Installation

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★For use with the Mark V Circuit-Switcher

November 13, 2023

Qualified Persons

⚠ WARNING

Only qualified persons who are knowledgeable in the installation, operation, and maintenance of overhead and underground electric distribution and transmission 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 the Type CS-1A Switch Operator. 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 **https://www.sandc.com/en/contact-us/product-literature/**.

Retain this Instruction Sheet

This instruction sheet is a permanent part of the Type CS-1A Switch Operator. 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 power operation of the Mark V Circuit-Switcher. The application must be within the ratings furnished for the equipment. Ratings and application information for the Type CS-1A Switch Operator are listed in the ratings table in Specification Bulletin 719-31. The ratings are also on the nameplate affixed to the product.

Warranty

The warranty and/or obligations described in S&C's Price Sheet 150, "Standard Conditions of Sale–Immediate Purchasers in the United States," (or Price Sheet 153, "Standard Conditions of Sale–Immediate Purchasers Outside the United States"), plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of the seller's entire liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150 (or Price Sheet 153), and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 (OR PRICE SHEET 153) IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150 (OR PRICE SHEET 153).

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels and tags attached to the Type CS-1A Switch Operator. Become familiar with these types of messages and the importance of these various 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

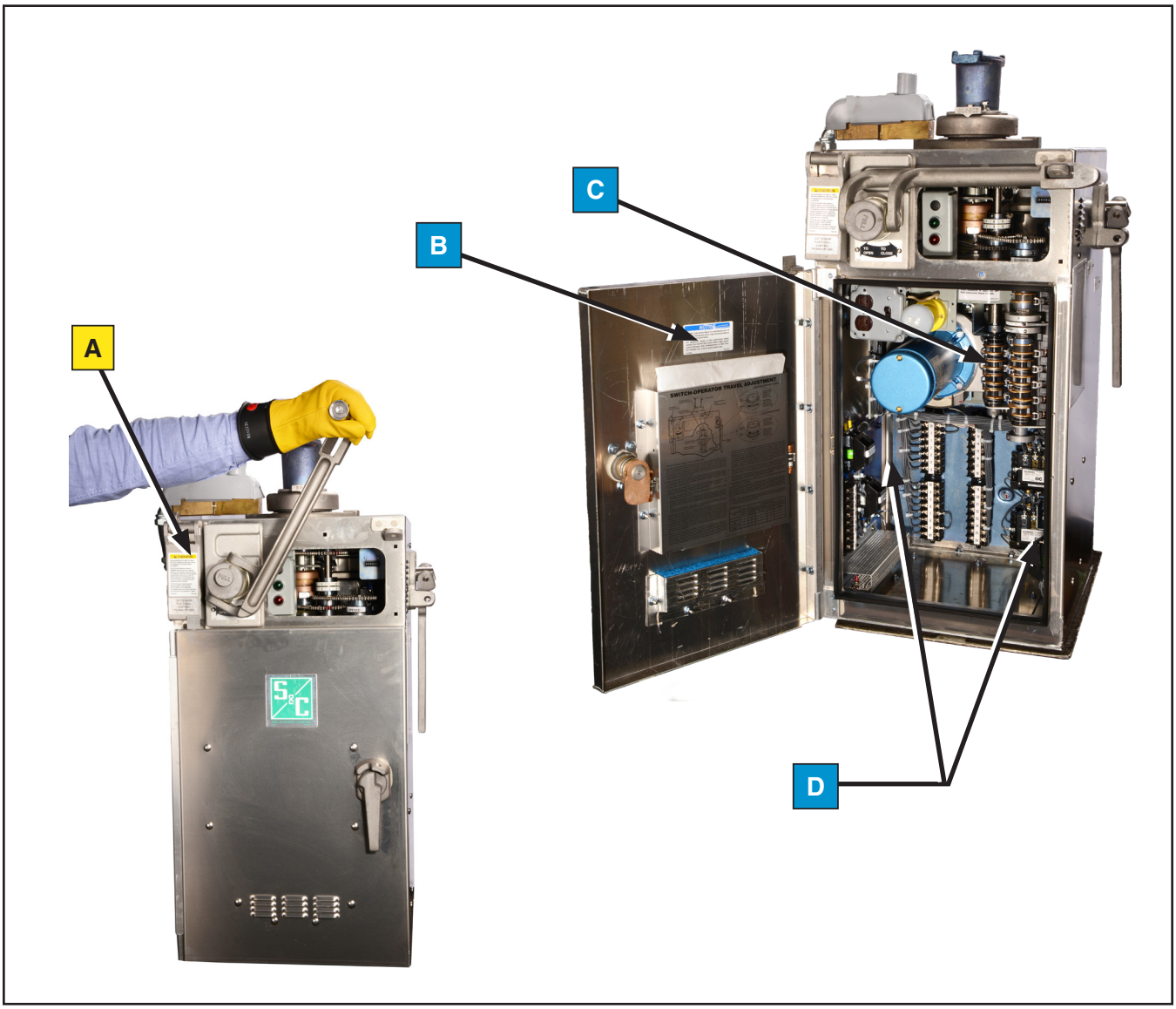
Read this instruction sheet thoroughly and carefully before installing the Type CS-1A Switch Operator.

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 Circuit-Switcher....	G-4527R3
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-4746R2
D	*NOTICE*	This contactor or relay has been blocked to prevent damage during shipment.	G-3684●

● One removable label per contactor or relay. Remove before operation.

⚠ 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 company 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 of the circuit-switcher 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 vertical operating shaft above the Type CS-1A 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. **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 is stored in a water-resistant envelope attached to the interrupter container on one of the three circuit-switcher pole-units. If the Mark V Circuit-Switcher has had a Type CS-1A Switch Operator specified for the installation, 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 CS-1A 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 CS-1A 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 Type CS-1A Switch Operator is a high-speed operator expressly designed for power operation of the Mark V Circuit-Switcher. Use Table 1 to identify the associated wiring diagram that should be consulted for the model of switch operator being installed. Check the catalog number on the switch operator to see that it is the correct operator for the installation before starting the installation. Become familiar with the parts of the switch operator as shown in Figures 2 and 3 on pages 8 and 9 and Figure 4 on page 10.

⚠ WARNING

Unauthorized changes should not be made to the wiring of the Type CS-1A Switch Operator. Should a control-circuit revision appear desirable, it should be made ONLY on the authority of a revised wiring diagram that has been approved by both the user and S&C Electric Company. Unauthorized changes may make the function of the operator unpredictable, causing damage to the operator, associated Mark V Circuit-Switcher, and possible serious personal injury.

Table 1. Switch Operators—Type CS-1A

Application		Motor and Control Voltage	Maximum Operating Time, Seconds①	Minimum Locked-Rotor Torque at Rated Control Voltage, Inch-Lbs.	Accelerating Current, Amperes	Catalog Number	Schematic Wiring Diagram Drawing Number
High-Voltage Device	Style and Rating of High-Voltage Device						
Mark V Circuit-Switcher without shunt trip device	Integer,34.5 kV thru 69 kV Vertical-Break,34.5 kV thru 161 kV Center-Break,230 and 345 kV, 3 gaps	48 Vdc	1.5	21 500	80	38845R4-A	CDR-3112R2
		125 Vdc		21 500	30	38845R4-B	CDR-3112R2
		115 V 60 Hz		18 000	46	38845R4-D	CDR-3123R2
Mark V Circuit-Switcher with shunt-trip device	Integer,34.5 kV thru 69 kV Vertical-Break,34.5 kV thru 161 kV Center-Break, 230 and 345 kV,3 gaps	48 Vdc		21 500 21 500	80	38846R5-AHP	CDR-3183
		125 Vdc		21 500 21 500	30	38846R5-B●	CDR-3184●

① Based on minimum battery and external control wire size requirements specified in S&C Data Bulletin 719-60; operating time will be less if a larger than minimum battery size and/or external control wire size is used.

● Catalog number 38858R1-B is used for applications where the circuit-switcher is to be used in conjunction with an S&C Automatic Control Device unless the switch operator is ordered with the optional shunt-trip contactor and time-delay relay accessory, catalog number suffix "-HP." In this instance, catalog number 38846R5-BHP will be specified. CDR-3183 is used for catalog number 38846R5-BHP. CDR-3195 is used for catalog number 38858R1-B.

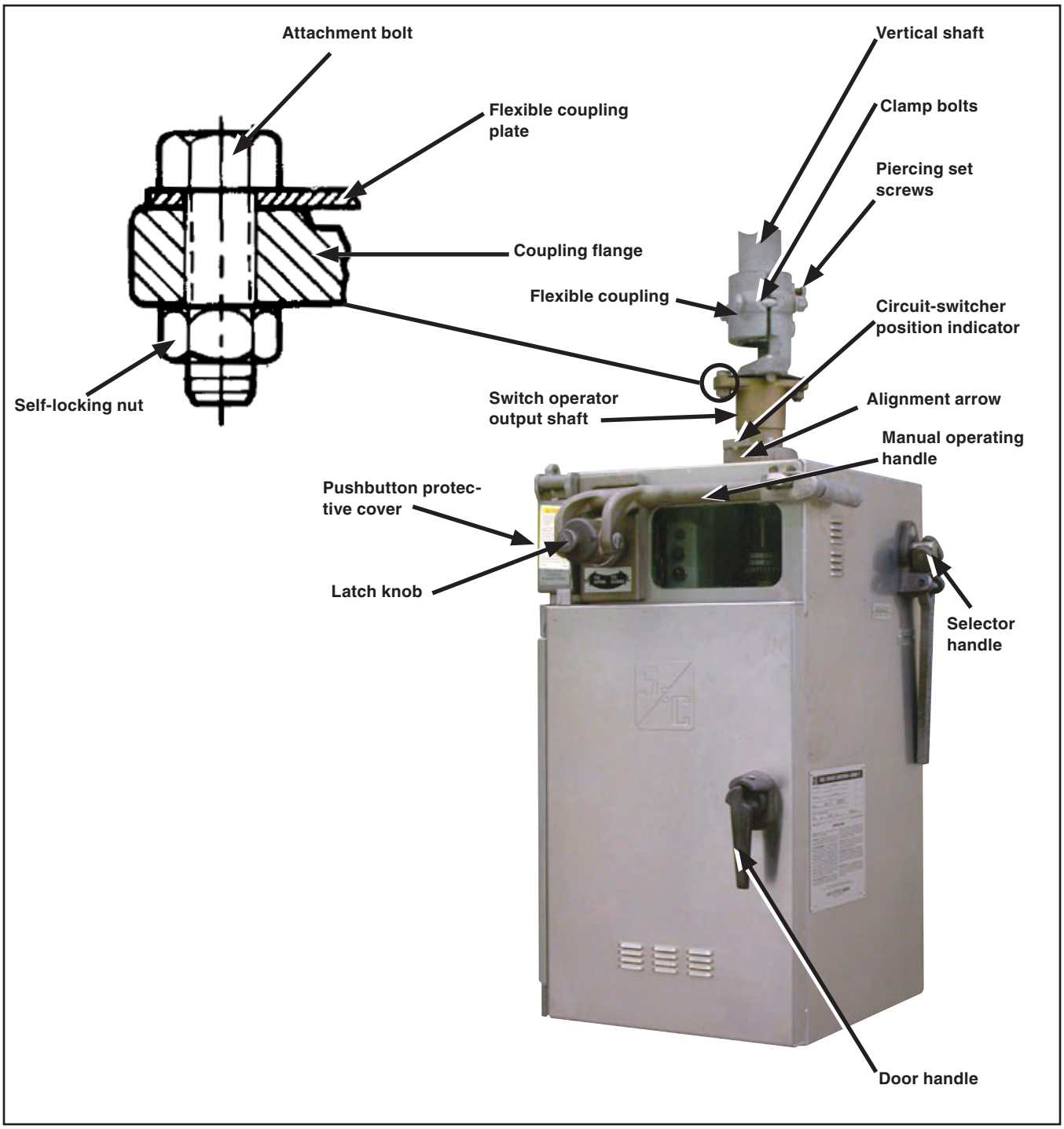


Figure 2. An external view of a Type CS-1A Switch Operator with the door closed.

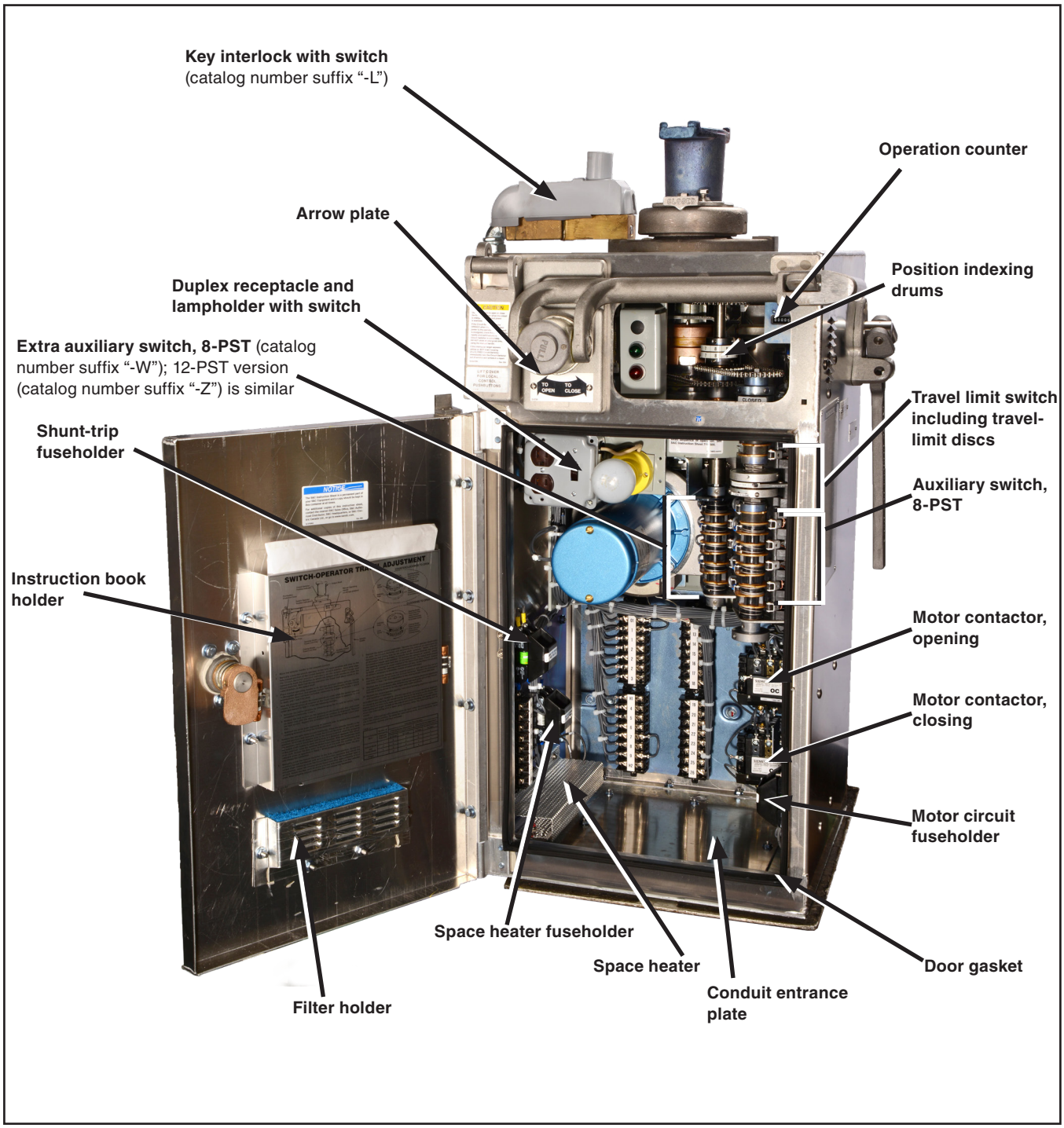


Figure 3. An interior view of a Type CS-1A Switch Operator with the door open.

Connecting the Switch Operator to the Circuit-Switcher Vertical Operating Shaft

Complete the following steps to connect the switch operator to the vertical operating shaft on the circuit-switcher:

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.

STEP 2. Attach a flexible coupling to the output shaft of the switch operator. See Figure 2 on page 8 and Figure 4. 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 attachment bolts.

STEP 3. Remove the clamp bolts and set aside the detachable half of the flexible coupling.

STEP 4. Make sure the cutting tips of the piercing set screws do not protrude through the body of the flexible coupling on the switch operator output shaft and the flexible coupling attached to the shaft extending from the gearbox on the circuit-switcher pole-unit base.

STEP 5. Install the vertical shaft between the flexible coupling that is attached to the shaft extending from the gearbox on the circuit-switcher pole-unit base and the flexible coupling attached to the switch operator output shaft. See Figure 4. At the gearbox end of the vertical shaft, tighten the flexible coupling 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 6. At the switch operator output shaft, replace the detachable half of the flexible coupling, but do not tighten the clamp bolts or the piercing set screws at this time.

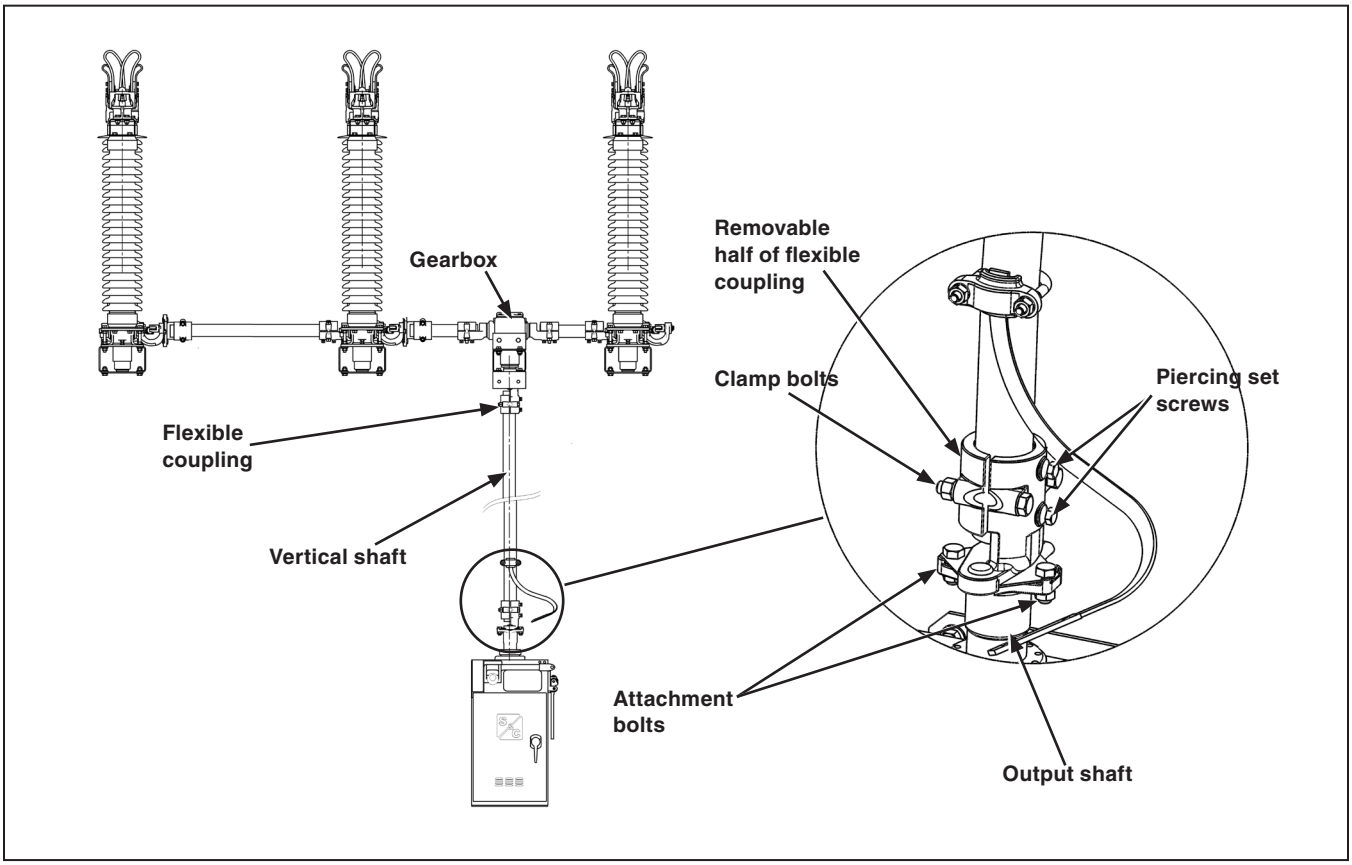


Figure 4. The connection between the circuit-switcher gearbox and the Type CS-1A Switch Operator.

Making Conduit Connections and Connecting External Control-Circuit Wiring

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, space-heater, and (if applicable) shunt-trip circuits. See Figure 3 on page 9. Reinsert the fuseholders only when indicated in the steps which follow.

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 on page 9.

STEP 2. Remove the conduit-entrance plate and cut out the necessary opening. (If the circuit-switcher is equipped with optional S&C Shunt-Trip Device, an entrance cutout for an additional one-inch conduit should also be made at this time.)

STEP 3. Replace the conduit-entrance 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. If the circuit-switcher is equipped with the optional shunt-trip device, install the one-inch-diameter conduit between adjacent shunt-trip solenoid housings and between one solenoid housing and the switch operator. Refer to S&C Instruction Sheet 711-600.

STEP 5. Remove the blocking labels (G-3684) 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

Observe recommended minimum wire size requirements for the control-circuit wiring and the shunt-trip device wiring where applicable, as shown in S&C Data Bulletin 719-60 and on the switch operator schematic wiring diagram furnished.

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-hand side of the enclosure.

⚠ WARNING

Manual closing of an energized circuit-switcher is not recommended because of the possibility of closing into a fault. Manual opening of an energized circuit-switcher is permissible. When the opening operation has been initiated, however, it should be completed quickly and without hesitation. Cranking should continue until the circuit-switcher is fully open, as indicated by resistance felt as the circuit-switcher power train progresses to its stops. As the circuit-switcher moves toward the **Open** position, the interrupters will close and the stored-energy source within the brains will charge and latch. The circuit-switcher disconnect blades should never be in the **Closed** position when the interrupters are in the **Open** position. **Manual closing of the circuit-switcher may cause arcing, equipment damage, and personal injury.**

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 2 on page 8 and Figure 5. (As the handle is pivoted forward and 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. However, the shunt-trip device, when this option is provided, remains operative unless the switch operator is in the **Open** position.

STEP 3. Crank the handle in the direction shown on the arrow plate for the **Open** position.

If desired, 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-hand inside wall of the enclosure. See Figure 3 on page 9. Likewise, the shunt-trip device may be rendered inoperative by removing the shunt-trip circuit two-pole pull-out fuseholder located on the left-hand inside wall of the enclosure.

Figure 5. Manual operation of the operating handle.

STEP 4. 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 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. However, if the switch operator and circuit-switcher are anywhere between the fully **Open** and fully **Closed** position when the manual operating handle is placed in the **Storage** position and the motor circuit fuseholder is inserted, the switch operator will automatically move to the **Open** position (because the switch operator control circuit is designed to allow an electrical closing only from the circuit-switcher's fully **Open** position).

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-hand side of the enclosure.

To decouple the switch operator from the circuit-switcher:

STEP 1. Swing the selector handle upright and slowly rotate it clockwise 50 degrees to the **Decoupled** position. See Figure 6. This decouples the switch operator mechanism from the switch operator output shaft.

STEP 2. Lower the selector handle to engage the locking tab. When thus decoupled, the switch operator may be operated either manually or electrically without operating the circuit-switcher.

When the selector handle is in the **Decoupled** position, the shunt-trip device (when this option is provided) is rendered inoperative.● Moreover, in the **Decoupled** position, the switch operator's output shaft is prevented from moving by a mechanical locking device located within 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 7 on page 15. The selector handle may be padlocked in either position.

Figure 6. Selector handle operation (side view).

● Only the shunt-trip device is rendered inoperative. The switch operator can still be opened through the user's protective-relay circuit. Thus "elective" checkout of the system protective scheme is possible at any time.

To couple the switch operator to the circuit-switcher:

STEP 1. Manually operate the switch operator to bring it to the same position (**Open** or **Closed**) as the circuit-switcher. The switch operator position indicator, seen through the observation window, will show when the approximate **Open** or **Closed** position has been attained. (The position indicator for the circuit-switcher, 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 to move the switch operator to the exact position for coupling. See Figure 7.

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.

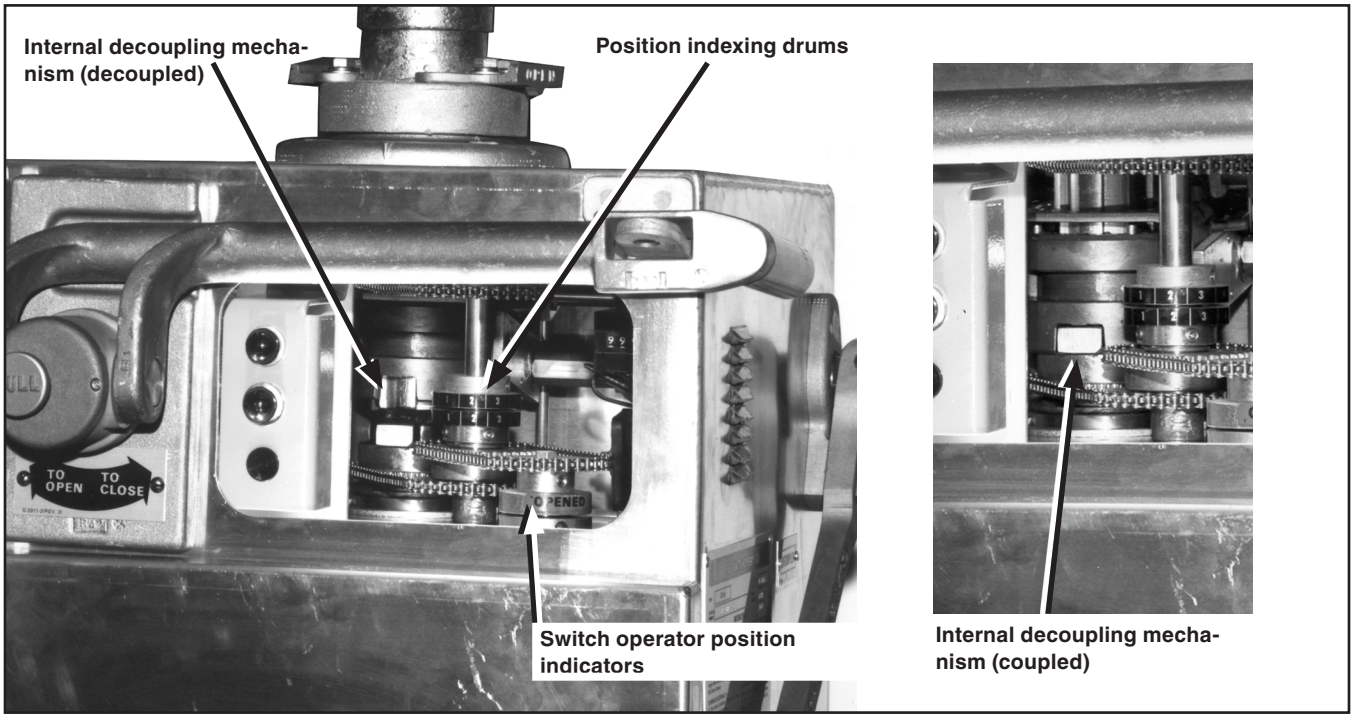


Figure 7. The internal decoupling mechanism viewed from the observation window.

Adjusting Position Indicator and Cranking Direction

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, space-heater, and (if applicable) shunt-trip circuits. See Figure 3 on page 9. Reinsert the fuseholders only when indicated in the following steps.

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

STEP 1. Manually operate the switch operator to bring it to the same position (fully **Open** or fully **Closed**) as the circuit-switcher. Tighten the flexible coupling 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 8.

STEP 2. With the selector handle in the **Coupled** position, crank the circuit-switcher to the fully **Open** position and then to the fully **Closed** position, and in each position accurately align the mechanical circuit-switcher position indicators on the output-shaft collar of the switch operator with the alignment arrow. See Figure 9.

STEP 3. Check the drive-shaft crank of each pole-unit of the circuit-switcher to determine it is in an **Overtoggle** position and against its open or closed stop at the fully **Open** or fully **Closed** position of the switch operator.

STEP 4. The cranking direction to close the circuit-switcher is indicated by an arrow plate located near the hub of the manual operating handle. See Figure 3 on page 9. 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.

Verify these rotation directions are correct as follows:

(a) With the selector handle in the **Coupled** position, manually crank the circuit-switcher to the fully **Open** position and then to the fully **Closed** position. Temporarily mark on the top of the switch operator enclosure the direction in which the output shaft rotates to close the circuit-switcher.

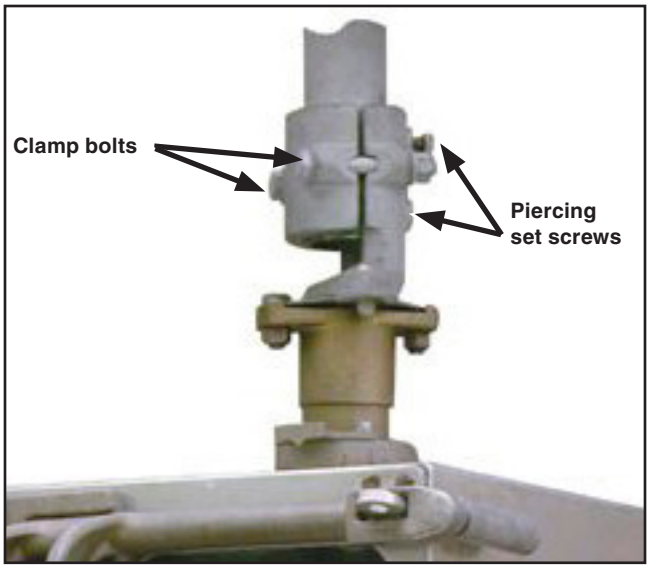


Figure 8. Tighten the clamp bolts and piercing set screws.

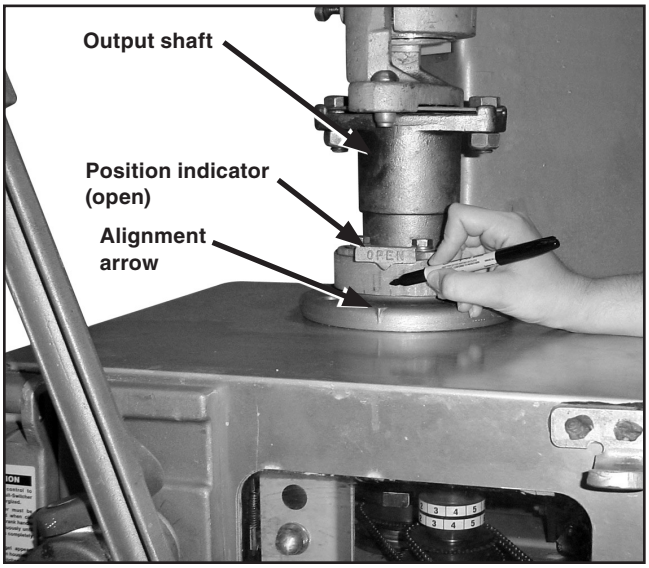


Figure 9. Adjust the position indicator. Mark the direction of operator rotation.

(b) If the cranking direction required to close the circuit-switcher is opposite to that indicated by the arrow plate, remove the arrow-plate mounting screws and remount the arrow plate, exposing its opposite side.

(c) 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 by means of the externally mounted OPEN/CLOSE pushbuttons, 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 discs rotate when the switch operator closes. The direction should agree with the temporary direction mark previously made on the top of the enclosure and with the direction displayed in the cutaway section on the outer ring of the travel-limit discs. See Figure 10 on page 18. (The rotation direction of the travel-limit discs is always the same as the output shaft rotation direction.

(d) If the direction of the travel-limit disc rotation noted in Step 4(c) is opposite to the temporary direction mark previously made in Step 4(a), 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: Reversing the motor direction reverses only the rotation direction of the output shaft and travel-limit discs. The identity of the opening-stroke and closing stroke travel-limit discs (to be adjusted later) will remain unaffected.

(e) In the event that the rotation direction of the travel-limit discs noted in Step 4(c) is opposite to the direction displayed in the cutaway section on the outer ring of the closing-stroke travel-limit disc, remove the positioning screws on the outer ring of the closing-stroke travel-limit disc. See Figure 10 on page 18. Rotate the outer ring until the desired direction is displayed in the cutaway section. Replace the positioning screws.

(f) Reinsert the motor-circuit fuseholder and operate the switch operator to the **Open** position.

(g) If the output-shaft rotation direction to open the circuit-switcher is opposite to that displayed in the cutaway section on the outer ring of the opening-stroke travel-limit disc, change the direction displayed as indicated in Step 4(e).

● For switch operators with 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.

Table 1. Initial Adjustment of Travel-Limit Discs

Circuit-Switcher Style	Number of Interrupter Gaps per Pole-Unit	Indicator Plate Number			
		Opening-Stroke Adjustment		Closing-Stroke Adjustment	
		Clockwise to Open	Counterclockwise to Open	Clockwise to Close	Counterclockwise to Close
Vertical break and center break	1	5	5	5	5
	2	6	4	5	5
	3	7	3	5	5
Integer	1	4	6	5	5

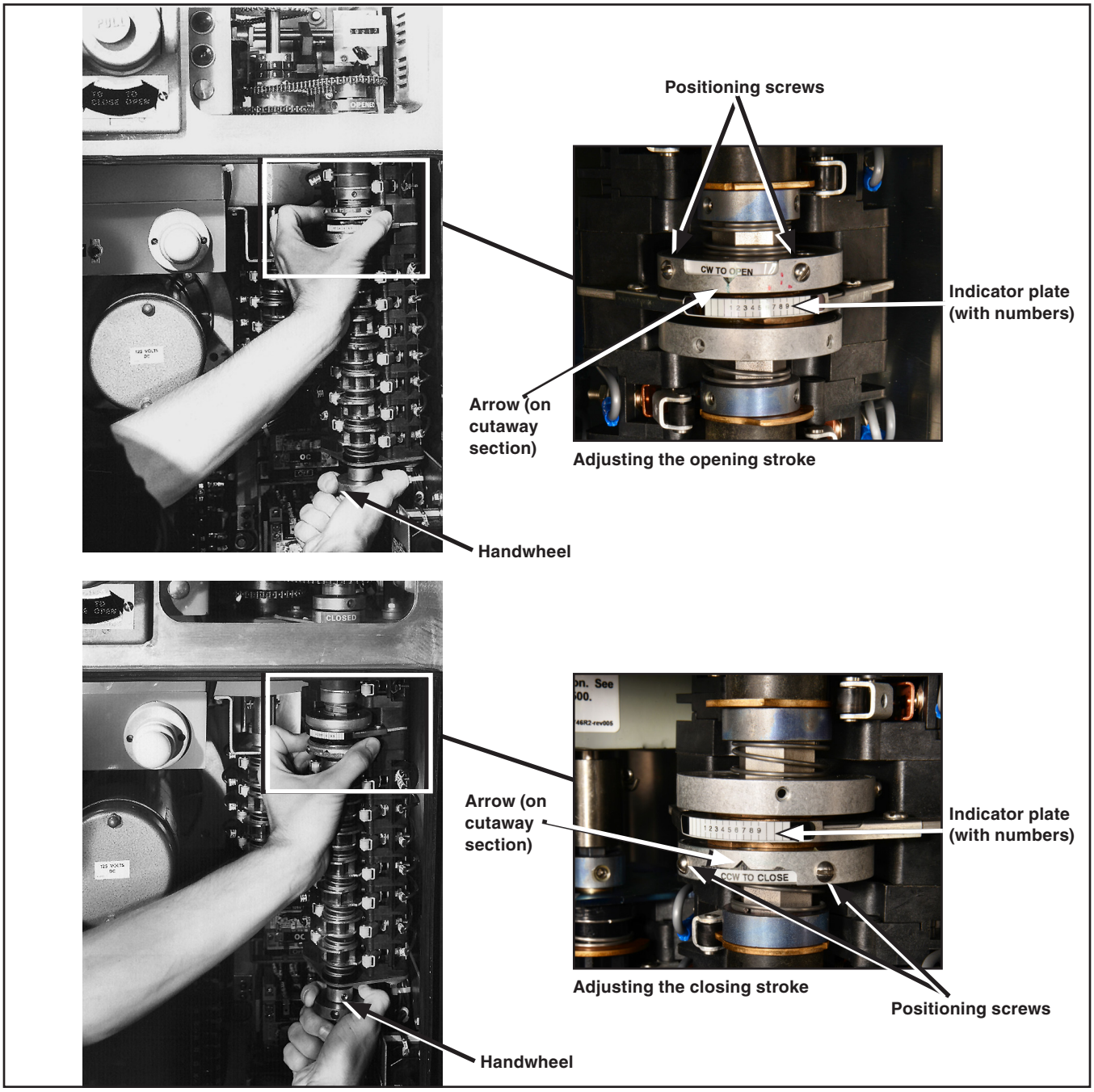


Figure 10. Adjusting the travel limit discs on the travel limit switch.

Adjusting the Travel-Limit Discs

The **Travel Limit** switch (coupled to the motor) that governs the extent of output-shaft rotation in the opening and closing directions includes six contacts operated by cam-actuated rollers. Positioning the cams to properly engage the rollers is facilitated by the travel-limit discs (the upper one is the opening stroke travel-limit disc; the lower one is the closing-stroke travel-limit disc.

Complete the following steps to adjust the travel-limit discs:

STEP 1. Adjustment of the opening-stroke travel-limit disc (and therefore the associated cams) is accomplished as follows:

(a) Remove the motor-circuit fuseholder. See Figure 3 on page 9.

(b) Place the selector handle in the **Coupled** position and manually crank the circuit-switcher to the **Open** position.

(c) For the circuit-switcher style installed and its number of interrupting gaps per pole-unit, determine from Table 1 on page 18 the indicator plate number to which the opening-stroke travel-limit disc is to be rotated. Select the indicator plate number from the "Opening-Stroke Adjustment-Clockwise to Open" column if the disc and output shaft rotate in the clockwise direction to open the circuit-switcher, or from the "Opening-Stroke Adjustment-Counterclockwise to Open" column if the disc and output shaft rotate in the counterclockwise direction to open the circuit-switcher.

(d) Grasp the handwheel and turn it to the extent possible in a direction opposite to the direction the output shaft rotates to open the circuit-switcher. See Figure 10 on page 18.

(e) With the handwheel held in the position indicated above, raise the opening-stroke travel-limit disc approximately 3⁄16 of an inch (5 mm) and rotate the disc until the arrow on its outer ring is in line with the number on the indicator plate as specified in Table 1. Lower the disc, make sure it is engaged, and release the handwheel. See Figure 10 on page 18.

STEP 2. Adjustment of the closing-stroke travel-limit disc (and therefore the associated cams) is accomplished as follows:

(a) Manually crank the circuit-switcher to the fully **Closed** position.

(b) Grasp the handwheel and turn it to the extent possible in a direction opposite to the direction the output shaft rotates to close the circuit-switcher. See Figure 10 on page 18.

(c) With the handwheel held in the position indicated above, lower the closing-stroke travel-limit disc approximately 3⁄16 of an inch (5 mm) and rotate the disc until the arrow on the outer ring is in line with the number 5 on the indicator plate. Raise the disc, make sure it is engaged, and release the handwheel.

STEP 3. After adjusting the travel-limit discs, check the following:

(a) Place the selector handle in the **Decoupled** position.

(b) Return the manual operating handle to its **Storage** position.

(c) Reinsert the motor-circuit fuseholder.

(d) Operate the switch operator electrically to open and to close as described in Step 4(c) on page 17. Verify the rotation direction of the travel-limit discs for opening and closing corresponds with the rotation direction of the output shaft and these directions agree with the direction displayed in the cutaway section on the outer ring of the travel-limit discs.

Note: When electrical operation is performed under the **Decoupled** or "no load" condition, the travel limit discs do not stop at the indicator plate positions for which they were previously set in Steps 1 and 2. This may be disregarded.

STEP 4. There should always be a certain amount of "unwind" or relaxation of the output shaft (in

both the **Open** and **Closed** positions) to indicate the circuit-switcher has been driven to a positive-toggle position against its open (or closed) stops.

(a) Place the selector handle in the **Coupled** position. Operate electrically to open the circuit-switcher and determine the amount of overtravel in the opening direction by releasing the motor brake and noting how far the output shaft "unwinds."

NOTICE

Before checking the "unwind" after a closing stroke, remove the motor-circuit fuseholder before releasing the motor brake. Excessive "unwind" at this point could cause travel-limit switch rotation sufficient to pick up a "bb" contact that, in turn, would cause the switch operator to open (if energized).

(b) Release the motor brake by unlatching the manual operating handle and pivoting it rapidly, with a snap motion, toward its **Cranking** position. Then, return the manual operating handle to its **Storage** position.

(c) If adjustment is needed, remove the motor-circuit fuseholder. To increase the amount of "unwind," move the opening stroke travel-limit disc (to increase travel) one indicator plate number at a time. See Figure 11 on page 21.

Note: The direction of disc rotation is always the same as that of the output shaft. The output shaft should never have sufficient "unwind" when the switch operator is decoupled to cause travel limit disc rotation. If travel-limit disc rotation is evident, advance the opening-stroke travel-limit disc (to decrease travel) an amount necessary only to eliminate the "unwind" rotation of the travel-limit discs.

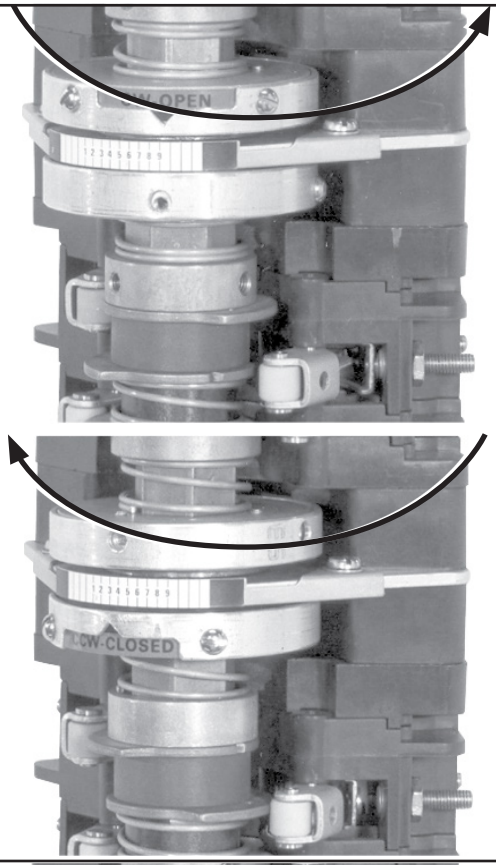
STEP 5. With the manual operating handle in its **Storage** position, reinsert the motor-circuit fuseholder, and operate the switch operator electrically to close the circuit-switcher. Repeat the procedure, as described in Step 4 and in Figure 11, and adjust the closing-stroke travel-limit disc one indicator plate number at a time to obtain the correct amount of overtravel in the closing direction.

STEP 6. Operate the circuit-switcher several times electrically with the switch operator and observe the action. Operation should appear smooth, with the circuit-switcher drive-shaft cranks coming to rest firmly against their stops, in an **Overtoggle** position, in both opening and closing directions.

Use when the output shaft and travel-limit disc rotation direction is clockwise to open.

Opening-stroke travel-limit disc
(With the circuit-switcher and switch operator in the fully **Open** position, raise and turn counterclockwise to increase travel of switch operator.)

Closing-stroke travel-limit disc
(With the circuit-switcher and switch operator in the fully **Closed** position, lower and turn clockwise to increase travel of switch operator.)



Use when direction of output shaft and travel-limit disc rotation is counterclockwise to open.

Opening-stroke travel-limit disc
(With the circuit-switcher and switch operator in fully **Open** position, raise and turn clockwise to increase travel of switch operator.)

Closing-stroke travel-limit disc
(With the circuit-switcher and switch operator in fully **Closed** position, raise and turn counterclockwise to increase travel of switch operator.)

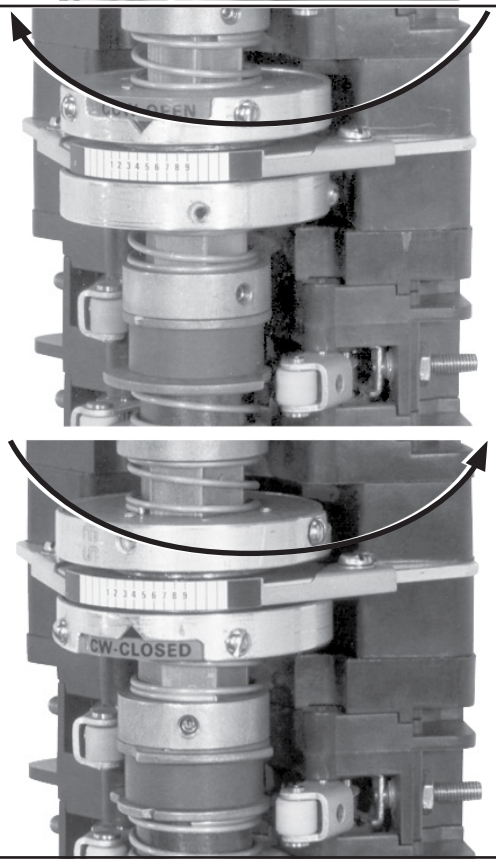


Figure 11. Adjusting the travel-limit discs for the desired "unwind" of the output shaft.

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 terminals 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 and can be positioned so roller engagement occurs at the desired point in the operating cycle.

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 switch operator in the **Open** position, the "a1" contacts are open and the "b1" contacts are closed. Conversely, with the switch operator 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. Conversely, a contact is open if its roller is engaged by a cam. See Figures 12 and 13.

Any auxiliary-switch contact being used must be checked for proper operation after the switch operator travel-limit discs have been adjusted. Check the auxiliary-switch contacts for both **Open** and **Closed** positions of the switch operator. To adjust the auxiliary switch contacts, refer to Figures 12 and 13 and Figure 14 on page 24 and proceed as follows:

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 that the cam is disengaged from the roller.

STEP 5. Reinsert the motor-circuit fuseholder.

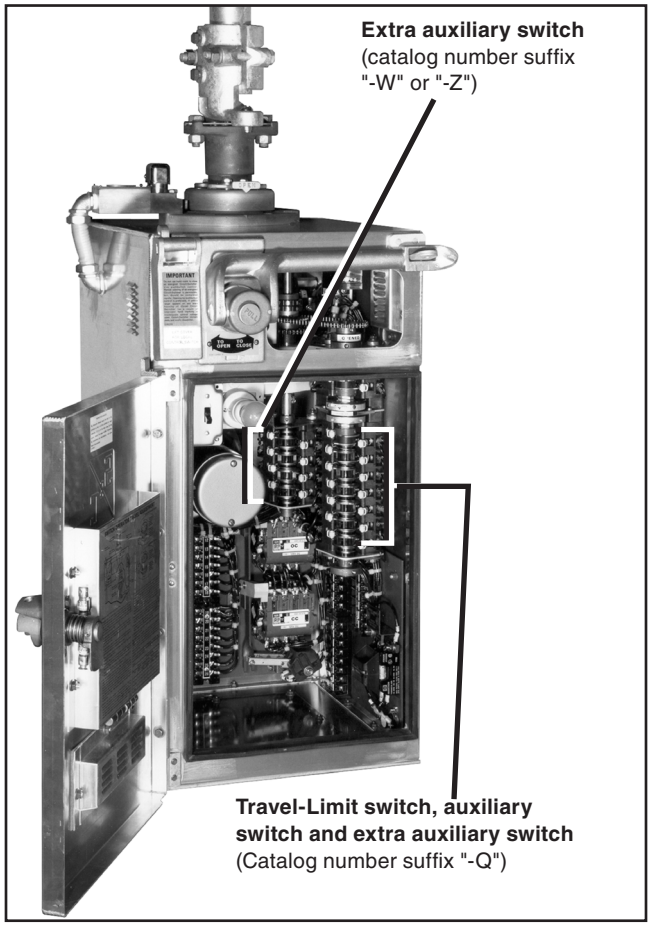


Figure 12. Open front view of switch operator "standard" contact configuration.

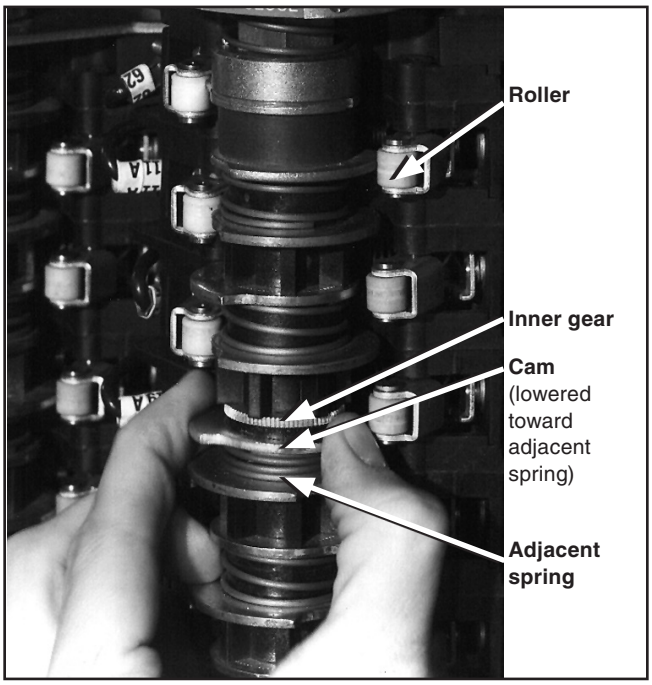


Figure 13. Adjustment of cams on auxiliary switch.

STEP 6. Operate the switch operator to the fully **Open** position. Remove the switch-circuit fuseholder and, if necessary, adjust the cams as described in Step 4 until all "b1" contacts are in the **Closed** position.

STEP 7. Reinsert the motor-circuit fuseholder and operate the circuit-switcher. Both sets of contacts should now be correctly positioned for both the **Open** and **Closed** positions of the circuit-switcher. Sufficient adjustment is available to provide correct positioning of both sets of contacts.

Because each cam can be individually adjusted in 4.5-degree increments, any "al" 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 for other than the "standard" contact 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 as described in Steps 1 through 6. See Figures 12 and 13 on page 22 and Figure 14 on page 24.)

STEP 8. Reinsert the fuseholders for the motor, space-heater, and (if applicable) shunt-trip circuits.

About the Extra Auxiliary Switches

Switch operators having catalog numbers with either the suffix "-W" or "-Z" are equipped with an extra auxiliary switch coupled to the circuit-switcher. 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 circuit-switcher 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 circuit-switcher in the fully **Closed** position, the "a2" contacts should be closed and the "b2" contacts should be open. Conversely, with the circuit-switcher in the fully **Open** position, the "a2" contacts should be open and the "b2" contacts should be closed. See Figure 15 on page 25.

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

Adjustment of the suffix "-W" or "-Z" extra auxiliary switch is identical to the adjustment performed for the auxiliary switch and the suffix "-Q" extra 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 22 and Figures 12 through 15 on pages 22 through 25.

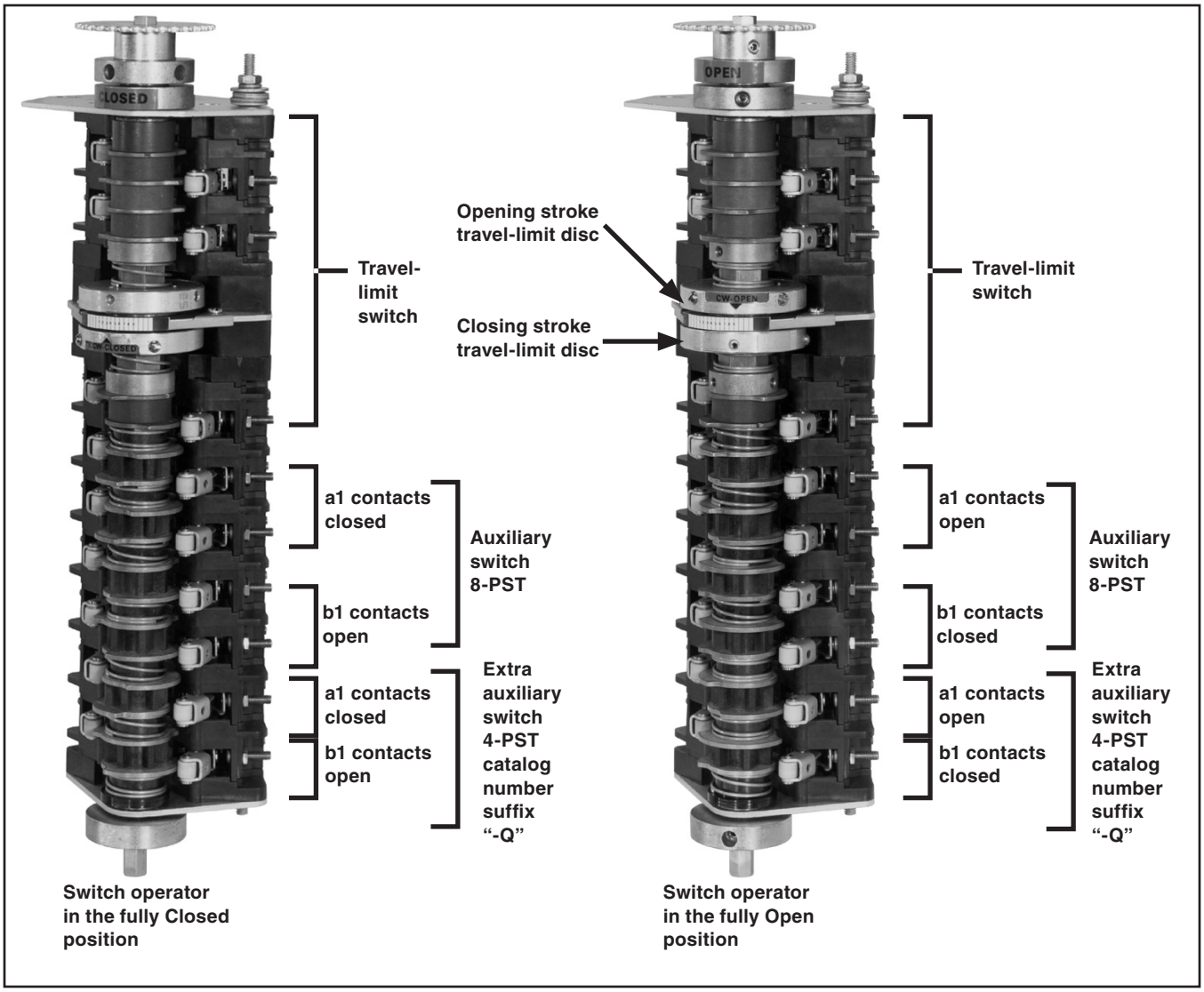


Figure 14. Details of travel-limit switch's auxiliary switch and extra auxiliary switch.

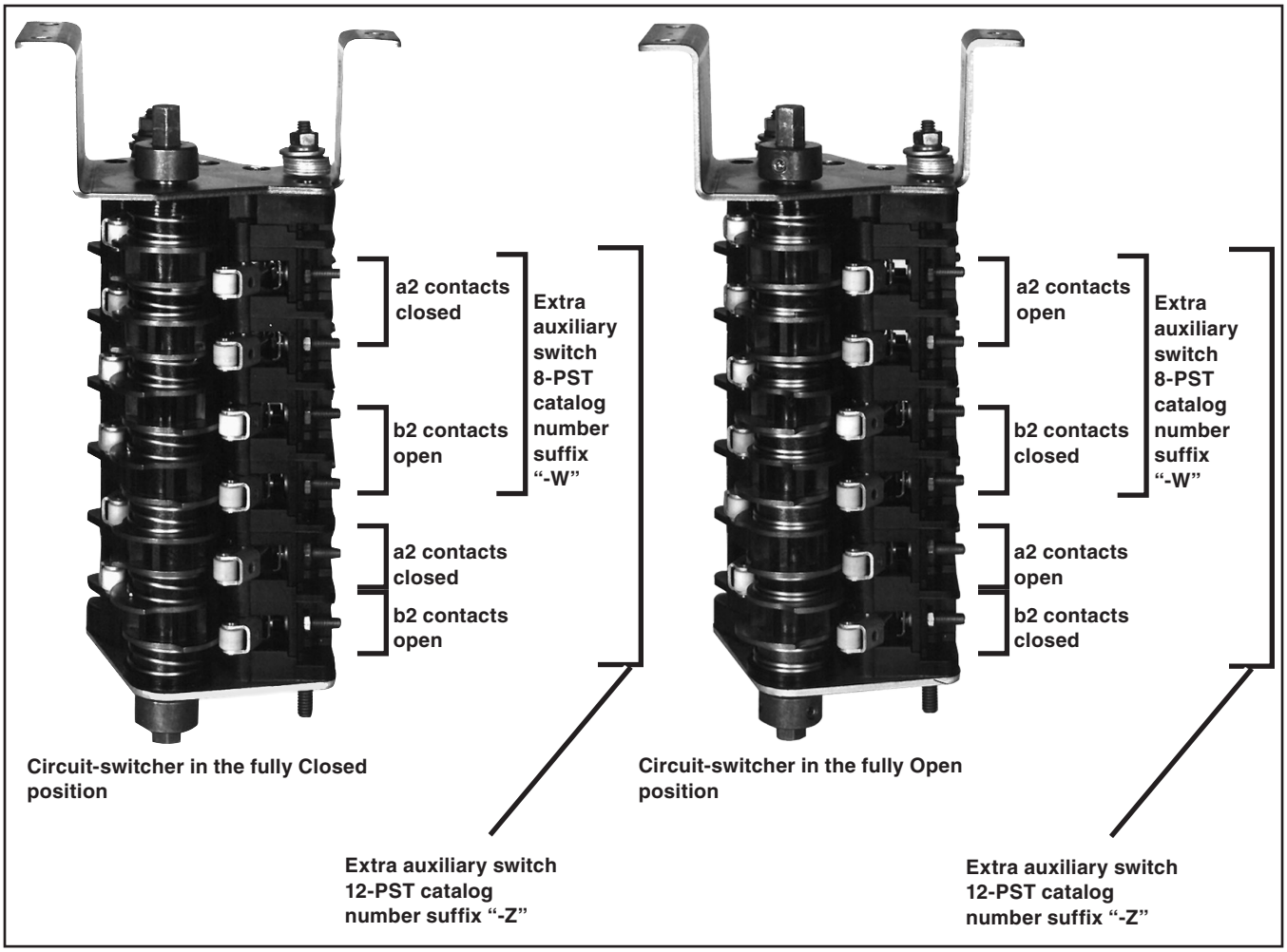


Figure 15. Details of the extra auxiliary switch.