Instructions for Installing Converted or Overhauled LRT200A-2 / LRT200-2 Mechanisms

These instructions cover the details needed to install an LRT200-2, or LRT200A-2 mechanism into an existing LTC tank. After removing from the shipping crate and before installation, the mechanism should be thoroughly inspected for damage that may have occurred during shipping as follows:

1. If the tap changer was sent in for overhaul / repair with the tap leads, it will be returned with all tap leads installed. Check for loose or damaged parts or hardware. If a tap lead connection is found to be loose it should be tightened to a torque of 16 – 18 ft-lbs.

2. Check all other electrical connections for tightness and for clearance between bare metal parts anywhere on the mechanism. The minimum clearance between bare parts is .312" (5/16").

3. With the mechanism on position and the interrupter closed, check the vacuum bottle pre-travel by measuring the gap between the drive nut and upper actuator arm on each vacuum interrupter as shown in Fig.1 below. This gap should be .125" +/- .010". This is required to control the opening impact.

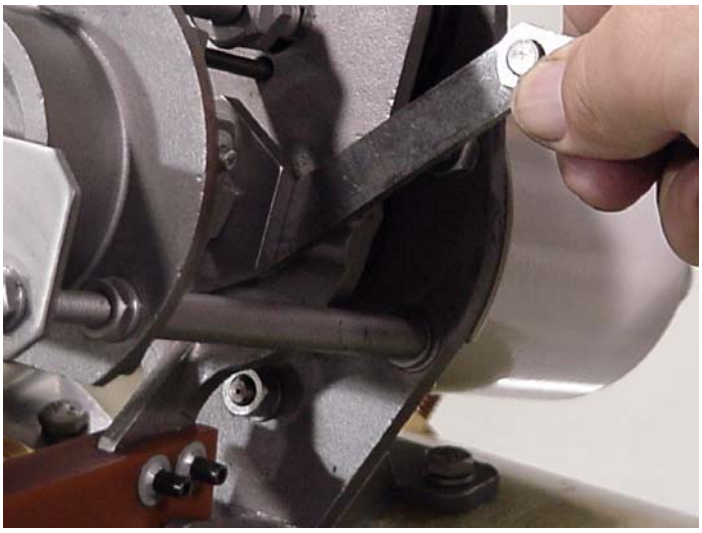

Fig. 1: Checking the interrupter bottle pre-travel

If this is not within the adjustment limits, loosen the locking nut just under the head of the vacuum interrupter adjusting screw, shown in Fig. 2, and turn the screw in the appropriate direction to correct the gap. Make sure to tighten the locking nut after making the needed adjustment.

Fig. 2: Vacuum interrupter adjusting screw

4. Verify that the mechanism is on the neutral position. Neutral is the position where both sets of moving selector switch contacts are on the "M" tap and the paint match marks on the drive gears inside of the endplates are aligned.

5. Check the LTC tank before installing the mechanism. It should be clean and free from all carbon, dirt, or metallic particles.

6. Check the position indicator on the LTC tank to insure it is on the neutral position.

> Note:
> On units with the high amp (wide flat) leads, the leads should be pre-shaped by hand to follow the contour of the main support cylinder prior to installing the mechanism into the tank. This is to insure the leads clear the studs on adjacent taps.

7. If the mechanism being installed has been converted to the 200-2 or 200A-2 then follow instructions 7(a) through 7(h). If the unit was originally the –2 design skip to step #8.

    a. The beveled gear on the left end of the control camshaft which mates to the beveled gear on the position indicator shaft has been installed but not pinned to the control camshaft. A bag with a setscrew and a roll pin has been provided and is attached to the shaft for pinning this gear

after installing the mechanism. This is to allow for correct positioning of the beveled gear to insure proper alignment of the position indicator with the mechanism.

b. Check to make sure the position indicator is on the neutral position. If it is not, rotate the position indicator gears in the control cabinet using the hand crank until the position indicator hand is on "N" (see Fig. 3).

d. Attach ropes or lifting cables through the lifting holes in both endplates. Lift the mechanism and install into the LTC. As the mechanism is being lowered into place make sure the slots in the coupling on the end of the position indicator shaft are aligned with the pin on the shaft in the LTC tank.

d. With the position indicator shaft coupling properly engaged, and while continuing to lower the mechanism in place, line the slots in the mechanism mounting angles attached to each end plate with the corresponding holes in the bottom of the LTC tank. Secure the mechanism in position using mounting bolts removed when the mechanism was taken out.

e. Check that the shoulder at the right end of the control camshaft is against the right endplate. Slide the beveled gear on the control camshaft over to the left until it fully engages the beveled gear on the top of the position indicator shaft. Check to make sure the paint match marks on the gears inside the endplates are still aligned and the position indicator pointer is indicating "on position" (see Fig. 3). Temporarily lock the beveled gear to the control camshaft using the setscrew.

Fig. 3: Paint marks on drive gears match up, position indicator on neutral, and bevel gears meshed with set screw tightened,

f. Cover the mechanism behind the beveled gears with a drop cloth and drill a hole through the control camshaft using the hole in the beveled gear as a guide.

g. Pin the beveled gear to the control camshaft using the roll pin. Remove drop cloth being careful to collect all metal shavings produced from drilling. Vacuum / wipe all remaining shavings and thoroughly inspect mechanism to insure no metallic particles are present.

d. Go to step #9.

8. On units that have been overhauled but not converted (were originally the –2 design) the beveled gear on the left end of the control camshaft has been pinned to the shaft using the original hole. The installation of the mechanism will be as follows:

d. Check to make sure the position indicator in on the neutral position. If it is not, rotate the position indicator gears in the control cabinet using the hand crank until the position indicator hand is on "N" (see Fig. 3).

d. While lowering the mechanism into the tank, make sure the position indicator is on neutral and check the relative orientation of the pin in the indicator shaft and the slot in the coupling on the mechanism. If they are not lined up, turn the position indicator in the direction which requires minimum movement to obtain alignment. Line up the complete mechanism and lower the coupling over the indicator shaft.

d. With the coupling properly engaged with the indicator shaft, line the slots in the mounting angles up with the holes in the bars in the base of the compartment and finish lowering the mechanism into the compartment. Replace the bolts and secure in place.

d. Without moving the mechanism from position, check the location of the paint marks on the position indicator gears in the control compartment (see Fig. 4). If the paint mark on the large diameter gear is more than 10 degrees (3 teeth) away from the center of the small gear or the "on position" pointer, it will be necessary to disengage the bevel gears at the top of the indicator drive shaft on the LTC mechanism so the position indicator can be adjusted without moving the mechanism. This is done by loosening the set screw and driving out the roll pin in the bevel gear on the horizontal control cam shaft on the mechanism and sliding the bevel gear to the right to unmesh it from the bevel gear at the top of the position indicator shaft.

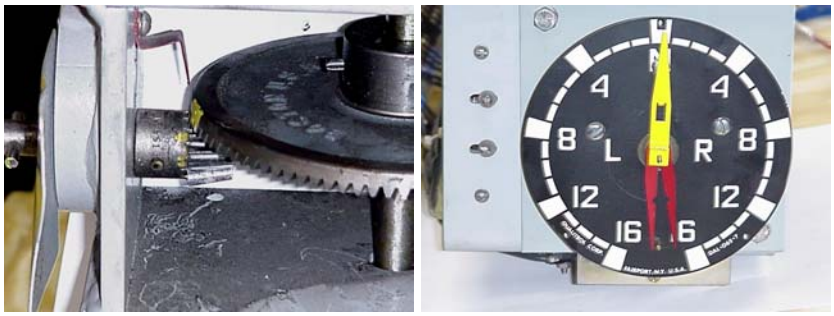

Fig. 4: Position indicator gear paint marks match within three teeth, and Position indicator on neutral

e. With these gears unmeshed, turn the position indicator shaft to the position nearest having the paint marks on the position indicator gears in the control compartment lined up. Next line up the original holes in the bevel gear and the control cam shaft while mating the teeth on the bevel gears together.

f. Tighten the set screw, and replace the roll pin in the bevel gear on the horizontal control cam shaft.

9. Attach all the tap leads from the mechanism to the studs in the transition board in the LTC tank. Make sure the tag identifying the lead matches the stud identification marked on the transition board. Tighten the bolts used to connect the leads to a minimum of 20 ft-lbs torque.

10. Reconnect the control leads to the same locations they were on when the mechanism was removed.

11. Operate the tap selector with the hand crank and check for binding. Check the auxiliary cams and the dual-slope control cams to insure they move freely and that they hold the outer cams back in each direction so the interrupters receive an impact for opening (see Fig. 5).

Fig.5: Dual–slope and Auxiliary Control Cam Assembly

12. Check operation of mechanism electrically using the raise/lower control switch and look for the following:

    a. Verify the braking relay 84X, functions to provide approximately 1 second of braking current to the drive motor at the end of a tap change sequence. The time delay is not critical within the range of .5 to 2 seconds and is adjustable by means of a knob on the bottom of the 84X relay.

    b. Verify the mechanism stops on position by checking to see that the paint mark on the gear above the position indicator (located in the position indicator housing) is aligned with its pointer. Verify the position marks on the upper drive gears on the mechanism inside the right hand end plate are aligned with each other. If there is not agreement between sets of marks, the marks on the mechanism gears take precedence in making adjustments. If the mechanism does not stop on position the control cams in the position indicator housing should be adjusted as required to do so.

    c. Verify that the auxiliary cam followers on the vacuum bottle actuator arm goes into the indent of the auxiliary cams on each phase in both directions.

    d. Verify the position indicator and operation counter operate properly.

    e. Verify the limit switches do not stop the mechanism before the final position is reached and that they do not permit initiation of a tap change after it is reached.

13. Check integrity of vacuum interrupters as follows:

    a. Operate the mechanism manually while carefully observing movement of the wear indicator pin and all components of the actuator assembly.

    b. The wear indicator pin should travel approximately .1” when vacuum interrupter goes from closed to open and back. If it does not, and the actuator assembly is working properly, indications are that the interrupter has lost it vacuum and needs replacement.

    c. Complete loss of vacuum can be verified by making a continuity test as follows. Turn the hand crank until the interrupters open. Connect the leads from a low voltage continuity tester across the contacts of the interrupter and operate the closing mechanism by compressing the actuator spring by hand. If the interrupter has lost vacuum the contacts will not close and the continuity tester will show the interrupter is open.

d. Minor leaks can be detected by performing a “hi-pot” test on each interrupter. This is done as follows:

- Open the control power circuit breaker 8M.
- Use the hand crank to run the mechanism until the interrupters are open.
- Disconnect the cable lead from the moveable contact rod (top end) at the point where it is attached to the by-pass switch.
- Separate the cable from the connector by at least 2” and connect the “hot” test lead to the cable.
- Connect the “ground” test lead to the stationary contact either at the bottom end of the interrupter or at the point where its cable lead is attached to the by-pass switch. Note, if the hi-pot equipment has a center grounded tap, both ends of the interrupter must be disconnected from the by-pass switch before testing.
- Apply a 10KV ac (or 14KV dc) hi-pot test voltage across the interrupter for one minute. Any signs of breakdown indicates a loss of vacuum signaling the need for replacement.
- Since external leakage current can result from surface contamination of the interrupter housing, some discretion is required when interpreting the hi-pot test results. Leakage currents up to 250 micro-amps are considered acceptable. Above that level warrants further testing. Make note of the voltage level at which the leakage current starts to increase and the approximate change in current for a 10% change in the voltage applied. If the current change is several times the voltage change it is probably due to breakdown of the internal gap between the contacts of the interrupter. This can be further verified by placing a .02” to .03” spacer between the actuator arm and the drive nut on the interrupter mechanism to increase the contact gap and repeating the hi-pot test. If there is internal breakdown, this should increase the potential at which the leakage current starts to flow. No change in current / voltage characteristics will indicate the leakage current is due to surface contamination. In this case, the interrupter should be thoroughly wiped down with a lint free cloth and re-tested. If internal leakage current is seen and a .03” spacer does not reduce the current to below 50 micro-amps the interrupter should be replaced.

14. Verify operation of the by-pass switches. With the mechanism on an operating position, verify that the stationary contacts balls are resting on the flat of the moving contact blade. Rotate the mechanism off position until the blade stops moving and check that the minimum gap between the end of the blade and its associated stationary contact assembly is .25" on all three phases. Continue to rotate until the opposite end of the by-pass blade can be checked in the same way.

15. Check the operation of the vacuum interrupter protective system by pressing and holding down the S2 switch in the TEST position while attempting to change taps in the raise direction by means of the control switch CST. The mechanism should run in the raise direction only long enough to open the interrupters and switch S3P. It should stop before the tap selector opens, reverse itself and run back to the position it was on. At this point, the red FAULT light should turn on and the controls should be locked out. Check the integrity of the lockout mechanism by attempting to operate the mechanism manually in either direction using control switch CST. No further movement should take place.

    After completing this test, press the reset switch S1P and repeat the test for the lower direction.

16. Recheck the gap between the drive nut and upper actuator arms again on each vacuum interrupter assembly as outlined in step 3 of these instructions.

17. Use a TTR (turn- to –turn ratio tester) to verify the ratios for all tap positions as compared to the nameplate on the transformer and insure all tap lead connections are correct.

18. Close the LTC compartment and seal by bolting access door in place.

Note: the tap changer tank MUST be filled under vacuum since the mechanism has been out of oil for an extended period while being repaired, and tap leads may have new dry insulation.

CAUTION:
On older model LRT-200/LRT-200A tanks it is recommended that an equivalent vacuum be pulled on the main tank and the LTC tank at the same time while performing the oil filling operation. This will insure the seal on the LTC transition board does not rupture causing oil to leak from the main tank into the LTC tank during normal operation.

19. Fill the LTC tank as follows:

    a. Remove the pressure vacuum bleeder and pressure gauge and replace with pipe plugs.

    b. Connect vacuum pump to LTC tank and draw a vacuum of 2 millimeters (266.6 kPa) absolute pressure and hold for a minimum of 4 hours.

    c. Break the vacuum and fill the tank with oil to the 25 degrees C level.

    d. After filling the LTC tank with oil and sealing, the tank, it should be pressurized to 2 psi (13.8 kPa) with dry nitrogen gas through the pressure test valve.

    e. Re-install the pressure vacuum bleeder and pressure vacuum gauge.

    f. Obtain a new oil sample for establishing a benchmark for dissolved gas analysis and allow the unit to stand for at least one hour before energizing.