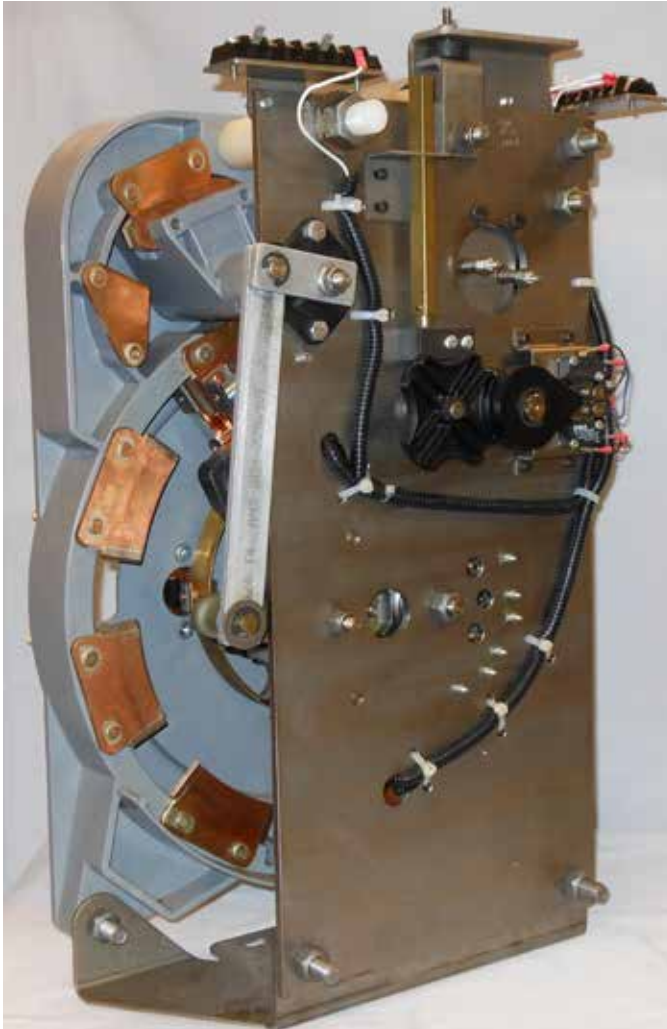


QD5 Quik-Drive voltage regulator tap-changer manual



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Safety for life



Eaton meets or exceeds all applicable industry standards relating to product safety in its Cooper Power™ series products. We actively promote safe practices in the use and maintenance of our products through our service literature, instructional training programs, and the continuous efforts of all Eaton employees involved in product design, manufacture, marketing, and service.

We strongly urge that you always follow all locally approved safety procedures and safety instructions when working around high voltage lines and equipment, and support our “Safety For Life” mission.

Safety information

The instructions in this manual are not intended as a substitute for proper training or adequate experience in the safe operation of the equipment described. Only competent technicians who are familiar with this equipment should install, operate, and service it.

A competent technician has these qualifications:

- Is thoroughly familiar with these instructions.
- Is trained in industry-accepted high and low-voltage safe operating practices and procedures.
- Is trained and authorized to energize, de-energize, clear, and ground power distribution equipment.
- Is trained in the care and use of protective equipment such as arc flash clothing, safety glasses, face shield, hard hat, rubber gloves, clampstick, hotstick, etc.

Following is important safety information. For safe installation and operation of this equipment, be sure to read and understand all cautions and warnings.

Hazard Statement Definitions

This manual may contain four types of hazard statements:

DANGER

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

WARNING

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

CAUTION

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

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in equipment damage only.

Safety instructions

Following are general caution and warning statements that apply to this equipment. Additional statements, related to specific tasks and procedures, are located throughout the manual.

DANGER

Hazardous voltage. Contact with hazardous voltage will cause death or severe personal injury. Follow all locally approved safety procedures when working around high- and low-voltage lines and equipment.

G103.3

WARNING

Before installing, operating, maintaining, or testing this equipment, carefully read and understand the contents of this manual. Improper operation, handling or maintenance can result in death, severe personal injury, and equipment damage.

G101.0

WARNING

This equipment is not intended to protect human life. Follow all locally approved procedures and safety practices when installing or operating this equipment. Failure to comply can result in death, severe personal injury and equipment damage.

G102.1

WARNING

Power distribution and transmission equipment must be properly selected for the intended application. It must be installed and serviced by competent personnel who have been trained and understand proper safety procedures. These instructions are written for such personnel and are not a substitute for adequate training and experience in safety procedures. Failure to properly select, install or maintain power distribution and transmission equipment can result in death, severe personal injury, and equipment damage.

G122.3

Product information

Introduction

Eaton combines more than 50 years of tap-changer experience with the latest technology providing the most advanced and reliable voltage regulator tap-changer in its Cooper Power series QD5 Quik-Drive™ tap-changer. Eaton provides the proven value customers have come to expect from the leader. By using advanced thermal-set material rather than Phenolic material Eaton has been able to design in strength to meet the most demanding applications. The design provides for an improved contact alignment and longer contact life. The QD5 tap-changer incorporates Cooper's exclusive holding switch circuit, which has set the standard for tap-changer tracking reliability.

The QD5 Quik-Drive tap-changer offers many advanced features when integrated with Eaton's Cooper Power series voltage regulator controls. Applications such as Preventative Maintenance Tapping (PMT™), Duty Cycle Monitor (DCM), and Time-ON-TAP™ features enables the unique capability to monitoring factors that affect tap-changer life.

Read this manual first

These instructions apply to distribution voltage regulators equipped with the QD5 tap-changer. Read these instructions carefully before attempting maintenance on the voltage regulator.

The equipment covered by these instructions should be operated and serviced only by competent personnel familiar with good safety practices. These instructions are written for such personnel and are not intended as a substitute for adequate training and experience in safe procedures for this type of equipment.

The text of this instruction includes information concerning hazards to safety, which are common to all regulators. This safety hazard information is offered for guidance when installing and operating the descriptive matter to aid in preventing damage to the equipment and to advise of possible hazards to personnel. When reading this text, the meaning and content of these statements should be understood and followed carefully.

Standards

ISO 9001 Certified Quality Management System

CAUTION

Do not operate the motor in air for excessive periods of time or overheating and failure may result.



Figure 1. Motor.

General

Service Information MN225012EN covers operating, maintenance and component replacement instructions for the QD5 Quik-Drive tap-changer in Eaton's Cooper Power series VR-32 voltage regulators. The QD5 tap-changer in 2003 replaced the 770 Direct Drive tap-changers for low current application single-phase voltage regulators. Replacing the medium direct drive model 770, 150 kV BIL, the QD5 tap-changer like the 770 direct drive tap-changer are used on voltage regulators with a load rating up to 328 Amps. In 2007, the original Phenolic contact board design of the QD5 was replaced by thermal-set material.

Motor

The motors for the QD5 Quik-Drive tap-changer are permanent split capacitor type suitable for operation in both directions of rotation at 120 Vac, single-phase, 50/60 Hz. All components are compatible with hot transformer oil and windings are oil cooled. The motor will carry locked-rotor current for at least 3000 hours.

Motor resistance

To measure the motor resistance of each motor directional winding, see the following:

Motor Ground "White Lead" to "Blue Lead" Raise	= 7.2 ohms
Motor Ground "White Lead" to "Red Lead" Lower	= 7.2 ohms
Raise "Blue Lead" to Lower "Red Lead"	= 13.9 ohms

Motor capacitor

The QD5 tap-changer motor uses a 50 μ F, 440 Vac, and 100°C motor capacitor. The motor capacitor is not part of the tap-changer assembly; it will be located in the voltage regulator control box.



Figure 2. Motor capacitor.

Motor capacitor

Size Rating

50 μ F, 440 Vac, 100°C for 50 and 60 Hertz

It is recommended that a replacement capacitor be of the same size and rating as was originally supplied with the unit. Incorrectly sized motor capacitors can cause the motor to labor and not run properly or at all; premature motor failure will result. Tap position tracking of the voltage regulator control will also be adversely affected by improperly sized motor capacitors.

Holding switch

Eaton's tap-changers are equipped with a holding switch to assure that a tap-changer operation is completed. This switch also provides a repetitive and accurate opening action causing the motor to stop the drive components with correct alignment. A signal from the holding switch activates the operations counter and prevents time delay reset during a tap change. The holding switch is operated by a pinion cam causing the holding switch lever to close in on either the raise or lower micro switch.

If there is a problem with one of the micro switches on the holding switch, the individual micro switch should not be replaced. Instead, the complete holding-switch assembly must be replaced. Replacement of an individual micro switch can cause alignment problems which will affect the operation of the tap-changer. Special fixtures are used to assemble the holding-switch assembly to ensure that alignment gap setting requirements are met.



Figure 3. Holding switch assembly.

Contacts

All movable and main stationary contacts employ copper-tungsten alloy tips at points subjected to arcing duty. Contact points not subjected to arcing employ a combination of EPT copper to provide a high conductivity current path. Movable contacts are split to make contact on both sides of mating parts and resist separation during high current surges. Contact pressure is maintained by steel compression springs.

Main stationary contacts

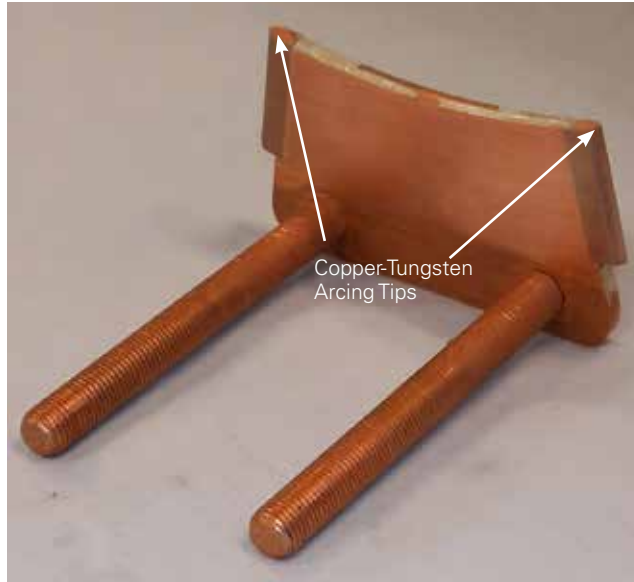


Figure 4. Main stationary contact.

The main stationary contact is used for stationary tap contacts and the neutral contact.

Main movable contacts



Figure 5. Main movable contact assembly.

The main movable contact assembly is made up of a set of two individual contact assemblies and a thermal set material insulating arm. Each of the main movable contacts makes contact with the main stationary contacts as the tap changer rotates through each tap position. At least one of the main movable contacts remains in contact with a stationary contact at all times. The main stationary contacts bolt to collector rings. The collector rings insert between a set of button contacts that are able to hold a continuous current path through all 32 steps of the tap changer and while in neutral. The movable contact assemblies are identical and can be used for either the right or left hand contacts.

Reversing stationary contacts



Figure 6. VL reversing stationary.



Figure 8. Figure 7. VR reversing stationary.



Figure 7. Figure 8. Neutral reversing stationary.

The set of reversing switch stationary contacts on the QD5 tap-changer consist of three individual stationary contacts, a VL-Reversing Stationary, a Reversing Neutral Stationary, and a VR-Reversing Raise Stationary contact. The reversing switch stationary contacts see less operating duty than the main stationary contacts and therefore do not utilize the copper-tungsten alloy arcing tips.

Main reversing movable contacts

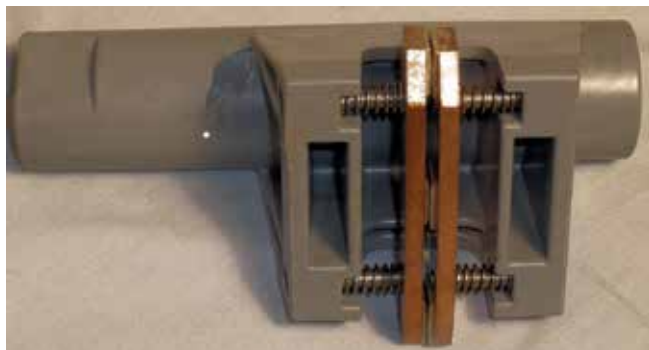


Figure 9. Reversing movable contact assembly.

The reversing switch changes the polarity of the tapped winding. When the QD5 Quik-Drive tap-changer is in neutral position, the reversing switch is located on the "VN" Reversing Neutral Stationary Contact. In the open position the reversing switch is not in the load current circuit.

The reversing switch motion on the QD5 tap-changer occurs as the main movable contacts enter or leave the neutral position. The QD5 tap-changer reversing switch movable contacts interact with the three reversing stationary contacts during the buck and boost operation of the tap changer.

The first tap step in either direction rotates the Reversing Segment actuator causing the Reversing Segment Actuator arms to rotate the reversing switch and engage the appropriate reversing stationary contact. When the tap-changer receives a signal for raise and the reversing switch contact is in neutral, the reversing movable contacts will move clockwise on to the VR stationary bridging the VR and VN stationary contacts. In the lower direction from neutral the reversing movable will move counter clockwise on to the VL stationary contact. The reversing movable will be bridging the VL and VN when moving in the lower direction.

Micro switches

Micro switches are used for the holding switch, reversing logic, neutral indication and tapping limit logic switches.

Two sets of normally closed switches are used to provide a safety switch circuit to prevent the tap-changer from tapping beyond 16R and 16L acting as a fail-safe to the mechanical stop. The switches enable the tap changer to step back from the mechanical stop when the holding switch is closed.

The micro switches used are rated for -40°C to 130°C , 5 Amp 125/250 Vac rating. The switches are designed to exceed one million operations at QD5 tap-changer current.

QD5 tap-changer operating sequence

When the tap-changer is in the neutral position and the control calls for a tap change, the following events occur:

1. Motor will start and drive the chain sprocket.
2. Rotation of the chain sprocket rotates the drive pinion.
3. The drive pinion cam engages and closes in the holding switch.
4. Drive pinion roller engages the position indicator drive gear advancing the position indicator pointer.
5. The sprocket drive roller engages the Geneva gear rotating the Geneva gear.
6. As the sprocket rotates and the holding switch is actuated, the sprocket cam dis-engages and releases the brake.
7. The rotation of the Geneva gear causes the reversing segment actuator to operate which moves the reversing switch movable contacts, via the linkage tying the reversing segment actuator to the reversing switch from neutral to VR or VL.
8. Rotation of the Geneva gear relocates the movable contacts on the stationary contacts.
9. Drive pinion cam returns to the open area opening the holding switch.
10. Tap Change is completed.

Maintenance, service and troubleshooting

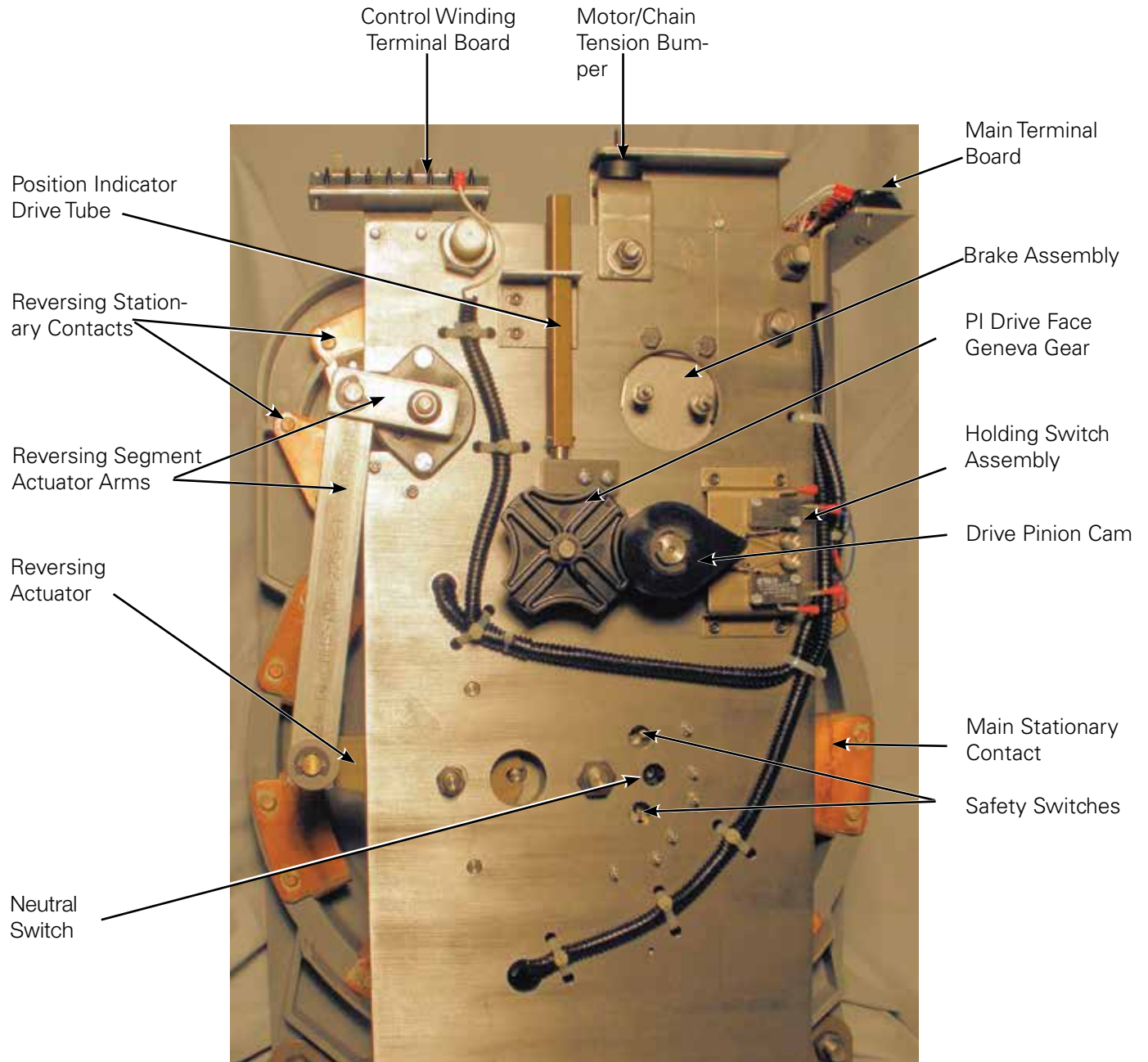


Figure 10. Tap-changer front view.

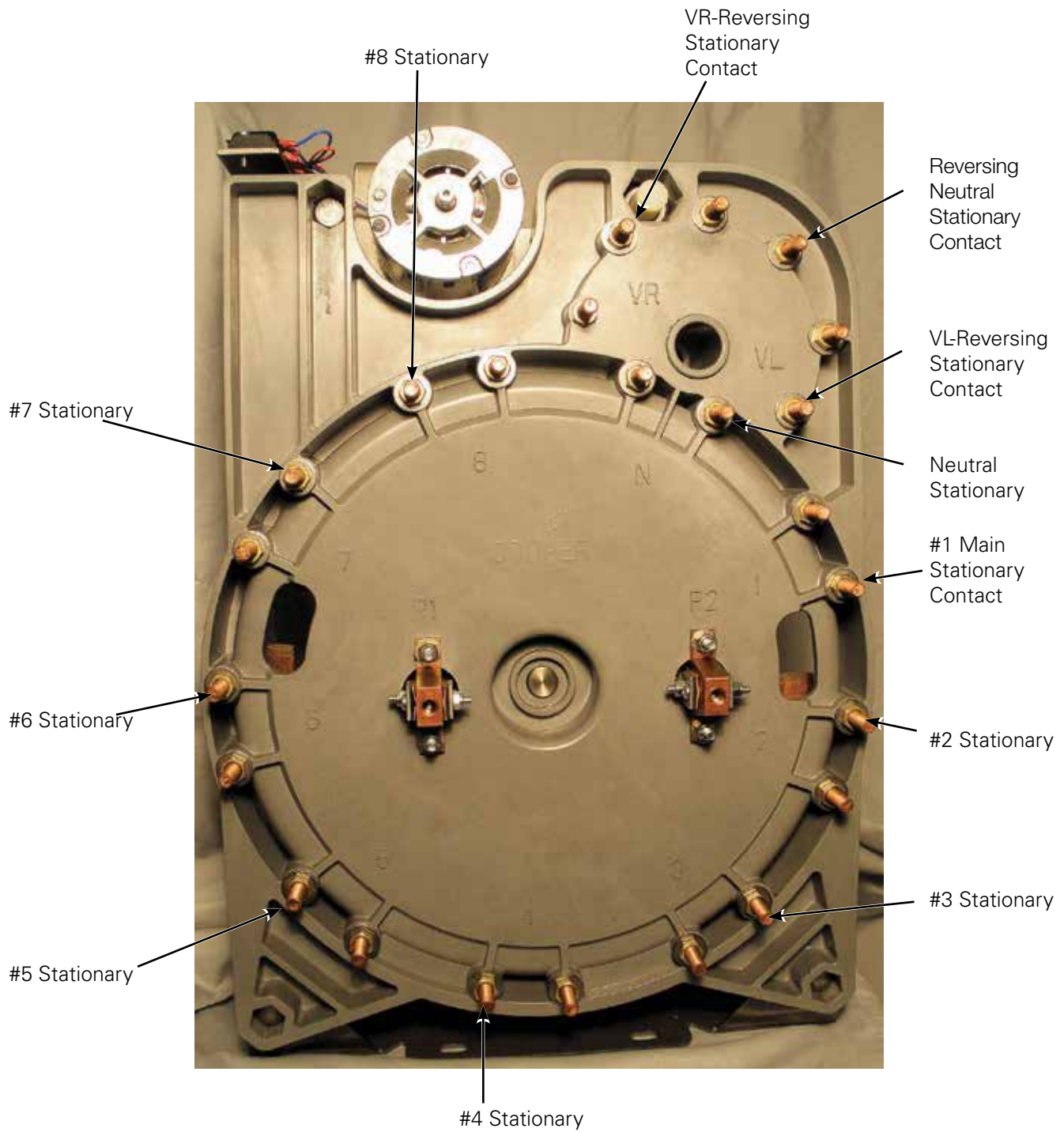


Figure 11. Back side of QD5 tap-changer.

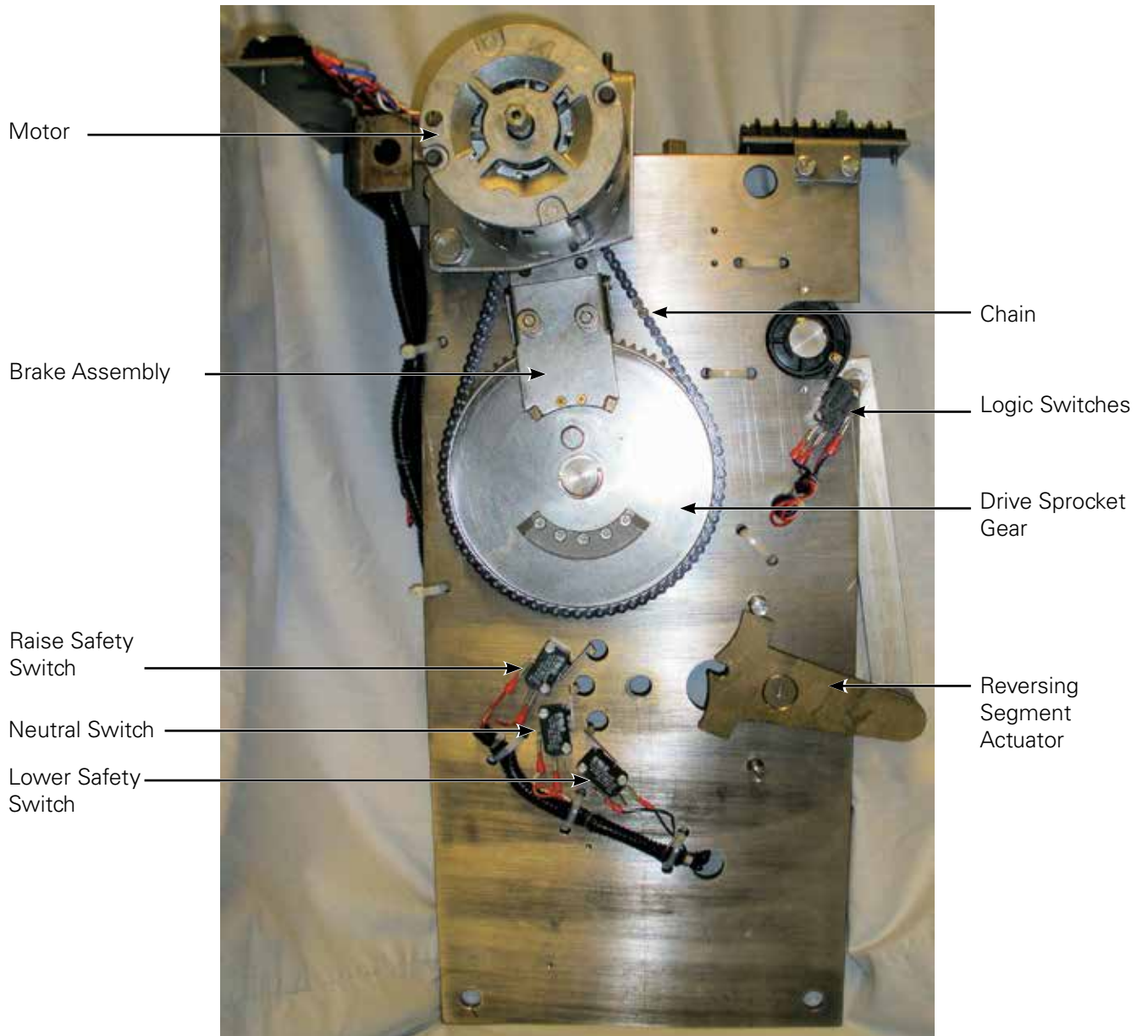


Figure 12. Inside drive frame.

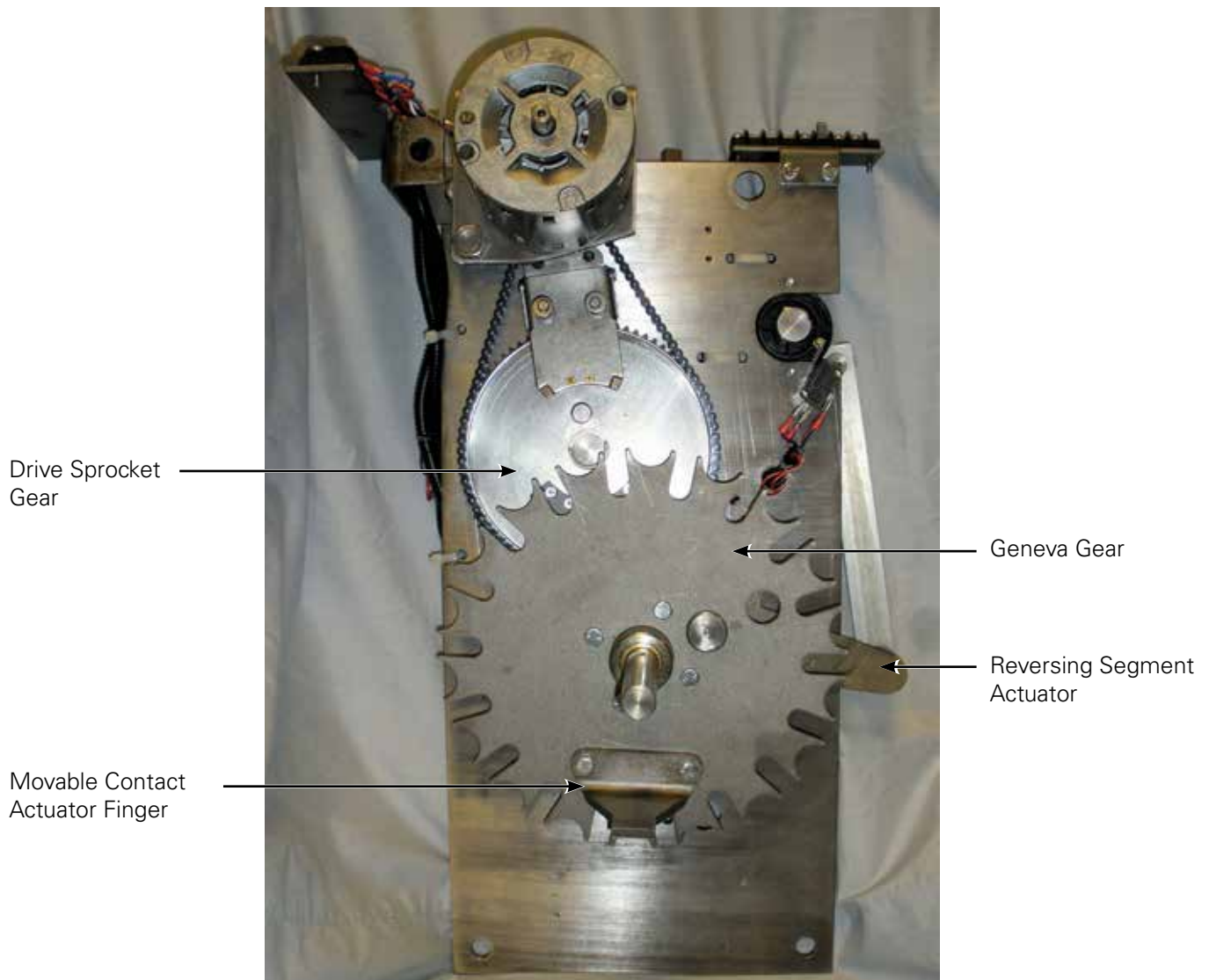


Figure 13. Drive frame with Geneva gear.

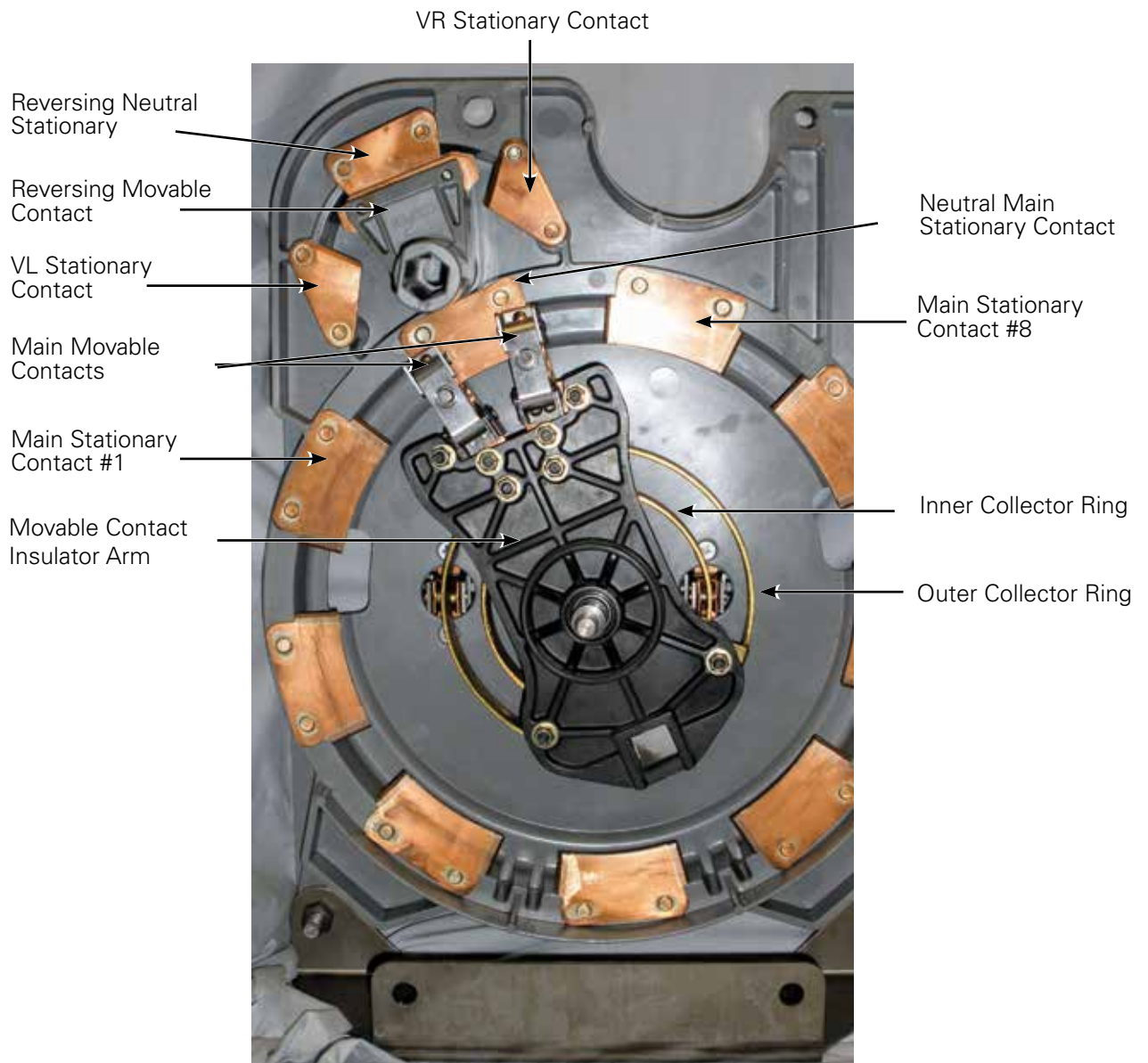


Figure 14. Inside contact assembly.

QD5 tap-changer schematic

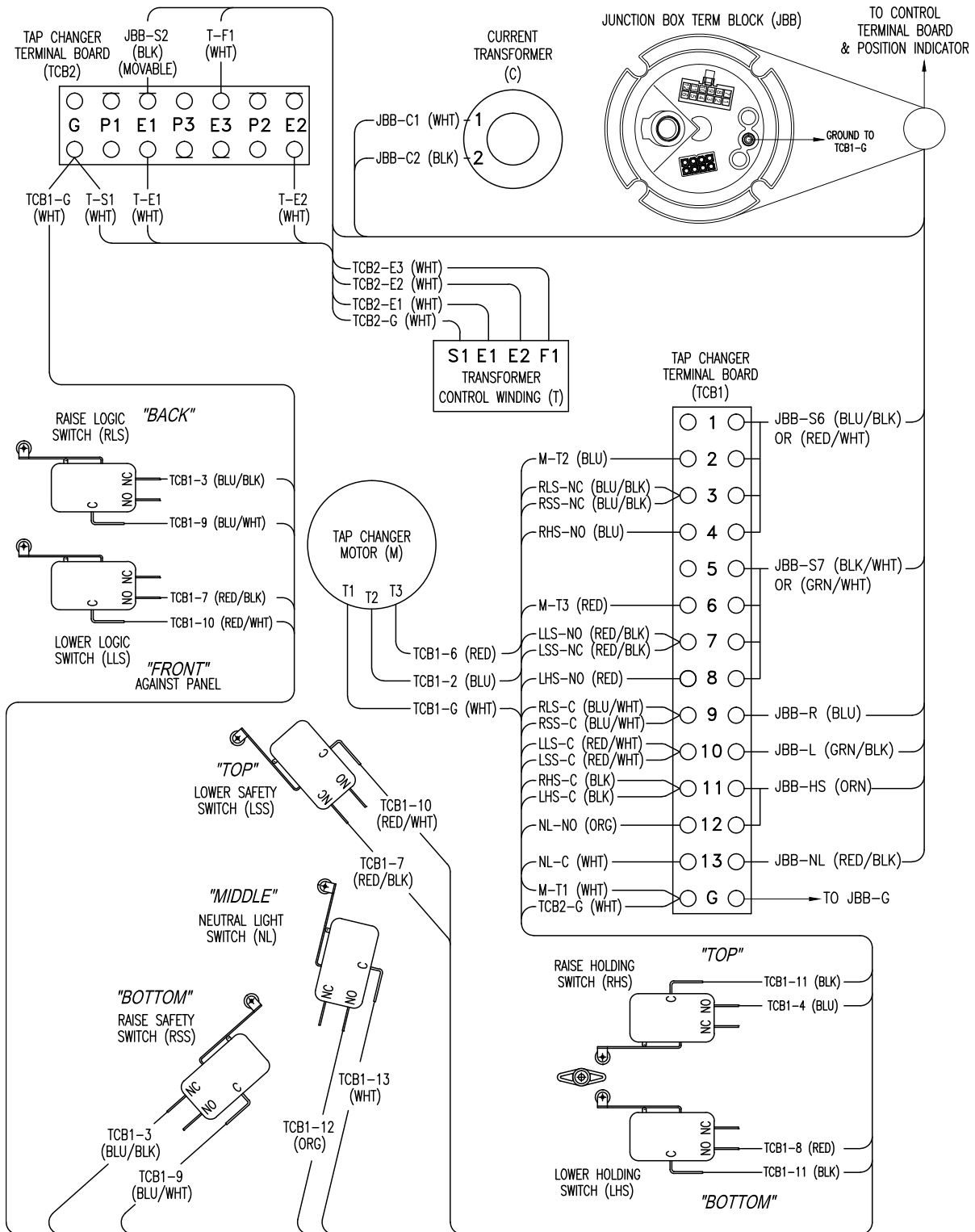
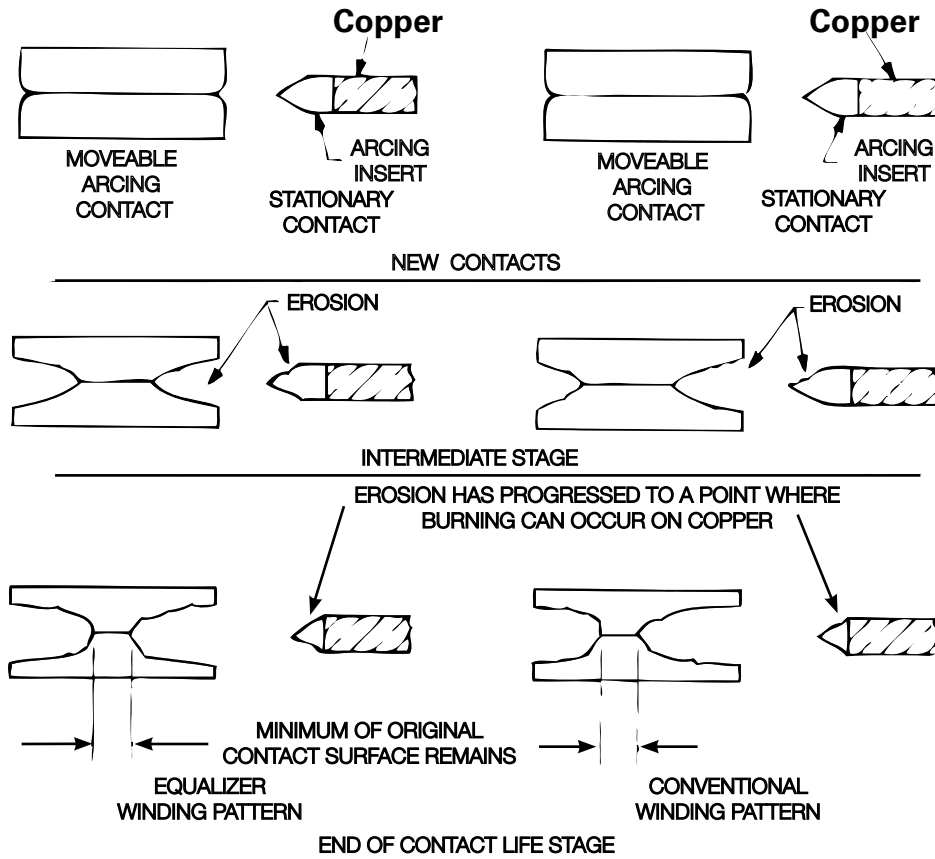


Figure 15. QD5 wiring schematic.

Contact erosion patterns



Contact erosion is a function of many variables such as tap voltage load current and power factor reactor design and tapped winding design. MEPS employs both equalizer and conventional windings which will produce the typical erosion patterns above.

Figure 16. Contact life stages.

Contact inspection

Tap-changer contacts are exposed to combination of electrical, mechanical and thermal conditions that result in deterioration. Erosion at the points subjected to arcing duty is the most visible indication of wear. Figures 19 and 20 illustrate typical contact erosion patterns resulting from normal service. Contacts at the end of life stage shown in Figures 21 and 22 must definitely be replaced. The figures below show actual contacts after various stages of contact erosion.

New contacts



Figure 17. QD5 tap-changer movable contact.



Figure 18. QD5 tap-changer stationary contact.

Intermediate life stage



Figure 19. QD5 tap-changer movable contact.



Figure 20. QD5 tap-changer stationary contact.

End of contact life stage

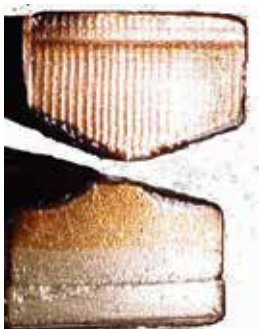


Figure 21. QD5 tap-changer movable contact.



Figure 22. QD5 tap-changer stationary contact edge.

QD5 tap-changer torque requirements

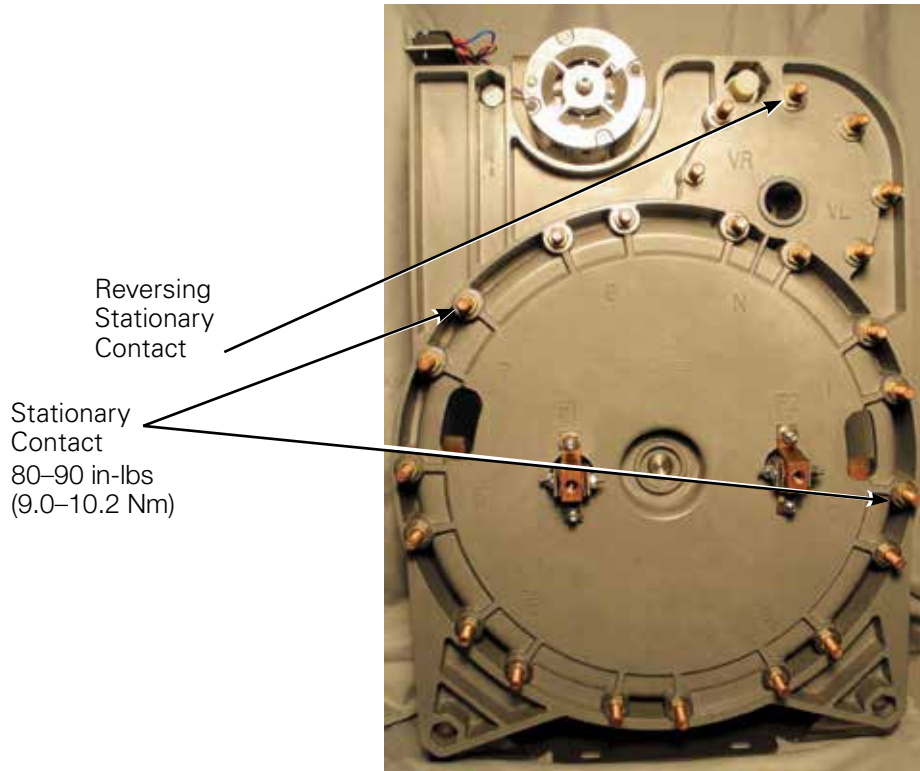


Figure 23. QD5 tap-changer stationary contact torque requirements.

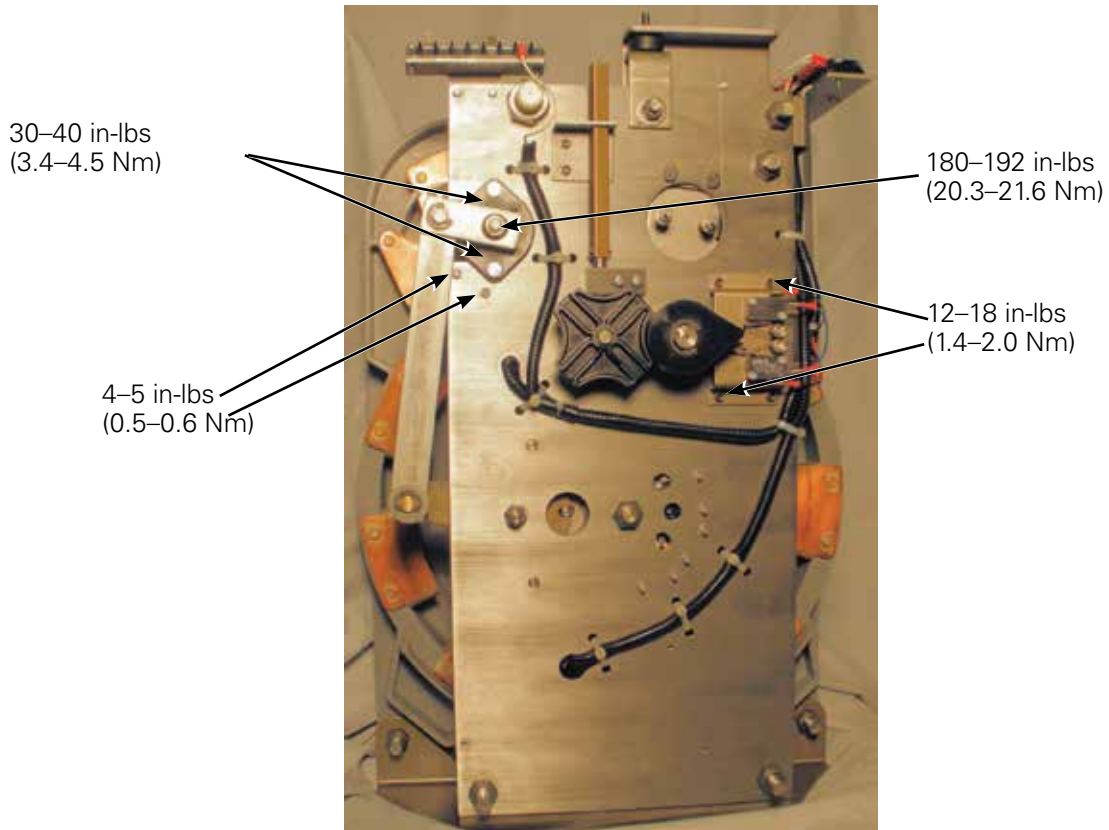


Figure 24. Front drive torque requirements.

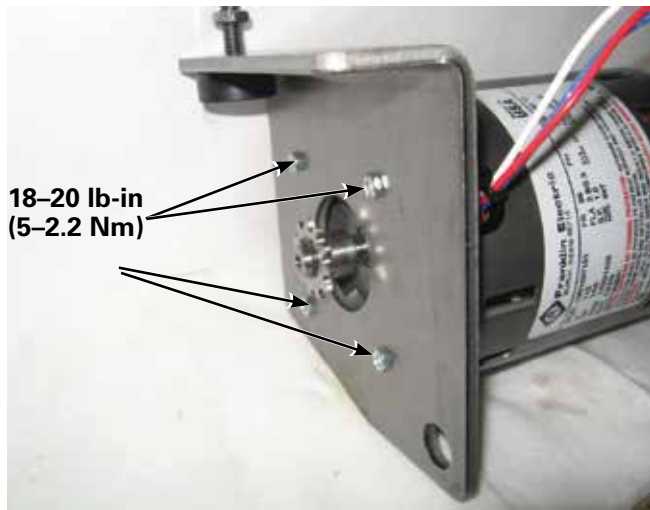


Figure 25. Motor to mounting bracket torque requirements.

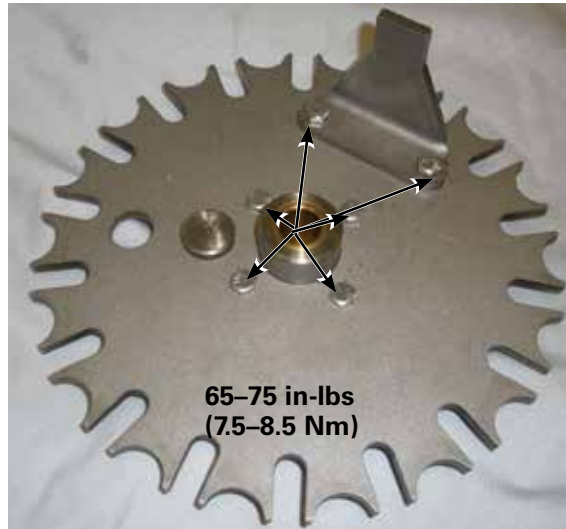


Figure 27. Geneva gear torque requirements.

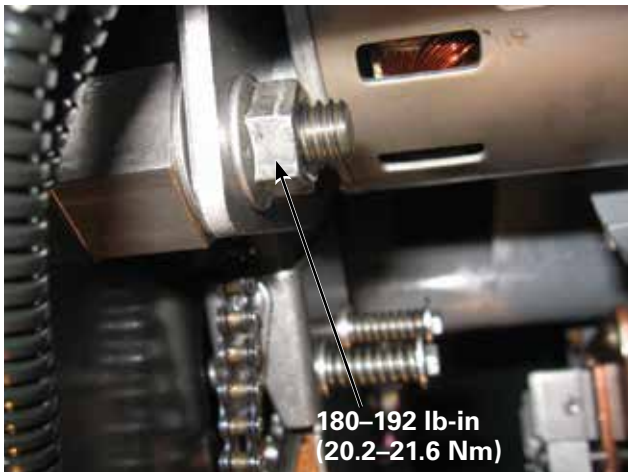


Figure 26. Motor pivot stud and locknut torque requirements.

QD5 tap-changer reversing movable contact assembly kit 5740785B72ER

(Refer to Service Information MN225024EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacing the reversing movable contact on a QD5 Quik Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	0740785B72	Reversing Movable Contact	1

Tools required

- Ratchet Wrench
- 3/8 inch Socket
- 7/16 inch Socket
- 9/16 inch Deep-well Socket
- 1/4 inch Wrench
- Small Flat-blade Screwdriver or 5/32 inch Allen Wrench
- Standard 8-inch Long Flat-blade Screwdriver
- Torque Wrench in-lbs
- Loctite® 243™ Threadlocker



Figure 28. Kit parts.

Installation procedure

Removal

1. Hold the reversing movable contact assembly to prevent the assembly from moving. Using a 9/16" wrench loosen and remove the reversing actuator arm nut. See Figure 29.

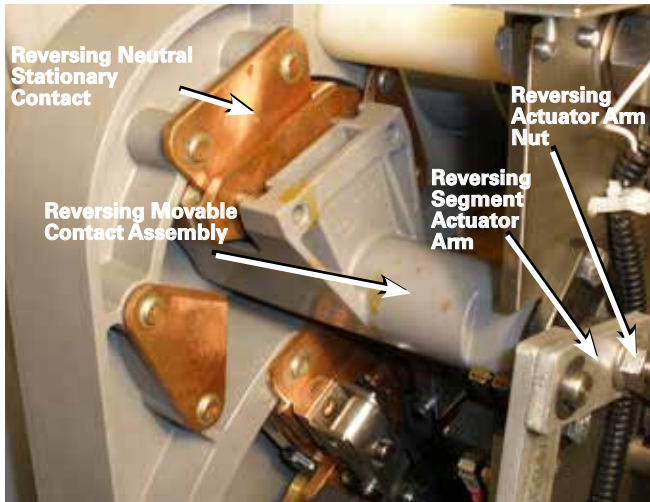


Figure 29. Actuator arm and hardware.

2. Lift outward on the reversing actuator arm and remove it from the reversing movable contact bushing. The reversing actuator shaft may be tapped in to allow clearance to remove the arm. See Figures 30 and 31.

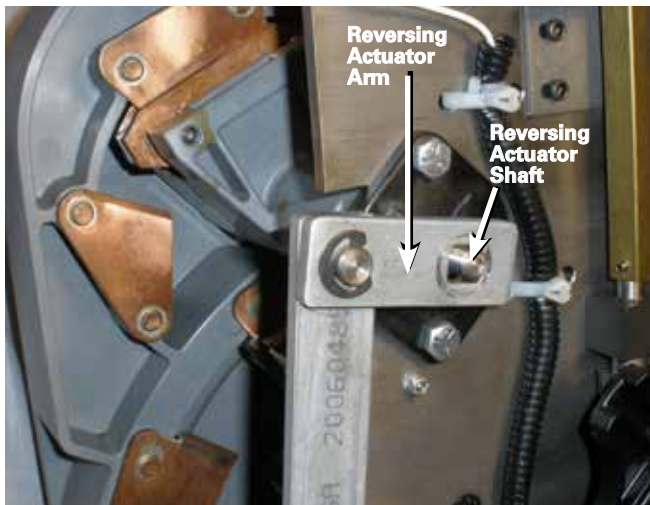


Figure 30. Removal of actuator arm.

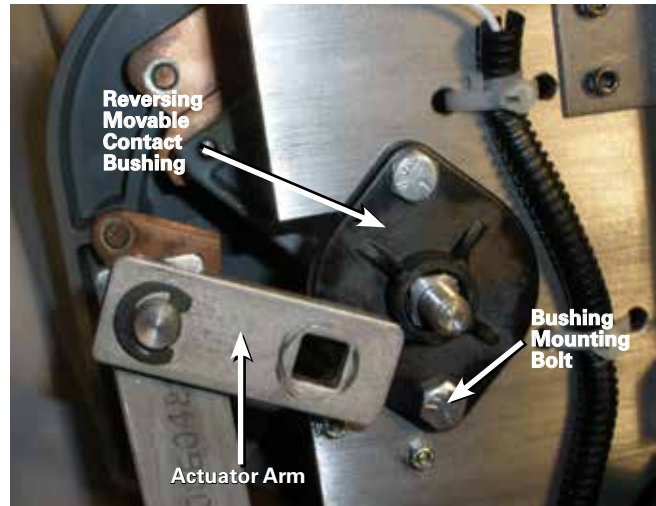


Figure 31. Bushing.

3. Using a 7/16" wrench, loosen and remove both bushing-mounting bolts. See Figure 32.
4. Remove the bushing from the reversing movable contact shaft. See Figure 32.

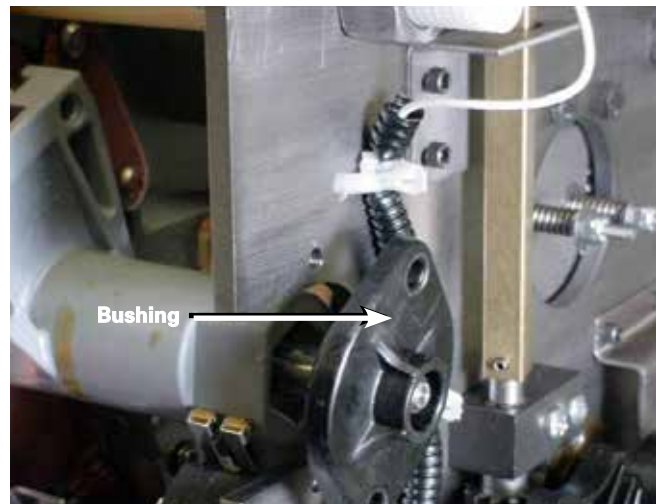


Figure 32. Removal of bushing.

- Use a small screw driver (or 5/32" Allen wrench) and a 1/4" wrench to loosen and remove the self-locking nuts and reversing logic switch mounting screws. See Figures 33 and 34.

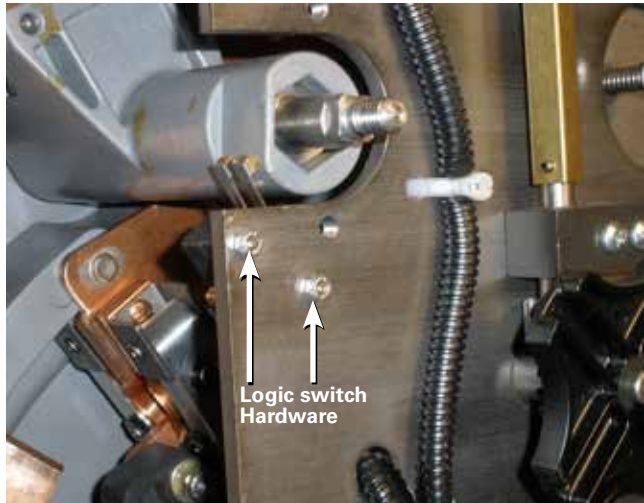


Figure 33. Reversing logic hardware.

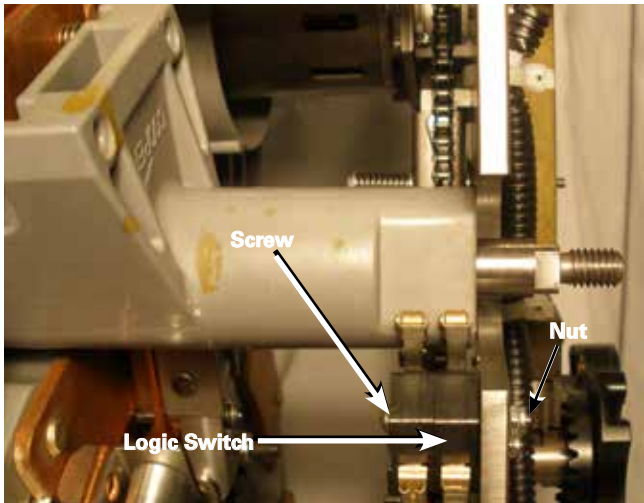


Figure 34. Removal of logic switch.

- After removing the reversing logic switch mounting screws the switch will drop away from the reversing movable switch tube. See Figure 35.

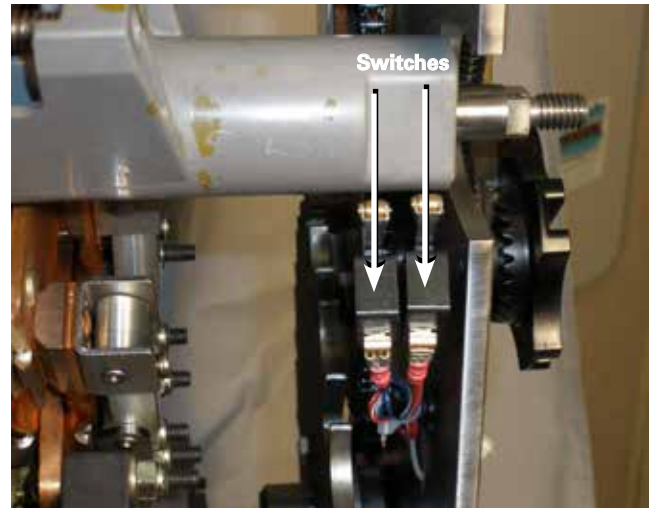


Figure 35. Loose logic switches.

- Use a 9/16" wrench to loosen and remove the nuts and flat washers from both of the reversing neutral stationary contacts on the back of the tap-changer contact panel. See Figure 36.



Figure 36. Reversing neutral stationary contact.

- Pull the reversing movable contact assembly and the reversing neutral stationary contact forward toward the steel front panel as far as possible. See Figure 37.

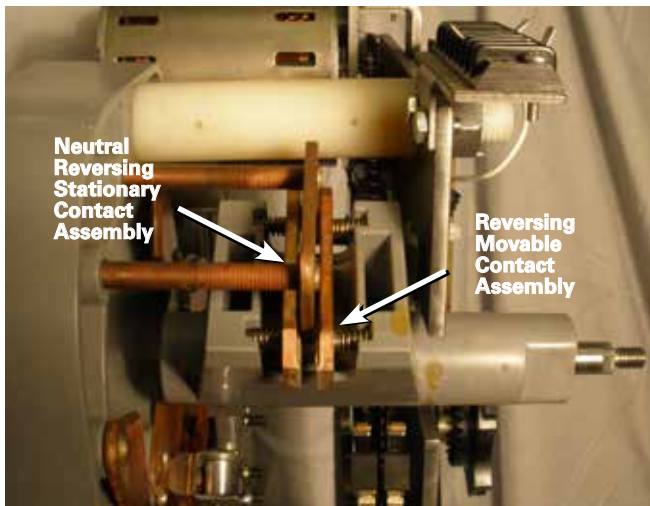


Figure 37. Reversing movable and stationary contacts.

- Rotate the reversing movable contact counter clockwise until the movable contact assembly disengages from the reversing neutral stationary contact and remove it from the tap-changer. See Figure 38.

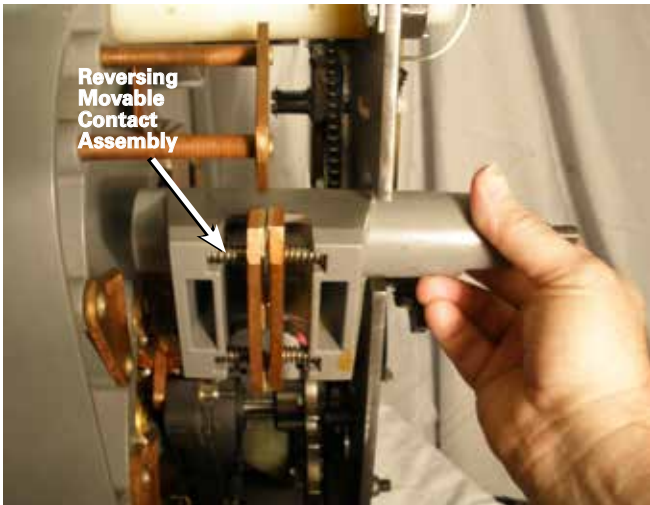


Figure 38. Rotating of reversing movable contact.

- Remove the reversing neutral stationary contact assembly from the tap-changer contact panel.

- Remove the reversing actuator shaft from the reversing movable contact assembly and retain for use in the new contact assembly. See Figure 39.



Figure 39. The actuator shaft removed from the reversing movable contact assembly.

Reassembly

- Insert the reversing actuator shaft into the new reversing movable contact assembly. See Figure 39.
- Place the reversing movable contact into the mounting slot in the tap-changer front panel, aligning the movable contact assembly with the reversing neutral stationary contact. The reversing neutral stationary contact should be inserted far enough into the contact board so that the blade lines up with the center of the reversing movable contacts. See Figure 40.

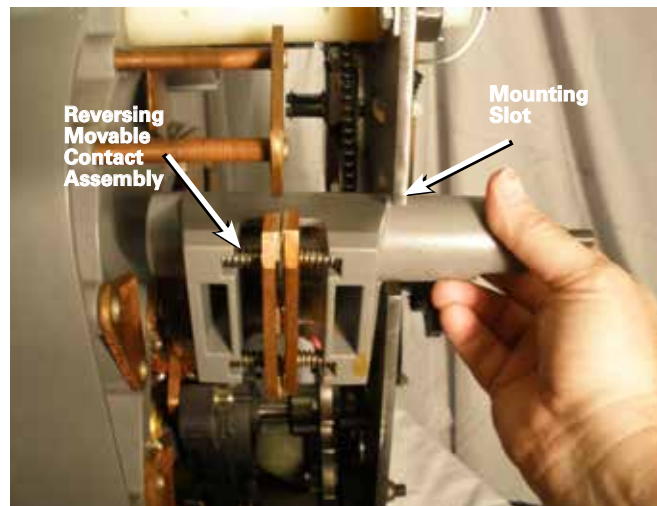


Figure 40. Reinstalling reversing movable contact.

14. Insert a standard flat screwdriver between the middle and top button contacts on the reversing movable contact assembly and twist to separate. Line up the movable and stationary contacts and rotate the reversing movable contact assembly clockwise over the reversing stationary contact. See Figure 41.



Figure 41. Positioning reversing movable contacts.

16. Slide the stationary and movable contact assembly toward the contact panel. Align the movable contact assembly so that the reversing movable tube aligns with and goes through the hole in the contact panel. At this point the stationary contact and movable contact should be fully engaged with the contact panel. See Figure 43.

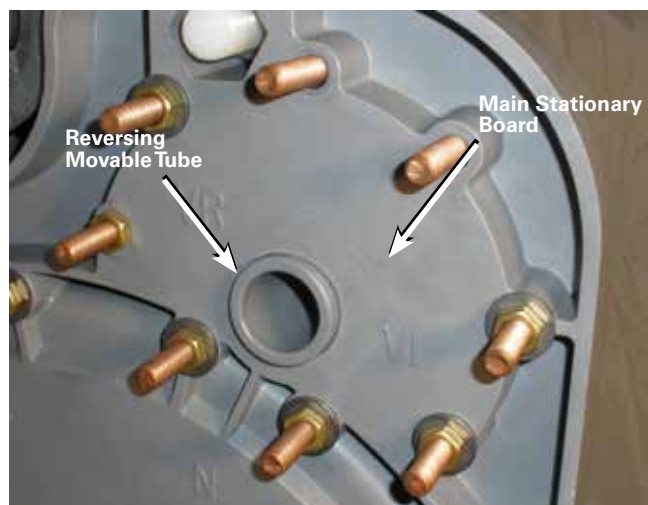


Figure 43. Aligning with main contact board.

15. Continue to reposition the screwdriver, separate the button contacts and rotate the reversing movable contact assembly until the middle button contact is fully engaged in the center of the reversing stationary contact blade. See Figure 42.

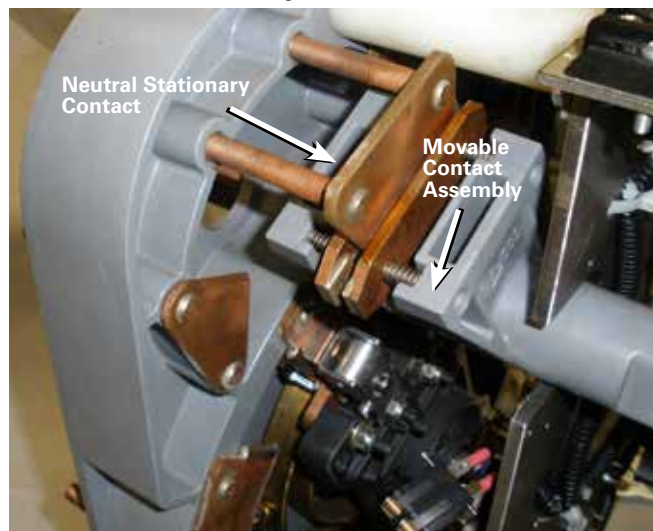


Figure 42. Engaging contacts.

17. Place a flat washer and nut over each of the reversing neutral stationary contact studs. Tighten to a torque of 80–90 in-lbs (9.0–10.2 Nm). See Figure 44.



Figure 44. Reinstalling neutral stationary and hardware.

- Place the mounting hardware onto the reversing logic switches and fasten to the tap-changer front plate. While holding a small screwdriver (or 5/32" Allen wrench), tighten the nuts to a torque of 4–5 in-lbs (0.5–0.6 Nm). See Figure 45.

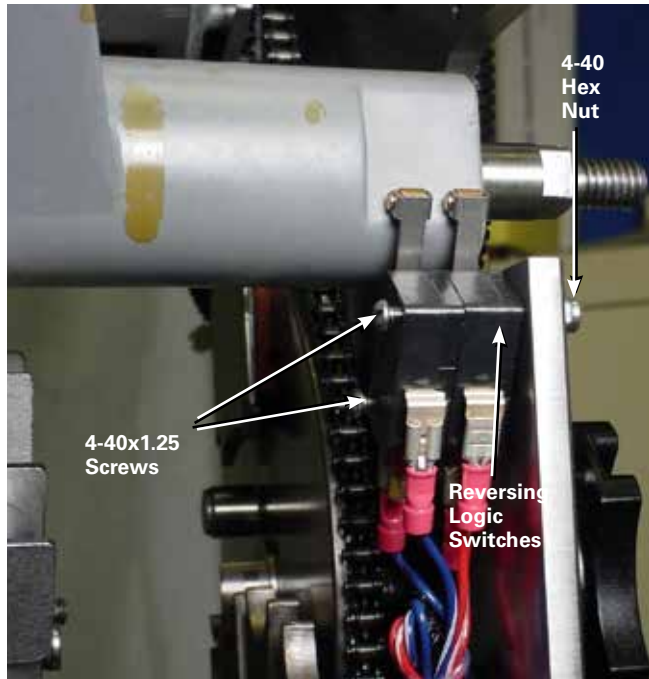


Figure 45. Reinstalling logic switches.

- If none is present on the threads, apply Loctite® 243™ threadlocker to the two 1/4-28 bolts. Using the bolts and a 7/16" wrench, fasten the reversing movable bushing to the front of the tap-changer. Tighten the bolts to a torque of 30–40 in-lbs (3.4–4.5 Nm). See Figure 46.

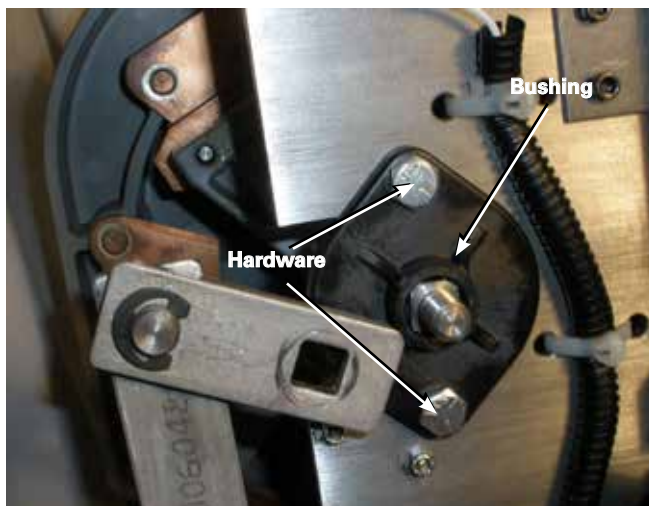


Figure 46. Reinstalling bushing.

- Place the reversing segment arm onto the reversing actuator shaft. Align the square portion of the shaft with the square hole in the arm. If needed, place a screwdriver through the movable contact tube and push the shaft forward while seating the arm over the shaft. It may be necessary to rotate the movable contact assembly slightly to align the shaft and hole. See Figures 47 and 48.

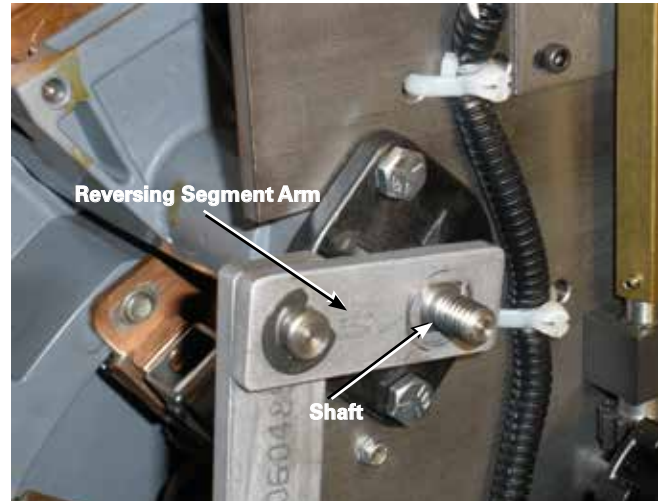


Figure 47. Installing reversing segment arm.



Figure 48. Positioning the reversing movable with the bushing.

21. Place the self-locking nut onto the reversing segment shaft and then tighten with a 9/16" wrench, while holding the reversing switch assembly to prevent it from moving. The nut should be tightened to a torque of 180 to 192 lb-ins (20.3 to 21.6 Nm). See Figure 49.

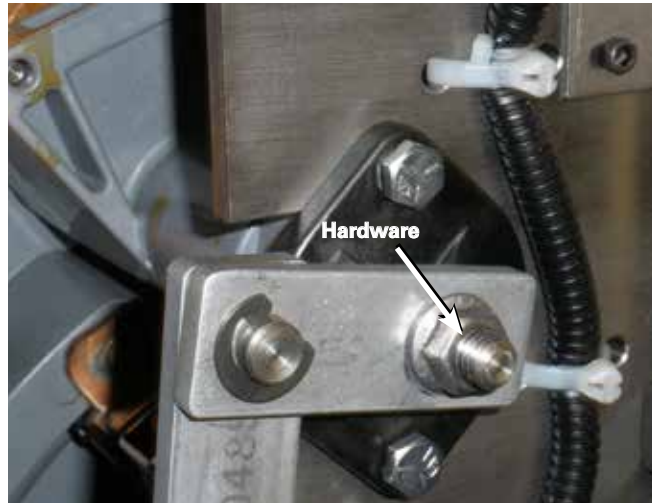


Figure 49. Fastening reversing segment.

22. Once the work has been completed place the tap-changer in the neutral position.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position:
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 50.

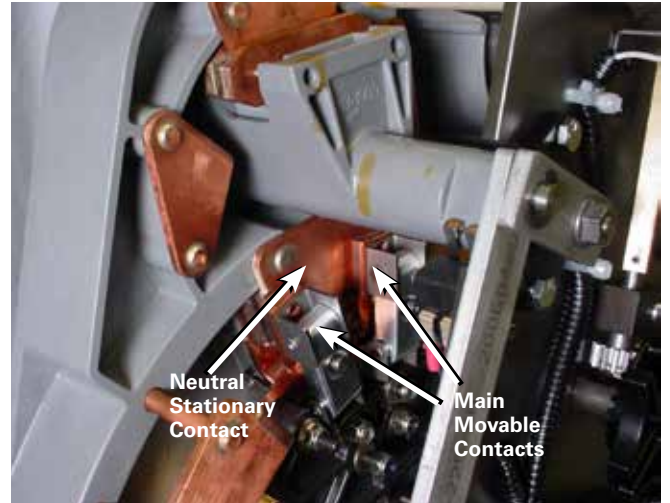


Figure 50. Neutral stationary contact position for main movable contacts.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 51.

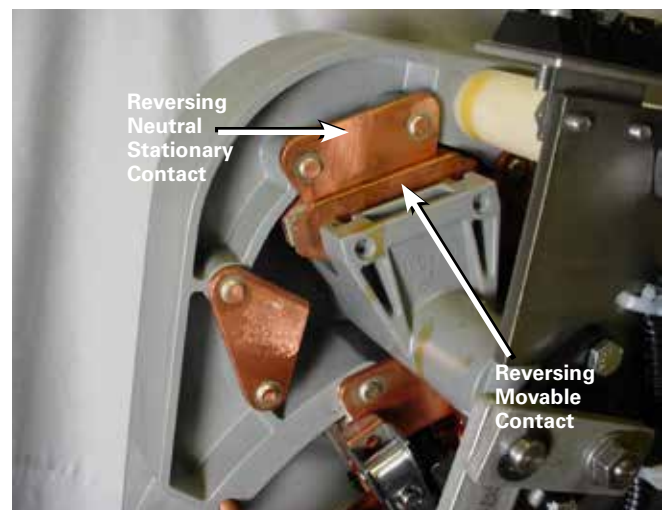


Figure 51. Neutral position for reversing movable.

C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 52.

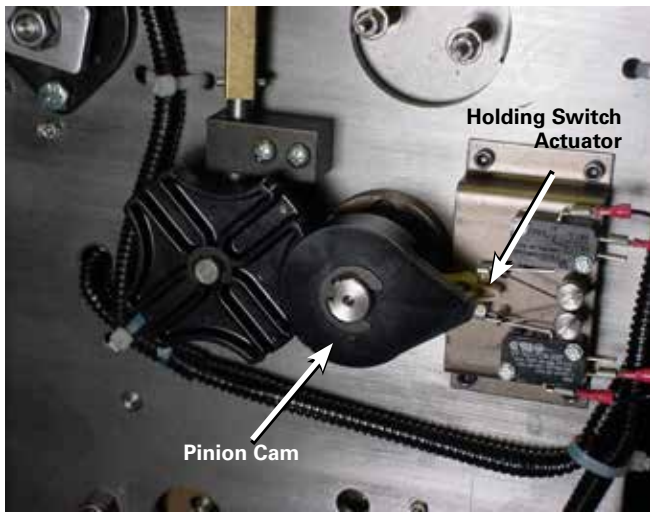


Figure 52. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer reversing neutral stationary contact assembly kit number 5791646A26

(Refer to service Information MN225025EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacement of the reversing neutral stationary contact on a QD5 Quik Drive tap-changer

Parts supplied

Item	Part Number	Description	Qty
1	0791646A26	Reversing Neutral Stationary Contact	1



Figure 53. Reversing neutral stationary contact.

Tools required

- Ratchet Wrench
- 3/8 inch Socket
- 7/16 inch Socket
- 9/16 inch Deep-well Socket
- Torque Wrench, in-lbs
- Small flat-blade Screwdriver or 5/32 inch Allen Wrench
- 8" Long flat-blade Screwdriver
- Loctite® 243™ Threadlocker

Installation procedure

Removing existing contact assembly

Note: Retain all hardware.

1. Hold the reversing movable contact assembly to prevent it from moving. Using a 9/16" wrench, loosen and remove the reversing actuator arm nut. See Figure 54.

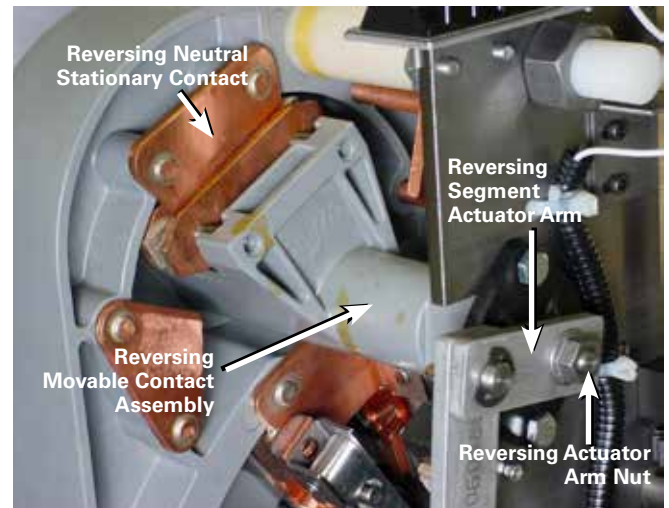


Figure 54. Reversing actuator arm nut removal.

2. Lift outward on the reversing actuator arm and remove it from the reversing movable contact bushing. The reversing actuator shaft may be tapped in to allow clearance to remove the arm. See Figures 55 and 56.

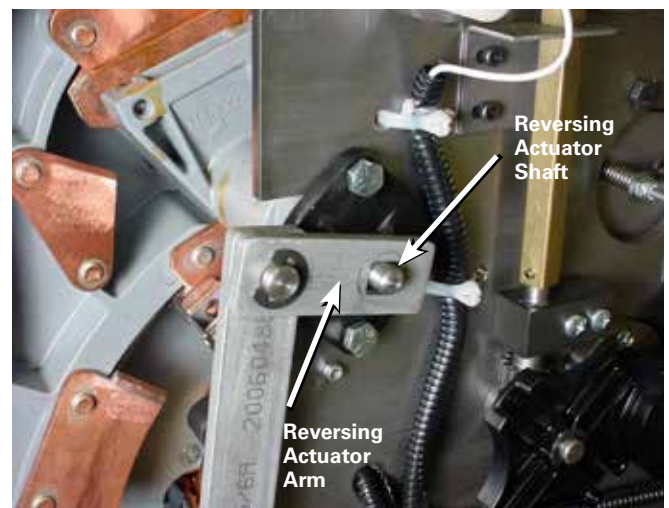


Figure 55. Reversing actuator arm removal.

3. Using a 7/16" wrench, loosen and remove both bushing-mounting bolts. See Figure 56.

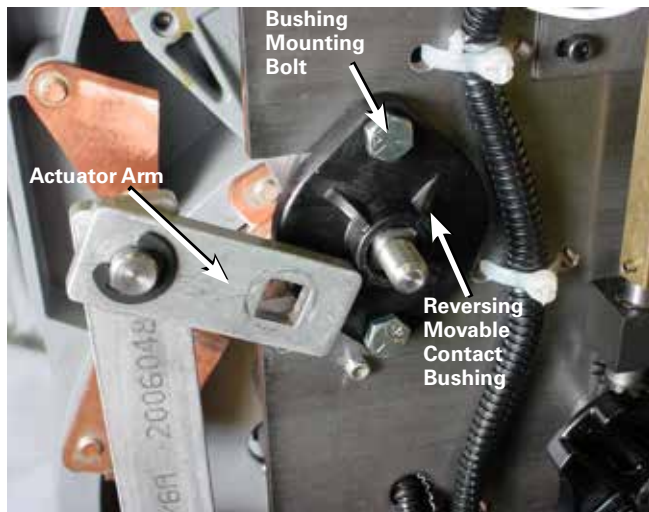


Figure 56. Reversing actuator arm removed.

5. Using a small screwdriver (or 5/32" Allen wrench) and a 1/4" wrench, loosen and remove the self-locking nuts and reversing logic switch mounting screws. See Figures 58 and 59.

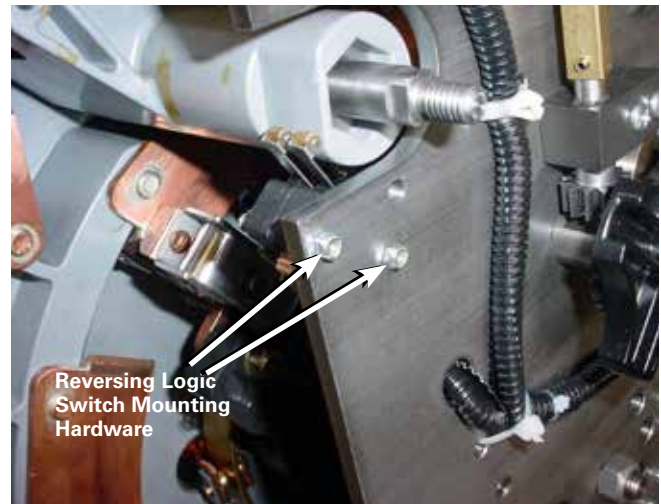


Figure 58. Logic switch removal.

4. Remove the bushing from the reversing actuator shaft. See Figure 57.

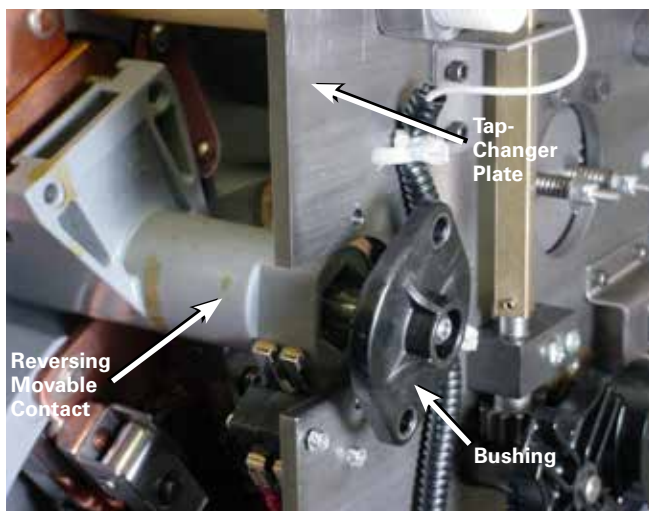


Figure 57. Removing reversing movable contact bushing.

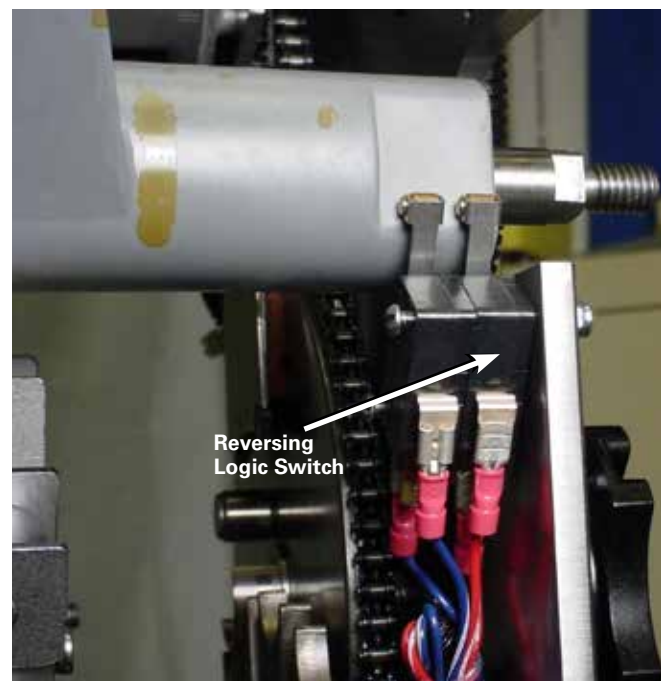


Figure 59. Reversing logic switch removal.

6. After the removal of the reversing logic switch mounting screws, the switch will drop away from the reversing movable switch tube. See Figure 60.

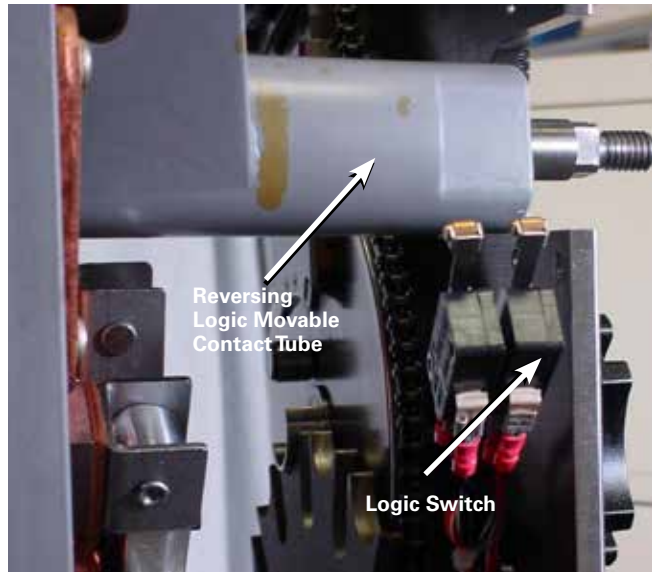


Figure 60. Reversing movable contact switch.

7. Using a 9/16" wrench, loosen and remove the nuts and flat washers from both of the reversing neutral stationary contacts on the back of the tap-changer contact panel. See Figure 61.

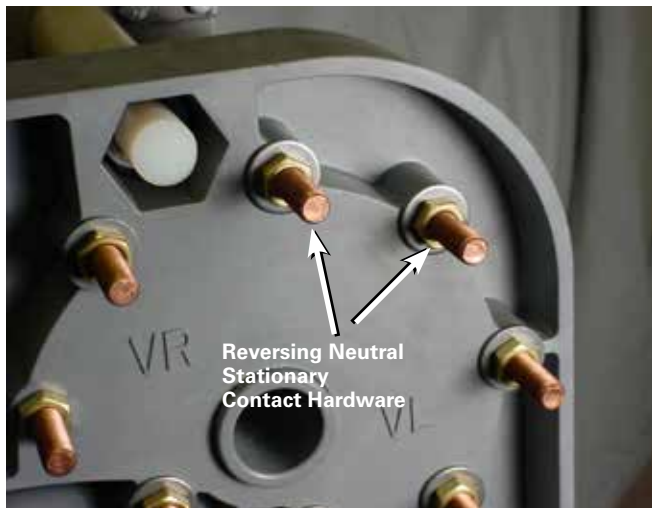


Figure 61. Reversing neutral stationary contact hardware.

8. Pull the reversing movable contact assembly and the reversing neutral stationary contact forward toward the steel front panel as far as possible. See Figure 62.

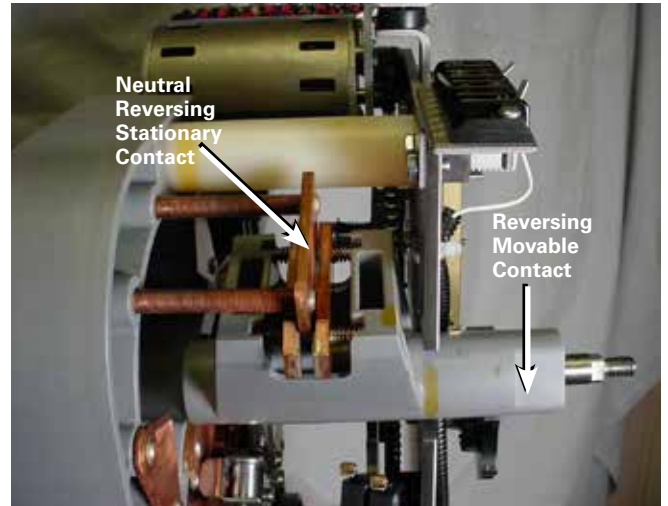


Figure 62. Removing movable contact assembly.

9. Rotate the reversing movable contact counter clockwise until the movable contact assembly disengages from the reversing neutral stationary contact and remove it from the tap-changer. See Figure 63.

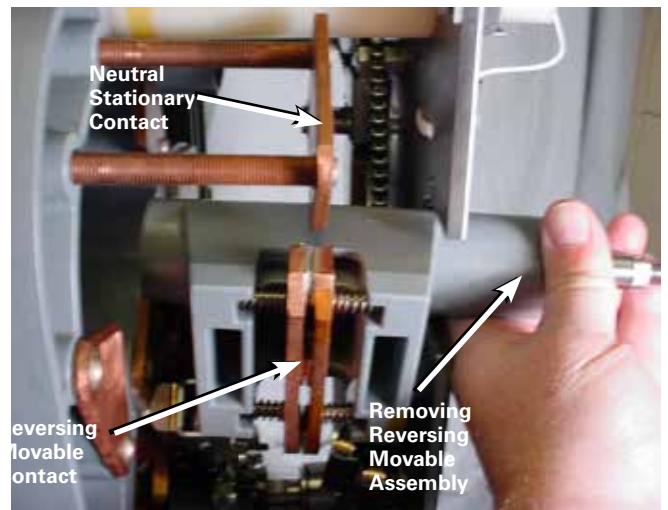


Figure 63. Removing reversing movable contact.

10. Remove the reversing neutral stationary contact assembly from the tap-changer contact panel.

Installing replacement contact and reassembly

1. Place a new reversing neutral stationary contact into the mounting holes in the contact panel. Place the contact assembly so that it is in the board but far enough out so that engagement can be made when installing the reversing movable contact assembly. See Figure 64.

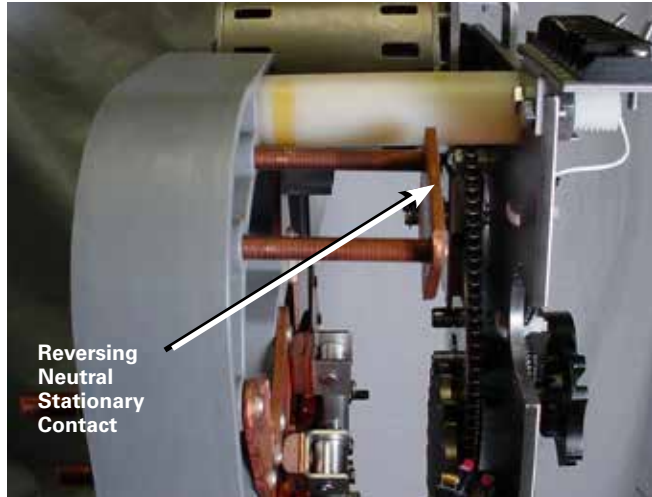


Figure 64. Replacing reversing neutral stationary contact.

2. Insert a standard flat screwdriver between the middle and top button contacts on the reversing movable contact assembly and twist to separate. Line up the movable and stationary contacts and rotate the movable contact assembly clockwise over the reversing stationary contact. See Figure 65.

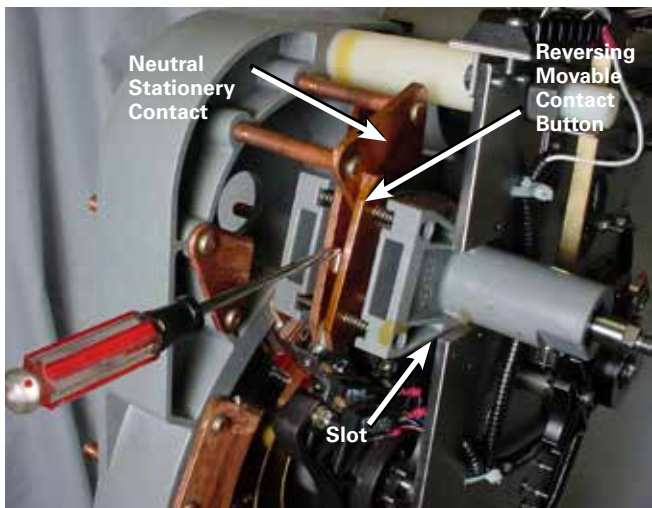


Figure 65. Reassembly of neutral stationary and reversing movable.

3. Continue to reposition the screwdriver, separate the button contacts and rotate the reversing movable contact assembly until the middle button contact is fully engaged in the center of the reversing stationary contact blade. See Figure 66.



Figure 66. Reassembly.

4. Slide the stationary and movable contact assembly toward the contact panel. Align the movable contact assembly so that the reversing movable contact tube aligns and goes through the hole in the contact panel. At this point, the stationary contact and movable contact should be fully engaged with the contact panel. See Figure 67.

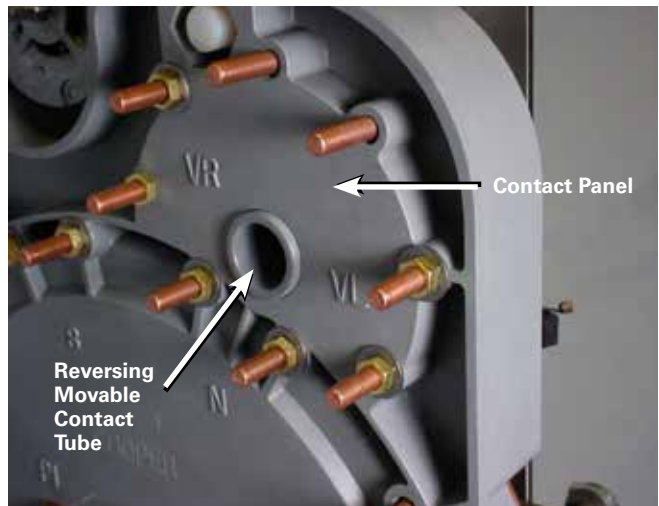


Figure 67. Stationary and movable contact alignment.

- Place a flat washer and nut over each of the reversing neutral stationary contact studs. Tighten to a torque of 80–90 in-lbs (9.0–10.2 Nm). See Figure 68.

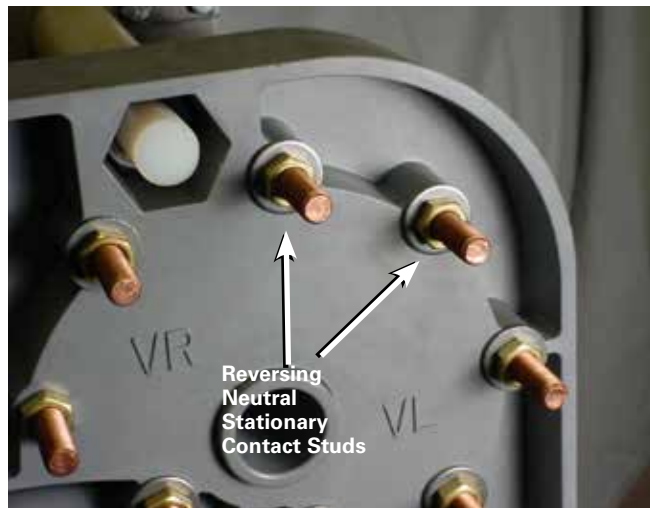


Figure 67. Reversing neutral stationary contact fastening.

- Place the mounting hardware onto the reversing logic switches and fasten to the tap-changer front plate. While holding a small screwdriver, tighten the nuts to a torque of 4–5 in-lbs (0.5–0.6 Nm). See Figure 69.

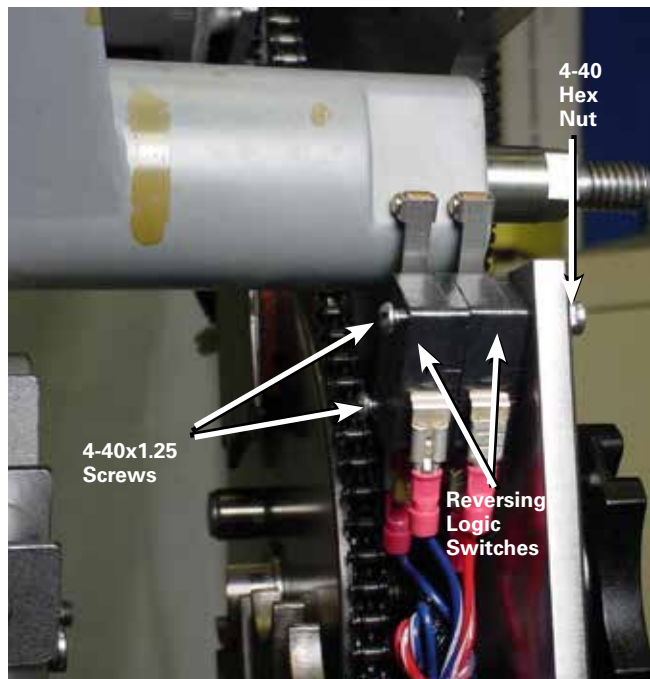


Figure 69. Reversing logic switch mounting.

- If not present on the threads, apply Loctite® 243™ threadlocker to the two 1/4-28 bolts. Using the bolts and a 7/16" wrench, fasten the reversing movable bushing to the front of the tap-changer. Tighten the bolts to a torque of 30–40 in-lbs (3.4–4.5 Nm). See Figure 70.

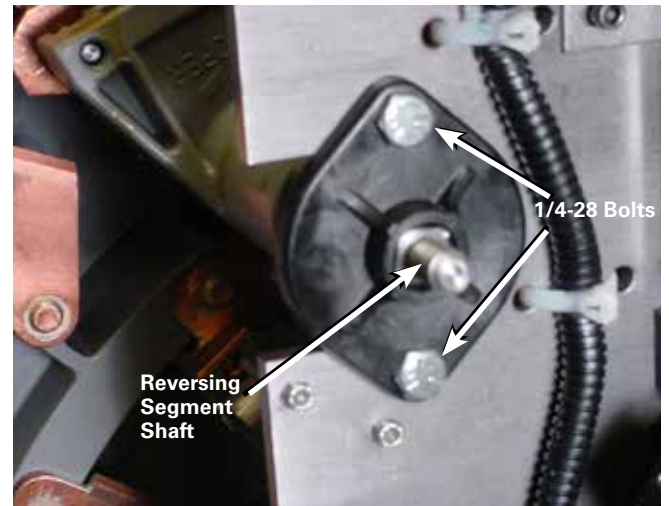


Figure 70. Reversing segment gear shaft.

- Place the reversing segment arm onto the reversing actuator shaft. Align the square portion of the shaft with the square hole in the arm. If needed, place a screwdriver through the movable contact tube and push the shaft forward while seating the arm over the shaft. It may be necessary to rotate the movable contact assembly slightly to align the shaft and hole. See Figures 71 and 72.

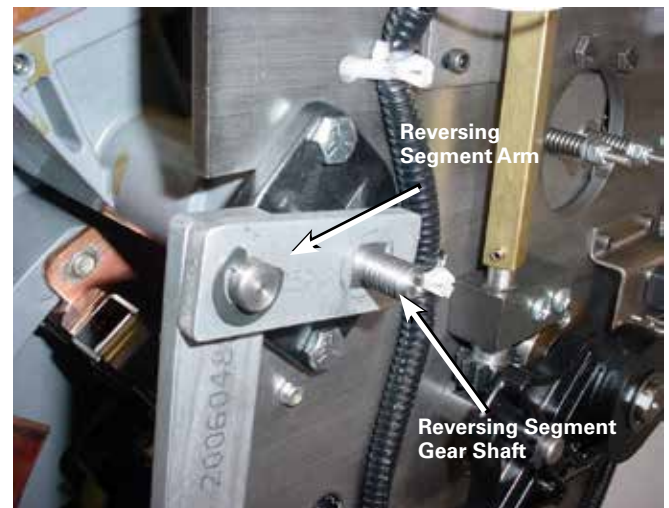


Figure 71. Placement of reversing segment arm.

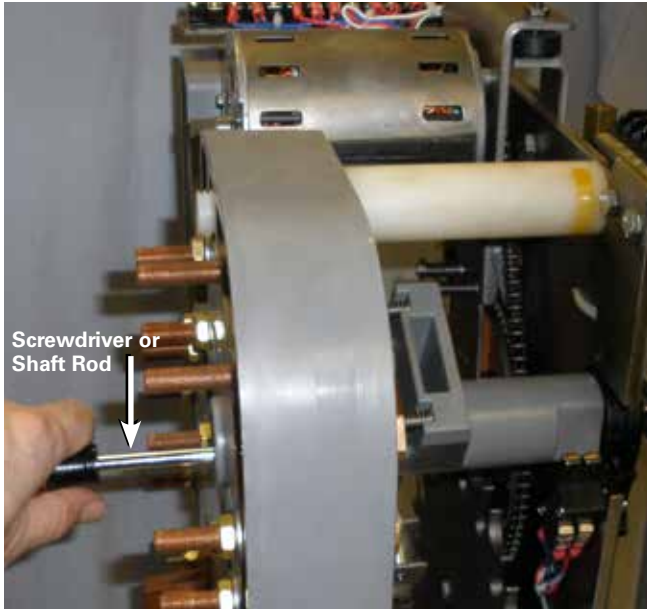


Figure 72. Pushing the reversing segment shaft forward.

9. Place the self-locking nut onto the reversing segment shaft. Using a 9/16" wrench, tighten to a torque of 180–192 in-lbs (20.3–21.7 Nm) while holding the movable contact assembly to prevent turning. See Figure 73.
10. Once the work has been completed, place the tap-changer in the neutral position.

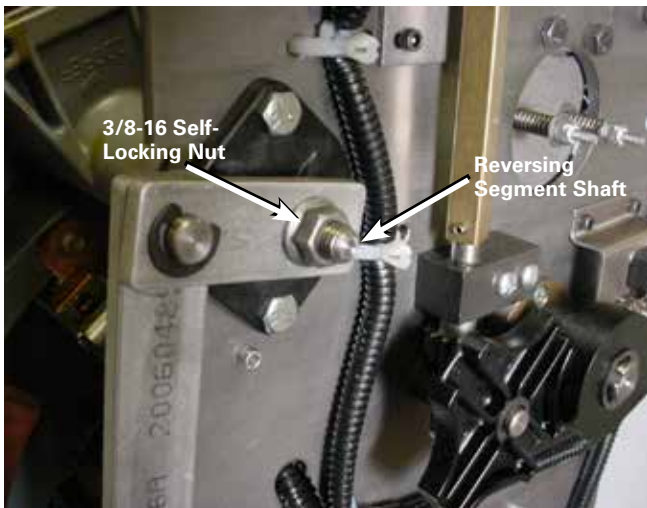


Figure 73. Reversing segment fastening.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 74.

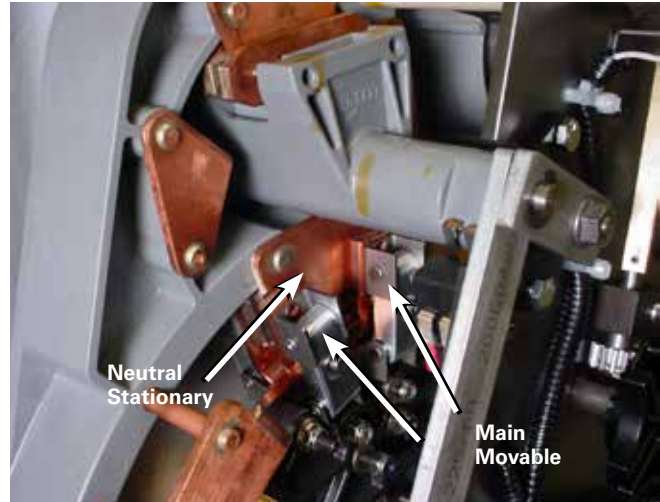


Figure 74. Neutral position for main movable contacts.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 75.

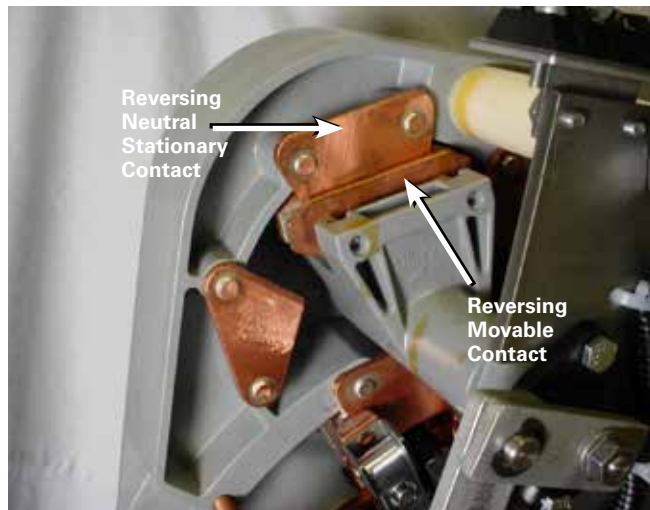


Figure 75. Neutral position for reversing movable.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 76.

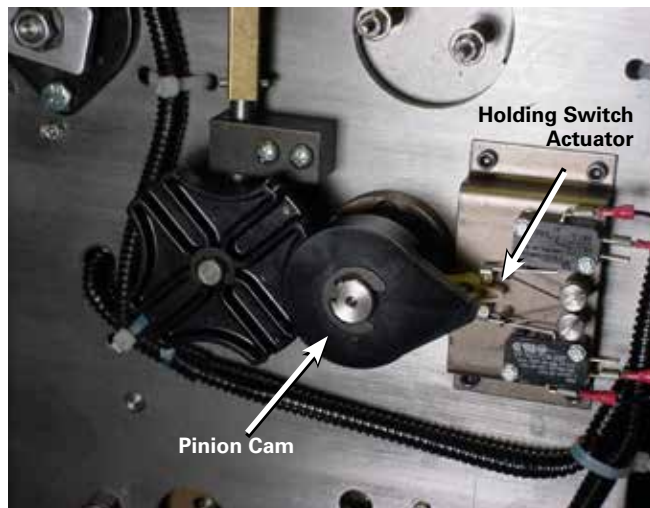


Figure 76. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer main stationary contact assembly kit 5791646A24

(Refer to Service Information MN225026EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacing the main stationary contacts on a QD5 Quik Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	0791646A24	Stationary Contact	1



Figure 77. Main stationary contact.

Tools required

- Ratchet Wrench
- 9/16 inch Deep-well Socket
- Torque Wrench in-lbs
- 3/8 inch Socket

Installation procedure

Stationary contact removal and installation instructions

1. Each QD5 tap-changer has nine main stationary contacts. Of these, eight are tap contacts and one is the neutral stationary contact. See Figure 78.

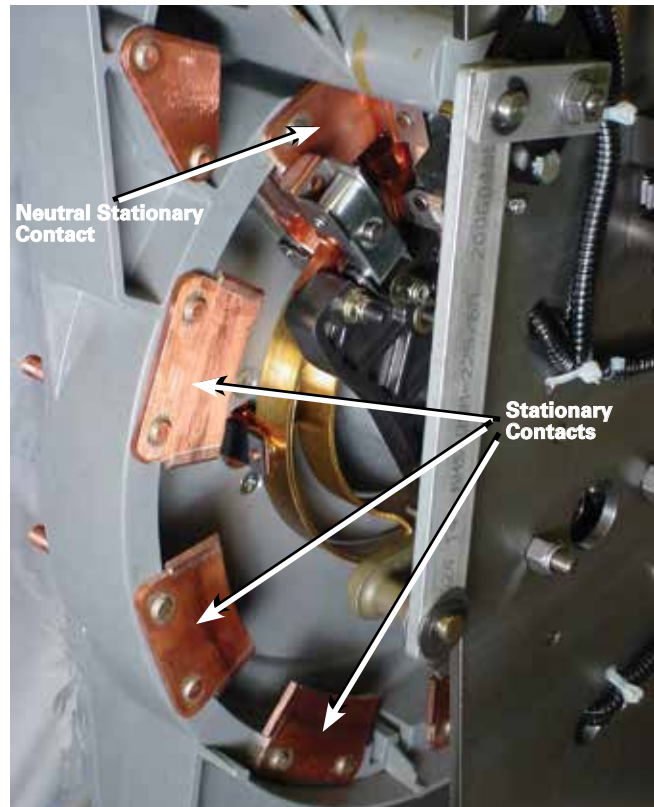


Figure 78. Stationary contacts.

2. Use a 9/16" deep-well socket and ratchet to loosen and remove the nuts and washers from each stationary contact stud. See Figure 79.



Figure 79. Removal of contact hardware.

3. Remove the stationary contact from the contact assembly panel. See Figure 79.
4. Install the new stationary contact into the mounting holes in the contact assembly board for the contact being replaced. See Figure 80.



Figure 80. Stationary contact removal.

5. Place a flat washer and nut on each stud. Use a 9/16" deep-well socket and ratchet to tighten the nuts. Using a torque wrench, tighten the nuts to a torque of 80–90 in-lbs (9.0–10.2 Nm). See Figure 81.



Figure 81. Contact hardware installation.

6. Repeat Steps 1 through 5 for each stationary contact to be replaced.
7. When the movable contacts are located on the stationary contact to be replaced, the movable contacts must be moved. Place a 3/8" socket onto the rear shaft of the motor. See Figure 82. Using a ratchet, rotate the motor to position the movable contacts off of the contact to be replaced.

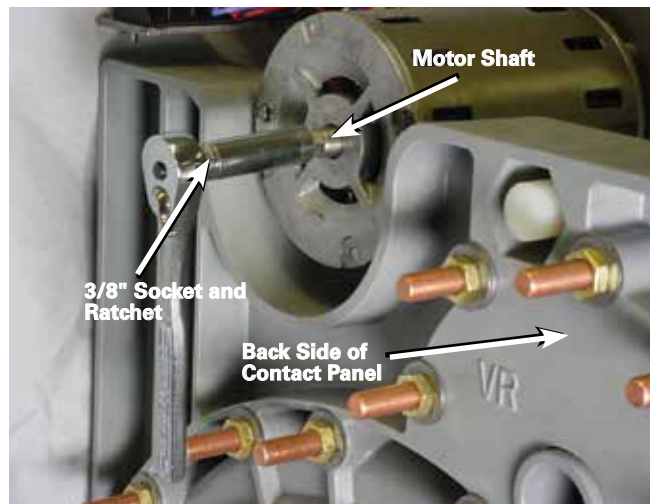


Figure 82. Motor and movable contact rotation.

8. Once the work has been completed, place the tap-changer in the neutral position.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 83.

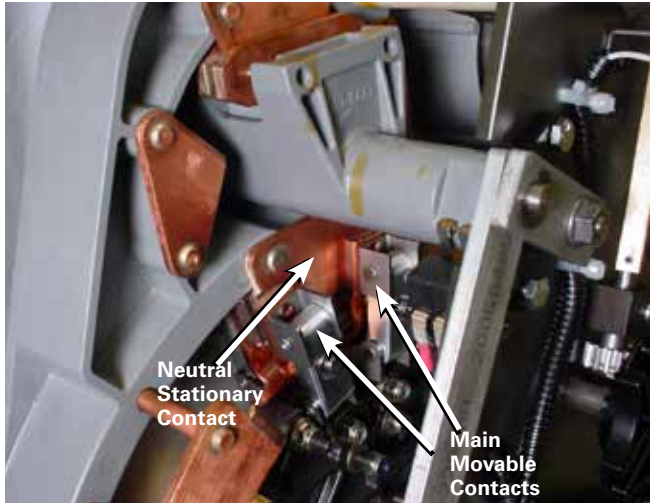


Figure 83. Neutral position for main movable contacts.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 84.

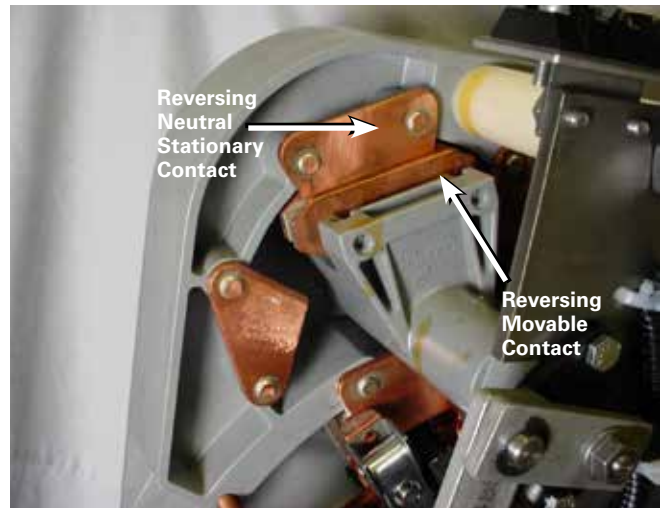


Figure 84. Neutral position for reversing movable.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 85.

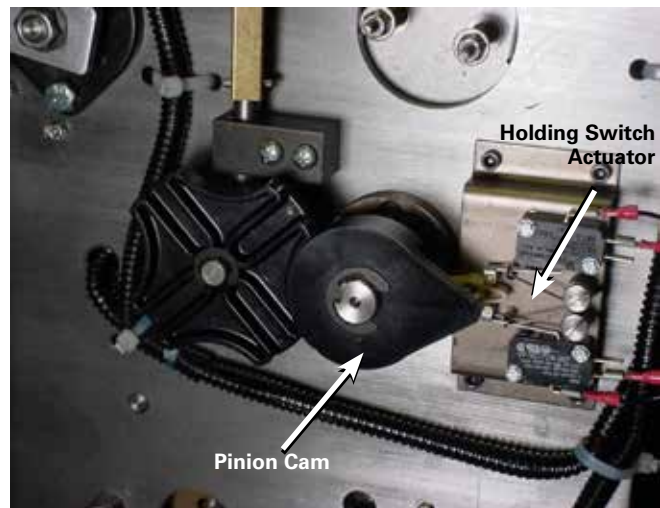


Figure 85. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer VL reversing stationary contact assembly kit number 5791646A25

(Refer to Service Information MN225027EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacement of the VL reversing stationary contacts on a QD5 Quik Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	0791646A25	VL Reversing Stationary Contact	1



Figure 86. VL reversing stationary contact.

Tools required

- Ratchet Wrench
- 9/16 inch Deep-well Socket
- Torque Wrench in-lbs
- 3/8 inch Socket

Installation procedure

VL reversing stationary contact removal and installation

1. Each QD5 tap-changer has one VL reversing stationary contact. See Figure 87.

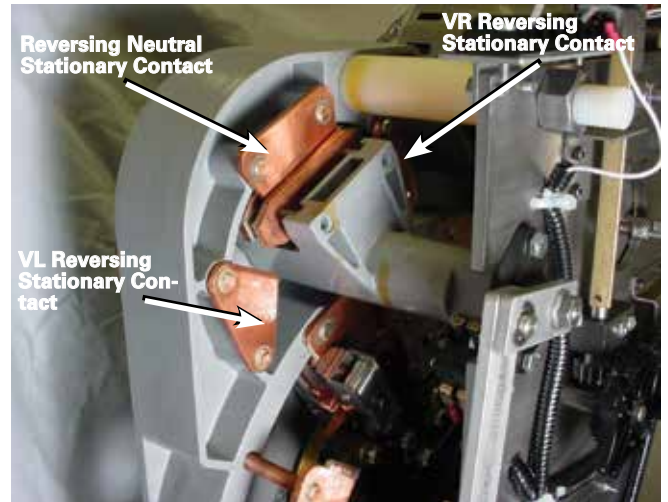


Figure 87. VL reversing stationary contact location.

2. If the reversing movable contacts are setting on the VL reversing stationary contact, place a 3/8" socket onto the rear shaft of the motor. See Figure 88. Using a ratchet, rotate the motor shaft counter-clockwise to move the reversing movable contacts off of the reversing stationary contact. It may be necessary to rotate the tap changer through several positions before the movable reversing contact will begin to move.

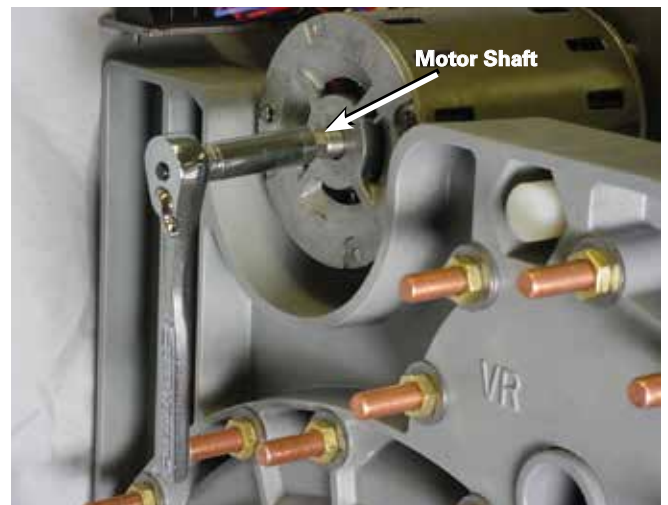


Figure 88. Motor and reversing movable contact rotation.

- To remove a VL Reversing Stationary Contact, use a 9/16" socket and ratchet to loosen and remove the nuts and flat washers from each of the contact studs. See Figure 89.



Figure 89. VL reversing stationary hardware and ID.

- Remove the VL reversing stationary contact from the contact assembly panel. See Figure 90.

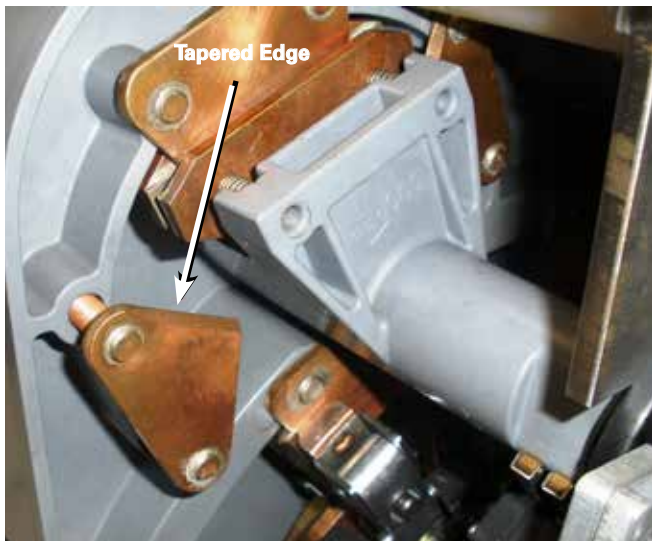


Figure 90. VL reversing stationary contact removal.

- Install the new VL reversing stationary contact into the mounting holes in the contact assembly board. Make sure when installing the contact that the leading tapered edge is positioned toward the reversing neutral stationary contact. If the tapered edge is facing in the wrong direction, the stationary VR contact is being used. See Figure 90.
- Place a flat washer and nut on each stud. Use a 9/16" socket and ratchet to tighten the nuts on each contact stud. Using a torque wrench tighten the nuts to a torque of 80–90 in-lbs (9.0–10.2 Nm). See Figures 91.

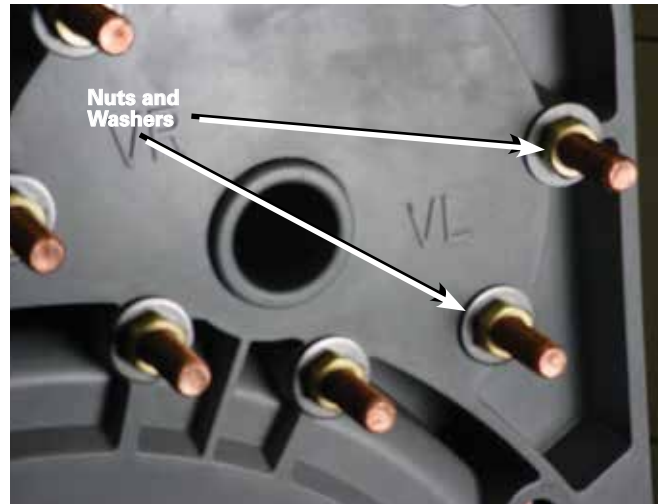


Figure 91. VL reversing stationary hardware.

- Once the work has been completed, place the tap-changer in the neutral position.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 92.

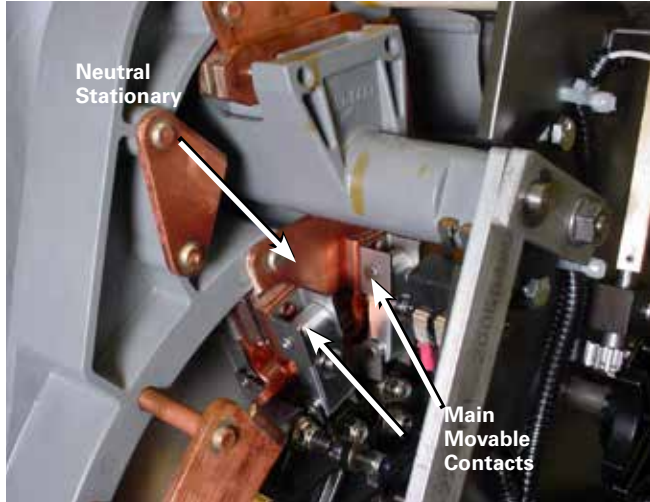


Figure 92. Neutral position for main movable contacts.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 93.

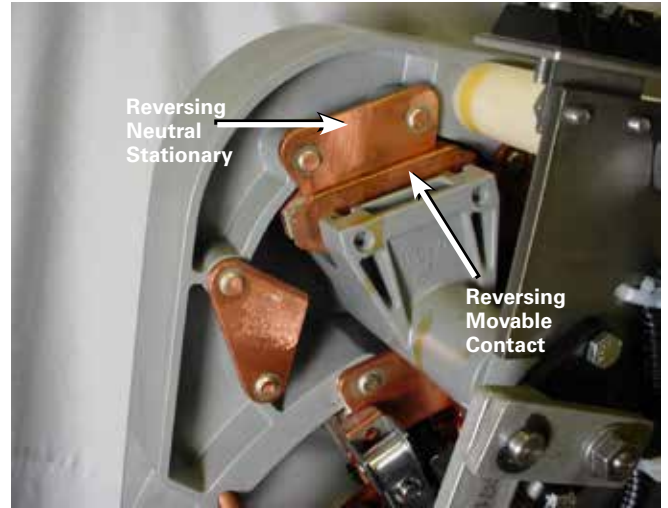


Figure 93. Neutral position for reversing movable contact.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 94.

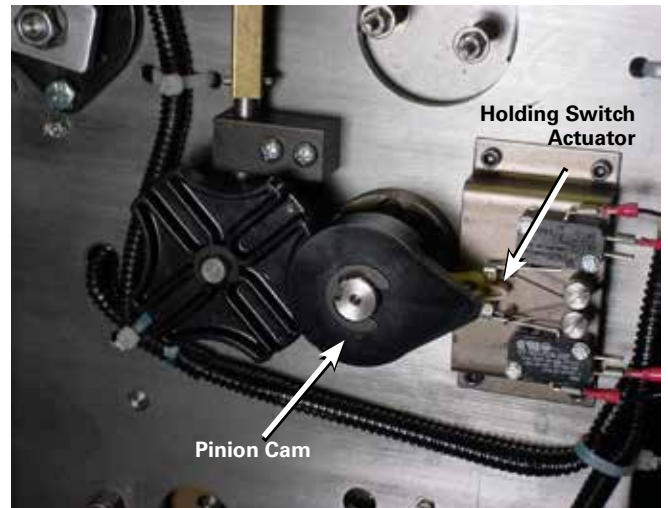


Figure 94. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer VR reversing stationary contact assembly kit number 5791646A27

(Refer to Service Information MN225028EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacing the VR reversing stationary contacts on a QD5 Quik Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	0791646A27	VR Reversing Stationary Contact	1



Figure 95. VR reversing stationary contact.

Tools required

- Ratchet Wrench
- 9/16 inch Deep-well Socket
- Torque Wrench in-lbs
- 3/8 inch Socket

Installation procedure

VR reserving stationary contact removal and installation

1. Each QD5 tap-changer has one VR reversing stationary contact. Note that in the photo, the nylon separating bar has been removed. It is not necessary to remove the bar to perform these steps. See Figure 96.

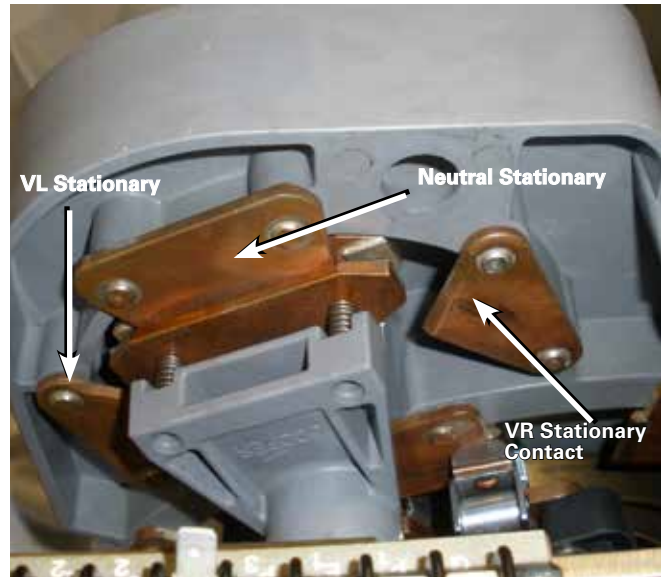


Figure 96. Reversing stationary contact.

2. If the reversing movable contacts are located on the VR reversing stationary contact, place a 3/8" socket onto the rear shaft of the motor. See Figure 97. Using a ratchet, rotate the motor shaft clockwise to move the reversing movable contacts off of the reversing stationary contact. It may be necessary to rotate the tap-changer through several positions before the movable reversing contact will begin to move.

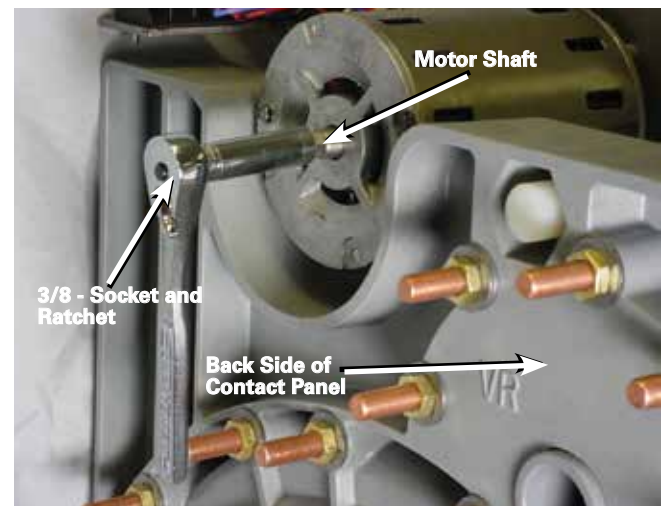


Figure 97. Motor and reversing movable contact rotation.

- To remove a VR Reversing Stationary Contact use a 9/16" socket and ratchet to loosen and remove both the nuts and flat washers from each of the contact studs. See Figure 98.



Figure 98. Reassembling hardware.

- Place a flat washer and nut on each stud. Use a 9/16" socket and ratchet to tighten the nuts on each contact stud. Using a torque wrench tighten the nuts to a torque of 80–90 lb-ins (9.0–10.2 Nm). See Figures 100.



Figure 100. Removing hardware.

- Remove the VR reversing stationary contact from the contact assembly panel. See Figure 106.

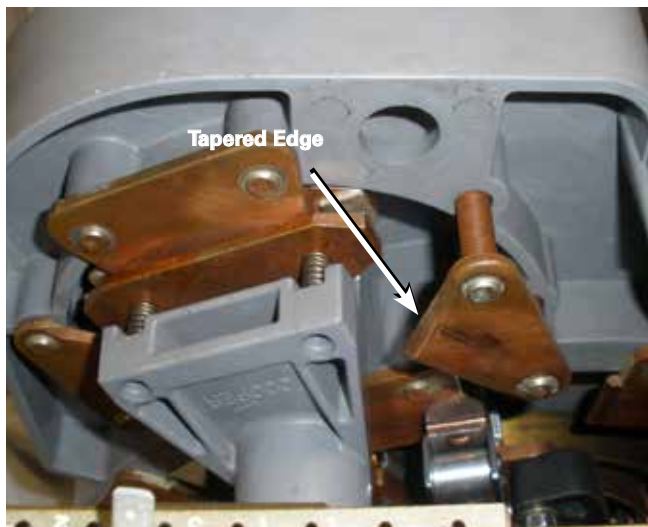


Figure 99. VR reversing stationary contact removal

- Once the work has been completed, place the tap-changer in the neutral position.

- Install the new VR reversing stationary contact into the mounting holes in the contact assembly board. Make sure when installing the contact that the leading tapered edge is positioned toward the reversing neutral stationary contact. If the tapered edge is facing in the wrong direction, the stationary VL contact is being used. See Figure 99.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 101.

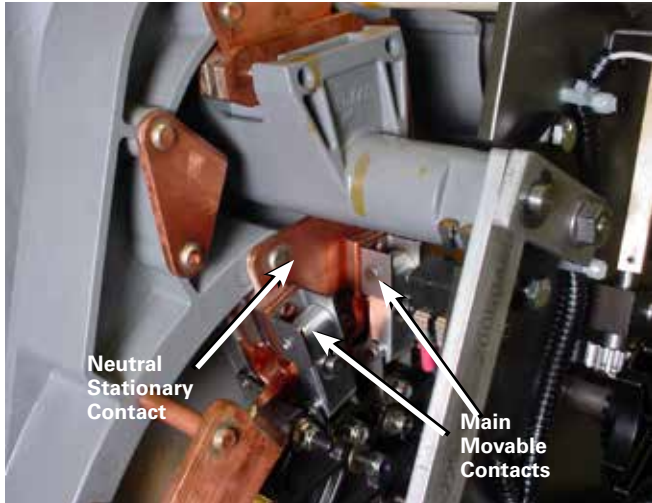


Figure 101. Neutral stationary contact.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 102.

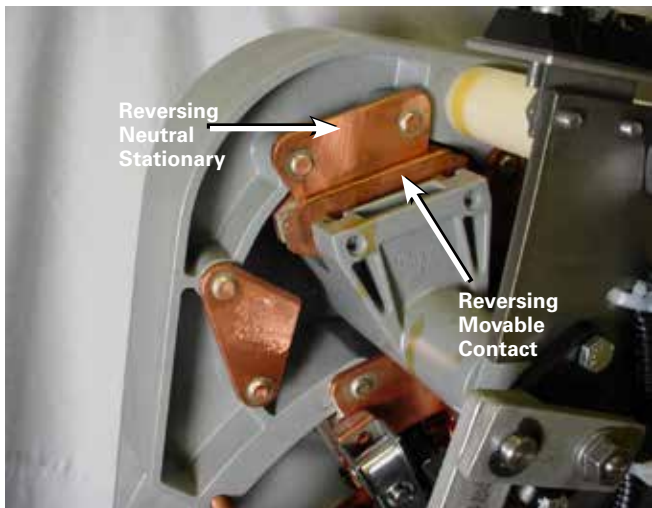


Figure 102. Neutral position for reversing movable.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 103.

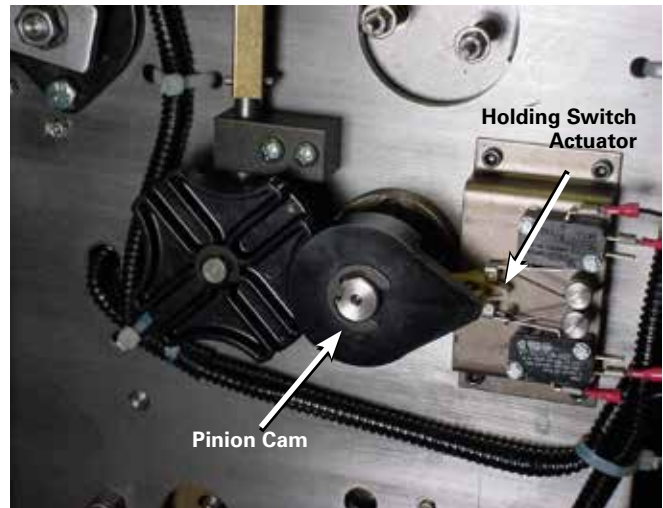


Figure 103. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer motor replacement procedure kit number 57A63675100A

(Refer to Service Information MN225029EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacing the motor on a QD5 Quik Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	2242190B01	QD8/QD5 Motor	1
2	TAA114651003	Ring terminal	3
3	0800011079Z	Wire ties	3
4	2240787B34	Motor sprocket (12-tooth)	1
5	2291647A34	Woodruff key	1
6	0800073173Z	Retaining ring	2
7	0800073190Z	Machine screw, 8-32x0.5	4
8	2240787B44	Motor sprocket (11-tooth)	1



Figure 104. Tap-changer motor replacement kit.

Tools required

- Ratchet Wrench
- 9/16 inch Socket
- 3/4 inch Socket
- 7/16 inch Combination Wrench
- 1/4 inch Socket
- 3/8 inch Socket
- Phillips Head Screwdriver #2
- Standard Blade Screwdriver
- Diagonal Cutters
- Loctite® 243™ Threadlocker
- External Snap Ring Pliers
- 0-200 in-lbs (0-25 Nm) Torque Wrench
- Crimping Tool
- Pliers

Installation procedure

1. The QD5 tap-changer should be secured to a bench before starting the replacement procedure if the tap-changer has been removed from the unit.
2. The tap-changer should be in the neutral position before starting the replacement procedure. Refer to Figure 105. If the tap-changer is not in the neutral position, turn the back of the motor shaft using a 3/8" socket on a ratchet until the tap-changer is in the neutral position.

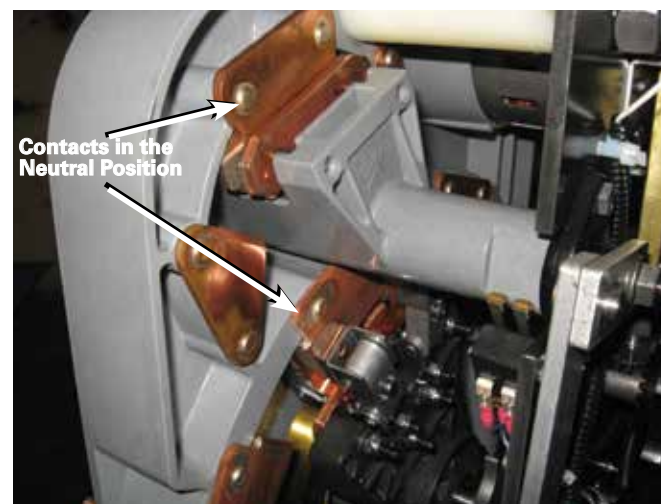


Figure 105. Neutral position.

3. Use diagonal cutters to cut the four wire ties from the motor wires. Refer to Figure 106.

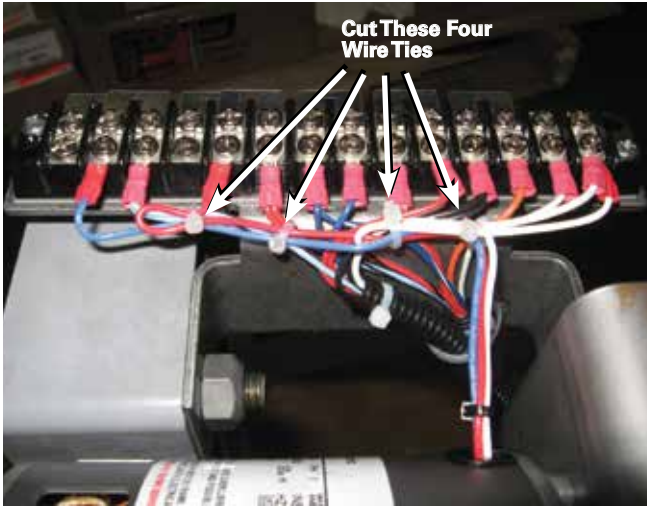


Figure 106. Removal of wire ties.

4. Use a Phillips screwdriver to disconnect the white motor wire located on terminal "G"; the red motor wire located on terminal #5 and the blue motor wire located on terminal #2. Refer to Figure 107.

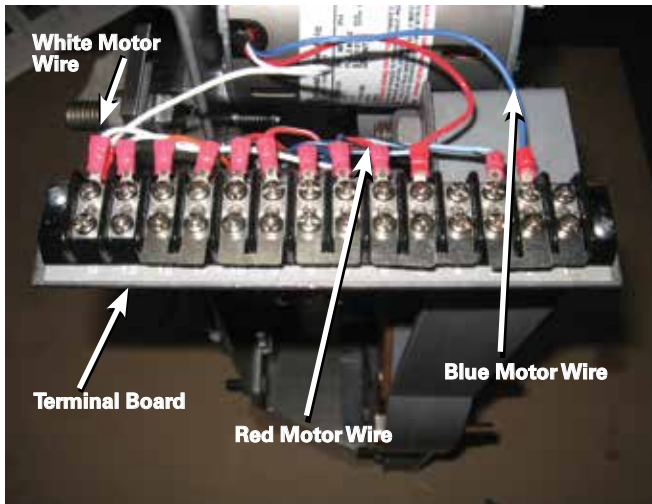


Figure 107. Disconnection of wires.

5. Loosen the jam nut on the chain tension screw with a 7/16" wrench. Loosen the chain tension screw with a screwdriver until the rubber bumper is against the motor mounting bracket. Refer to Figure 108.

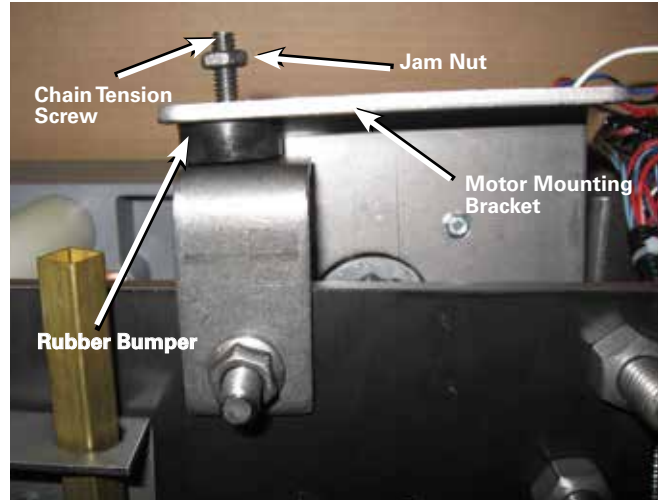


Figure 108. Loosening the chain tension.

6. If the tap-changer has a motor pivot stud design with a lock nut as shown in Figure 109, remove the motor pivot stud lock nut with a 9/16" socket on a ratchet. Pull the motor off of the motor pivot stud; make sure the Belleville washer stays on the motor pivot stud and does not fall into the tank. Set the motor in the motor relief area of the molded back panel. Refer to Figure 113.

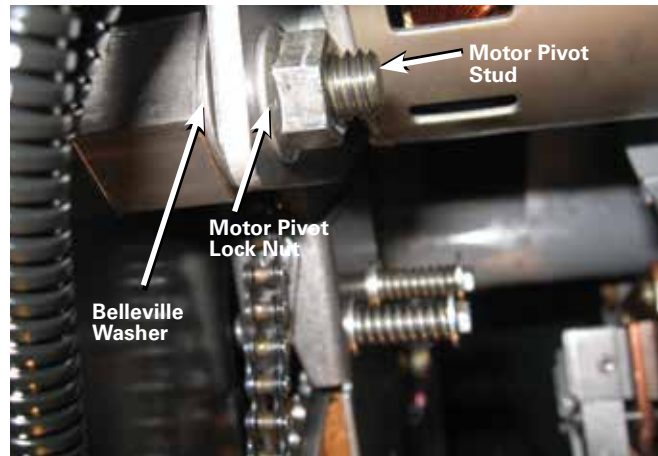


Figure 109. Motor pivot stud design.

7. If the tap-changer has a motor pivot bolt design as shown in Figure 110, remove the motor pivot bolt with a 3/4" socket on a ratchet; make sure the fiber washer does not fall off the motor pivot bolt and into the tank. Set the motor in the motor relief area of the molded back panel. Refer to Figure 111.

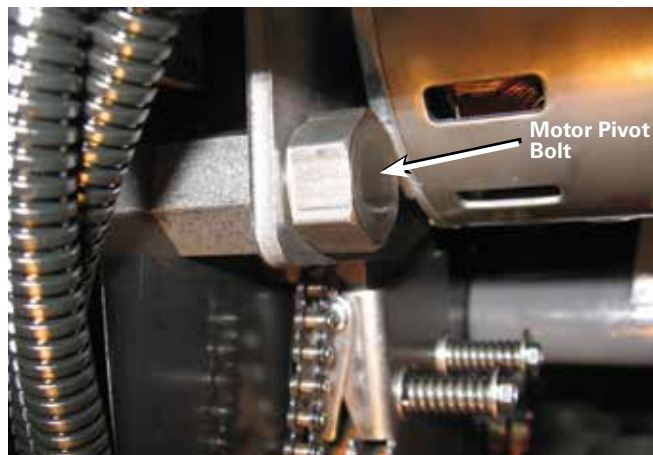


Figure 110. Motor pivot bolt design.

8. Remove the chain from the motor sprocket and set it on the brake assembly. This will prevent the chain from falling in between the Geneva gear and sprocket. Refer to Figure 112. Remove the motor from the tap-changer assembly.

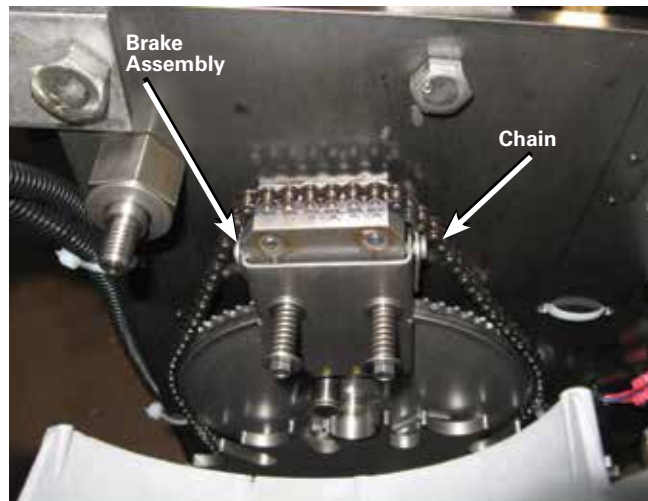


Figure 112. Removal of the chain.

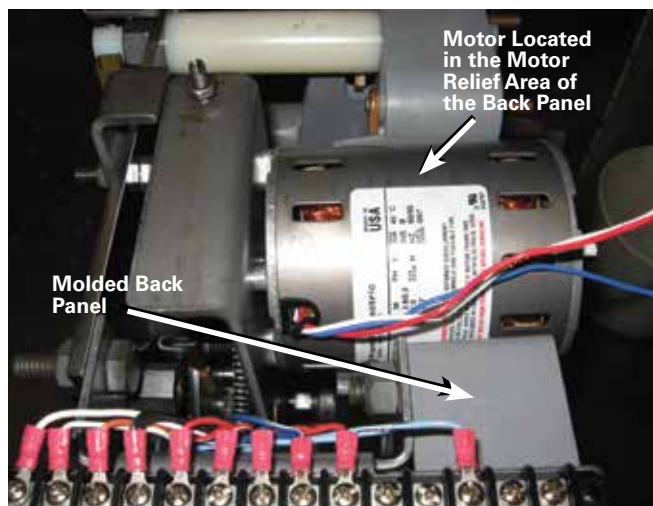


Figure 111. Removal of the motor.

9. Remove the four screws securing the motor to the motor mounting plate using a 1/4" socket on a ratchet. Remove the motor mounting plate from the old motor. Refer to Figure 113.

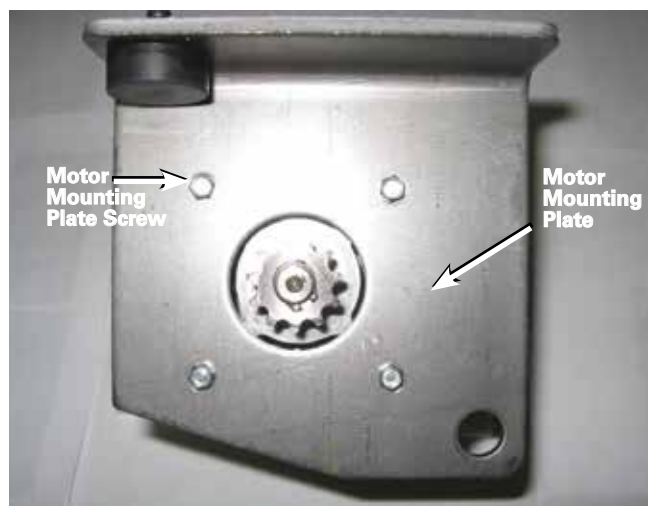


Figure 113. Removal of the motor plate.

- The new motor kit (Part # 57A636751A100A) has a 12 tooth sprocket for the QD8 tap-changer and an 11 tooth sprocket for the QD5 tap-changer. The motor shaft has two snap ring grooves and a woodruff keyway. Install a snap ring with a snap ring pliers into the inner snap ring groove behind the woodruff keyway. Using a pliers, put the woodruff key into the keyway with the woodruff key tilted down towards the end of the motor shaft. Refer to Figure 114.

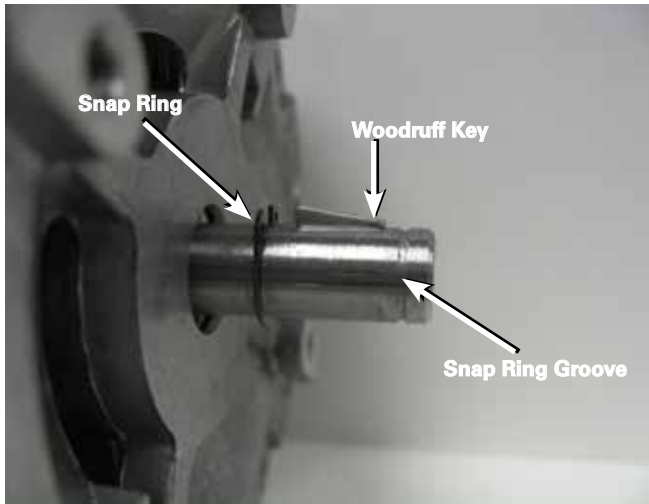


Figure 114. Woodruff key placement.

- Align the sprocket keyway with the woodruff key on the motor shaft. Slide the sprocket onto the motor shaft with the sprocket hub end towards the motor. Install the second snap ring into the outer snap ring groove using a snap ring pliers. Refer to Figure 115.

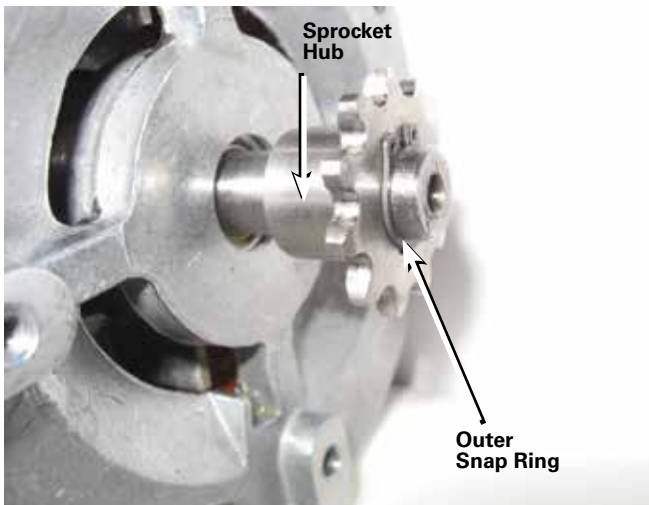


Figure 115. Placement of the sprocket.

- Use a 1/4" socket on a ratchet to attach the motor mounting plate to the new motor using the new motor mounting plate screws provided in the motor replacement kit. Do not fully tighten. Make sure the motor wires are extending out of the top right of the motor when looking at the motor from the sprocket end. Refer to Figure 116. Using a torque wrench, now tighten the motor plate mounting screws to 18–20 lb-ins (2.0–2.2 Nm).

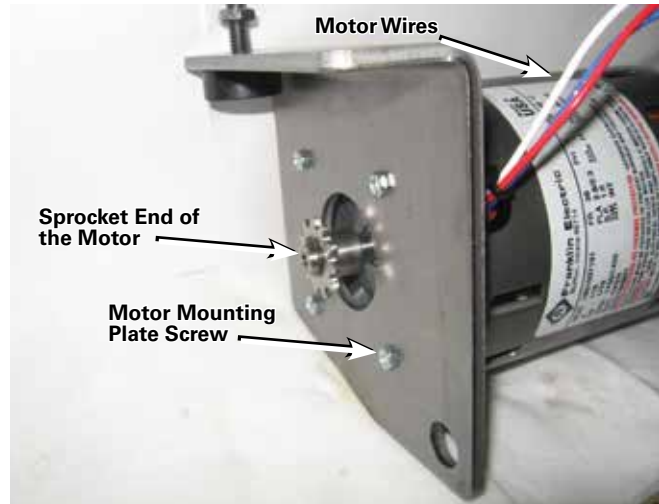


Figure 116. Motor mounting plate.

- Place the motor into the motor relief area of the molded back panel. Put the chain on the motor sprocket engaging the sprocket teeth. Make sure the chain is fully engaged around the bottom of the drive sprocket gear. If there are any loose links around the bottom of the gear, the motor will not fit properly. Refer to Figure 117.

Note: If you have the motor pivot stud design as shown in Figure 113, follow Step 13. If you have the motor pivot bolt design as shown in Figure 114, follow Step 14.

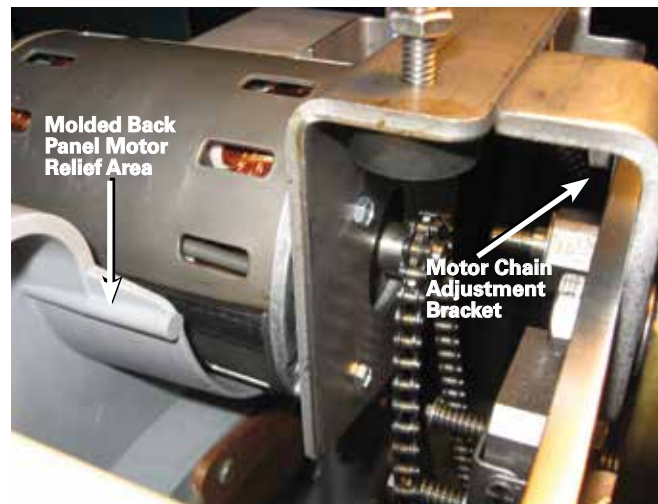


Figure 117. Locating motor.

14. Move the motor assembly into position with the motor chain adjustment screw bumper located on top of the adjustment bracket and the motor pivot stud inserted through the mounting hole in the motor mounting plate. Secure the motor mounting plate to the motor pivot stud with the locknut removed in Step 6. Refer to Figures 118 and 119. Using a torque wrench with a 9/16" socket, tighten the pivot motor stud locknut to 180–192 in-lbs (20.0–21.1 Nm). Proceed to Step 16.

IMPORTANT

Make sure that the mounting hole in the motor mounting bracket is fully seated on the shoulder of the mounting bolt. If it is not fully seated, the chain may bind and fall off.

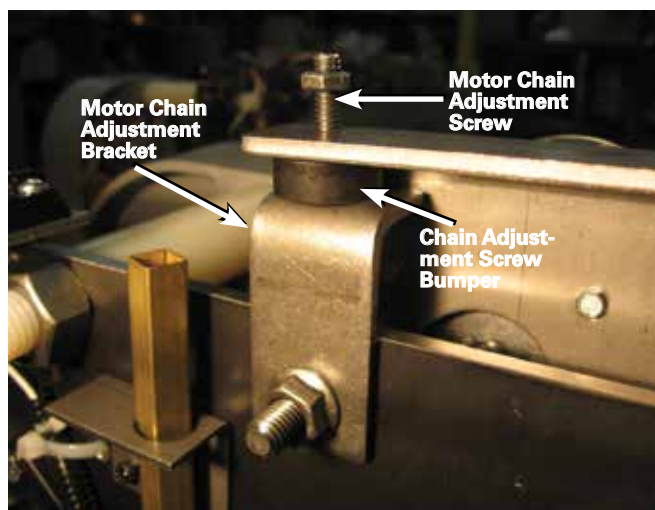


Figure 118. Motor positioning.

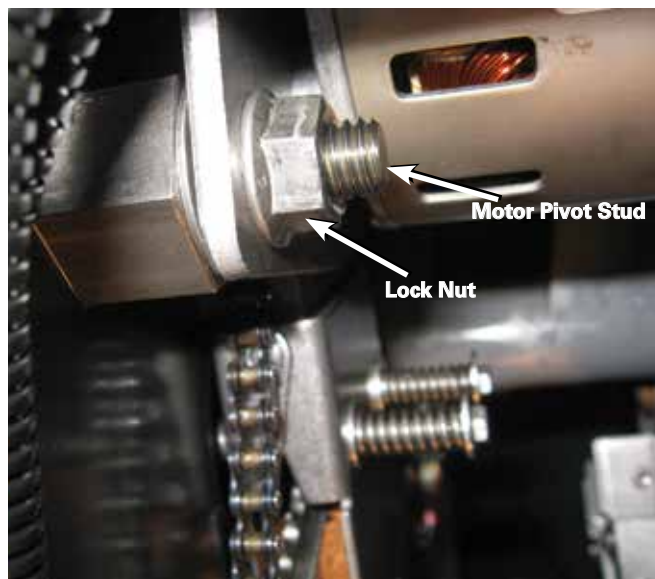


Figure 119. Motor pivot stud.

15. Apply Loctite® 243™ threadlocker on the threads of the motor pivot bolt and verify the fiber washer is still located on the motor pivot bolt shoulder. Refer to Figure 120. Move the motor assembly into position with the motor chain adjustment screw bumper located on top of the adjustment bracket. Refer to Figure 118. Align the hole in the motor mounting plate with the hex spacer hole. Insert the motor pivot bolt through the motor mounting plate and hand tighten into the hex spacer. Refer to Figure 124. Make sure that the shoulder on the bolt is completely inserted through the hole in the motor mounting bracket. Using a torque wrench with a 3/4" socket, tighten the motor pivot bolt to 45–55 in-lbs (5.0–6.1 Nm).

IMPORTANT

Make sure that the mounting hole in the motor mounting bracket is fully seated on the shoulder of the mounting bolt. If it is not fully seated, the chain may bind and fall off.

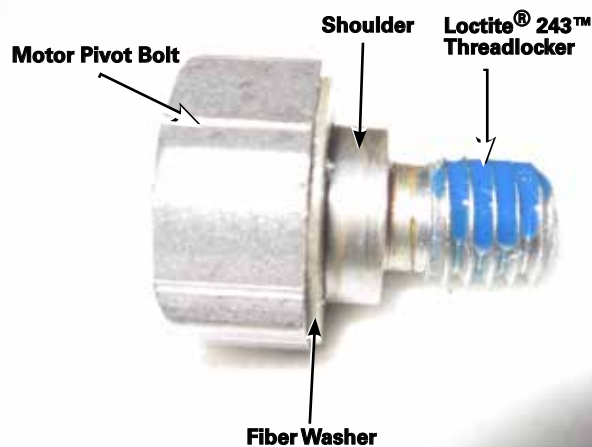


Figure 120. Motor pivot bolt.

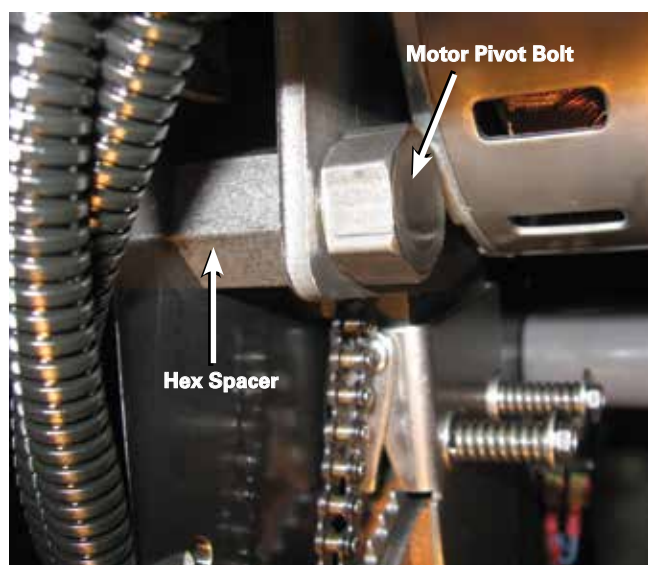


Figure 121. Placement of motor pivot bolt.

- Adjust the chain tension by turning the motor bumper screw with a blade screw driver. Adjust the motor mount bumper screw until 1/4" deflection exists when exerting pressure on the chain. Secure the motor mount bumper screw in place with the jam nut using a 7/16" wrench. Refer to Figure 122.

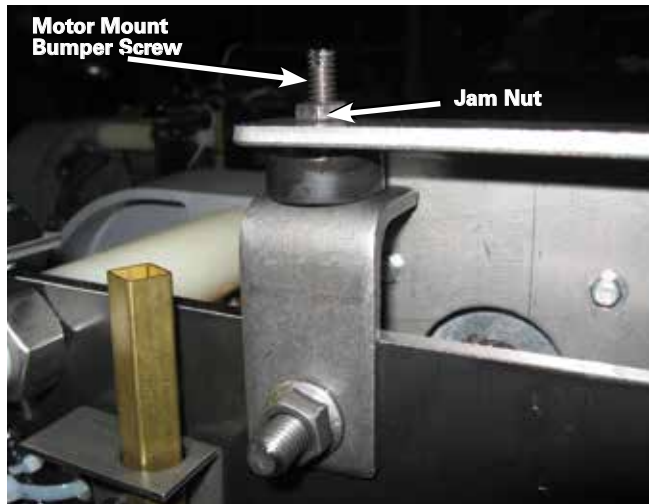


Figure 122. Chain tension.

- The motor wire connection points are as follows: the white wire connects to terminal "G"; the red wire connects to terminal #5 and the blue wire connects to terminal #2. Trim the motor wires with a diagonal cutter allowing an extra two inches of wire between the motor and the connection points. Strip 1/4" of wire insulation from the end of each wire. Crimp a supplied ring tongue connector to the end of each wire, making sure the wire is fully inserted into the ring tongue connector. The wire should not stick out of the connector by more than 1/16 (1.5 mm) of an inch. Attach the ring tongues to the motor connection points on the terminal board as described above. Refer to Figure 123.

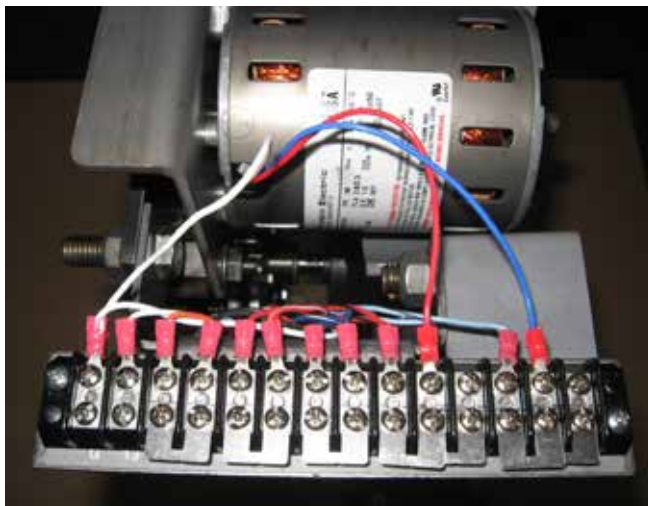


Figure 123. Wiring connections.

- Use the wire ties provided in the motor replacement kit to bundle all the wires near the terminal board to complete the motor replacement procedure. Refer to Figure 124.



Figure 124. Wire fastening.

- Ensure that the tap-changer is in the neutral position when the work is completed.

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 125.

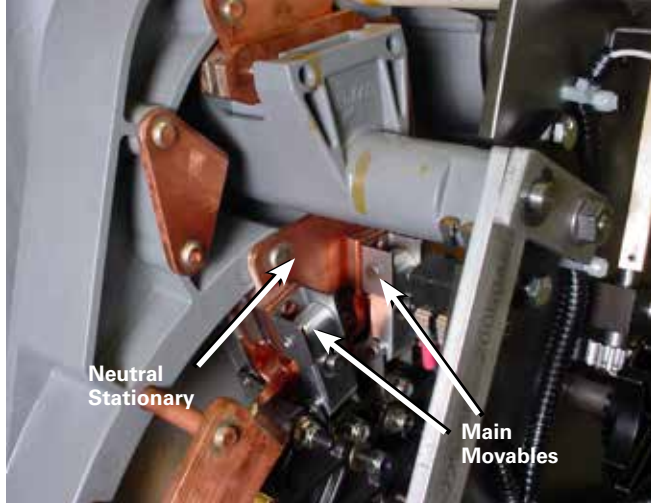


Figure 125. Neutral stationary contact.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 126.

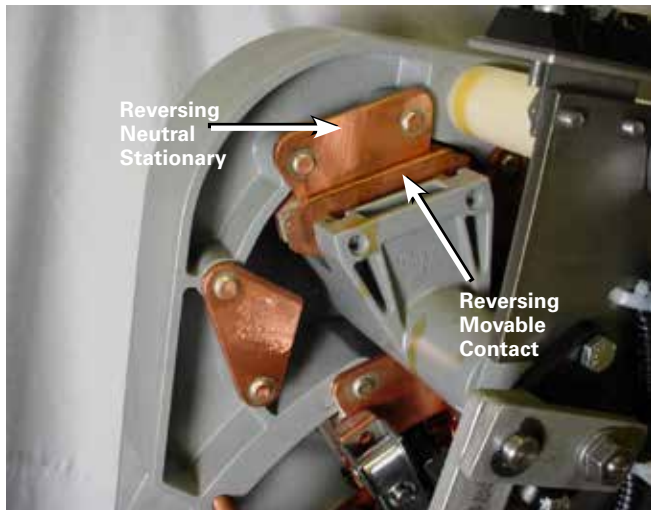


Figure 126. Neutral position for reversing movable.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 127.

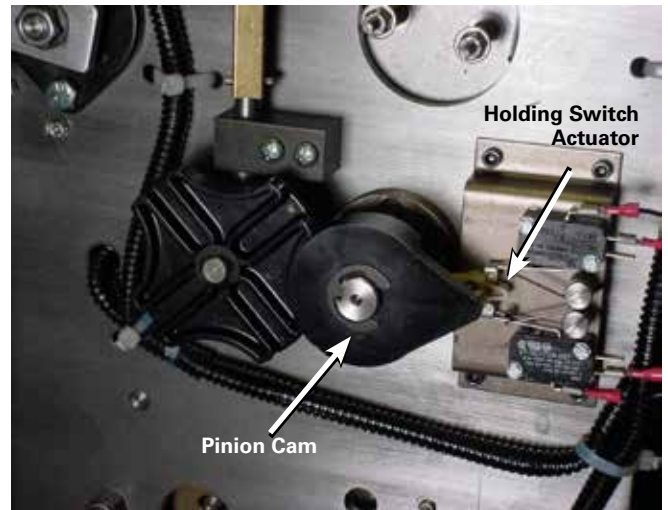


Figure 127. Neutral position for position indicator pinion cam and holding switch.

QD5 tap-changer main movable contact replacement kit number 5740785B33

(Refer to Service Information MN225030EN)

General

The purpose of this replacement kit is to provide the parts and installation instructions for replacing the main movable contacts on a QD5 Quik-Drive tap-changer.

Parts supplied

Item	Part Number	Description	Qty
1	5740785B33	Main Movable Contact Replacement Kit	1



Figure 128. Main movable contact replacement kit.

Tools required

- Ratchet Wrench
- 3/4 inch Socket
- 3/8 inch Socket
- 7/16 inch Deep-well Socket
- 9/16 inch Deep-well Socket
- 5/8 inch open end Wrench
- Torque Wrench 0-300 in-lbs
- Small-bladed Screwdrivers (2)
- Bladed Screwdriver
- 5/32 inch hex Wrench
- Lineman's Pliers
- Locktite® 243 Threadlocker

Installation procedure

1. The tap-changer should be secured to a bench before starting the replacement procedure if the tap-changer has been removed from the unit.

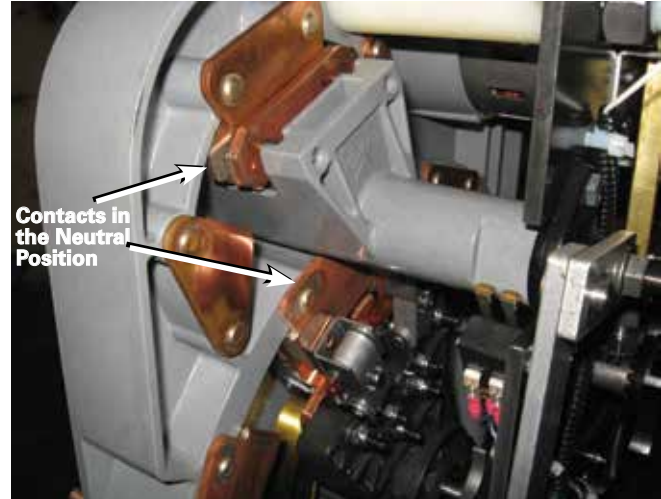


Figure 129. Neutral position.

2. The tap-changer should be in the neutral position before starting the replacement procedure. Refer to Figure 129. If the tap-changer is not in the neutral position, turn the shaft on the back of the motor shaft using a 3/8" socket on a ratchet until the QD5 tap-changer is in the neutral position.
3. Remove the number 1 stationary contact from the molded panel using a 9/16" deep well socket wrench. Refer to Figure 130.

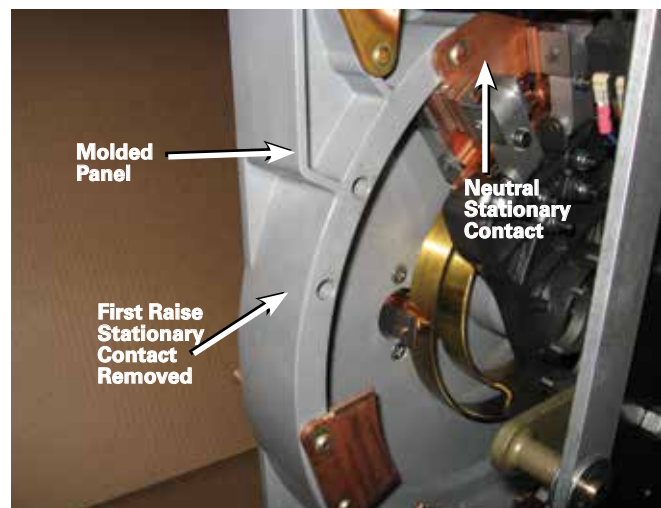


Figure 130. Stationary contact.

- Using a 3/8" socket on a ratchet, rotate the shaft on the back of the motor to move the movable contacts into the space opened up when the number 1 stationary contact was removed.



Figure 131. Main movable contacts in number 1 stationary position.

- Remove the two bolts that mount the actuator finger with a 7/16" socket wrench. Remove the actuator finger. Refer to Figure 132.

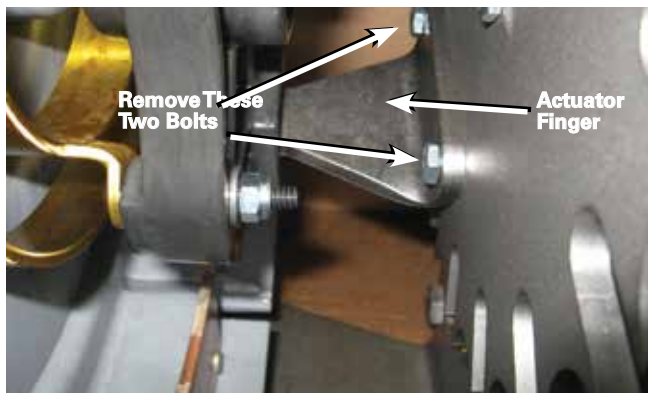


Figure 132. Actuator finger.

- Remove the nut on the end of the main shaft using a 3/4" socket wrench. Use a 5/8" open end wrench positioned on the flats of the main shaft to hold the shaft in place during this procedure. Refer to Figures 133 and 134.

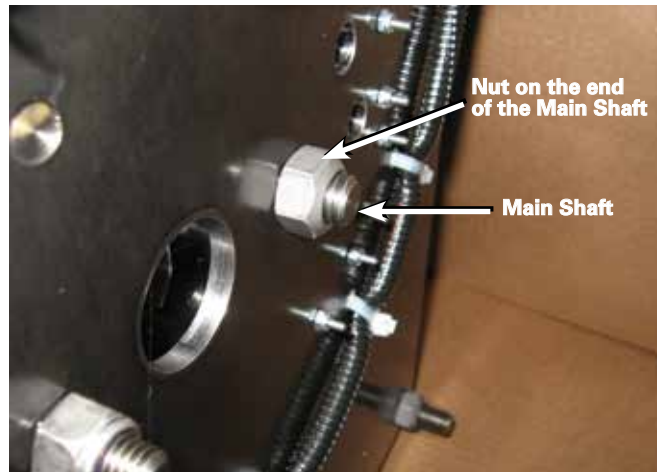


Figure 133. Fastening nut for main shaft.

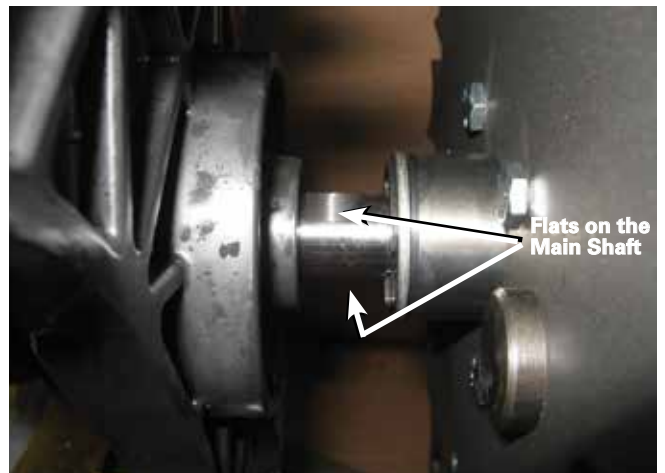


Figure 134. Main shaft.

- Push the main shaft from the threaded end partially through the steel front plate of the tap-changer so that the retaining ring on the main shaft is centered between the movable contact panel and the washer/ Geneva gear hub. Refer to Figure 135.

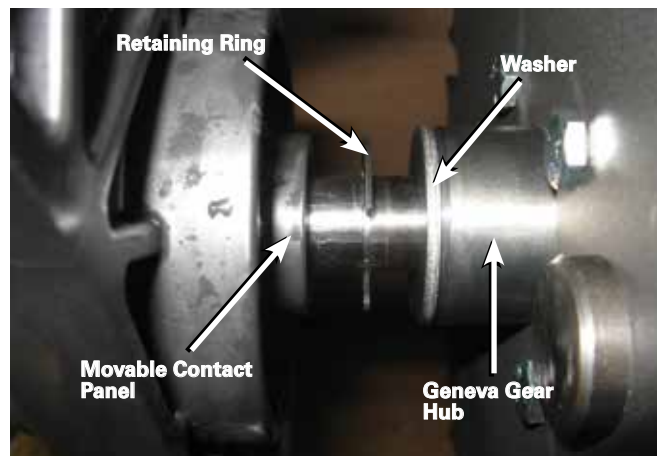


Figure 135. Shaft positioning.

- Use a pair of lineman's pliers to remove the retaining ring. Slide the washer up against the movable contact panel. Refer to Figure 136.

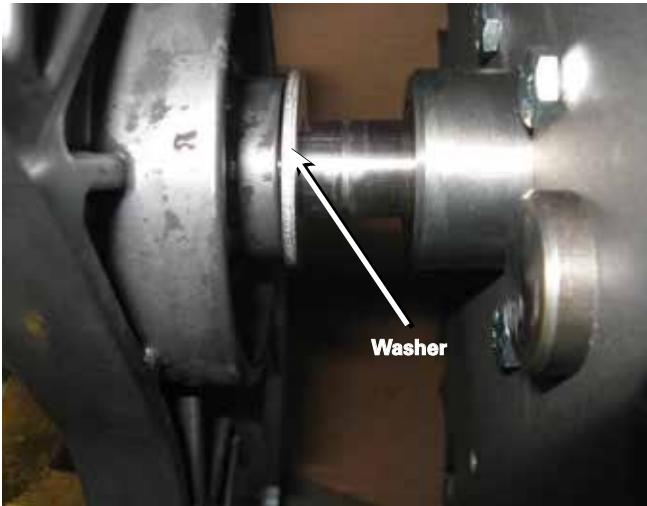


Figure 136. Washer.

- Push the threaded end of the main shaft through the steel panel toward the molded panel. Support the Geneva gear with one hand and pull the main shaft out from the back of the molded panel until the main shaft is out of the Geneva gear hub. Make sure the washer remains on the shaft and does not fall into the tank. Remove the Geneva gear and slide the washer off the shaft. Refer to Figure 137.

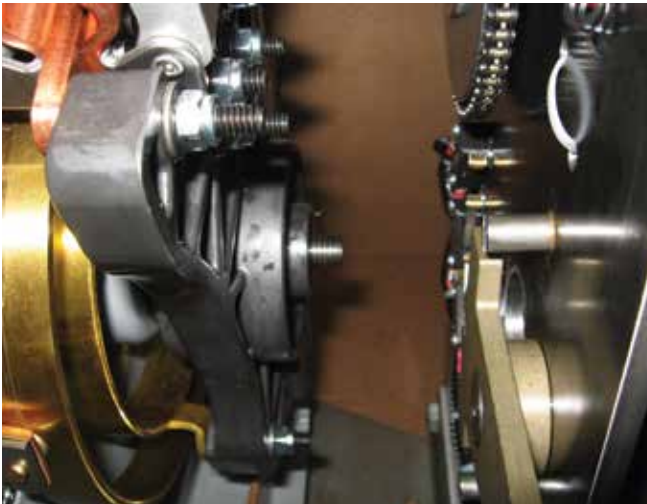


Figure 137. Removal of shaft.

- Pull the main shaft completely out of the back of the molded panel. Pull the contact rings out of the button contacts and remove the movable contact panel assembly. Refer to Figure 138.

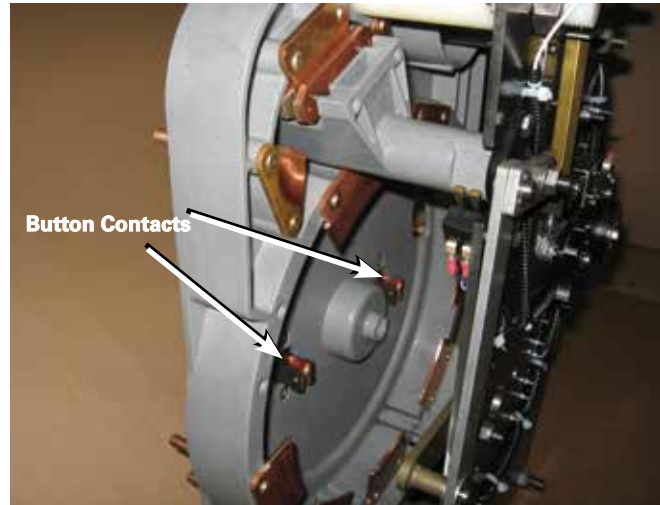


Figure 138. Removal of main contacts.

- Remove the three button head screws, nuts and washers that secure each contact to the movable contact panel using a 5/32" hex wrench and a 7/16" deep well socket wrench. Refer to Figures 139 and 140.

Note: The center button head screw on each movable contact assembly has a flat washer and a Belleville washer under the nut.

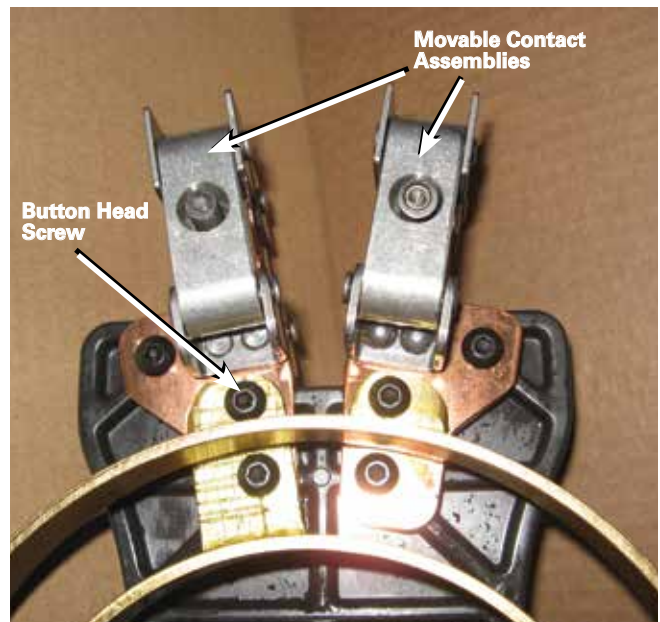


Figure 139. Movable contact removal from insulating arm and rings.

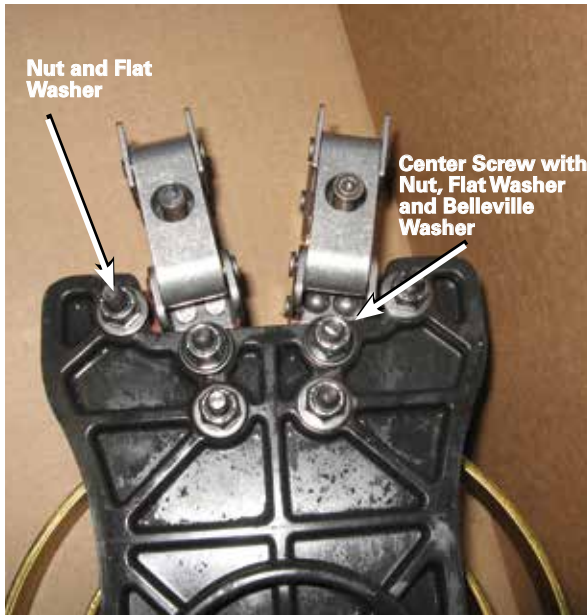


Figure 140. Removal of contacts.

12. The two replacement movable contact assemblies are identical; therefore, they can be installed in either position on the movable contact panel. Position one of the replacement movable contact assemblies between the contact ring and the movable contact panel and align the holes. Insert the three button head screws from the contact ring side of the assembly so the screw heads secure the contact ring in place. On the side opposite the contact ring, place a flat washer on all three screws. Place a Belleville washer on the center screw and thread a Nylok® nut onto all three screws. Tighten the Nylok® nuts to 65 to 75 in-lbs (7.3–8.5 Nm) using a 7/16" deep well socket wrench while holding the screw in place with a 5/32" hex wrench. Refer to Figures 140 and 141. Repeat this procedure for the other movable contact assembly.

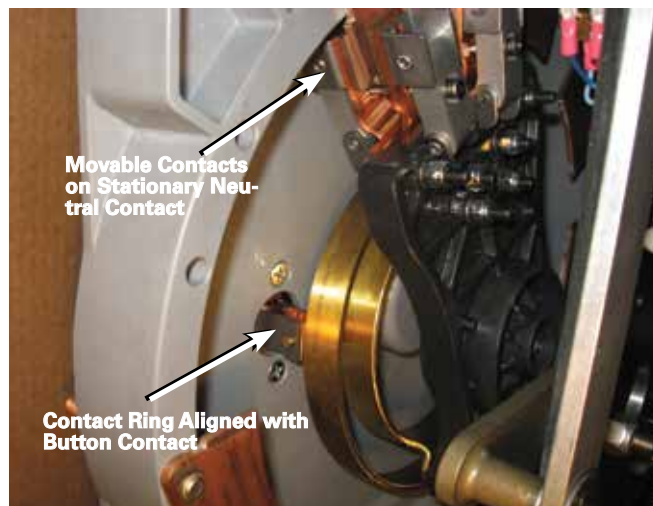


Figure 141. Installation of movable contacts and of rings.

13. Position and center the movable contact panel assembly in the molded panel cavity with the contact rings facing the molded panel. Locate the movable contacts in the area of the removed stationary contact. Rotate the movable contact panel and slide the movable contacts onto the neutral stationary contact. Align the contact rings with the button contacts. Refer to Figure 143.
14. For the outer contact ring, spread the button contacts using a bladed screwdriver and insert the contact ring between the contact buttons. See Figure 142.



Figure 142. Inserting the outer contact ring between the button contacts.

15. For the inner contact ring, from the back of the molded panel, insert a small blade screwdriver between the button contact spring and the button contact shunt on each side of the contact. Refer to Figure 143.

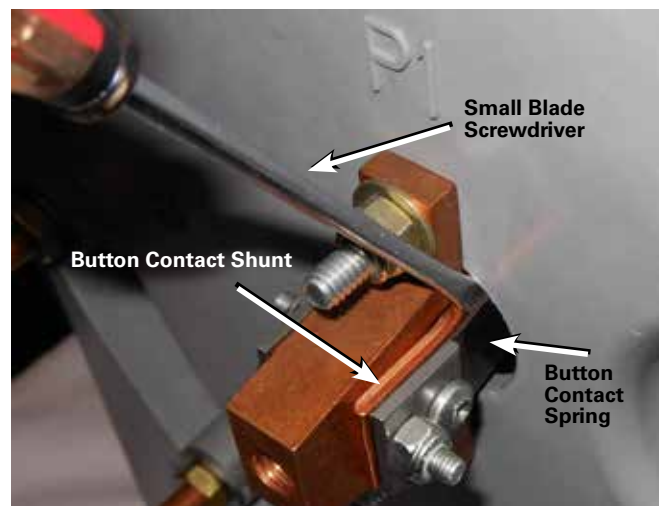


Figure 143. Installing rings into P1 and P2.

16. Squeeze the handles of the small screwdrivers together to spread apart the button contacts. Push the aligned ring contact in between the button contact so the buttons are fully engaged with the contact ring. Refer to Figures 144 and 145.



Figure 144. Installing ring into P1 contact.

17. Insert the threaded end of the main shaft through the back of the molded panel, then through the movable contact panel until the threads of the shaft are just protruding out of the movable contact panel. Slide the washer onto the main shaft and position it against the movable contact panel. Refer to Figure 146.



Figure 146. Installing main shaft.

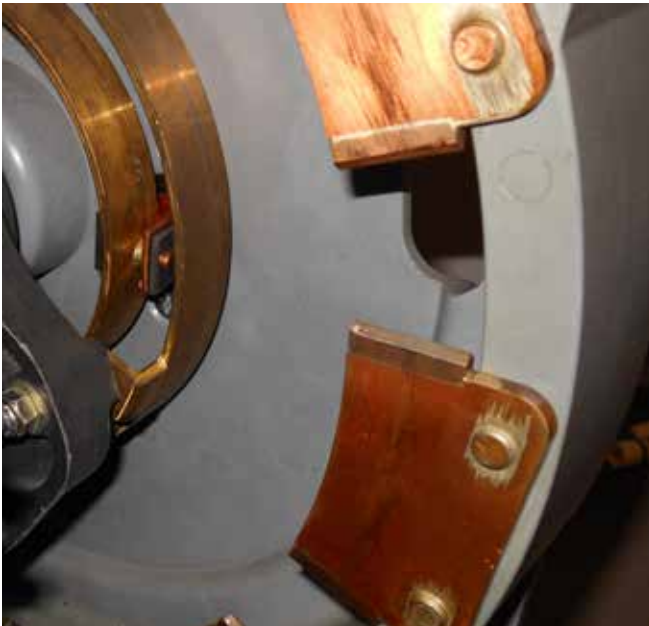


Figure 145. Ring and P1 contacts.

18. Line up the main shaft with the hole in the Geneva gear. Push the shaft through Geneva gear until the threaded end of the shaft reaches the steel front plate. Lift on Geneva gear to assist in lining up the shaft with the hole in the front plate. Insert the shaft tip just slightly into the hole. The Geneva gear should be rotating freely on the shaft. See Figures 147 and 148.



Figure 147. Geneva gear rotating freely on main shaft.

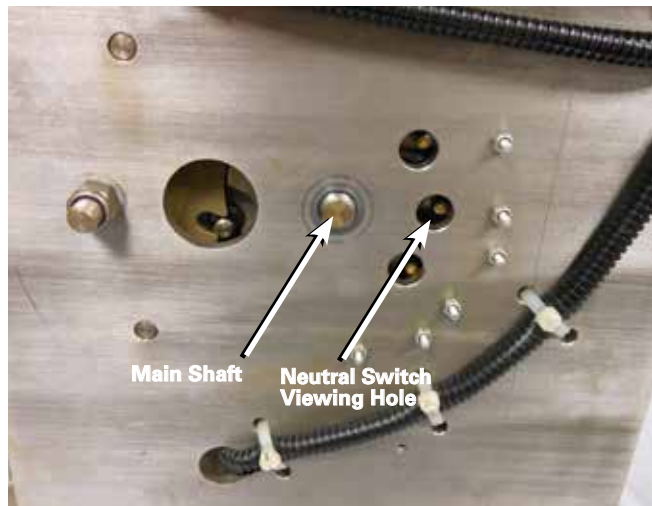


Figure 148. Aligning Geneva gear.

19. Rotate the Geneva gear so the pin on the back of the Geneva gear lines up with the slot in the reversing actuator.
20. Gently push the Geneva gear toward the steel plate. If there is resistance and the Geneva gear cannot be pushed all the way forward into place, the neutral switch actuator is hitting the neutral switch arm.

Note: Do not force it into place or damage to the neutral switch will result. Instead, insert small screwdriver through the small hole in the steel plate and depress the neutral switch while fully seating the Geneva gear. See Figure 148.

21. Push the washer against the Geneva gear and use a lineman's pliers to install the e-clip into the e-clip groove on the main shaft. See Figure 149.



Figure 149. Locating of e-clip.

22. Push the shaft the remainder of the way through the hole in the steel plate. Secure the steel shaft to the steel panel using the 1/2" -13 lock nut. Use a 5/8" open end wrench to hold the steel shaft while securing the nut on the threaded end of the shaft with a 3/4" socket wrench. Tighten the nut to a torque of 180 to 400 in-lbs (20.3–45.2 Nm). Refer to Figure 150.

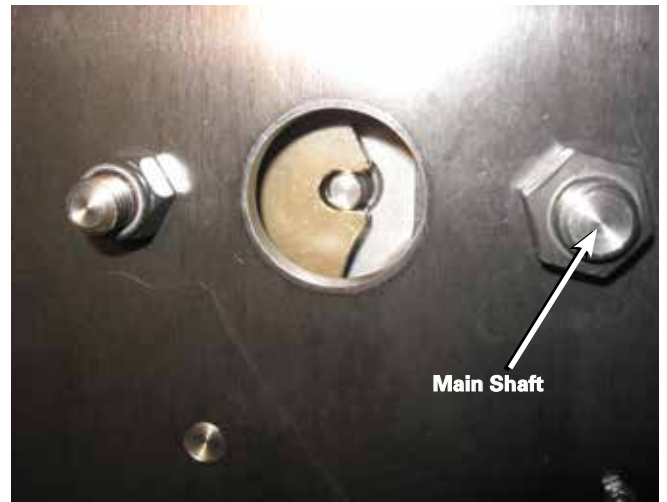


Figure 150. Main shaft with nut installed.

23. Rotate the movable contact insulator arm so the only one of the movable contacts is engaging the neutral stationary contact as shown in Figure 151. This should line the arm up with the Geneva gear so that the actuator finger pocket in the arm is across from the bolt holes used to attach the finger to the Geneva gear.

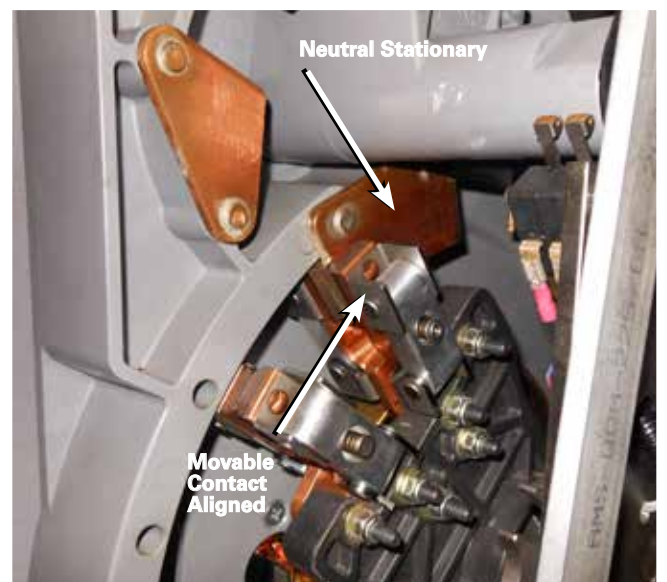


Figure 151. Main movable contact aligned with neutral stationary for installation of the actuator finger.

24. If none is present, apply Loctite® 243 threadlocker to the two actuator finger bolts and then install the actuator finger. It may be necessary to reposition the movable contact insulator arm if the holes do not quite line up. See Figure 152.



Figure 152. Installing the actuator finger.

25. Place the tap-changer into the neutral position. See the next section for instruction on how to confirm that the tap-changer is in the neutral position.
26. Reinstall the number 1 stationary contact and tighten the nuts to a torque of 80–90 in-lbs (9.0–10.2 Nm).

Placing tap-changer into neutral

1. Place a 3/8" socket and ratchet on the output shaft of the motor; rotate the motor so that the contacts and other components are aligned in the neutral position
2. Confirm that the regulator is in the neutral position.
 - A. Main movable contacts are located on the neutral stationary contact, which is located at the 11 o'clock position and under the reversing switch movable contact assembly. See Figure 153.

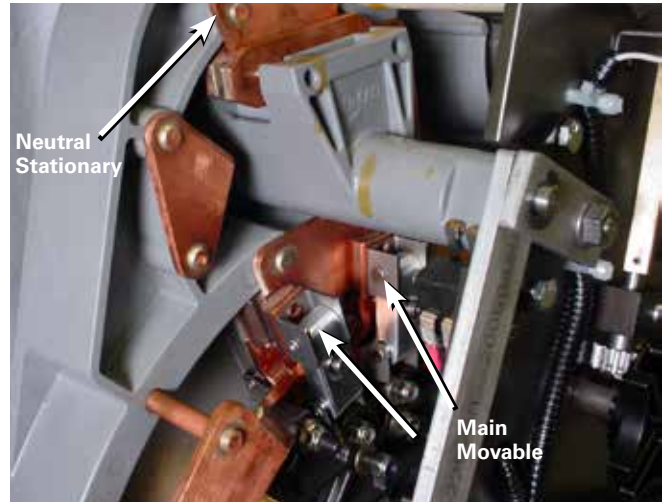


Figure 153. Neutral stationary contact.

- B. The reversing movable contact is located on the reversing neutral stationary contact. See Figure 154.

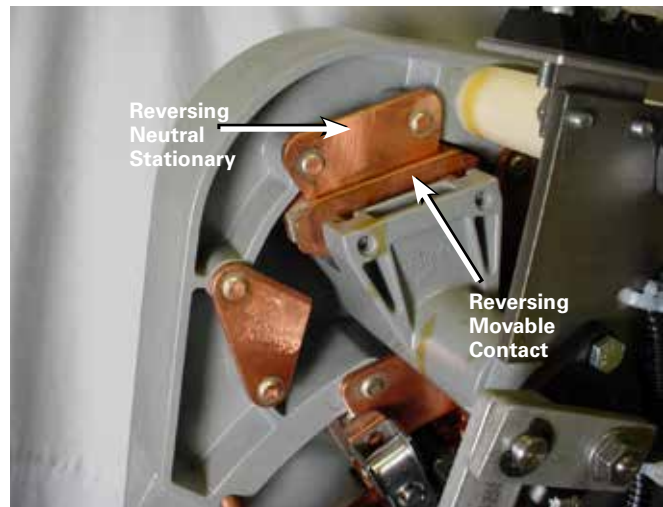


Figure 154. Neutral position for reversing movable.

- C. The pinion cam is pointing to the right over the holding switch actuator. See Figure 155.

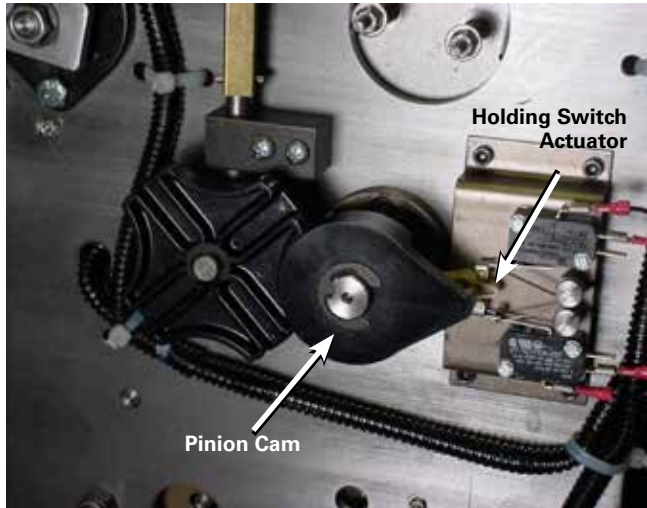


Figure 155. Neutral position for position indicator pinion cam and holding switch.

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