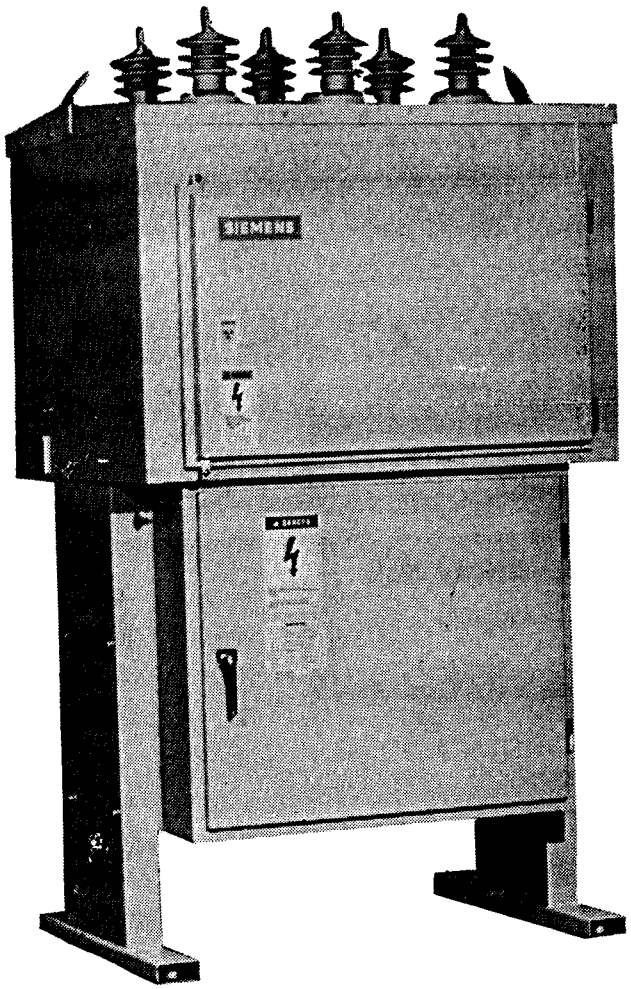
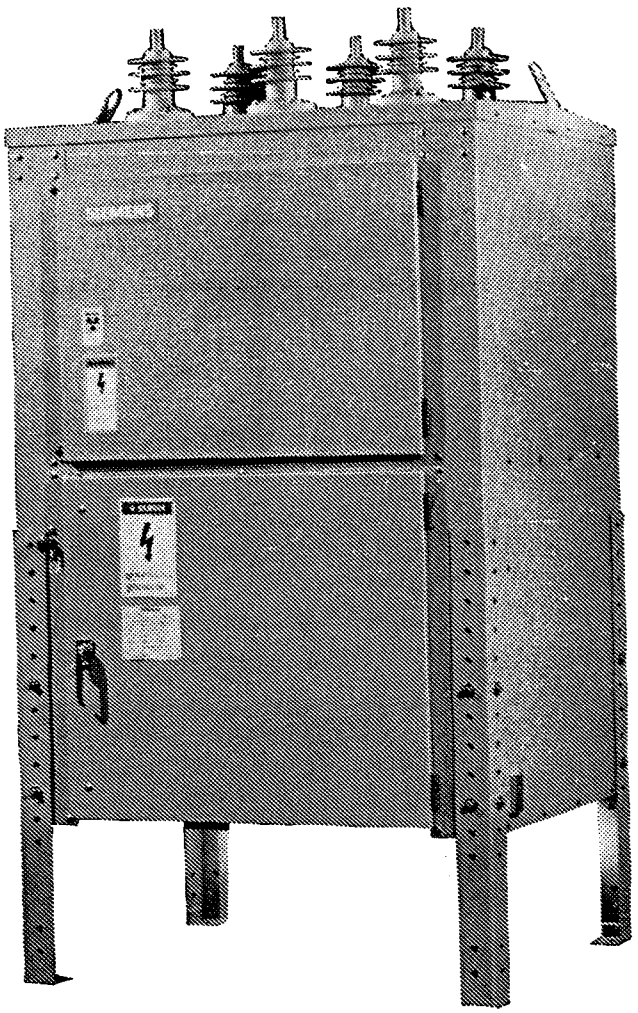
SIEMENS

Instructions

Installation
Adjustment
Maintenance





Type SDV-3 and 4
Power Circuit Breaker 15, 25kV

PB 3788-03

For Emergency Service
Call: 1-800-241-4453

Siemens Energy & Automation, Inc.

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Important

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes in the specifications shown herein or to make improvements at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material, or both, the latter shall take precedence.

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Summary

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office.

The contents of this instruction manual should not become part of or modify any prior or existing agreement, commitment or relationship. The sales contract contains the entire obligation of Siemens. The warranty contained in the contract between the parties is the sole warranty of Siemens. Any statements contained herein do not create new warranties or modify the existing warranty.

Introduction And Safety

Introduction

The SDV vacuum breakers are designed to meet all the applicable ANSI, NEMA, and IEEE standards. Successful application and operation of this equipment depends as much upon proper installation and maintenance by the user as it does upon the careful design and fabrication by Siemens.

The purpose of this instruction manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment.

Safety

This equipment contains hazardous voltages and remotely controlled mechanical parts which move at high speed. Severe personal injury or property damage can result if safety instructions are not followed.

Only qualified personnel should work on or near this equipment after becoming familiar with all warnings, safety notices and maintenance procedures described in the manuals covering this equipment.

Qualified Person

A "Qualified Person" is familiar with the installation, construction and operation of this equipment. In addition, he or she has the following qualifications:

a) Is trained and authorized to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety procedures.

c) Is trained in rendering first aid.

Signal Words

Distinctive signal words (DANGER, WARNING, CAUTION) are used in this instruction book to indicate degrees of hazard that may be encountered by the user. For the purpose of this manual and product labels, these signal words are defined below:

DANGER Indicates an imminently hazardous situation which, if not avoided, **will** result in death or serious injury.

WARNING Indicates a potentially hazardous situation which, if not avoided, **could** result in death or serious injury.

CAUTION Indicates a potentially hazardous situation which, if not avoided, **may** result in minor or moderate injury.

DANGER

Hazardous voltage and mechanisms. Death or serious injury due to electrical shock, burns and entanglement in moving parts or property damage will result if safety instructions are not followed.

To prevent:

Do not service or touch until you have de-energized high voltage, grounded all terminals and turned off control voltage.

Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, instructions and maintenance procedures contained herein. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance.

Dangerous Procedures

In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following:

1. Always work on a de-energized breaker. The breaker should be isolated, grounded, and have all control power removed before performing any tests, maintenance or repair.

2. Always perform maintenance on the breaker after the opening and closing springs are discharged (except for tests of the charging mechanisms). Check to be certain that the indicator flags read OPEN and DISCHARGED.

3. Do not disable or defeat any interlock or safety device which may be provided in the breaker.

Field Service Operation

Siemens can provide competent, well-trained Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment. Contact regional service centers, sales offices or the factory for details.

Receiving, Handling And Storage

Introduction

This section of the manual covers the receiving, handling and storage instructions for Type SDV circuit breakers prior to installation.

Receiving Procedure

Inspection

Make a physical inspection of the circuit breaker, checking for shipment damage or indications of rough handling by the carrier. Check each item against the manifest to identify any shortages.

Shipping Damage Claims (When Applicable)

Follow normal shipment damage procedures, which should include:

1. Check for visible damage upon arrival.
2. Visible damage must be noted on delivery receipt, and acknowledged with driver's signature. Notation "Possible internal damage, subject to inspection" must be on the delivery receipt.
3. Notify Siemens Sales Office immediately of any shipment damage.
4. Arrange for carrier's inspection. Do not move the unit from its unloading point.

Handling Procedure

Handle the breaker by the use of sling and lifting lugs or with a forklift when the breaker is on a skid. Lifting lugs are provided on each side of the breaker so that the unit may be lifted by a sling or hooks of the proper size. Refer to the breaker nameplate for the weight. Be sure that the forklift blades pass completely under the breaker.

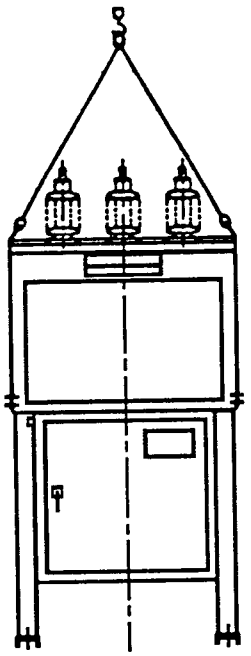
Refer to Figure 1 for lifting of the breaker using a sling.

WARNING

Heavy equipment with a high center of gravity. Death, serious injury, or damage to the circuit breaker could result if dropped or allowed to tip over.

To prevent:

1. Check nameplate for weight of breaker and be sure hoisting equipment is adequately rated.
2. Use the proper sling length to prevent damage to breaker.
3. Read instruction manual for handling procedures.



Recommended Sling Length is 60 Inches

Figure 1. Lifting Vacuum Breaker

Storage

If the breaker is not to be placed in service immediately, it should be set on an adequate foundation, and the internal parts kept dry with the compartment heaters or other space heaters that will maintain the inside temperature of the breaker above ambient. Prolonged outdoor storage without heaters could result in corrosion of internal parts. It is also recommended that the breaker receive periodic inspection during storage.

Installation

Introduction

Proper installation of the circuit breaker is essential for satisfactory operation, safety and ease of maintenance. This section provides general recommendations for setting up the breaker on site.

Location

The breaker should be located so that it is readily accessible for manual operation and inspection. Ample clearance should be provided for doors and panels to swing open, or to be removed for servicing the breaker.

The foundation should be reasonably level and 0.75 inch diameter anchor bolts are recommended. No special leveling procedures are required.

Preparation For Installation

SDV breakers without auxiliary cabinets are shipped with the legs positioned for shipment. The legs must be removed, turned to the proper position and set to the desired height. Directions are given in the notice decal.

⚠ DANGER

Hazardous voltage.
Death or serious injury will result.

To prevent:

The user must adjust the breaker height to ensure compliance with safety codes for electrical clearance.

Primary Lead Connections

The primary leads should be brought down from above the breaker if possible, with adequate clearance to other parts, and with the proper supports so that the breaker bushings are not subjected to excessive strains.

The leads should be sized to have a capacity at least equal to the maximum operating current of the circuit and within the rating of the breaker. Connections are to be made to the bolted terminals of the bushings and must be securely tightened to a clean, bright surface to assure good contact.

Ground Connections

Diagonally opposite grounding pads are provided for connecting the cabinet to ground using at least a 4/0 AWG conductor. A good low-resistance ground is essential for adequate protection.

Secondary And Control Wiring

A conduit panel opening is provided in the bottom of the relay and control power compartment for the connection of control circuits. The control wires should be run separately from high voltage wiring to prevent inductive coupling between them and should be sized for full operating current to avoid a drop in voltage below that specified on the nameplate. All conduits should be sealed off at their entrance to the relay and control power compartment.

Terminal blocks are provided inside the relay and control power compartment for the connections necessary for the control wiring, bushing current transformers and relay panel (if so equipped). These terminal blocks are located on panels at the top of the control compartment immediately behind the control compartment access door.

Connection diagrams are provided with each breaker and will be found in the pocket inside the control compartment door.

Initial Functional Checks

Introduction

This section provides a description of the inspections, checks and tests to perform on the circuit breaker prior to operation.

Inspections, Checks, And Tests Without Control Power

Vacuum breakers are normally shipped with the primary contacts open and the springs discharged. It is important to verify the discharged condition of the spring loaded mechanism before moving the circuit breaker.

Spring Discharge Check

Refer to Figure 2.

DANGER

Hazardous voltages and high-speed mechanical parts.
Death or serious injury and property damage will result.

To prevent:

Read instruction manuals, observe safety instructions and use qualified personnel.

The spring discharge check consists of the following steps, performed in the order given:

1. Press the TRIP pushbutton.
2. Press the CLOSE pushbutton.
3. Again press TRIP pushbutton.
4. Verify that the indicator flags read "DISCHARGED" and "OPEN".

This check assures that both the tripping and closing springs are fully discharged.

Hand Charging Socket

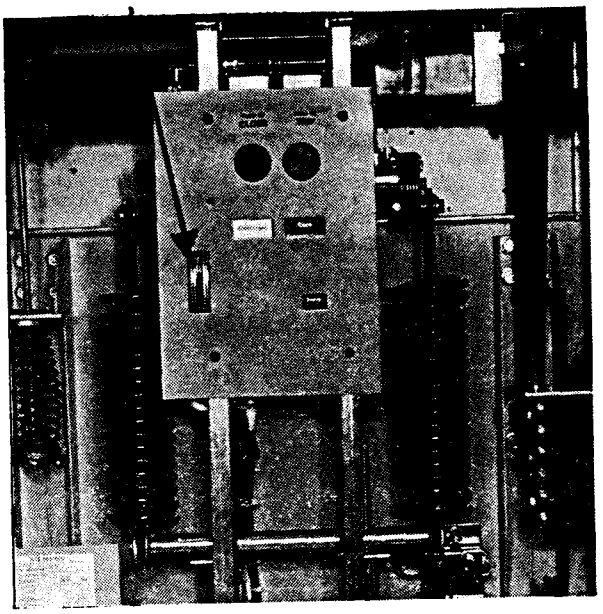


Figure 2 -- Operator Control Panel

Physical Inspections

1. Verify that the rating of the circuit breaker is compatible with the system.
2. Check for any damage which may have occurred during shipping or handling.

Manual Spring Check

1. Insert the manual spring charging lever into the hand charging socket as shown in Figure 2. Operate the lever up and down until the spring charge indicator flag shows "CHARGED".
2. Repeat the spring discharge procedure given previously.
3. Verify that the indicator flags now read "OPEN" and "DISCHARGED".

Initial Functional Checks

Automatic Spring Charging Check

The automatic spring charging feature of the circuit breaker should be checked for proper functioning. Control power is required for automatic spring charging to take place.

Note A temporary source of control power and test leads will be required if the control power source has not been connected to the circuit breaker. When control power is connected to the breaker, the operator should automatically charge the closing springs.

Use the CLOSE and TRIP pushbuttons to verify that the primary contacts of the circuit breaker close and open.

When the automatic spring charging check is completed, perform the spring discharge check procedure to verify that the breaker contacts are open and the springs are discharged.

Final Inspection Of Installed Breaker

1. Make sure the breaker is properly set up and reasonably level on its foundation.
2. Check the tightness of all hardware on the cabinet, adjustable legs, bushings, bus bars and operator mechanism.
3. See that the operating mechanism has been properly lubricated.
4. Inspect all insulated wiring to see that it has not been damaged, and test for possible grounds or short circuits.
5. See that all covers, and bolted connectors are securely fastened.
6. Retouch any paint that has been damaged during installation.

CAUTION

Styrofoam bracing and tag between phase barriers may damage circuit breaker.

To prevent:

Remove bracing and tag before energizing breaker high voltage.

7. Check to see that all mechanisms are free of any packing, including shipping braces in high voltage compartment.
8. Examine the vacuum interrupter envelopes for damage, and wipe the interrupters and other insulating parts with a clean, dry cloth.
9. Charge the closing spring manually and push the CLOSE pushbutton to close the breaker.
10. Observe the contact condition indicator flag and confirm that it reads CLOSED. Press the OPEN pushbutton and verify that the contact condition indicator flag reads OPEN. The spring condition indicator flag should also read DISCHARGED.
11. Energize the control circuits. The motor should run to charge the closing springs, and then automatically turn off.
12. Close the circuit breaker electrically and verify that the breaker is closed and remains closed by checking the position indicator flag. Note that the motor will immediately run to recharge the closing springs.
13. Trip the breaker electrically.
14. Repeat the close and trip operations several times to assure proper operation.
15. Check the tripping and closing times from coil energization to contact break or make.

16. Check the integrity of the vacuum interrupter by performing a hi-pot on each interrupter while in the open position. The interrupter hi-pot is to verify that damage has not occurred during shipment and is not intended as a verification of the breaker dielectric rating. The voltage should be raised gradually and the contact gap should sustain 27 kV, 60 Hz AC for one minute, or 38 kV DC for one minute. If these levels cannot be sustained, the interrupter must be replaced.

CAUTION

Hazardous radiation.
Minor injury may result.

To prevent:

To eliminate this hazard the low frequency withstand test must be performed with all covers on and doors closed.

Observe the following precautions when hi-potting the vacuum interrupters:

1. Test personnel should remain at least 6 feet (1.8 meters) away from the interrupter being tested.
2. Tests should be performed with normal metallic doors and panels installed, and test personnel should position themselves to take advantage of the shielding provided by the metallic barriers.
3. The circuit breaker bushings and metallic midband on the interrupter may retain a static charge after the hi-pot test, and should be discharged with a grounded probe before handling.

DANGER

Hazardous voltage.
Death, serious injury, or damage to the circuit breaker will result.

To prevent:

Do not touch or service until you have de-energized the high voltage, grounded the entrance bushings and turned off control voltage.

Note

No hazardous X-radiation is produced with closed contacts, or with open contacts with rated operating voltage applied.

Description

Introduction

This section describes the operation of each major subassembly as an aid in the operation, installation, maintenance and repair of the SDV Vacuum Circuit Breaker.

Vacuum Interrupters

A cutaway view of the Siemens vacuum interrupter is shown in Figure 3. The current carrying parts of the interrupter are contained within an insulated shell. The shell is sealed after a high vacuum is established internally. The stationary contact is rigidly attached to the end cap which serves as one terminal of the interrupter. The movable contact is free to move in the guide, and is connected to the operating mechanism by a system of linkages. A metal bellows assembly provides a secure seal around the terminal, preventing loss of vacuum while permitting movement of the contact.

When the contacts separate, the current to be interrupted initiates a metal vapor arc discharge and flows through this plasma until the next current zero. The arc is then extinguished and the conductive metal vapor condenses on the inner surface of the arc chamber. As a result, the dielectric strength of the contact gap builds up very rapidly, interrupting the current.

The contacts are designed so that a self generated field causes the arc to travel. This prevents localized overheating when interrupting large currents.

The rapid buildup of the dielectric strength in the gap enables the arc to be safely extinguished even if contact separation occurs immediately prior to current zero.

The arc drawn in the vacuum breaker is not cooled. The metal vapor plasma is highly conductive and the resulting arc voltage only attains values between 20V and 200V. For this reason and because of the short arcing times, the arc energy developed in the break is very small. This also accounts for the long life expectancy of the vacuum interrupter.

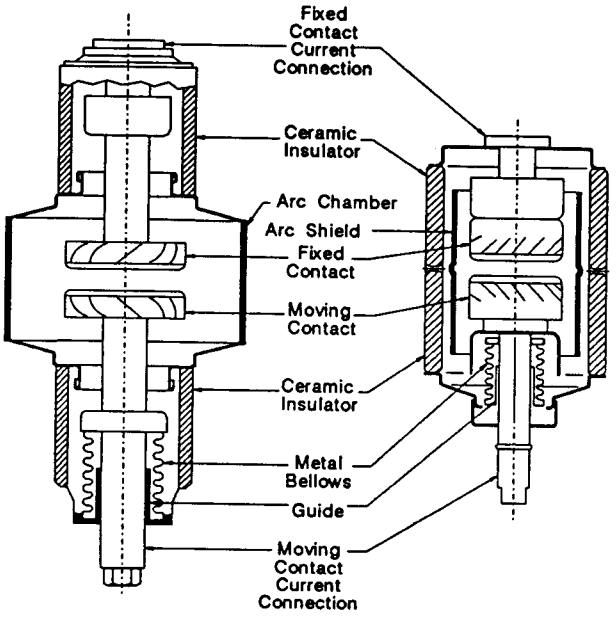


Figure 3. Section through Vacuum Interrupters
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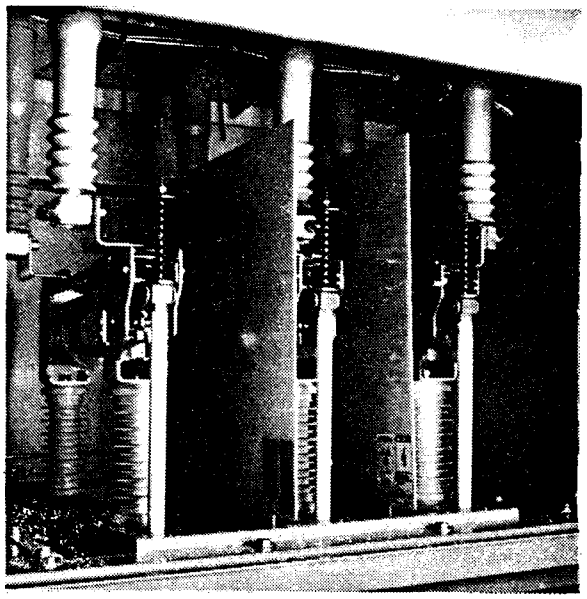

Figure 4. Phase Barriers

Phase barriers are used in conjunction with the vacuum interrupters as shown in Figure 4. These plates of insulating material are attached to the circuit breaker housing and provide suitable electrical insulation between the vacuum interrupter primary circuits.

Operating Mechanism

The operating mechanism of the SDV circuit breaker is a stored energy, spring powered design. The operator is also fully trip free, i.e., spring charging does not automatically change the position of the primary contacts and the closing function may be overridden by the tripping function at any time.

Modes Of Operation

Some maintenance procedures are more easily understood when the operating mechanism modes of operation are described in detail. The following paragraphs explain the five modes or status conditions (charging, closing, trip-free, opening and rapid auto reclosing).

Spring Charging Mode (Figures 5 and 6)

Figures 5 and 6 show several key components of the operator mechanism in positions corresponding to the breaker open, with the closing springs discharged (Figure 5) and charged (Figure 6). Figure 7 shows portions of the operator mechanism that manually or electrically charge the closing springs. The drive cam (20), the closing spring crank arms (Figure 9) and spring condition indicator cam (18) are directly keyed to the main cam shaft (3). The main cam shaft rotates counterclockwise. The closing springs are attached to the crank arms, and are extended during the charging cycle.

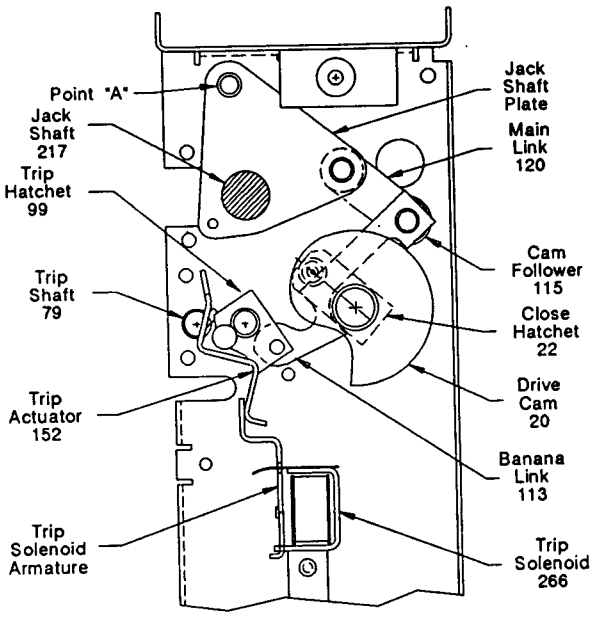

Figure 5. Breaker Open – Closing Springs Discharged 72-250-712-402

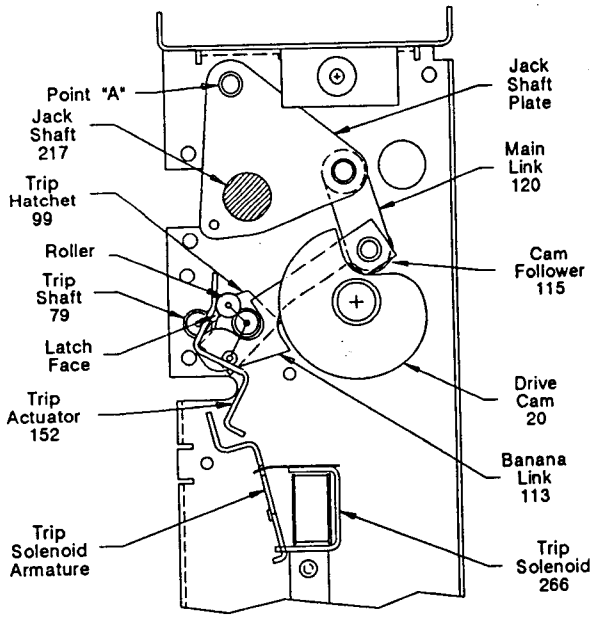

Figure 6. Breaker Open – Closing Springs Charged 72-250-712-403

Description

Figure 7 shows the ratchet wheel (15) which is free to rotate about the main cam shaft (3). The ratchet wheel is driven by either the charging motor or the manual charge handle socket (52). When the springs are charged electrically, the motor eccentric (100) introduces a rocking motion into the drive plate (13). As this plate rocks back and forth, the upper pawl (24-1) (which is connected to the drive plate) imparts counterclockwise rotation of the ratchet wheel (15), one tooth at a time. The lower pawl (24-2) acts as a holding pawl during electrical charging.

When the springs are charged manually, up and down pumping action of the spring charging handle in the manual charge handle socket (52) causes the pawl plate (11) to rock back and forth through the movement of the manual charging link (48). The lower pawl (24-2) drives the ratchet plate counterclockwise during manual charging, and the upper pawl (24-1) becomes the holding device.

At the beginning of the charging cycle, ratchet pin (16) is at the 12 o'clock position. The ratchet pin is connected to the ratchet wheel. Upon being advanced by ratchet action to the 6 o'clock position, this pin engages the drive arms (8) which are keyed to the main cam shaft. Consequently, counterclockwise rotation of the ratchet wheel causes the ratchet pin to drive the main cam shaft counterclockwise. When the ratchet pin reaches the 12 o'clock position, the closing springs are fully charged. Driving pawl (24-1) is disengaged, the spring condition indicator cam (18) has rotated allowing the spring charged flag (132) to drop into the lower (charged) position, which also operates the motor cutoff switch (LS1) and spring charged switch (LS2) (258) (see Figures 8 and 15). The closing springs are restrained fully charged by close hatchet (22) against close shaft (72).

Closing Mode (Figure 8)

Energizing the close solenoid (265) pulls the solenoid armature against the closing shaft actuator (75) and causes the closing shaft (72) to rotate approximately 15°. If the closing springs are charged, the close hatchet (22) will be released by this rotation allowing the main cam shaft (3) to be driven by the closing springs. Depressing the

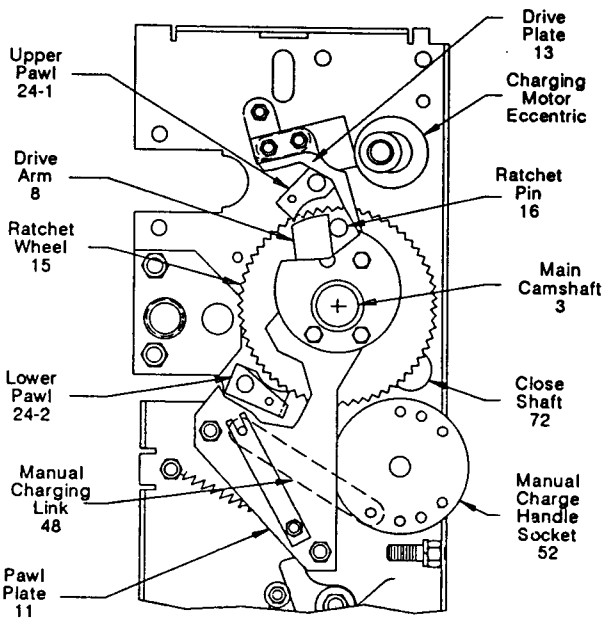

Figure 7. Pawl and Ratchet Drive

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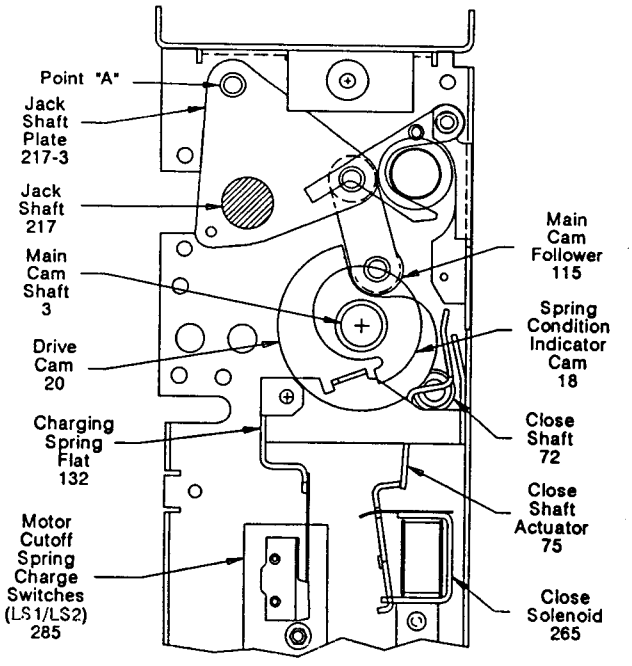


Figure 8. Closing Mode

72-250-712-405

manual close button on the operator panel causes the rotation of the close shaft (72) by the lower end of the close shaft actuator (75). Rotation of the main cam shaft (3) is identical to that of the electrical closing operation.

As the main cam shaft (3) rotates, the cam follower (115) is driven by drive cam (20) and the main link (120) is forced outward, and rotation of the jack shaft assembly (217) occurs. There are three drive links attached to Point "A" of each of the three jack shaft drive plates. Each drive link is connected to the movable contact of one vacuum interrupter. Closing rotation (counterclockwise) of the jack shaft assembly closes the contacts of the three vacuum interrupters.

During the closing operation, the rotation of jack shaft assembly (217) forces the opening (i.e., tripping) spring into its charged position.

Trip Free Mode

If at any time during breaker closing, the trip shaft (79) (Figure 5) operates as a result of either an electrical or mechanical trip, the trip hatchet (99) is free to rotate. When the trip hatchet (99) rotates, cam follower (115) is displaced by the drive cam (20) without motion of the jack shaft (217). Mechanical trip free operation is provided by manual tripping or electrical tripping.

Opening Mode

Opening or tripping the vacuum interrupter contacts is accomplished by rotation of the trip shaft (79). Rotation may be produced either electrically by energizing the trip solenoid (266) (Figure 6), or manually by pressing the trip button. Energizing the trip solenoid causes the lower arm of the trip actuator (152) to rotate counterclockwise. Pressing the trip button causes the trip actuator upper arm to move, again producing rotation of the trip shaft. All of the linkages are trip free, and tripping or opening is unaffected by the charging status of the closing springs or position of the drive cam (20).

Rapid Auto-Reclosing Mode

The closing springs are automatically recharged by the motor driven operating mechanism when the breaker has closed. The operating mechanism is capable of the open-close-open duty cycle required for rapid auto reclosing. A trip latch check switch and a relay (delay on dropout) prevent release of the closing spring energy if the trip hatchet (99) is not in its reset position. This ensures the mechanism does not operate trip free on an instantaneous reclosure.

Closing And Tripping Springs

The stored energy assembly consists of dual closing springs and a single tripping spring. Figure 9 shows the three springs and their linkages. The two closing springs are connected to crank arms mounted on the rotating main cam shaft. The closing springs are tensioned (charged) by rotation of the crank arms connected to the movable ends of the springs. The fixed ends of these springs are attached to a support arm, which in turn is bolted to the structure of the operator.

The tripping spring is connected to the jack shaft. When the circuit breaker closes, rotation of the jack shaft causes the tripping spring push rod to compress and charge the tripping spring. The tripping spring is therefore automatically charged whenever breaker contacts are closed.

Trip Free Operation

The SDV circuit breaker is mechanically and electrically trip free. This important function enables the breaker to be tripped before, during or after a closing operation. Operation of the tripping spring is initiated whenever the trip shaft is moved as the result of mechanical or electrical signals.

Shock Absorber Assembly

The SDV operator mechanism is equipped with an hydraulic shock absorber to smooth the final motion of an opening operation. The hydraulic shock absorber consists of a piston moving inside a cylinder filled with fluid. The motion of the piston creates a force opposing the force of the tripping spring as the mechanism nears the end of the opening stroke, controlling the bottoming velocity and reducing impact.

The hydraulic shock absorber and its linkage are shown in Figure 10.

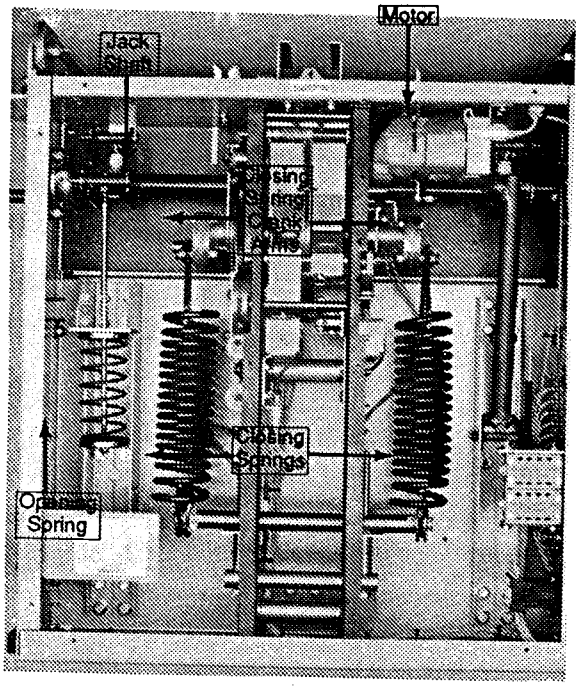


Figure 9. Close and Trip Springs

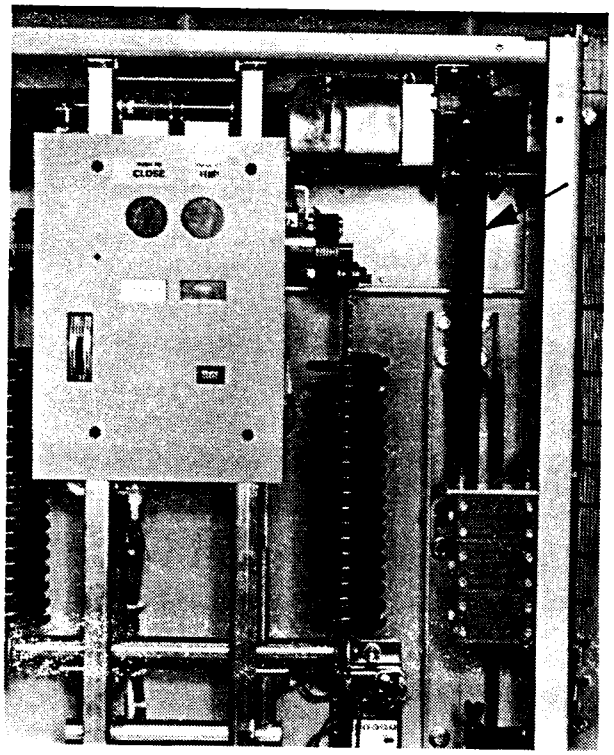


Figure 10. Shock Absorber

Manual Spring Charging

Manual charging of the closing springs is accomplished using a lever in lieu of the spring charging motor. Figure 11 shows the principal components of the manual spring charging mechanism.

The manual spring charging lever is inserted into a rectangular socket in the hand operator. The socket is accessible through the front panel of the circuit breaker. Moving the lever up and down causes rotation of the spring charging components.

> **CAUTION**
>
> Manual spring charging components may be damaged by overcharging.
>
> To prevent:
>
> Manual charging action must be suspended when the operator sees the charged status appear on the front panel of the circuit breaker and hears the sound of impact against the internal closing latch.

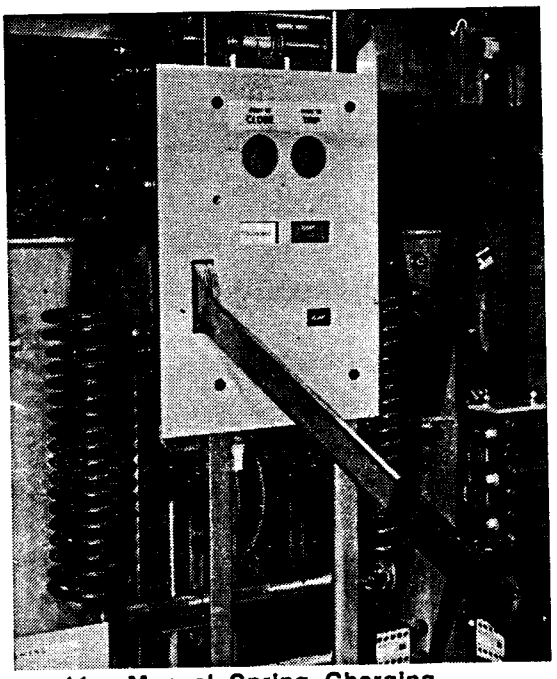


Figure 11. Manual Spring Charging

Spring Charging Motor

Figure 12 shows the spring charging motor mounted in the upper right corner of the operator frame. A universal motor is used to permit operation on either ac or dc control power. The control circuits call for automatic charging of the springs by the motor whenever control power is available and the springs are discharged.

Electrical connections to the motor utilize locking type, quick disconnect terminations for ease of servicing.

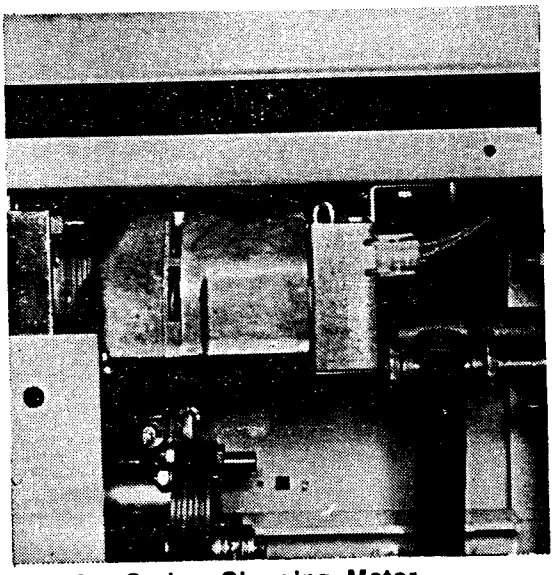


Figure 12. Spring Charging Motor

Close Solenoid, Trip Solenoid And Anti-Pump Relay

Figure 13 shows the two solenoids controlling the operation of the circuit breaker by external electrical signals.

When the close solenoid is energized, it causes the two closing springs to be released from their charged state. This forces the three coupling rods to move downward and close the vacuum interrupter contacts.

The anti-pump relay electrically isolates signals to the close solenoid so that only one releasing action by the close solenoid can occur during each application of the close command. The circuit breaker must be tripped, the springs recharged and the closing signal removed (interrupted) before the close solenoid can be energized a second time.

When the trip solenoid is energized, it allows rotation of the jack shaft by the tripping spring. This rotation pushes the three coupling rods upward and the vacuum interrupter contacts are opened.

Electrical connections to the solenoids are made through locking type, quick disconnect terminations for ease of servicing.

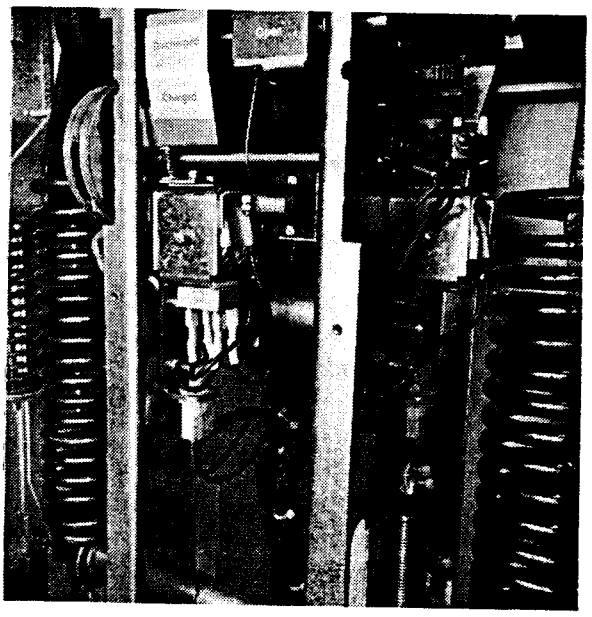


Figure 13. Close and Trip Solenoids

Auxiliary Switch

The breaker mounted auxiliary switch is shown in Figure 14. This switch provides auxiliary contacts for control of circuit breaker closing and tripping functions. Contacts are available for relaying and external logic circuits. This switch is driven by linkage connected to the jack shaft.

The auxiliary switch contains both "b" and "a" contacts. When the circuit breaker is open, the "b" switches are closed and the "a" switches are open.

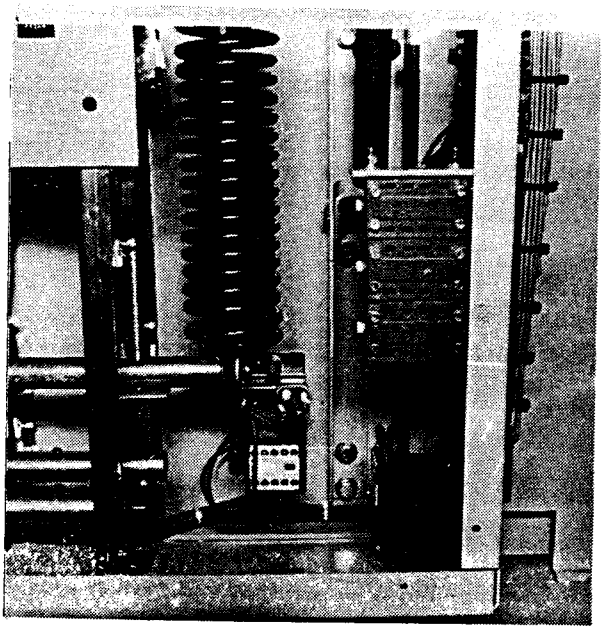


Figure 14. Auxiliary Switches

Limit Switches

The motor cutoff switch LS1 (Figure 15) senses the position of the mechanism and de-energizes the charging motor when the CHARGED position of the closing springs is reached. When the closing springs are discharged, this switch energizes the circuit powering the spring charging motor.

The trip latch check switch LS3 operates when the trip latch linkage is in the reset position.

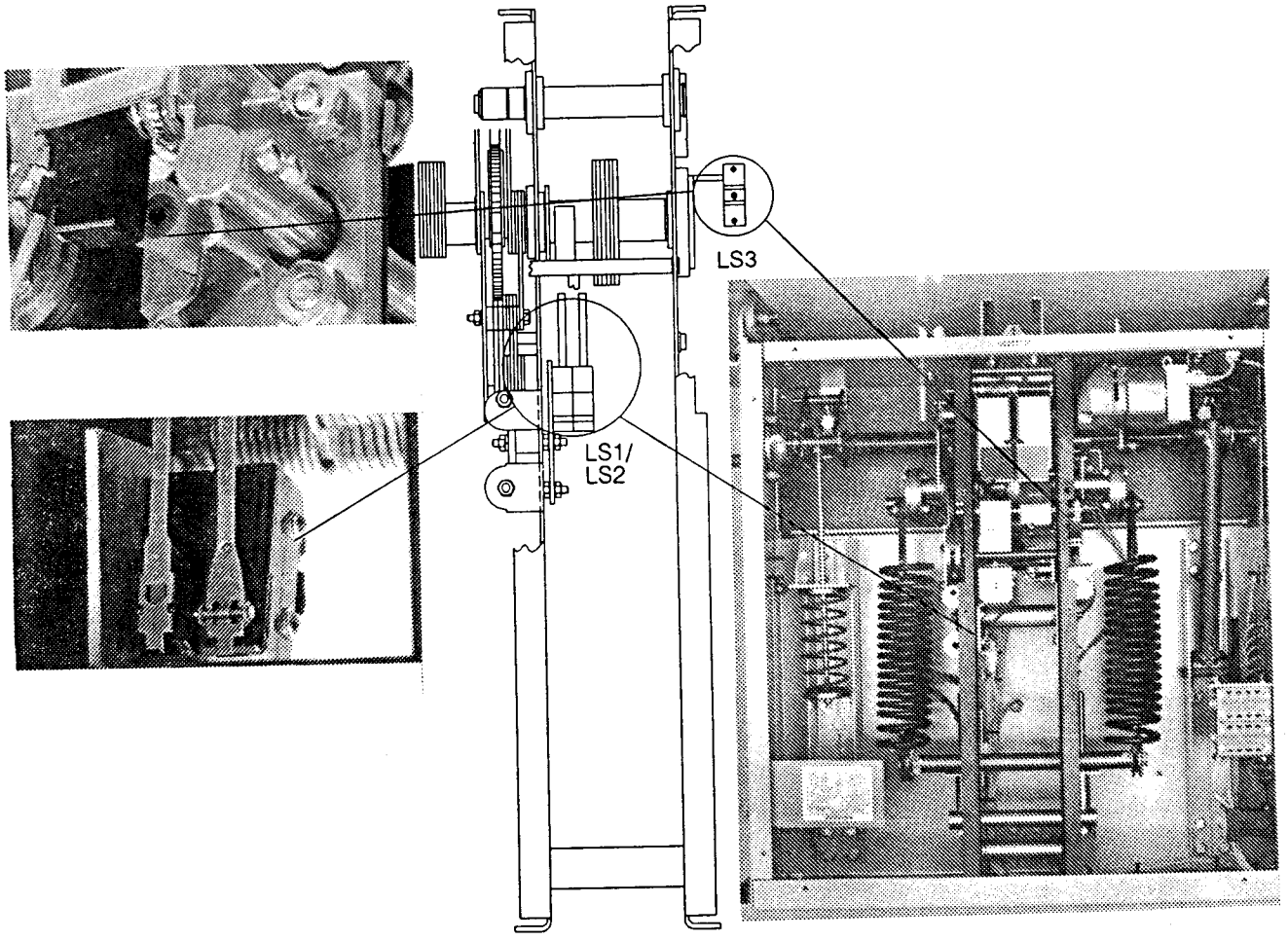


Figure 15. Circuit Breaker Limit Switches

72-250-712-406

Description

Standard Schematic And Wiring Diagrams

The schematic diagram shown in Figure 16 provides a clear picture of the logic states of the various devices for the three basic control functions.

These are:
1. Automatic charging of the closing springs.
2. Electrical closing of the primary contacts.
3. Electrical tripping of the primary contacts.

Automatic spring charging by the charging motor (88) occurs when secondary control power is available, and the motor cutoff switch (LS1) has not operated. The springs are automatically recharged after each closing operation.

Electrical closing occurs with closing control power applied and when all of the following conditions exist:

1. External close switch O1/C is closed.
2. Anti-pump relay 52Y is not energized.
3. Auxiliary switch 52b indicates the breaker is in the open position.
4. Limit switch LS3 shows that the trip latch has been reset.
5. Limit switch LS2 indicates that the closing springs are charged.

Electrical tripping occurs with tripping control power applied and when the auxiliary switch 52a shows the breaker is closed, and when a trip signal is provided by the close switch O1/T or protective relays.

While external power is required for either electrical closing or tripping, the circuit breaker can be manually charged, closed and tripped without external power.

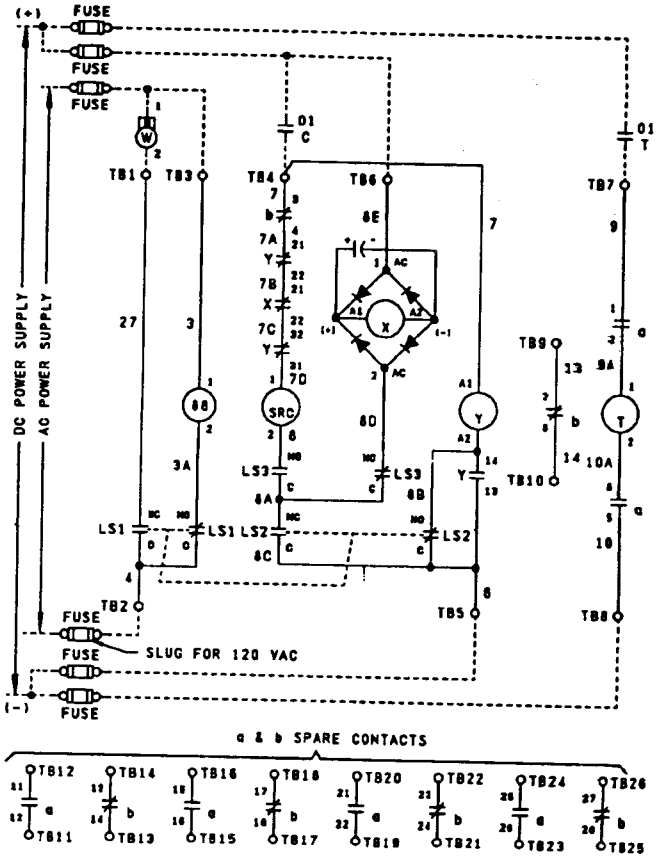


Figure 16. Typical Schematic

Figure 17 is a standard wiring diagram of the circuit breaker operating from dc control power. All of the device symbols are the same as shown in the schematic diagram.

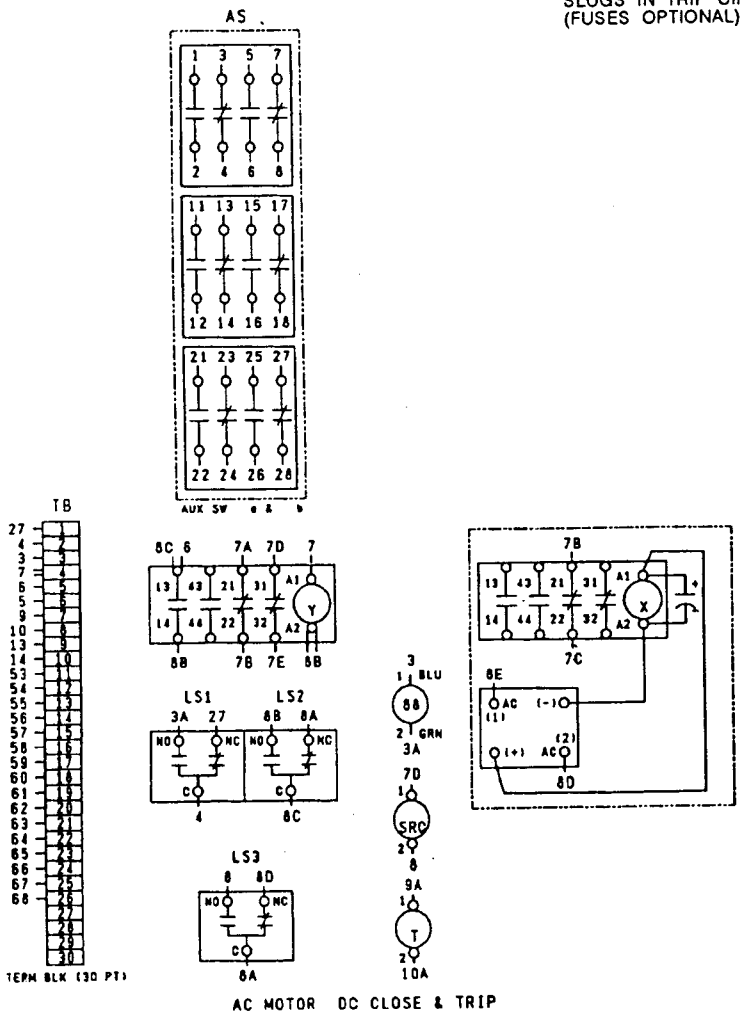
SYMBOLS

LS1	MOTOR CUTOFF SWITCH
LS2	SPRING CHARGED SWITCH
LS3	TRIP LATCH CHECK SWITCH
52a	AUX SWITCH, OPEN WHEN BKR OPEN
52b	AUX SWITCH, CLOSED WHEN BKR OPEN
52 SRC	CLOSING, SPRING RELEASE COIL
52T	TRIP COIL
52X	RECLOSING DELAY RELAY
52Y	ANTI PUMP RELAY
69	CLOSING CUTOUT SWITCH
88	MOTOR
01/C	CONTROL SWITCH CLOSE
01/T	CONTROL SWITCH TRIP
W	WHITE INDICATING LIGHT

NOTE:

1. ALL EQUIPMENT SHOWN WITH CIRCUIT BREAKER OPEN. TRIP LATCH NOT-RESET. RELAY DE-ENERGIZED AND SPRINGS DISCHARGED.

2. STANDARD:
   FUSES IN CLOSE CIRCUIT
   SLUGS IN TRIP CIRCUIT
   (FUSES OPTIONAL)



WIRE TABLE		
WIRE NO.	FROM	TO
3	TB-3	88-1
3A	LS1-NO	88-2
4	TB-2	LS1-C
6	TB-5	Y-13
7	TB-4	AS-3
7	TB-4	Y-A1
7A	AS-4	Y-21
7B	Y-22	X-21
7C	X-22	Y-32
7D	Y-31	SRC-1
8	LS3-NO	SRC-2
8A	LS2-NC	LS3-C
8B	LS2-NO	Y-A2
8C	LS2-C	Y-13
8D	LS3-NC	X-2
8E	TB-6	X-1
9	TB-7	AS-1
9A	AS-2	T-1
10	TB-8	AS-5
10A	AS-6	T-2
13	TB-9	AS-57
14	TB-10	AS-58
27	TB-1	LS1-NC
53	TB-11	AS-12
54	TB-12	AS-11
55	TB-13	AS-14
56	TB-14	AS-13
57	TB-15	AS-16
58	TB-16	AS-15
59	TB-17	AS-18
60	TB-18	AS-17
61	TB-19	AS-22
62	TB-20	AS-21
63	TB-21	AS-24
64	TB-22	AS-23
65	TB-23	AS-26
66	TB-24	AS-25
67	TB-25	AS-28
68	TB-26	AS-27

Figure 17. Standard Wiring Diagram

Maintenance

General

This instruction book section describes procedures to be followed when adjustments or part replacement is necessary. The step-by-step instructions given should be followed carefully to assure proper equipment operation. Reference to the included instruction leaflets and instruction books may be necessary.

Thorough, periodic inspection is important to satisfactory operation. Inspection and maintenance frequency depends on installation, site, weather and atmospheric conditions, experience of operating personnel and special operation requirements. Because of this, a well-planned and effective maintenance program depends largely on experience and practice.

WARNING

Failure to properly maintain the equipment could result in death, serious injury, product failure, and prevent successful functioning of connected apparatus.

To prevent:

The instructions contained herein should be carefully reviewed, understood and followed. The following maintenance procedures should be performed regularly:

STEP 1

Be sure that the circuit breaker and its mechanism are disconnected from all electric power, both high voltage and control voltage, before it is inspected or repaired.

STEP 2

After the circuit breaker has been disconnected from power lines, attach the grounding leads properly before touching any of the circuit breaker parts.

STEP 3

Be sure that the breaker is in the open position and that the mechanism closing spring is discharged before it is inspected or repaired.

STEP 4

Inspect the operating mechanism periodically and keep the bearing surfaces of the toggles, rods, and levers adequately lubricated where required.

DANGER

Hazardous voltage and mechanisms. Death or serious injury due to electrical shock, burns and entanglement in moving parts; or property damage will result if safety instructions are not followed:

To prevent:

1. Do not service or touch until you have de-energized high voltage, grounded all terminals and turned off control voltage. Grounding terminals with line to ground capacitors may produce a small arc.
2. Never trip or close the breaker while working on it, since the parts move rapidly and can cause injury.
3. Discharge the breaker's energy storage system before performing maintenance or inspection.
4. Secure the operator against accidental tripping when adjustments require breaker in closed position.
5. Breaker and its mechanism must be disconnected from all electrical power before performing maintenance or inspection. Grounding leads should be properly attached and framework grounded.
6. Never operate the breaker manually while it is energized or control power is connected.
7. Remove the maintenance closing device before operating the breaker.
8. Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices, instructions and maintenance procedures contained herein. The successful and safe operation of this equipment is dependent upon proper handling, installation, operation and maintenance.

STEP 5
Keep the mechanism clean.

STEP 6
Be sure the circuit breaker is well grounded.

STEP 7
See that bolts, nuts, washers, cotter pins and all terminal connections are in place and tight.

STEP 8
After all inspections or maintenance operate the breaker by hand to see that the mechanism works smoothly and correctly before operating it with power.

This checklist does not represent an exhaustive survey of maintenance steps necessary to ensure safe operation of the equipment. Particular applications may require further procedures. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local Siemens sales office.

WARNING

The use of unauthorized parts in the repair of the equipment, tampering by unqualified personnel, or incorrect adjustments could result in dangerous conditions which could cause serious injury or equipment damage.

To prevent:

Follow all safety instructions contained herein.

Ordering Replacement Parts

When ordering replacement parts for a Siemens Circuit Breaker, it is very important to give complete information. This information should include:

1. Breaker serial number. (On breaker nameplates.)
2. Type of operator. (On operator nameplate.)
3. Type of breaker.
4. Rated amperes of breakers.
5. Rated voltage of breaker.
6. Description of part. Use instruction book description insofar as possible.
7. Instruction book number. (On breaker nameplate.)
8. Instruction book reference number.
9. Number of pieces required.

While the breaker can be identified by the serial number alone, all additional information that is given will serve as a check to be certain that the part or parts furnished are correct for the breaker in question. Without this serial number Siemens cannot be sure of the correct identify of the desired parts.

If any doubt exists as to the instruction book reference number of the description, a dimensional sketch of the desired part will help to properly identify it.

Siemens recommends that a supply of repair parts be kept on hand so that emergency repairs can be made without waiting for shipment of parts from the factory. A list of recommended spare parts is sent with the breaker.

Before removing any part to be replaced, observe its function and adjustment. This usually saves adjustment time during installation.

Recommended Hand Tools

Type SDV circuit breakers use both standard American and metric fasteners. Metric fasteners are used in the vacuum interrupter assembly. American standard fasteners are used in most other locations.

Metric Tools

Deep Sockets: 18 and 24 mm
Torque Wrench: 0-150 Nm (0-100 lb-ft)

American

Socket and Open-end Wrenches: 5/16, 3/8, 7/16, 1/2, 9/16, 3/4
Hex Keys: 3/16, 1/4
Screw Drivers: 0.032 x 1/4 wide, and 0.055 x 7/16 wide
Pliers
Light Hammer
Drift Pins: 1/8, 3/16, 1/4 dia.

Recommended Inspections

Periodic inspections and maintenance are essential to obtain safe and reliable operation of the SDV circuit breaker.

When the circuit breaker is operated infrequently (less than 20 times per week) annual inspections are usually satisfactory. When the breaker is operated more than 20 times per week, or when adverse environmental conditions exist, more frequent inspections may be necessary.

Periodic inspections should include all the tasks shown in Table 1. Recommended procedures for each of the listed tasks is provided in this section of the manual.

Table 1. Inspection/Maintenance Tasks

--	Checks of primary power path
--	Checks of operator mechanism and interrupters
--	Electrical control checks
--	High potential test
--	Inspection and cleaning of breaker insulation
--	Functional tests

For a "quick reference" to these tasks, see the "Maintenance Tasks" chart at the end of this section.

Checks Of Primary Power Path

The primary power path consists of the three vacuum interrupters, six bus connections to the bushings, and the top mounted bushings. These components are checked for cleanliness and condition. The vacuum interrupters are also checked for vacuum integrity.

If preferred, the contact erosion check can be made during the manual spring charging check of the operator, since charging of the springs is necessary to place the contacts in the closed position.

The vacuum integrity check is usually performed in conjunction with the high potential tests.

These instructions follow the recommendation that these tests (contact erosion/manual spring charging, and vacuum integrity/high potential tests) will be combined as described.

Cleanliness Check

Figure 18 is a side view of the SDV circuit breaker with one of the phase barriers removed to show the vacuum interrupter, bus connections and bushings. All of these components must be cleaned and free of dirt or any foreign objects. Cleaning should be done with a lint free cloth.

Also inspect the buswork for any evidence of loose bolts, and bushings for any evidence of damage.

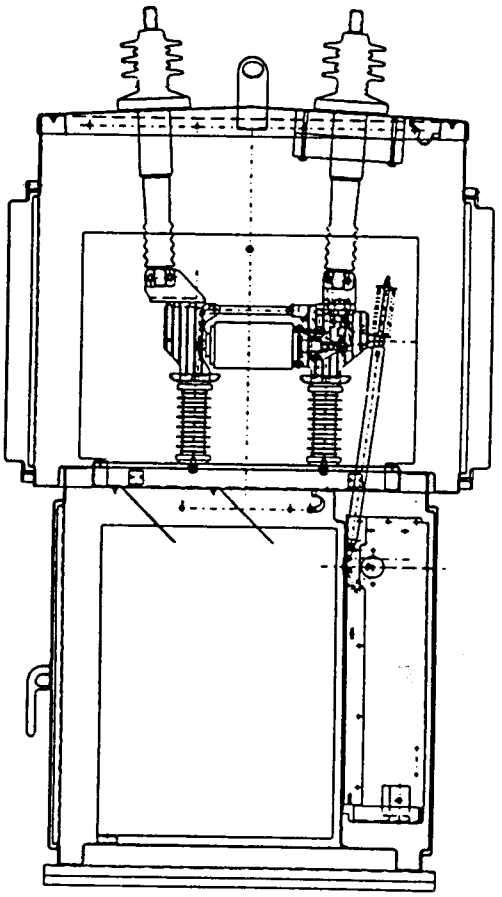


Figure 18. Side View SDV, Typical

Checks Of Interrupter Operator

The interrupter operator checks are divided into mechanical and electrical checks for simplicity and better organization.

Cleaning And Lubrication

The lubrication schedule is based on the requirements of ANSI C37.06, Table 8, for usual service conditions. The recommendations given reflect an average environment, and may need to be revised to accommodate local conditions.

Number of Closing Operations	Maintenance Intervals
1000	1 Year

Clean the entire operator mechanism with a lint-free cloth. Check all components for evidence of excessive wear, missing fasteners or retainers, or loose bolts. Replace any of these items which appear damaged or worn, or which appear to have been frequently removed and replaced. Special attention should be given to the closing spring cranks and the various linkages.

Bearings And Sliding Surfaces

Lubricate bearings and sliding surfaces such as cams with Beacon 325 or equivalent lubricant. This is available in convenient 1-ounce packets, Siemens P/N W962030.

Pivots And Articulated Joints

Use Tectyl 910 or SAE 10 motor oil with rust inhibitors.

Manual Spring Charging And Contact Erosion Checks

The Manual Spring Charging Check and Contact Erosion Check may be performed together for convenience, since several steps are common to both procedures.

1. Insert the hand charging lever into the hand lever slot at the front of the operator control panel (see Figure 19). Operate the lever up and down until the spring condition indicator flag shows CHARGED.
2. Press the Close pushbutton. The contact position indicator flag should show CLOSED.
3. Perform the contact erosion check as described in the following steps.

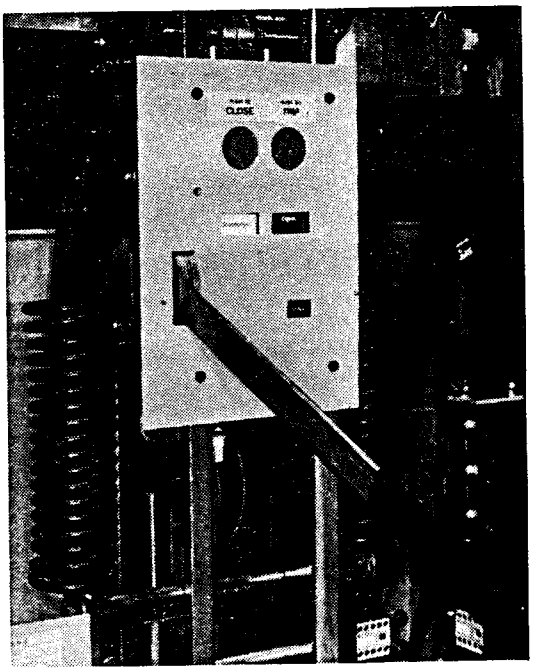


Figure 19. Manual Spring Charging

WARNING

Hazardous voltage and charged tripping spring.
Death or serious injury could result.

To prevent:

1. Remove all voltage from the circuit breaker before performing any work.
2. Observe precautions concerning physical contact with components of the breaker subjected to sudden high speed movement.

-- Be sure the primary contacts are closed.

-- Measure the gap between the end of the coupling rod and the bottom of the pivot block (see Figure 20). Subtract this measurement from the base dimension recorded on the decal next to the interrupter. If the difference is 0.22 inch or more, the interrupter must be replaced. See Appendix E for replacement procedures.

4. Press the TRIP pushbutton after completing the contact erosion check. Visually verify the discharged condition of the closing springs, and that the contact position indicator flag shows OPEN. The spring condition indicator flag should show DISCHARGED.

5. Press the CLOSE pushbutton. Nothing should happen.

Electrical Control Checks

The electrical controls of the SDV circuit breaker should be checked during annual inspections. It is important to identify any mechanical damage to controls and wiring, and to verify proper operation of automatic control functions such as spring charging, trip and close.

Unless otherwise noted, all of these tests are performed without any control power applied to the breaker.

Check Of The Wiring And Terminals

1. Physically check all of the breaker wiring for evidence of abrasion, cuts, burning or mechanical damage.

2. Check all terminals to be certain they are solidly attached to their respective device. Be sure to check the locking-type quick disconnects used at the close and trip solenoids and charging motor to be certain that they are fully seated and locked on.

Automatic Spring Charging Check

The circuit breaker must be supplied with control power for this check.

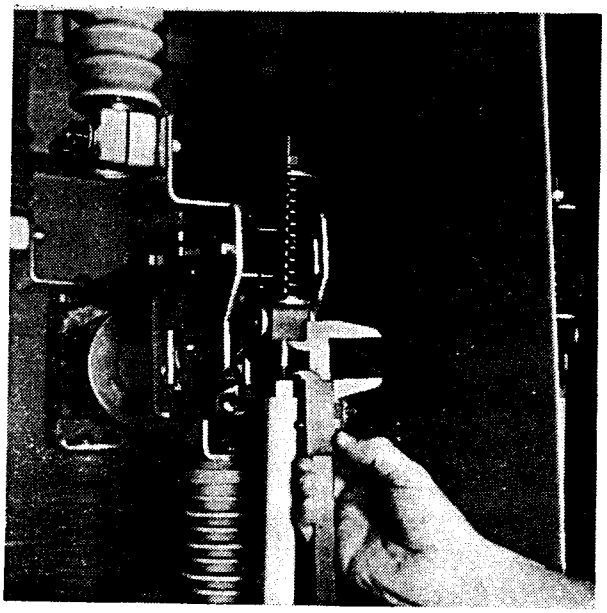


Figure 20. Erosion Check

1. When control power is applied, the motor should automatically charge the closing springs.

2. Visually verify that the closing springs have been charged (tensioned). The spring condition indicator flag should show CHARGED.

3. Proceed to Electrical Close and Trip Check, below.

Electrical Close And Trip Check

For breakers equipped with electrical close and trip switches (either pistol grip switch, or two pushbuttons):

1. Verify that the closing springs are CHARGED.

2. Move the pistol grip switch to CLOSE, or press the CLOSE pushbutton.

3. The breaker should close, and the contact position indicator flag should show CLOSED.

4. The motor should automatically recharge the closing springs, and the spring condition indicator flag should show CHARGED.

5. Move the pistol grip switch to TRIP, or press the TRIP pushbutton.

6. The breaker should open, and the contact position indicator flag should show OPEN.

Completion of these checks demonstrates satisfactory operation of auxiliary switches, internal relays and solenoids.

For breakers not equipped with electrical close and trip switches, perform the above checks by utilizing the remote control close and trip signals.

Check Of Spring Charging Motor

No additional checks of the spring charging motor are necessary. Once every 10,000 operations the motor brushes should be replaced. Use the operations counter to determine when brush replacement is required.

High Potential Tests

The next series of tests involve the use of high voltage test equipment. The breaker under test should be inside a suitable test barrier equipped with warning lights.

Electrical Vacuum Integrity Check

A high potential test is used to verify the vacuum integrity of the circuit breaker. This test is conducted on the circuit breaker with the primary contacts in the OPEN position.

DANGER

High Potential tests employ hazardous voltages.
Death or serious injury will result.

To prevent:

Follow safe procedures, exclude unnecessary personnel and use safety barriers. Keep away from the breaker during application of test voltages.

After test completion, ground both ends and the middle portion of the vacuum interrupter to dissipate any static charges.

CAUTION

Vacuum interrupters may emit X-ray radiation which may result in minor injury. X-rays can be produced when a high voltage is placed across two circuit elements in a vacuum.

To prevent:

Keep personnel more than six (6) feet away from a circuit breaker under test.

The test equipment shall be capable of supplying 27 kV, 60 Hz AC or 38 kV DC.

CAUTION

Hazardous radiation.
Minor injury may result.

To prevent:

To eliminate this hazard the low frequency withstand test must be performed with all covers on and the door closed.

Vacuum Integrity Test Procedure

Observe the safety precautions listed in the DANGER and CAUTION advisories. Construct the proper barrier and warning light system.

1. Ground each pole not under test.
2. Apply test voltage across each pole for one (1) minute.
3. If the pole sustains the test voltage for that period, the vacuum integrity of the pole has been verified.

As-Found Insulation Tests

As-found tests verify the integrity of the breaker insulation system. Megger or Doble tests conducted on equipment prior to installation provide a basis for future comparison to detect changes in the protection afforded by the insulation system. A permanent record of periodic as-found tests enables the maintenance organization to determine when corrective actions are required by watching for sudden deterioration in insulation resistance, or increases in contact resistance.

The following test equipment will be required in addition to the high potential test equipment used in the vacuum integrity test:

-- AC Hi-Pot tester with test voltage of 1125 volts, 60 Hz

-- Ductor for contact resistance

As-Found Test Procedure

1. Observe the safety precautions listed in the DANGER and CAUTION advisories for the vacuum check tests.

2. Close the circuit breaker. Ground each pole not under test. Use manual charging, closing and tripping procedures.

3. Apply the proper AC (27 kV) or DC (38 kV) high potential test voltage between a primary conductor of the pole and ground for one minute.

4. If no disruptive discharge occurs, the insulation system is satisfactory.

5. After test, ground both ends and the middle of each vacuum interrupter to dissipate any static charge.

6. Disconnect the leads to the charging motor.

7. Connect all points of the operator terminal block (located on the right side of the operator frame) with a shorting wire. Connect the shorting wire to the high potential lead of the high voltage tester. Ground the breaker housing. Starting with zero volts, gradually increase the test voltage to 1125 volts RMS, 60 Hz and maintain for one (1) minute.

8. If no disruptive discharge occurs, the secondary insulation level is satisfactory.

9. Disconnect the shorting wire from the terminal block. Reattach the leads to the spring charging motor.

10. Perform contact resistance checks of the primary contacts using a Ductor. Contact resistance should not exceed the values listed in the table below.

Current Rating (Amps)	Contact Resistance (Micro-Ohms)
1200	150
2000	130

11. Make a permanent record of all tests performed.

Inspection And Cleaning Of Breaker Insulation

1. Remove control power from the breaker.

2. Be sure that all springs are discharged by pressing the TRIP pushbutton, then pressing the CLOSE pushbutton, and again pressing the green TRIP pushbutton. Verify that the spring condition indicator flag shows DISCHARGED and the contact position indicator flag shows OPEN.

3. Remove the phase barriers and clean using one of the following solvents and a clean rag:

   -- Soap and water
   -- Either No. 1 or No. 2 denatured alcohol
   -- White kerosene
   -- Varsol No. 2
   -- VM and Naptha
   -- Either isopropyl or isobutyl alcohol

4. Clean post insulators and entry bushings using clean rags and one of the above solvents.

CAUTION

Cleaning compounds containing chlorinated hydrocarbons such as trichlorethylene, perchlorethylene or carbon tetrachloride may damage the material used in phase barriers or other insulation used in the circuit breaker.

To prevent:

Use only the cleaning solvents specified in the instruction manual.

5. Replace all barriers. Check fasteners for condition and tightness.

Functional Tests

Refer to the Installation Checklist in the Installation Checks and Initial Functional Tests section of this manual. Functional tests consist of performing at least three (3) Manual Spring Checks and three (3) Automatic Spring Charging Checks. After these tests are complete, and the springs fully discharged, all fasteners and connections should be rechecked for tightness and condition before placing the breaker back in service.

Bushing Current Transformer

The high voltage bushings extend through bushing current transformers mounted in the cover of the high voltage compartment. Three transformers are standard on each vacuum breaker; however, the BCT nameplate should be checked for the exact number, location, and rating. Space is available for 12 BCT's per breaker. The bushing current transformer connections are wired to separate terminal blocks located in the control and relay compartment.

DANGER

Hazardous voltage.
Death, serious injury, or damage to the circuit breaker will result.

To prevent:

Current transformers must not be operated with an open circuit and must be either connected to a burden or short circuited and grounded at the terminal blocks.

Relay Panel

The breaker can be equipped with a relay panel when required. A relay package can be supplied on a hinged panel mounted in the front of the control compartment. The following items can be accommodated on the swing out panel:

1. Breaker control switch with red and green indicating lights.
2. Three overcurrent phase relays.
3. One overcurrent ground relay.
4. Three ammeters.
5. One automatic reclosing relay.

Refer to the wiring and schematic diagrams, and other instruction literature shipped with the breaker for additional specific relay requirements.

Summary of Maintenance Tasks

Sub-Assembly	Item	Inspect For
Primary power path	Vacuum interrupter	1. Cleanliness 2. Contact erosion Note: Perform with manual spring checks 3. Vacuum integrity Note: Perform with high potential tests
Interrupter operator mechanism	Cleanliness	1. Dirt or foreign material
	Fasteners	1 Tightness of nuts and other locking devices
	Manual spring check	1. Smooth operation of manual charging, and manual closing and tripping
	Lubrication	1. Evidence of excessive wear 2. Lubrication of wear points
	Wiring	1. Mechanical damage or abrasion
Electrical controls	Terminals and connectors	1. Tightness and absence of mechanical damage
	Close and trip solenoids, anti-pump relay, auxiliary switches	1. Automatic charging 2. Close and trip with control power
	Spring charging motor (88)	1. Replace brushes after 10,000 operations
High potential test	Primary circuit to ground	1. 60 second withstand, 37.5 or 45kV, 60 Hz (depending upon voltage rating of breaker)
	Control circuit to ground	1. 60 second withstand, 1125V, 60 Hz
	Vacuum interrupter contact resistance	1. Record contact resistance with contacts closed, and re-check each year to monitor condition
Insulation	Barriers and all insulating components	1. Cleanliness 2. Cracking

Component Replacement

Introduction

This section provides information on the replacement of field serviceable components, and is a complement of the troubleshooting procedures given in Appendix C. This permits maintenance personnel to identify and correct malfunctions of the SDV operator mechanism.

Assistance with other problems may be obtained by contacting the nearest Siemens field service office.

WARNING

Hazardous voltages and mechanisms.
Death or serious injury could result.

To prevent:

Do not attempt work on the breaker until the breaker is completely de-energized and the operator springs have been discharged.

Replacement Of Closing Springs

Figure 21 shows the use of a 3/4 inch socket wrench to relieve spring tension on the closing springs. The bottom of the operator frame has holes which provide access to the tensioning bolts.

The bolts are turned clockwise to relieve the tension on the springs, alternating from the left bolt to the right bolt in small increments. This keeps the sliding cross arm relatively level as the tension is removed from the springs.

Once the tension has been relieved from the springs, retaining ring pliers are required to remove the top and bottom retaining rings which attach the spring to the cross shaft and crank arm.

When one or both springs are reinstalled, be sure the support bolts are inserted through the support bolt spacers. These spacers maintain the correct tension on the closing springs by limiting the travel of the sliding crossbar.

Position the closing springs over the ends of the crossbar and crank arms, and replace the washers and retaining rings to secure the spring ends.

Check the assembly to be sure the retaining rings are properly installed before retensioning the springs.

Retension the springs by turning the support bolts counterclockwise, alternating sides to keep the crossbar approximately level until the crossbar makes contact with the spacers.

Tighten the bolts firmly. Again check the assembly for proper installation of spacers, washers and retaining rings. This completes the replacement.

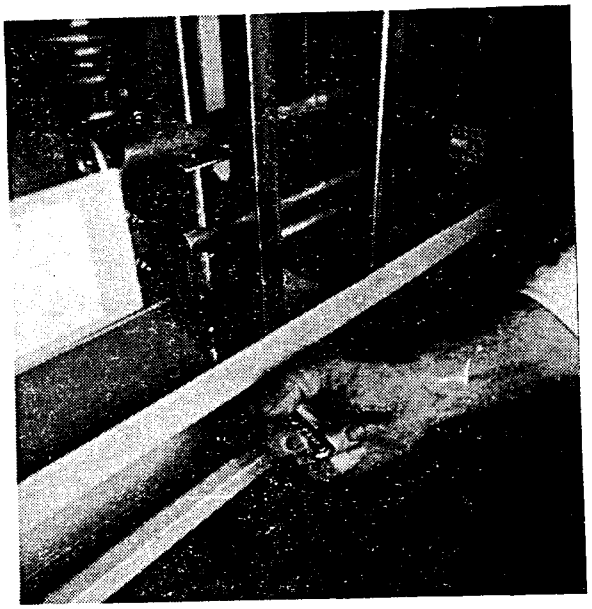


Figure 21. Closing Spring Removal

Replacement Of Opening (Trip) Spring

The opening spring is located on the left side of the operator mechanism as shown in Figure 22. The opening spring rod extends downward from the jackshaft, passing through a fixed bracket and through the center of the opening spring. The lower end of the spring is held by a spring cap retained by a nut and jam nut on the spring rod. There is sufficient thread length on the rod to assure that the spring is completely unloaded before the nut reaches the end of the rod.

The spring is removed by loosening the jam nut and then turning both nuts clockwise until the spring is unloaded and both nuts are disengaged from the spring rod. The end cap and spring may then be removed.

Replacement of the spring requires that the parts be assembled in the reverse order.

The opening spring has a free length of 8.5 inches, and when installed should be compressed to a length of 4.6 inches. The jam nut should be tightened firmly against the adjusting nut when the compressed length has been reached. Recheck the spring length to assure that the proper compressed length has been set.

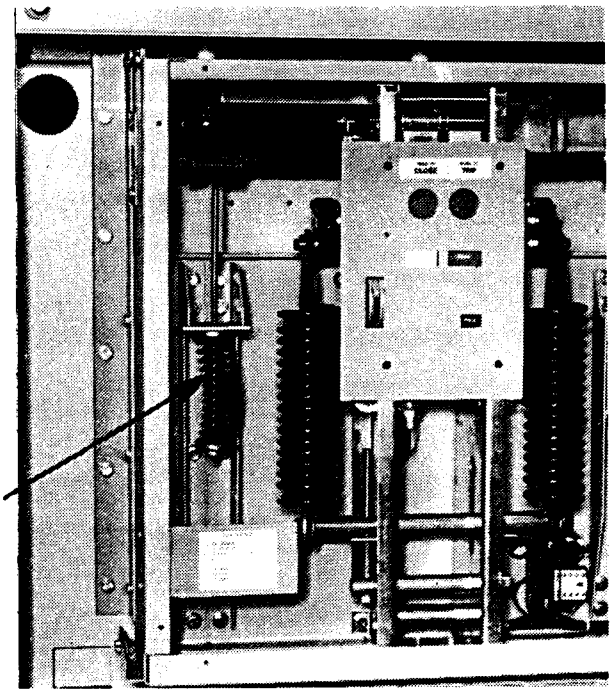


Figure 22. Trip Spring

Replacement Of Closing And Tripping Solenoids (Devices 52SRC And 52T)

Figure 23 shows the location of the closing solenoid (52SRC) and tripping solenoid (52T). Each solenoid has two mounting screws and one quick disconnect terminal. Either solenoid may be removed by disconnecting the terminal and removing the two mounting screws.

The replacement solenoid is installed by placing it in position and securing the two mounting screws. When reconnecting the terminal, be sure that the locking tabs are fully engaged.

No adjustments are required for either solenoid.

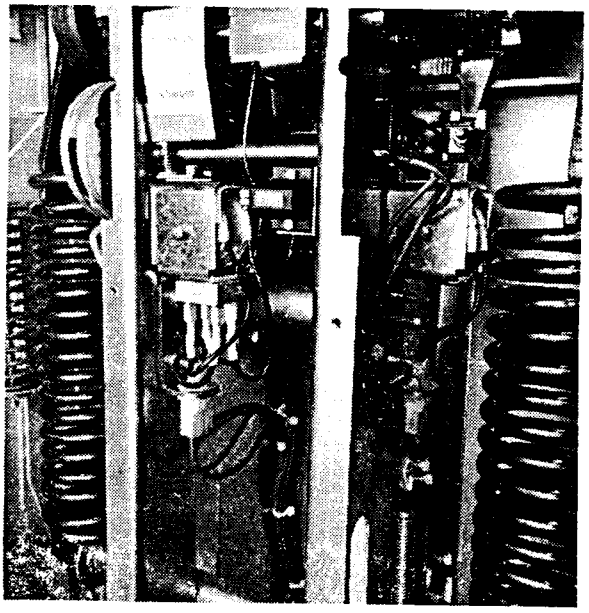


Figure 23. Close and Trip Solenoids

Appendix A1 -- SDV/A2 and G2 Ratings and Specifications

Ratings

Identification				Ratings					Related Capabilities		
		Voltage		Insulation Level		Current – Amp.			Current Values – Amp.		
Type	Nominal kV Class	Rated Max. kV	Rated Voltage Range Factor K	Rated Withstand Test Voltage		Rated Cont. at 60 Cycles*	Rated S.C. Current at Rated Max. kV	Interr. Time (Cycles)	Max. Symmetrical Capability RMS	3-Sec Short-Time Current Carrying Capability RMS	Closing and Latching Capability RMS
				Low Freq. (kV, RMS)	Impulse (kV, Crest)						
SDV-15-12.5	14.4	15.5	1	50	110	2,000	12,500	3	12,500	12,500	20,000
SDV-15-16	14.4	15.5	1	50	110	2,000	16,000	3	16,000	16,000	25,600
SDV-15-20	14.4	15.5	1	50	110	2,000	20,000	3	20,000	20,000	32,000
SDV-15-25	14.4	15.5	1	50	110	2000	25,000	3	25,000	25,000	40,000
SDV-25-16	23	25.8	1	60	150	1200/2000	16,000	3	16,000	16,000	25,600
SDV-25-20	23	25.8	1	60	150	1200/2000	20,000	3	20,000	20,000	32,000
SDV-25-25	23	25.8	1	60	150	1200/2000	25,000	3	25,000	25,000	40,000
SDV-27.6-12	25	27.6	1	60	150	1200/2000	12,500	3	12,500	12,500	20,000
SDV-27.6-16	25	27.6	1	60	150	1200/2000	16,000	3	16,000	16,000	25,600
SDV-27.6-20	25	27.6	1	60	150	1200/2000	20,000	3	20,000	20,000	32,000
SDV-27.6-25	25	27.6	1	60	150	1200/2000	25,000	3	25,000	25,000	40,000

*Refer to factory for other available ratings.

Specifications

ITEM	UNIT	SDV-15	SDV-25
Lightning Impulse Withstand Voltage			
Full Wave 1.2/50 s	kV	110	150
*Chopped Wave 2 s	kV	142	194
*Chopped Wave 3 s	kV	126	172
Rated Making Current	kA	---12.5/16/20/25---	
Closing and Latching Capability			
RMS	kA	--------40--------	
Peak	kA	--------63--------	
Normal Frequency	cycles	--------60--------	
Capacitance Switching			
Overhead Line	A	--------100--------	
Isolated Current	A	--------400--------	
Back to Back	A	--------400--------	
Closing Time (max)	ms	--------83--------	
Trip Time (max)	ms	--------36--------	
Rated Permissible Tripping Delay (Y)	sec	---------2---------	
Normal Operating Temperature Range			
Standard	°C	-------- -30-------	
Special	°C	-------- -40-------	
Phase Spacing	in.	13.5	13.5
Contact Gap ± .04	in.	0.63	0.63

*Breaker in closed position only.

ITEM	UNIT	SDV-15	SDV-25
External Creep			
Standard	in.	11	17
Special	in.	17	26
External Strike To Ground			
Standard	in.	6	7.5
Special	in.	7.5	10.5
Breaks Per Phase	--	---------1---------	
Auxiliary Voltage	Vdc Vac	--48/125/250-- ---115/230---	
Dual Trip Coils (mech. and elec. independent)	--	---Optional---	
Trip and Close Coil Rating	Vdc Vac	--48/125/250-- ---115/230---	
Operating Mechanism	--	--Stored Energy--	
Interrupting Medium	--	-----Vacuum-----	
Emergency Trip	--	----Optional----	
Rated Reclosing Time	Cycles	---------20---------	
RIV 1000kHz	V	---------500---------	
Rated Duty Cycle	--	--CO-15 Sec-CO--	
Seismic Withstand			
Standard	g	---------0.2---------	
Optional	g	----0.5 Horiz.---- ----0.375 Vert.----	
Rated Voltage Range Factor (k)	--	---------1.0---------	
Asymmetrical Int. Capability Ratio (S)	--	---------1.2---------	

Appendix A2 -- SDV/E1P Ratings and Specifications

Ratings

Identification				Ratings					Related Capabilities		
Type	Nominal kV Class	Voltage		Insulation Level		Current – Amp.			Current Values – Amp.		
		Rated Max. kV	Rated Voltage Range Factor K	Rated Withstand Test Voltage		Rated Cont. at 60 Cycles*	Rated S.C. Current at Rated Max. kV	Interr. Time (Cycles)	Max. Symmetrical Capability RMS	3-Sec Short-Time Current Carrying Capability RMS	Closing and Latching Capability RMS
				Low Freq. (kV, RMS)	Impulse (kV, Crest)						
SDV-15-12.5	14.4	15.5	1	50	110	1,200	12,500	3	12,500	12,500	20,000
SDV-15-16	14.4	15.5	1	50	110	1,200	16,000	3	16,000	16,000	25,600
SDV-15-20	14.4	15.5	1	50	110	1,200	20,000	3	20,000	20,000	32,000
SDV-15-25	14.4	15.5	1	50	110	1,200	25,000	3	25,000	25,000	40,000

*Refer to factory for other available ratings.

Specifications

ITEM	UNIT	SDV-15
Lightning Impulse Withstand Voltage		
Full Wave 1.2/50 s	kV	110
*Chopped Wave 2 s	kV	142
*Chopped Wave 3 s	kV	126
Rated Making Current	kA	—12.5/16/20/25—
Closing and Latching Capability		
RMS	kA	——40——
Peak	kA	——63——
Normal Frequency	cycles	——60——
Capacitance Switching		
Overhead Line	A	——100——
Isolated Current	A	——400——
Back to Back	A	——400——
Closing Time (max)	ms	——83——
Trip Time (max)	ms	——36——
Rated Permissible Tripping Delay (Y)	sec	——2——
Normal Operating Temperature Range		
Standard	°C	—— -30——
Special	°C	—— -40——
Phase Spacing	in.	13.5
Contact Gap ± .04__	in.	0.32

*Breaker in closed position only.

ITEM	UNIT	SDV-15
External Creep		
Standard	in.	11
Special	in.	17
External Strike To Ground		
Standard	in.	6
Special	in.	7.5
Breaks Per Phase	--	——1——
Auxiliary Voltage	Vdc	—48/125/250—
	Vac	—115/230—
Dual Trip Coils (mech. and elec. independent)	--	—Optional—
Trip and Close Coil Rating	Vdc	—48/125/250—
	Vac	—115/230—
Operating Mechanism	--	—Stored Energy—
Interrupting Medium	--	—Vacuum—
Emergency Trip	--	—Optional—
Rated Reclosing Time	Cycles	——20——
RIV 1000kHz	V	——500——
Rated Duty Cycle	--	—CO-15 Sec-CO—
Seismic Withstand		
Standard	g	——0.2——
Optional	g	—0.5 Horiz.— —0.375 Vert.—
Rated Voltage Range Factor (k)	--	——1.0——
Asymmetrical Int. Capability Ratio (S)	--	——1.2——

Appendix B -- Electrical Control Data

TYPICAL DATA
Close Coil
Trip Coil
Spring Charging Motor

Control Voltages, ANSI C37.06 Table 10			Close Coil	Trip Coil	Spring Charging Motor		
Nominal	Range				Amperes		Charging
	Close	Trip	Amperes*	Amperes*	Run (Avg.)	Inrush (Peak)	Seconds
48 VDC	38-56	28-56	9	9	8.5	12.6	10
125 VDC	100-140	70-140	4	4	2.7	10.2	10
250 VDC	200-280	140-280	2	2	1.3	7.4	10
120 VAC	104-127	104-127	4	4	3.3	10.6	10
240 VAC	208-254	208-254	2	2	1.7	7.1	10

*Current at nominal voltage.

INTERRUPTING CAPACITY
Auxiliary Switch Contacts

Type Auxiliary Switch	Continuous Current Ampere	Control Circuit Voltage				
		120 Ac	240 Ac	48 Dc	125 Dc	250 Dc
		Non-inductive circuit interrupting capacity in amperes				
Breaker Auxiliary Switch	20	20	20	20	10	2
		Inductive circuit interrupting capacity in amperes				
Breaker Auxiliary Switch	20	20	20	20	10	2

HEATER DATA

High Voltage Compartment	W	200*
Control and Mechanism Compartment	W	100
Low Temperature (Special -40°C)	W	250**

* Thermostat controlled and set to turn off at 95°F
**Thermostat controlled and set to turn off at 10°F

Appendix C -- Troubleshooting Guide

Problem	Symptoms	Possible Causes and Remedies
Breaker Fails to Close	Closing springs will not automatically charge.	1. Secondary control circuit is de-energized or control circuit fuses are blown. Check and energize or replace if necessary. 2. Damage to wiring, terminals or connectors. Check and repair as necessary. 3. Failure of charging motor (88). Check brushes and replace if required. 4. Motor cut-off switch (LS1) fails to operate. Replace if necessary. 5. Mechanical failure of closing springs or tie-bar assembly. Check and replace as required. 6. Mechanical failure of operating mechanism. Refer to factory or authorized service shop.
Breaker Fails to Close	Closing springs charge, but breaker does not close. -- Closing coil or solenoid (52SRC) fails to energize. No sound of breaker closing	1. Secondary control circuit de-energized, or control circuit fuses blown. Correct as indicated. 2. TB4, TB4 connections. Check and correct as required. 3. Failure of anti-pump relay (52Y) contacts 21-22 or 31-32 or 13-14. Check and replace as required. 4. Failure of close coil (solenoid) (52SRC). Check and replace as required. 5. Auxiliary switch NC contacts 3-4 are open when breaker contacts are open. Check linkage and switch. Replace or adjust as necessary. 6. Spring charged switch (LS2) NO contact remains open after springs are charged. Check and replace as required. 7. Mechanical failure of operating mechanism. Check and contact factory or authorized service shop.

Appendix C -- Troubleshooting Guide

Problem	Symptoms	Possible Causes and Remedies
Breaker Fails to Close	-- Closing coil energizes. Sound of breaker closing is heard, but breaker contacts do not close.	1. Mechanical failure of operating mechanism. Check and contact factory or authorized service shops.
Nuisance or False Close	Electrical Problem	1. Nuisance or false closing signal to secondary disconnect contact 13. Check relay logic. Correct as required. 2. Closing coil (52SRC) terminal 2 is shorted to ground. Check to determine if problem is in wiring or coil. Correct as required.
Nuisance or False Close	Mechanical Problem	1. Mechanical failure of operating mechanism. Check and contact factory or authorized service shop.
Circuit Breaker Will Not Trip	Tripping coil, or solenoid (52T) does not energize. There is no tripping sound.	1. Secondary control power is de-energized or control power fuses are blown. Correct as indicated. 2. Damage to wiring, terminals or connectors. Check and repair as necessary. 3. Failure of trip coil (52T). Check and replace if necessary. 4. Auxiliary switch NO contacts 1-2 or 5-6 are open when breaker is closed. Check linkage and switch. Replace or adjust as necessary. 5. Mechanical failure of operating mechanism. Check and contact factory or authorized service shop.

Appendix C -- Troubleshooting Guide

Problem	Symptoms	Possible Causes and Remedies
Circuit Breaker Will Not Trip	Tripping coil (52T) energizes. No tripping sound is heard, and breaker contacts do not open (i.e., they remain closed).	1. Failure of tripping spring or its mechanical linkage. Check and replace if required.
Circuit Breaker Will Not Trip	Tripping coil (52T) energizes. Tripping sound is heard, but breaker contacts do not open.	1. Mechanical failure of operating mechanism. Check and contact factory or authorized service shop. 2. One or more of the vacuum interrupters are held closed. Check and replace as necessary.
Nuisance or False Trip	Mechanical Problem	1. Mechanical failure of operating mechanism. Check and contact factory or authorized service shop.

Appendix D -- Operator Adjustments

The following adjustments are not required during routine maintenance of the breaker. These adjustments should be considered if:

1. The spring charging motor runs but does not advance the ratchet wheel (springs do not charge).

2. The breaker does not close and open in a normal manner, electrical controls check out is satisfactory.

Before these adjustments can be made, the front panel of the operator must be removed to gain access to the adjustment points of the mechanism.

Spring Charging Adjustment (Figure 24)

1. Remove the spring charging motor.

2. Install a 1/2 inch drive extension and ratchet wrench in the eccentric drive shaft.

3. Rotate the eccentric shaft until the eccentric is at its maximum inward position.

4. Adjust the hex socket screw (66) until the driving surface of the upper pawl is approximately 0.031 inch from the face of the ratchet tooth.

5. Mount the spring charging motor and operate the charging system electrically. Adjust the hex socket screw (66) until the ratchet moves with minimum noise.

6. Lock the screw in position using the lock nut.

This completes the adjustment of the charging system mechanism.

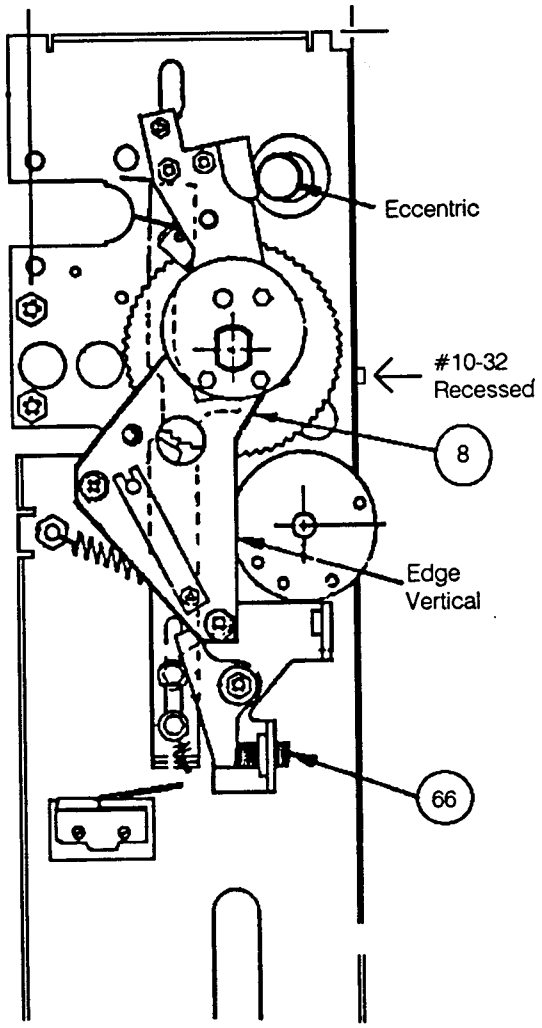


Figure 24. Charging Adjustment

Appendix D -- Operator Adjustments

Spring Release Latch "Bite" Adjustment

1. Remove front panel of operator.
2. Find spring release latch adjusting screw located in the vertical flange of the operator (10-32 recessed, see Figure 24).
3. Nominal latch bite adjustment occurs with the latch lying in the horizontal position as shown in the accompanying figure. This position is achieved when the adjusting screw has been turned into the prevailing torque self clinching nut 14 full turns.

The set screw will be within 1 to 2 turns of being flush to the self clinching nut, protruding slightly.

The adjusting screw should <u>not</u> be advanced more than 16 turns. Four turns beyond the nominal 14 turns is sufficient to reach the "threshold" beyond which the spring release will occur and latch stability will be lost.

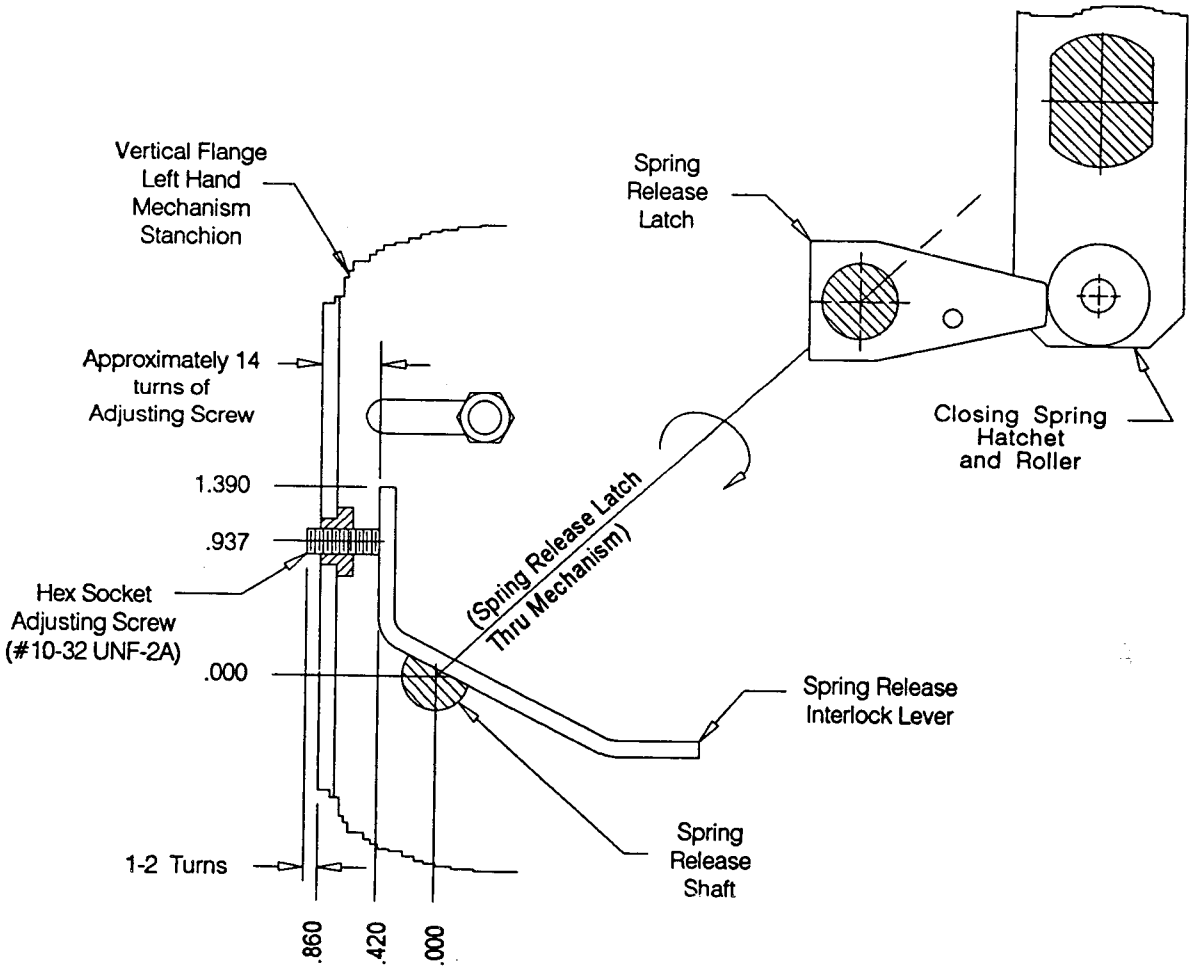


Figure 25. Trip Adjust Screw

Appendix E -- Vacuum Interrupter Replacement And Adjustment (Figure 26)

The following steps should be followed whenever it is necessary to remove or replace an interrupter.

DANGER

Hazardous voltage.
Death, serious injury, or damage to the circuit breaker will result.

To prevent:

Do not touch or service until you have de-energized the high voltage, grounded the entrance bushings and turned off control voltage.

Removal Of Interrupter

Before starting work, be sure that the operator springs have been discharged and the breaker is open. Verify that the indicator flags read DISCHARGED and OPEN. The procedure for achieving these conditions is given on page 5, SPRING DISCHARGE CHECK.

1. Remove the phase barriers from the high voltage compartment for easier access to the interrupters. Set aside for reinstallation later.

2. Remove the two snap rings from either end of the pins of the pivot block. With a large flat bladed screwdriver, pry the lever arms from the pivot block. Grasp and pull the coupling rod toward you with one hand while prying the lever off the pin, first on one side, then on the other side of the pivot block. Once both levers are free from the pivot block pins, the levers will be pulled down abruptly due to the vacuum pulling the interrupter closed.

3. Locate the small pin passing through the levers and the eye of the rod end bearing of the interrupter. Remove the two snap rings from the ends of this pin and push the pin out through the side openings of the polehead. Retain the pin, spacers and snap rings for later use.

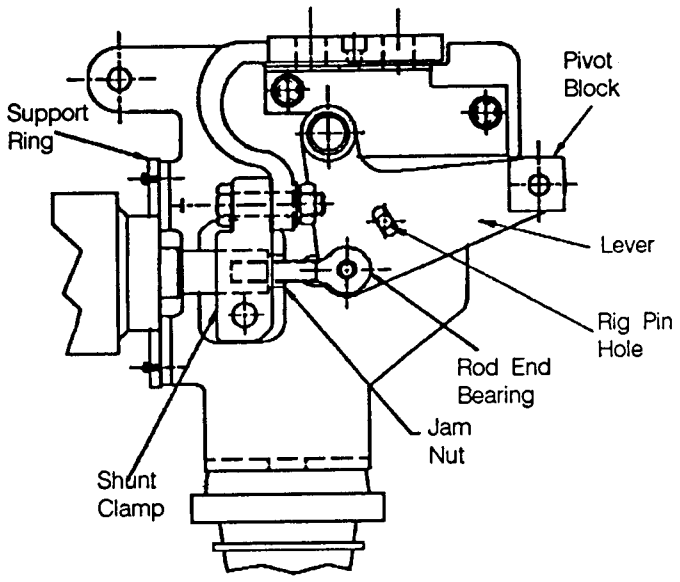


Figure 26. Polehead Assembly

4. Loosen the jam nut on the rod end bearing. Remove the rod end bearing by turning counterclockwise.

5. Loosen the shunt clamp bolt at the moving terminal of the interrupter. The shunt clamp should be free to move on the terminal. If not, remove the clamp bolt completely and spring the clamp open with a flat bladed screwdriver.

6. Remove the cap screws (three for G2, one for E1) in the stationary end of the interrupter. Move the stationary end of the interrupter sideways until it is clear of the small polehead and withdraw the interrupter.

Appendix E -- Vacuum Interrupter/Replacement And Adjustment (Figure 26)

Replacement Of Interrupter

7. Inspect the replacement interrupter for evidence of damage such as dents, cracks or chips. Manually pull on the moving terminal of the interrupter to check vacuum integrity; there should be a noticeable resistance to movement (approximately 20 lbs).

8. Position the interrupter with the slot in the moving terminal uppermost and slide the moving terminal through the plastic support ring on the large polehead. Move the stationary end of the interrupter into position on the small polehead and install the cap screws (three for G2, one for E1) into the interrupter finger tight only.

9. Check the end of the interrupter at the large polehead to be sure that the body of the interrupter is supported in the plastic ring. This is a snug fit and may require a slight twisting motion.

10. Check the orientation of the moving terminal slot to be sure it is positioned at the top. While maintaining this position, tighten the cap screws (three for G2, one for E1) to 60 lb-ft.

11. Slide the shunt clamp over the moving terminal and position the clamp firmly against the shoulder on the terminal. Replace the clamp bolt and nut, and tighten firmly. Check to be sure the shunt clamp is positioned vertically and has adequate clearance on both sides. If the clamp is tilted, reposition vertically and retighten.

12. Thread the jam nut onto the rod end bearing as far as it will go, and then screw the rod end bearing into the moving terminal approximately half way. DO NOT TIGHTEN AT THIS TIME.

13. Place a .250 inch drill rod or No. 2 Phillips screwdriver through the rig pin hole in the side of the polehead. Pass the rod through the slots in the levers and then through the rig pin hole in the oppcsite side of the polehead. This locks the levers in a fixed position for adjusting the drive mechanism.

14. Push the small pin removed in Step 5 through the open hole in a lever, through the rod end bearing, and through the other lever. If the holes do not line up to permit this, the rod end bearing must be screwed in or out until the pin passes freely through both levers and the rod end bearing. USE CARE IN THIS ADJUSTMENT. THE PIN MUST PASS THROUGH ALL THREE HOLES WITH A LIGHT PRESSURE BY HAND.

15. Maintain the position of the rod end bearing while tightening the jam nut against the terminal end to approximately 20 lb-ft. WHEN PROPERLY INSTALLED, THE ROD END BEARING WILL BE IN A VERTICAL POSITION.

16. Remove the small pin and reassemble with the spacers and snap rings removed in Step 5. BE SURE THE SNAP RINGS ARE FIRMLY SEATED IN THEIR GROOVES. REPLACE THE RINGS IF THEY ARE BENT OR FEEL LOOSE AFTER INSTALLATION.

17. With the .250 inch drill rod in place, pull the coupling rod into firm contact with the side of the pivot block. While maintaining this position, check to see that the top of the coupling rod is flush with the top of the pivot block. This is the correct adjustment of the coupling rod.

18. If the coupling rod is higher or lower than the top of the pivot block, the coupling rod must be readjusted. Locate the LOWER end of the coupling rod, where it attaches to the operator jackshaft levers. The threaded stud of the coupling rod passes through a threaded hole in the jackshaft lever pin, and has a jam nut above and below the lever pin. Loosen the upper and lower jamnuts to permit the rotation of the coupling rod. These parts have been assembled using a serviceable threadlocking adhesive and will have some resistance to turning.

19. Adjust the coupling rod as follows:

    a. If the coupling rod extends above the top surface of the pivot block, turn the coupling rod clockwise until the surfaces are flush.

b. If the coupling rod is below the top surface of the pivot block, turn the coupling rod counterclockwise until the surfaces are flush.

c. Apply fresh serviceable threadlocking adhesive Loctite 242 to the threads between the jam nuts and the jackshaft pin. Tighten the jam nuts securely.

20. REMOVE THE DRILL ROD FROM THE LARGE POLEHEAD AT THIS TIME.

21. Twist the pivot block so that the axis of the block pins approach the axis of the lever holes at approximately 45°. Manually raise the levers. When the lever pole is aligned with the most forward pin, push on the coupling rod to lock that lever in position. Apply pressure while prying the other lever outward to pass over the other pin. As the last pin passes between the levers, the first pin will snap into its hole. The second lever may have to be raised or lowered to align with its hole. Replace the snap rings on the ends of the pivot block pins.

22. This completes the installation and adjustment of the interrupter. Operate the breaker manually several times and recheck all fasteners to assure that they are properly installed or tightened.

23. Replace the phase barriers removed in Step 1.

Appendix F -- Vacuum Interrupter Stroke Check (Figure 27)

Careful use of the setup procedure given in Appendix E will result in accurate setting of the stroke and synchronization of the three phases. The procedure outlined below is useful as a check following adjustment, replacement or other service of the operating linkages but is not intended as a substitute for the setup procedure of Appendix E. The accuracy of stroke measurement is highly dependent on the care and consistency used in determining the two dimensions required.

⚠ DANGER

Hazardous voltage.
Death, serious injury, or damage to the circuit breaker will result.

To prevent:

Do not touch or service until you have de-energized the high voltage, grounded the entrance bushings and turned off control voltage.

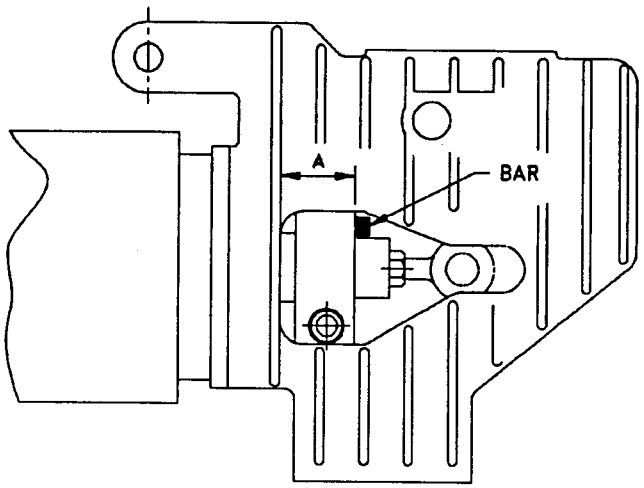


Figure 27 – Vacuum Interrupter Stroke Check

1. Place the breaker in the OPEN position.
2. Hold a straight, rectangular bar against the face of the shunt clamp as shown in Figure 27 so that the bar extends out through the window in the side of the polehead.
3. Measure dimension "A" using a caliper (preferred) or steel rule (less accurate). The dimension will be taken between the face of the rectangular bar and the vertical fin at the large end of the window. Note this reading.
4. Remove the rectangular bar, then place the breaker in the CLOSED position.
5. Place the rectangular bar against the shunt clamp in the same position used in Step 2.
6. Measure dimension "A" using the caliper or scale in the same manner as in Step 3. This dimension will be smaller. Note this dimension.
7. Subtract the second dimension from the first. The difference is the stroke of the interrupter.
8. Repeat for all phases if desired.
9. The stroke should be very close to the contact gap given in Appendix A1 and A2.

SIEMENS

Siemens Energy & Automation, Inc.
Power Products Division
P.O. Box 6289
Jackson, MS 39288-6289
Phone: 601-939-0550
Fax: 601-939-3606

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