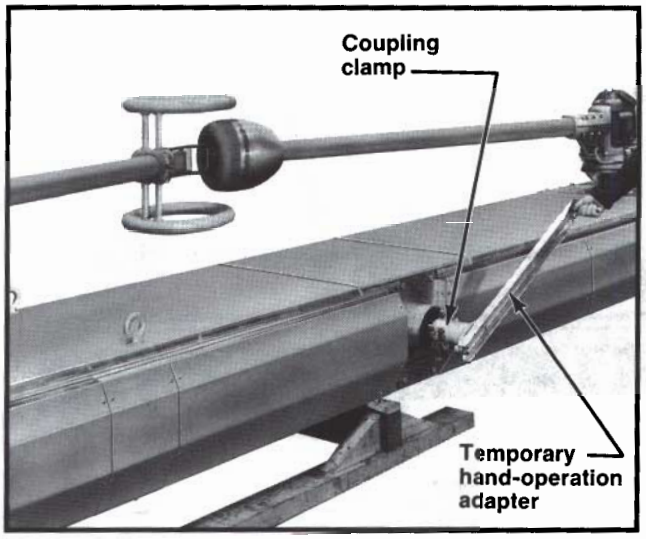


Figure 4. Operating a pole-unit with the temporary hand-operation adapter.

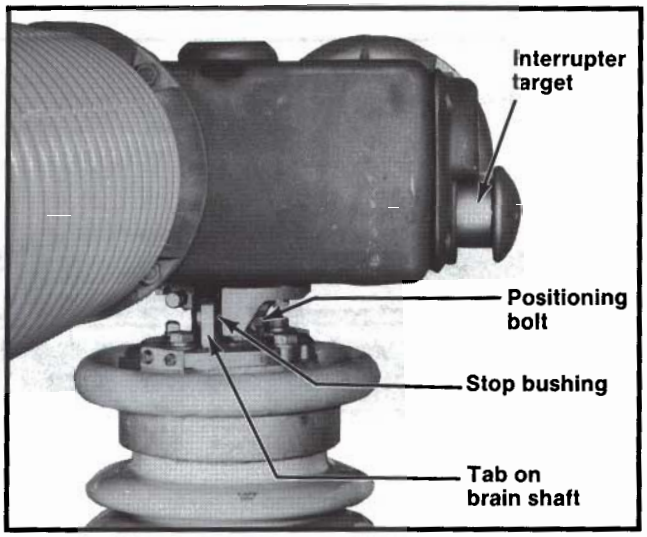


Figure 5. Closeup of brain adjustment-holding device (pole-unit in fully open position).

the procedure described below. Use care, during this procedure, to avoid damage to the corona shields at each live-part mounting position.

(a) Attach lifting slings such that the assembly is supported at each end *and at the center*. See Figure 7. The lifting loads must be equalized so that no stress is placed at the brain end of either interrupter. Be sure that the slings do not interfere with the interrupter target on the side of the brain, the gas-pressure indicators, the pressure-relief devices, or the shunt-trip operating shaft (if applicable).

(b) At the disconnect end, loosen the adjusting screws at the blade-adjustment disc. Then remove the bolts fastening the blade assembly to the blade-adjustment disc. See Figure 8. Retain the stainless-steel hardware (including the special, thick flat washers) for later reassembly.

At the terminal end, remove and discard the bolts fastening the terminal support to the insulator support. See Figure 9.

At the brain, remove and discard the remaining two bolts fastening the brain mounting flange to the insulator support. Also, detach the corona shield but retain the stainless-steel hardware.

(c) Use a fall line to prevent the disconnect blade from swinging. Then hoist the assembly of disconnect blade, brain, and interrupters 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).

Use care also to avoid damage to the corona shields at each live-part mounting position.

(d) Remove the guide disc, now exposed, from the brain insulator support. See Figure 6.

(e) Remove the blade-adjustment disc (and the corona shield) from the disconnect-end insulator support.

Step 7

At the disconnect-blade terminal end, remove the blade assembly and then the blade-adjustment disc. Retain the stainless-steel hardware (including the special, thick flat washers) for later reassembly.

Step 8

At all four insulator supports, remove the bolt-circle adapters. (This step applies to 500-kv Circuit-Switchers only. Bolt-circle adapters are not used at 345 kv unless special insulators have been ordered.)

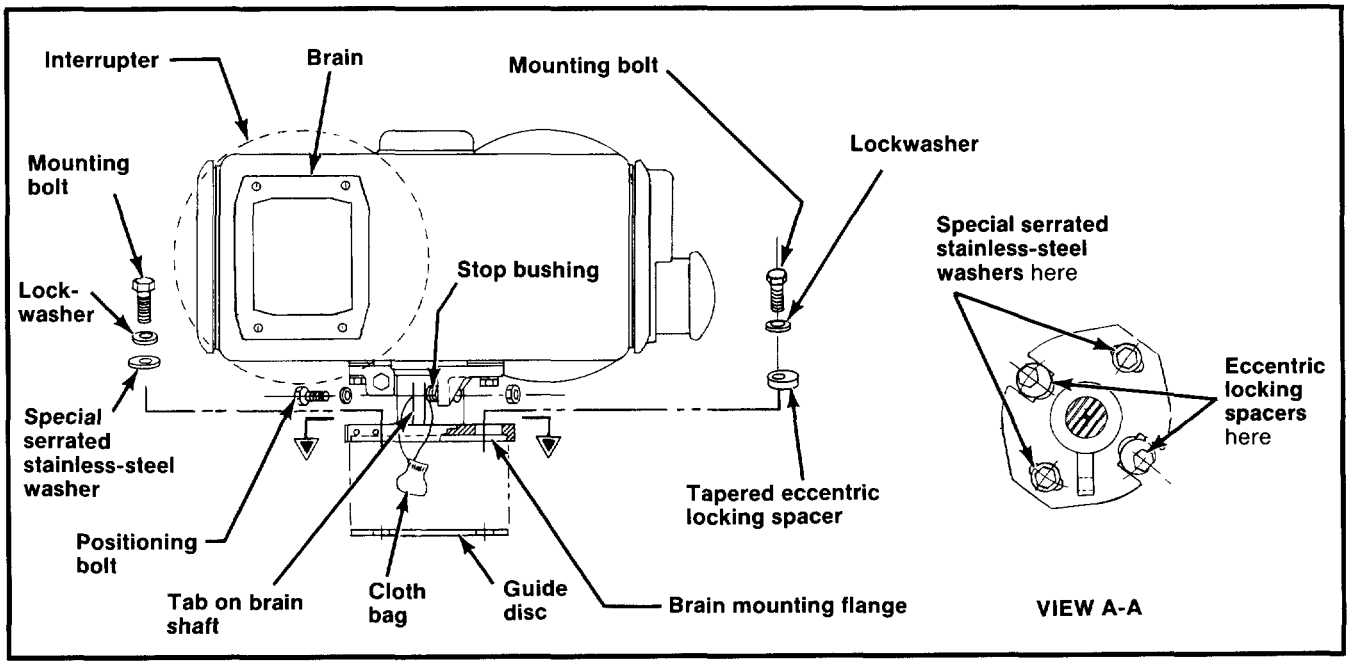


Figure 6. Brain mounting and adjustment-holding device detail.

INSTALLATION — Continued

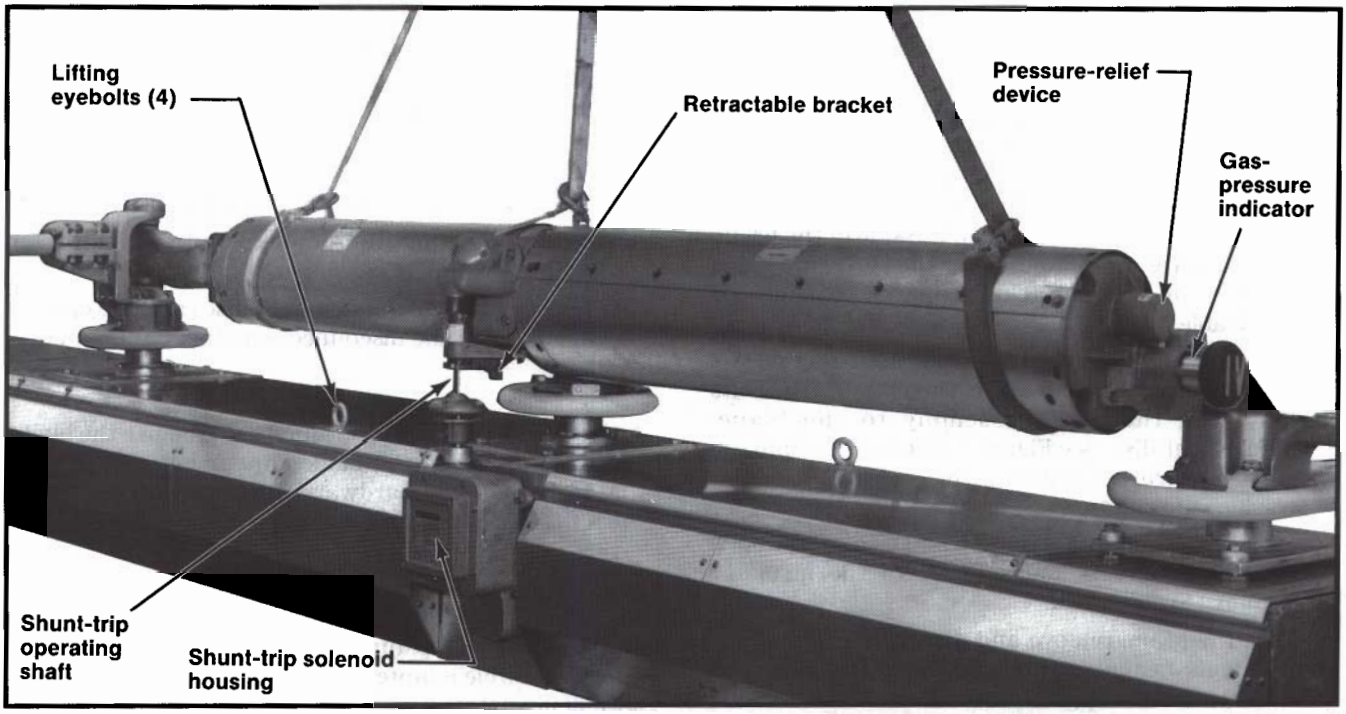


Figure 7. Lifting slings positioned for three-point support of the assembly consisting of disconnect blade, brain, and interrupters.

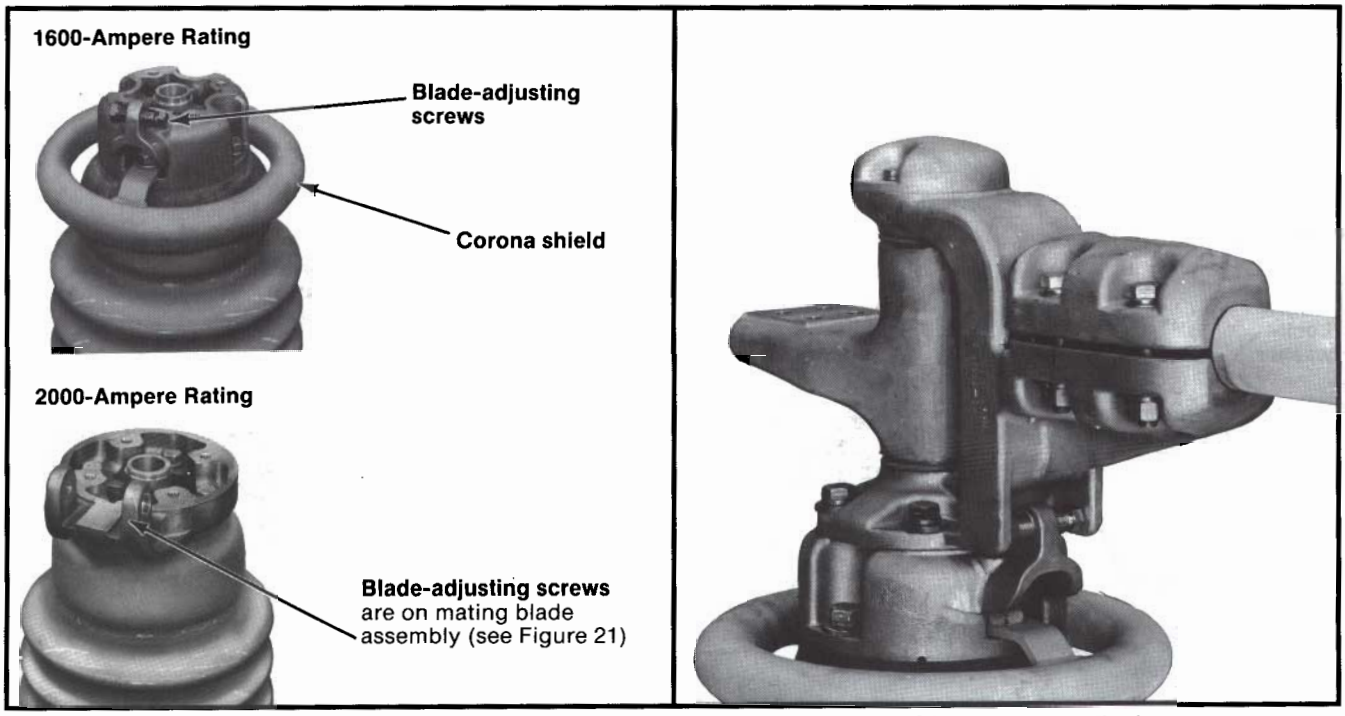


Figure 8. Blade-adjustment discs. At right, blade assembly has been added (typical of 1600-ampere rating).

Discard the fiber spacers that are now exposed. Discard also the galvanized bolts used to fasten the live parts to the insulator supports (or bolt-circle adapters, as applicable).

Make sure that the pole-unit power train is in its fully open position. (The erection drawing shows the direction of blade-opening rotation.) Then remove the temporary hand-operation adapter.

Step 9

Install the mounting pedestals. Make sure that the pedestal to which the switch operator is to be mounted is positioned as shown on the erection drawing. Adjust the bottom set of anchor-bolt nuts at each pedestal to *generally* plumb and level the pedestal. The upper set of anchor-bolt nuts should only be loosely attached at this time. Figure 10 illustrates a typical pedestal mounting detail.

Step 10

Attach lifting slings to the eyebolts on the pole-unit base. Unbolt the base from the shipping skid and lift it onto the mounting pedestals in the position shown on the erection drawing. Note that the hex shaft extending beneath one of the bases is for connection to the switch operator.

Make sure that the upper set of mounting-pedestal anchor-bolt nuts is *loosely* attached. Then *securely bolt* the pole-unit base to its associated mounting pedestals.

Adjust the lower set of anchor-bolt nuts to level the rotating support for the insulator stack associated with the Circuit-Switcher brain. Then securely tighten the upper set of anchor-bolt nuts. Note that it is not the pole-unit base itself that is to be leveled—only the insulator support.

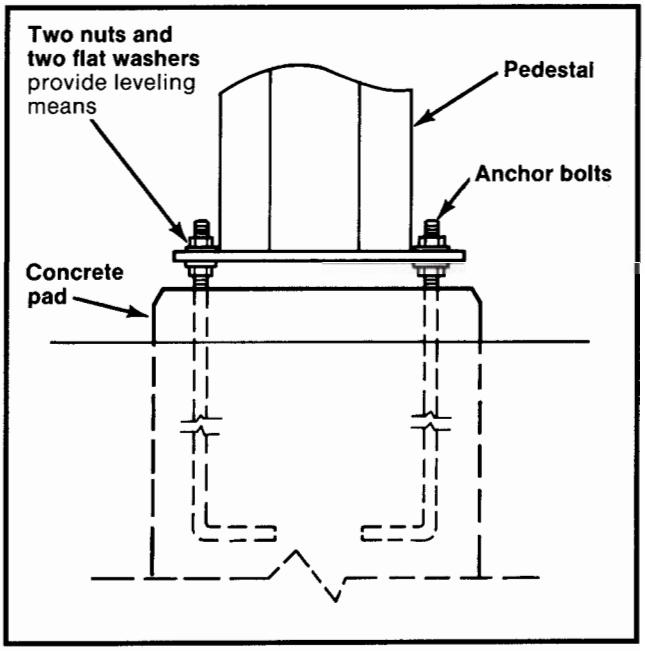


Figure 10. Pedestal mounting detail.

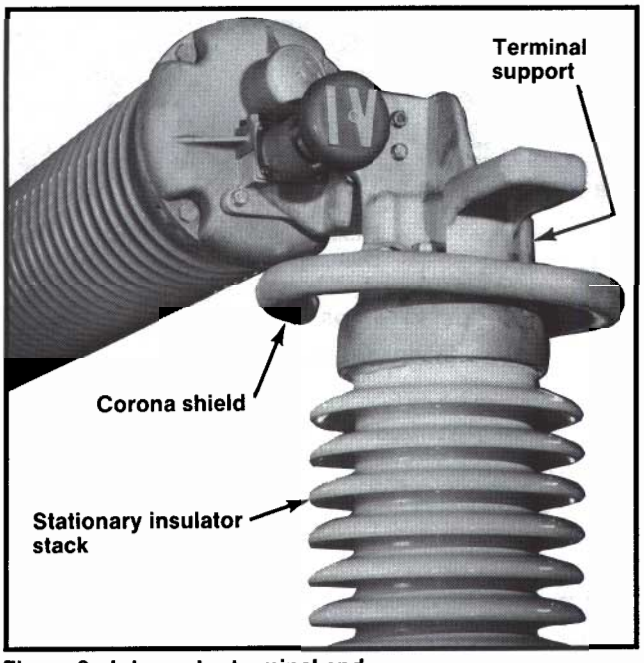


Figure 9. Interrupter terminal end.

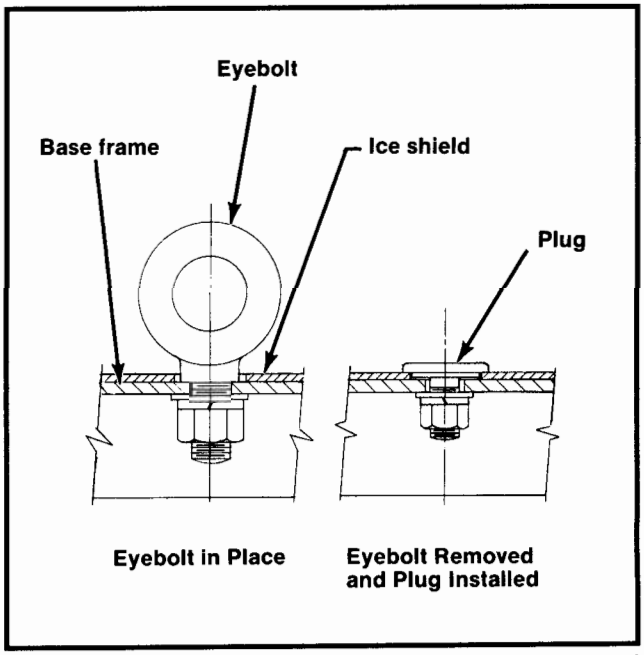


Figure 11. Cross-sectional views, before and after removal of lifting eyebolts.

INSTALLATION — Continued

Remove the lifting eyebolts from the base and install a plug (furnished) in each of the four eyebolt holes. See Figure 11. (Note: Sculptured side panels may be removed to facilitate eyebolt removal.)

Step 11

Mount the switch operator as shown on the erection drawing.▲

Step 12

LOCKING HARDWARE

In instances where self-locking hex nuts are specified, it is essential that the threads of the associated cap screws be lubricated with a general-purpose grease, to facilitate tightening.

Install interphase shafts as follows.

For 345-kv rating:

(a) Attach flexible couplings to the drive-shaft hubs of the three pole-units as specified on the erection drawing.

(b) For each interphase shaft, attach an extension weldment to one of the pole-unit drive-shaft couplings. See Figure 13. Typically, both extension weldments are attached to the center pole-unit. Note that, on the base containing the gearbox, one side must first be fitted with a flange-mounted hub. See Figure 13. Attach this flange-mounted hub such that its hex "flats" are aligned with the flats of the hex on the adjacent pole-unit hub.

(c) Install each interphase shaft with its circular mounting flange toward the circular flange on the extension weldment.

Slide the interphase shaft over the tubular projection on the extension weldment to temporarily support that end of the shaft. (It may be necessary to loosen the clamp bolts on the drive-shaft hub to permit this to be done.) See Figure 13. Then attach the opposite end of the interphase shaft to the flexible coupling on the adjacent pole-unit. See Figure 12. Tighten all clamp bolts.

▲ If more than one switch operator is available, be sure to select the one intended for the Circuit-Switcher installation being made. Make certain that 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.

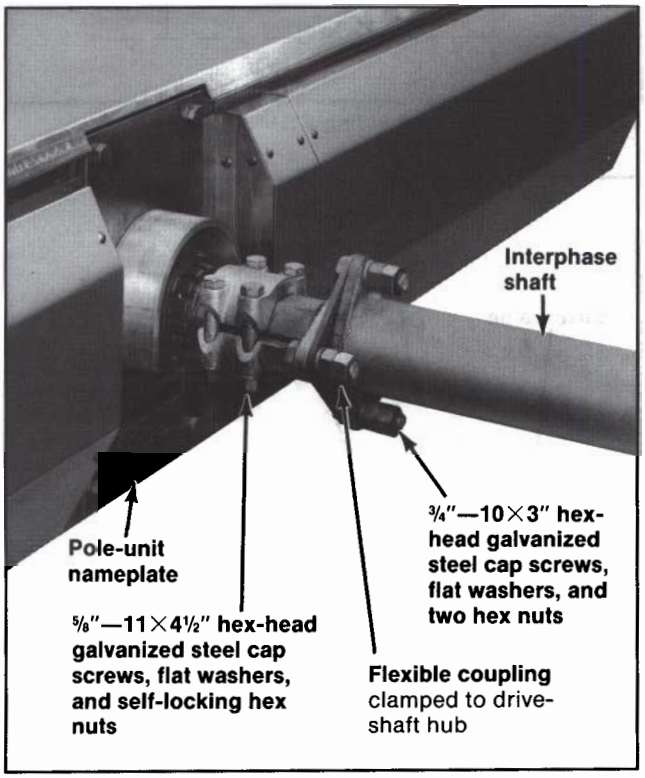


Figure 12. Interphase-shaft coupling detail, typical outer pole-unit of 345-kv rating.

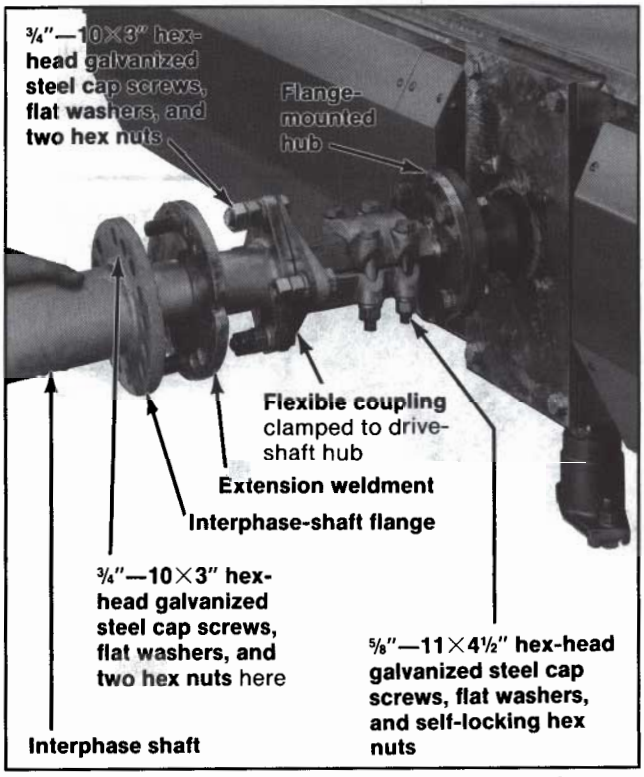


Figure 13. Interphase-shaft coupling detail, typical center pole-unit of 345-kv rating.

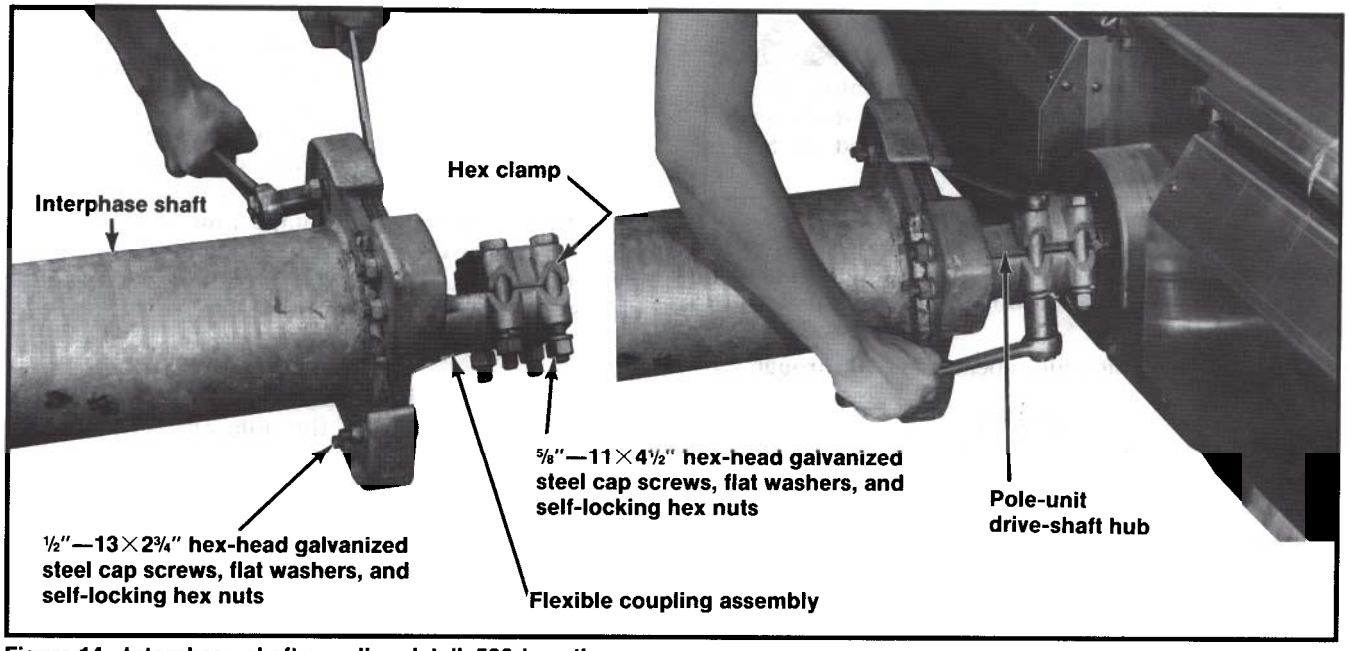


Figure 14. Interphase-shaft coupling detail. 500-kv rating.

(d) Make sure that the drive-shaft crank in each of the three Circuit-Switcher pole-unit bases is resting against its open stop. See Figure 15. Then locate a pair of holes in each interphase-shaft flange which line up with a matching pair of holes in the mating extension weldment and bolt together tightly. The matching holes should be as nearly diametrically opposite as possible. See Figure 13.

(e) After the interphase shafts have been securely bolted in place (tightness of clamps and flange bolts is very important) recheck the position of the drive-shaft cranks in each of the three Circuit-Switcher pole-unit bases. Each should be resting firmly against its stop. See Figure 15.

If this is not the case, remove the flange bolts installed in (c) above to permit movement of the drive-shaft crank independent of the interphase shaft. After the proper stop position of each drive-shaft crank has been attained, reinstall the flange bolts in the manner described in (d) above.

For 500-kv rating:

(a) Prepare the interphase shafts for installation by attaching flexible coupling assemblies to both ends of each interphase shaft. See Figure 14. Torque the attachment bolts to final tightness. Then disassemble the hex clamp portions of the flexible coupling assemblies.

(b) Make sure that the drive-shaft crank in each of the three Circuit-Switcher pole-unit bases is resting against its open stop. Then hoist the interphase shafts into position and interconnect the pole-units by assembling the hex clamps to the drive-shaft hubs. See Figure 14. Torque the clamping bolts to final tightness.

Step 13

Refer to S&C Type CS-2A Switch Operator Instruction Sheet 719-510, which has been placed inside the door of the switch operator, and proceed as outlined therein under "Installation" and "Manual Operation."

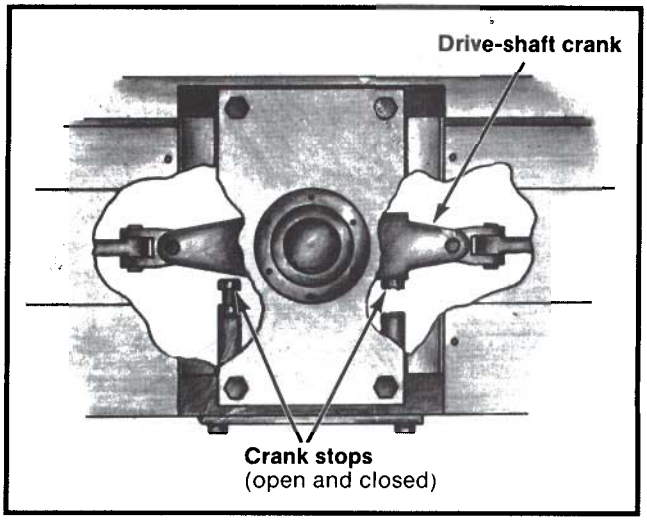


Figure 15. Drive-shaft crank stops.

INSTALLATION — Continued

⚠ CAUTION

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 719-510.

Using the manual operating handle on the switch operator, crank the power train to its fully open position such that the drive-shaft cranks in the bases are against their open stops.

Then, for each pole-unit, repeat Steps 14 through 25.

Step 14

Assemble the insulator stacks with rain shields (where applicable) in accordance with the insulator manufacturer's instructions. (Hardware for assembling the individual insulators to make up the stacks are included with the insulator shipment.) Securely tighten all cap screws.

Attach the insulator stacks to the pole-unit insulator supports with the galvanized hardware (furnished) as shown in Figure 16. Securely tighten all cap screws.

It is recommended that scaffolding or other means be provided to permit erection and adjustment of the pole-units without introducing strains which could distort or otherwise interfere with their proper operation. It is especially important that insulator alignment measurements and adjustments be made *without placing any weight or strain on the insulator stacks.*

Step 15

Check the eccentricity of the insulator stacks associated with the brain and with the adjacent (jaw-contact) disconnect blade as follows:

(a) Locate the centerpoint of each of these insulator stacks by accurately drawing, on the top of each insulator cap, temporary lines which bisect and connect opposite bolt holes. See Figure 16.

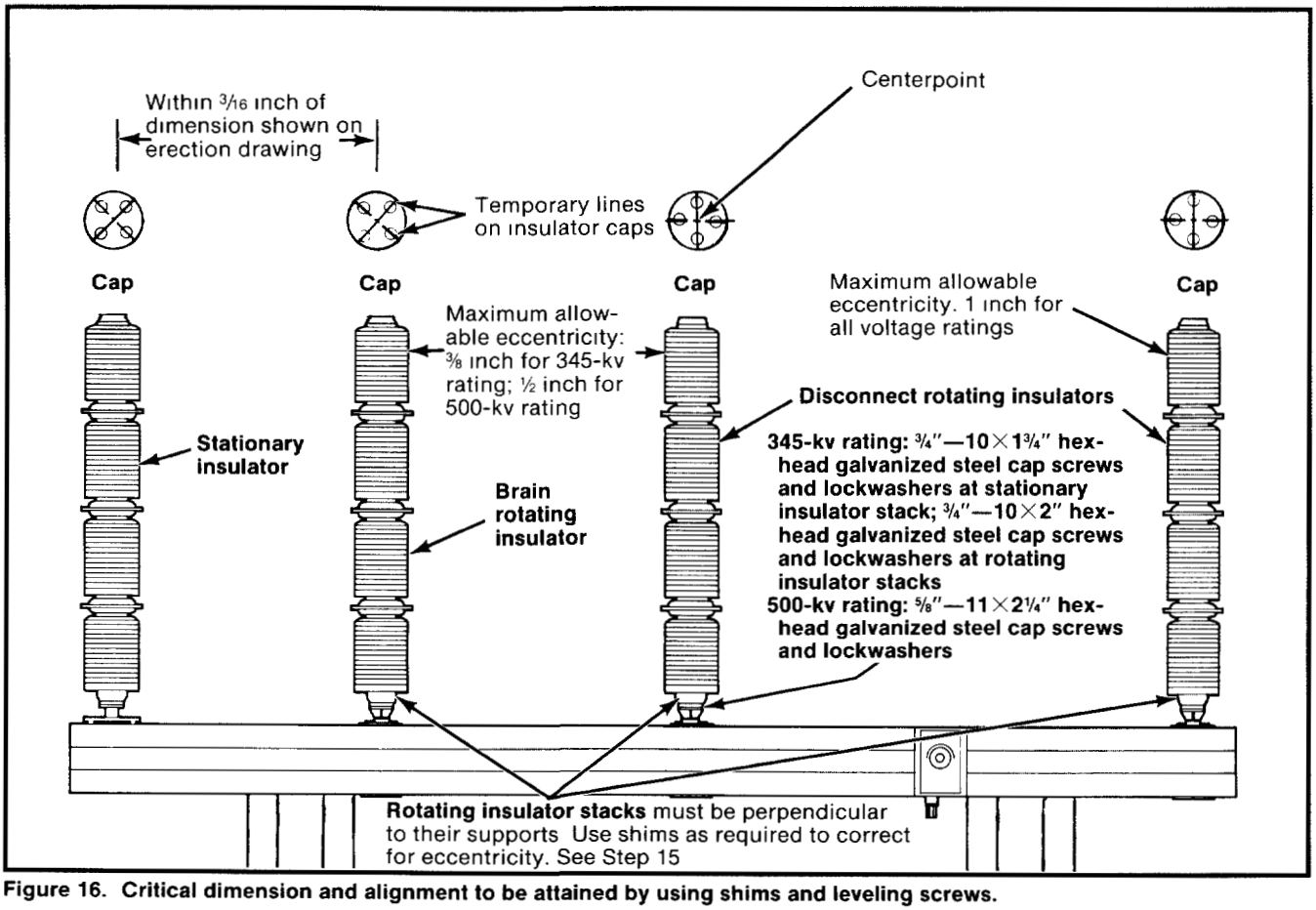


Figure 16. Critical dimension and alignment to be attained by using shims and leveling screws.

(b) For use as a reference, extend a fixed object over the centerpoint at the top of each insulator stack. (The fixed object may be, for example, a piece of wood extending from the stationary insulator stack, rigidly held in position; or a taut cord strung between the stationary insulator and the scaffolding.)

(c) Crank the manual operating handle on the switch operator to rotate the insulator stacks through their full travel. (The full open-close rotational travel of the rotating insulator stacks is as follows: approximately 104 degrees for the insulator stack associated with the brain, and approximately 95 degrees for the insulator stacks associated with the disconnect blades.) Verify that the centerpoint of each insulator cap does not move more than as specified in Figure 16 and, at the same time, observe the arc of this movement. Any excess eccentricity must be corrected by shimming the insulator stack(s)—the higher up in the stack that the shims are placed, the less the degree of correction. Shimming material is included with the insulator hardware in a cloth sack attached to the pole-unit base.

Torque to final tightness all insulator-stack cap screws, including those fastening the insulator stacks to the insulator supports.

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

Step 16

The stationary insulator stack should be checked for alignment with the two adjacent rotating insulator stacks by stretching a cord taut across the top of the insulator caps so that it crosses the centerpoint of all three insulators. The centerpoint of the insulator stack associated with the brain must not deviate more than ¼ inch from this alignment.

Then measure the center-to-center distance between the stationary insulator stack and the brain rotating insulator stack. See Figure 16. This distance must be within 3/16 inch of the dimension shown on the erection drawing.

Step 17

Adjust for the necessary centerline distance and the stack alignment, described in Step 16, as follows:

Remove the sculptured panel from one side of the base, below the stationary stack. Refer to Figure 17. Loosen the four threaded wedges within the base enclosure. Then loosen the four locking bolts located at the corners of the insulator-support plate (the associated locking nuts are accessible inside the base). Turn the leveling screws (the leveling screws are threaded into the insulator-support plate).

To avoid changing the effective height of the insulator stack, *do not use more than three of the four leveling screws* for this adjustment.

Retighten the four locking bolts. Then retighten the four threaded wedges.

Replace the sculptured panel after completing adjustments.

> Note: Alignment of the insulator stacks, as described in Steps 15, 16, and 17, is essential to obtain correct latching of the brains and to obtain close interphase simultaneity during opening.

Step 18

Verify that all insulator-stack cap screws are torqued to final tightness.

Return the pole-unit power train to its fully open, positive-toggle position. (The erection drawing shows the direction of blade-opening rotation.)

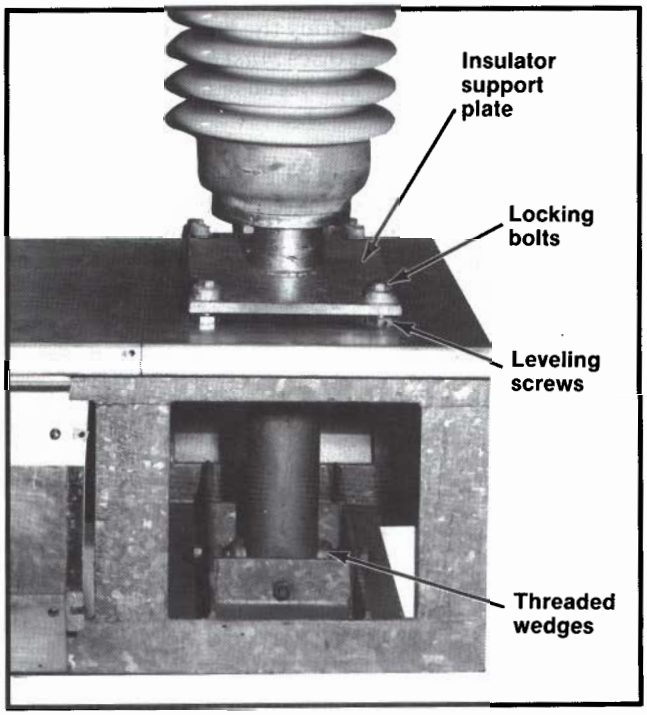


Figure 17. Leveling screws for alignment of stationary insulator stack. See Step 17.

INSTALLATION — Continued

Step 19

For 500-kv Circuit-Switchers only: At the top of each of the four insulator stacks attach a bolt-circle adapter (furnished), using ⅝″—11×2″ hex-head galvanized steel cap screws, lockwashers, and nuts.

Torque the cap screws to final tightness.

Step 20

On the two rotating insulator stacks associated with the disconnect blades, mount the blade-adjustment discs as directed below. (Remember that the pole-unit power train is in the *open* position, and hence the discs must be oriented so that the blade-adjusting screws will be approximately at right angles to the base, in the blade-opening direction.)

For 345-kv rating: Select the two corona shields that are identical and attach them along with the blade-adjustment discs. Use ¾″—10×2″ hex-head galvanized steel cap screws and lockwashers at the corona-shield mounting tabs and ¾″—10×1¾″ hex-head galvanized steel cap screws and lockwashers in the alternate holes.

For 500-kv rating: Place the applicable corona shields (see erection drawing) loosely over the insulators. Then mount the blade-adjustment discs, using ¾″—10×1¾″ hex-head galvanized steel cap screws and lockwashers in all holes.

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

Step 21

On the insulator stack associated with the brain, place the guide disc. The guide disc is to fit into the recess of the brain mounting flange as a positioning device to ensure that the brain operating shaft is concentric with the insulator stack. See Figure 6.

Step 22

Place the appropriate corona shield loosely over the insulator stack associated with the brain.

Step 23

With slings attached as described in Step 6(a), hoist the assembly of disconnect blade, brain, and interrupters. Mount the assembly onto its appropriate insulator stacks, following the sequence described below and using the hardware listed in Table I. Be sure to place the assembly on the same pole-unit from which it was removed.

(a) At the brain, make sure that the slots in the guide disc (placed on the insulator stack in Step 21) are aligned with the insulator bolt holes. Insert *only two* cap screws, lockwashers, and special serrated stainless-steel washers through the *slotted holes* of the brain flange (not the *open slots*) and through the guide-disc slots, into the insulator bolt holes. Leave the cap screws loose enough to permit movement of the assembly, within the limits of the slotted holes, independent of the insulator to which it is attached.

(b) Attach the disconnect end of the assembly to its rotating insulator stack, using four hex-head stainless-steel cap screws, lockwashers, and special 3/16-inch-thick flat washers as indicated. Remember that the pole-unit power train is in the open position and that the blade must be at approximately a right angle to the base to allow it to be attached to the blade-adjustment disc. See Step 20. Tighten these cap screws securely.

(c) Next, at the brain flange, securely tighten the two cap screws installed in (a) above. Then insert the tapered eccentric locking spacers, small diameter down, in the open slots of the brain mounting flange.

Rotate the eccentric locking spacers to align them with the insulator bolt holes and fasten them with the cap screws and lockwashers indicated.

Then attach the corona shield to the brain flange, using 5/16"—18×7/8" hex-head stainless-steel cap screws and lockwashers.

(d) At the interrupter terminal end, make sure that the live-part mounting holes line up with the insulator bolt holes. If the holes are not in alignment, the insulator stack must be repositioned following the procedure described in Step 17.

Then attach the live parts, using the cap screws, lockwashers, and flat washers indicated. See Table I. Note that the longer cap screws indicated are for attachment of the terminal-end corona shield.

(e) Remove the wooden block fastened to the casting supporting the interrupter at the middle of the pole-unit.

TABLE I—HARDWARE FOR MOUNTING LIVE PARTS (as described in Steps 23 and 24)

Live-Part Mounting Location	For Circuit-Switcher Rated, Kv	Quantity and Type of Hardware Required
Interrupter Terminal End—Stationary Insulator Stack	345	(2) 3/4"—10×1 3/4" Hex-Head Galvanized Steel Cap Screws (2) 3/4"—10×2" Hex-Head Galvanized Steel Cap Screws (4) 3/4" Galvanized Steel Lockwashers (4) 3/4" Galvanized Steel Flat Washers
	500	(2) 3/4"—10×2 1/2" Hex-Head Galvanized Steel Cap Screws (2) 3/4"—10×1 3/4" Hex-Head Galvanized Steel Cap Screws (4) 3/4" Galvanized Steel Lockwashers (4) 3/4" Galvanized Steel Flat Washers
Brain—Rotating Insulator Stack	345 and 500	(4) 3/4"—10×1 3/4" Hex-Head Galvanized Steel Cap Screws (4) 3/4" Galvanized Steel Lockwashers (2) 3/4" Special *Serrated* Stainless-Steel Washers (2) Tapered Eccentric Locking Spacers
Disconnect Blade—Rotating Insulator Stacks (2)◆	345 (1600 Amperes)	(8) 5/8"—11×1 1/2" Hex-Head Stainless-Steel Cap Screws (8) 5/8" Stainless-Steel Lockwashers (8) 5/8" Stainless-Steel Flat Washers▲
	345 and 500 (2000 Amperes)	(8) 5/8"—11×2" Hex-Head Stainless-Steel Cap Screws (8) 5/8" Stainless-Steel Lockwashers (8) 5/8" Stainless-Steel Flat Washers▲

◆ Applies to mounting of blade assemblies on previously installed blade-adjustment discs

▲ Special 1/16-inch-thick flat washers required for the slotted mounting holes in the blade assemblies

INSTALLATION — Continued

Step 24

At the disconnect-blade terminal-end rotating stack, attach the blade assembly to the blade-adjustment disc previously mounted on the insulator stack. Remember that the pole-unit power train is in the open position and that the blade must be at approximately a right angle to the base to allow it to be attached to the blade-adjustment disc. See Step 20. Use the hex-head stainless-steel cap screws, lockwashers, and special 3/16-inch-thick flat washers as listed in Table I. Do not tighten the cap screws.

Step 25

Now remove the positioning bolt (which was installed in Step 5) from the adjustment-holding device under the brain.

Step 26

Crank the manual operating handle on the switch operator to fully close the Circuit-Switcher.

In this position note the guide mark on each tongue-contact blade. See Figure 18 or 19. This mark should be in line with the edge of the jaw-contact housing to ensure proper blade engagement.

If any guide mark does not line up with the edge of its associated jaw-contact housing, loosen the blade clamp that holds the tongue-contact blade assembly and move that blade assembly in or out as required.

Torque the blade-clamp bolts to final tightness.

Step 27

For Circuit-Switchers rated 1600 amperes, adjust the position of the tip of each fault-closing tongue contact for 1/8-inch to 3/16-inch clearance from the inside of the contact housing, as shown in Figure 19 (inset), 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.

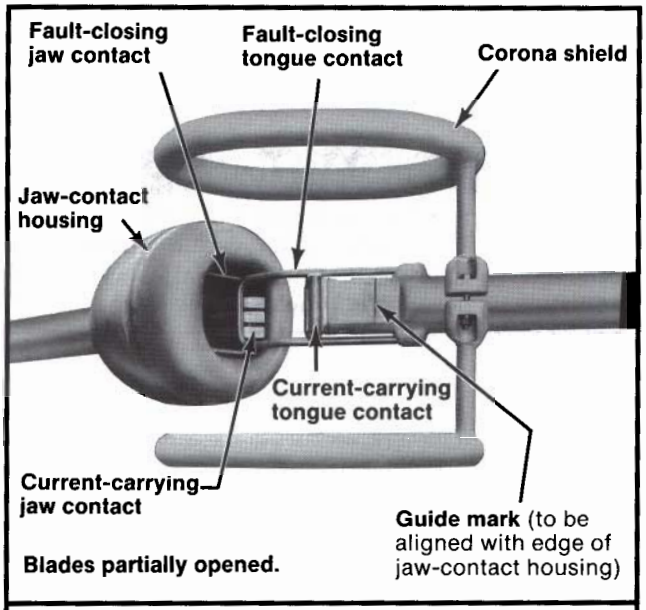
Step 28

Open and reclose the Circuit-Switcher 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.

Also, in the fully closed position of the pole-unit, check for undertravel or overtravel of the blades—they should be in line.

To adjust either blade, loosen the bolts which fasten the affected blade assembly to the blade-adjustment disc (sufficient to permit movement). Loosen also the blade-adjusting screws. See Figures 8 and 21.

Turn the blade-adjusting screws to attain a satisfactory blade stance and lock the adjusting screws in place. Torque the blade assembly mounting bolts to *final* tightness. Then lock the blade-adjustment screws in place. See Figure 20.



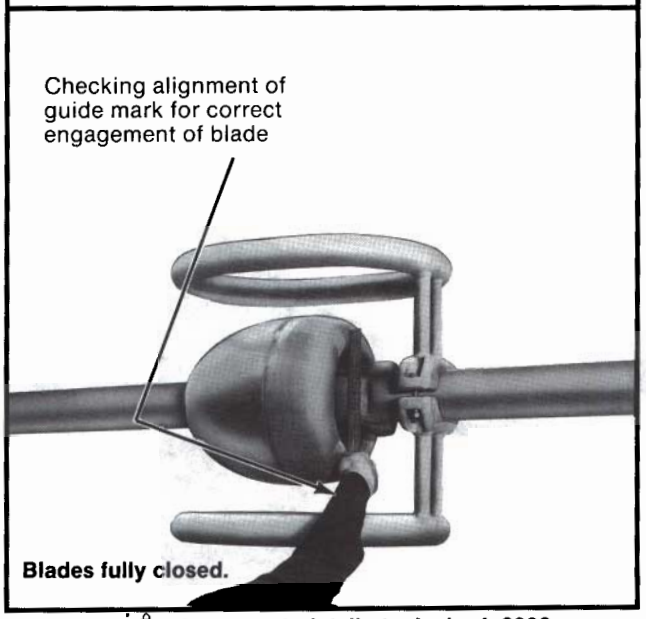


Figure 18. Blade-contact detail, typical of 2000-ampere rating.

Step 29

For 2000-ampere rated Circuit-Switchers install, on each pole-unit, the corona shields at the top of the two insulator stacks associated with the disconnect blades, using ⅜″—16×1″ hex-head stainless-steel cap screws, lockwashers, and flat washers. Also, install

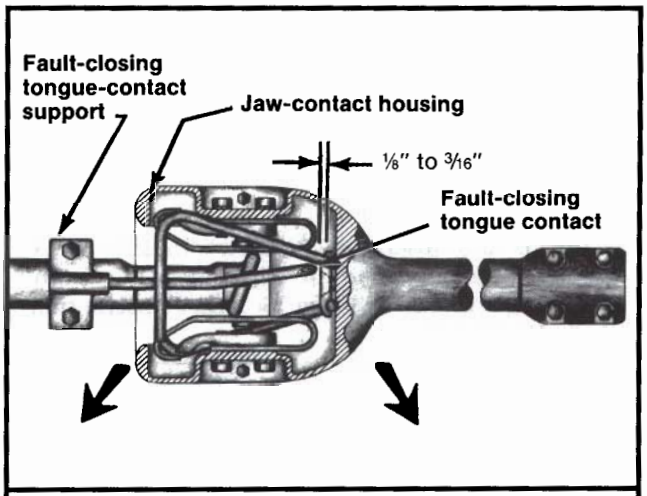


Figure 19. Blade-contact detail, typical of 1600-ampere rating.

INSTALLATION — Continued

(500-kv rating only) on the top of each blade assembly, an extended corona-shield assembly. See Figures 21 and 22.

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 Step 34 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. See S&C Instruction Sheet 711-600, Figure 3.

Step 30

Connect high-voltage conductors to their respective Circuit-Switcher terminal pads.

⚠ CAUTION

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.

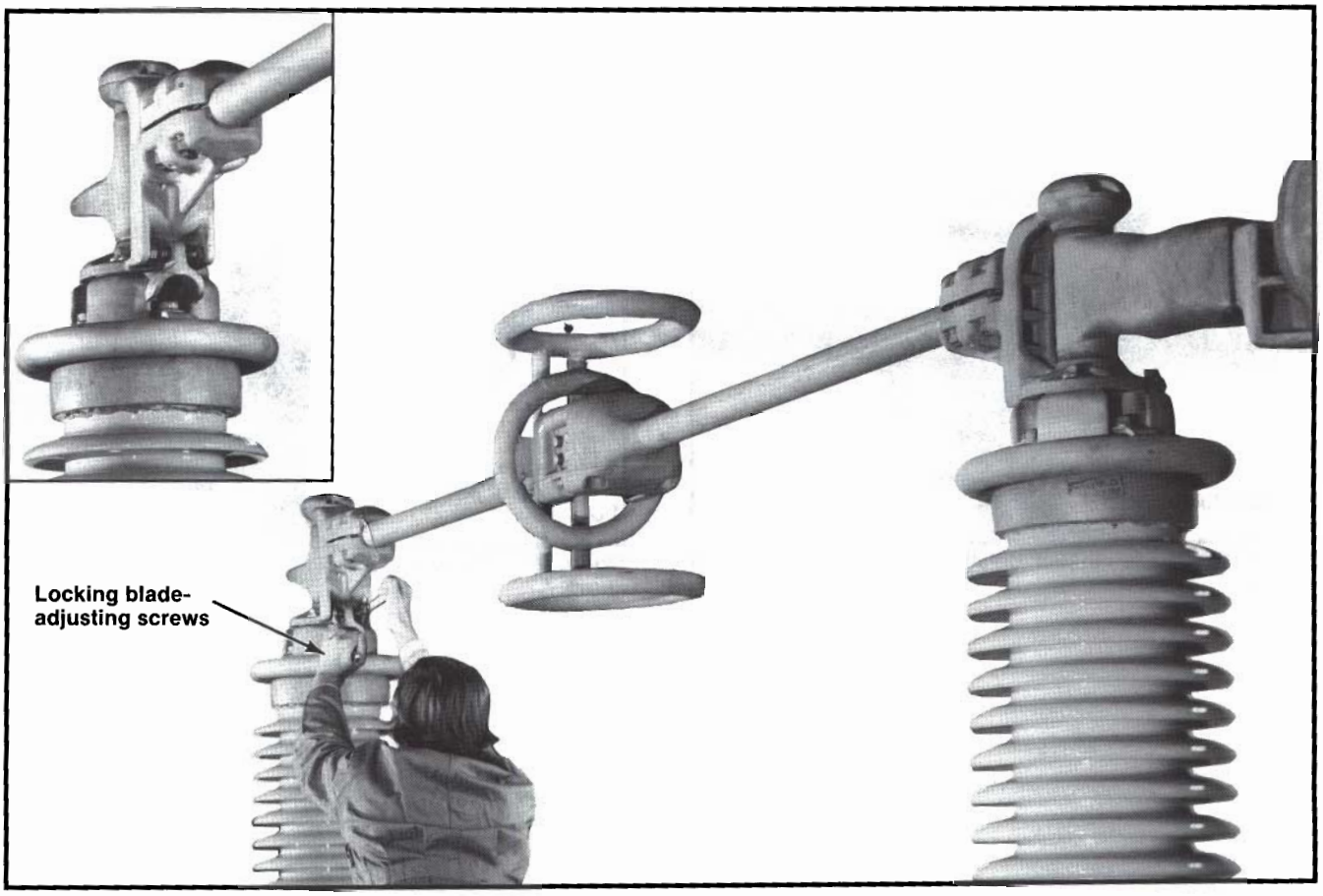


Figure 20. Blade alignment. (1600-ampere rating shown.)

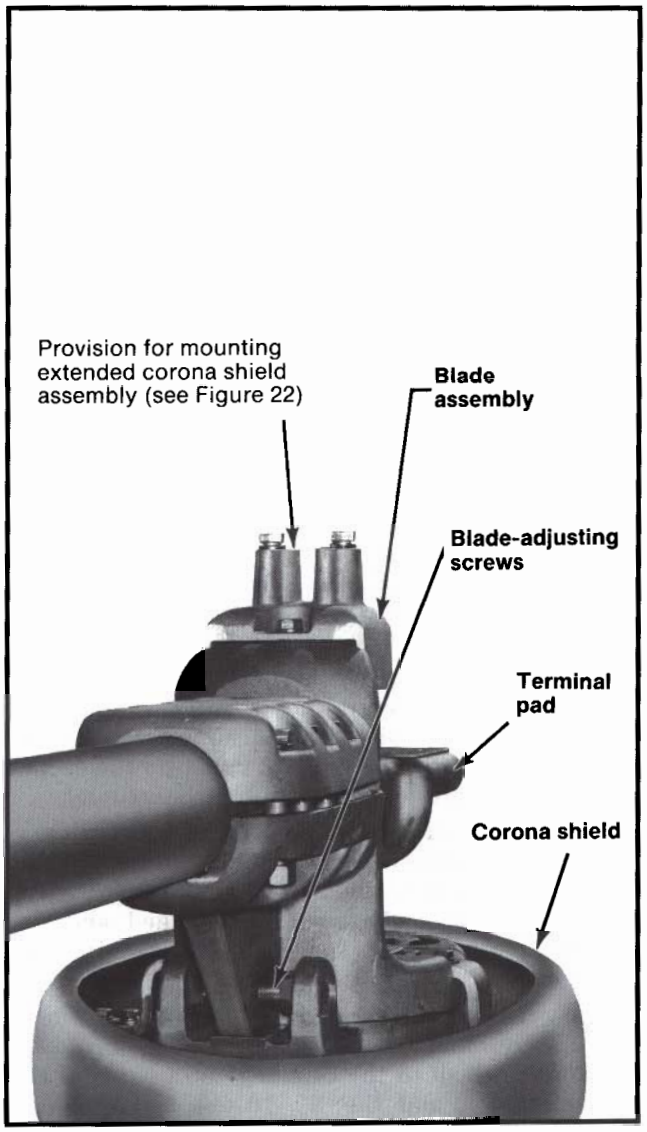


Figure 21. Corona shield as installed at the tops of the two rotating insulator stacks associated with the disconnect blades. (500-kv rating shown.)

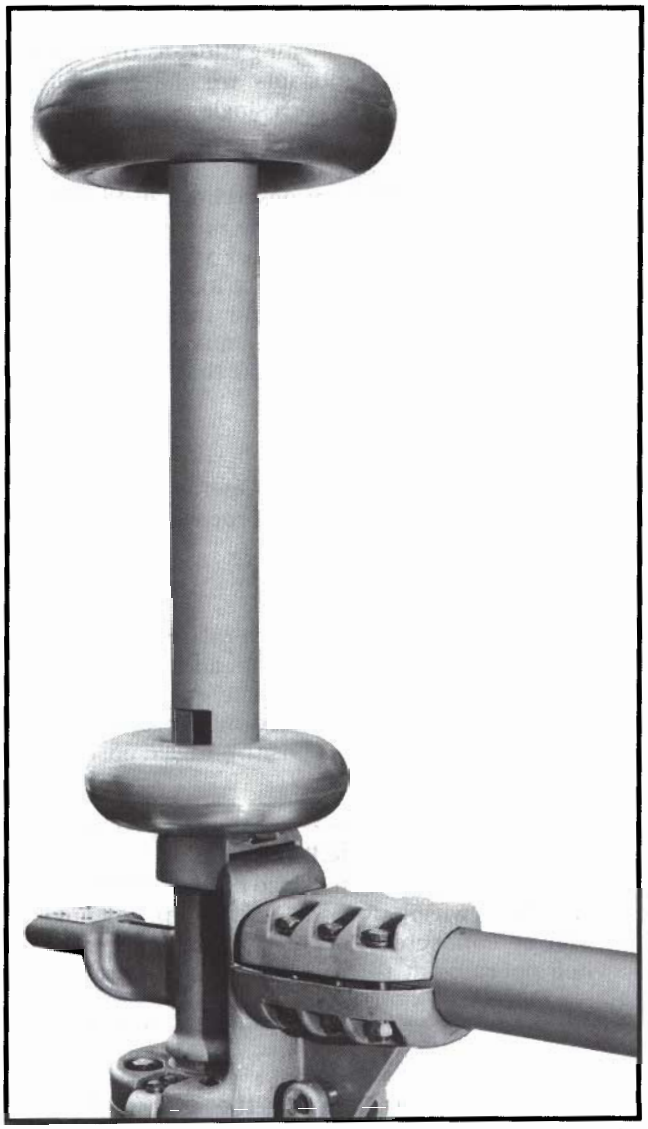


Figure 22. Extended corona-shield assembly for 500-kv rating.

FINAL CHECKS AND ADJUSTMENTS

Step 31

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 32

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 interrupters open, then back to gray, indicating the normally closed position of the interrupters. In addition, the interrupter targets remain gray when the Circuit-Switcher is closed, indicating that the interrupters are closed.

Step 33

Refer to S&C Type CS-2A Switch Operator Instruction Sheet 719-510 furnished and proceed as outlined therein under "Adjustments."

Step 34

Operate the Circuit-Switcher several times with the switch operator and observe the action. Operation should appear smooth, in both the opening and the closing directions, with the drive-shaft crank of each pole-unit coming to rest in a positive-toggle position.

SHUNT-TRIP DEVICE

If the optional shunt-trip device has been 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.

Step 35

Opening of the interrupters of the three pole-units under switch operator power should be simultaneous within 1.5 cycles (0.025 second). Check for this simultaneity by slowly opening the Circuit-Switcher (by manually cranking at the switch operator). Listen for the tripping action of the individual interrupters, and observe the interrupter targets. Note the point at which the interrupters of the first pole-unit trip. From this point, no more than 75 degrees of rotation of the manual operating handle should be required before the interrupters of the other two pole-units trip. If this condition exists, the desired simultaneity has been attained.

If simultaneity within the limits specified above is not attained, instructions for corrective adjustment will be provided by an S&C factory service specialist.

Step 36

After all adjustments are completed, close the bottoms of the bases with the perforated panels and fastening springs provided. The fastening springs are to be installed by hand—no tools are required. Recheck all bolted fastenings for tightness. This is important in maintaining optimum performance.

Step 37

Remove the container from each interrupter as follows:

(a) Remove and discard the ⅜″—16 zinc-plated serrated hex nuts which run the length of the container.

(b) Remove and discard the ⅜″—16×⅞″ and two ⅜″—16×1″ 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″ and two ⅜″—16×1″ zinc-plated hex-head cap screws and flat washers which attach the upper container-half to the indicator end casting of the interrupter.

(c) Pry the container-halves apart with a screwdriver. The upper container-half can now be removed and discarded—slotted holes are provided so that a rope or lifting sling can be attached and the container-half more conveniently lowered to the ground.

(d) Now remove and discard the ⅜″—16×⅞″ 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″ hex-head cap screw and flat washer which attach the lower container-half to the indicator end casting of the interrupter. Then discard this container-half.

(e) Finally, remove and discard the foam-core inner liner wrapped around the interrupter.

Now remove the shield for the pressure-relief device.