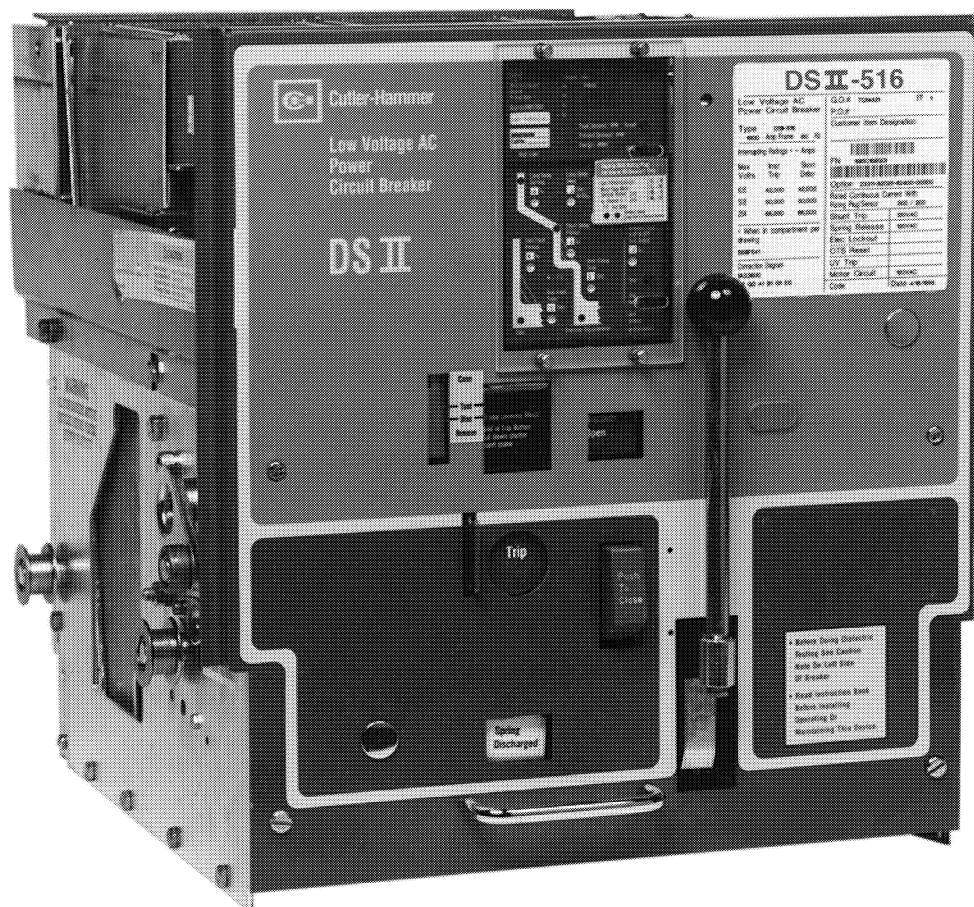




Instructions for Installation, Operation and Maintenance of Low Voltage Power Circuit Breakers Types DSII and DSLII



PURPOSE

This instruction manual is expressly intended to cover the installation, operation and maintenance of Types DSII and DSLII Power Circuit Breakers and Type DSII Drawout Fuse Trucks. These breakers are usually supplied as part of low voltage metal enclosed drawout switchgear. This manual applies only to the circuit breakers and their details. Type DSII breakers, not Type DSLII, may also be supplied as fixed mounted units. In the case of fixed versions of the Type DSII breaker, certain sections of this manual referring to such items as position interlocks and the drawout mechanism will not apply.

Trip units associated with Type DSII and DSLII Power Circuit Breakers will be addressed in a general manner in this manual. Specific trip unit details and time-current characteristic curves are covered in a separate document specific to the trip unit itself.

For information concerning Types DSII and DSLII Power Circuit Breakers, Type DSII Drawout Fuse Trucks and their accessories consult the applicable Instruction Book or other descriptive publications.

For application information, consult Cutler-Hammer Inc., see applicable Descriptive Bulletins, Application Publications and/or Industry Standards.

SAFETY

All safety codes, safety standards and/or regulations must be strictly observed in the installation, operation and maintenance of this equipment.



WARNING

THE WARNINGS AND CAUTIONS INCLUDED AS PART OF THE PROCEDURAL STEPS IN THIS MANUAL ARE FOR PERSONNEL SAFETY AND PROTECTION OF EQUIPMENT FROM DAMAGE. AN EXAMPLE OF A TYPICAL WARNING LABEL HEADING IS SHOWN ABOVE TO FAMILIARIZE PERSONNEL WITH THE STYLE OF PRESENTATION. THIS WILL HELP TO INSURE THAT PERSONNEL ARE ALERT TO WARNINGS. IN ADDITION, CAUTIONS ARE ALL UPPER CASE AND BOLDFACE.

All possible contingencies which may arise during installation operation or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation or maintenance of particular equipment, contact the local Cutler-Hammer Inc. representative.

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SECTION 1: INTRODUCTION

1-1 GENERAL INFORMATION

Type DSII and DSLII Power Circuit Breakers are horizontal drawout magnetic air circuit breakers utilizing an electronic tripping system. They are designed for use in metal enclosed switchgear assemblies having maximum voltages of 635 volts AC for Type DSII breakers and 600 volts AC for Type DSLII breakers. Depending on the specific breaker being considered, DSII and DSLII breakers are available in frame sizes from 800 through 5000 amperes with interrupting ratings as high as 85,000 amperes rms symmetrical for Type DSII and 200,000 amperes rms symmetrical for Type DSLII breakers. (Figure 1-1, Tables 1.1 and 1.2). The breaker nameplate provides complete rating information and all DSII breakers conform to applicable NEMA, ANSI and IEEE standards (Figure 1-2).

Each DSII and DSLII breaker consists of a basic breaker assembly, three interrupter assemblies (arc chutes), barriers and an electronic trip unit. DSLII breakers have integrally mounted, series connected current limiters. The purpose of the current limiters is to extend the interrupting rating of the standard DSII breaker (Figure 1-3).

The Type DSII breaker is a four position drawout (Connect, Test, Disconnect and Remove) design supplied with either a manually or electrically operated, two-step stored energy mechanism. This type of mechanism assures positive control at the instant of closing the main contacts.

Controls and indicators are functionally grouped on the front of the breaker. The faceplate, in conjunction with a closed breaker compartment door, provides a double steel safety barrier.

DSII breakers can be withdrawn on extension rails for inspection, minor maintenance or a visual inspection of the inside of the breaker compartment. The captive extension rails are a permanent part of the breaker compartment (Figure 1-4).

NOTICE

Please read and understand these instructions before attempting to unpack, operate or maintain this equipment. Study the breaker and its mechanism carefully before attempting to operate it on an energized circuit.

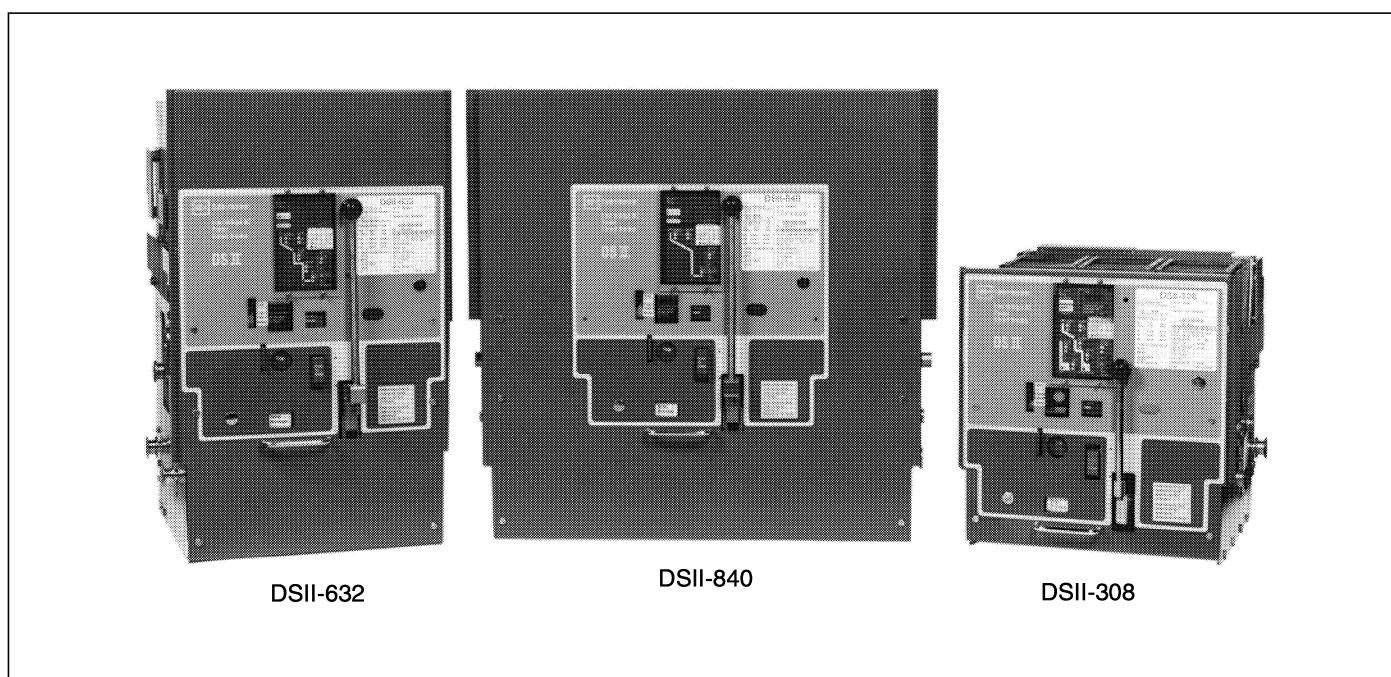


Figure 1-1 Type DSII Circuit Breaker Family

**WARNING**

TYPE DSII AND DSLII BREAKERS ARE PROTECTIVE DEVICES. AS SUCH, THEY ARE MAXIMUM CURRENT RATED DEVICES. THEREFORE, THEY SHOULD NOT UNDER ANY CIRCUMSTANCES BE APPLIED OUTSIDE THEIR NAMEPLATE RATINGS. OPERATION OUTSIDE OF THESE RATINGS COULD RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

1-2 SAFETY FEATURES

Types DSII and DSLII Circuit Breakers and associated drawout equipment are manufactured with built-in interlocks and safety related features. They are provided to reduce hazards to operating personnel and provide proper operating sequences.

**WARNING**

TYPES DSII AND DSLII CIRCUIT BREAKERS ARE STRONGLY BUILT AND PROVIDED WITH SAFETY FEATURES. NEVERTHELESS, THE VOLTAGES,

CURRENTS AND POWER LEVELS AVAILABLE IN AND AROUND THIS EQUIPMENT WHEN IT IS IN OPERATION ARE EXTREMELY DANGEROUS AND COULD BE FATAL UNDER NO CIRCUMSTANCES SHOULD INTERLOCKS AND OTHER SAFETY FEATURES BE MADE INOPERATIVE, AS THIS MAY RESULT IN DEATH, BODILY INJURY OR PROPERTY DAMAGE.

1-3 SAFETY PRACTICES

To protect personnel associated with the installation, operation and maintenance of this equipment, the following practices must be followed:

1. Only qualified electrical personnel familiar with the equipment, its operation and the associated hazards should be permitted to work on the equipment. Additionally, only qualified personnel should be permitted to install or operate the equipment.
2. Always be certain that the primary and secondary circuits are de-energized or the circuit breaker is removed to a safe work location before attempting any maintenance.
3. For maximum safety, only insert a completely assembled breaker into an energized cell.

Table 1.1 Type DSII Breaker Ratings

Breaker Type	Frame Size, Amp.	Interruption Ratings, RMS Symmetrical Amperes ^①					
		With Instantaneous Trip			With Short Delay Trip ^{②③}		
		208-240 V	480 V	600 V	208-240 V	480 V	600 V
DSII-308	800	42,000	30,000	30,000	30,000	30,000	30,000
DSII-508	800	65,000	50,000	42,000	50,000	50,000	42,000
DSII-608	800	65,000	65,000	50,000	65,000	65,000	50,000
DSII-516	1600	65,000	50,000	42,000	50,000	50,000	42,000
DSII-616	1600	65,000	65,000	50,000	65,000	65,000	50,000
DSII-620	2000	65,000	65,000	50,000	65,000	65,000	50,000
DSII-632	3200	85,000	65,000	65,000	65,000	65,000	65,000
DSII-840	4000	130,000	85,000	85,000	85,000	85,000	85,000
DSII-850	5000	130,000	85,000	85,000	85,000	85,000	85,000

① Maximum voltages at which the interrupting ratings apply are:

System Voltage	Maximum Voltage
208 or 240	254
480	508
600	635

② Also short-time ratings.

③ Short circuit ratings of non-automatic breakers except the DSII-840/850 which is 65,000.

4. Always insure that drawout breakers are in one of their designed cell positions, such as Connected, Test, Disconnected or Withdrawn. A breaker permitted to remain in an intermediate position could result in control circuits being improperly connected resulting in electrical failures.



1-4 QUALIFIED PERSONNEL

For the purpose of operating and maintaining low voltage circuit breakers, a person should not be considered qualified if the individual is not thoroughly trained in the operation of the circuit breaker and how it interfaces with a switchboard. In addition, the individual should have knowledge of the connected loads.

For the purpose of installing and inspecting circuit breakers and their associated switchboard, a Qualified Person should also be trained with respect to the hazards inherent to working with electricity and the proper way to perform such work. The individual should be able to de-energize, clear and tag circuits in accordance with established safety practices.

1-5 OTHER PUBLICATIONS AND DOCUMENTATION

In addition to this instruction manual, other printed information and documentation is available and supplied as appropriate. This additional information can include, but not necessarily be limited to, an instruction manual for the specific electronic trip unit being used with the circuit breaker, a Renewal Parts Data Book, and necessary dimensional drawings.

DSII-516		
Low Voltage AC Power Circuit Breaker		
G.O.#	TQ14421	IT 1
P.O.#		
Customer Item Designation		
		
FN 895C189G01		
		
Option 2331F-82025-62400-00000		
Rated Continuous Current With Rating Plug/Sensor 200 / 200		
Shunt Trip	120VAC	
Spring Release	120VAC	
Elec Lockout		
OTS Reset		
UV Trip		
Motor Circuit	120VAC	
Code	Date 4/18/1995	

1600 Amp Frame 60 Hz		
Interrupting Ratings * - Amps		
Max Volts	Inst Trip	Short Delay
635	42,000	42,000
508	50,000	50,000
254	65,000	65,000
* When in compartment per drawing		
568F541		
Connection Diagram		
1A33600		
D0 G0 A1 B1 G1 E0		

Figure 1-2 Typical DSII Nameplate

Table 1.2 Type DSLII Breaker and Combination Ratings

Type	Frame Size, Amp.	Max Interrupting Rating, RMS Sym. Amp., System Voltage 600 or Below
DSLII-308 ^①	800	200,000
DSLII-516 ^①	1600	200,000
DSLII-620 ^①	2000	200,000
DSLII-632 ^②	3200 ^④	200,000
DSLII-840 ^③	4000	200,000

① Limiter Integral with drawout breaker element.

② DSLII-632 breaker and DSII-FT32 drawout fuse truck in separate interlocked compartments.

③ DSII-840 breaker and DSII-FT40 drawout fuse truck in separate interlocked compartments.

④ Maximum continuous rating limited to 3000A when fuse truck compartment is above breaker compartment.

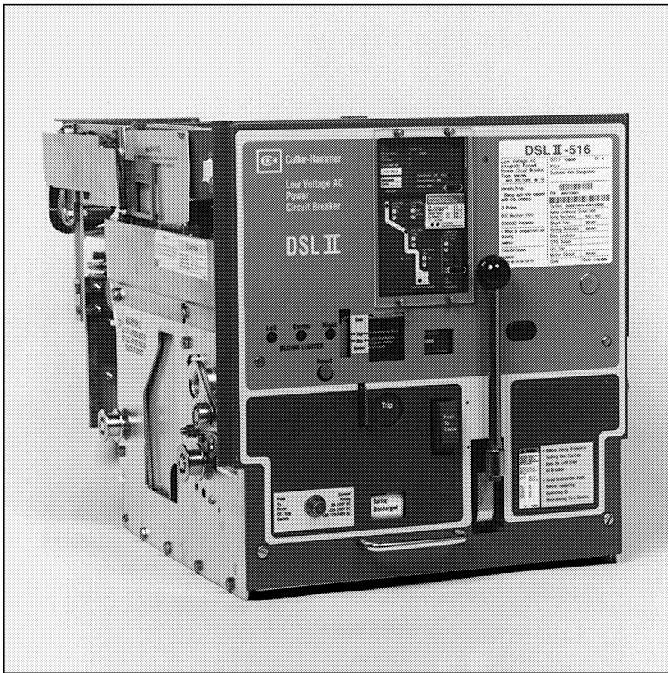


Figure 1-3 Type DSLII Breaker with Integral Current Limiters

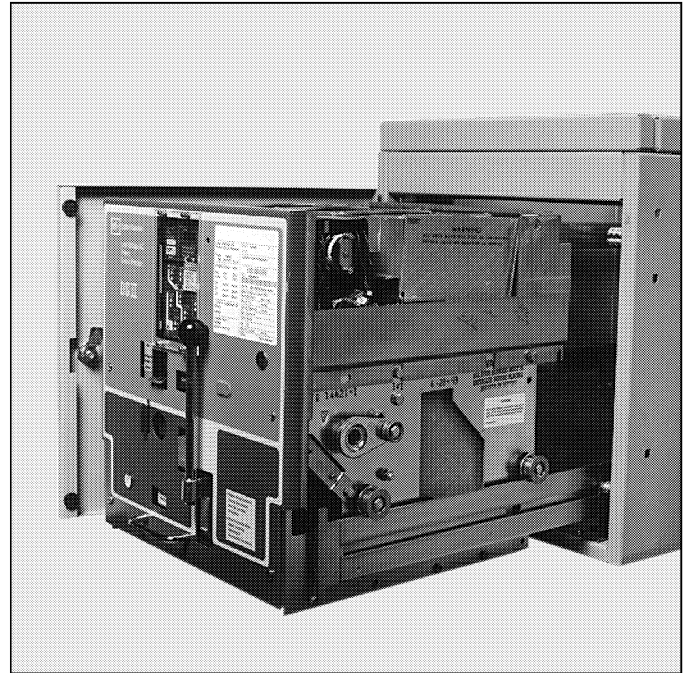


Figure 1-4 DSLII Breaker Shown on Compartment's Captive Extension Rails

SECTION 2: RECEIVING, HANDLING AND INSTALLATION

2-1 GENERAL INFORMATION

Types DSII and DSLII Circuit Breakers, when supplied as part of a metal-enclosed switchgear assembly, may be shipped completely assembled and already installed in their respective breaker compartments. Receiving and handling of this equipment is addressed in an assembly instruction manual supplied with the assembled equipment. This instruction manual still applies, however, to all other aspects of the circuit breakers.

Before beginning to unpack new DSII breakers, read and understand these directions. Following the directions will ensure that you have caused no damage.

Every effort is made to insure that DSII breakers arrive at their destination undamaged and ready for installation. Care should be exercised, however, to protect the breakers from impact at all times. Do not remove protective packaging until the breakers are ready for inspection, testing and/or installation. Shipping containers should be inspected for obvious signs of rough handling and/or external damage incurred during the transportation phase. Record any observed damage for reporting to the transportation carrier and Cutler-Hammer, once the inspection is completed. All reports and claims should be as specific as possible and include shop order and general order information.

2-2 UNPACKING CIRCUIT BREAKER

When ready to inspect and install the DSII breaker, carefully open the shipping container and remove any packing material and any internally packed documentation. The circuit breaker is designed and balanced to be easily lifted from the shipping container using the appropriate lifting yoke and an overhead or portable lifting device.



CAUTION

DO NOT ATTEMPT TO LIFT BREAKERS WITH ORDINARY CRANE HOOKS, ROPES, CHAINS OR OTHER SUCH DEVICES. FAILURE TO FOLLOW THIS CAUTION COULD RESULT IN DAMAGE TO VITAL PARTS SUCH AS ARC CHUTES, BARRIERS AND WIRING.

2-2.1 STORING CIRCUIT BREAKER

If it is necessary to store a circuit breaker before installation, do so in its original shipping container. Keep the circuit breaker in a clean dry place. Ensure there is ample air circulation and heat, if necessary, to prevent condensation. It is very important that the insulation used in the breaker not be exposed to dirt or moisture.

NOTICE

A circuit breaker that has been stored for any length of time should be operated a minimum of five times before it is placed in service.

2-3 LIFTING CIRCUIT BREAKER

To closely examine, install or just to become more familiar with the circuit breaker, carefully lift and place the breaker on a solid work surface capable of handling the breaker's weight (Table 2.1) or on the captive drawout extension rails of the breaker compartment (Figure 1-4). This is accomplished by using the appropriate lifting yoke and lifter. The lifting yoke consists of two sheet steel hooks specially shaped to hook under the top edges of the large openings on each circuit breaker side sheet (Figure 2-1).

Table 2.1 Circuit Breaker and Fuse Truck Weights

Type	Pounds
DSII-308	150
DSII-508	195
DSII-608	200
DSII-516	195
DSII-616	200
DSII-620	200
DSII-632	300
DSII-840	400
DSII-850	400
DSLII-308	200
DSLII-516	260
DSLII-620	275
DSII-FT32 Fuse Truck	325
DSII-FT40 Fuse Truck	430

If the breaker is to be lifted onto the compartment's extension rails, be certain the rails are fully extended before the breaker is lifted. Be certain that the four rollers, two on either side of the circuit breaker, are seated properly on the extension rails before removing the lifting device.

2-4 BREAKER INSPECTION

All breakers, once removed from their shipping containers, should be visually inspected for any obvious damage.

Remove the glass polyester interphase barriers. Note any cautions or instructions printed directly on the barriers. These instructions will insure proper positioning of the barriers in the circuit breaker once the barriers are replaced (Figure 2-2).



WARNING

INTERPHASE BARRIERS ASSIST IN MAINTAINING PROPER CLEARANCES AND MUST BE IN PLACE

AT ALL TIMES DURING CIRCUIT BREAKER OPERATION WITHIN A BREAKER COMPARTMENT.

Remove the three arc chutes which are mounted on top of the pole units. Each arc chute is held in place by one top inserted screw (Figure 2-3).



WARNING

ARC CHUTES MUST ALWAYS BE SECURED PROPERLY IN PLACE BEFORE A CIRCUIT BREAKER IS INSTALLED IN A CIRCUIT BREAKER COMPARTMENT.

Inspect the primary contact structure to be sure no damage has occurred during shipment. Replace all interphase barriers and arc chutes.

Checking the electrical and/or manual operation of each breaker can be done later following the instructions outlined in Section 4.

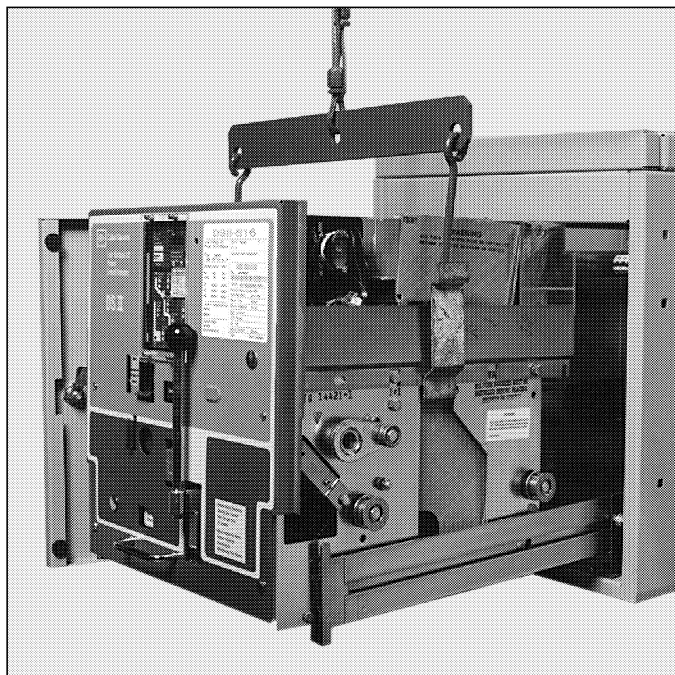


Figure 2-1 DSII Breaker with Lifting Yoke Installed

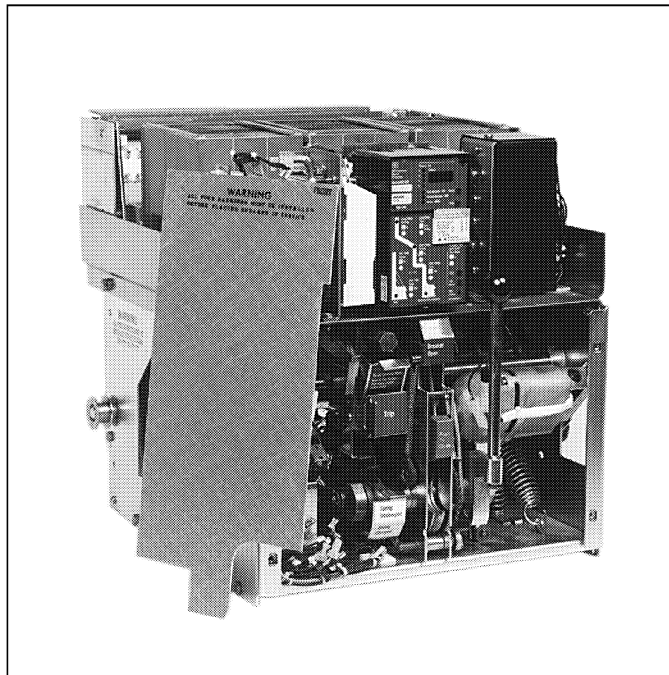


Figure 2-2 DSII Breaker with One Interphase Barrier Removed

2-5 LEVERING CIRCUIT BREAKER

**WARNING**

EXCESSIVE LEVERING TORQUE CAN DAMAGE THE BREAKER, THE SWITCHGEAR AND CAUSE SEVERE PERSONAL INJURY. DO NOT APPLY TORQUE IN EXCESS OF 25 FOOT-POUNDS.

The breaker drawout element has four normal positions in its compartment as determined by the levering device:

- REMOVE Position (Figure 2-4)
- DISCONNECT Position
- TEST Position
- CONNECT Position

The REMOVE position is the first position in the compartment as the breaker element is pushed directly by hand as far as it will go. The DISCONNECT, TEST and CONNECT positions are reached only by means of the levering device. The levering device is hand operated with a removable crank handle. The handle is placed on the levering device worm shaft, which is exposed by pushing

and holding the Push-To-Trip button on the front of the breaker and depressing the shutter (Figure 3-3).

With the breaker sitting on the extension rails, make certain that the breaker levering mechanism arms are in the REMOVE position (Figure 2-4). If they are not, turn the levering crank in the direction required to get the levering arms in the REMOVE position. Carefully push the circuit breaker into the breaker compartment until it physically stops. Begin turning the levering crank in a clockwise direction. Initially, it helps to push a bit on the front of the breaker while turning the levering crank to get the mechanism engaged and started. A continued clockwise rotation of the levering crank will move the breaker to the DISCONNECT, TEST and the CONNECT positions. When the CONNECT position is reached, the crank suddenly becomes hard to turn. At this point, stop turning the crank. Note that as the breaker is cranked and the different positions are reached, a position indication is given in the position indicator window on the front of the breaker (Figure 3-3).

Rotation of the levering crank counterclockwise will turn the levering device arms so as to withdraw the breaker from the compartment. The procedure is basically the same as just described except in the opposite direction.

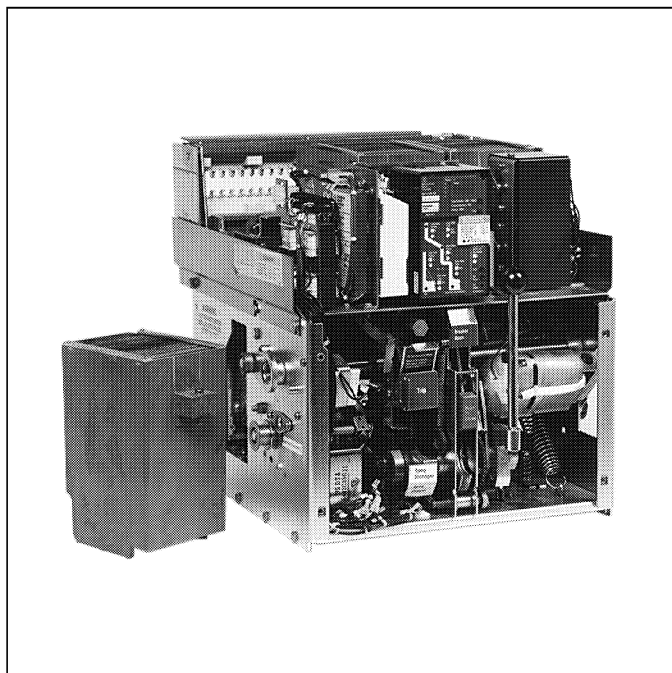


Figure 2-3 DSII Breaker with One Arc Chute Removed

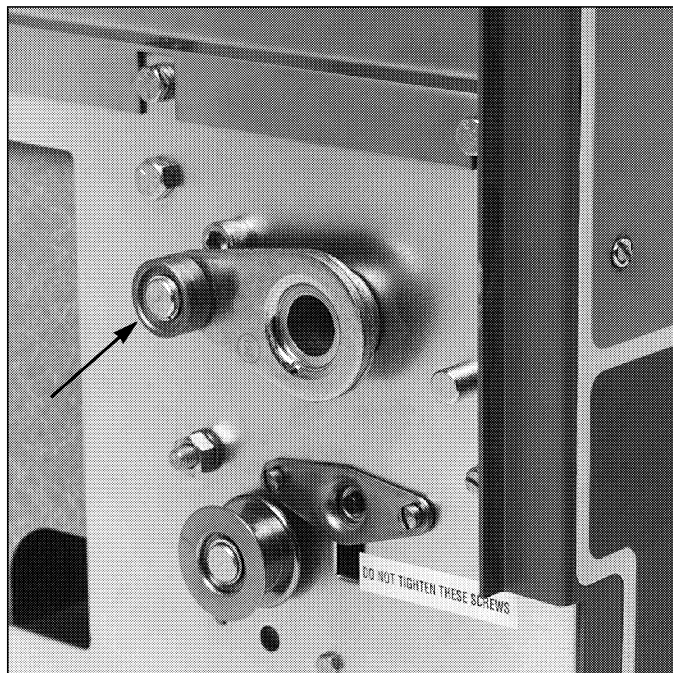


Figure 2-4 DSII Levering Device Arm Shown in REMOVE Position

NOTICE

If the breaker is levered out from the TEST position to the REMOVE position with the closing springs charged, a trip free closing operation automatically takes place, but the breaker contacts do not close.

2-6 DRAWOUT DUMMY ELEMENT

A dummy element consists of a drawout frame or truck with disconnecting contacts and connecting links between the upper and lower terminal on each pole. When inserted into a compartment, it bridges the upper and lower stationary disconnecting contacts in each phase. This makes it the equivalent to an isolating disconnecting switch.

IT MUST BE EMPHASIZED THAT A DUMMY ELEMENT IS NOT A BREAKER. IT HAS NO CURRENT BREAKING ABILITY WHATSOEVER. The dummy element is almost always key interlocked with a breaker or other load interrupting device to insure that it will be isolated or carrying NO current before it can be levered to the DISCONNECT position.

Dummy elements require the same size compartment as an equivalent Type DSII breaker of the same frame size.

2-7 FIXED CIRCUIT BREAKER

The Type DSII Fixed Circuit Breaker differs from the drawout version in that it has no levering device, primary disconnects and secondary disconnects. A fixed circuit breaker does not have a padlock feature to hold the breaker in a "trip-free" position. To insure the proper sequence of operation between two or more breakers, a key interlock is mounted in the levering device location.

The breaker stabs have holes for bolting to primary bus connections. Rear mounted terminal blocks serve as secondary contacts. The basic breaker frame is modified to permit the fixed breaker to be mounted on a panel (Figure 2-5).

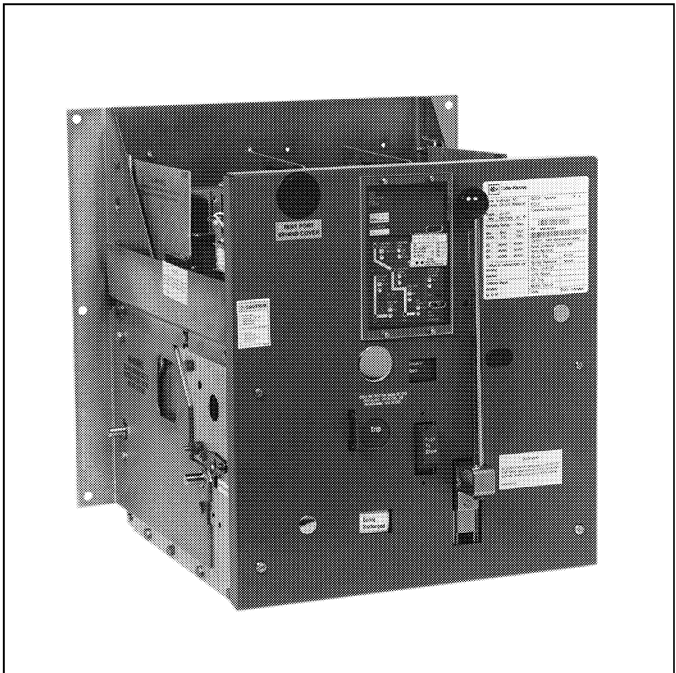


Figure 2-5 Typical Fixed Type DSII Circuit Breaker

SECTION 3: EQUIPMENT DESCRIPTION

3-1 TYPE DSII CIRCUIT BREAKER

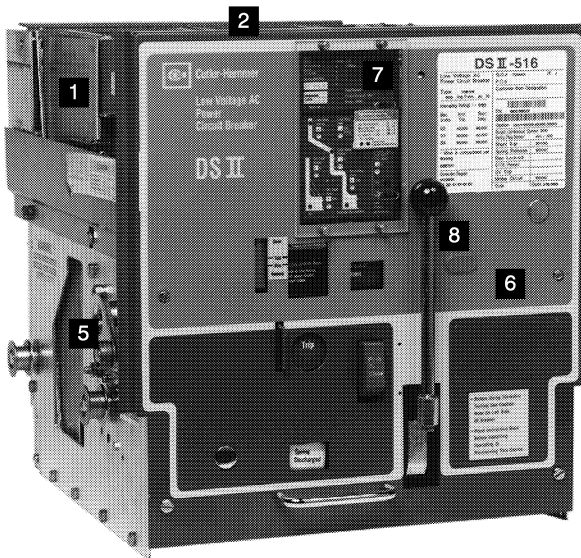
Type DSII Circuit Breakers are designed specifically for use in metal enclosed low voltage switchgear assemblies (Figure 3-1).

The controls and indicators are functionally grouped on the front of the circuit breaker. Easy access to the stored energy mechanism and control devices is gained by removing the circuit breaker faceplate. Inspection, minor maintenance, and many replacement functions

involving the mechanism, control, and/or accessory devices can be easily accomplished.

DSII Circuit Breakers are available with either a manually operated or electrically operated two-step stored energy mechanism. It provides positive control of the closing instant.

Six continuous current frame sizes, 800 through 5000 amps, are covered by just three physically different circuit breaker sizes. A variety of optional accessories are available and common to all circuit breaker frames.



- 1 Interphase Barrier
- 2 Arc Chutes
- 3 Secondary Disconnects
- 4 Main Disconnect
- 5 Levering Device Arm
- 6 Metal Faceplate
- 7 Trip Unit
- 8 Emergency Charge Handle
- 9 Trip Unit Sensors

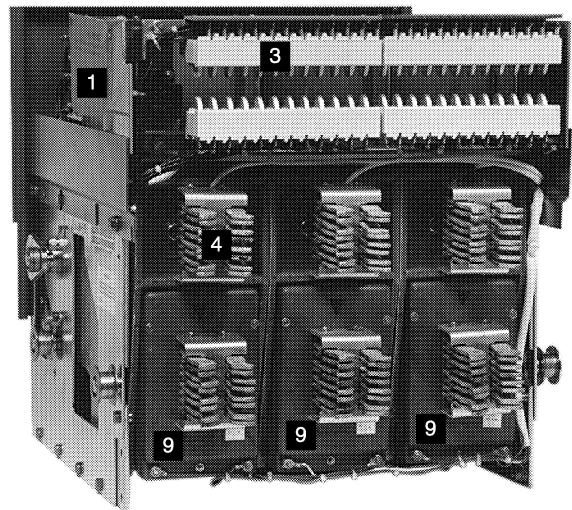


Figure 3-1 Type DSII Circuit Breaker (Front and Rear Views)

The frame width and height are the same for the DSII-308 through the DSII-620 circuit breakers. They could be placed into compartments having the same dimensions. However, interference interlocks are provided to prevent insertion of circuit breakers with mismatching disconnects or insufficient interruption ratings into compartments carrying higher current.

Circuit Protection is supplied by an electronic, micro-processor based tripping system. True RMS sensing is provided for proper correlation with thermal characteristics of conductors and equipment.

3-2 TYPE DSLII (LIMITER) CIRCUIT BREAKER

Type DSLII Circuit Breakers are coordinated combinations of standard DSII Circuit Breakers and series connected current limiters. The primary purpose of the current limiters is to extend the interrupting rating of the DSII Circuit Breaker up to 200,000 amps (Figure 3-2).

DSLII Circuit Breakers are intended for applications requiring the overload protection and switching functions of air circuit breakers on systems whose available fault currents (1) exceed the interrupting ratings of the circuit breakers alone and/or (2) exceed the withstand and interrupting ratings of downstream circuit components.

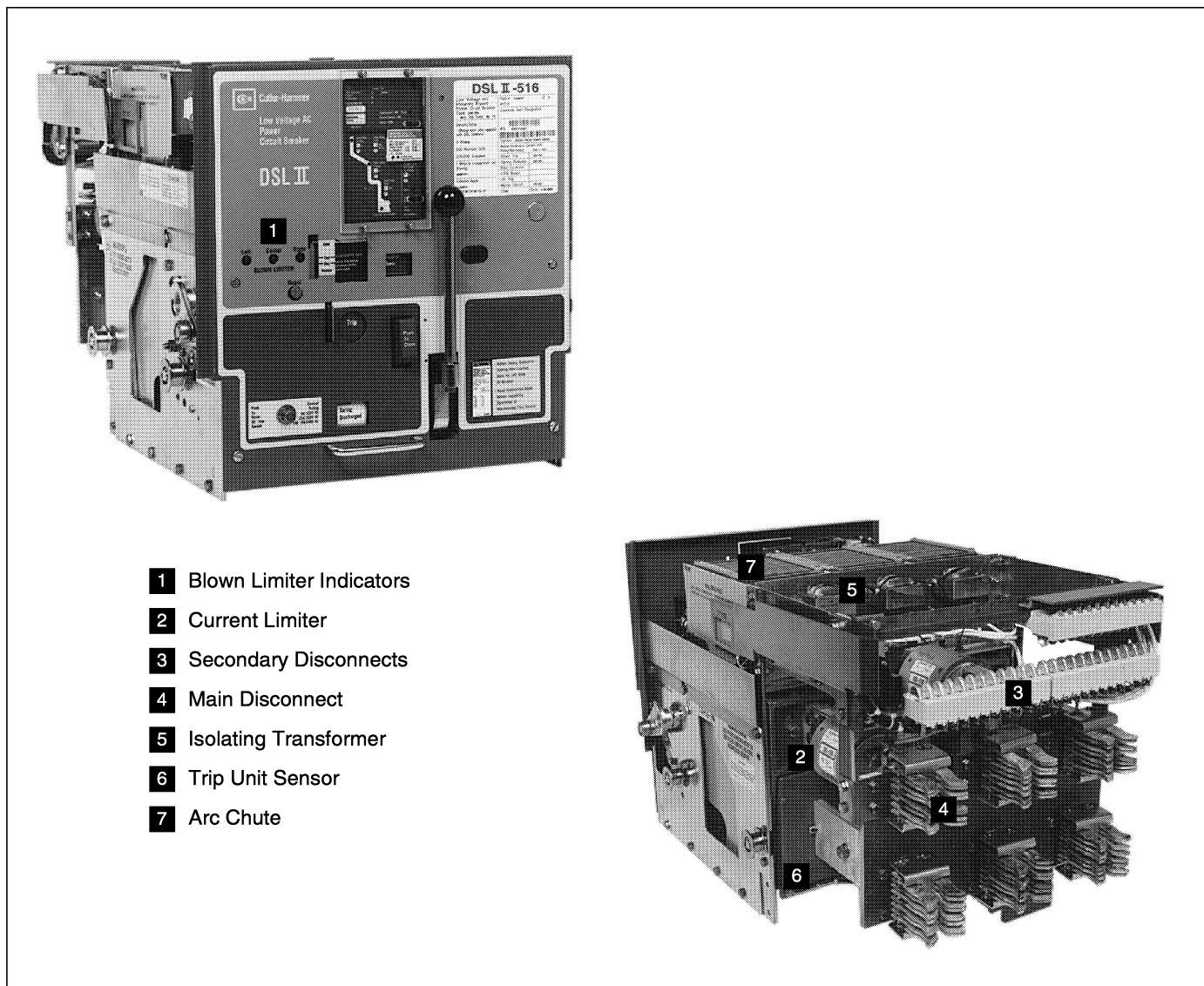


Figure 3-2 Type DSLII Circuit Breaker (Front and Rear Views)

The 800 through 2000 amp frame DSLII Circuit Breakers have the limiters integrally mounted on the drawout breaker elements. On 3,200 and 4,000 amp frame combinations, the limiters are mounted on separate drawout trucks. They fit into compartments of equal size to their compatible circuit breakers and are normally positioned adjacent to one another.

On overloads and faults within the circuit breaker interrupting rating, the circuit breaker protects the limiters. On higher fault currents exceeding the circuit breaker rating, the limiters protect the circuit breaker.

Interlock arrangements trip the circuit breaker whenever any limiter blows. The circuit breaker cannot be reclosed on a live source unless there are three unblown limiters on the circuit. The blown indicator provides a visual indication when a current limiter in any phase has interrupted a short circuit. In addition, it is the device that insures a circuit breaker will be tripped when any current limiter has blown, preventing single phasing.

DSLII-308 through DSLII-620 Circuit Breakers must be completely withdrawn from the compartment, thus assuring complete isolation, before the integral fuses are accessible.

Fuses for Types DSLII-632 and DSLII-840 Circuit Breakers are mounted on a separate fuse truck. The fuse truck is key interlocked with the circuit breaker to prevent withdrawing or insertion unless the circuit breaker is disconnected.

NOTICE

Refer to Section 4 for additional information concerning limiter ratings, limiter replacement, blown fuse indicator operation, and fuse truck installation.



WARNING

THE CIRCUIT BREAKER'S FACEPLATE, INTER-PHASE BARRIERS AND ARC CHUTES MUST BE IN PLACE BEFORE INSTALLING A CIRCUIT BREAKER IN A CIRCUIT BREAKER COMPARTMENT. IF A CIRCUIT BREAKER IS ENERGIZED WITHOUT THESE ITEMS PROPERLY INSTALLED, A DISASTROUS SHORT CIRCUIT FAULT WITHIN THE SYSTEM COULD OCCUR, RESULTING IN EQUIPMENT DAMAGE, BODILY INJURY AND/OR DEATH.

3-3 BASIC BREAKER ASSEMBLY

The basic breaker assembly includes a chassis, a control panel, an operating mechanism, a tripping system, a levering-in device (drawout breakers only), various required interlocks, and three insulated pole unit assemblies.

The control items needed for proper operation of the breaker are located on the front panel. Controls are functionally grouped for convenience. All operating personnel should be familiar with their locations and functions (Figure 3-3).

Access to the operating mechanism and internally mounted auxiliary devices is gained by removing the breaker faceplate. The faceplate is held in place by front accessible bolts.

3-4 POLE UNITS

The pole unit assembly is a molded base of high strength insulating material in which is mounted one to three sets of primary contact assemblies. The exact design configuration depends upon the frame size of the circuit breaker.

A DSII-308 pole unit assembly consists of a single molded base and three sets of primary contact assemblies. The primary contact assembly is made up of two parts, the stationary contact assembly and the movable contact assembly, each mounted individually in the insulating base (Figures 3-4 and 3-5).

Pole unit assemblies for other DSII circuit breaker frame sizes are similar to the DSII-308 in design configuration, except each of the three poles are mounted on individual insulating bases (Figures 3-6 and 3-7).

3-4.1 PRIMARY MOVING CONTACT ASSEMBLY

The primary moving contact assembly for all ratings consists of moving arms hinged at the bottom to the lower main terminal through controlled pressure rotating contacts. At the upper end of the primary moving assembly are the main and arcing contacts. The arcing contacts of all frame sizes are essentially the same design. The number of moving arms, the number of main contacts, and the number of main disconnect contact fingers vary with the frame size. A strong and rigid insulating link operates the moving contact blade assembly.



- | | | |
|-------------------------------------|--|-----------------------------------|
| 1 Digitrip Trip Unit | 5 Shutter (Levering Shaft Access) | 9 Push to Close Button |
| 2 Nameplate | 6 Open-Close Indicator | 10 Spring Charge Indicator |
| 3 Emergency Charge Handle | 7 Padlock Plate | 11 Remove Assist Handle |
| 4 Drawout Position Indicator | 8 Push to Trip Button | |

Figure 3-3 Typical DSII Faceplate

3-4.2 PRIMARY STATIONARY CONTACT ASSEMBLY

The stationary contact assembly consists of butt type main contacts which carry the main continuous load current. It is comprised of a multiplicity of individual fingers. Each finger is hinged at the upper end under controlled pressure. The stationary arcing contacts are similar for all frame sizes and consist of two parallel fingers, one on each side of the upper main terminal. They are spring loaded toward each other by compression springs and have arc resisting tips. The previously described moving

arc contact wedges the stationary contact fingers apart as the breaker closes. In addition, the parallel action of the magnetic fields of the currents in each arcing contact finger causes the fingers to be attracted toward each other when closing against fault currents. This results in a "blow-on" action on the arcing contacts.

3-5 INTERPHASE BARRIERS

Glass polyester interphase barriers assist in maintaining proper clearances and must be in place at all times dur-

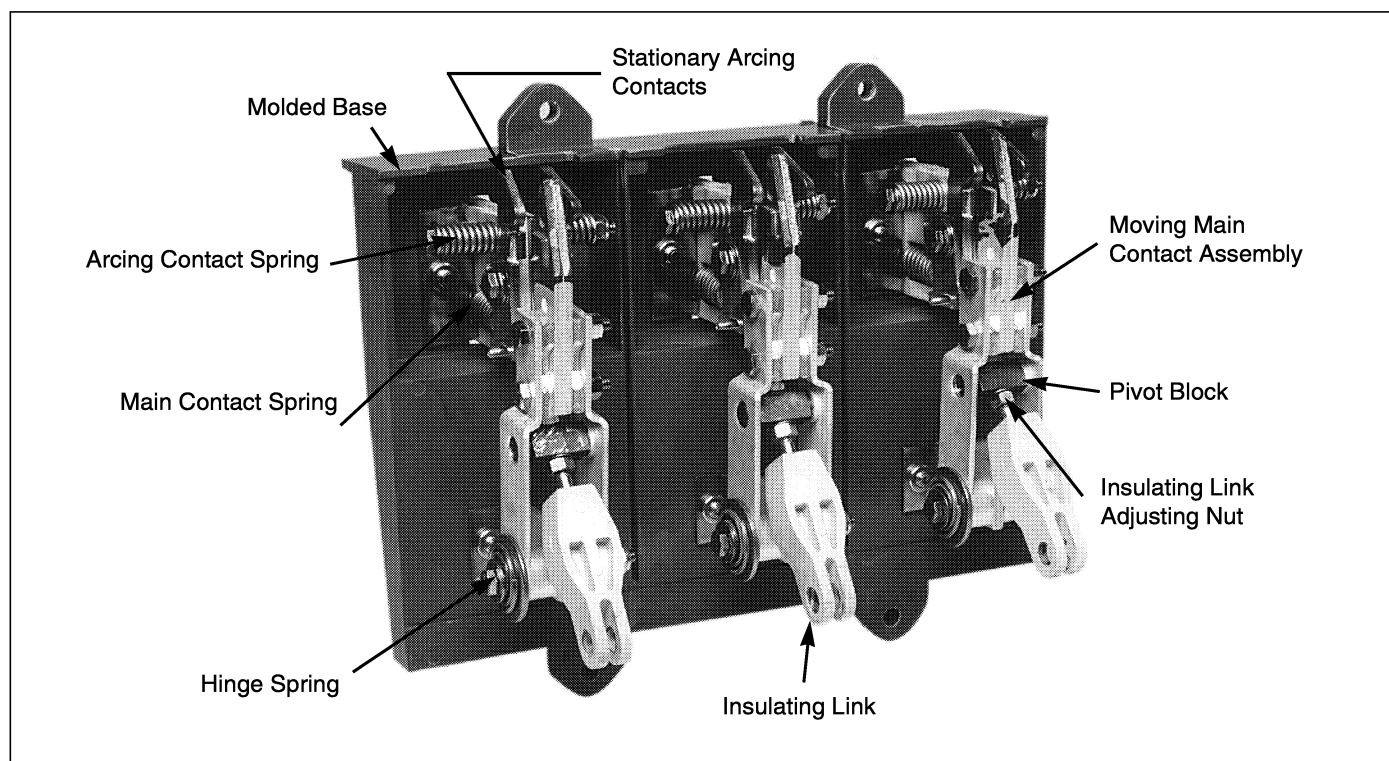


Figure 3-4 Type DSII-308 Pole Unit Assembly (Front View)

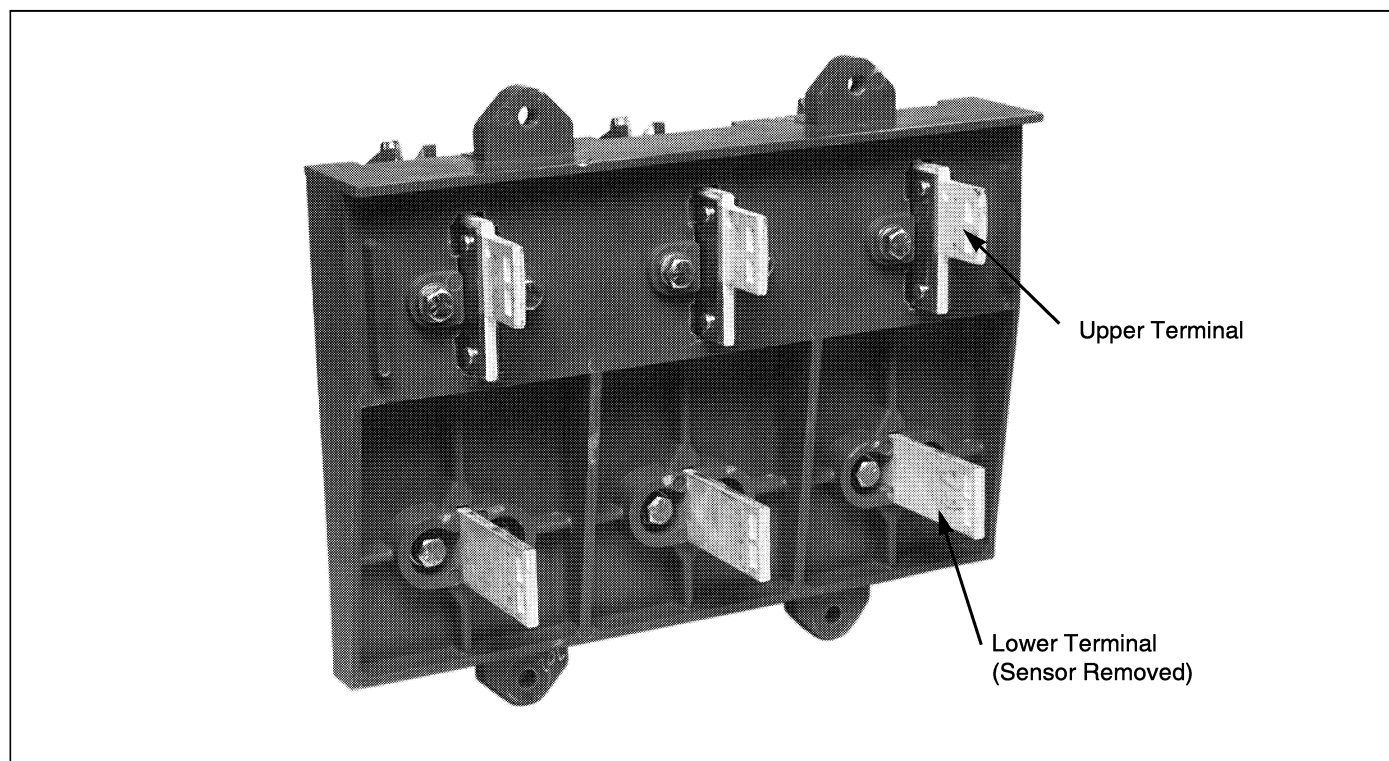


Figure 3-5 Type DSII-308 Pole Unit Assembly (Rear View)

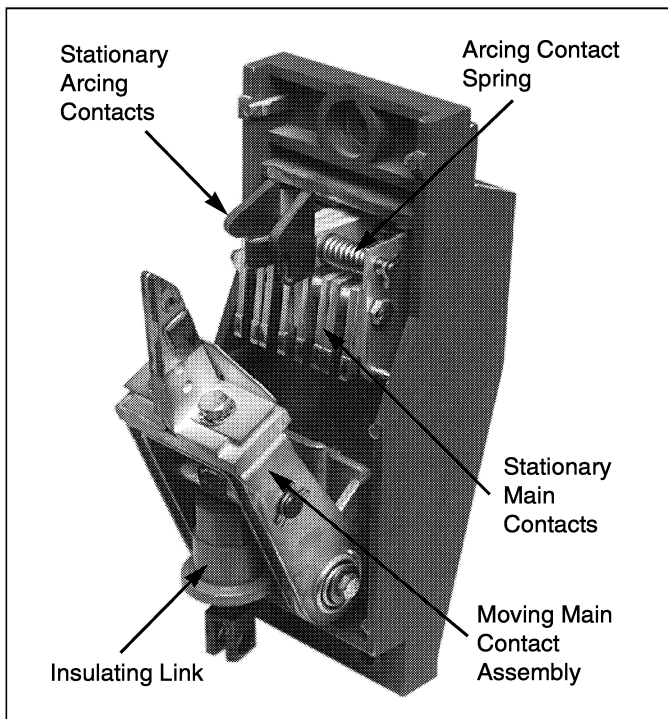


Figure 3-6 Type DSII-516 Pole Unit Assembly (Front View)

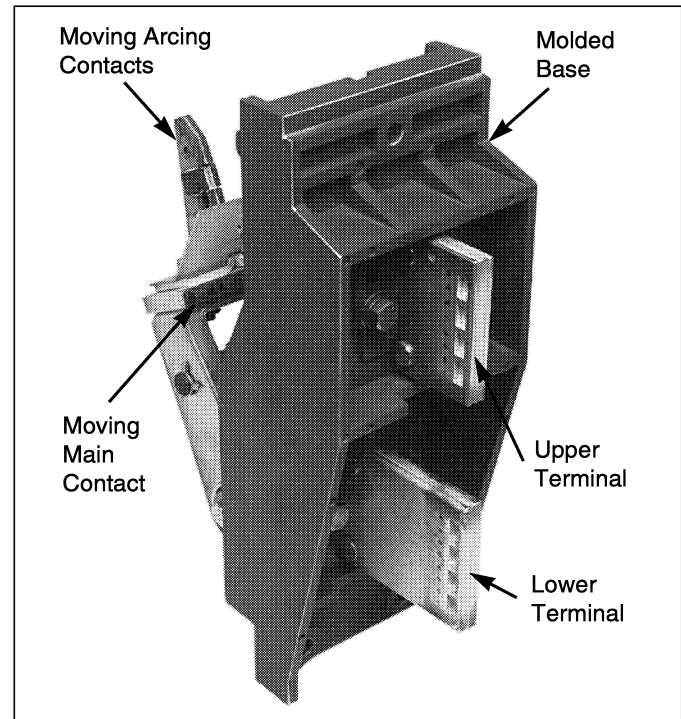


Figure 3-7 Type DSII-516 Pole Unit Assembly (Rear View)

ing circuit breaker operation within its compartment. Each barrier is held firmly in place by its positioning in the circuit breaker, with no fastener of any type required (Figure 3-8).

To remove a barrier, carefully but firmly grasp the top of the barrier and pull upward until it clears the circuit breaker chassis. Note all cautions and instructions printed directly on the barriers during removal or replacement. These notes help to insure proper positioning of the barriers in the circuit breaker. In addition, the barriers are designed such that proper seating of the barriers cannot be accomplished, if the barriers are not replaced correctly.

3-6 DE-ION ARC CHUTES (INTERRUPTER ASSEMBLIES)

The arc chutes mount on top of the pole units, well down over the arcing contacts (Figure 3-1). This positioning confines arcs inside the chutes at all times and for all values of current.

Each arc chute contains crosswise, vertical steel splitter plates having an inverted "V" notch to attract the arc and interrupt it, by essentially cooling and stretching the arc. In addition to steel plates, the larger arc chutes include

hard, arc-resistant glass polyester plates. These plates produce turbulence in the exhaust gases above the steel plates, and prevent electrical breakdown over the top of the arc chute or to ground. The arc chute components are all assembled in an insulating jacket.



CAUTION

NO ATTEMPT TO REMOVE THE ARC CHUTES SHOULD BE MADE UNTIL STORED ENERGY SPRINGS ARE COMPLETELY DISCHARGED.

Each arc chute is held in position by one top inserted screw. To remove an arc chute, remove the mounting screw and lift the arc chute out of the circuit breaker (Figure 3-9).

3-7 ELECTRONIC TRIPPING SYSTEM

The electronic trip unit can be considered the intelligence part of what is a three part, flux transfer tripping system. The integrally mounted sensors and the trip actuator make up the rest of the system (Figure 3-10). All three parts of the system are discussed here. For

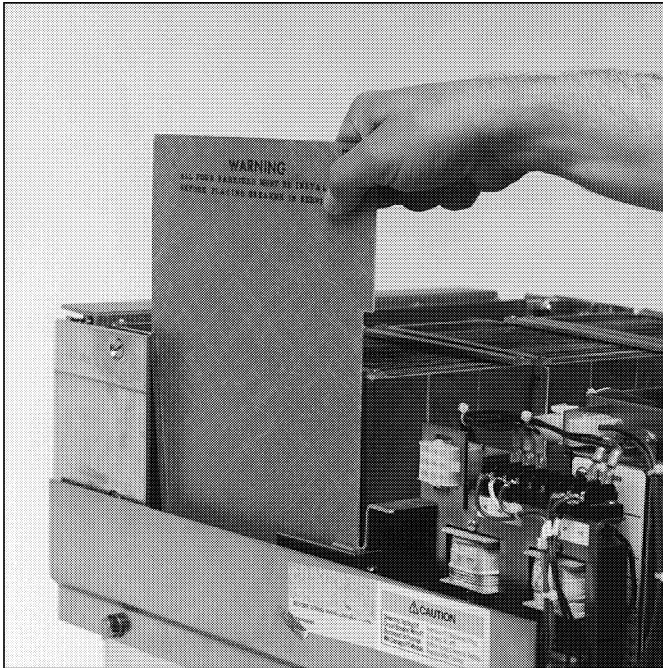


Figure 3-8 DSII Interphase Barriers Being Removed

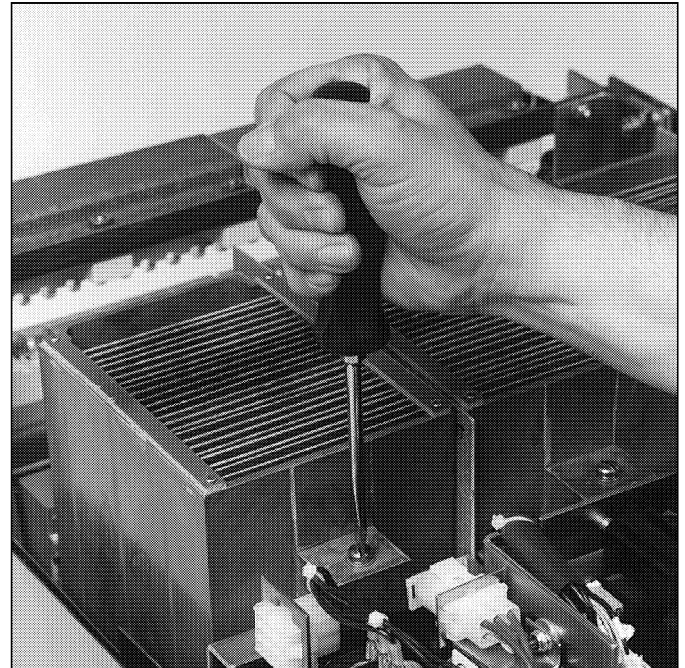


Figure 3-9 DSII Arc Chute Being Removed

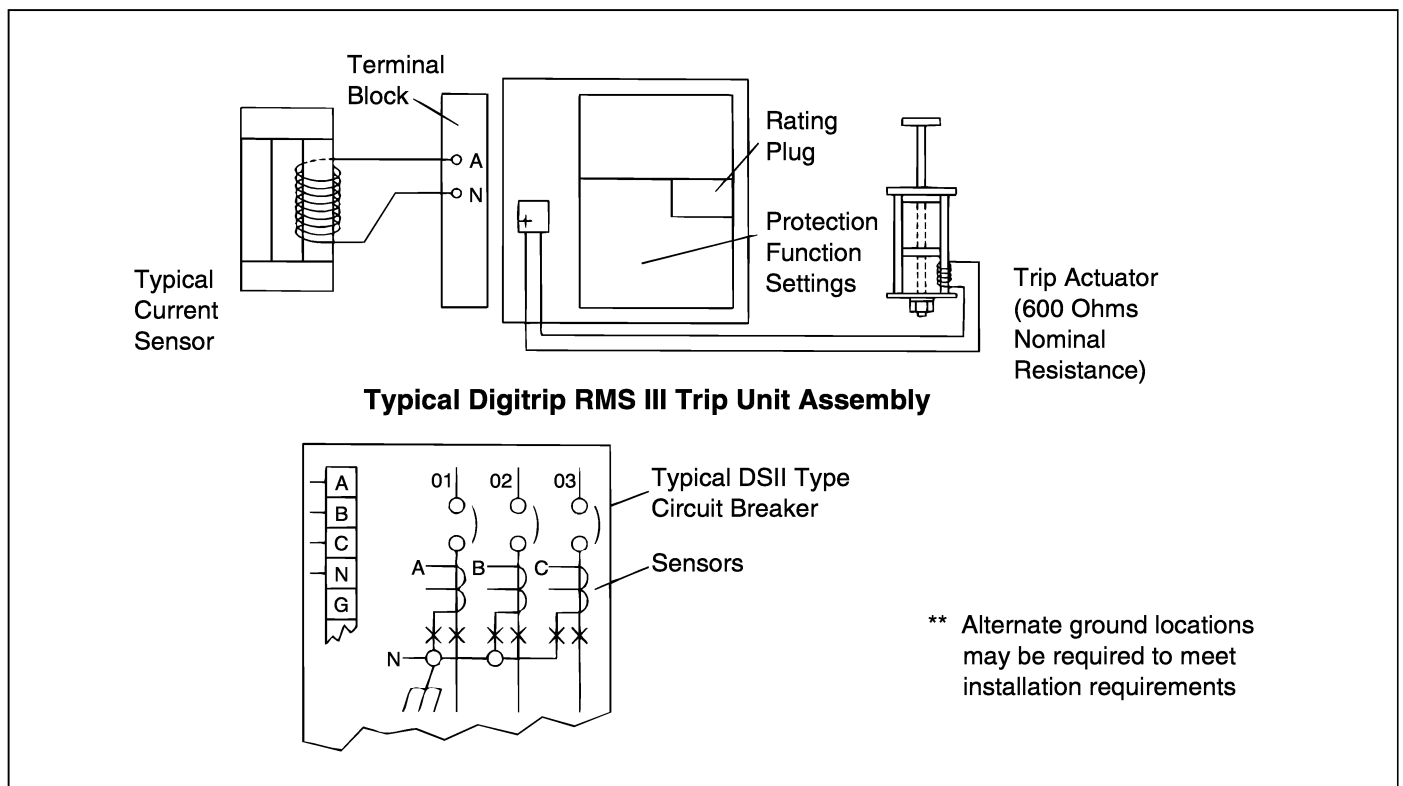


Figure 3-10 Typical Type DSII Tripping System Diagram

more detailed information about the specific trip unit used with Types DSII and DSLII circuit breakers, refer to the specific trip unit instruction book for details.

3-7.1 ELECTRONIC TRIP UNIT

Types DSII and DSLII circuit breakers, whether manual-ly or electrically operated, are supplied with a state-of-the-art electronic, microprocessor-based trip units. True RMS sensing is provided for proper correlation with thermal characteristics of conductors and equipment.

In addition to circuit protection, electronic trip units provide information and integral testing functions. Optional remote communications and energy monitoring functions are also available.

The electronic trip units are completely self-contained and, when the circuit breaker is closed, no external power is required to operate their protection systems. They operate from current signal levels and the control power is derived from current sensors integrally mounted in the circuit breaker.

When the circuit breaker is shipped from the factory, the trip unit's protective functions are normally set at nomi-

nal values. For specific overload tripping characteristics to coordinate with the load or system, refer to the specific trip unit instruction book.

3-7.2 SENSORS

Three current sensors are installed at the rear of the circuit breaker on the lower studs, directly behind the main disconnecting contacts (Figures 3-1 and 3-2). The sensors produce an output current proportional to the load current. Under preselected conditions of current magnitude and time, the sensors furnish the electronic trip unit with a signal and the energy required to trip the circuit breaker.

Since the continuous current rating for any frame size breaker is associated with both the sensors and the trip unit itself, a complete tabulation of available current sensors is presented in the specific trip unit instruction book, not this instruction book for the circuit breaker.

3-7.3 TRIP ACTUATOR

The electronic trip unit provides a pulse to the trip actuator, which produces a mechanical force to trip the circuit breaker (Figure 3-11). The actuator is comprised of a

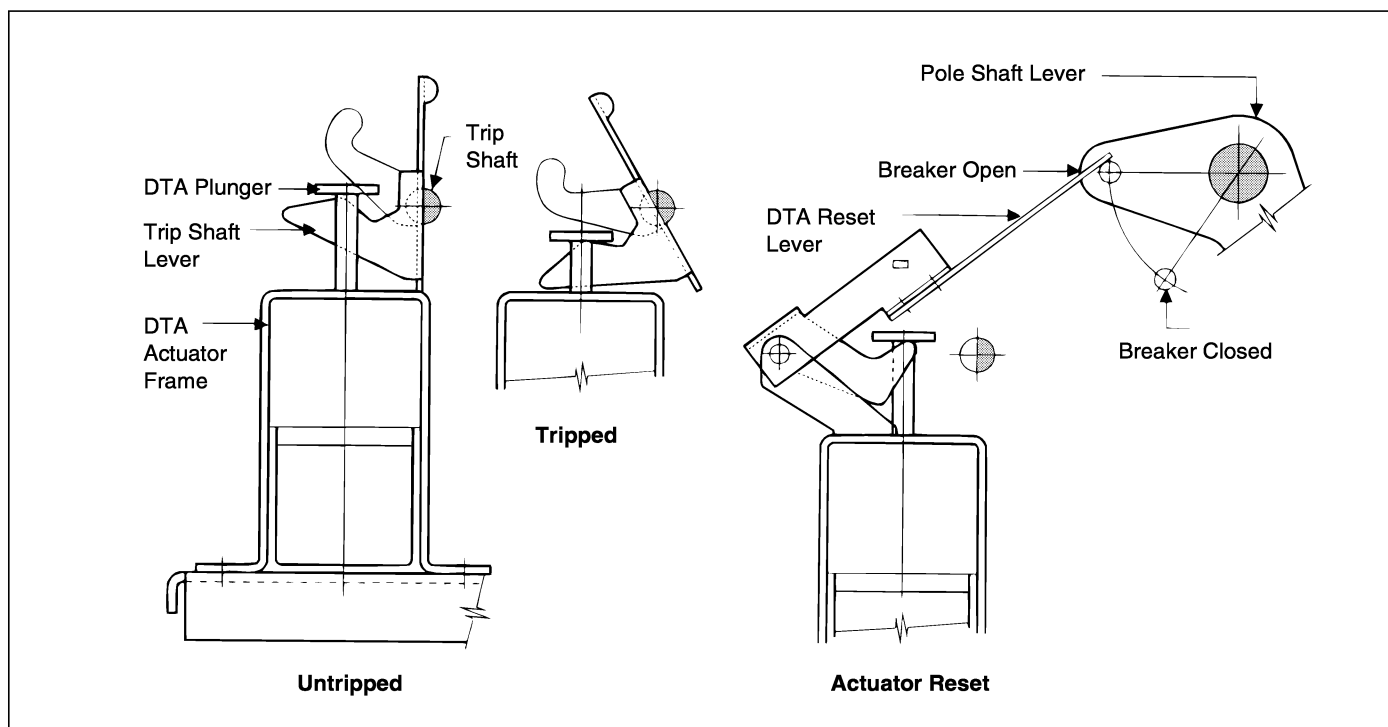


Figure 3-11 Type DSII Trip Actuator

permanent magnet, a disc held by the magnet, a rod acted on by a spring, a lever for tripping the breaker, and a lever for mechanically resetting the actuator. The trip unit's tripping pulse counteracts the effect of the permanent magnet, allowing the spring to separate the disc from the magnet pole piece, while moving the rod to actuate the trip shaft lever. The device is reset when the breaker opens, since the reset lever causes the disc to contact the magnet. If the disc is not fully reset, the trip shaft lever will hold the breaker mechanism in the trip-free condition, and the breaker cannot be reclosed.

3-8 OPERATING MECHANISM

The operating mechanism is of the spring charged stored energy type. It consists of two major parts:

1. Stored energy or spring-charging mechanism
2. Mechanism for closing and opening breaker

The basic parts of these mechanisms are combined into one sub-assembly. Two varieties of the mechanism, manual and power operated spring charge, cover the entire line of DSII and DSLII circuit breakers (Figures 3-12 and 3-13).

3-8.1 MANUALLY OPERATED CIRCUIT BREAKER

On manually operated circuit breakers, the closing springs can be charged only by hand. This is accomplished through the use of a front mounted spring-charge handle. The spring charge handle used with manually operated circuit breakers is significantly longer than the handle used with power operated circuit breakers. Actual closing of the breaker is done only by pushing on the front control panel close bar (Figure 3-3). An optional electrical spring release, normally supplied only on power operated circuit breakers, can be supplied on the manually operated version.

The breaker can be tripped open manually by pushing the trip plate on the front control panel. Tripping will also occur if the trip plate on the circuit breaker compartment door is pushed while the breaker is in the CONNECT position.

Electrical tripping of a manually operated circuit breaker can take place through the following devices:

- Optional shunt trip device
- Trip actuator energized from the electronic trip unit
- Optional undervoltage trip device
- Blown limiter indicator on DSLII type breakers

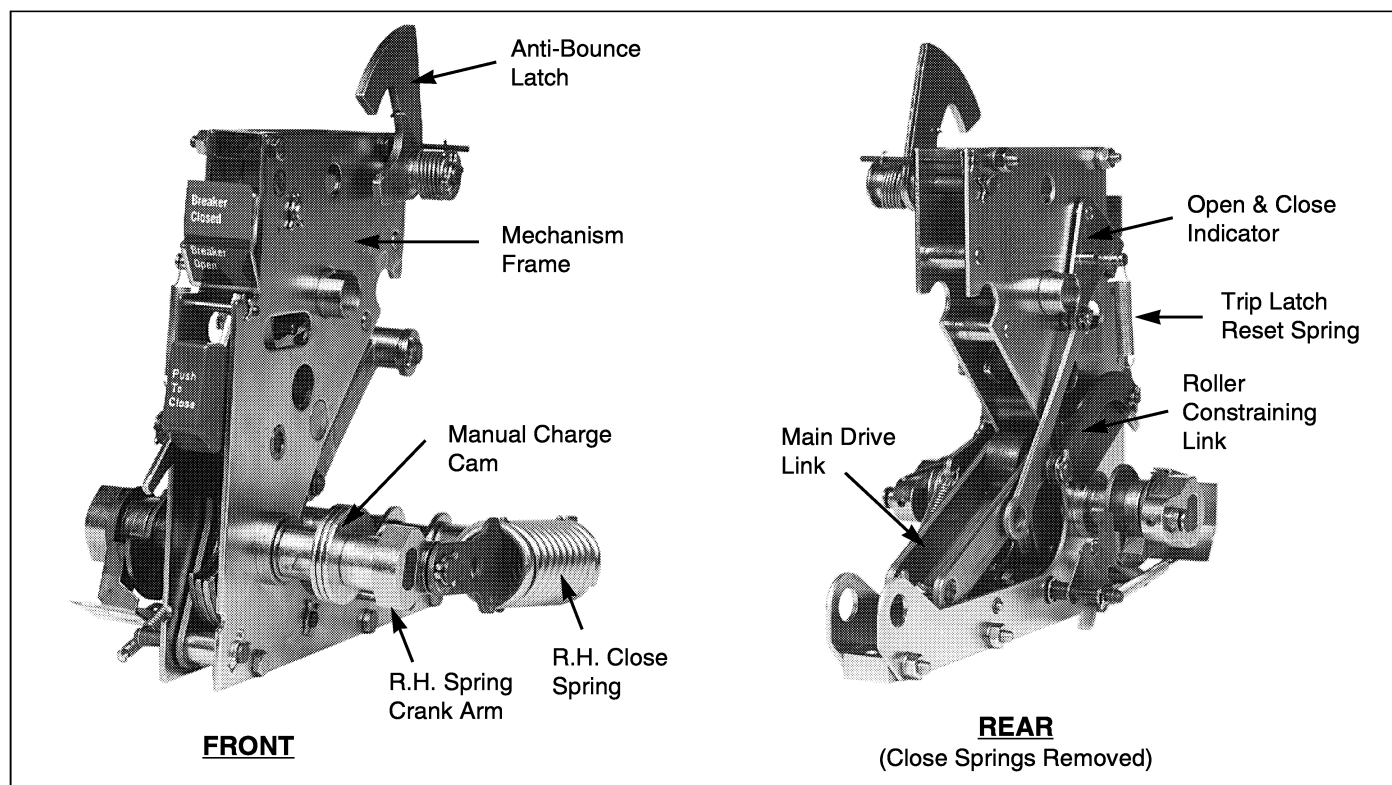


Figure 3-12 Typical Front/Rear Views of Manual Spring Charge Mechanism

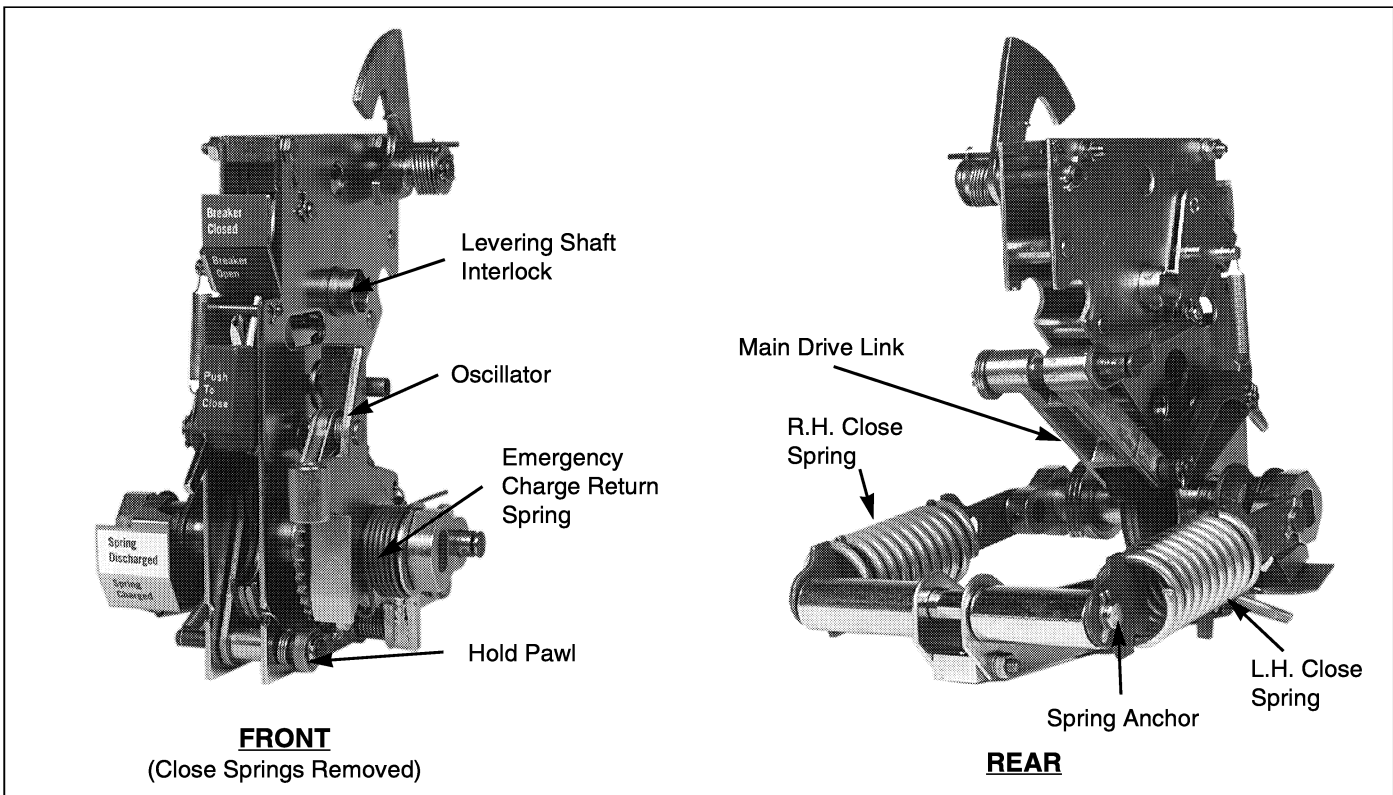


Figure 3-13 Typical Front/Rear Views of Power Operated Spring Charge Mechanism

The drawout manually operated circuit breaker has four normal positions in its compartment, determined by the levering device: REMOVE, DISCONNECT, TEST AND CONNECT. Refer to Paragraph 2-5 for additional information.

3-8.2 POWER OPERATED CIRCUIT BREAKER

On power operated circuit breakers, the closing springs can be charged both electrically and manually. Normally, the springs are automatically charged by a universal type electric motor, which is part of the mechanism. If necessary, the springs can be charged manually through the use of a front mounted spring-charge handle. The spring charge handle used with power operated circuit breakers is significantly shorter than the handle used with manually operated circuit breakers. Closing is accomplished electrically by an electromagnet which lifts the closing spring release latch. Like the manually operated circuit breaker, the power operated circuit breaker can also be closed manually by pushing on the front control panel close bar (Figure 3-3).

Like the manually operated version, the power operated circuit breaker can also be tripped open manually by

pushing the trip plate on the front control panel or the trip plate on the circuit breaker compartment door.

Power operated circuit breakers can be electrically tripped through the following devices:

- Standard shunt trip device
- Trip actuator energized from the electronic trip unit
- Optional undervoltage trip device
- Blown limiter indicator on DSLII type breakers

3-9 MOVABLE PRIMARY AND SECONDARY CONTACTS

The primary connection of a drawout circuit breaker to the primary stabs in the breaker compartment is provided by six primary disconnect finger clusters (Figures 3-1 and 3-2). Each finger cluster is comprised of a number of spring loaded fingers. The number of fingers varies, depending upon the current rating of the breaker. Finger clusters attach to the primary studs of the breaker's pole unit assembly. Finger clusters can be easily removed using a finger cluster removal tools.

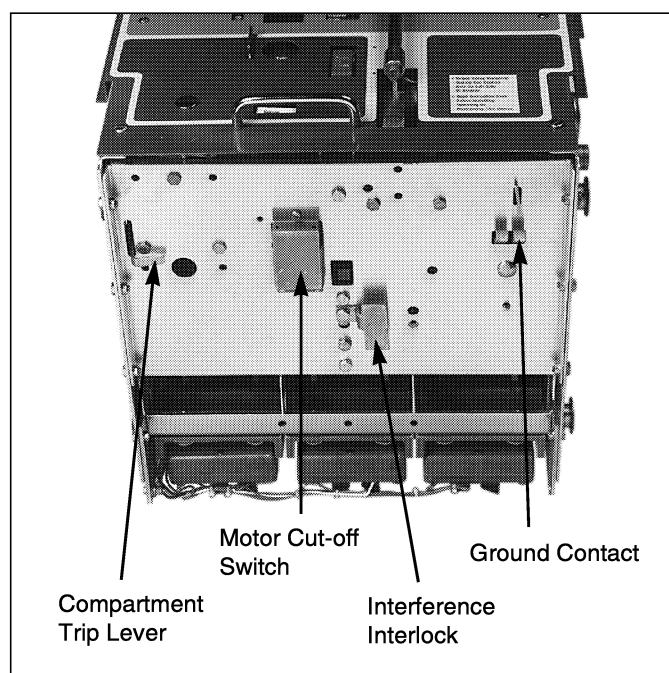


Figure 3-14 Type DSII Circuit Breaker (Bottom View)

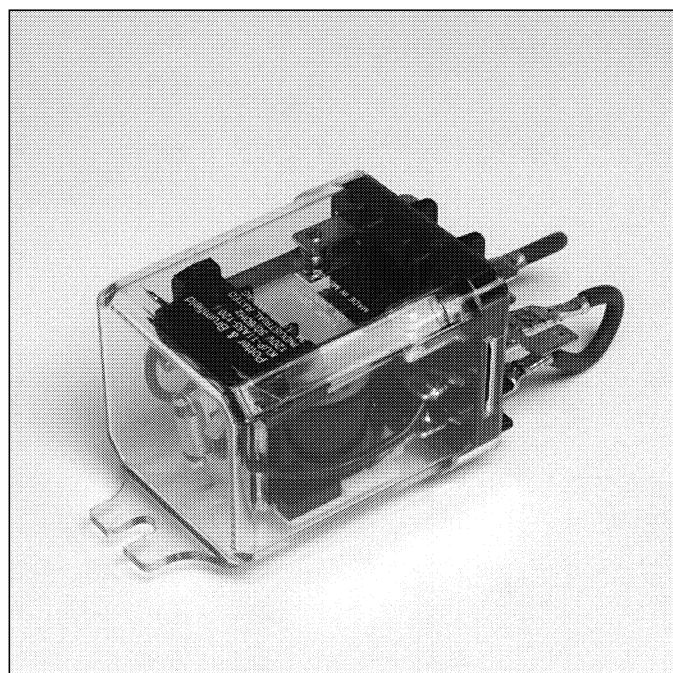


Figure 3-15 Anti-Pump Relay Shown Unmounted

The secondary connection of a drawout circuit breaker is provided by contact blocks mounted on the rear upper frame of the circuit breaker. They are mounted, as required, in two rows of two blocks per row. Each block consists of 12 spring loaded contacts. Protective covers over the top row of contacts help to protect from damage (Figures 3-1 and 3-2).

3-10 STANDARD AND OPTIONAL DEVICES

3-10.1 MOTOR CUT-OFF SWITCH (LS)

The motor cut-off switch is standard on all power operated breakers. It disconnects the motor when the closing springs are fully charged, and is operated by the motor cut-off switch lever on the operating mechanism (Figure 3-14).

3-10.2 SPRING RELEASE DEVICE (SRD)

The spring release device is standard on power operated breakers and optional on manually operated breakers. It permits a breaker to be closed electrically. A close signal is applied to the spring release device to begin the closing operation. The spring release coil is energized through the anti-pump relay, the motor cut-off

switch, and a normally closed “b” auxiliary switch contact, which operates the spring release latch to release the closing springs.

3-10.3 ANTI-PUMP RELAY (Y)

Power operated breakers have an anti-pump relay mounted in the upper left front portion of the breaker just behind the faceplate. It disconnects the spring release device after the breaker has been closed (Figure 3-15). This prevents the breaker from trying to close immediately after being tripped open (pumping) on concurrent close and trip signals.

3-10.4 SHUNT TRIP ATTACHMENT (STA)

The shunt trip attachment is standard on power operated breakers and optional on manually operated breakers (Figure 3-16). It is an electromechanical device of the clapper type. A trip signal to the shunt trip device energizes a coil which causes its armature to be attracted to the core. The armature pushes the trip lever on the breaker trip shaft, causing the breaker to trip. As the breaker trips, a normally open “a” auxiliary switch contact in series with the shunt trip attachment coil de-energizes the coil.

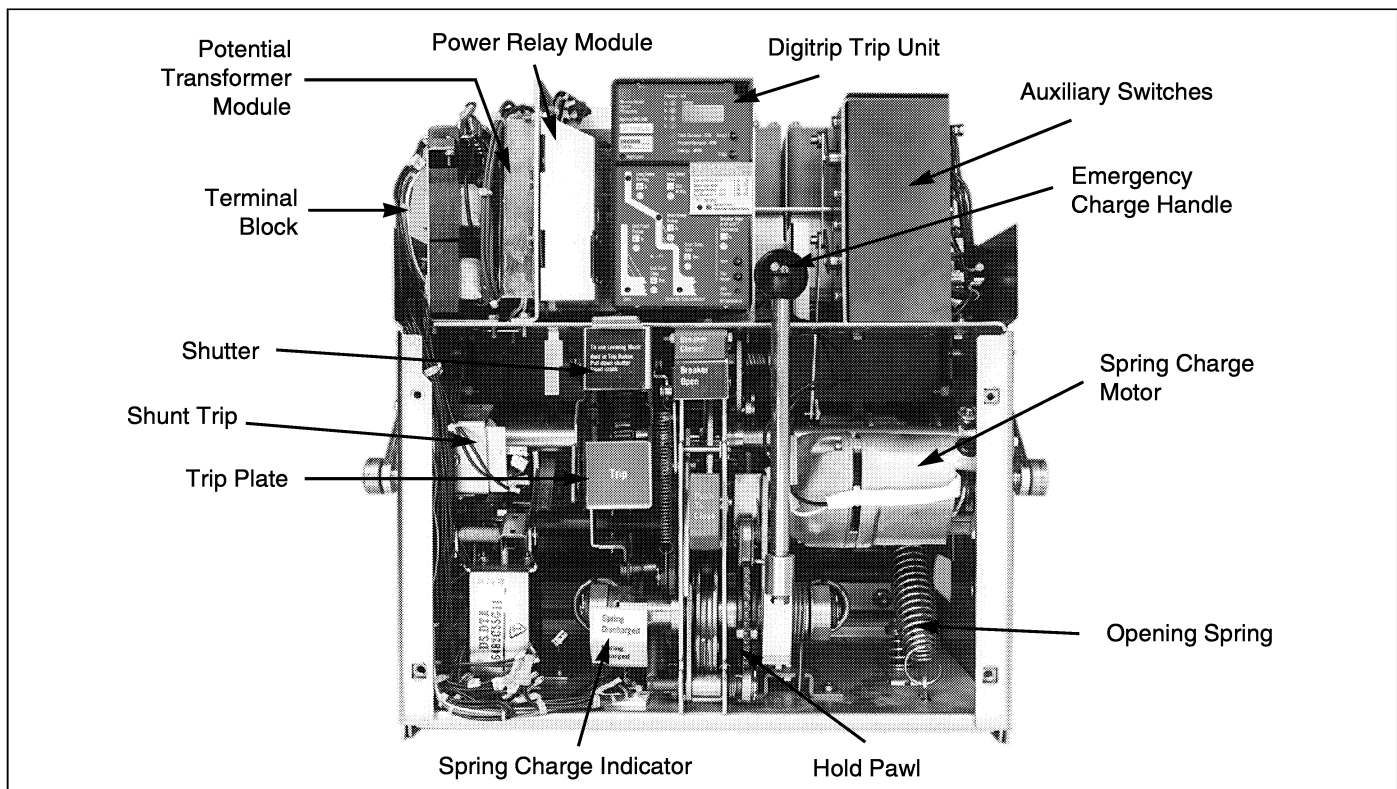


Figure 3-16 Power Operated DSII Breaker (Front Cover Removed)

3-10.5 LATCH CHECK SWITCH

The latch check switch consists of a switch mounted on the inside of the left hand breaker side sheet. It is located such that when the breaker trip shaft is in the "reset" position, a normally closed contact of the switch is closed (Figure 3-17). When the switch is supplied, the contact is usually connected in the closing circuit of the breaker to insure that the tripping system is reset before the circuit can be energized to close the breaker.

3-10.6 AUXILIARY SWITCH

Up to two auxiliary switches can be mounted on a breaker (Figure 3-16). They are stacked units located in the right front portion of the breaker chassis. Each switch has nine contacts which may be normally open "a" or normally closed "b" contacts. Auxiliary switch contacts are rated 10 amperes at 120/240 volts AC, 10 amperes at 125 volts DC, and 2 amperes at 250 volts DC. Two normally open and two normally closed contacts or five normally open and five normally closed contacts are available for use on both manually and power operated breakers.

3-10.7 UNDERVOLTAGE TRIP ATTACHMENT (UVTA)

The undervoltage trip attachment is optional on both manually or power operated breakers. The undervoltage trip attachment is an electromechanical device that trips the breaker when the voltage on its coil falls to between 30 to 60 percent of normal. The standard unit trips instantaneously. A similar device is also available with a non-adjustable time delay, intended to ride through momentary fluctuations of system voltage.

In operation, a moving core is normally held magnetically against a stationary core and a spring. This is linked to a latch carrying a roller which restrains the main tripping lever of this assembly (Figure 3-18). When the coil voltage is sufficiently reduced, a spring overcomes the magnetic attraction between the two cores. The moving core travels upward, and rotates the latch counterclockwise so the roller moves from beneath the tail of the main tripping lever. A torsion spring around the pivot pin of the tripping lever then rotates it counterclockwise, causing a projection on right side of this lever to strike a pin in the mechanism trip shaft. The result is that the trip shaft rotates clockwise and trips the breaker.

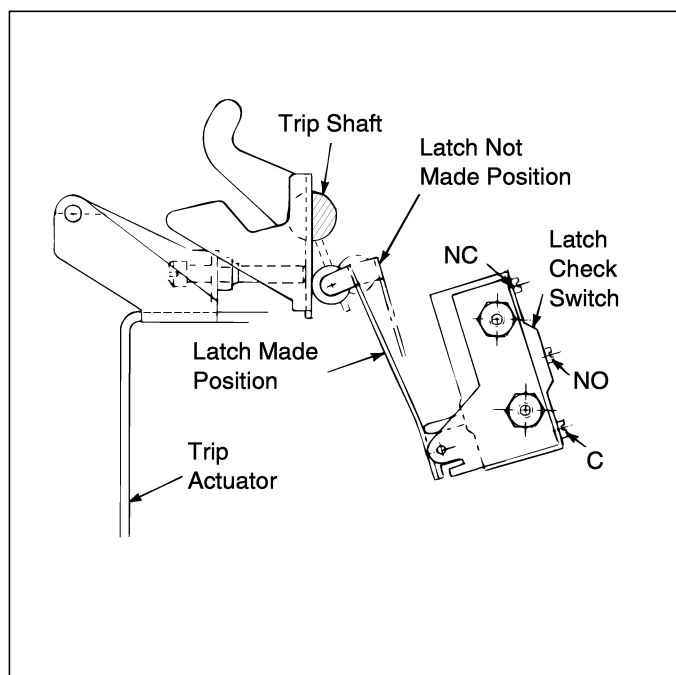


Figure 3-17 Latch Check Switch Operation

As the breaker opens, a pin on the left pole unit shaft strikes a vertical leg (reset arm) of the undervoltage tripping lever and rotates it counterclockwise against its torsion spring. Another arm on the tripping lever resets the roller latch and moving core. A slight amount of over-travel on the trip latch insures positive resetting under all conditions.

The undervoltage trip attachment is bolted in place in the lower circuit breaker chassis. Always connect the undervoltage coil on the line side of the breaker unless the attachment is equipped with a time delay device. In this case, the time delay will delay tripping of the breaker long enough to permit energization of the undervoltage coil from the load side. Do not use an auxiliary switch contact in the undervoltage circuit.

3-10.8 OVERCURRENT TRIP SWITCH

The overcurrent trip switch is optional on both manually and power operated breakers. Its function is to provide a signal to indicate that the breaker has tripped open by action of the electronic trip unit due to phase or ground overcurrent. Tripping by the trip plate, shunt trip device, undervoltage trip device and other such methods does not cause it to operate.

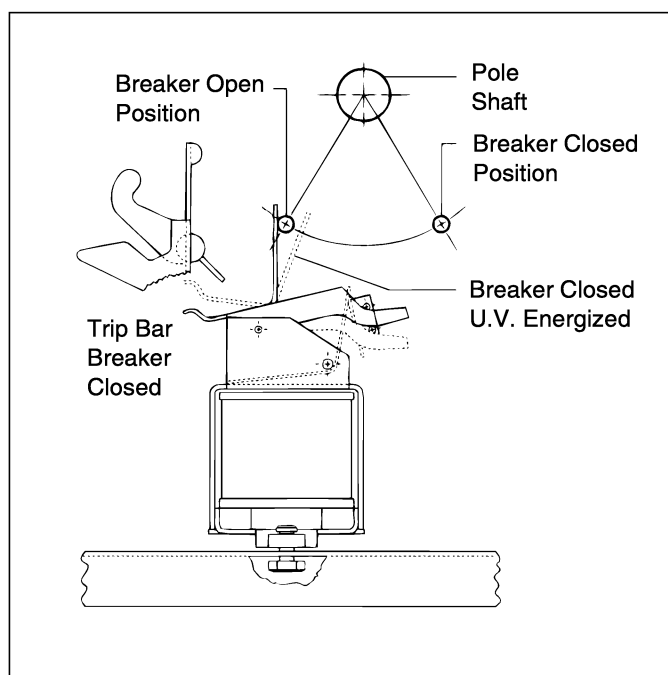


Figure 3-18 Undervoltage Trip Attachment Operation

It is mounted on and operates from the trip actuator of the breaker. Three standard contact arrangements are available: (1) two normally open, (2) two normally closed, or (3) one normally open and one normally closed. These are independently wired to breaker secondary disconnect contacts. Special units may have one additional contact.

The device is latch-type and must be manually reset by means of a pushbutton mounted on the breaker front panel. An electric reset type is available for remote operation (Figure 3-19).

3-11 MISCELLANEOUS DETAILS

3-11.1 INTERFERENCE INTERLOCK

A "Z" shaped bracket prevents a circuit breaker with an insufficient interrupting rating or mismatched disconnects from being inserted into the wrong compartment (Figure 3-14). The breaker mounted bracket has to properly key with a bracket mounted on the compartment floor to permit breaker insertion (Table 3.1). An interference interlock bracket is standard on all drawout circuit breakers.

3-11.2 GROUND CONTACT

The standard circuit breaker ground contact engages a corresponding contact on the compartment floor and provides positive grounding of the breaker frame (Figure 3-14).

3-11.3 CLOSE BAR GUARD

The optional close bar guard covers the close bar to prevent unintentional manual closing of the breaker (Figure 3-20). In the case of emergency, the breaker can be closed by pushing the close bar through the small hole in the close bar guard.

3-11.4 OPERATION COUNTER

The operation counter is a mechanical counter used to provide a record of the number of breaker operations (Figure 3-3). The counter is linkage connected to the pole shaft.

Table 3.1 Compatible Circuit Breakers and Compartments

Compartment	Breakers Accepted
DSII-308	DSII-308, DSII-608
DSII-508	DSII-508, DSII-608, DSII-616, DSII-620
DSII-608	DSII-608, DSII-616, DSII-620
DSII-516	DSII-516, DSII-616, DSII-620
DSII-616	DSII-616, DSII-620
DSII-620	DSII-616, DSII-620
DSLII-308	DSLII-308
DSLII-516	DSLII-516
DSLII-620	DSLII-620

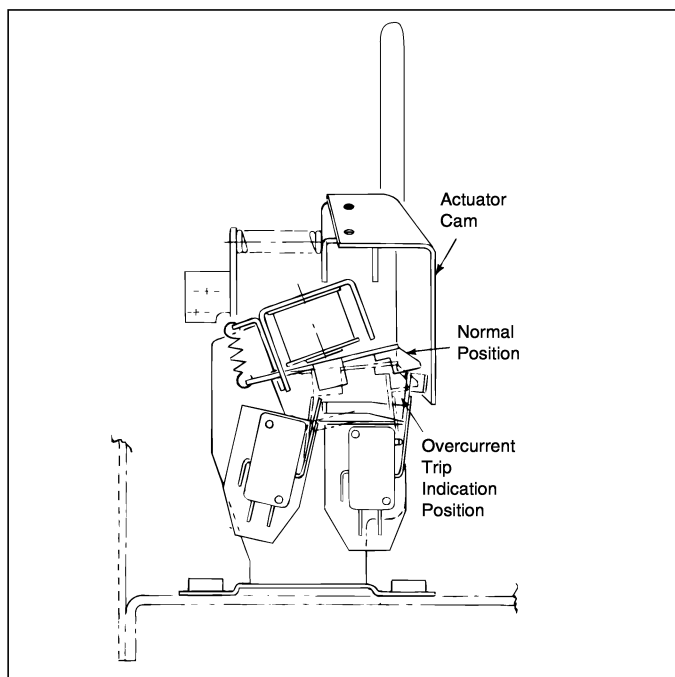


Figure 3-19 Overcurrent Trip Switch Operation

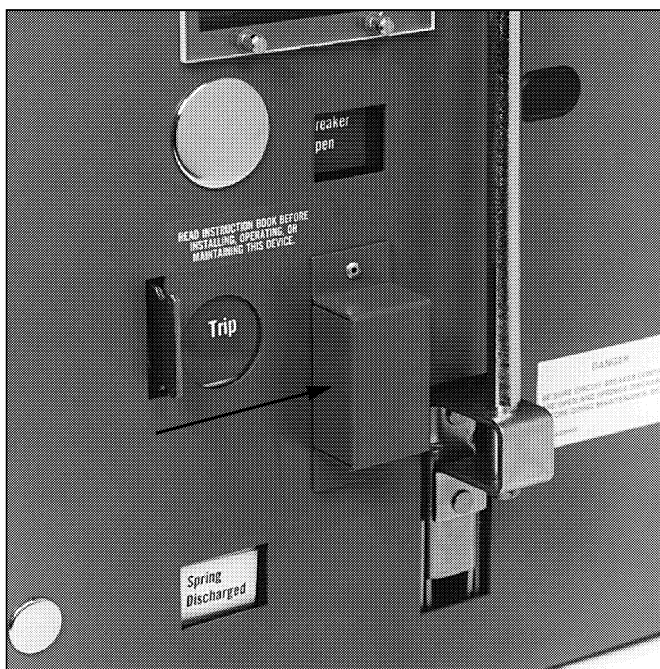


Figure 3-20 Close Bar Guard Shown Installed

SECTION 4: BASIC OPERATING INSTRUCTIONS



WARNING

WHEN CHARGING A CIRCUIT BREAKER ON ITS COMPARTMENT EXTENSION RAILS OR ON A WORKBENCH, HOLD IT TO PREVENT IT FROM TILTING FORWARD AND POSSIBLY TOPPLING TO THE FLOOR CAUSING EQUIPMENT DAMAGE AND/OR SERIOUS BODILY INJURY.

4-1 MANUAL CIRCUIT BREAKER OPERATION

On manually operated circuit breakers, the closing springs can only be charged by hand. The circuit breaker cannot be in the REMOVE position when manually charging the springs. The design is such that the springs will not be permitted to fully charge, before discharging (trip-free close operation). If a circuit breaker has been removed from its compartment to a remote location for maintenance and charging of the closing springs is required, the levering device arms on the sides of the breaker must be rotated away from the REMOVE position to the TEST position (Figure 2-4). This is accomplished through the use of the levering crank as described in paragraph 2-5.

When the circuit breaker is in the CONNECT or TEST position as indicated on the front control panel indicator, the closing springs can be charged by a single stroke downward on the spring charging handle to a position nearly 90 degrees from its normal upright rest position (Figure 4-1). When the springs are charged, the handle will suddenly become very easy to move, and a metallic “click” will be heard as the over center closing springs stop is reached. The spring charge indicator on the front control panel will also indicate “Spring Charged.”



CAUTION

DO NOT RELEASE THE CHARGING HANDLE BEFORE THE CHARGING OPERATION IS COMPLETED. IF THE HANDLE IS RELEASED BEFORE THE OPERATION IS COMPLETED, THE HANDLE WILL RETURN TO ITS NORMAL POSITION WITH A VELOCITY GREAT ENOUGH TO BREAK THE CHARGING HANDLE KNOB OR CAUSE BODILY INJURY.

Standard manually operated circuit breakers can only be closed by hand using the close bar (Figure 3-3). An

optional closing spring release device can be supplied for this same purpose. Refer to paragraph 3-10.2 for additional information.

Standard manually operated circuit breakers can be opened manually by using the trip plate on the front control panel or the trip plate on the compartment door. Automatic opening of the circuit breaker can be accomplished through the use of several standard and/or optional devices. Refer to paragraph 3-8.1 for details.

4-1.1 SPRING CHARGE MECHANISM FOR MANUALLY OPERATED BREAKERS

The mechanism in a manually operated circuit breaker is graphically illustrated in Figure 4-2. The actuator is omitted for the sake of clarity.

Figure 4-3 shows details of the spring-charging device. It is located between the mechanism right hand side frame and the right crank arm. A part of this assembly is the manual charge cam. It is rigidly fixed to the crank shaft, the same as the main close cam and crank arms.

The other parts are the front crank assembly. It is pivoted to a bracket fastened to the main frame base, and has a socket for the manual charge handle. The rear crank is pivoted to the front portion, and has a cross-



Figure 4-1 Manual Charging of Breaker Closing Springs

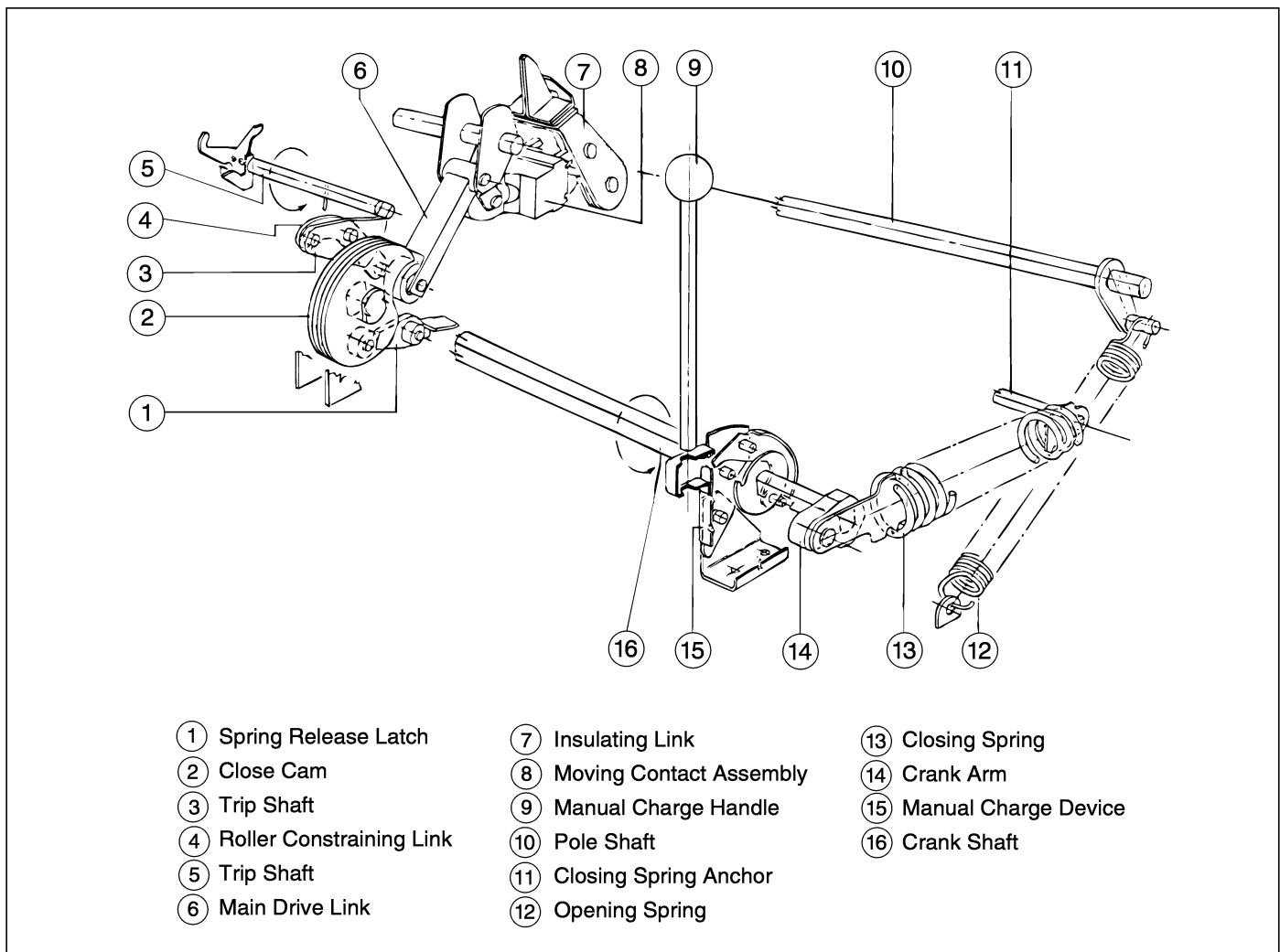


Figure 4-2 Principal Parts in Manually Charged Spring Operated Mechanism

wise pin on the end. A spring forces this pin against the cam. Another spring holds the front crank assembly in a clockwise direction against a stop, so that the manual spring-charge handle socket is normally upright in the unused position.

The manual charge cam is mounted on the crank shaft so that the crank pin hooks behind the hook-shaped surface of the manual charge cam, when the handle is upright and the springs discharged (Figure 4-3). The springs are fully charged by an almost 90 degree movement downward of the charging handle, as previously detailed in Paragraph 4-1.

It is possible to manually recharge the closing springs immediately after closing the breaker and before it has

been tripped open. This results in the springs loading the associated bearings and latches for long periods. In addition, an extra close operation or trip-free operation will be necessary on levering the breaker to the DISCONNECT and REMOVE positions. Therefore, it is recommended that the springs be charged just prior to closing the breaker.

4-2 POWER CIRCUIT BREAKER OPERATION

On power operated circuit breakers, the closing springs are normally charged automatically through the use of an electric motor. In the case of an emergency or lack of control power, the springs can be charged manually.

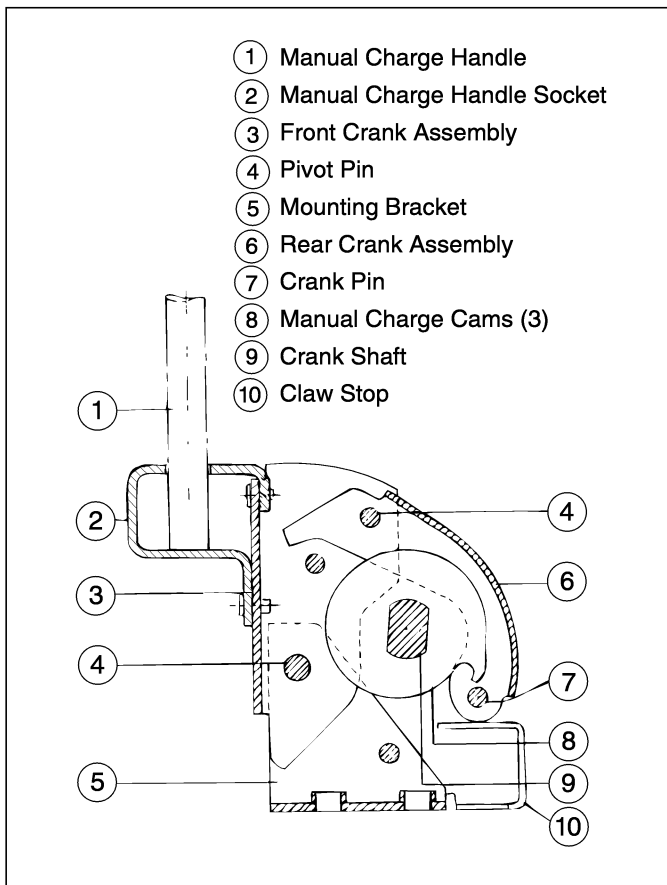


Figure 4-3 Manually Operated Spring-Charging Mechanism Details

Closing springs can be charged manually by using the short, front mounted emergency charging handle. The length of this charging handle is significantly shorter than its manual version. This is one way to quickly identify a manually or power operated circuit breaker. The manual charging mechanism on a power operated circuit breaker operates on a ratchet principle, requiring 10 to 12 handle pumping operations to completely charge the springs. When charged, a definite metallic “click” is heard and the spring charge indicator on the front control panel will show “Spring Charged.” Do not try to force the charging handle beyond this point.

Closing of the circuit breaker is accomplished electrically by an electromagnet (spring release device) which lifts the closing spring release latch. Like the manually operated circuit breaker, the power operated circuit breaker can also be closed manually by pushing the front control panel close bar (Figure 3-3).

Power operated circuit breaker can be opened manually or electrically. Refer to paragraph 3-8.2 for details.

4-2.1 SPRING CHARGE MECHANISM FOR POWER OPERATED BREAKERS

The mechanism in a power operated circuit breaker is graphically illustrated in Figure 4-4.

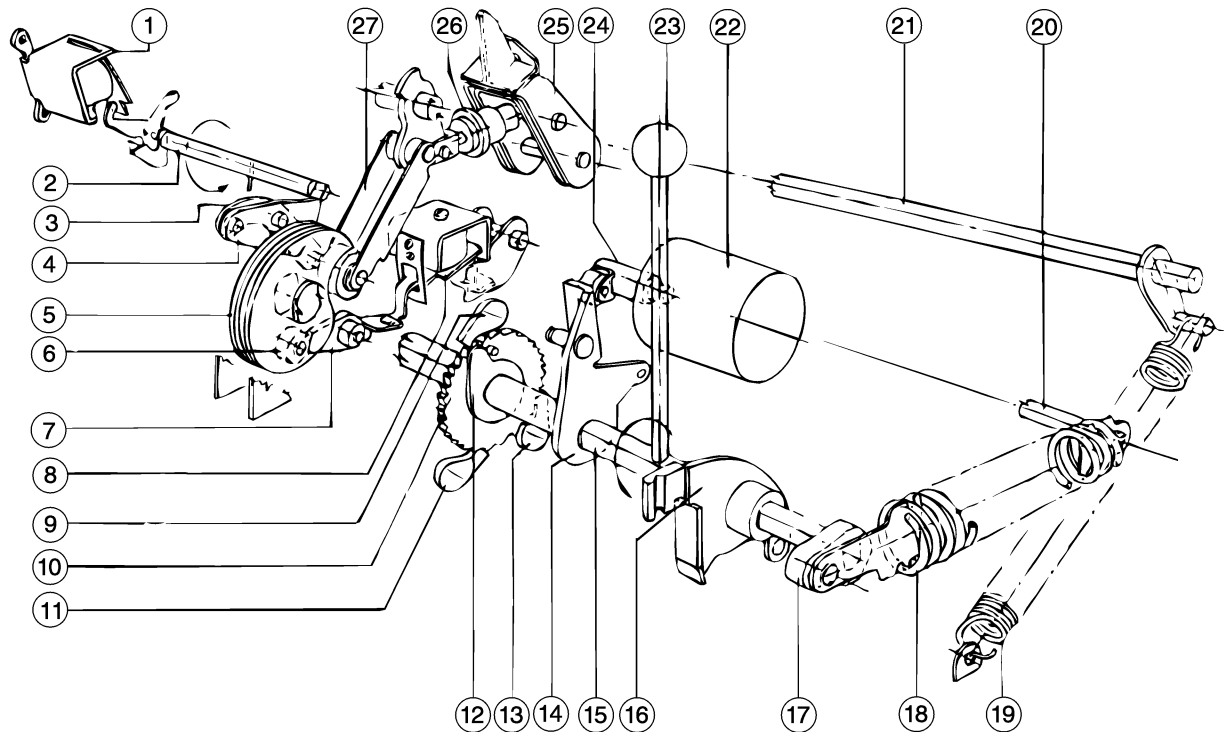
Figure 4-5 is a front view drawing showing the principal parts of the spring-charging portion of this mechanism. Some parts are omitted for clarity. Figure 4-6 shows in greater detail the major parts of the spring-charge mechanism in the two basic positions:

1. Closing springs charged as viewed looking into right end of crankshaft (Figure 4-6a)
2. Closing springs discharged partial view

Refer to Figure 4-5. The basic elements are mounted on the crank shaft (8). This is a straight shaft with four flats machined on it, and a crank arm (11) attached to each end. Each crank arm connects to its closing spring (9) by a formed spring end (10) in Figure 4-6b. The rear of the springs anchor to the rear of the mechanism frame. The crank arms (11), motor cutoff switch cam (7), close cam (6) and two drive plates (25) have matching flats, and are thus anchored to the crank shaft. The spring charge indicator (12) ratchet wheel (17), oscillator (30), and emergency charge device (26) do not have internal flats, but are mounted on separate bushings and are free to rotate on the crank shaft.

The motor crank shaft assembly (29), carrying a roller for driving the oscillator, is pivoted in the right hand mechanism side frame. The hold pawl (18) is mounted by means of a pin on the mechanism side frame.

In operation, rotation of the motor crank pushes the oscillator arm counterclockwise to make the oscillator pawl (28) push a tooth in the ratchet wheel (17), and rotate the ratchet wheel slightly more than one tooth in the counterclockwise direction. The holding pawl snaps behind the corresponding advanced tooth, and holds it against the torque of the closing springs while the oscillator arm rotates back clockwise to catch another ratchet tooth. Thus the ratchet wheel is rotated counterclockwise until the ratchet wheel pin (21) engages the two drive plates (25), which in turn rotate the crank shaft and crank arms in the same direction until the arms are slightly past horizontal dead center. Since the close cam (6) is rigidly mounted on the crank shaft like the drive plates, it has rotated the same amount as the plates. The close cam carries a stop roller as shown in Figure 4-7b. Just after



- | | | |
|----------------------------|---------------------------|---------------------------|
| ① Shunt Trip Device | ⑩ Ratchet Wheel | ⑲ Reset Spring |
| ② Trip Shaft | ⑪ Hold Pawl | ⑳ Closing Spring Anchor |
| ③ Roller Constraining Link | ⑫ Drive Plate | ㉑ Pole Shaft |
| ④ Trip Latch | ⑬ Emergency Charge Pawl | ㉒ Motor |
| ⑤ Close Cam | ⑭ Oscillator | ㉓ Emergency Charge Handle |
| ⑥ Stop Roller | ⑮ Crank Shaft | ㉔ Motor Crank and Handle |
| ⑦ Spring Release Latch | ⑯ Emergency Charge Device | ㉕ Moving Contact Assembly |
| ⑧ Spring Release Device | ⑰ Crank Arm | ㉖ Insulating Link |
| ⑨ Oscillator Pawl | ⑱ Closing Spring | ㉗ Main Drive Link |

Figure 4-4 Principal Parts in Power Operated Mechanism (Close Spring Shown in Charged Position)

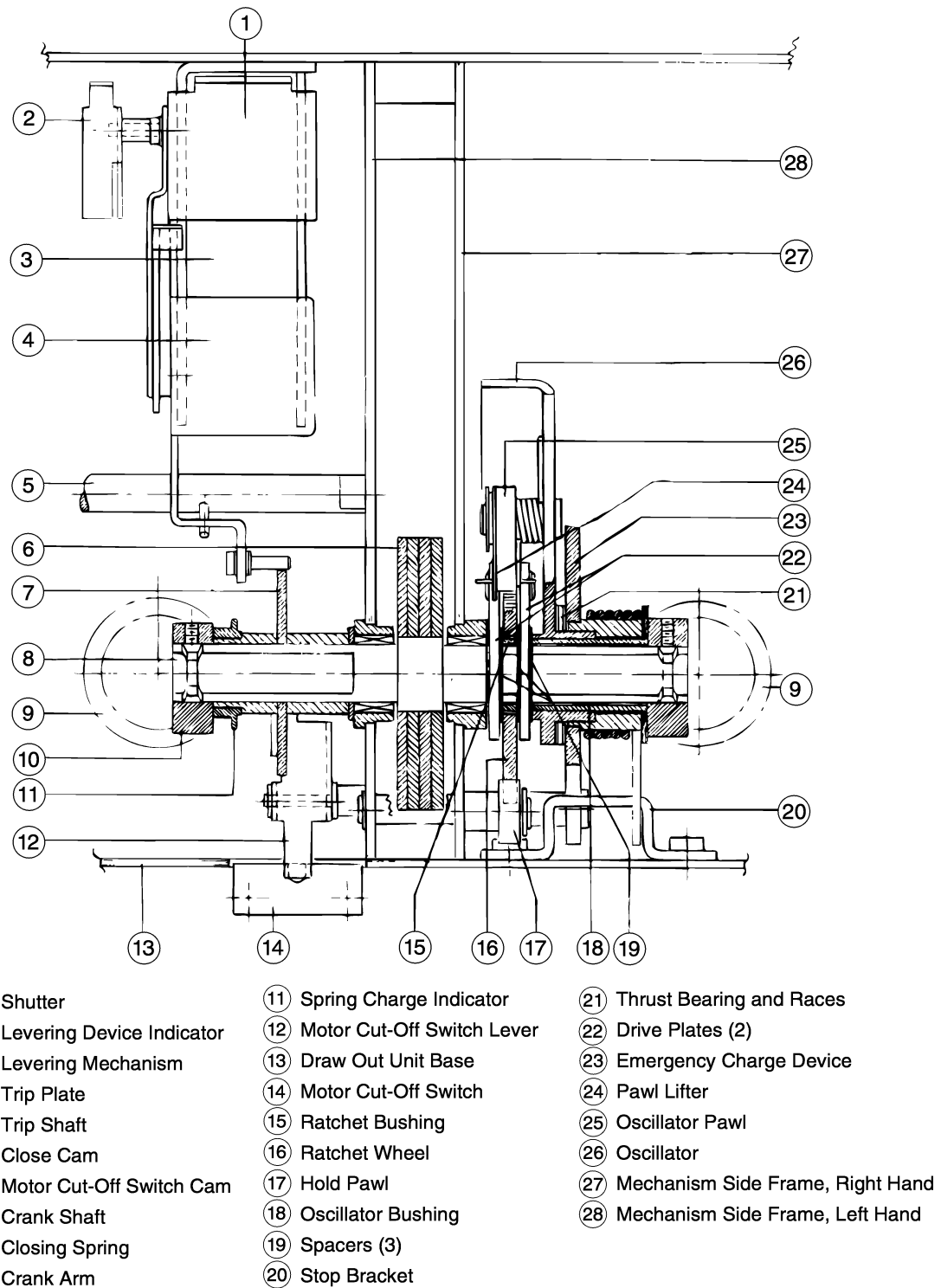
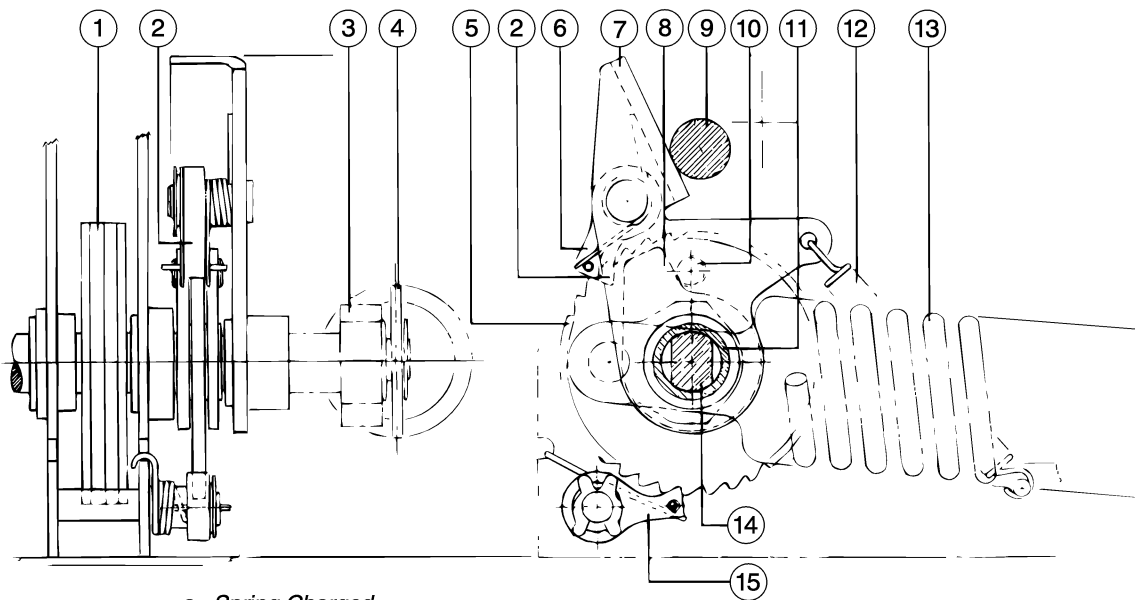
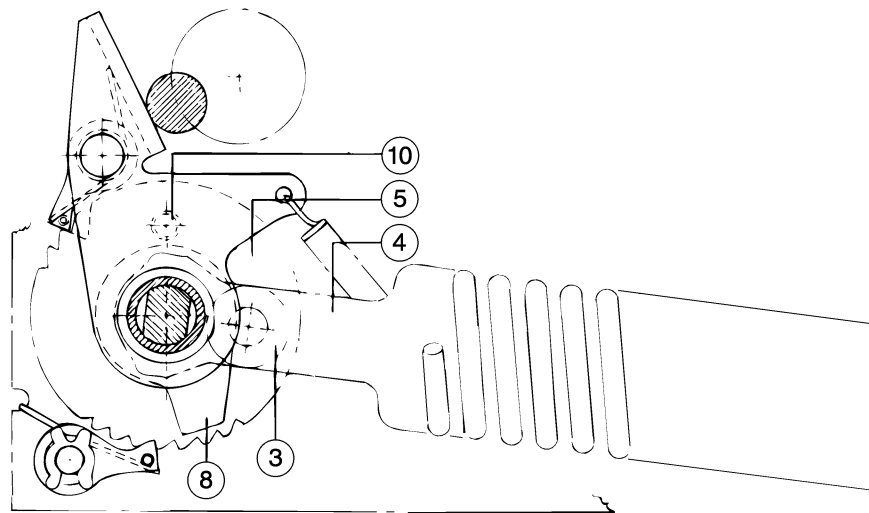


Figure 4-5 Crank Shaft Assembly Front View (Some Parts Omitted for Clarity)



a. Spring Charged

Note: Main cam position for this crank shaft position is shown in Fig. 4-7.



b. Spring Discharged

- | | | |
|-----------------|----------------------|----------------------|
| ① Close Cam | ⑥ Oscillator Pawl | ⑪ Oscillator Bushing |
| ② Pawl Lifter | ⑦ Oscillator | ⑫ Oscillator Spring |
| ③ Crank Arm | ⑧ Drive Plate | ⑬ Closing Spring |
| ④ Spring End | ⑨ Motor Crank Roller | ⑭ Crank Shaft |
| ⑤ Ratchet Wheel | ⑩ Ratchet Wheel Pin | ⑮ Hold Pawl |

Figure 4-6 Power Operated Spring-Charge Details

horizontal dead center of the crank arms is reached, the torque of the closing springs starts to rotate the crank independently of the driving motor. However, the stop roller on the closing cam quickly stops the movement of the crank at only a few degrees over center, and holds it there by coming against the spring release latch. This is the "spring charged" position. The motor cut-off switch cam (7) operates the switch (15) through a lever (13) at this time, and the motor stops.

At the instant the springs snap over dead center, the lobes of the drive plates raise the pawl lifters (27), and prevent the oscillator pawl (28) from engaging the next tooth in the ratchet wheel. Thus the oscillator is free and renders the exact stopping point of the motor not critical.

When the spring release latch is moved below the level of the stop roller, the close cam is free to rotate; and the two closing springs rotate the crankshaft counterclockwise to close the breaker contacts. They assume the position shown in Figure 4-6b and the cam as shown in Figure 4-7c. During rotation, the drive plates move away from the ratchet wheel pin. The ratchet wheel does not rotate during the closing operation, thus preventing excessive wear on the teeth and pawls.

Power operated breakers are also equipped for emergency hand charging of the closing springs (Figure 4-8). This operation is similar to that of the motor and oscillator except a separate emergency charge pawl (33) is used to advance the ratchet wheel (17) several teeth on each stroke of the charge handle (34). This device (26) also pivots on the crank shaft.

4-2.2 POWER OPERATION

Refer to Figure 4-9 for the basic schematic and connection diagrams.

With the breaker open and springs discharged, the motor is energized through the limit switch (LS) and the "b" contact. The green indicating light (G) is controlled by a separate "b" contact, and when lit indicates the breaker is open.

The motor runs and charges the closing springs. When the springs are fully charged, the limit switch (LS) opens in the motor circuit and closes in the spring release coil (SR) circuit.

When the close contact (CS-C) makes, the spring release coil (SR) is energized through the normally closed "Y" contact, the limit switch (LS), and the breaker "b" contacts. This releases the latch holding the stop roller on the close cam.

The springs are released to close the breaker. When the breaker closes, the "b" contact opens to cut off the spring release coil (SR) and motor (MOT), and the limit switch (LS) contacts reset.

If the close contact (CS-C) is maintained, the anti-pump relay (Y) will be picked up by the current through the spring release coil (SR), and will open its "Y" contact in the spring release (SR) circuit. This allows only one close operation until the close contact (CS-C) has been reset. The "Y" coil has a very low drop-out voltage.

On some breakers a special closing circuit may be provided which permits the closing springs to be automatically recharged immediately after the breaker is closed, instead of only after the breaker is opened. This is accomplished by separating the motor and limit switch from the "b" contact so the motor operation is independent of the position of the breaker contacts. This arrangement makes the breaker suitable for use with instantaneous reclosing relays or in special operating sequences.

Standard control utilizes AC or DC control power. For 240 or 120 volt AC equipment, the control power can be taken directly from the source through fuses. For 480 and 600 volt AC operation, a suitable control power transformer is used. The transformer is optional for 240 volt AC systems. DC control voltages are 48, 125 or 250.

When the breaker closes, the "a" contact in the shunt trip (SH-TR) coil circuit also closes to complete this trip circuit. The red indicator lamp (R) supervises the shunt trip circuit to show that it is in working order. It also indicates that the breaker is closed.

When control power is turned on, any power operated breaker in the TEST or CONNECTED positions with its springs discharged will have its motor energized until the closing springs are charged.

4-3 CLOSING MECHANISM

The mechanism is of the general variety of mechanically trip free mechanisms. This means that the breaker can be opened or tripped free from the closing mechanism at any point in its closing stroke. It also means that if the trip latch is held in the "trip" position while the spring release latch is released, the closing springs will make a trip-free operation but the breaker contacts will not close or move appreciably toward the closed position.

Based on this construction, the breaker close and trip linkage can have four steady state conditions. The arrangements of the basic close and trip linkage for these four conditions are shown in Figure 4-7.

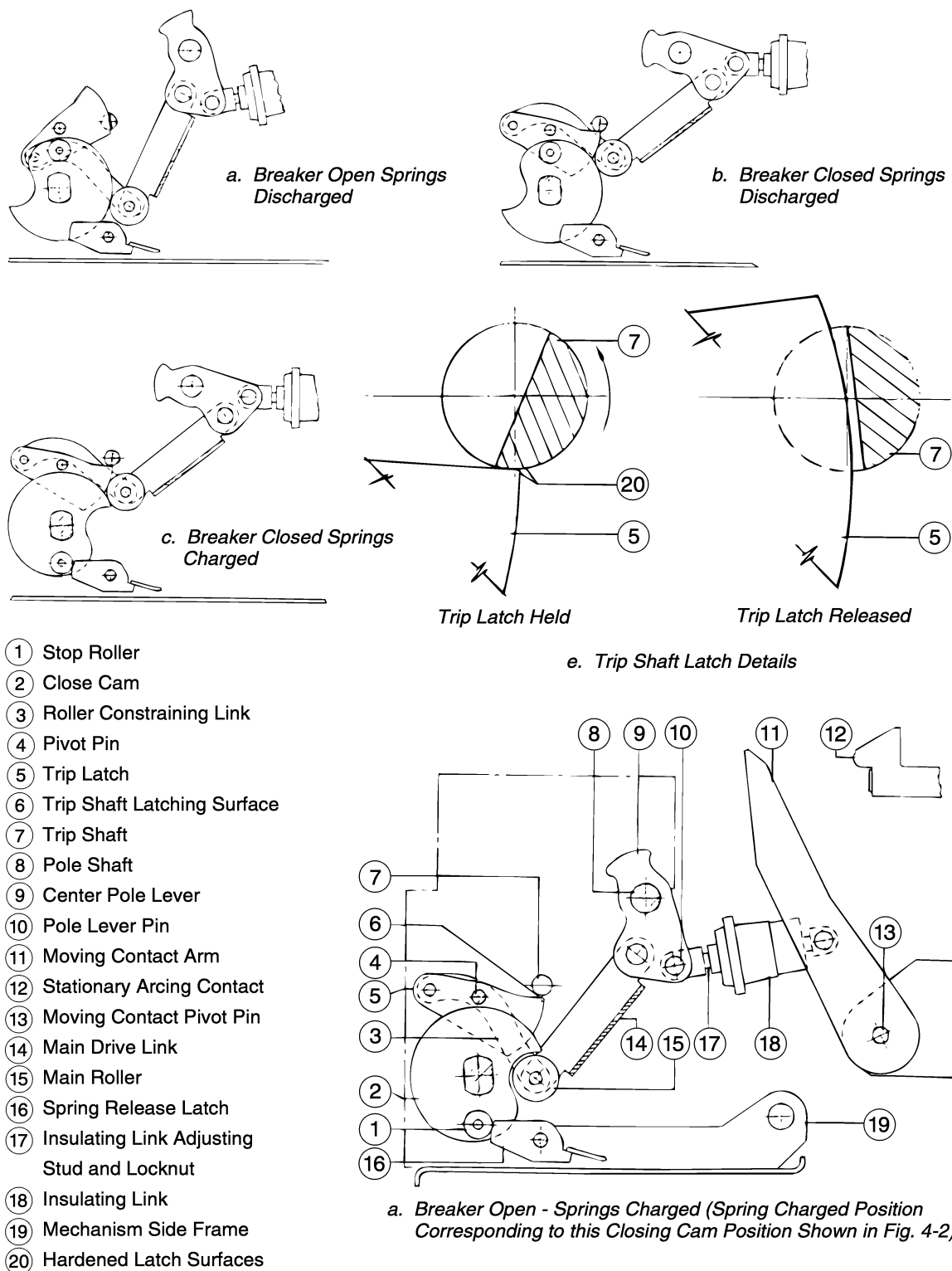


Figure 4-7 Four Basic Positions of Breaker and Linkage (Enlarged View of Trip Shaft)

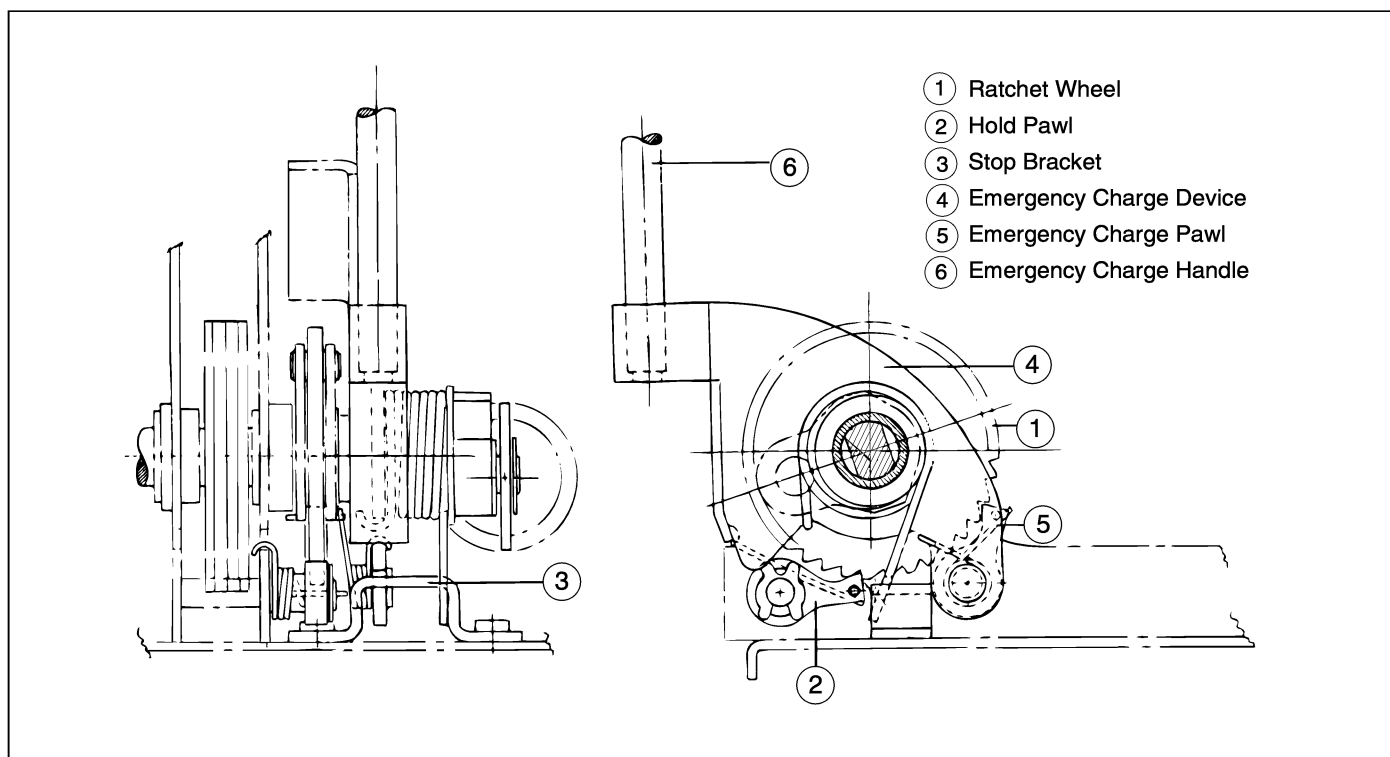


Figure 4-8 Emergency Spring-Charge on Power Operated Mechanism

The angular position of the close cam in Figure 4-7 corresponds to the angular position of the drive plates and closing spring crank arms shown in Figure 4-6. The trip latch is in the tripped position and it will reset to the latched position at the end of the spring charging stroke. The closing springs are charged by counterclockwise rotation of the ratchet and drive plates until the close cam stop roller meets the spring release latch, as shown in Figure 4-7b.

Note in Figure 4-7b also that the lower end of the main drive link with the main roller has swung upward and toward the left, pushing the trip latch constraining link so as to rotate the trip latch back to the reset position. This occurs at the same time that the spring charge is complete and just before the close cam stop roller strikes the spring release latch. The position of the cam in Figure 4-7b corresponds to the position of the drive plates in Figure 4-6a spring charged, breaker open.

The breaker is now ready to be closed. Closing is started by counterclockwise rotation of the spring release latch (Figure 4-7b). This removes the hold on the close cam stop roller, and allows the force of the closing springs to rotate the close cam counterclockwise and close the breaker. The linkage is then in the position

shown in Figure 4-7c. The close cam has rotated approximately 180 degrees.

The spring release latch can be rotated by two methods:

1. Spring Release Device (Paragraph 3-10.2, Figures 4-4 and 4-14)
2. Close Bar (through linkage shown in Figure 4-14b)

4-4 OPENING (TRIPPING) MECHANISM

The breaker is tripped open by counterclockwise rotation of the trip shaft (Figure 4-7c). The trip shaft extends across the left hand part of the breaker, from the left hand mechanism side sheet to the left hand breaker side sheet.

Rotation of the trip shaft accomplishes breaker opening as follows (Figure 4-7c): The main contacts (not shown) produce a clockwise twisting force or torque on the pole shaft. This is transmitted by the center pole lever downward through the main drive link to the main roller. The main drive link at the main roller is connected to the trip latch by the roller constraining link. This force tends to

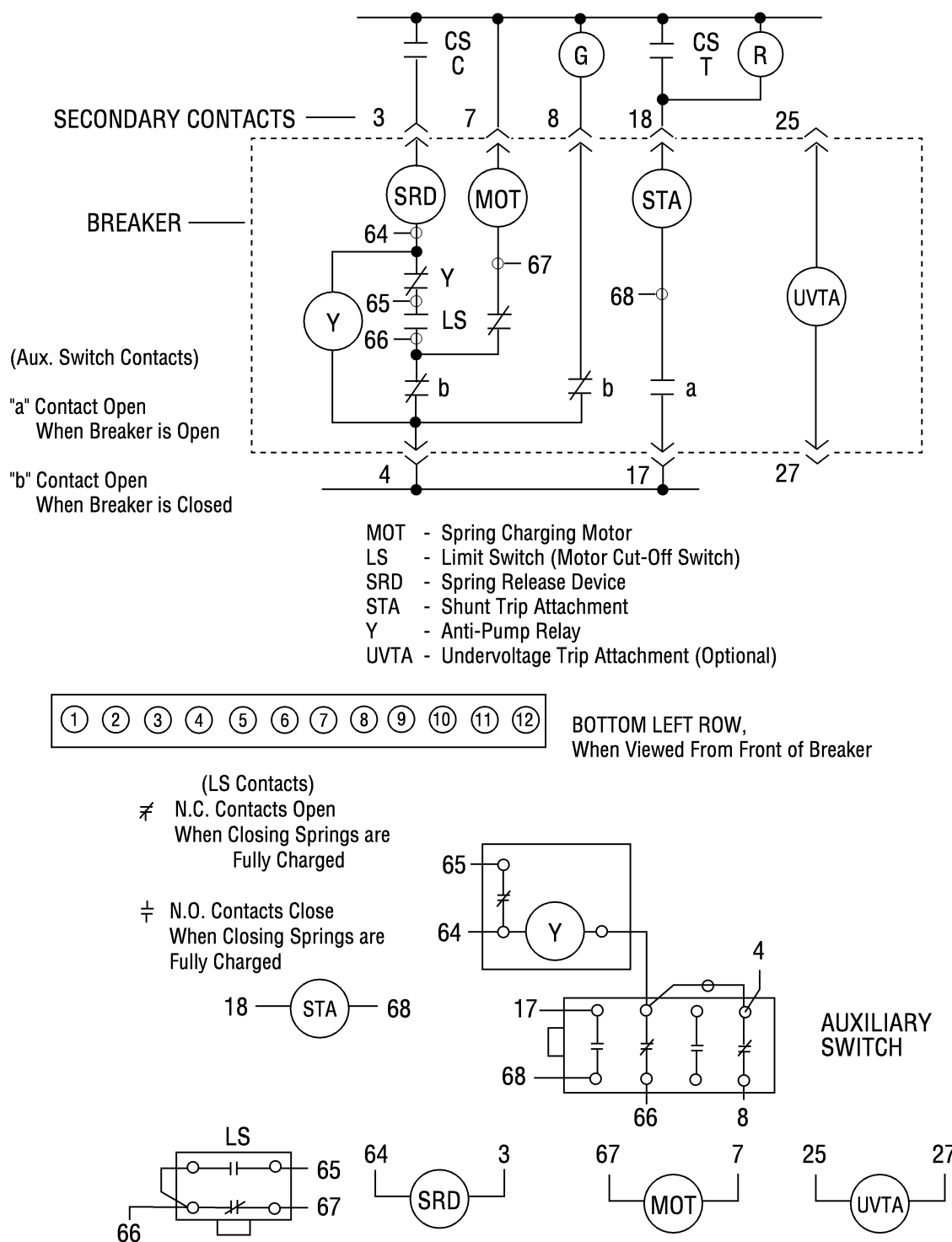


Figure 4-9 Basic Schematic and Connection Diagrams for Power Operated Breaker

rotate the trip latch counterclockwise, but the trip latch is kept from rotating by overlap of the latch surface of the trip shaft. A very small rotation of the trip shaft thus releases the trip latch to rotate counterclockwise to the position shown in Figure 4-7a. The enlarged views of the trip shaft and trip latch tip in Figure 4-7e show in detail the rotation of the trip shaft for release of the trip latch. The entire linkage collapses under the force of the main contacts and comes to rest with the breaker open (Figure 4-7a). Note that the trip latch is still in the released position (not reset).

If the breaker stands open with springs charged as in Figure 4-7b, and if the trip shaft is held in the rotated or trip position, an attempt to close will result in a trip-free operation. This is so because with the trip shaft in the trip position, there is no restraint on the trip latch. Therefore, no force is applied to the main link to close the breaker.

Although certain interlocking operations may or will result in this trip-free type of operation, it causes some extra shock on the mechanism parts. Therefore, trip-free operations should be avoided.

The trip shaft can be rotated to trip the breaker in a number of ways:

1. Breaker Trip Plate (Figure 3-3) — Pushing the trip plate will trip the breaker. This item has a tab which pushes against a pin on the trip shaft, which applies a direct rotating force on the shaft in the tripping direction (Figure 4-11).
2. Shunt Trip Device (Refer to Paragraph 3-10.4)
3. Trip Actuator (Refer to Paragraph 3-7.3)
4. Compartment Door Trip Flap — If the breaker is in the CONNECTED position in its compartment, pushing the door mounted trip flap will trip the breaker. It operates through a sliding link and lever fastened to the drawout cradle floor. When pushed, it engages the compartment trip lever, extending from the bottom of the breaker, to cause tripping (Figure 3-16).
5. Undervoltage Trip Attachment (Refer to Paragraph 3-10.7)

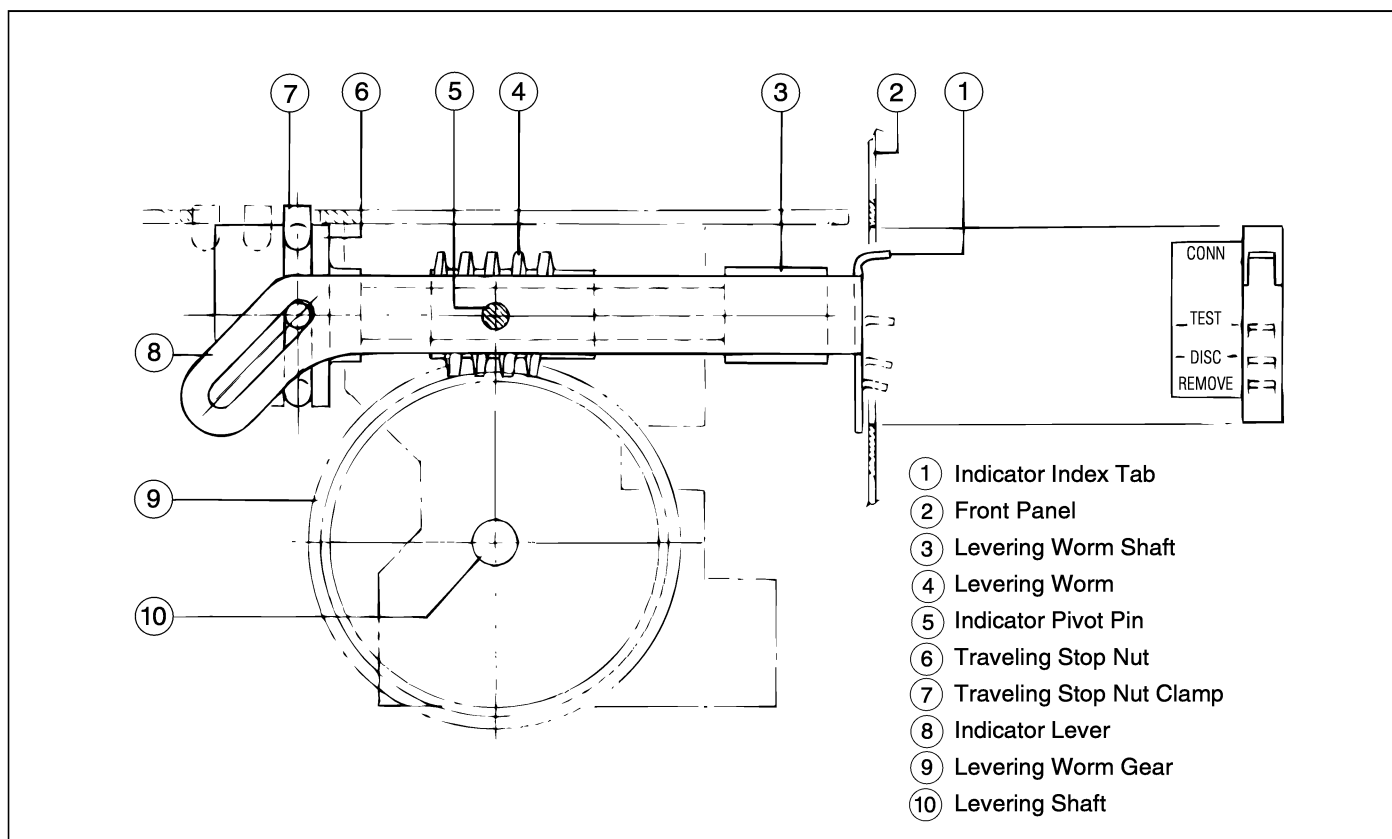


Figure 4-10 Drawout Unit Position Indicator

6. Blown Limiter Indicator (Refer to Paragraph 3-2 and Figure 4-16)

4-5 MECHANICAL INTERLOCKING SYSTEM DESCRIPTION



WARNING

DO NOT TAMPER WITH THE INTERLOCKING SYSTEM. IF ANY PART OF THE SYSTEM IS NOT FUNCTIONING CORRECTLY, HAVE IT CORRECTED IMMEDIATELY. INTERLOCKING THAT IS NOT FUNCTIONING PROPERLY COULD RESULT IN MECHANICAL AND ELECTRICAL EQUIPMENT DAMAGE, SERIOUS BODILY INJURY AND/OR DEATH.

To increase safety to personnel and the circuits to which the breaker is connected, the complete unit is equipped with an automatic mechanical interlocking system. This interlocking system is effective in various ways in the four breaker positions: REMOVE, DISCONNECT, TEST and CONNECT (Figure 4-10) .

In addition, there is an interference interlock described in Paragraph 3-11.1 used to prevent the insertion of a circuit breaker into a non-compatible compartment.

The mechanical interlock system serves basic and distinctive purposes in each of the four breaker positions. The following information describes the interlocking conditions which exist in each of the positions. The shutter referred to in these detailed explanations is the device which covers access to the levering device worm shaft on the front of the breaker (Figure 3-3).

4-5.1 REMOVE POSITION

In the REMOVE position, the breaker is nearest to the front of the compartment. It is also where the breaker must be placed when being installed, after having been completely outside the compartment.

In this position, the following conditions exist:

1. The breaker is open.
2. The closing springs are discharged. If an attempt is made to charge the springs, a trip-free operation will result.
3. The breaker cannot be closed electrically or manually.

4. The breaker can be withdrawn from the compartment by direct pull. The levering device is not engaged with the cradle at this point.
5. The levering device arms are in a horizontal position with their rollers pointing toward the rear (Figure 2-4).

4-5.2 DISCONNECT POSITION

In the DISCONNECT position, the breaker has moved only a fraction of an inch into its compartment. This position is indicated by the position indicator on the front of the breaker (Figure 3-3).

In this position, the following conditions exist:

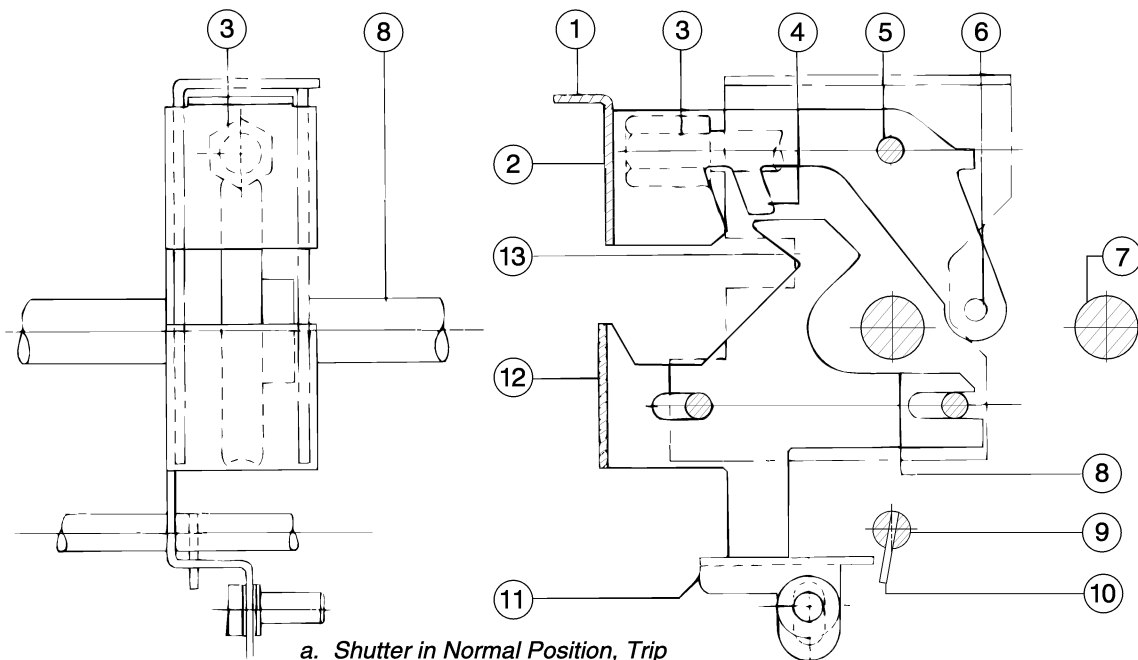
1. The breaker is held in its compartment, since the levering rollers lowered into the slots in the compartment's cradle arms.
2. The shutter closes over the levering device hex shaft.
3. The shutter may be locked closed and the breaker held trip-free with a padlock, thus locking it in its compartment. Padlocking provisions are described later in this section.
4. Both primary and secondary disconnect contacts are separated.
5. The breaker is open.

4-5.3 TEST POSITION

In the TEST position, the breaker is at a point that is in between the DISCONNECT and CONNECT positions, as indicated the drawout position indicator. The main disconnecting contacts are sufficiently separated to permit safe operation of the breaker. The secondary contacts are now made up.

In this position, the following conditions exist:

1. The breaker arrives in this position, whether being inserted or withdrawn, with its contacts open. Its closing springs can be either charged or discharged when coming from the CONNECTED position.
2. After the levering crank is removed, it is possible to close and trip the breaker both manually and electrically.
3. Just before the breaker arrives in the TEST position from the DISCONNECT position, the secondary contacts make up and the spring-charge motor on power



- ① Shutter Push Tab
- ② Shutter
- ③ Levering Device Worm Shaft
- ④ Shutter Lower Projection
- ⑤ Shutter Pivot Pin
- ⑥ Shutter Interlock Pin
- ⑦ Pole Shaft
- ⑧ Levering Device Shaft
- ⑨ Trip Shaft
- ⑩ Trip Shaft Pin
- ⑪ Tripping Tab
- ⑫ Trip Plate
- ⑬ Trip Plate Hook
- ⑭ Levering Device Crank Handle

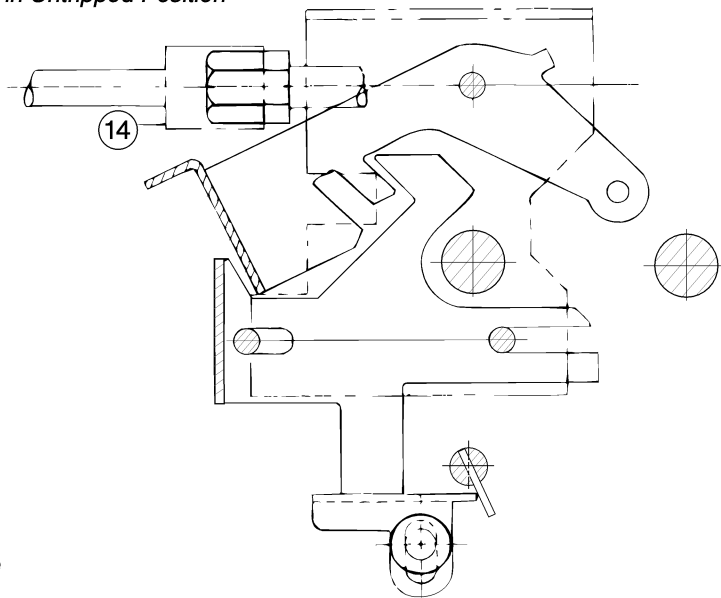


Figure 4-11 Shutter, Trip Plate and Trip Shaft Relationship

operated breakers automatically runs and charges the closing springs.

4. The breaker can be closed manually or electrically after the springs are charged.
5. The breaker can be opened (tripped) manually or electrically through a shunt trip device.
6. The trip flap on the breaker compartment door will not trip the breaker.
7. The breaker must be opened before further levering can be done.
8. Overload tripping characteristics and other tripping system functions can be visually checked and/or changed in this position. All trip unit testing can be carried out in this position.

4-5.4 CONNECT POSITION

In the CONNECT position, the breaker's primary and secondary disconnecting contacts are both engaged with their stationary counterparts in the breaker compartment.

This is the farthest position from the front of the compartment into which the breaker can be levered. The CONNECT position is indicated by:

1. The drawout position indicator on the front of the breaker
2. A sudden mechanical stop is felt in the form of an increase in load on the levering crank handle

NOTICE

When levering in from the TEST position, an increase in load on the crank handle is felt as the main disconnecting contacts are engaged. As cranking is continued, the load will decrease some and then suddenly increase, as the final connected position stop is reached.

In this position, all the conditions listed for the TEST position exist, except:

1. IN THIS POSITION, DO NOT ATTEMPT TO ELECTRICALLY CHECK THE ELECTRONIC TRIP DEVICE WITH A TEST KIT OR ANY OTHER METHOD, SINCE THE BREAKER WILL BE

TRIPPED AND CAUSE A DISRUPTION OF SERVICE.

2. The trip flap on the breaker compartment door is operative, and can be used to trip the breaker with the door closed.

4-5.5 MECHANICAL INTERLOCKING SYSTEM OPERATION

Figure 4-11 shows that part of the interlock system which prevents closing of the breaker while being driven in either direction by the levering device, or while it is standing in any intermediate position between TEST and CONNECT or DISCONNECT. Figure 4-11a shows the shutter and trip plate for normal operation, such as in the DISCONNECT, TEST, or CONNECT positions. The breaker can be closed and tripped open by all available devices in the latter two positions, except for the trip flap on the breaker compartment door.

In Figure 4-11a, the shutter prevents pushing the levering device crank handle onto the worm shaft. If the shutter alone is pushed downward, it will rotate slightly about its pivot pin and its lower projection strikes the hook on the trip plate, and the worm shaft will not be cleared. Therefore, it is necessary to push the trip plate in, which moves the hook back out of the way of the shutter lower projection. This permits the shutter to be pushed downward to clear the worm shaft for the levering device crank (Figure 4-11b).

It should be noted that pushing the trip plate in also pushes the trip shaft pin so as to rotate the trip shaft counterclockwise, thus tripping the breaker open. If closing is attempted with the linkage in a position as shown in Figure 4-11b, a trip-free operation will occur.

Movement of the shutter is also controlled by the interlock cam which is mounted on the levering device shaft to the left of the worm gear. The interlock cam has a fixed relationship to the levering device arms. Figure 4-12 shows the relationship between the shutter, interlock cam and levering device arms for the four basic positions of the drawout unit in the compartment.

Figure 4-12a shows the CONNECT position. The cam is in a position to allow free travel of the shutter interlock pin. Therefore, the shutter can be pushed downward, but only after pushing in the trip plate (Figure 4-11). This trips the breaker and prevents levering out with the breaker closed.

Figure 4-12b shows the TEST position. Note that between the CONNECT and TEST positions the cam

will rotate so as to block the shutter interlock pin. This prevents the shutter from returning to its closed position and releasing the trip plate, if the levering crank is removed. Thus, if a closing operation is attempted during this part of the travel, a trip-free operation occurs and the breaker contacts do not close. Note that this is true for either direction of breaker travel so that no load is made or broken at the disconnecting contacts.

When the breaker gets to the TEST position, a slot in the interlock cam allows free movement of the shutter

interlock pin, and the shutter returns to its closed position when the levering crank is removed. The levering device arms are now almost vertically downward.

Figure 4-12c shows the DISCONNECT position. Here the cam also rotates so as to block the shutter interlock pin while the breaker is between positions, thus holding the shutter open. When the exact position, as shown on the indicator, is reached, the shutter will close when the levering crank is removed. The levering arms will be approximately 40 degrees below the horizontal.

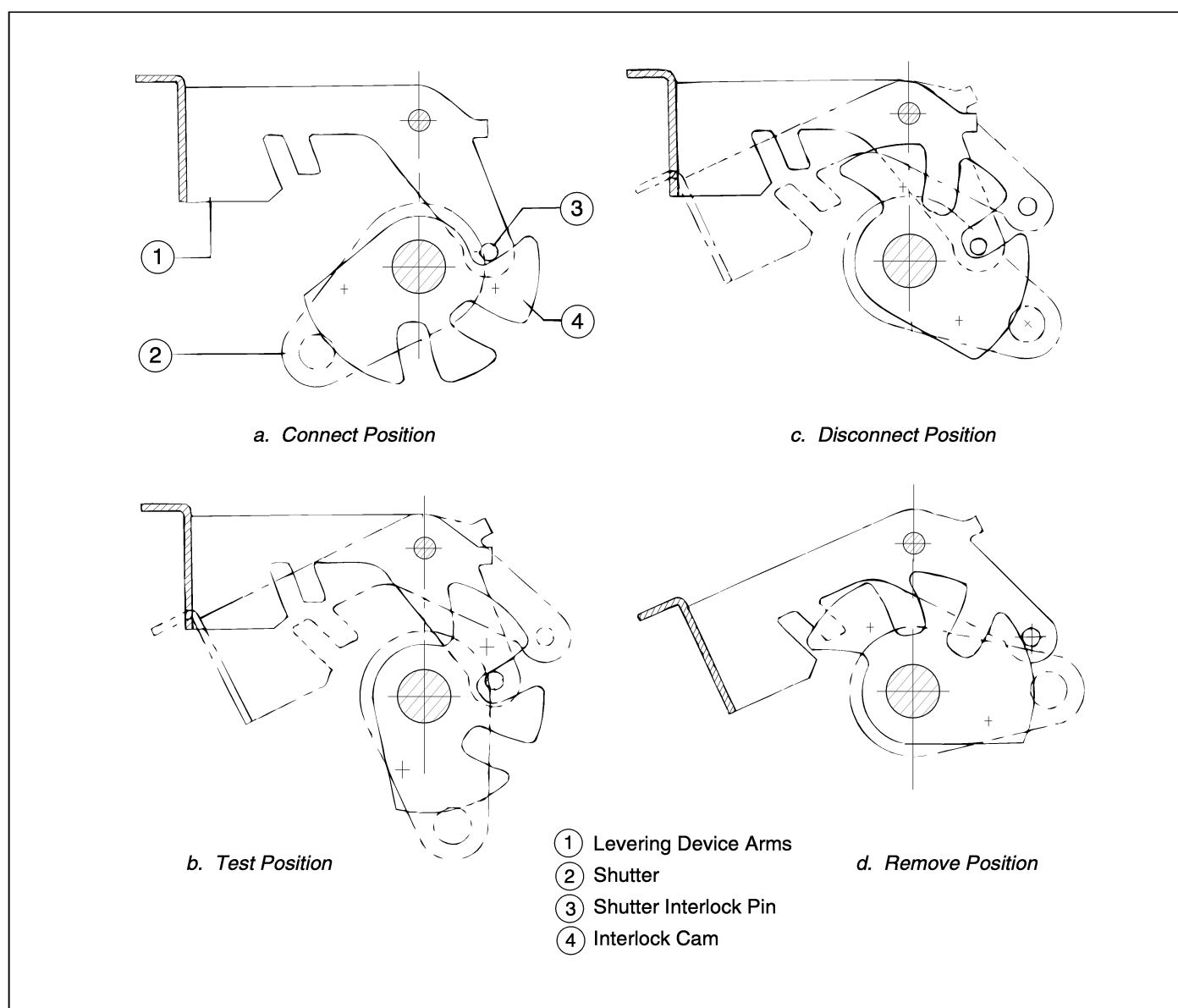


Figure 4-12 Shutter, Interlock Cam and Levering Device Arms Relationship

Figure 4-12d shows the REMOVE position. Here the interlock cam stops with the shutter interlock pin blocked. The shutter stays down and the breaker stays tripped when the levering crank is removed. The breaker is held trip-free and cannot be closed. In addition, another interlock, described later, stops the close-release latch from being released.

4-5.6 SPRING DISCHARGE INTERLOCK

The spring discharge interlock operates the close-release latch as the breaker is moved out beyond the TEST position. This causes a trip-free operation of the closing mechanism because it occurs while the levering crank is still on the worm shaft, and the closing springs are charged on a power operated breaker. This is because the levering crank is still being used to move the breaker in the final part of its travel to the DISCONNECT position. The trip plate is still pushed in and the breaker is trip-free.

Figure 4-13 shows the essential parts of the spring discharge interlock. Figures 4-13a and b show the levering device in the -remove position. The interlock plate has two horizontal pins (7 and 8) extending from it, as shown in Figure 4-13. The upper one is designate Pin "A" and the other Pin "B". In levering the breaker out to the REMOVE position, the levering shaft turns counterclockwise until the levering device arms are horizontal to the rear (Figures 4-13a and b). As it rotates, the close bar cam is rotated counterclockwise by Pin "B" to the CLOSE position. This releases the spring release latch through the linkage shown in Figure 4-13. This results in a trip-free operation of the breaker if the closing springs are charged. It happens because the levering crank has the trip plate held in the "Trip" position. If the breaker is manually operated, levering out can be stopped at the TEST position. Remove the levering crank and (1) close the breaker and (2) trip the breaker. This will discharge the springs so that, when the REMOVE position is reached, there will not be a trip-free operation. The close bar is merely pulled into the "Close" position.

4-5.7 CONNECTED BREAKER MANUAL CLOSE INTERLOCK

The purpose of this interlock is to provide a choice between being able to close the breaker by pushing on the close bar and not being able to, with the breaker in the CONNECT position. Referring to Figure 4-13a, the interlock plate assembly is keyed loosely to the levering device shaft by a drive pin. If the interlock screw is omitted, the interlock plate can be rotated freely on the shaft about 10 degrees. This is because the wide slot is con-

siderably wider than the drive pin. If the interlock screw is in place in the narrow slot, the interlock plate has practically no play and is forced to rotate exactly as much as the levering device rotates.

Figure 4-13c shows the standard arrangement without the interlock screw, with the levering device arms in the CONNECT position. Note that there is a clearance between the back of the hook and Pin "A". This permits the close bar to be pushed to the "Close" position and the breaker to close.

All parts in Figure 4-13d are in the same position as in Figure 4-13c, except that the interlock screw is placed in the narrow slot. This forces the interlock plate to rotate about 10 degrees further than in Figure 4-13c. In this case, there is almost no clearance between Pin "A" and the back of the hook. Consequently, the close bar cannot be pushed to the "Close" position. The breaker can, however, be remotely closed by supplying control voltage to the spring release coil through a control switch or other circuit making device.

4-5.8 ELECTRIC LOCKOUT EQUIPPED BREAKER

Manually operated breakers can be equipped for electric lockout. This means that closing an unenergized circuit is prevented. This can be the main circuit or any other desired circuit. It is accomplished by making it impossible for the required spring release device to release the spring release latch unless the monitored circuit is energized. The spring release coil (SR) is wired through the contact on the auxiliary switch, a front panel closing pushbutton switch, and to the terminals of the circuit being monitored. When the monitored circuit is energized properly, the breaker can be closed through the panel pushbutton switch, provided that the closing springs are charged.

As an additional safeguard against undesired closing under this electric lockout condition, all such breakers are provided with the interlock screw described in the previous paragraph (4-5.7). This prevents hand closing of the breaker in the CONNECT position.

4-5.9 CLOSED BREAKER INTERLOCK

Figure 4-14 shows how operating of the spring release latch is prevented when the breaker is already closed. The close bar is connected to the spring release latch by a link and bell crank. The link is pivoted on the lower end of the close bar cam by a pin. As the close bar is pushed, the pin and latch link move to the right along with the lower end of the cam. The lower end of the link

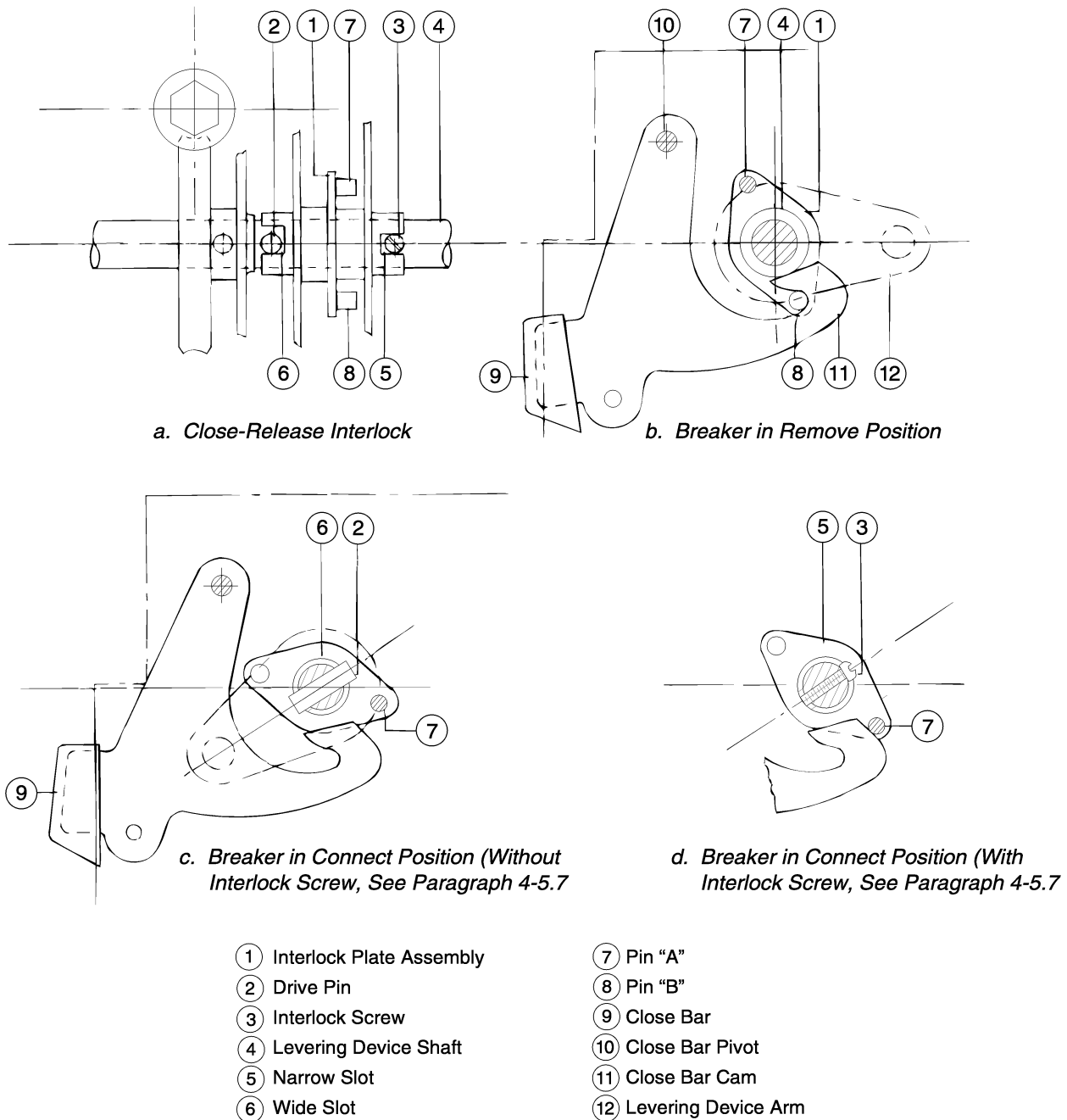


Figure 4-13 Close-Release Interlock to Discharge Springs on Levering Out

is facing a knife edge pivot on the vertical arm of the bell crank. The upper end of the link is facing the "Open-Close" indicator pin. This pin is at the left end of its slot in the mechanism side frame with the breaker open and at the right end with the breaker closed. As the close bar is pushed, the link has two possible end pivots. If the breaker is open, the upper end of the link will swing to the right until it touches the indicating pin. The lower end of the link will then swing to the right and push the vertical arm of the bell crank to the right. The horizontal arm of the bell crank moves downward and presses directly on the spring release latch, allowing the breaker to close.

If the breaker is already closed and the close bar is pushed, the upper end of the spring release latch link swings free to the right because the indicator pin is not there to stop it. Consequently, no force is applied to the vertical arm of the bell crank and nothing else happens.

4-5.10 PADLOCKING PROVISION

Figure 4-15 shows the essential parts of the padlock interlock. The breaker is padlocked in the trip-free condition (Figure 3-3). In this condition, the breaker cannot be closed nor can it be moved with the levering device.

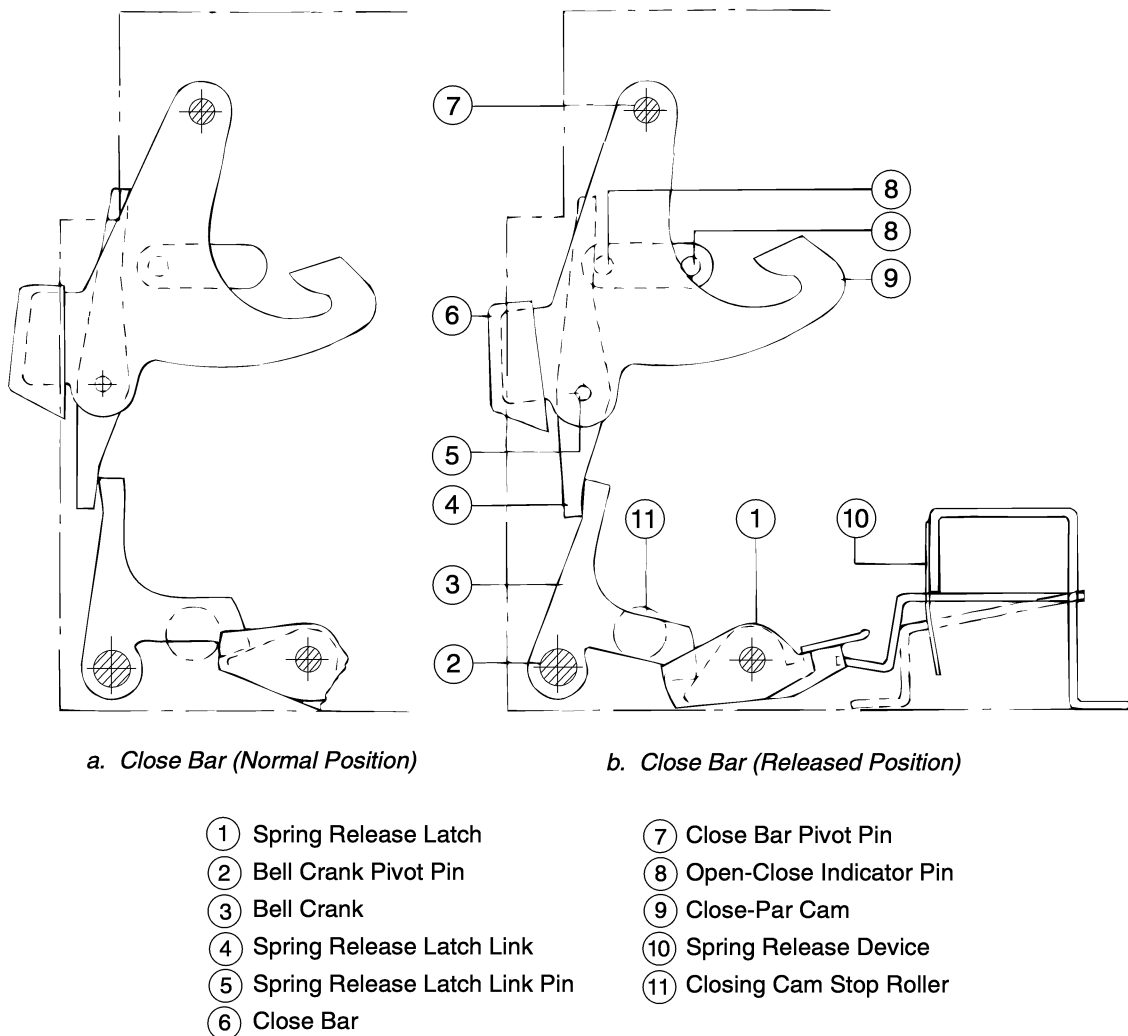


Figure 4-14 Close Interlock Preventing Efforts to Close Already Closed Breaker

Figure 4-15 shows the parts relationship for padlocking in the trip-free shutter up condition. The three major parts are interleaved and assembled on the left hand side of the levering device assembly.

1. Shutter
2. Trip Plate
3. Padlock Interlock Lever

The padlock interlock lever is located between the trip plate and padlock plate. It is pivoted on a fixed center toward the rear of the breaker. The front part of this lever has a sloping slot in which a projection from the

trip plate extends. Horizontal movement of the trip plate by cam action of the projection against the walls of the slot causes the front of the interlock lever to move up or down. The interlock lever is pushed upward by a spring. This lever also has a short pin extending outward, normally into a curved notch in the bottom edge of the padlock plate.

To padlock the breaker with the shutter closed, push the trip plate in and pull the padlock plate forward. This exposes the padlock slot in the padlock plate. Insert the padlock and lock.

Movement of the trip plate pushes the front end of the padlock interlock lever down, moving its pin downward and out of the notch in the padlock plate. Forward movement of the padlock plate and backward movement of the trip plate places the pin in the padlock interlock lever behind the notch in the padlock plate. With the padlock plate held forward, the padlock interlock lever cannot move. Consequently, the projection from the trip plate is held in the slot in the padlock interlock lever. This holds the breaker locked in the trip-free condition until the padlock is removed and the members are returned to their normal positions by return springs. While locked, the shutter is prevented from downward travel by a horizontal projection striking a bent over tab on the padlock plate.

4-6 DSLII CIRCUIT BREAKER AND FUSE TRUCK

An overall description of Type DSLII Circuit Breakers and Fuse Trucks is provided in Section 3 (Figure 3-2). More detailed information is provided here relative to application, operation, replacement and installation. Table 4.1 outlines the available limiters recommended for use with DSLII circuit breakers.

If current limiters are sized in keeping with Table 4.1 recommendations, the circuit breaker will function and interrupt routine fault currents. Infrequent high faults are cleared by the limiters. The limiters protect the circuit breaker on faults above the rating of the breaker. The limiters will blow below the circuit breaker short-time rating, if the fault currents equal the system maximum capacity.

In some applications the current limiters are sized smaller than necessary for protection of the DSLII circuit breaker in order to provide protection for downstream equipment. When this is done, the current limiters will blow on fault currents which could have been satisfactorily interrupted by the basic circuit breaker.

Type DSII-FT32 and DSII-FT40 fuse trucks provide for separate mounting of current limiting fuses on drawout

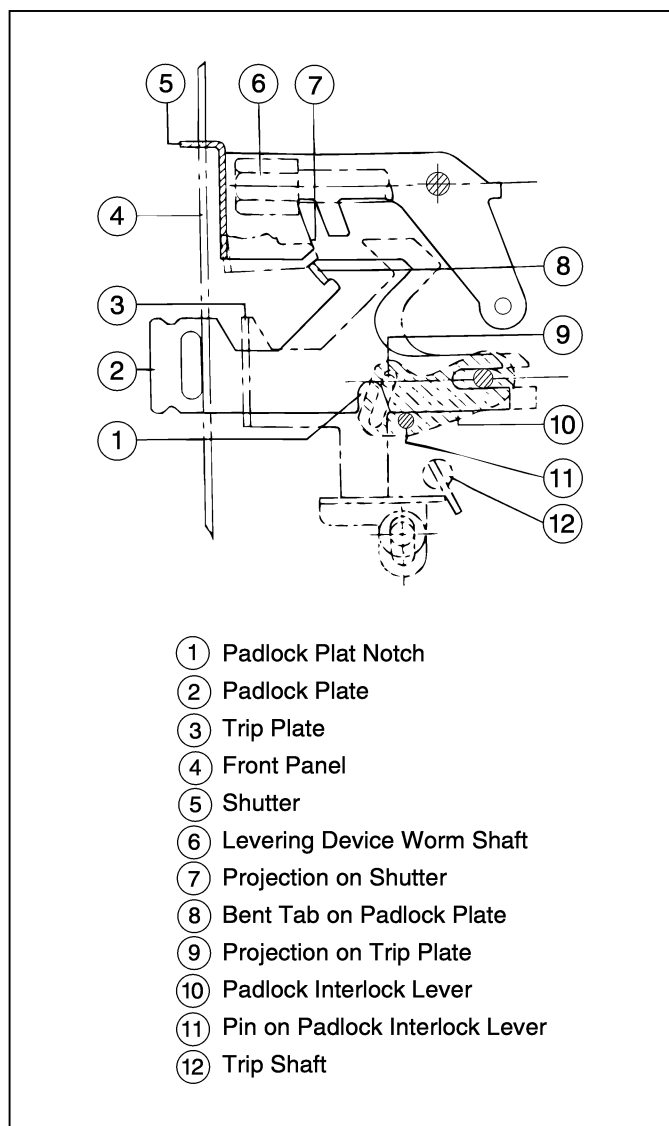


Figure 4-15 Padlock Device (Locked Trip-Free with Shutter Raised)

Table 4.1 Sensor and Limiter Ratings

Breaker Type	Sensor Rating	ϕ Recommended	Limiter Ratings *Minimum	**Maximum
DSLII-308	800A	1600A	1200A	2000A
DSLII-308	600A	1200A	800A	2000A
DSLII-308	Less than 600A	1200A	125% or more of sensor rating	2000A
DSLII-516	1600A	3000A	3000A	3000A
DSLII-516	1200A	2500A	2000A	3000A
DSLII-516	Less than 1200A	2000A	125% or more of sensor rating	3000A
DSLII-620	2000A	3000A	3000A	3000A

ϕ Minimizes nuisance blowing of limiters

* Use only when current limiting is required for downstream equipment. If long delay pickup is set above 100%, minimum limiter ratings should not be used.

** Highest rating that will protect breaker.

trucks. They are used in series with DSII-632 and DSII-840 circuit breakers respectively. This separate mounting is made necessary by the size of the fuses and their high temperature characteristics.

4-6.1 DSLII CURRENT LIMITERS

Do not replace limiters with sizes other than permitted by Table 4.1. DSLII current limiters have been tested and approved by Underwriters Laboratories, Inc. for use in DSLII circuit breakers when applied according to Table 4.1. They are not electrically or physically interchangeable with current limiting fuses of any other design.

The current limiters are held in place in an extension provided on the back of the circuit breaker (Figure 4-16). This extension makes the DSLII circuit breaker eight inches deeper than the corresponding DSII circuit breaker. The current limiters can only be removed from the circuit breaker and replaced when the circuit breaker is removed from its associated compartment. For this reason there is no fixed mounted version of the DSLII circuit breaker.

4-6.2 BLOWN LIMITER INDICATOR

The blown limiter indicator provides a visual indication on the front of the DSLII circuit breaker when a current limiter in any phase has interrupted a short circuit. It also insures that the circuit breaker will be tripped when any current limiter has blown. This prevents single

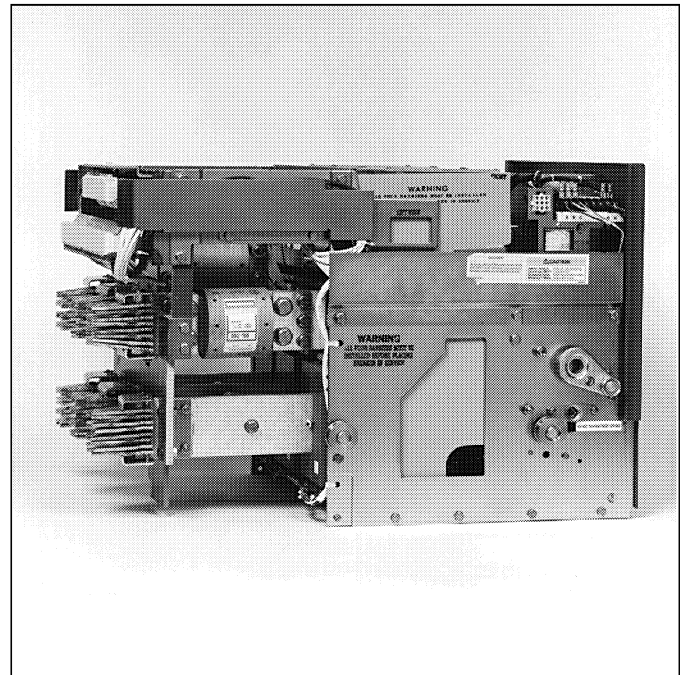


Figure 4-16 DSLII-516 Circuit Breaker (Side View)

phase power from being applied to a three-phase load (Figure 4-17).

The indicator device consists of three solenoids, each connected in parallel with one of the limiters. When a limiter is blown, the resulting voltage across the open limiter causes the associated solenoid to operate. Operation of the solenoid trips the circuit breaker mechanically and extends an indicator through the front cover of the circuit breaker (Figure 3-2). The indicator will remain extended and the breaker will be held trip-free until the reset button is pushed. If the device is reset and the breaker reclosed on an energized circuit before the blown limiter is replaced, the breaker will immediately be reopened and held trip-free. The solenoids are isolated from the primary circuit voltage by three transformers located above the limiters (Figures 3-2 and 4-16).

4-6.3 FUSE TRUCK

DSII-FT32 and DSII-FT40 fuse trucks provide drawout mounting for current limiting fuses when installed in low voltage switchgear. These drawout trucks physically fit in the same compartment as the DSII-632 and DSII-840 circuit breakers respectively. They are moved in and out of the compartment using a similar levering mechanism as provided on DSII circuit breakers (Figure 4-18 and 4-19).

4-6.4 FUSE TRUCK INSTALLATION AND USE

The fuse truck is normally installed in series with a circuit breaker of the same current rating. When this is done, the fuse truck should be in the circuit ahead of the circuit breaker in order to maximize protection of the equipment. The fuse truck must never be permitted to close the current circuit or to open it when levering the truck in or out of the compartment, because the primary disconnect contacts are not designed for this service. For this reason, a key interlocking system is always provided which prevents opening of the fuse truck compartment door unless the associated circuit breaker has been opened, pulled out and held in the DISCONNECT position. This key interlock is installed on the fuse truck compartment door, not the fuse truck itself.

4-6.5 FUSE REPLACEMENT

DSII-FT32 and DSII-FT40 fuse truck fuses are normally provided when the fuse truck is manufactured. The fuse trucks are interlocked to prevent the use of maximum current rated fuses other than the Cutler-Hammer truck fuse. Class L current limiting fuses up to 3000A maximum can be used on the DSII-FT32 and up to 4000A maximum on the DSII-FT40.

After the fuse truck has been withdrawn from its compartment, the fuses can be removed by unbolting them from the conductors on the fuse truck. This is a relatively uncomplicated procedure on the DSII-FT40 fuse truck, because there is sufficient working space within

the truck. Since the DSII-FT32 fuse truck is more space restricted, it is necessary to first remove the front cover, levering device assembly and bracket (Figure 4-20).

After replacing the fuses, be sure that all connection bolts are tight and that all truck parts removed during the process are replaced.

4-6.6 BLOWN FUSE INDICATOR



CAUTION

FOR PROTECTION AGAINST SINGLE-PHASING, THE CONTROL POWER FOR TRIPPING THE CIRCUIT BREAKER MUST BE FROM A RELIABLE SOURCE.

The same blown fuse indicator is provided on fuse trucks as previously described on DSLII circuit breakers. However, since there is no opening mechanism on fuse trucks, it cannot serve directly as an anti-single phase device. In order to perform this function, the blown fuse indicator is arranged to mechanically operate a switch, which is wired to secondary contacts on the fuse truck. The switchgear assembly wiring must be arranged to connect this switch into the tripping circuit of the associated circuit breaker (Figure 4-19). Again, the indicator must be reset after being operated to reset the switch, or its contact will prevent the breaker from being closed.

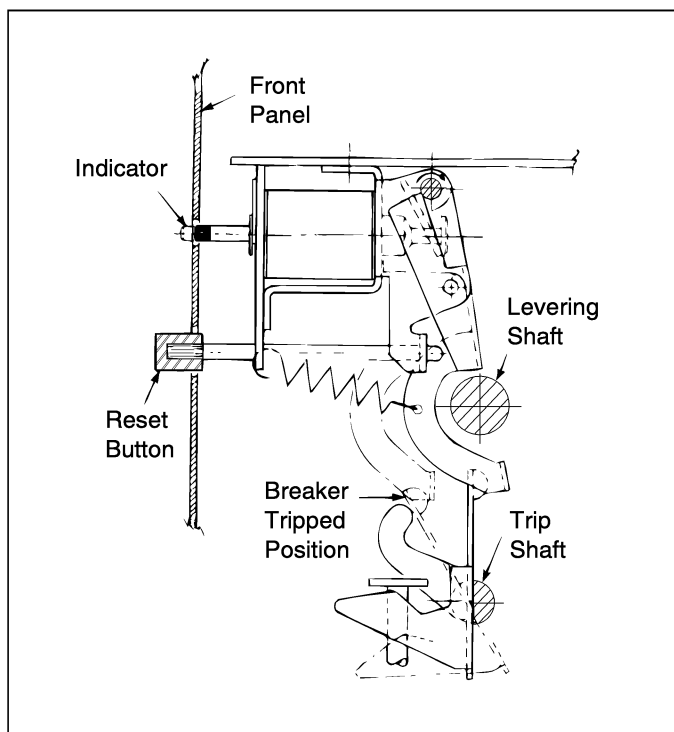


Figure 4-17 Blown Limiter Indicator

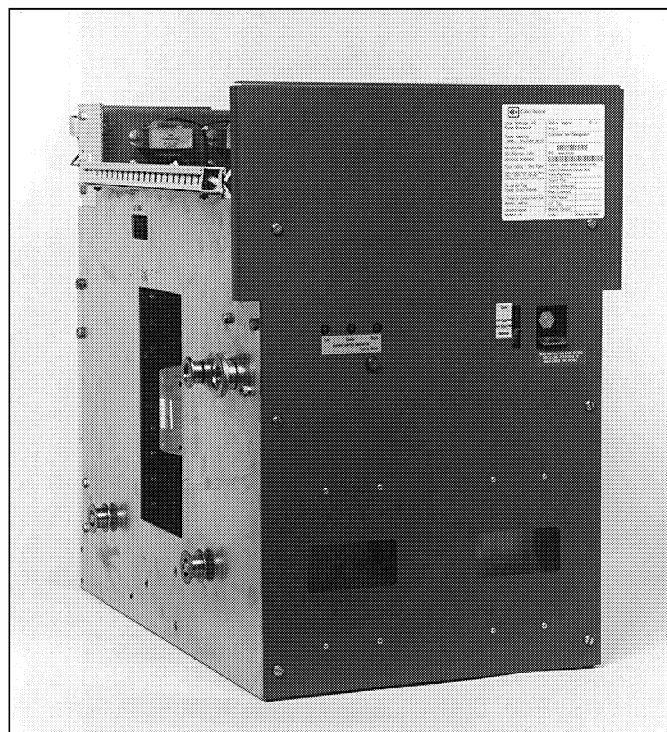


Figure 4-18 DSII-FT32 Fuse Truck (Front View)

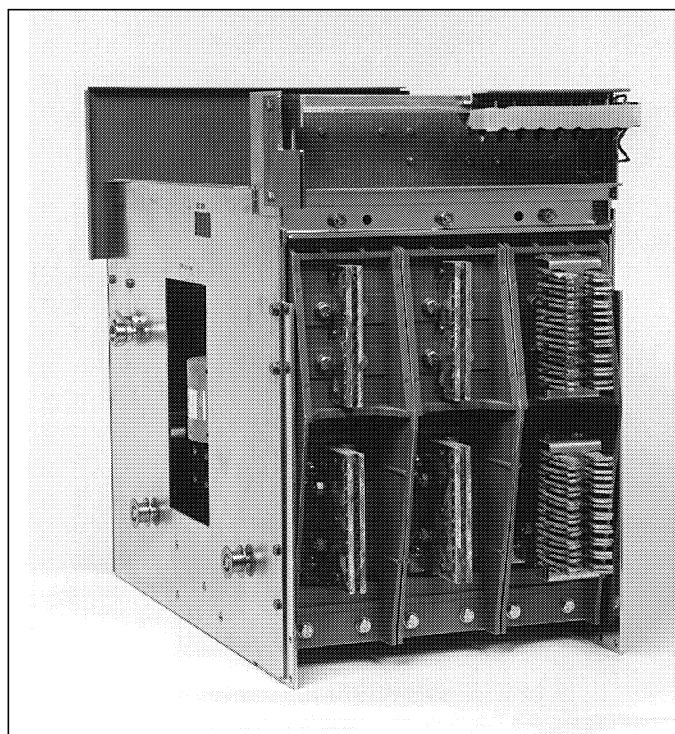


Figure 4-19 DSII-FT32 Fuse Truck (Rear View)

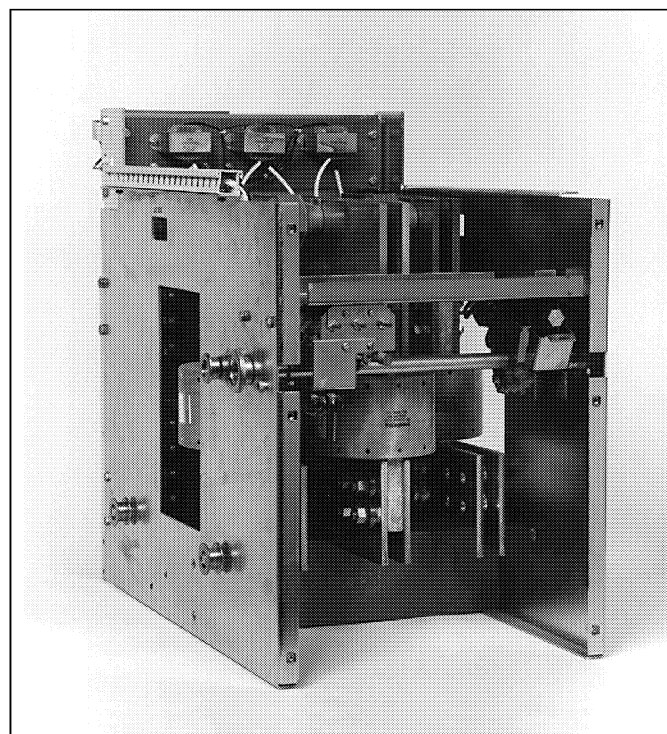


Figure 4-20 DSII-FT32 Fuse Truck (Front Cover Removed)

SECTION 5: INSPECTION AND MAINTENANCE

5-1 GENERAL



WARNING

FAILURE TO INSPECT, CLEAN AND MAINTAIN CIRCUIT BREAKERS CAN REDUCE EQUIPMENT LIFE OR CAUSE THE EQUIPMENT NOT TO OPERATE PROPERLY UNDER FAULT CONDITIONS, WHICH COULD RESULT IN EQUIPMENT DAMAGE AND/OR BODILY INJURY.



CAUTION

INSPECTION AND MAINTENANCE PROCEDURES SHOULD BE CARRIED OUT ONLY BY PERSONNEL FAMILIAR WITH THE HAZARDS ASSOCIATED WITH WORKING ON POWER CIRCUIT BREAKERS. ADDITIONALLY, THEY SHOULD BECOME FAMILIAR WITH THE SPECIFICS ASSOCIATED WITH TYPE DSII CIRCUIT BREAKERS AS PRESENT IN THIS INSTRUCTION BOOK.

Type DSII Circuit Breakers are "Top of the Line" equipment. This means they are manufactured under a high degree of quality control, with the best available materials and with a high degree of tooling for accuracy and parts interchangeability. Design tests and actual installation experience show them to have durability well beyond minimum standards requirements. All of these factors give the DSII line of breakers high reliability. However, because of the variability of application conditions and the great dependence placed upon these breakers for protection and the assurance of service continuity, inspection and maintenance activities should take place on a regularly scheduled basis.

Since maintenance of these breakers consists mainly of keeping them clean, the frequency of scheduled inspection and maintenance depends to some degree on the cleanliness of the surroundings. Cleaning and preventive measures are a part of any good program. Plant operating and local conditions can vary to such an extent that the actual schedule should be tailored to the conditions. When the equipment is subject to a clean and dry environment, cleaning is not required as frequently as if the environment is humid with a significant amount of dust and other foreign matter.

It is recommended that maintenance record sheets be completed for the equipment. Careful and accurate documentation of all maintenance activities provides a valuable historical reference on equipment condition over time.

5-2 GENERAL CLEANING RECOMMENDATIONS

Circuit breaker cleaning activities should be a part of an overall activity that includes the assembly in which the circuit breaker is installed. Loose dust and dirt can be removed from external surfaces using an industrial quality vacuum cleaner and/or lint free cloth. Unless otherwise indicated, never use high pressure blowing air, since dirt or foreign objects can be driven into areas, such as the breaker mechanism, where additional friction sources could create problems. Never use a wire brush to clean any part of the circuit breaker.

5-3 WHEN TO INSPECT

Do not wait for specific scheduled periods to visually inspect the equipment, if there are earlier opportunities. If possible, make a visual inspection each time a circuit breaker compartment door is opened, and especially when a circuit breaker is withdrawn on its compartment extension rails. This preventive measure could help to avoid future problems.

Industry standards for this type of equipment recommend a general inspection and lubrication after the number of operations listed in Paragraph 6.1 of this section. This should also be conducted at the end of the first six months of service, if the number of operations has not been reached.

After the first inspection, inspect at least once a year. If these recommended inspections show no maintenance requirements, the period may be extended to a more economical point. Conversely, if the recommended inspection shows, for instance, a heavy accumulation of dirt or other foreign matter that might cause mechanical, insulation or other electrical damage, the inspection and maintenance interval should be decreased.

5-4 WHAT TO INSPECT

First withdraw the circuit breaker from its compartment. Remove its barriers and arc chutes. If there is a deposit of dust, use a vacuum, as previously mentioned, to remove it from the circuit breaker. Clean compressed air, if available, can be used to blow dust and dirt away

from the arc chutes and barriers, as long as it is done out of the immediate vicinity of the circuit breaker. Wipe accessible areas with a clean and dry lint-free cloth. Carefully inspect the contacts.

NOTICE

Switching, fault interruptions and the making of motor inrush currents will cause some pitting of the breaker contact parts. A large accumulation of operations will give the contacts, especially the arcing contacts, a mottled, dirty, eroded appearance. This appearance is the normal result of arc burning and in itself is no cause for concern.

During any inspection, cleaning, part adjustment or part replacement, be certain to look over all visible parts for missing pin retainers, loose hardware, bent, worn or damaged parts. Be especially alert for foreign matter that should be removed. Make appropriate corrections to anything found out of order.

After any such activity, make sure that all parts are properly installed on the breaker, especially the arc chutes and all four barriers. Take the time to double check all work against provided drawings and written instructions.

5-4.1 DSII-308 THROUGH DSII-620 INSPECTION

NOTICE

DSII-516 adjustments and maintenance apply to the DSII-508. DSII-620 adjustments and maintenance apply to the DSII-608 and DSII-616.

Remove the barriers and arc chutes to expose the contacts. With the breaker open, examine the contact tips of the moving and stationary arcing and main contacts (Figures 5-1 and 5-2). If the tips are burned or worn more than .030 inches, the contacts must be replaced. Also check the dimension (C) between the stationary arcing contacts. It should be .420 plus or minus .08 inches. If this dimension is not maintained, the stationary arcing contacts must be replaced.

Close the breaker and check the contact engagement (Figures 5-1 and 5-2). The main stationary contact fingers should be parallel (B) to the fixed contact cage. If not, adjust the contacts according to Paragraph 5-5.3. Also check the dimension (A) between the stationary

arcing contacts and the center section of the cage. If this dimension is not .02 inches or greater, the stationary arcing contacts should be replaced.

NOTICE

Be certain that all barriers and arc chutes are replaced after the inspection is completed.

5-4.2 DSII-632 AND DSII-840/850 INSPECTION

In addition to the requirements for the DSII-308 through DSII-620 outlined in Paragraph 5-4.1, several additional procedures are required (Figures 5-3 and 5-4).

The lower main fixed contacts should be inspected to ensure that they have adequate contact pressure. This is determined by Pin "X" being free to slide in the contact cage. Unlike the DSII-308 through DSII-620 breakers, the top row of fixed main contacts are compressed beyond the parallel position to assure adequate contact pressure for the lower row of fixed main contacts.

5-4.3 DSII-308 CONTACT REPLACEMENT

To replace the stationary contacts, remove the rear mounted disconnect finger contacts (Figure 3-1), followed by the two bolts holding the upper contact assembly to the molded base. Withdraw the contact assembly from the front. Replace the removed contact assembly with a new contact assembly. Be certain that all bolts are tightened securely. Close the breaker and check all contact dimensions as outlined in Paragraph 5-4.1.

Both the main moving and arcing contacts are held between the two moving arms by two bolts with self-locking nuts. Removal of the two bolts permits the replacement of the moving contacts. These bolts must be securely tightened after replacement.

The fixed arcing contacts are held by a single bolt passing through the contacts and their pressure springs. On reassembly, the self-locking nut is tightened so that a dimension of 3.12 inches is obtained between the inside surfaces of the flat washers on the spring ends.

5-4.4 DSII-516 THROUGH DSII-840/850 CONTACT REPLACEMENT

The moving arcing and main contacts are secured to the moving contact assembly by two bolts. Removal of

these bolts permits the replacement of the moving contacts (Figures 5-2, 5-3 and 5-4).

To change the fixed arcing and main contacts, the fixed contact assembly must first be removed from the pole unit. Remove the rear mounted disconnect finger contacts (Figure 3-1). Remove the screws holding the contact assembly to the pole unit base and withdraw the contact assembly.

Reassemble a new contact assembly in the pole unit with the holding screws finger tight. Close the circuit breaker and check "A" dimensions. The "A" dimensions

should be approximately equal. If not, trip the breaker and adjust the fixed contact system until alignment is obtained. Tighten the screws and contacts as described in Paragraph 5-5.2.

5-4.5 ARC CHUTES

The V-shaped slots in the arc chutes will undergo slow erosion with arc interruptions. Switching operations will give them a pitted, mottled and sooty appearance. This is normal. Heavy fault interruptions will cause a greater amount of erosion.

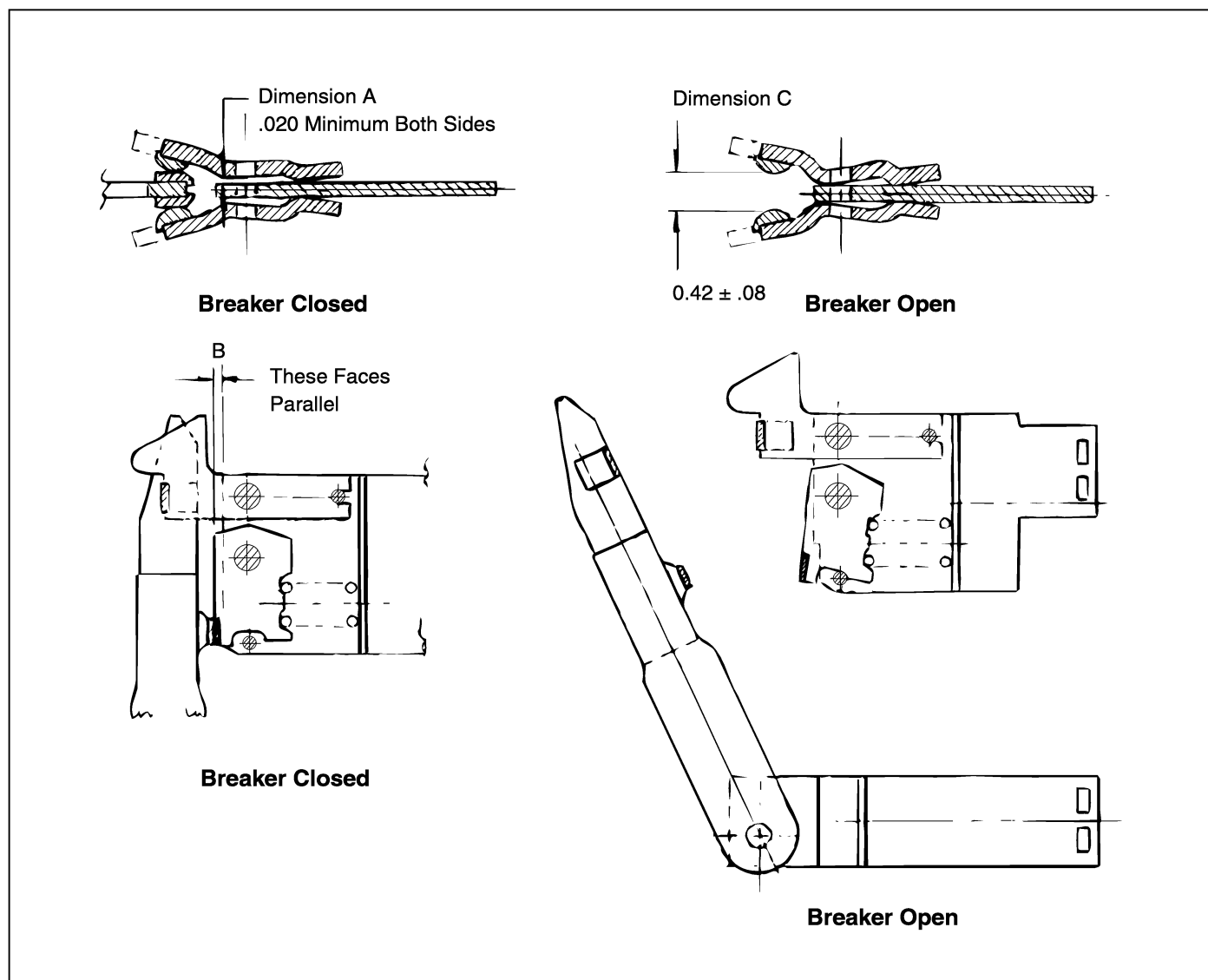


Figure 5-1 DSII-308 Contacts and Adjustments

If the steel splitter plates have more than 0.25 inch of material eroded away at the top of the V-shaped slots, the arc chutes should be replaced. This can be determined by comparing a plate near the center with a plate near the end.

5-4.6 POWER OPERATED MECHANISM

Examine the driving face of the oscillator pawl (Figures 4-5 and 4-6). Normal operation of the spring charging mechanism will result in the removal of plating from the face of the pawl. If the face is chipped, distorted or broken, it should be replaced.

5-5 FACTORY ADJUSTMENTS

NOTICE

These adjustments are required only when a major overhaul has been performed, not during normal maintenance procedures.

Type DSII Circuit Breakers are designed and built with very few adjustable parts. The operating parts and frame mounting parts are accurately tool made for automatic and accurate assembly relationships. The parts

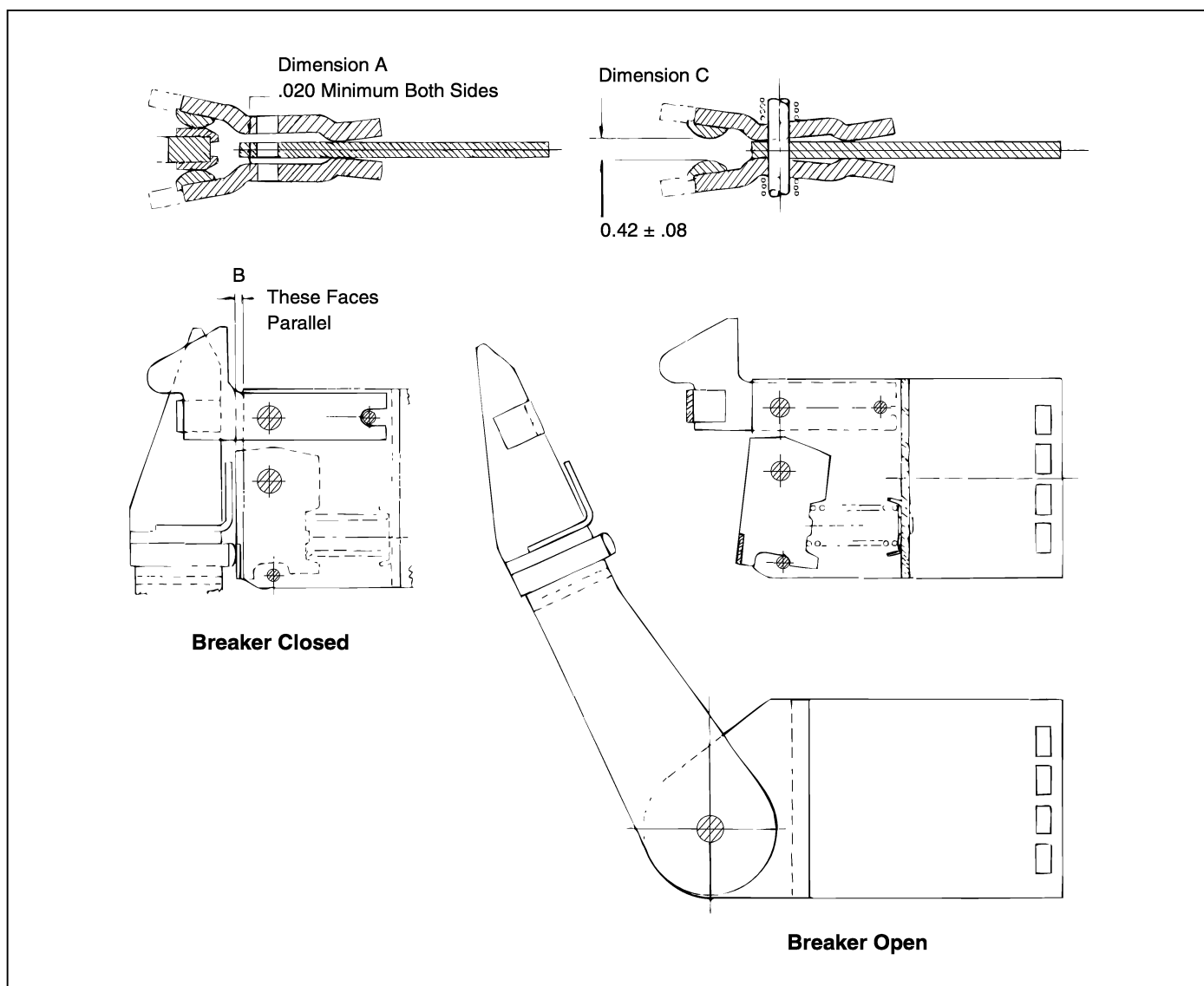


Figure 5-2 DSII-516/620 Contacts and Adjustments

are made of material that are affected to the minimum by repeated operations and normally encountered atmospheric temperature and contaminant conditions.

There are a few adjustments made at the factory and are subjected to quality control inspection and test. These factory settings can normally be expected to hold for the life of the breaker.

Factory settings adjustments should only be necessary when parts are reassembled after dismantling, as described in Paragraphs 5-5.1 and 5-5.2.

Maintenance adjustments should be made as indicated on maintenance inspections and are described in Paragraph 5-5.3.

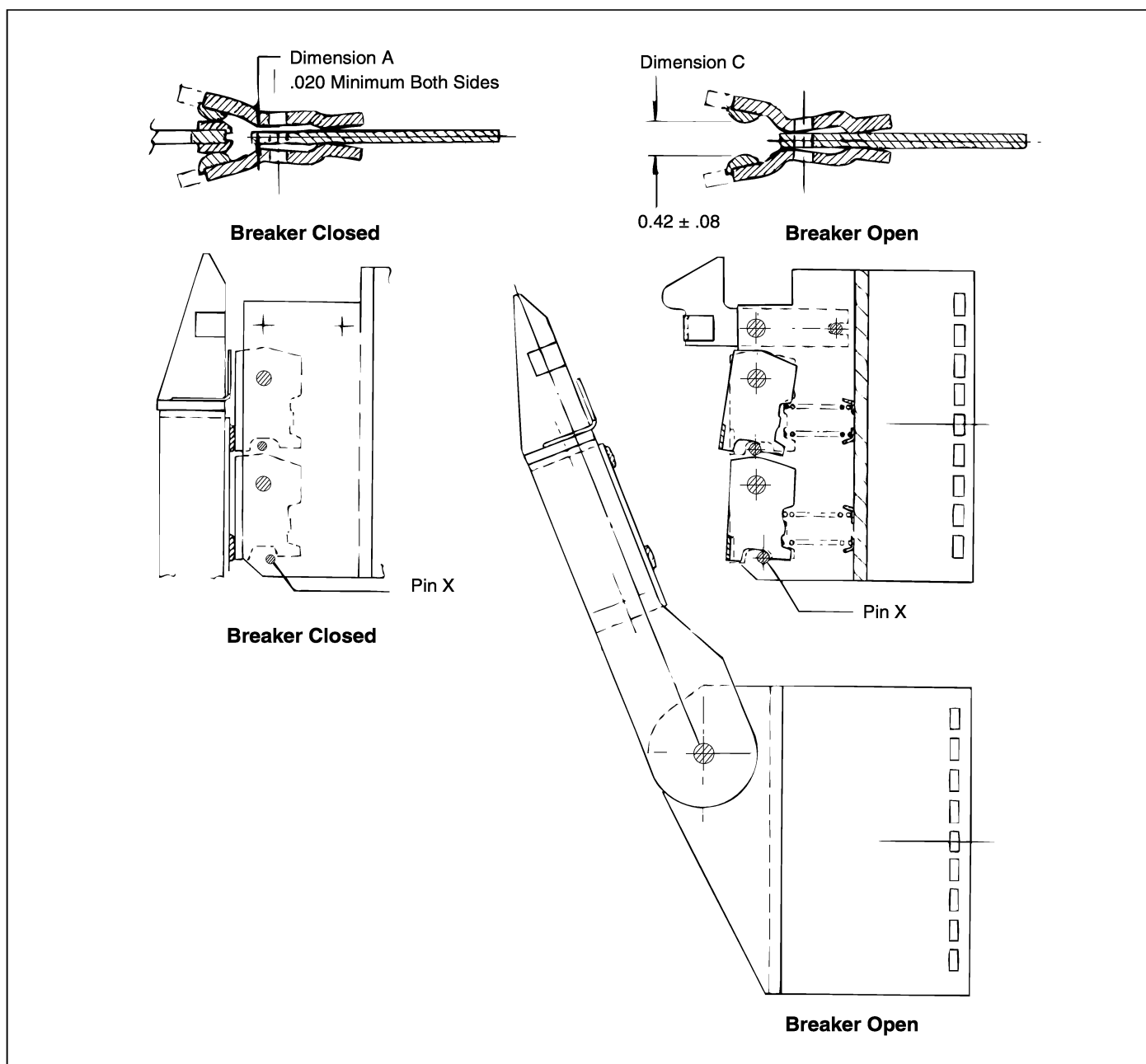


Figure 5-3 DSII-632 Contacts and Adjustments

5-5.1 TRIP LATCH OVERLAP ADJUSTMENT

Figure 5-5a shows a composite view of the shunt trip lever and the trip latch, as described in Paragraph 4-4. The angular position of the trip shaft latch surface is adjustable in relation to the trip latch surface. This adjustment is made possible by a screw located in the top of the actuator frame (Figure 5-5b).

The proper adjustment procedure is as follows:

1. Close the breaker.
2. Slowly rotate the adjusting screw clockwise until the breaker trips. This is the "no overlap" position.

3. Conclude by rotating the adjusting screw four turns in a counterclockwise direction.

5-5.2 BREAKER OPEN POSITION STOP ADJUSTMENT (DSII-632 ONLY)

The proper adjust procedure is as follows:

1. Refer to Figure 5-6.
2. Open the breaker and loosen the open position stop bolt nuts so that the eccentric cylinders can be turned by hand but will stay put.

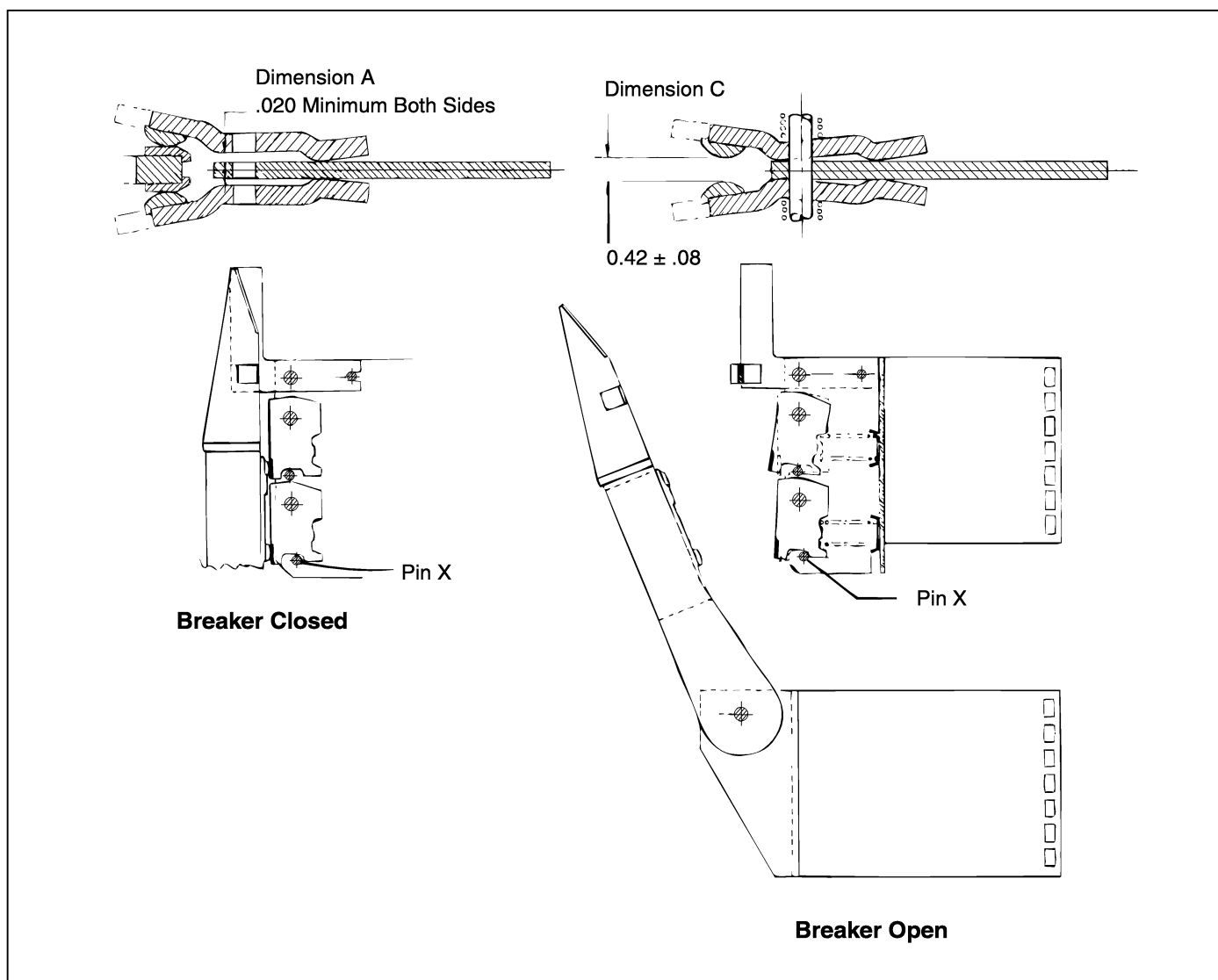


Figure 5-4 DSII-840/850 Contacts and Adjustments

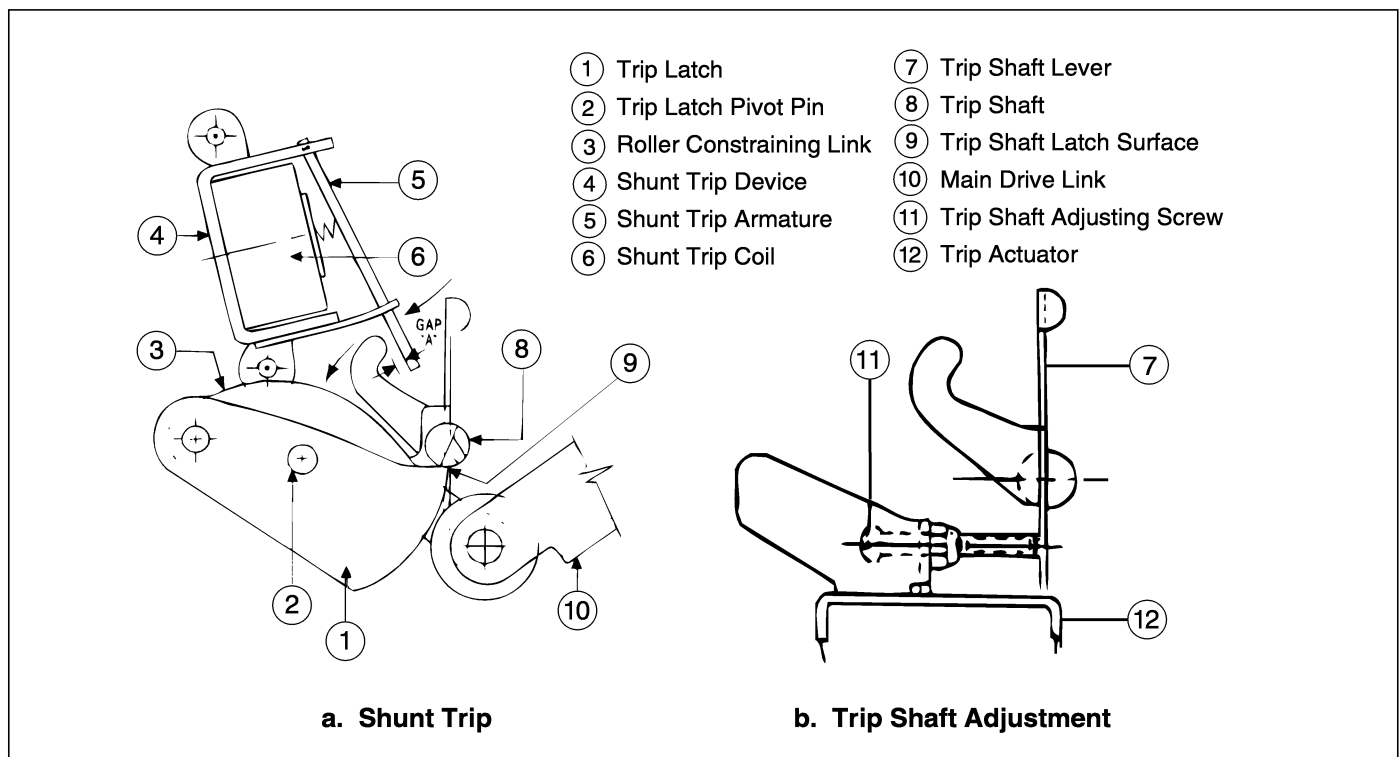


Figure 5-5 Shunt Trip Details Showing Trip Shaft Adjustment

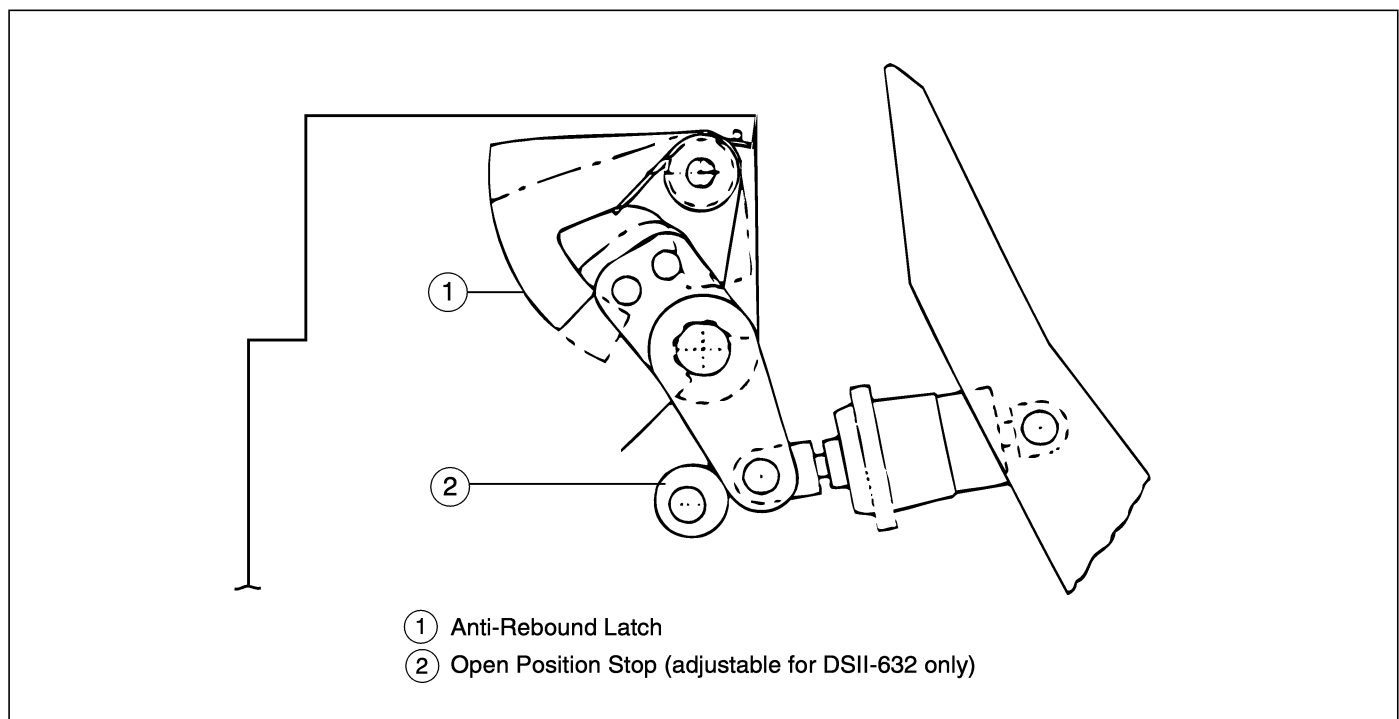


Figure 5-6 Open Position Stop and Anti-Rebound Latch

3. Rotate the cylinders to obtain a clearance of approximately 0.005 inch between the cylinders and the stop levers.
4. Tighten the nuts on the bolts.

5-5.3 MOVING CONTACT ADJUSTMENT

The contact assemblies are adjustable for the amount of engagement only. The lead of the arcing contacts over the main contacts is fixed. The correct engagement of the contacts is achieved when the vertical faces of the main fixed contacts and the fixed contact cage are parallel.

For the DSII-308, this is obtained by the adjusting nuts located on the insulating link stud above and below the pivot block (Figures 3-4 and 3-5). These nuts are self-locking and must be tight when the adjustment is complete.

The moving pole of the DSII-516/620 is adjusted by rotating the insulating link after the locknut has been loosened (Figure 3-6). Tighten the locknut securely after the adjustment has been completed.

The DSII-632 and DSII-840/850 have two adjusting studs on each pole.

Both adjusting studs must be moved together to retain the parallelism. Refer to the Renewal Parts Data Book if a pictorial reference is needed to make the adjustment. A spring type locking clip holds the adjustment for the DSII-632. For the DSII-840/850, locking nuts similar to those used with the DSII-516/620 hold the adjustments.

5-5.4 LEVERING MECHANISM ADJUSTMENT

The complete levering mechanism is shown in Figure 5-7. If the traveling stop nut on the rear of the worm shaft has been removed, it must be replaced in the exact position with respect to the worm gear position for proper interlock operation. This is achieved when the threaded worm shaft bottoms in the stop nut and the interlock cam is in the connected position (Figure 4-12a). The shutter interlock pin will then drop to its normal position beneath the lobe of the cam. The retaining clamp ring also operates the position indicator and may be slipped into its groove in the stop nut. The stop nut is prevented

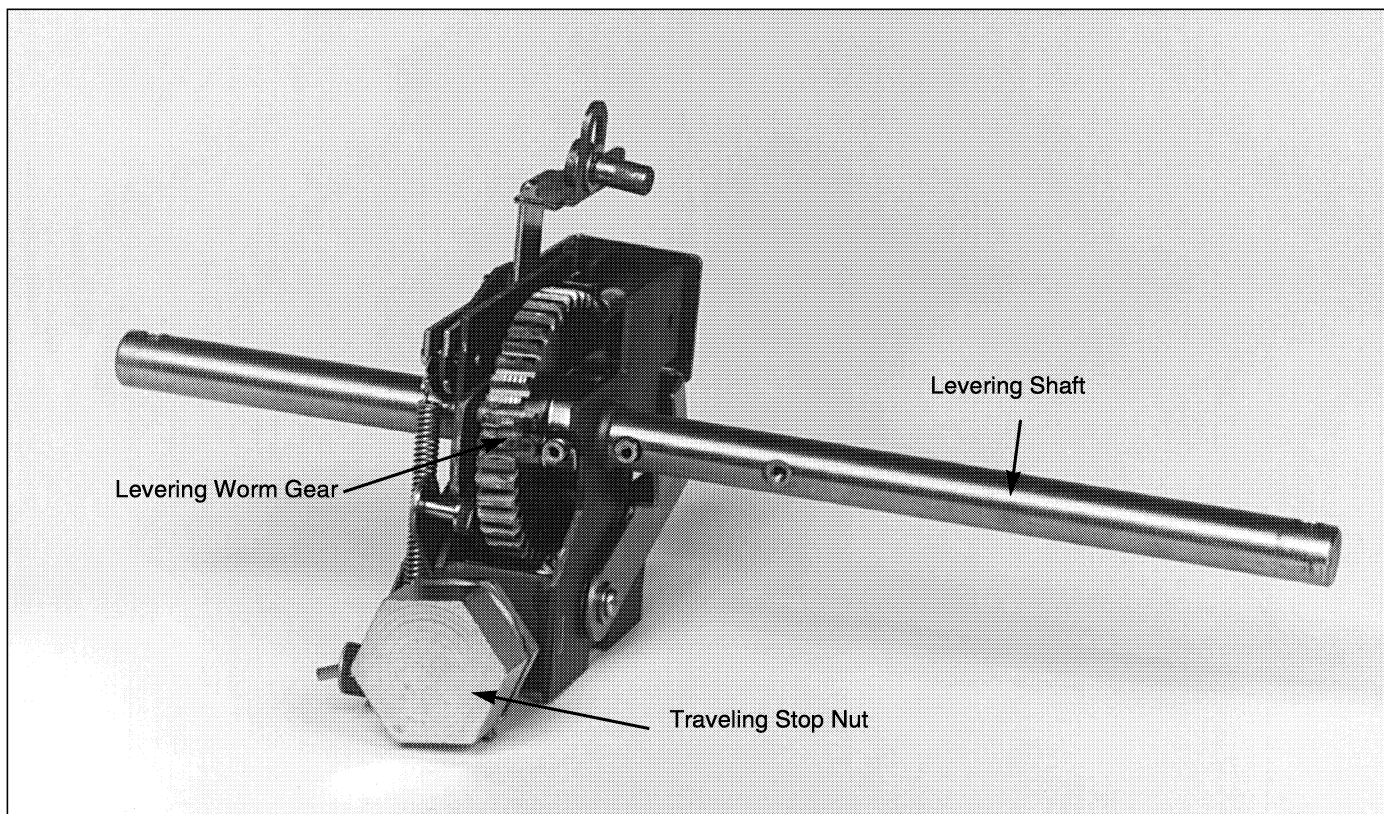


Figure 5-7 Levering Mechanism

from rotating by having a “flat” against the bottom of the breaker horizontal top pan.

During reassembly, care must be taken to insure that the two guide spacers are located in the slots of the top pan. This permits the mechanism to float. Screws should be tightened and then backed off one half turn to allow the mechanism to float.

5-6 LUBRICATION

In general, the circuit breaker requires only moderate lubrication at regular intervals. The use of a special lubricant is required in a few places, and must be applied with care. Only small quantities are needed. All excess must be removed with a clean cloth to prevent any accumulation of dust or dirt. Avoid getting any lubricant on insulation or other electrical parts. Care must be taken to prevent any of the molybdenum lubricant from reaching any current carrying contact surface.

5-6.1 LUBRICATION FREQUENCY

Under normal operating conditions, refer to Table 5.1 for the recommended lubrication frequency for DSII circuit breakers by frame size. Special conditions, such as contaminated environments, high temperatures and excessive humidity, might dictate that a different schedule be considered.

NOTICE

Any circuit breaker that has been stored should be operated a minimum of five times before being put in service.

5-6.2 LUBRICANT LOCATION

NOTICE

All parts of the levering mechanism have sufficient lubrication, and should not require any further attention (Figure 5-7).

The following numbered lubrication point references correspond to the numbers shown on Figures 5-8 through 5-12.

Molykote BR-2 Plus by Dow Corning (Molybdenum Disulphide in Lithium Grease) or equivalent should be used sparingly on the following:

- 1 Spring-charge indicator surface engaging with the cut-off switch link
- 2 Cam surface operating the cut-off switch link
- 3 Pins on both ends of constraining link
- 4 Shunt trip moving armature surface
- 5 Curved surface of trip latch
- 6 Spring release moving armature surface
- 7 Several trip shaft points
- 8 Surface of cut-off switch link
- 9 Main spring pins on each end of crankshaft and fixed ends
- 10 Rear face of oscillator



WARNING

BE CERTAIN THAT CIRCUIT BREAKER CONTACTS ARE OPEN AND CLOSING SPRINGS DISCHARGED AFTER COMPLETING MAINTENANCE ACTIVITIES. FAILURE TO DO SO COULD RESULT IN BODILY INJURY.

Table 5.1 Lubrication Frequency

Breaker Type	Interval * (Breaker Cycles)
DSII-308, DSII-508, DSLII-308	1750
DSII-608, DSII-516, DSII-616, DSII-620, DSLII-516, DSLII-620	500
DSII-632, DSII-840/850	250

* Breaker Cycle - one no load open/close operation.

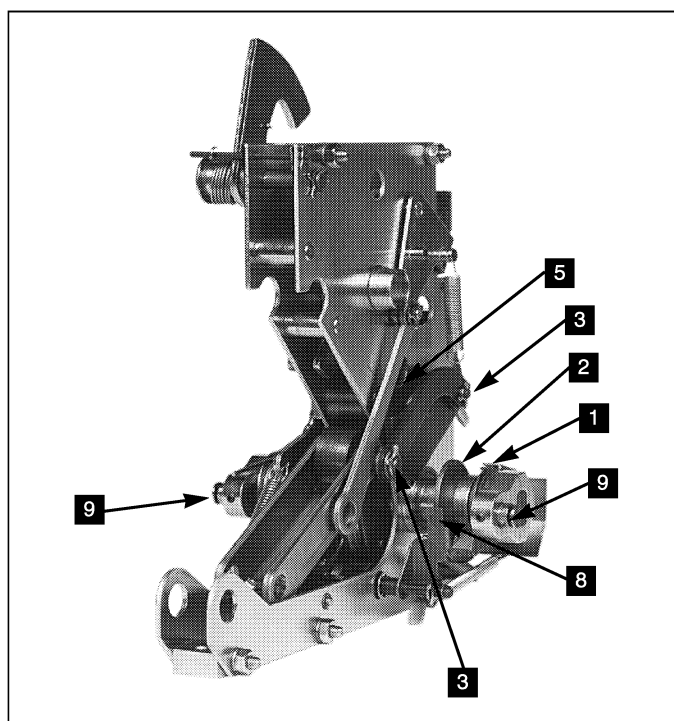


Figure 5-8 Left Side of Mechanism Lubrication Points

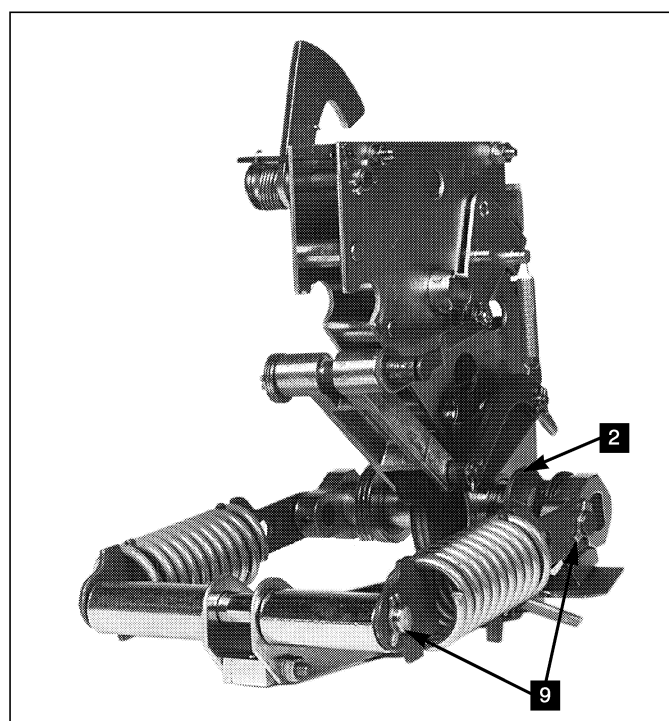


Figure 5-9 Right Side of Mechanism Lubrication Points

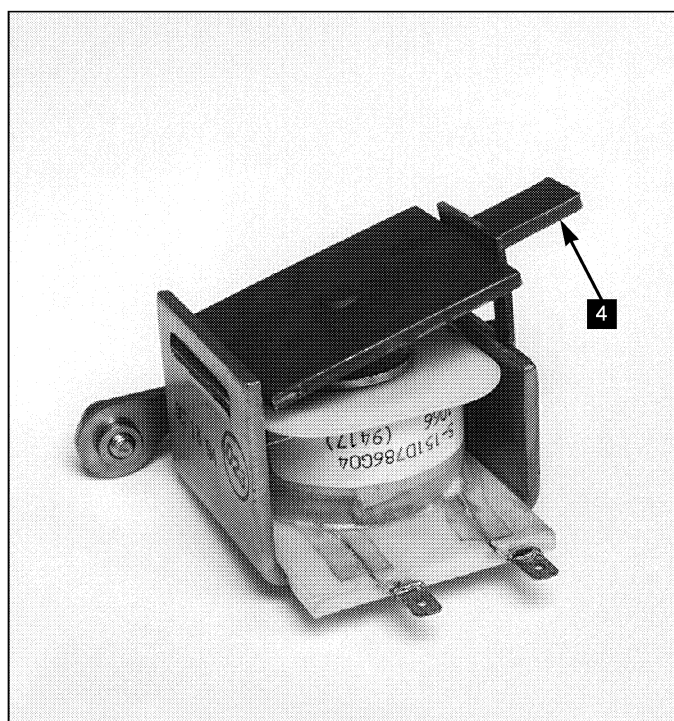


Figure 5-10 Shunt Trip Device Lubrication

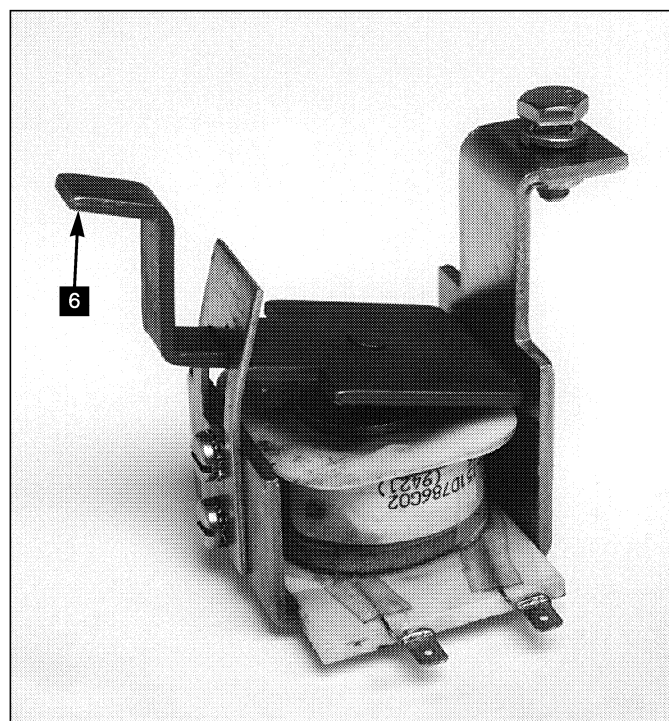


Figure 5-11 Spring Release Device Lubrication

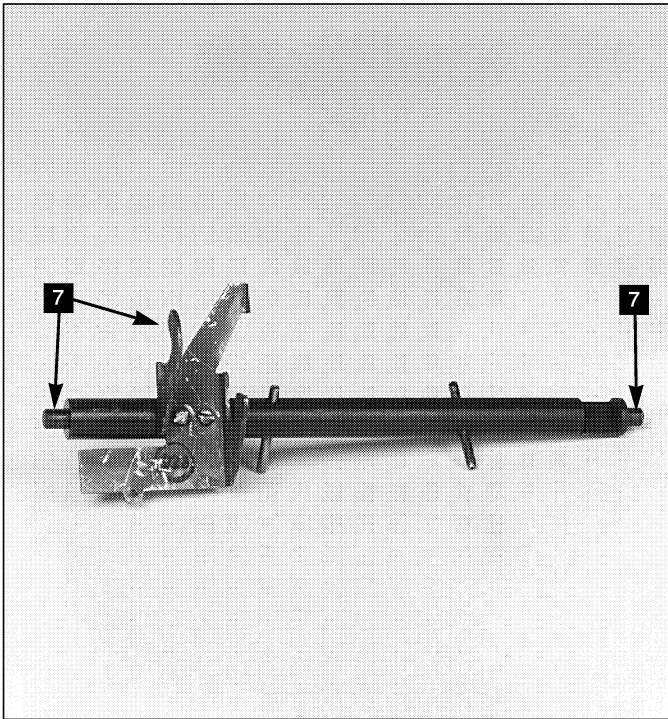


Figure 5-12 Trip Shaft Lubrication

SECTION 6: RENEWAL PARTS

6-1 GENERAL

All renewal parts and/or spare parts recommendations for Type DSII Circuit Breakers are supplied in the Renewal Parts Data Book, not this instruction manual. Refer to the most recent version of the Renewal Parts Data Book for specific assistance.

When ordering parts, always specify, if known, the part name and style number. The Renewal Parts Data Book provides this kind of detailed information. If the style number is not known, refer to a pictorial and/or graphic

reference, name and item number as shown in the Renewal Parts Data Book. Also include the breaker type, shop/order number or style number as shown on the nameplate on the front cover of the circuit breaker.

Some of the detailed parts shown in the figures in this manual will be available only as a part of a sub-assembly. Certain parts, due to manufacturing or installation procedures, are only recommended in this form. In some instances, the detailed parts in the figures are illustrated just to show their function and location in the assembly. The Renewal Parts Data Book indicates which parts are available as individual items or in a sub-assembly.

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