

Installation

Table of Contents

Qualified Persons	2	Installation	7
Read this Instruction Sheet	2	Before Starting	7
Retain this Instruction Sheet	2	Mounting the Switch Operator	8
Proper Application	2	Making Conduit Connections and Connecting External Control-Circuit Wiring	9
Safety Information	3	Using the Manual Operating Handle	10
Understanding Safety-Alert Messages	3	Using the Selector Handle (Coupling and Decoupling)	11
Following Safety Instructions	3	Adjusting the Switch Operator	13
Replacement Instructions and Labels	3	Adjusting the Position Indicator and Cranking Direction	13
Location of Safety Labels	4	Preliminary Adjustment of Travel-Limit Cams	17
Safety Precautions	5	Intermediate Adjustment of Travel-Limit Cams	20
Shipping and Handling	6	Final Adjustment of Travel-Limit Cams	20
Inspection	6	Adjusting the Auxiliary Switches	21
Packing	6	About the Extra Auxiliary Switches	22
Storage	6		
Handling	6		

★ S&C Type LS-1 Switch Operators were discontinued in 2024. For more information, contact your local S&C Sales Office.



Introduction

Qualified Persons

WARNING

Only qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution equipment, along with all associated hazards, may install, operate, and maintain the equipment covered by this publication. A qualified person is someone who is 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 Type LS-2 Switch Operators. Become familiar with the Safety Information and Safety Precautions on pages 3 through 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 Type LS-2 Switch Operators. 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 a specific application. The application must be within the ratings furnished for the equipment. Ratings for Type LS-2 Switch Operators are listed in the ratings table in Specification Bulletin 753-31. 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. Their telephone numbers are listed on S&C’s website sandc.com, or call the S&C Global Support and Monitoring Center at 1-888-762-1100.

NOTICE	
Read this instruction sheet thoroughly and carefully before installing Type LS-2 Switch Operators.	

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 that 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	CAUTION	Use pushbuttons to open or close the switch....	G-6251
B	NOTICE	The S&C Instruction Sheet is a permanent part of your S&C Equipment....	G-3733R2
C	NOTICE	Auxiliary switch cams are individually adjustable. Check the auxiliary switch cams...	G-4887R3
D	NOTICE	This contactor or relay has been blocked to prevent damage during shipment.	G-3684●

- This tag is to be removed and discarded after the switch operator is installed and adjusted.

⚠ DANGER



Type LS-2 Switch Operators 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 Line-Rupter™ Switches and Type LS-2 Switch Operators 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.** Power-operated Line-Rupter Switches and LS-2 Switch Operators contain fast-moving parts that can severely injure fingers.
6. **ENERGIZED COMPONENTS.** Always consider all parts of the Line-Rupter Switch 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 energized or installed near energized lines should be considered live until tested and grounded.
7. **GROUNDING.** The Line-Rupter Switch and LS-2 Switch Operator 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 vertical operating shaft above the Type LS-2 Switch Operator must also be connected to a suitable earth ground.

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. **LOAD-INTERRUPTER 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.

Shipping and Handling

Inspection

Examine the shipment for external evidence of damage as soon after receipt as possible, preferably before removal from the carrier's conveyance. Check the bill of lading to verify 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 is stored in a water-resistant envelope attached to the Line-Rupter Switch base or in the LS-2 Switch Operator's instruction book holder. The operator drawings will be included in the main drawing envelope. Study the erection drawing carefully and check the bill of material to make sure all parts are at hand.

Storage

NOTICE

Connect control power to the switch operator when storing it outdoors. The Type LS-2 Switch Operator is equipped with a space heater that must be energized during storage to prevent condensation and corrosion within the operator enclosure.

If the switch operator must be stored before installation, keep it in a clean, dry, corrosion-free area to protect it from damage. Make sure the crating rests firmly on the ground and is reasonably level. Shoring under the crate may be necessary if the ground is uneven. If storing outdoors, connect control power to the space heater inside the switch operator per the wiring diagram furnished.

Handling

Lift the Type LS-2 Switch Operator with a lifting sling looped around the switch operator output shaft. See Figure 1.




Figure 1. Lifting the switch operator.

Before Starting

The high-speed Type LS-2 Switch Operator, with a maximum operating time of 2.2 seconds, is especially designed for power operation of Line-Rupter Switches.

catalog number and wiring diagram for the installation before beginning the installation. See Table 1.

Become familiar with the parts of the switch operator as shown in Figure 2 on page 8, Figure 3 on page 9, and Figure 4 on page 10.

 WARNING
<p>Unauthorized changes should not be made to the wiring of the Type LS-2 Switch Operator. Should a control-circuit revision seem desirable, it should be made only by following a revised wiring diagram approved by both the utility and S&C Electric Company. Unauthorized changes can make the function of the operator unpredictable, causing damage to the operator, associated Line-Rupter Switch, and possible serious personal injury.</p>

Two motor and control voltages are available for the Type LS-2 Switch Operator. Make sure to have the correct

Table 1. Type LS-2 Switch Operators

Application		Switch Operator Type	Motor and Control Voltage	Maximum Operating Time, Seconds ^①	Minimum Locked-Rotor Torque at Rated Control Voltage, Inch-Lbs.	Accelerating Current, Amperes	Catalog Number	Schematic Wiring Diagram Drawing Number
High-Voltage Device	Rating of High-Voltage Device							
Line-Rupter Switches	115 kV thru 230 kV	LS-2	48 Vdc	2.2	18 000	30	38915-A	CDR-3238
			125 Vdc		21 500	15	38915-B	

^① Based on minimum battery and external control wire size requirements specified in S&C Information Bulletin 753-60; operating time will be less if a larger-than-minimum battery size and/or external control wire size is used.

Installation

Mounting the Switch Operator

Complete the following steps to install a Type LS-2 Switch Operator:

STEP 1. Lift the switch operator as shown in the “Handling” section on page 6. Then, mount the switch operator to the structure as indicated on the erection drawing. Bolt the switch operator in position with 5/8-inch mounting hardware using any two of the four holes in each of the mounting angles at the rear of the switch operator.

STEP 2. Attach the flexible coupling furnished for the vertical operating pipe to the switch operator output shaft. See Figure 2. Thread the attachment bolts through the flexible coupling plate and through the coupling flange on the output

shaft. 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.

Remove the clamp bolts and set aside the detachable half of the flexible coupling.

STEP 3. Place the Line-Rupter Switch pole-units in their fully **Closed** positions. Install the inter-phase and vertical operating pipe sections. However, at the switch operator, do not attach the vertical pipe section to the switch operator output shaft until the “Adjusting the Position Indicator and Cranking Direction” section on page 13.

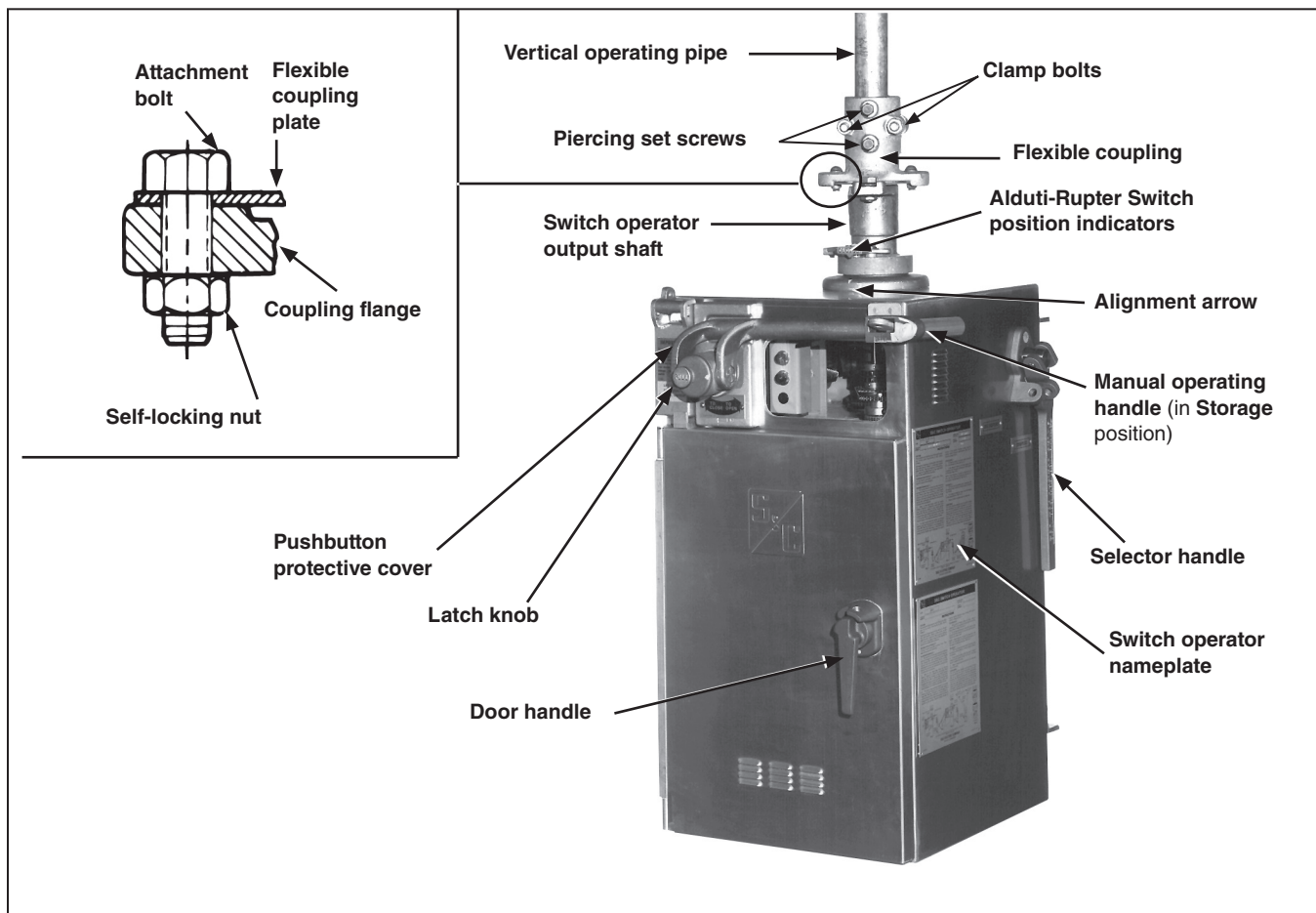


Figure 2. Exterior view of a switch operator.

Making Conduit Connections and Connecting External Control-Circuit Wiring

- STEP 1.** Mark the conduit-entrance location for the control circuit wiring on the conduit-entrance plate in the bottom of the switch operator enclosure. See Figure 3.
- STEP 2.** Remove the conduit-entrance plate and cut out the required opening.
- STEP 3.** Replace the plate and assemble the entrance fittings. Apply sealing compound (provided with each switch operator) when replacing the conduit entrance plate. Verify the entrance fittings are properly sealed to prevent water ingress.
- STEP 4.** Remove the blocking from the motor contactors. Connect the external control-circuit wiring (including space heater source leads) to the terminal blocks of the switch operator in accordance with the wiring diagram furnished.

NOTICE

To avoid accidental energizing of the operator after the external connections have been completed, remove the two-pole pull-out fuseholders for the motor circuit and space-heater circuit. See Figure 3. Reinsert the fuseholders only when indicated in the following steps.

NOTICE

Observe recommended minimum wire size requirements for the control-circuit wiring, as shown in S&C Information Bulletin 753-60 and on the switch operator schematic wiring diagram furnished.

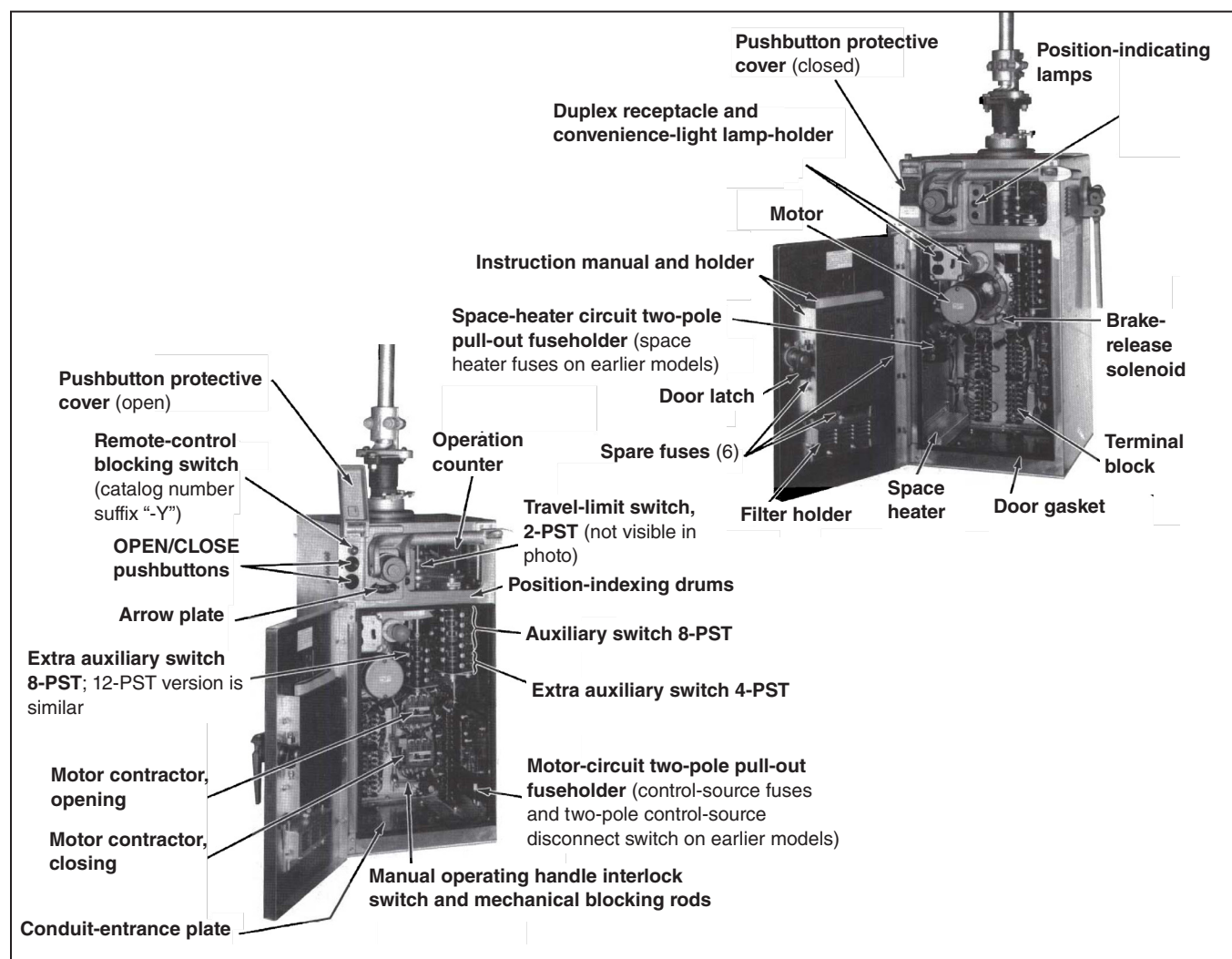


Figure 3. Interior views of a switch operator.

Installation

Using the Manual Operating Handle

The manual operating handle is used during switch operator adjustment. Become familiar with the operation of the manual operating handle, as described on the switch operator nameplate on the right side of the enclosure.

⚠ WARNING

DO NOT manually open or close the switch operator while the Line-Rupter Switch is energized.

Operating the switch under reduced operating speed can cause excessive arcing, resulting in shortened interrupter life, damage to the interrupters and arcing horns, or personal injury.

If switch operator control voltage is not available and emergency manual opening is absolutely necessary, crank the manual operating handle rapidly through its full travel. **Do not** stop or hesitate part way. **Never close the switch manually.**

STEP 1. Pull the latch knob on the hub of the manual operating handle and pivot the handle forward slightly from its **Storage** position.

STEP 2. Release the latch knob while continuing to pivot the handle forward to lock it into the **Cranking** position. See Figure 4.

(As the handle is pivoted forward, the motor brake is mechanically released, both leads of the control source are automatically disconnected, and both the opening and closing motor contactors are mechanically blocked in the **Open** position.)

During manual operation, the switch operator may also be disconnected from the control source by removing the motor-circuit two-pole pull-out fuseholder located on the right inside wall of the enclosure.

STEP 3. To return the manual operating handle to its **Storage** position, pull the latch knob and pivot the handle approximately 90 degrees. The handle will then be disengaged from the switch

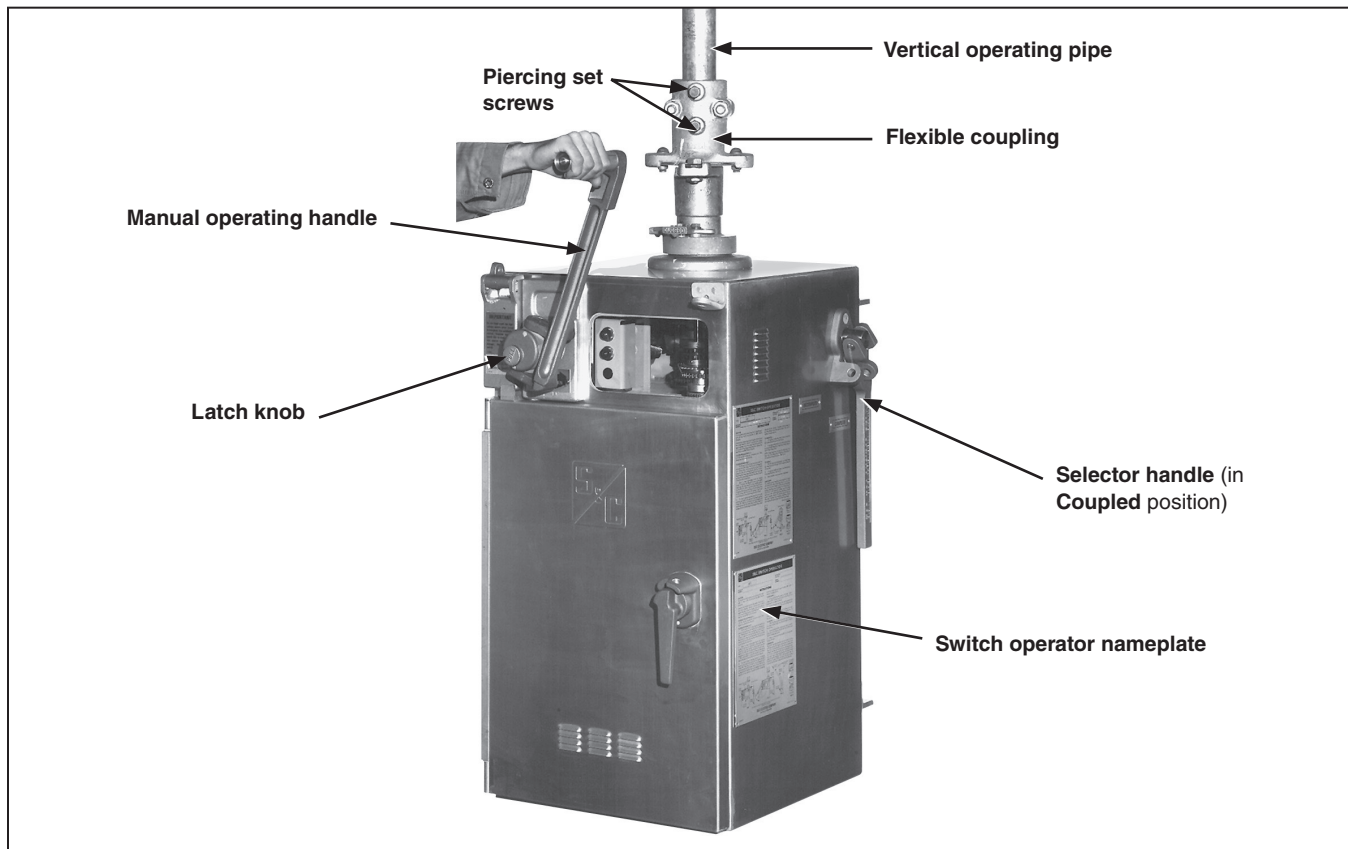


Figure 4. Manual operation.

operator and may be rotated freely in either direction to its **Storage** position.

Complete the handle storage by pivoting the operating handle backward approximately 90 degrees until it latches in the **Storage** position.

Note: the manual operating handle may be disengaged from the switch operator mechanism at any position of the handle.

Note: The handle may be padlocked in its **Storage** position.

Using the Selector Handle (Coupling and Decoupling)

The selector handle will be used during switch operator adjustment. The integral external selector handle, for operation of the built-in internal decoupling mechanism, is located on the right-hand side of the switch operator enclosure. Become familiar with the operation of the selector handle, as described on the switch operator nameplate on the right side of the enclosure.

To decouple the switch operator from the switch:

- STEP 1.** Swing the selector handle upright and slowly rotate it clockwise 50 degrees to the **Decoupled** position. See Figure 5. This decouples the switch operator mechanism from the switch operator output shaft.
- STEP 2.** Lower the selector handle to engage the locking tab. When decoupled, the switch operator may be operated either manually or electrically without operating the high-voltage switch.

When the selector handle is in the **Decoupled** position, the output shaft is prevented from moving by a mechanical locking device inside the switch operator enclosure.

During the intermediate segment of the selector handle travel, which includes the position at which actual disengagement (or engagement) of the internal decoupling mechanism occurs, the motor circuit source leads are momentarily disconnected and both the opening and closing motor contactors are mechanically blocked in the **Open** position.

Visual inspection through the observation window will verify whether the internal decoupling mechanism is in the **Coupled** or **Decoupled** position. See Figure 8 on page 14. The selector handle may be padlocked in either position.

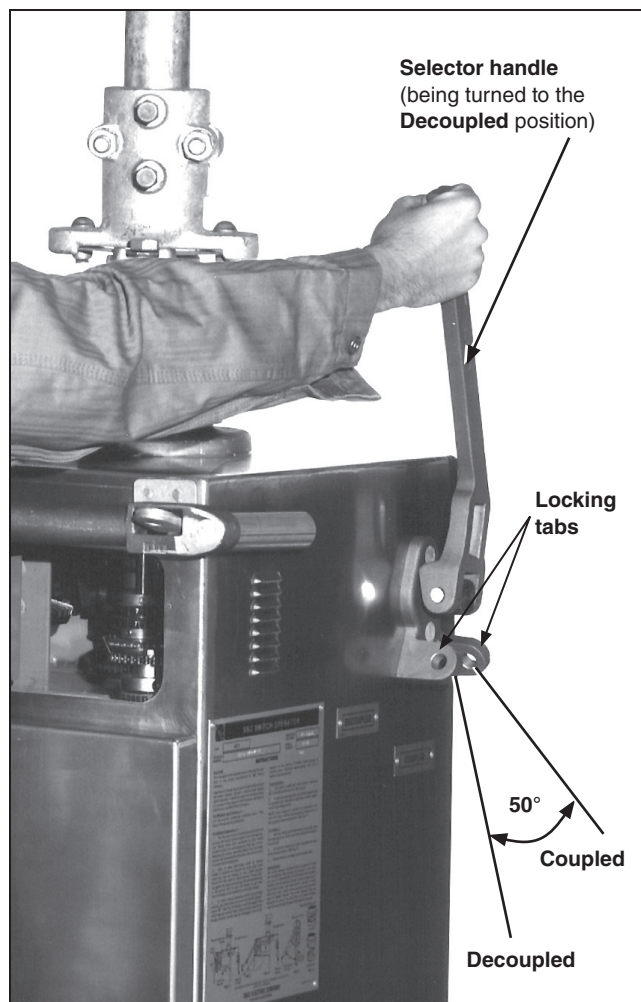


Figure 5. Selector handle operation.

Installation

To couple the switch operator to the switch:

STEP 1. Manually operate the switch operator to bring it to the same **Open** or **Closed** position as the high-voltage switch.

The switch operator position indicator, seen through the observation window, will show when the approximate **Open** or **Closed** position has been attained. See Figure 8 on page 14. (The position indicator for the high-voltage switch, located on the output-shaft collar of the switch operator, will be aligned later.)

STEP 2. Turn the manual operating handle slowly until the position-indexing drums are numerically aligned.

STEP 3. Swing the selector handle upright and rotate it counterclockwise to the **Coupled** position. Lower the handle to engage the locking tab. The selector handle is now in the **Coupled** position.

Adjusting the Position Indicator and Cranking Direction

NOTICE

To avoid accidental energizing of the operator, remove the two-pole pull-out fuseholders for the motor circuit and space-heater circuit and do not reinsert them until so directed.

Complete the following steps to adjust the position and cranking direction of the switch operator:

- STEP 1.** Make sure the main contacts on all high-voltage switch pole-units are fully closed.
- STEP 2.** With the selector handle in the **Coupled** position, manually crank the switch operator to the fully **Closed** position, as indicated by the switch operator position indicator. See Figure 8 on page 14.
- STEP 3.** At the switch operator output shaft, replace the detachable portion of the coupling clamp. Make sure the cutting tips of the piercing set screws do not protrude through the body of the coupling. Torque the flexible coupling clamp bolts equally to final tightness so the clamp pulls down evenly on the vertical operating-pipe section. Then, tighten the associated piercing set screws, piercing the pipe, and continue turning until feeling a firm resistance. Figure 6.
- STEP 4.** With the selector handle in the **Coupled** position, crank the high-voltage switch to the fully **Open** position and then to the fully **Closed** position. In each position, accurately align the high-voltage switch position indicators on the output-shaft collar of the switch operator with the alignment arrow below. See Figure 7 on page 14.

Each high-voltage-switch position indicator can be shifted after loosening the hex-head screws that fasten it to the output-shaft collar. Tighten these screws after making the alignments.

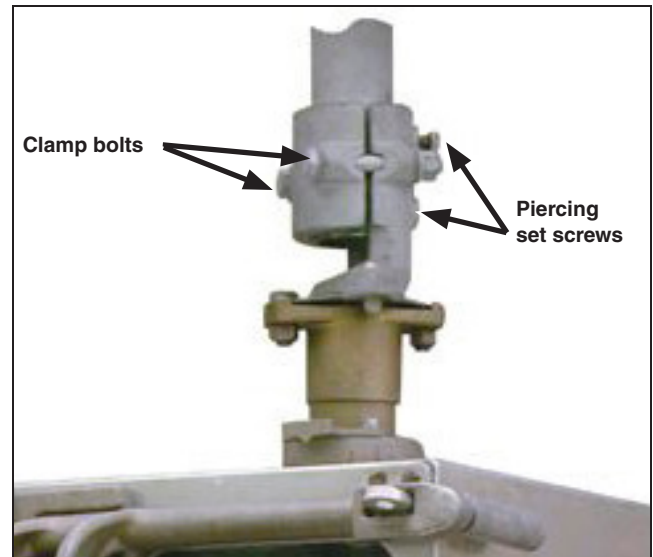


Figure 6. Tighten the clamp bolts and piercing set screws.

Adjusting the Switch Operator

The cranking direction to close the high-voltage switch is indicated by an arrow plate located near the hub of the manual operating handle. See Figure 8. This direction has been predetermined from the erection drawing for the specific installation and has been factory set accordingly. The direction of rotation of the switch-operator motor has also been set at the factory.

When the cranking direction required to close the high-voltage switch is opposite to that indicated by the arrow plate, remount the arrow plate, exposing its opposite side.

Temporarily mark on the top of the switch operator enclosure the direction in which the output shaft rotates to close the high-voltage switch.

STEP 5. Place the selector handle in the **Decoupled** position in preparation for electrical operation.

STEP 6. With the manual operating handle in its **Storage** position and the selector handle in the **Decoupled** position, reinsert the motor-circuit fuseholder. Open the pushbutton protective cover and operate the switch operator with the externally mounted OPEN/CLOSE push-buttons, if provided, or, in their absence, by momentarily jumpering terminals 1 and 8 to open, and 1 and 9 to close. ■

Note the direction in which the travel-limit cams rotate when the switch operator closes. This direction should agree with the temporary direction mark previously made on the top of the enclosure. (The direction of rotation of

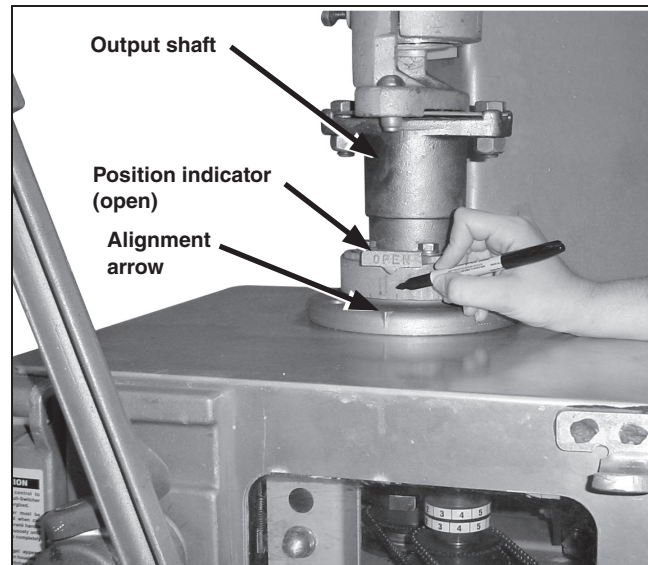


Figure 7. Adjust the position indicator. Mark the direction of operator rotation.

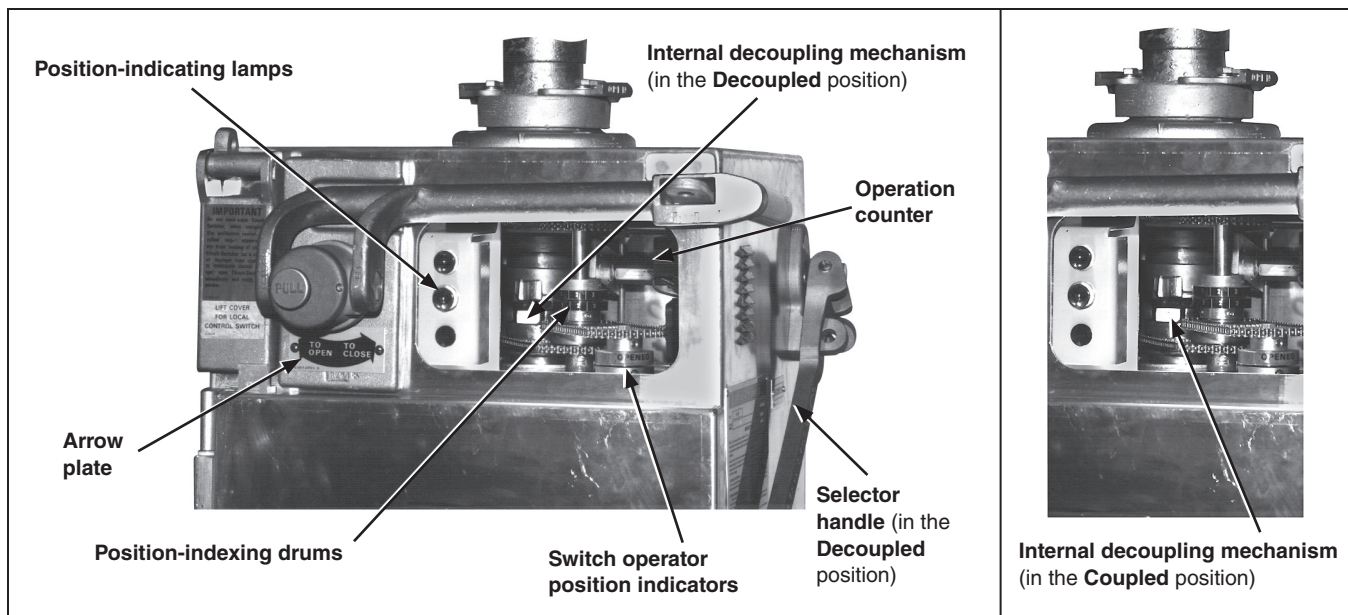


Figure 8. Views of a switch operator through the observation window.

the travel-limit cams is always the same as the direction of rotation of the output shaft.)

When the direction of rotation of the travel-limit cams (as noted above) is opposite to the temporary direction mark previously made on the top of the enclosure, a reversal of the motor direction will be necessary. Remove the motor-circuit fuseholder to avoid accidental or remote energization of the control circuit. Interchange the "S1" and "S2" motor leads connected to terminals 4 and 5 on the terminal block in the switch operator enclosure.

Note: Reversal of the motor direction reverses only the direction or rotation of the output shaft and travel-limit cams. The identity of the opening-stroke and closing-stroke travel-limit cams (which will be adjusted later) will remain unaffected.

STEP 7. The travel-limit switch (coupled to the motor), which governs the extent of output-shaft rotation in the opening and closing directions, includes two contacts operated by cam-actuated rollers. See Figure 7 on page 14. The cams (upper one is the opening-stroke travel-limit cam; the one immediately below is the closing stroke travel-limit cam) are individually adjustable in 4.5-degree increments. Therefore, each cam can be adjusted to advance or limit engagement with its roller and thus open or close the corresponding switch contact, as required, during motor operation.

Advancing a cam advances roller engagement to de-energize the corresponding motor contactor earlier and thus decreases the extent of output-shaft rotation. Conversely, retarding a cam limits engagement with its roller to delay de-energization of the corresponding motor contactor and thus increases the extent of output-shaft rotation.

The travel-limit cams (as well as the auxiliary-switch cams) are to be adjusted as directed in the "Preliminary Adjustment of Travel-Limit Cams" section on page 17, the "Intermediate Adjustment of Travel-Limit Cams" section on page 20, the "Final Adjustment of Travel-Limit Cams" section on page 20 and when using the following procedure (do not make any adjustments at this time):

- (a) Remove the motor-circuit fuseholder.
- (b) Raise (or lower) the cam toward its adjacent spring until the cam is separated from the teeth of the inner gear.
- (c) Rotate the cam to advance or limit engagement with its roller. See Figure 9 on page 16 and Figure 10 on page 17. Advance the cam to decrease travel. Retard the cam to increase travel.
- (d) Lower (or raise) the cam, making sure the teeth mesh with the inner gear.

● For switch operators with an optional remote-control blocking switch (suffix "-Y"), opening the pushbutton protective cover prevents remote operation of the switch operator.

■ Terminal designations may differ in special wiring diagrams. In such cases, refer to the specific wiring diagram for the correct terminal designations.

Adjustments

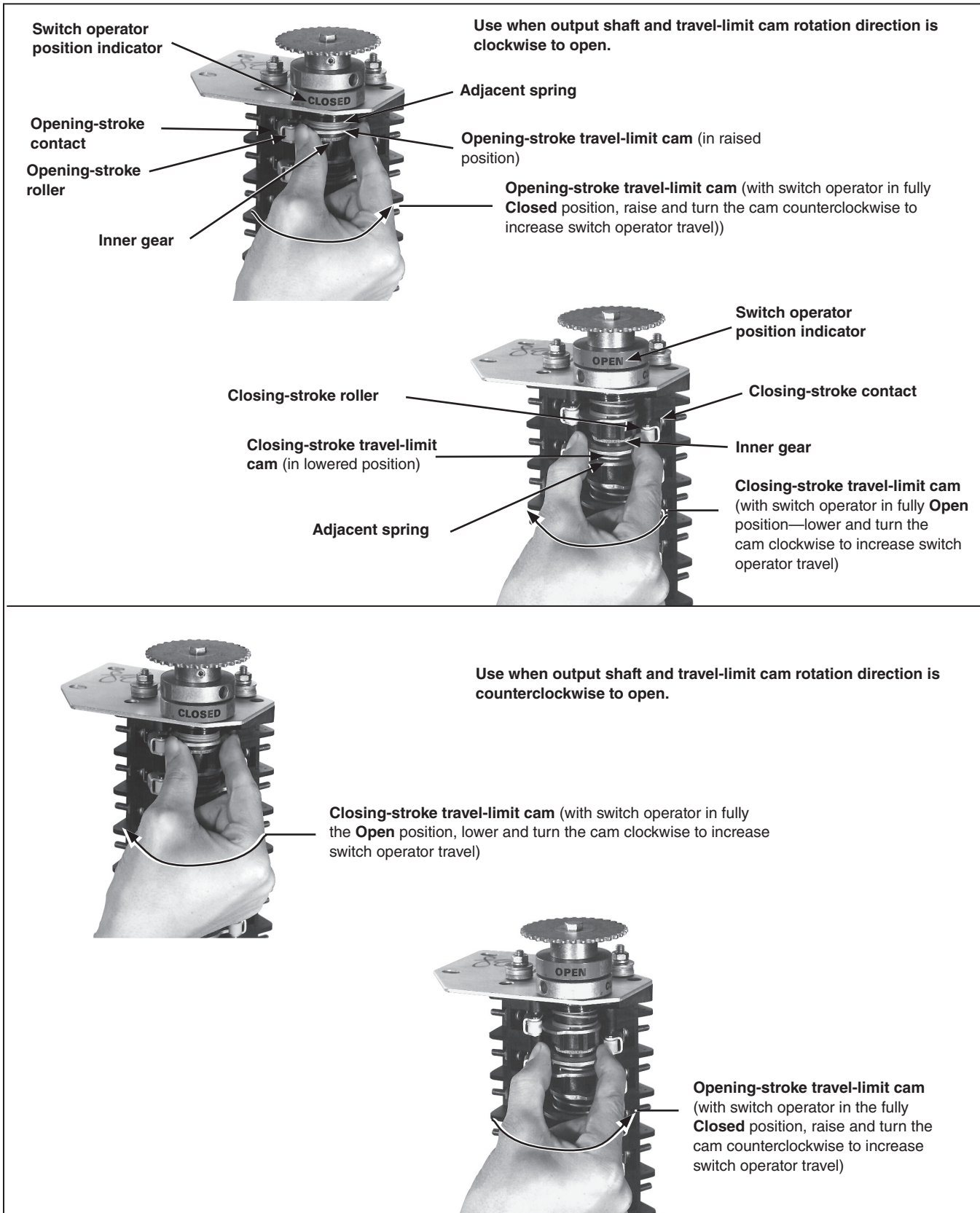


Figure 9. Adjusting of travel-limit cams.

Preliminary Adjustment of Travel-Limit Cams

The adjustments described in this section are necessary only when either or both of the following occur:

- The switch operator output-shaft rotation (adjustable over a 35- to 235-degree range) was not factory-set for the specific requirement of this installation
- A reversal of the motor direction was required, as described in Step 6 on page 14.

STEP 1. To adjust the closing-stroke travel-limit cam, place the selector handle in the **Coupled** position. Manually operate the switch operator in the closing direction and observe the closing-stroke travel-limit cam.

At the completion of the switch operator closing stroke, the leading edge of the closing-stroke travel-limit cam should be engaged with its associated roller. If the leading edge is not engaged with its roller, adjust the

closing-stroke travel-limit cam (as described in Step 7 on page 15) so its leading edge touches (or nearly touches) the roller.

STEP 2. To adjust the opening-stroke travel-limit cam, with the selector handle in the **Coupled** position, manually operate the switch operator in the opening direction and observe the opening-stroke travel-limit cam. At the completion of the switch operator opening stroke, the leading edge of the opening-stroke travel-limit cam should be engaged with its roller.

If the leading edge is not engaged with its roller, adjust the opening-stroke travel-limit cam (as described in Step 7 on page 15) so its leading edge touches (or nearly touches) the roller. Return the manual operating handle to its **Storage** position.

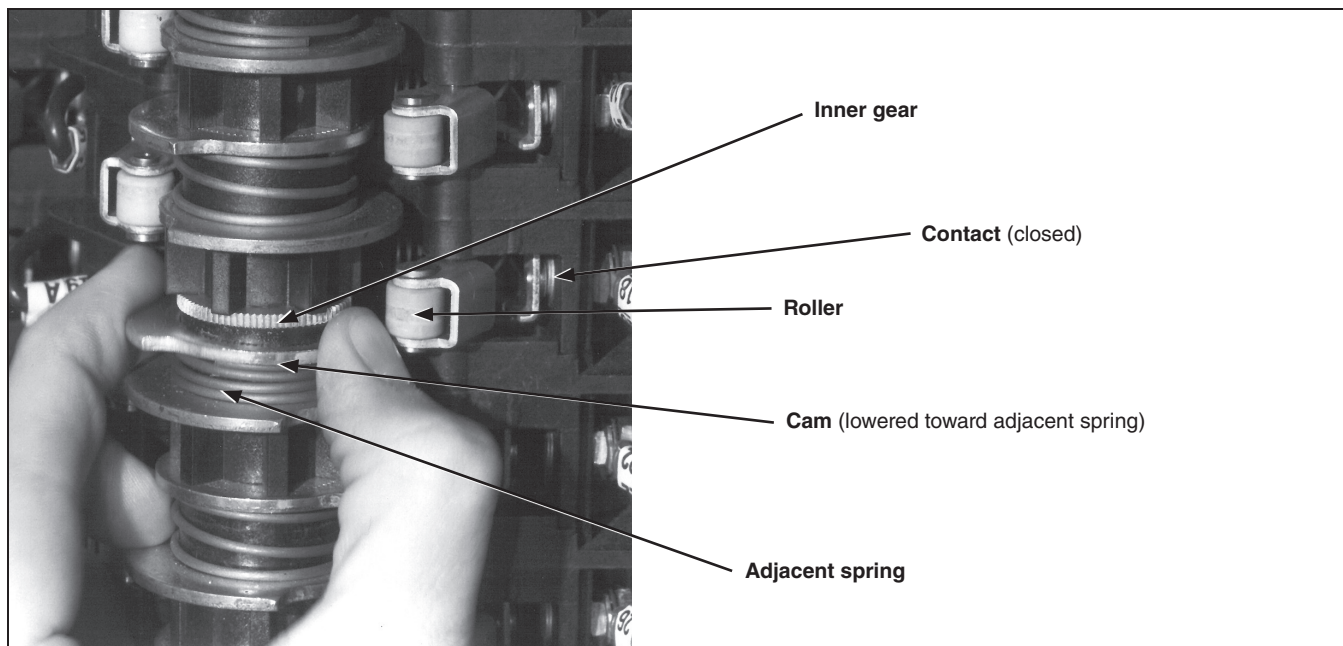


Figure 10. Adjusting the auxiliary switch cams.

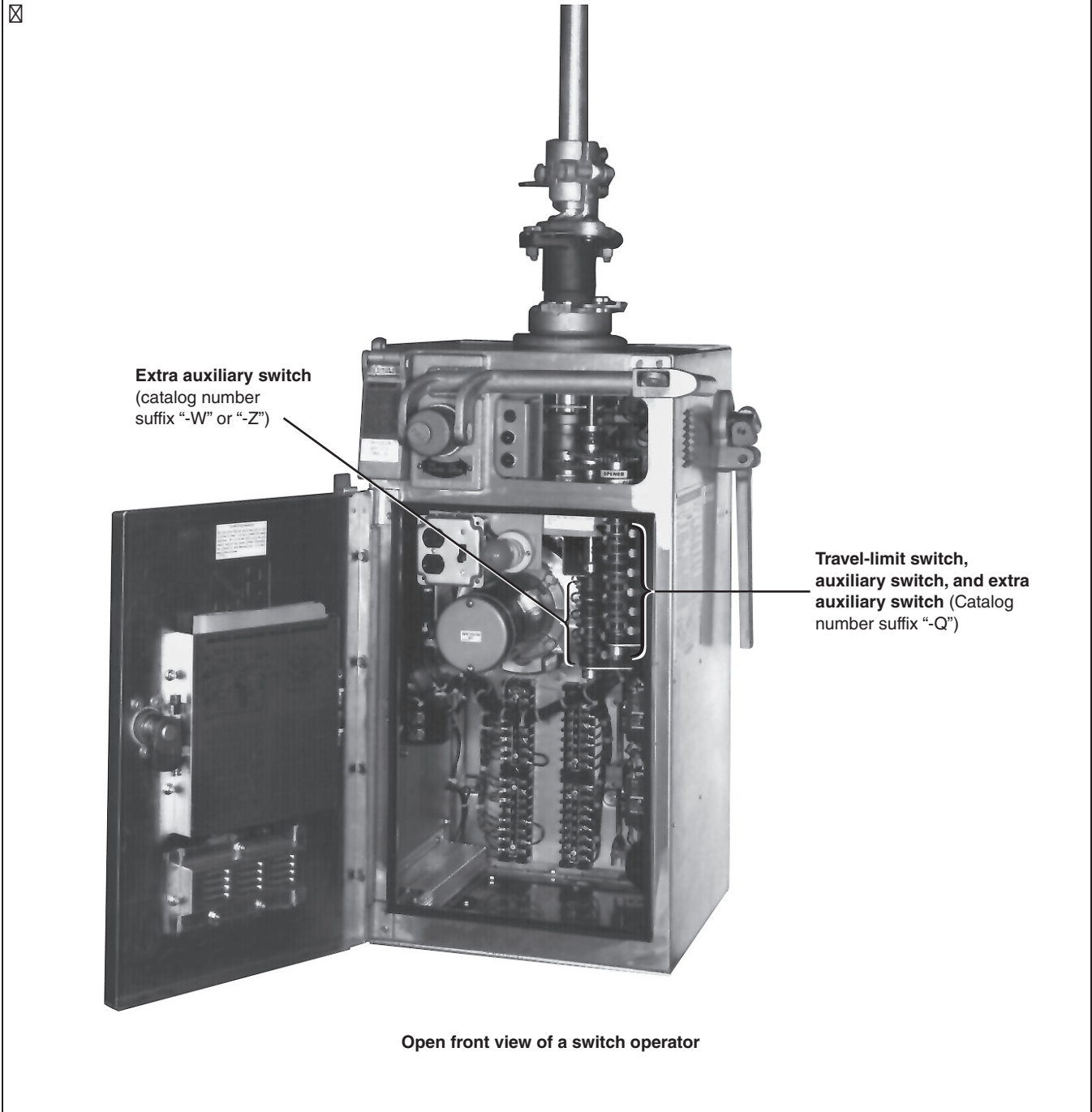


Figure 11. "Standard" contact configurations.

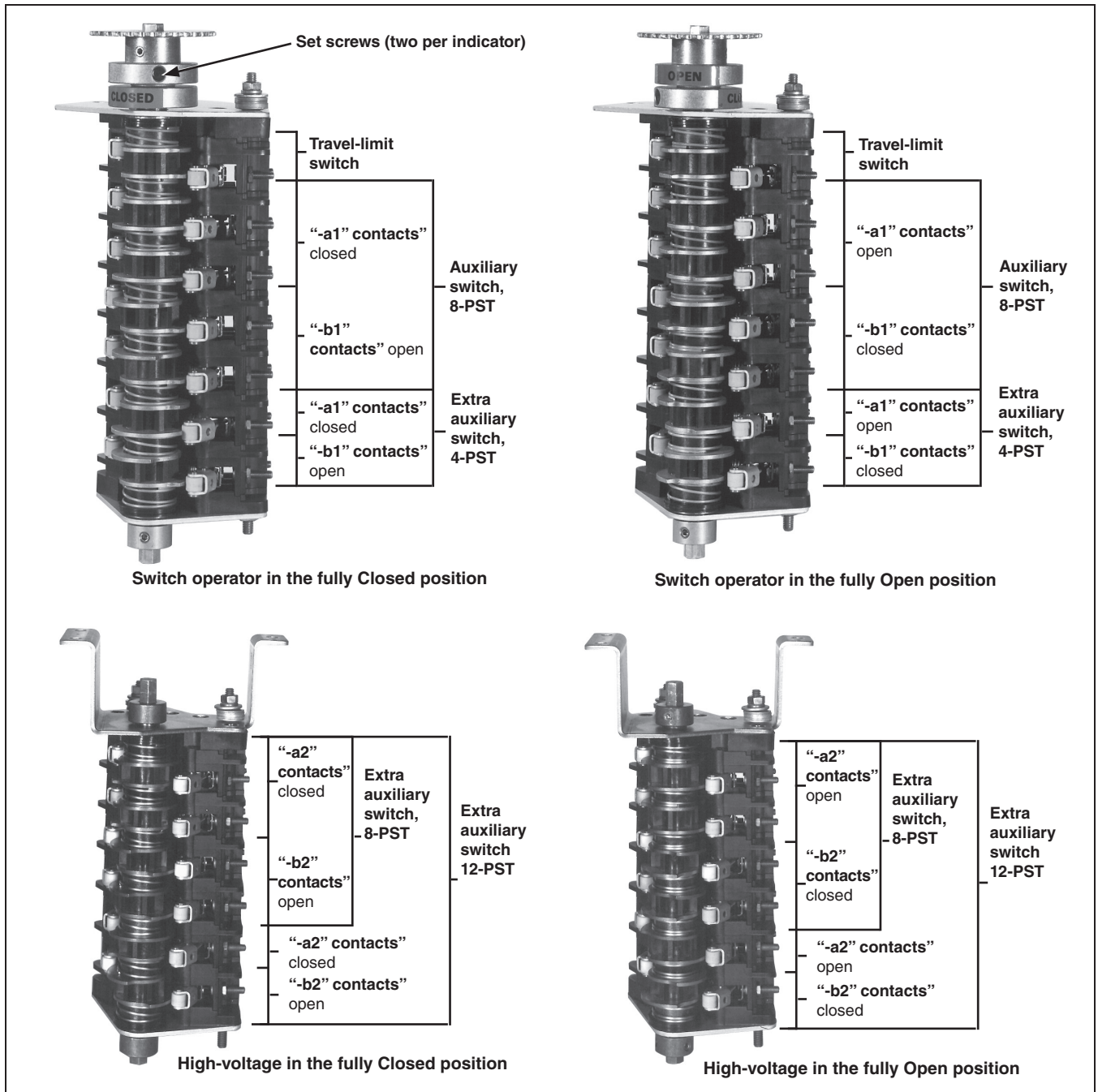


Figure 12. Travel-limit cam and auxiliary switch contact detail view.

Intermediate Adjustment of Travel-Limit Cams

The adjustments described in this section are required to obtain a close approximation of the correct travel of the switch operator in the **Decoupled** position, i.e., in a no-load condition, to avoid inadvertently overdriving the high-voltage switch when the switch operator is first used for power-opening or power-closing the high-voltage switch.

STEP 1. To adjust the closing-stroke travel-limit cam, with the selector handle in the **Coupled** position, manually crank the high-voltage switch to its fully **Closed** position. Return the manual operating handle to its **Storage** position. Then, place the selector handle in the **Decoupled** position and replace the motor-circuit fuseholder.

Operate the switch operator electrically to open and then to close. If the position-indexing drums are not numerically aligned, operate the switch operator electrically to open. Remove the motor-circuit fuse holder. Then, adjust the closing-stroke travel-limit cam, as described in Step 7 on page 15, the necessary number of increments to attain numerical alignment of the position-indexing drums at the completion of a switch operator closing stroke.

STEP 2. *For the opening-stroke travel-limit cam:* With the selector handle in the **Coupled** position, manually crank the high-voltage switch to its fully **Open** position. Return the manual operating handle to its **Storage** position. Then, place the selector handle in the **Decoupled** position and replace the motor-circuit fuseholder.

Operate the switch operator electrically to close, and then to open. If the position-indexing drums are not numerically aligned, operate the switch operator electrically to close. Remove the motor-circuit fuse holder. Then adjust the opening-stroke travel-limit cam, as described in Step 7 on page 15, the necessary number of increments to attain numerical alignment of the position-indexing drums at the completion of a switch operator opening stroke.

Final Adjustment of Travel-Limit Cams

The adjustments described in this section are necessary to ensure complete opening and closing of the high-voltage switch. The open and closed stops of the high-voltage switch should be checked and adjusted as follows:

STEP 1. Operate the switch operator electrically to open and close the high-voltage switch. Observe the toggle mechanisms (if applicable) and the open stops on the high-voltage switch. Full opening and closing travel likely will not have been attained. This is because the travel-limit cams were adjusted to limit the extent of output-shaft rotation while the switch operator was in the **Decoupled** position i.e., in a no load condition.

To attain full stop positions (and over-toggle positions, where applicable) of the high voltage switch, refer to Figure 9 on page 16 and proceed as described below.

STEP 2. Adjust the closing stroke travel-limit cam if full closing of the high-voltage switch was not attained, by replacing the motor-circuit fuseholder and operating the switch operator electrically to open the high-voltage switch. Remove the motor-circuit fuse holder.

To increase travel in the closing direction, adjust the closing-stroke travel-limit cam one 4.5-degree increment (1) in the clockwise direction if the travel-limit cam and output shaft rotate clockwise to open the high voltage switch, or (2) in the counterclockwise direction if the travel-limit cam and output shaft rotate counterclockwise to open the high-voltage switch. Replace the motor-circuit fuseholder and operate the switch operator electrically to close. If full closing travel has not been attained, repeat the procedure described above until full closing travel is attained.

STEP 3. *Adjust the opening stroke travel-limit cam* if full opening of the high-voltage switch was not attained, by operating the switch operator electrically to close the switch. Remove the motor-circuit fuseholder.

To increase travel in the opening direction, adjust the opening-stroke travel-limit cam one

4.5-degree increment (1) in the counterclockwise direction if the travel-limit cam and output shaft rotate clockwise to open the high-voltage switch, or (2) in the clockwise direction if the travel-limit cam and output shaft rotate counterclockwise to open the high-voltage switch.

Replace the motor-circuit fuseholder and operate the switch operator electrically to open. If full opening travel has not been attained, repeat the procedure described above until full opening travel is attained.

- STEP 4.** When travel-limit cam adjustments have been completed, it may be necessary to realign the high-voltage switch position indicators on the switch operator output-shaft collar with the alignment arrow.

With the switch operator in the fully **Open** position and then in the fully **Closed** position, check the corresponding switch operator position indicator. In each position, the corresponding position indicator should be readily visible from the front of the enclosure.

If adjustment of either position indicator is necessary, remove the motor-circuit fuseholder, loosen the two set screws on the position indicator, and rotate the position indicator to the desired position. Retighten the set screws. See Figure 12 on page 19.

Adjusting the Auxiliary Switches

The auxiliary switch, which is permanently coupled to the motor, includes eight contacts (terminals 11 through 26). If the optional position-indicating lamps are included, six contacts are available (terminals 13 through 18 and 21 through 26). These contacts are provided so external circuits can be established to monitor switching operations.

Each contact is operated by a cam-actuated roller. The cams are individually adjustable in 4.5-degree increments. Adjustment of the cams is accomplished in a manner identical to that indicated in Step 7 on page 15 or the travel limit cams.

The “standard” configuration for the auxiliary switch consists of four “a1” contacts (terminals 11 through 18) and four “b1” contacts (terminals 19 through 26).

Thus, with the high-voltage switch in the **Open** position, the “a1” contacts are open and the “b1” contacts are closed. Conversely, with the high-voltage switch in the **Closed** position, the “a1” contacts are closed and the

“b1” contacts are open. A contact is closed if its roller is disengaged from a cam and, conversely, a contact is open if its roller is engaged by a cam. See Figure 11 on page 18.

Any auxiliary-switch contact being used must be checked for proper operation after the switch operator travel-limit cams have been adjusted. Check the auxiliary-switch contacts for both the **Open** and **Closed** positions of the high-voltage switch. If necessary, adjust the cams as described in Step 7 on page 15 so the auxiliary switch contacts are in the desired **Open** or **Closed** position (i.e., cam engaged with roller, or cam disengaged from roller). See Figure 10 on page 17.

Because each cam can be individually adjusted in 4.5-degree increments, any “a1” contact can be changed to a “b1” contact, or vice versa. Also, because of the many positions to which the cams can be adjusted, the various rollers can be engaged or disengaged to respectively open or close their contacts simultaneously, sequentially, randomly, or in various combinations.

Adjustment of the auxiliary-switch contacts for other than the “standard” configuration is left to the user. The motor-circuit fuseholder should be removed when adjusting these contacts. (Switch operators having catalog numbers with the suffix “-Q” are equipped with an extra auxiliary switch, terminals 27 through 34, having four contacts—two “a1” and two “b1”—that may be adjusted:

- STEP 1.** With the selector handle in the **Coupled** position, operate the switch operator to the fully **Closed** position (manually or electrically).
- STEP 2.** Remove the motor-circuit fuseholder.
- STEP 3.** Determine which “a1” contacts are not in the **Closed** position. A contact is closed if its roller is disengaged from a cam, and conversely, a contact is open if its roller is engaged by a cam.
- STEP 4.** For the “a1” contacts that are not in the **Closed** position, raise (or lower) the corresponding cam toward its adjacent spring until the cam is separated from the teeth of the inner gear. Rotate the cam until it is in a position so that when lowered (or raised) it will be disengaged from the roller.
- Lower (or raise) the cam, making sure the teeth are in mesh with the inner gear and the cam is disengaged from the roller.
- STEP 5.** Reinsert the motor-circuit fuseholder.

About the Extra Auxiliary Switches

Switch operators having catalog numbers with either the suffix “-W” or “-Z” are equipped with an extra auxiliary switch permanently coupled to the high-voltage switch. The suffix “-W” auxiliary switch consists of eight contacts (terminals 35 through 50). The suffix “-Z” auxiliary switch consists of 12 contacts (terminals 35 through 50 plus terminals 80 through 87).

These contacts are provided so external circuits can be established to monitor high-voltage switch operation. Each contact is operated by a cam-actuated roller, and the cams are individually adjustable in 4.5-degree increments.

The “standard” configuration for the suffix “-W” extra auxiliary switch consists of four “a2” contacts (terminals 35 through 42) and four “b2” contacts (terminals 43 through 50). The “standard” configuration for the suffix “-Z” extra auxiliary switch consists of six “a2” contacts (terminals 35 through 42 and terminals 80 through 83) and six “b2” contacts (terminals 43 through 50 and terminals 84 through 87).

Thus, with the high-voltage switch in the fully closed position, the “a2” contacts should be closed and the “b2” contacts should be open. Conversely, with the high voltage switch in the fully **Open** position, the “a2” contacts should be open and the “b2” contacts should be closed. See Figure 11 on page 18.

Any suffix “-W” or “-Z” auxiliary-switch contact being used must be checked for proper operation after satisfactory electrical operation of high-voltage switch has been achieved. Check the auxiliary-switch contact engagement for both the **Open** and **Closed** positions of the high-voltage switch.

Adjustment of the suffix “-W” or “-Z” extra auxiliary switch is identical to the adjustment performed for the travel-limit switch, the auxiliary switch, and the suffix “-Q” auxiliary switch. Therefore, if adjustment of the suffix “-W” or “-Z” auxiliary switch is needed, refer to the “Adjusting the Auxiliary Switches” section on page 21.