

INSTRUCTIONS

For Operation

INTRODUCTION

CAUTION: The equipment covered by this publication must be 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.

The S&C Switch Operator—Type CS-10 is a high-speed operator, with an operating time of 1.5 seconds maximum. It is expressly designed for power operation of S&C Circuit-Switchers—Type A and Type G, Vertical-Break Style, having reciprocating operating mechanisms, as indicated in the table below.

For S&C Circuit-Switchers having rotating type operating mechanisms, the S&C Switch Operator—Type CS-1A is required, except for 6-gap S&C Circuit-

Switchers, for which the S&C Switch Operator—Type CS-2A is required.

For S&C Alduti-Rupter® Switches—Outdoor Distribution and S&C Alduti-Rupter Switches with Power Fuses—Outdoor Distribution, S&C Switch Operators—Type AS-1A and Type AS-10 are offered for use with rotating or reciprocating operating mechanisms, respectively.

For S&C Line-Rupters™, the S&C Switch Operator—Type LS-2 is available.

For switches of other manufacture, the S&C Switch Operator—Type LS-1 is available. The LS-1 is a low-speed operator, with an operating time of 4 to 7 seconds. It is designed for power operation of outdoor high-voltage disconnects and interrupter switches for which this low operating speed is appropriate.

SWITCH OPERATORS—Type CS-10

Application		Motor and Control Voltage	Operating Lever		Maximum Operating Time, Seconds ^②	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		Sector ^①	Length, Inches					
S&C Circuit-Switcher without Shunt-Trip Device	Type A Vertical-Break, 34.5 thru 138 kv	48 v dc	LH	6 ¹³ / ₁₆	1.5	21 500	80	38860R4-A	CDR-3112R2
		125 v dc	LH	6 ¹³ / ₁₆	1.5	21 500	30	38860R4-B	
		115 v 60 hz	LH	6 ¹³ / ₁₆	1.5	18 000	46	38860R4-D	
		230 v 60 hz	LH	6 ¹³ / ₁₆	1.5	18 000	23	38860R4-E	
	Type G Vertical-Break, 34.5 thru 161 kv	48 v dc	LH	4%	1.5	21 500	80	38861R4-A	CDR-3112R2
		125 v dc	LH	4%	1.5	21 500	30	38861R4-B	
		115 v 60 hz	LH	4%	1.5	18 000	46	38861R4-D	
		230 v 60 hz	LH	4%	1.5	18 000	23	38861R4-E	
S&C Circuit-Switcher with Shunt-Trip Device	Type G Vertical-Break, 34.5 thru 161 kv	48 v dc	LH	6 ¹³ / ₁₆	1.5	21 500	80	38864R5-AHP	CDR-3185 CDR-3186■
		125 v dc	LH	6 ¹³ / ₁₆	1.5	21 500	30	38864R5-B	
		48 v dc	LH	4%	1.5	21 500	80	38865R5-AHP	CDR-3185 CDR-3186■
		125 v dc	LH	4%	1.5	21 500	30	38865R5-B	

① Operating lever travels in left-hand or right-hand sector as indicated, viewed from front (door side) of switch operator. Operating lever in the "Up" position corresponds to the "Closed" position of the Circuit-Switcher.

② Based on minimum battery and external control wire size requirements specified in S&C Data Bulletin 719-60; operating time will be less if larger-than-minimum battery size and/or external control wire size is utilized.

■ CDR-3185 for Catalog Numbers 38864R5-BHP and 38865R5-BHP



S&C Switch Operators — Type CS-10

INTRODUCTION — Continued

S&C Switch Operators—Type CS-10 include the following features as standard:

- Built-in internal decoupling mechanism, operable by integral external selector handle, with padlocking provisions and automatic mechanical locking of output shaft. Laminated safety-plate window permits “visible air-gap” verification of complete disengagement of output shaft.
- Open-close pushbuttons, externally operable, with padlockable cover.
- Built-in nonremovable, foldaway manual operating handle
- Mechanical position indicators for switch operator “open” and “closed” positions.
- Non-reset electric operation counter.
- Laminated safety-plate window for inspection of built-in internal decoupling mechanism, mechanical position indicators, and operation counter (and position-indicating lamps, if furnished as accessories).
- Foolproof recoupling. Impossible with position-indexing drums to couple the switch operator and the Circuit-Switcher “unsynchronized.”
- Limits of output-shaft rotation factory adjusted.
- Eight-pole auxiliary switch, coupled to motor, with fingertip precision adjustment of individual contacts using self-locking spring-biased cams.
- Antifriction bearings throughout; tapered roller bearings for all high-torque gear-train shafts.

- Weatherproof, dustproof enclosure, equipped with 120/240-volt ac space heater, factory connected for 240-volt ac operation. Can readily be field reconnected for 120-volt ac operation.
- Tamper-resistant design—welded enclosure; baffled louvers; gasketed, flanged door opening; cam-action door latch; provisions for padlocking.
- Foul-weather accessibility to interior of enclosure. Access is by door rather than by removal of entire enclosure.
- Two-pole pull-out fuseholders for motor circuit and space-heater circuit.

Switch-operator catalog numbers are suffixed with one or more letters. The first letter following the catalog number designates the motor and control voltage:

Suffix	Voltage
-A	48 volts dc
-B	125 volts dc
-D [■]	115 volts, 60 hz
-E [■]	230 volts, 60 hz

■ Not applicable to Catalog Number 38864R5 or 38865R5.

Other suffix letters which may be added to the switch-operator catalog number indicate the inclusion of optional accessories as follows:

ACCESSORIES

Item	Suffix Added to Switch Operator Catalog Number
Shunt-Trip Contactor and Time-Delay Relay, minimize control-current inrush by energizing shunt-trip device and switch-operator motor in sequence ^①	-HP
Deletion of Externally Operable Open-Close Pushbuttons	-J
Space Heater Thermostat	-K
Key Interlock with Switch, locks Circuit-Switcher open and disconnects motor-control circuit	-L
Position-Indicating Lamps (one red, one green), mounted inside the enclosure	-M
Extra Auxiliary Switch (individually adjustable contacts), 4-PST (coupled to motor)	-Q
Duplex Receptacle and Convenience-Light Lampholder with Switch	-V
Extra Auxiliary Switch (individually adjustable contacts), 8-PST (coupled to Circuit-Switcher) ^②	-W
Remote-Control Blocking Switch, prevents remote operation of switch operator when the protective cover for the externally mounted open-close pushbuttons is open	-Y
Extra Auxiliary Switch (individually adjustable contacts), 12-PST (coupled to Circuit-Switcher) ^②	-Z

^① Available as an optional accessory only with S&C Switch Operator Catalog Numbers 38864R5-B and 38865R5-B; included as standard equipment with Catalog Numbers 38864R5-AHP and 38865R5-AHP. Permits use of minimum-size control wire.

^② The 8-PST Extra Auxiliary Switch (suffix “-W”) cannot be furnished if the 12-PST version (suffix “-Z”) is specified, and vice versa.



OPERATION

The instructions that follow are based on the assumption that the switch-operator operating lever has been connected to the Circuit-Switcher, that electrical connections to the control source have been completed, and that the switch operator has been correctly adjusted in accordance with S&C Instruction Sheet 719-520.

Do not assume that the switch-operator position necessarily indicates the open or closed position of the Circuit-Switcher. Upon completion of an opening or closing operation (electrical or manual), check to be sure that the following conditions exist:

- The switch-operator position indicator, Figure 5, signals "Open" or "Closed" to indicate that the switch operator has moved through a complete operation. Also note the position-indicating lamps, Figure 5, if furnished.
- The operating lever, at the rear of the switch operator, Figure 1, is in the "Up" position for a Circuit-Switcher "Closed" position. Conversely, the operating lever is in the "Down" position for a Circuit-Switcher "Open" position.
- The Circuit-Switcher disconnect blade on each pole-unit is fully open or fully closed.

Then tag and padlock the switch operator in accordance with standard system operating procedures. In all cases, make certain that the switch operator is padlocked before "walking away."

Correct operation of the Circuit-Switcher depends on charging and latching the stored-energy source within each brain as the disconnect blades move to the fully open position and the interrupters close. The interrupter target located on the side of each brain housing appears yellow when the interrupters are open. The target appears gray (normal) when the interrupters are closed.

Because the interrupters are closed as the Circuit-Switcher blades move to the fully open position, the

target appears yellow only briefly during the opening operation. The target should never appear yellow when the Circuit-Switcher is in the fully open or fully closed position.

CAUTION: When in service, interrupters should *never* be open while the blades are in the closed position. To close the interrupters, Circuit-Switcher must be completely opened and then reclosed. For this reason, the switch operator incorporates a control circuit that causes the switch operator to return automatically to the open position whenever power is restored while the switch operator is at any position between fully open and fully closed. Such action takes place regardless of the direction in which it was operating prior to loss of voltage. This control circuit is a built-in feature to prevent Circuit-Switcher from being closed from a partially open position after the interrupters have tripped open.

Electrical Operation

To open or close the Circuit-Switcher electrically, unlock and lift the external pushbutton protective cover.* Then press the appropriate pushbutton.† See Figure 2.

Alternatively, the switch operator may be activated by operating associated, remotely located control switches. (No instructions are included for activating the switch operator by means of remotely located control switches because control schemes vary with different installations. With any given installation, however, it may be possible and desirable to effect such operation. Instructions presented herein cover operation at the switch operator only.)

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

† Open-close pushbuttons are not included on switch operators specified with catalog number suffix "-J"



S&C Switch Operators — Type CS-10

OPERATION — Continued

Manual Operation

The switch operator can be operated manually to open or close the Circuit-Switcher.

CAUTION: 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. Once the opening operation has been initiated, however, it should be completed with dispatch. Cranking should continue until the Circuit-Switcher is fully open, as indicated by resistance which will be felt as the Circuit-Switcher power train progresses to its stops. As the Circuit-Switcher moves toward the open position, the inter-

rrupters 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. If the Circuit-Switcher is equipped with a control unit, it will not be possible to close the Circuit-Switcher without first moving it to the fully open position.

To open or close the Circuit-Switcher manually, pull the latch knob on the hub of the manual operating handle and pivot the handle forward slightly from its storage position. Release the latch knob while continuing to pivot the handle forward to lock it into the cranking position. See Figures 1 and 3. (As the handle

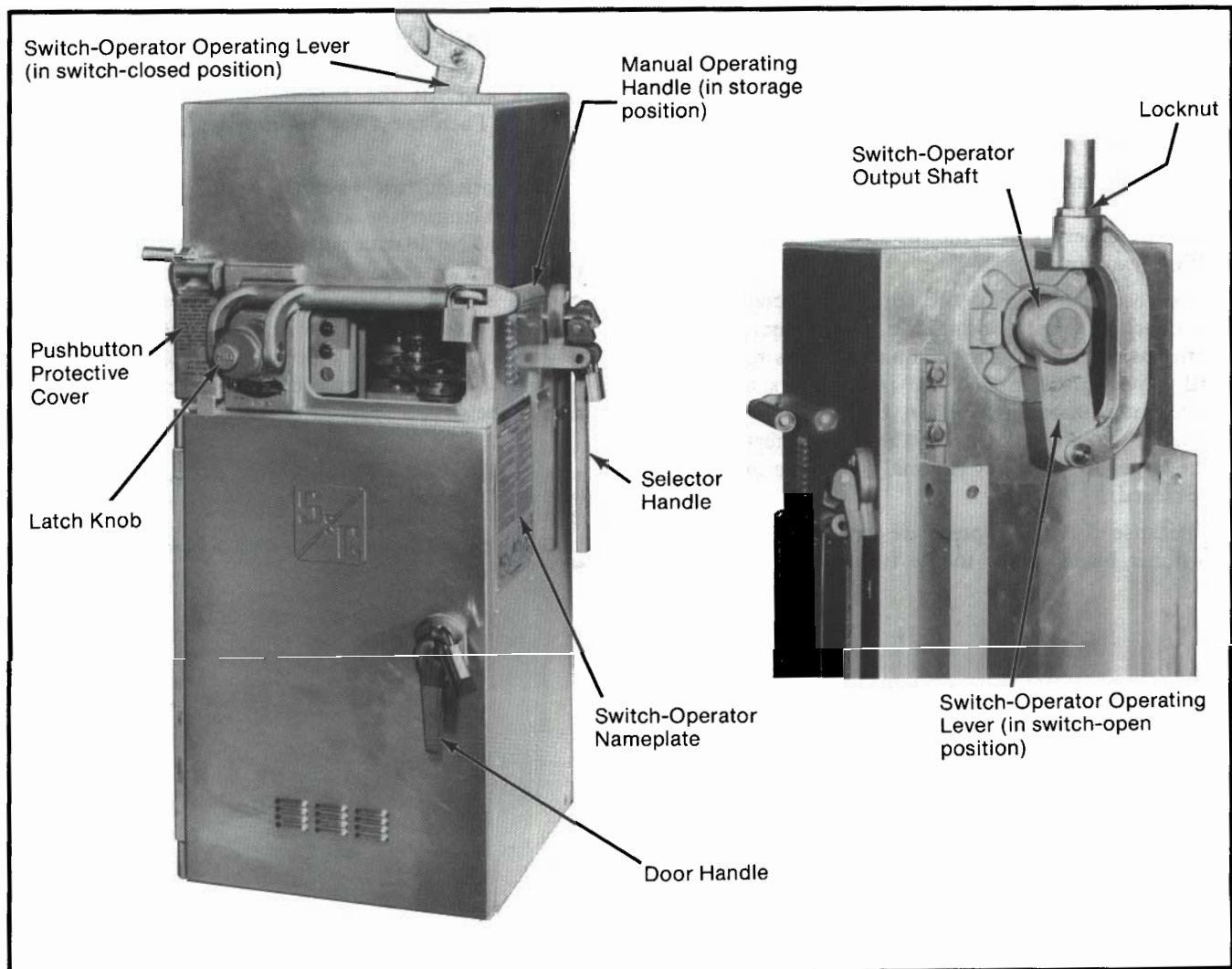


Figure 1. Exterior views of switch operator.

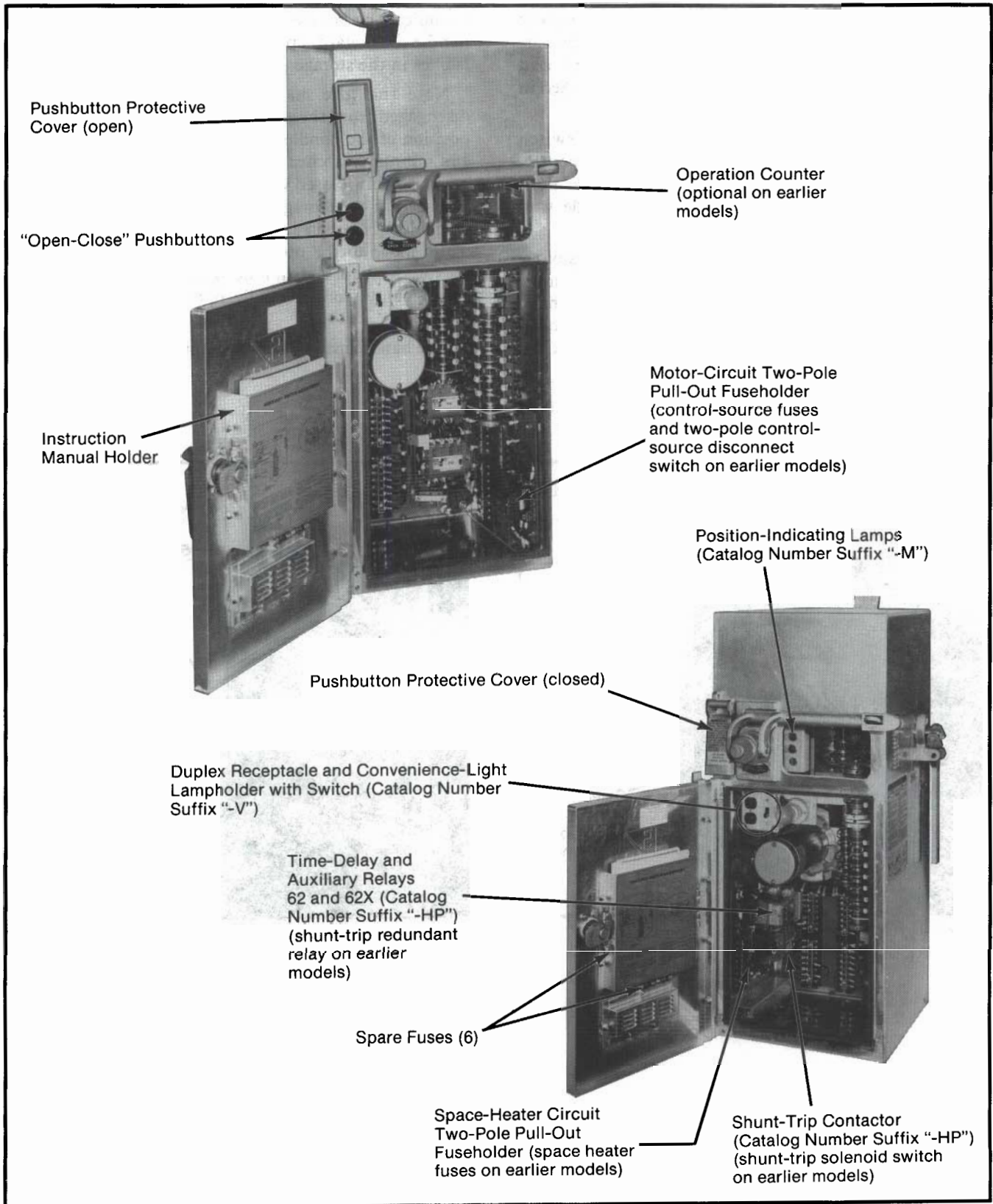


Figure 2. Interior views of switch operator.

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OPERATION — Continued

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.)

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.

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 that 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 at any position between fully open and fully closed 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 fully open position of Circuit-Switcher).

The handle may be padlocked in its storage position.

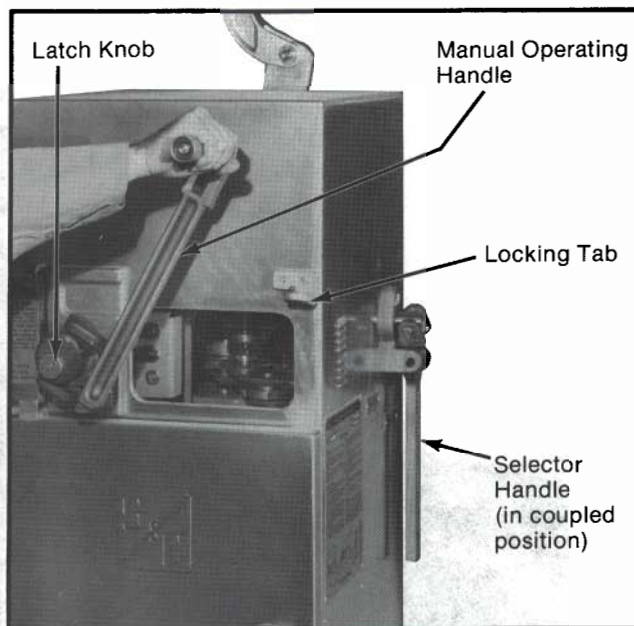


Figure 3. Manual operation.

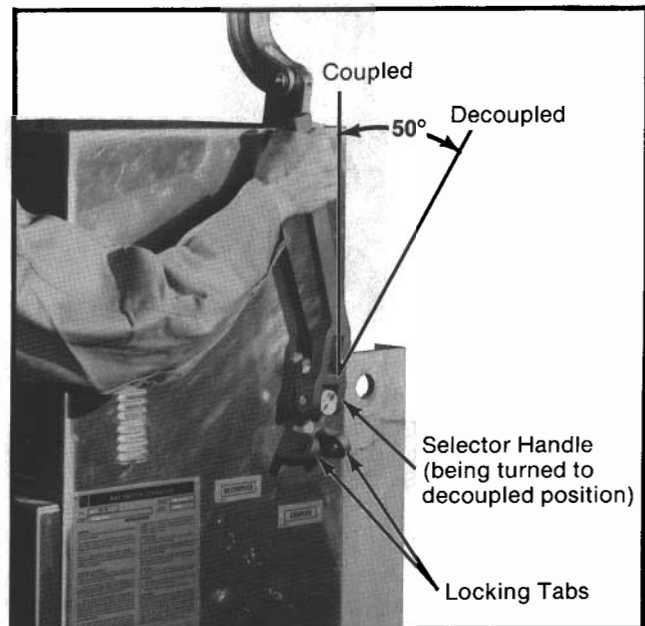


Figure 4. Selector handle operation.

Decoupling

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. See Figure 3. Swing the selector handle upright and *slowly* rotate it clockwise 50 degrees to the decoupled position. See Figure 4. This decouples the switch-operator mechanism from the switch-operator operating lever. Then 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 operating lever 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 5. The selector handle may be padlocked in either position.

Coupling

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. See Figure 5. To move the switch operator to the exact position for coupling, turn the manual operating handle slowly until the position-indexing drums are numerically aligned. Then 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.

* 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.

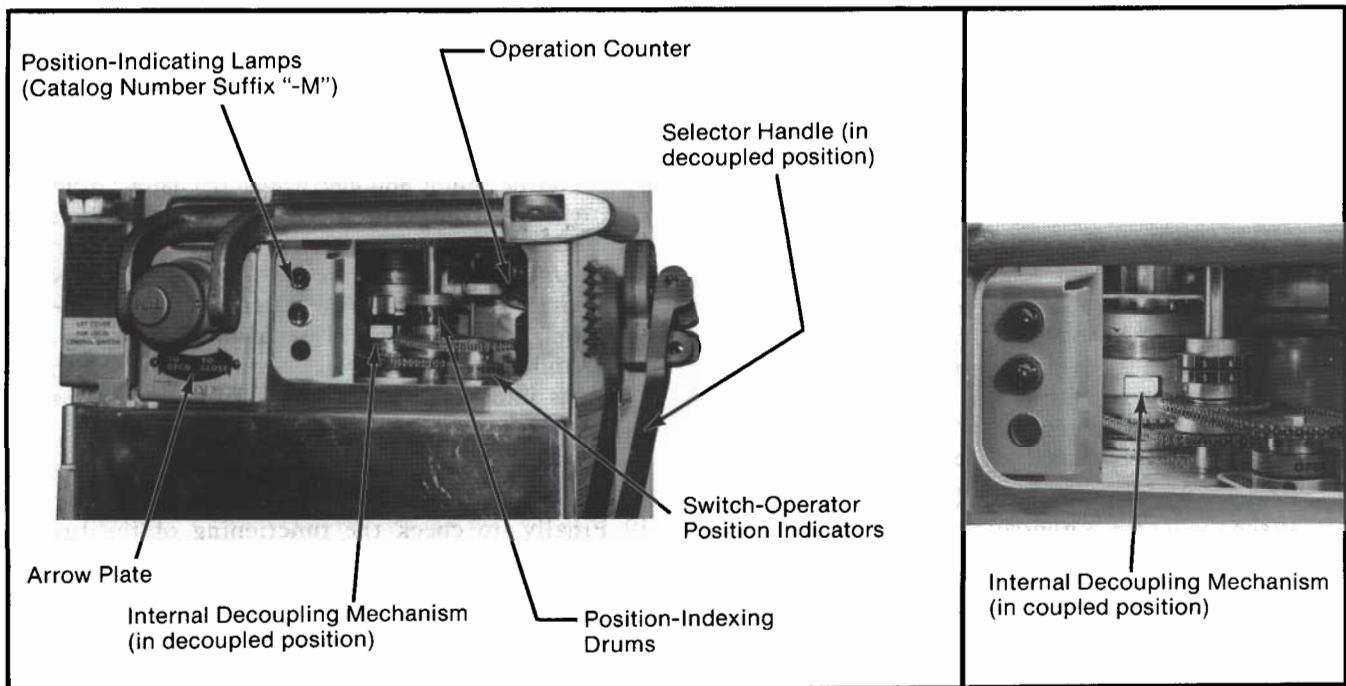


Figure 5. Views of switch operator through observation window.



S&C Switch Operators — Type CS-10

INSPECTION SCHEDULE AND PROCEDURES

To optimize performance of the Type G or Type A Circuit-Switcher and associated Type CS-10 Switch Operator, they should be exercised and inspected annually. Refer to S&C Instruction Sheet 711-590 for recommended inspection procedures.* (Note: The recommended inspection *schedule* for Circuit-Switcher components contained in Instruction Sheet 711-590 is intended for Mark II, III, IV, and V models and *does not* apply to Type G and Type A models because these devices have significantly different and less robust construction features than subsequent models. The recommended inspection *procedures* for Circuit-Switcher components contained therein are, however, generally applicable to Type G and Type A models.)

Since the Type CS-10 Switch Operator may be conveniently decoupled 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; when the switch operator is in the decoupled position, the shunt-trip device—if furnished—is rendered inoperative, thus permitting checkout of the system protective scheme.

The brake in the Type CS-10 Switch Operator should be inspected every 2500 operations or 5 years, whichever occurs more often. The inspection procedure is as follows. See Figure 6.

1. Place the selector handle in the decoupled position.
 2. Remove the two-pole pull-out fuseholders for the motor circuit and space-heater circuit.
 3. Disconnect the linkage rod by removing the $\frac{1}{4}$ "—20 X $1\frac{1}{4}$ " hex-head screw, lockwasher, flat washer, and spacer-bushing from the end of the brake lever, as shown in Detail A. Be careful not to lose these parts. Then raise the brake lever and measure the vertical free play, as shown in Detail B. This dimension should be $\frac{5}{8}$ " to $\frac{3}{4}$ ". Should the measurement be outside this range, brake-wear compensation is required; proceed to Step 4. If the measurement is within this range, reattach the linkage rod and tighten the $\frac{1}{4}$ "—20 X $1\frac{1}{4}$ " hex-head screw securely; proceed to Step 9.
 4. Remove the four $\frac{5}{16}$ "—18 X $1\frac{1}{4}$ " screws used to attach the motor, withdraw the motor, and carefully rest its shaft on the floor of the enclosure. Be careful
5. Using a $\frac{3}{32}$ " Allen wrench, loosen the pad assembly socket-head set screw on the side of the caliper assembly approximately one-half turn. See Detail A.
 6. Then, using a $\frac{5}{16}$ " Allen wrench, rotate the pad assembly clockwise until the free play at the end of the brake lever is $\frac{5}{8}$ " to $\frac{3}{4}$ ", as shown in Detail B. Now tighten the $\frac{3}{32}$ " pad assembly socket-head set screw.
 7. Insert the spacer-bushing through the angle bracket and brake lever, and reattach the linkage rod using the $\frac{1}{4}$ "—20 X $1\frac{1}{4}$ " hex-head screw, lockwasher, and flat washer. Tighten the screw securely.
 8. Insert the square key in the keyway, as shown in Detail A. Slip the tubular spacer (if furnished) over the motor shaft and reinstall the motor. Position the motor such that the two weep holes on the side of the housing face downward. Replace the four $\frac{5}{16}$ "—18 X $1\frac{1}{4}$ " screws used to attach the motor and tighten them securely. On 115-volt ac and 230-volt ac motors, further, retighten the $\frac{1}{4}$ "—20 socket-head set screw on the side of the brake disc hub.
 9. Check the operation of the brake linkage as follows: Pull the latch knob on the hub of the manual operating handle and *slowly* pivot the handle forward from its storage position toward its cranking position until the brake disc can be rotated by hand. *Be careful not to get grease on the brake disc.* Now measure the distance that the end of the brake lever travels from the point of initial brake release to the bottom of its stroke (which occurs when the handle locks into the cranking position). This dimension should be $\frac{1}{8}$ " to $\frac{1}{4}$ ". See Detail D. Should the measurement be outside this range, refer to the nearest S&C Sales Office.
 10. Finally, to check the functioning of the brake, decouple the operator and then open and close the operator electrically. After each operation, check the position of the indicator on the appropriate travel-limit disc: it should stop between indicator-plate numbers 2 and 8. See Figure 6. Should the indicator on the travel-limit disc stop outside this range, refer to the nearest S&C Sales Office.

* Superseded-design switch operators, Catalog Numbers 38864 through 38864R3, 38865 through 38865R3, 38866 through 38866R3, and 38867 through 38867R3, equipped with optional shunt-trip solenoid switch and redundant relay (catalog number suffix "-HP"), should also have these components exercised annually. See page 10.



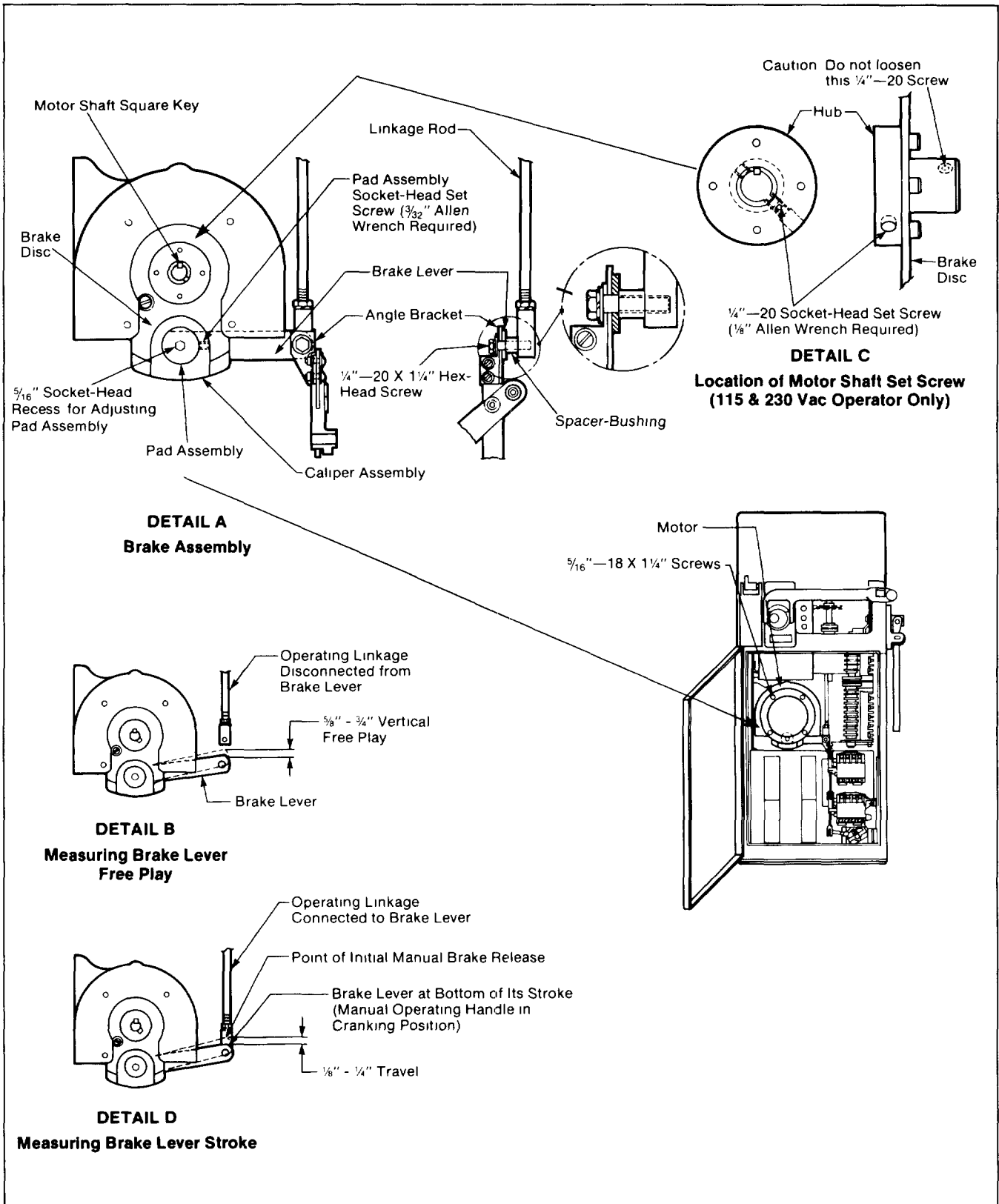


Figure 6. Brake inspection procedure.



Recommended Exercising Procedure for Superseded-Design Switch Operators, Catalog Numbers 38864 through 38864R3, 38865 through 38865R3, 38866 through 38866R3, and 38867 through 38867R3, Equipped with Optional Shunt-Trip Solenoid Switch and Redundant Relay (Catalog Number Suffix “-HP”)

In these superseded-design switch operators, a shunt-trip solenoid switch (94) and redundant relay (62) are utilized to minimize control-current inrush by energizing the shunt-trip device and switch-operator motor in sequence; the redundant relay provides a backup function, ensuring Circuit-Switcher actuation independent of shunt-trip operation. To verify their proper functioning, it is recommended that the shunt-trip solenoid switch and redundant relay each be exercised separately (preferably through the protective-relay circuit, to check out the external control wiring as well) while the other component is temporarily disabled.

The following annual exercising procedure is recommended. (Note that the wire and terminal designations referenced apply to the standard wiring diagrams for these superseded models—CDR-3116R3-1 and CDR-3116R3-2—and may differ on special wiring diagrams.)

To exercise the shunt-trip solenoid (94) switch:

1. Open the control-source disconnect switch; then place the switch-operator selector handle in the *decoupled* position. (When the switch operator is thus decoupled, the shunt-trip solenoids at the Circuit-Switcher pole-units are rendered inoperative.)
2. Disable the opening contactor (OC) by removing wires numbered 8C and 8D from the opening-contactor (OC) coil terminal C7. This will allow the opening operation of the switch operator to be totally controlled by the contacts of the solenoid (94) switch.
3. Close the control-source disconnect switch and energize the solenoid (94) switch (to move the switch operator to the open position) by a simulated shunt-trip operation. Return the switch operator to the closed position by means of the pushbutton control. Repeat four times for exercising purposes.
4. Open the control-source disconnect switch and reconnect wires numbered 8C and 8D to the opening-contactor (OC) coil terminal C7.

To exercise the redundant (62) relay:

1. Make sure that the control-source disconnect switch is opened and the switch-operator selector handle is in the *decoupled* position.
2. Disable the solenoid (94) switch by removing wire number 2I from terminal L1 on the redundant (62) relay. This will allow an opening operation of the switch operator to be initiated by the contacts of the redundant (62) relay.
3. Close the control-source disconnect switch and energize the redundant (62) relay (to move the switch operator to the open position) by a simulated shunt-trip operation. Energization should be for a duration of more than ¼ second to allow time for closing of the redundant (62) relay contact. Return the switch operator to the closed position by means of the pushbutton control. Repeat four times for exercising purposes.
4. Open the control-source disconnect switch and reconnect wire number 2I to the redundant (62) relay terminal L1.
5. To return the switch operator to service, bring the switch operator to the same position as the Circuit-Switcher; place the selector handle in the coupled position; and close the control-source disconnect switch.

CAUTION

Do not assume that the switch-operator position necessarily indicates the open or closed position of the Circuit-Switcher. Upon completion of an opening or closing operation (electrical or manual), check to be sure that the following conditions exist:

- The switch-operator position indicator, Figure 5, signals "Open" or "Closed" to indicate that the switch operator has moved through a complete operation. Also note the position-indicating lamps, Figure 5, if furnished.
- The operating lever, at the rear of the switch operator, Figure 1, is in the "Up" position for a Circuit-Switcher "Closed" position. Conversely, the operating lever is in the "Down" position for a Circuit-Switcher "Open" position.
- The Circuit-Switcher disconnect blade on each pole-unit is fully open or fully closed.

Then tag and padlock the switch operator in accordance with standard system operating procedures. In all cases, make certain that the switch operator is padlocked before "walking away."

Correct operation of the Circuit-Switcher depends on charging and latching the stored-energy source within each brain as the disconnect blades move to the fully open position and the interrupters close. The interrupter

target located on the side of each brain housing appears yellow when the interrupter is open. The target appears gray (normal) when the interrupter is closed.

Because the interrupters are closed as the Circuit-Switcher blades move to the fully open position, the target appears yellow only briefly during the opening operation. The target should *never* appear yellow when the Circuit-Switcher is in the fully open or fully closed position.

To restore to normal operation

So that the switch operator is ready for normal power operation of Circuit-Switcher by remote automatic or supervisory control, be sure that the following conditions exist:

- The selector handle is in the coupled position.
- The manual operating handle is in its storage position.
- The two-pole pull-out fuseholders for the motor circuit and space-heater circuit are inserted.
- The pushbutton protective cover is closed.
- The switch operator is tagged and padlocked in accordance with standard system operating procedures.

