Cutler-Hammer

I.B. 48030

Instructions for Installation, Operation, and Maintenance of Type LBS Medium-Voltage Disconnect Switch rated 7.2kV

Fig. 1 Typical LBS Switch with Auxiliary Fuse Compartment

Read and understand these instructions before attempting any Installation, Operation or Maintenance of an LBS switch.

Cutler-Hammer
Power Distribution and Assemblies Division
Arden NC 28704

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PURPOSE

This instruction book is expressly intended to cover the operation and maintenance of LBS load interrupter switches. It does not purport to cover all possible contingencies, variations, and details that may arise during operation or maintenance of this equipment.

If further information is desired regarding this product, contact the local Cutler-Hammer sales office.

TABLE OF CONTENTS **Page**

For the location of your nearest Cutler-Hammer distributor, call toll free 1-800-525-2000

SECTION 1 - INTRODUCTION

1.1 Basic Description and Application

The Type LBS switch is a three-pole, manually operated, quick-make, quick-break switch available in both 600 ampere and 1200 ampere continuous ratings. This device is used primarily as a disconnect switch in AC power systems with maximum voltages up to 7200 volts and may be supplied with or without fuses.

A Type LBS switch without fuses is capable of closing under fault conditions and interrupting magnetizing and load currents, but is not intended to interrupt fault currents. When supplied with fuses, a Type LBS switch may be used to provide fault protection up to the interrupting rating of the fuses. Refer to Table 1 for ratings.

LBS Switch Ratings

Description	Cont. and Break Current	Fault-Close (un-fused)	Short-time (2 sec) Current	Fused Interrupting Rating (Symm)
Switch with internal fuses (450E max @5kV, 350E max @ 7.2kV)	600A	40kA	25kA	50kA
Switch with 600E and 750E fuses (5kV max)	1200A	61kA	38kA	40kA
Switch with 1100E and 1350E fuses (5kV max)	1200A*	61kA	38kA	31.5kA
Unfused (7.2kV max)	1200A	61kA	38kA	N/A

*1200A rating is for NEMA 1 enclosure with vented covers. NEMA 3/12 rating (without vents) is 1000A.

Table 1 Ratings

Each Type LBS switch is designed for operation in an enclosure and should **not** be operated under load with the enclosure door open.

1.2 Switch Identification

A rating nameplate is located on the handle coverplate (behind the handle access door) of each type LBS switch. Contained on this nameplate are the switch type and ratings as required by industry standards. A unit nameplate located near the upper left corner of the medium voltage door contains the factory's general order number. This number should be given to the Cutler-Hammer Sales Office if a question should arise concerning the switch or if renewal parts are required.

DANGER!

Exceeding the nameplate ratings of an LBS switch may cause property damage, severe injury, or death.

Do not apply an LBS switch beyond its nameplate ratings.

1.3 Safety Features

The Type LBS load interrupter switch is manufactured with several built-in interlock provisions and safety features to reduce hazards and provide proper operating sequences:

1. A mechanical interlock prevents opening the main door when the switch is in the closed position.

2. An additional interlock prevents inadvertent closing of the switch when the front enclosure door is open.

3. The switch design includes provisions for padlocking the switch in the open or closed position.

4. Mechanical indicators with labels show whether the switch is open or closed.

5. Optional key interlock provisions may be provided for Main-Tie-Main and other configurations. Refer to the specific order drawings to determine if key interlocks have been provided.

6. A grounded metal safety screen is located behind the medium voltage door. The screen prevents inadvertent contact with live parts yet allows full-view inspection of the switch blade position.

Danger!

Type LBS switches are often energized by a back-fed condition that allows the blades to be energized with the switch in the open position. The line-side break jaws are also likely to be energized with the switch open.

All power sources must be isolated and locked out before removing the safety screen.

1.4 Safe Practices

Only qualified electrical workers with training and experience on medium voltage circuits should be permitted to work on this equipment. They should be familiar with the work to be performed, the safety equipment required, and hazards involved.

Read and understand these instructions before attempting any assembly, operation, or maintenance of an LBS switch.

Disconnect all power sources before making any adjustments or performing maintenance.

WARNING!

Defeating or disengaging safety interlocks on an LBS switch that is properly installed and connected to a power source may result in property damage, bodily injury or death.

Do not defeat or disengage any safety interlocks when the switch is connected to any power source.

Never energize an LBS switch without the arc chutes and phase barriers installed.

Always be sure that all hardware is in place and properly tightened before putting an LBS switch into operation after any maintenance operation. The contact and blade hardware must be tightened as described in Section 5 to provide the correct contact pressure while maintaining free operation of the blades.

SECTION 2 – RECEIVING, HANDLING AND STORAGE

2.1 Receiving

When receiving an LBS switch, a visual inspection should be performed immediately upon receipt of the switch and before removing it from the truck. Shipping papers should be checked to be sure that all boxes or other accompanying pieces have been received. If any damage or shortages are evident, a claim should be filed at once with the carrier and the nearest Cutler-Hammer sales office should be notified.

2.2 Handling

An LBS switch is insulated for high voltages and must be protected at all times against damage during handling.

2.3 Storage

If it is necessary to store an LBS switch before installation, keep it in a clean, dry location with ample air circulation and heat to prevent condensation. Like all electrical apparatus, an LBS switch contains insulation that must be protected against dirt and moisture.

SECTION 3 – Inspection Before Initial Energizing of an LBS Switch

NOTE!

Each switch is properly adjusted at the factory before shipment. However, vibration and mechanical stresses imposed by transit and installation can adversely affect switch adjustment; therefore, a final inspection is essential before energizing. If this inspection reveals the switch has come out of adjustment, the switch should be re-adjusted according to alignment procedures in Section 5.2.

Inspection procedures require closing and opening the switch with the main door open. This requires override of the switch safety interlock as described in Section 5.3.1 and must be accomplished before energizing.

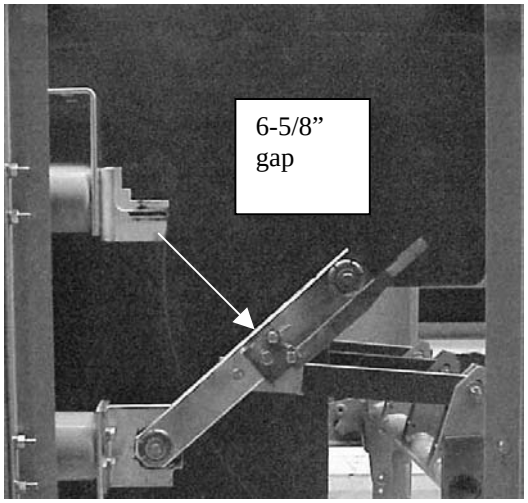

Fig. 2 Main Blade Adjustment

Inspection Procedure:

a. With the switch in the open position (see Fig. 2) the distance between the edge of the main blade and the closest point of the break jaw should be 6-5/8"+/- 1/8".

b. Main and flicker blades must be in proper alignment with break jaws and arc chute openings respectively. This can be checked by closing the switch and then partially opening it using the maintenance hub as described in Section 5.1.3.

c. In the closed position the drive rod links and shaft ears must be 1/16" to 1/8" over toggle when checked with a straight edge (see Fig. 3).

d. With the switch closed, the upper spacers of the main blades should rest 3/16"+/-1/16" above the bottom of the depression of the stationary break jaw (see Fig. 4).

e. With the switch closed, each main blade assembly should engage the break jaw such that the back of the blades is between flush and 1/8” from flush with the top of the vertical surface of the break jaw (see Fig. 10).

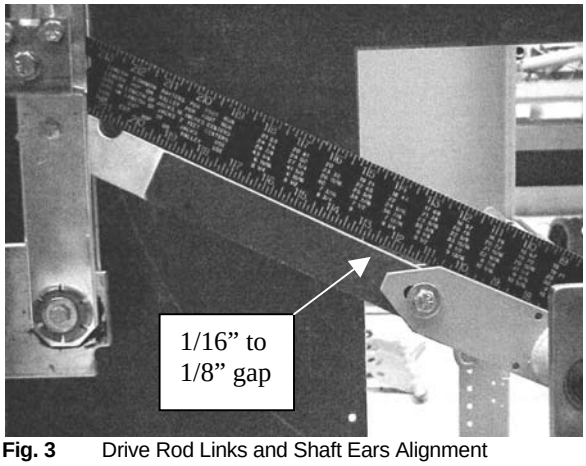

Fig. 3 Drive Rod Links and Shaft Ears Alignment

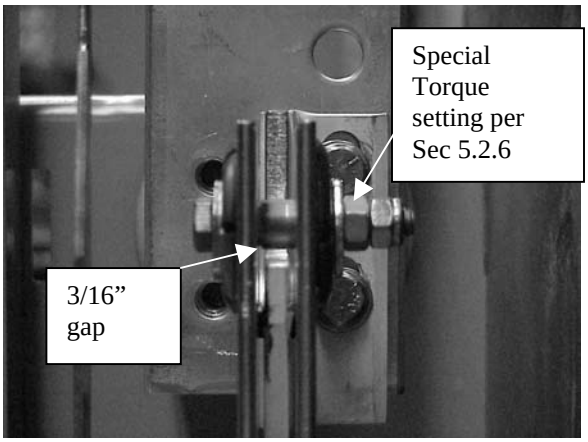

Fig. 4 Main Blade Spacer Adjustment

f. When LBS fuse mountings are supplied, check to ensure the fuse mountings are securely fastened and fuses are properly clamped in place. Ensure all threaded fasteners are torqued to the appropriate value in section 6.0.

h. Wipe away any dust or dirt that may have accumulated in the switch or fuse compartments, paying particular attention to insulators and insulating material.

i. A final thorough inspection should be made to ensure that no tools or other objects have been accidentally left inside the enclosure.

SECTION 4 - OPERATION

4.1 MECHANICAL SAFETY INTERLOCKS

WARNING!

Defeating or disengaging safety interlocks on an LBS switch that is connected to a power source may result in property damage, bodily injury or death.

Do not defeat or disengage any safety interlocks unless all power sources have been disconnected and locked out.

The LBS switch is equipped with switch interlocks and door interlocks as described in section 1.2.

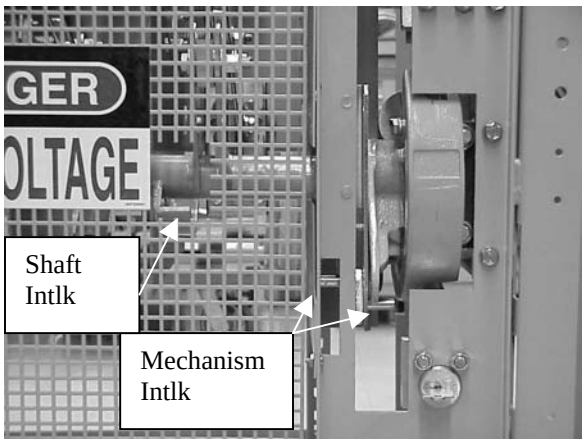

Fig. 5 Door/Switch Interlocks

4.1.1 Door/Switch Mechanism Interlock

This mechanical interlock prevents inadvertent closure of the switch if the enclosure door is open. When the door is closed, a bracket fastened to the inside of the enclosure door causes the interlock latch to move out of the blocking position (see Fig. 5).

4.1.2 Door/Switch Shaft Interlock

This interlock prevents the door of the enclosure from being opened when the switch is closed. If the switch is closed, a hook welded to the operating shaft engages a bracket fastened to the inside of the switch enclosure door, thus preventing the door from being opened. (See Fig. 5.)

4.1.3 Key Interlocking, LBS Switch

Key interlocks for one or two key, Kirk brand type "F" locks (or other manufacturers' equal) with one-inch bolt projection are optionally available on the LBS switch. Refer to the specific order drawings for a description of operation for these interlock schemes, when provided.

4.2. Switch Operation

CAUTION!

Attempting to operate an LBS Switch with a key interlock bolt extended will result in equipment damage and may also expose a person to bodily injury or death.

The key must be inserted into the interlock and rotated to retract the locking bolt before operating an LBS switch.

CAUTION!

Make certain that the switch door is fully closed and the ¼-turn latches fully engaged before operating the switch.

Operating the switch without the main door and ¼-turn latches fully closed could result in damage to the door or door interlock.

To close or open an LBS switch, the operating handle is inserted into the handle casting and rotated up or down as appropriate. This charges the compression spring, and as the spring lever goes over-toggle, the stored energy of the spring is transferred to the shaft which snaps the switch open or closed. The blades thus move at a predetermined speed that is independent of the operator.

When the LBS in mounted in the bottom compartment of an Ampgard structure, care should be taken to insure that the operator's hand is not located between the handle end and the floor. Grasp the operating handle as shown in Figure 6 to insure safe, reliable operation of the switch. The operator should stand clear of the handle while opening or closing the switch. Care should be exercised to avoid dropping the handle.

Store the handle in the clips provided on the handle coverplate (see Fig 6).

Fig. 6 Handle Operation

The quick-make mechanism provides power to overcome blowout forces that occur if the switch is closed into a fault. These forces are not transmitted to the operating handle since it is not rigidly connected to the blades. The switch can therefore be safely closed under short circuit conditions within its fault-close rating.

Load interruption is accomplished by flicker blades and contact fingers located inside a DE-ION arc chute. On opening the switch, the main blades open first and all current is shunted through the spring-loaded flicker blades. Further travel of the main blades cause the flicker blades to snap out of their contact fingers. Arcing takes place within the arc chutes between the contact fingers and flicker blades.

4.3 Fuse Replacement

WARNING!

When accessing fuses, failure to assure that the fuses are de-energized may result in equipment damage, bodily injury, or death.

Make sure that all power sources are de-energized before attempting to access the fuses.

When specified, the Type LBS switch is supplied with Cutler-Hammer Type CLE or HLE current limiting power fuses. Fuse puller, part number 6391D55G01, is supplied with fuses rated 450 amps or less to aid in the insertion and removal of the fuses. Instructions for using the fuse puller are mounted on the inside of the switch enclosure door. Fuses rated 600E to 1350E are of the bolted type and are mounted in auxiliary compartments.

SECTION 5 - MAINTENANCE

An LBS switch should be thoroughly inspected prior to initial energizing. Every 100 operations or yearly thereafter a cursory inspection to clean, lubricate, and check for signs of wear and tear, damage, etc., is recommended as described in section 5.1. If any problems are discovered they should be corrected by following procedures in sections 5.2 and 5.3. After 30 interruptions at the rated current or after the switch has been exposed to fault currents, the switch should be thoroughly inspected at the first opportunity. If the switch has been moved or otherwise subjected to mechanical strain, inspection procedures described in Section 3 should be performed.

The rated mechanical life of the LBS is 500 operations.

5.1 Inspection Procedure

WARNING!

Failure to completely disconnect the switch from all power sources prior to inspection or maintenance may result in severe injury or death.

An LBS switch must be completely disconnected from all power sources before performing inspection.

5.1.1 Main Blade and Flicker Blade Contact Inspection

Check main blades and flicker blades for arc erosion. Severely damaged blade assemblies should be replaced as described in Sections 5.3.1 and 5.3.2.

If flicker blades become rough from arc erosion, they may be smoothed with a few light strokes of a fine file. No attempt should be made to file out pit marks. Do not use any abrasive material for cleaning. If questionable, don't file the flicker blades.

The main blade current carrying contact surfaces must not be filed. Opening and closing the switch will keep them clean. If main blade current carrying contact surfaces are burned, they must be replaced.

5.1.2 Arc Chute Inspection

Inspect arc chute sides for cracks or erosion and replace if damaged. Use a flashlight to examine the arcing contacts inside the arc chute. If contacts are found to be burned or pitted over half of their surface, or if the contacts are out of alignment, the arc chute should be replaced.

CAUTION!

Slow closing or slow opening the switch using the maintenance hub may result in bodily injury if care is not taken to hold the operating handle firmly.

Be sure to hold the handle firmly while performing slow closing or slow opening operations.

5.1.3 Flicker Blade Engagement Check

First, close the switch. Next, insert the removable handle in the pipe-like maintenance hub welded to the switch shaft (see Fig. 7) and slowly open the switch. The flicker blades should remain engaged in their contact fingers while the main blades open. When the main blades clear the break jaws, they will hit a stop on the flicker blade brackets and start the flicker blades out of their contact fingers. The flicker blades will then snap open from the forces in their charged torsion springs.

Inspect the tightness of the bolts securing the flicker blades to their mounting brackets. Inspect the flicker blade mounting bracket to insure that does not pivot up and down on its mounting bolt. Tighten the bolt if pivoting is observed. Do not overtighten. To verify that the mounting bracket bolt has not been overtightened, push the flicker blade to the rear. It should rebound smoothly.

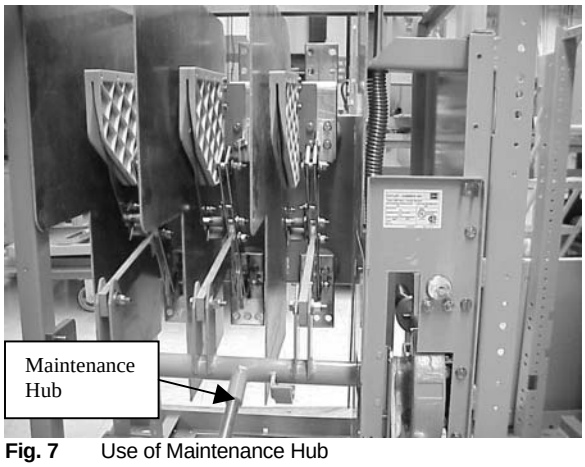

Fig. 7 Use of Maintenance Hub

5.1.4 Interphase Barrier Inspection

Check interphase barriers for carbon or metallic deposits. Replace if deposits are present.

5.1.5 Cleanliness check

Wipe away any dust or dirt that may have accumulated on the switch parts, paying close attention to insulators and insulating material.

5.1.6 Mechanical Operation Check

Close and open the de-energized switch at least three times to check the performance of the operating mechanism.

5.2 Alignment Procedures

Check each of the following items for adjustment and alignment. If out of adjustment and alignment, follow the instructions given.

WARNING!

Failure to completely disconnect the switch from all power sources prior to inspection may result in severe injury or death.

The switch must be completely disconnected from all power sources before performing inspection.

5.2.1 Override of Door / Switch Mechanism Interlock

To close the switch with the door open, the interlock must be disengaged. To close the switch, insert the handle into the handle casting and push upward, at the same time push the latch that is accessible through a slot in the handle cover inward until the handle casting clears the interlocking bolt. (See Fig. 8) To open the switch, reverse this procedure, making sure that the door interlock is fully depressed.

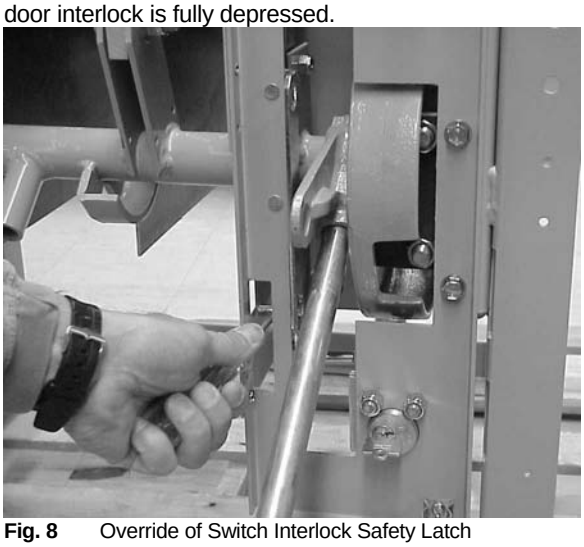

Fig. 8 Override of Switch Interlock Safety Latch

5.2.2 Close-Open Stop Adjustment

Remove the handle mechanism cover by removing the bolts securing the cover to the switch frame. Remove the casting with the switch position indicators by loosening 2 bolts. The adjusting bolts are now accessible as shown in Fig 9. Adjustment is made by loosening the lock nut and turning the bolt.

The bottom stop bolt adjusts the closed position. When properly closed, the shaft rod ends should be slightly over-toggle. Verify the adjustment by laying a straight edge on top of the drive rod so that its end extends over the shaft (see Fig. 3). If a 1/16" to 1/8" gap appears between straight edge and drive rod, adjustment is correct.

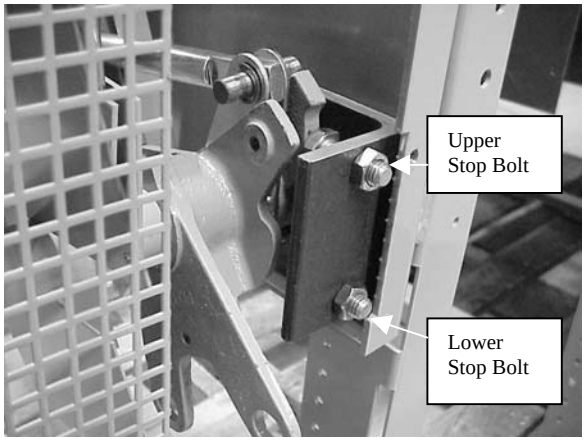

Fig. 9 Close-Open Stop Adjustment Bolts

Check to see that the blades are closing fully. To do this, measure the distance from the upper switch terminal pad to the outer edge of the main blade (See Fig. 10). This dimension should be 3-5/16" to 3-7/16". Should adjustment be required, loosen the bolt holding the drive rod to the main shaft clevis and adjust the blade travel. Re-tighten the bolt to 25 foot pounds.

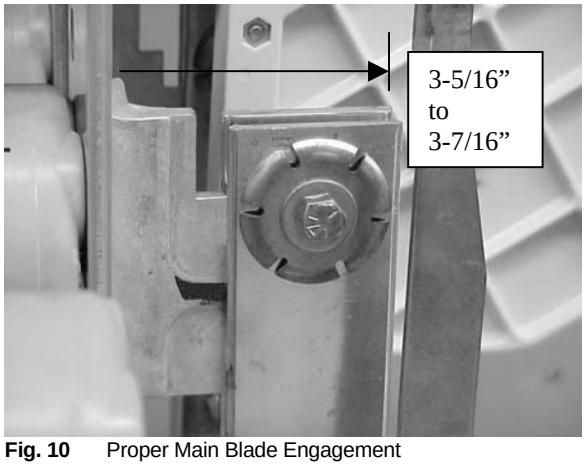

Fig. 10 Proper Main Blade Engagement

In the open position, clearance between the edge of the main blade and the break jaw should be 6-5/8” as described in Section 3 and Figure 2. The top stop bolt adjusts this dimension (see Fig. 9).

If the switch is equipped with key interlocking, care must be taken when replacing the switch mechanism cover to ensure that it is properly repositioned. The key interlock bolt must clear the open-closed indicating cam handle casting when retracted.

5.2.3 Main Blade Alignment

It is important that the main blades be properly aligned with the upper break jaw to insure smooth operation of the switch. To align the blades and jaw after one or both have been replaced, follow the procedure below:

Loosen the four hinge bolts and the two break jaw bolts. Insert the removable handle in the maintenance hub on the shaft and close the switch. (For safety purposes, the switch will not fully close and will revert to the open position if pressure on the handle is released). Hold the switch in the closed position with the handle and tighten the bolts on both the hinge and jaw to 25 foot-pounds. Hold handle firmly throughout alignment process.

5.2.4 Arc Chute Alignment

Loosen the two arc chute mounting bolts. Adjust the arc chute so that its opening is parallel to the main blade. Tighten the mounting bolts enough to prevent movement. Using the maintenance hub located on the switch shaft (see fig. 7), slowly close the switch and check that the flicker blade is in line with the arc chute opening. If necessary, move the arc chute left or right until it lines up with the flicker blade. Completely tighten the arc chute mounting bolts and recheck the alignment.

5.2.5 Vertical Position of Break Jaw

Close the switch. Check that the upper spacers of the main blades are between 1/8”and 7/32” above the tops of the break jaws. If they are not, loosen the bolts holding the break jaw. Adjust as necessary. When setting is correct, tighten bolts to 25 foot-pounds (see Fig. 4).

5.2.6 Break Jaw Bolt and Hinge Contact Bolt Tightness

The disk springs on the main blade assembly must provide the necessary contact pressure between the main blades and stationary mating parts when the switch is closed (see Fig. 4). At the break jaw end, if the elastic stop nut must be removed a sensitive torque wrench used to set the proper contact pressure as tabulated below.

Fault-Close Rating, kA	Inch-pounds of torque

asymmetrical	
40	**20**
61	**25**

The elastic stop nut at the hinge end must be tightened to a value of **20 inch-pounds** on all switches.

It is critical that the bolts at both ends of the main blade assembly be properly tightened. If the bolts are over-tightened, the switch may not properly open or close. If the bolts are under-tightened, the blades will not make a good electrical connection and the switch will overheat. A resistance reading across each pole can be used to verify that the blades are tight enough, but will not indicate if they have been over-tightened. Ohm readings between the top terminal pad and the bottom terminal pad on each pole should not exceed 60 micro-ohms when the bolts are tight.

5.3 Replacement Procedures

WARNING!

Failure to completely disconnect the switch from all power sources prior to inspection may result in severe injury or death.

The switch must be completely disconnected from all power sources before performing inspection.

5.3.1 Main Blade/Hinge Subassembly and Break Jaw Replacement

Begin with the switch should be in the closed position. Disconnect the drive rod link from the clevis on the main shaft. Remove the four bolts holding the hinge assembly to the lower terminal pad. The hinge, main blade and flicker blade assembly is now free and may be removed, along with the lower terminal pad. Remove the two bolts holding the break jaw to the upper terminal. Remove the old jaw. Replace the jaw and finger tighten the two mounting bolts. Replace the main blade and hinge assembly on top of the lower terminal pad and finger tighten the four bolts. Align the blade per paragraph 5.2.3. Tighten the jaw and hinge mounting bolts. Lubricate per Sec 5.4.

Align flicker blade and arc chute per paragraph 5.2.4. Check flicker blade function per paragraph 5.1.3. If satisfactory, re-connect the drive rod link to the main shaft clevis, being sure to reinstall the clinch spacer in the large hole in the drive rod. Check the switch for adjustments per paragraph 5.2.2 and 5.2.5. Perform the pre-operation check (see Section 3).

5.3.2 Flicker Blade Replacement

Remove the locknut and bolt securing the flicker blade assembly to the main switch blade. When re-installing, made certain that the spring is installed against the stop pin. Verify by pushing the assembly back and observing its return to the original position.

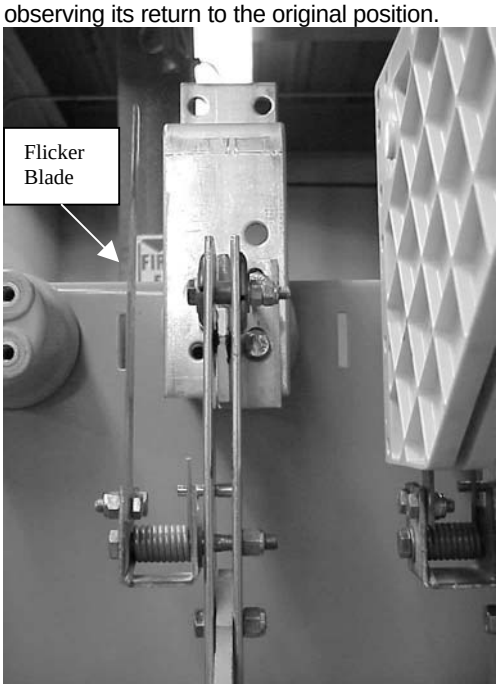

Fig.11 Flicker Blade Assembly

5.3.2 Springs

The main spring is a large horizontally mounted compression spring along the inside of the switch frame on the operating handle side. For higher fault-close ratings, there is also an auxiliary spring vertically mounted and connected to the main shaft.

The main and auxiliary springs are not field replaceable.

5.3.3 Pre-Use Check

After completing any maintenance, the alignment should be checked (See Section 5.2.). After completing any alignment, the switch should be operated at least three "close-open" operations to check for proper performance. Insure that the break jaw has been properly lubricated per Section 5.4.

5.4 Lubrication

Lubrication is critical to the proper operation of the switch and should be performed every 100 operations or yearly, during switch maintenance (see Section 5). C-H conductive grease, part number 7274A48H02, should be applied moderately to contact surfaces on

each break jaw (Fig 12). Avoid any lubrication on insulation.

Failure to regularly lubricate the break jaws may result in the failure of the switch to properly open or close.

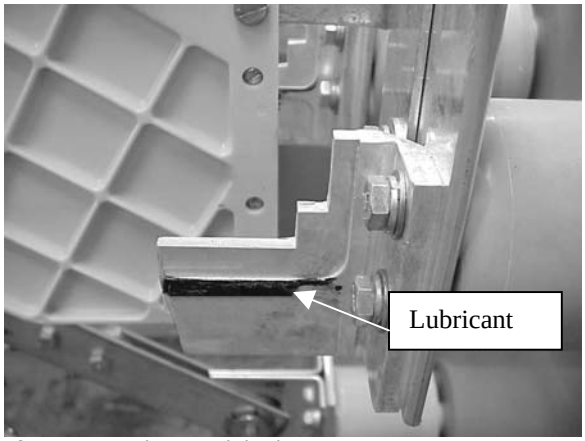

Fig. 12 Break Jaw Lubrication

Section 6 - Bolt Tightness for Connections to Terminal Pads

Use the following torque value for tightening bus joints.

Note: This table is for bus connections only. Use the special torque values listed in the respective sections for the main blades.

Torque Values in Foot-pounds for Bolt Diameter					
Diameter, inches	.25	.31	.38	.50	.62
Nominal Torque	4	8	25	50	65