INTRODUCTION

This instruction manual contains installation, operation and maintenance information for Type VV-1500 vacuum circuit breaker of the 34.5 kV class, with Type 515-4 V stored energy operator.

WARRANTY

The sales contract carries all information on warranty coverage.

RECEIVING

Circuit breakers are shipped from the factory completely assembled. Observe weight markings on crates and ensure that capable handling equipment is used.

Remove crating carefully with the correct tools. Check each item with the shipping manifest. If any shortage or damage is found, immediately call it to the attention of the local freight agent handling the shipment. Proper notation should be made by him on the freight bill. This prevents any controversy when claim is made, and facilitates adjustment.

When handling breaker (Fig. 1) with a crane or hoist, secure one sling around handle on front of breaker and other sling under bottom of truck frame at rear of breaker. Use a spreader to prevent truck frame distortion and/or damage to interrupters. Do not attach lifting hooks, rope, etc., to bushings, insulating parts, fittings, etc. Do not attempt to roll breaker off of shipping skid without using ramps provided for this purpose.

STORAGE

Indoor — The circuit breaker should be installed as soon as possible. If storage is necessary, breaker should be kept in a clean dry place where it will not be exposed to dirt, corrosive atmospheres or mechanical abuse.

Outdoor — Outdoor storage of circuit breakers is not recommended. If breakers must be stored outdoors, they must be covered completely and a heat source provided to prevent condensation and subsequent corrosion.

CIRCUIT BREAKER PREPARATION

Prepare the circuit breaker for insertion into its cubicle as follows:

1. Remove crate and hardware securing breaker to shipping skid. Secure the unloading ramps provided to the skid and roll breaker off skid.

> **NOTE**
>
> Breaker is shipped in the closed position. DO NOT TRIP OPEN UNTIL STEP 5.

2. Remove the four bolts at the breaker frame which attach the glass polyester barrier assembly. Lift the barrier assembly vertically to clear the vacuum interrupter assemblies. See Fig. 2 & 2a.
3. Examine the vacuum interrupter tubes and supporting structure for any obvious evidence of shipping damage.
4. With breaker still in closed position observe the distances marked "A1" & "A2" in Figure 3. An average between "A1" & "A2" will produce distance "A" which represents the additional compression imparted to the contact pressure springs from the point where the interruptor contacts make, to the point where closing linkage has completely toggled. Distances "A1" & "A2" should be approximately 1/8 inch and should not require adjustment. Do not attempt to adjust these dimensions to be exactly 1/8 inch on each side as it is not required and could disturb other settings.

   Distance "A" also represents the maximum allowable erosion of approximately 1/8 inch of the interrupter contacts. As the contacts erode during the service life of the circuit breaker, distance "A" will become less. When distance "A" measures within .030 to .015 inches, the vacuum interrupter should be replaced. This distance should be checked at periods of routine maintenance and after periods of high short-circuit interruptions. The rate of erosion will vary with the service conditions. See "CONTACT EROSION," page 10.
5. Push manual trip button to open breaker (Fig. 15).
6. Wipe the outside of the interrupters and supporting insulating parts with a clean, dry cloth.

7. Hi-pot each individual vacuum interrupter while in the open position, to verify that damage has not occurred during shipment. The voltage should be raised gradually, and the contact gap should sustain 30 kV, 60 Hz ac for 1 minute, or 42 kV dc for 1 minute. If it does not, the interrupter is faulty and must be replaced. **Test each interrupter individually, not two in series.**

CAUTION

OBSERVE THE FOLLOWING ITEMS WHEN HI-POTTING THE VACUUM INTERRUPTERS.

- With respect to X-radiation: (No hazardous X-radiation is produced with closed contacts or with open contacts or with open contacts with rated operating voltage applied to them).
- Do not hi-pot the interrupters at voltages higher than listed.
- Test personnel should remain at least six feet away from the interrupter being tested.
- The circuit breaker current carrying parts on the interrupter may retain a static charge after the hi-pot test, so discharge with a grounded probe before handling.

8. Install plug jumper and energize control. (Spring charging motor will run to compress closing springs.) Refer to Switchgear Instruction Book 18X5847 for plug jumper installation instructions.
9. Close the circuit breaker electrically by using the control switch on the switchgear cubicle panel. Note that the motor will immediately run again, charging the closing springs.
10. Verify that the circuit breaker is closed and remains closed by checking the mechanical position indicator.
11. Trip the circuit breaker with the control switch.
12. Close the breaker by pulling on the manual close loop (72, Fig. 6).
13. Repeat the close and opening operations several times either manually or electrically observing that the following items are functioning properly:
    Operation Counter (6, Fig. 22)
    Open-Close Indicator (40, Fig. 15)
    Charge-Discharge Indicator (25, Fig. 15)
14. It is suggested that the opening and closing times be established for the breaker when new and periodically when routine maintenance is performed. The closing time should be within the range of .036 to .056 seconds, and the tripping time within .015 to .023 seconds.
15. De-energize control power and remove plug jumper. Close and trip breaker manually to discharge springs.
16. Coat movable primary and secondary disconnects with a film of A-C contact lubricant, 15-171-370-002.
17. Replace barrier assembly, centering with respect to interrupter assemblies. Note: Barrier assembly mounts on the side of the angles farthest from the operating mechanism (Fig. 2).

CAUTION

PUSH MANUAL TRIP BUTTON TO MAKE SURE BREAKER IS OPEN BEFORE ATTEMPTING TO INSERT BREAKER INTO CUBICLE.

18. Insert breaker into cubicle. Breaker must be aligned with cubicle rails by maneuvering in the aisle. It is recommended that a reference pivot point for the center wheels of the breaker be located on the aisle floor to facilitate alignment. The breaker cubicle has floor-mounted guide angles to funnel the front wheels into proper position and the front of the breaker has a fender plate to protect the barrier assembly while inserting.
19. Should interference occur as the breaker starts into the cubicle, check that the continuous current ratings of the breaker and cubicle are the same. An angle on the floor of the cubicle will interfere with insertion if the ratings are not the same.
20. The breaker must be pushed into the cubicle (see caution above) until the latch bar (LB, Fig. 26) engages the slot in the cubicle angle (CA, Fig. 26). Should the breaker stop before latch bar (LB, Fig. 26) engages, check to see that the breaker is in the open position. If not, manually trip open and push the breaker in.
21. Swing test block (TB, Fig. 25) clockwise until it maintains its position against the secondary disconnect (SD, Fig. 25).
22. Energize the control and test the close-open operation of the breaker. Observe the operation of the stationary mounted auxiliary switch (if one is provided). See Fig. 22.

23. Leave the breaker in the closed position. De-energize the control and disconnect the test block.
24. With the breaker closed, attempt to raise the breaker by inserting the racking crank (Fig. 25) and turn clockwise. It should not be possible to turn the crank, nor should the cranking effort trip the breaker.
25. Manually trip the breaker, and again turn the crank clockwise. This time the cranking effort will turn against the resistance of the racking screw clutch (Fig. 7) until the racking interlock is cammed out. Then the screw will turn and the breaker will start to rise.

    Note that the first one or two turns require extra torque to cam out the interlock.
26. Observe that the shutter moves and that the breaker disconnects clear the shutter.
27. After several turns in the clockwise direction, return the breaker to the disconnect position by turning the crank counterclockwise. When the breaker has reached the disconnect position, the trip free interlock bar snaps to the right and the cranking should be stopped.
28. Place a padlock hasp in hole shown in Fig. 12. Attempt to crank the breaker. It should not be possible.
29. Remove the padlock and slowly turn the racking crank clockwise until the trip free interlock has cammed to the left. Then place the padlock hasp in hole shown in Fig. 12. This will maintain the breaker in the trip free position. Check by repeating steps 21 and 22 above.
30. Remove the padlock, open the breaker, turn control power off, and with the line and bus de-energized, rack breaker into fully connected position. IF BUS OR LINE ARE ENERGIZED, GET CLEARANCE BEFORE BEGINNING THIS STEP.
31. Repeat Step 22.
32. Lock out kirk interlock (if provided) and check that the breaker remains trip-free.
33. Open the breaker and turn the racking crank counterclockwise to lower the breaker. At about the half way position, the breaker should not lower itself (negative crank effort). If the breaker tends to fall, the brake band spring (BBS, Fig. 5) should be tightened when the breaker has been removed from the cubicle. To make this adjustment see view "A" Fig. 5 and tighten cap screw 65, stopnut 59, spring 74 as required.
34. To remove the breaker from the cubicle, check that the control power is off, the test block disconnected and that the breaker has been manually closed and opened to remove any residual spring energy. If spring energy is not removed, operation of the breaker release lever will close the breaker. Push manual trip button to open breaker before attempting to pull breaker out of cubicle. Push breaker release lever (Fig. 9), to the right and pull on the breaker handle. If the breaker moves outward only a few inches, and seems to jam, push it in a short distance and again attempt to pull it outward. The swivel wheels at the operator end of the breaker may wedge on the guide funnel, but can be cleared by the above action.

CIRCUIT BREAKER DESCRIPTION

A typical circuit breaker consists of primary disconnects, vacuum interrupters, and operator sections (Fig. 2a). The primary disconnect section contains the main contacts which supply power to the load. The vacuum interrupters open and close the electrical system during normal and/or fault conditions. The operator section contains the mechanism which operates the drive bar used to close and open the main contacts. This mechanism consists of a stored energy operator with its associated linkages and control circuitry.

TRIPPING

The vacuum circuit breaker is tripped due to operation of the manual trip button (Fig. 15) or the trip solenoid (59, Fig. 6).

INTERRUPTION

When the circuit breaker is tripped while carrying current, the contacts within the vacuum interrupters part, and an arc is established. Due to the efficiency of the vacuum interrupter, the arc is normally interrupted at the first current zero.

CLOSING

The breaker is closed by the stored energy operator straightening a toggle in the four-bar linkage which forces the drive bar (36, Fig. 4) back, rotating the bell cranks (37, Fig. 4) upward, closing the breaker.

STORED ENERGY OPERATOR

The stored energy operator (Fig. 6) uses charged springs to power the closing operation. A stored energy operator consists of three systems: spring charging drive, cam and ratchet assembly, and four bar toggle linkage (Fig. 18). These systems are disengaged from each other except while performing their specific functions. For example — the spring charging drive and cam-ratchet assembly are disengaged except when the cam-ratchet arrangement is being charged. Similarly, the cam-ratchet and four bar linkage are free of each other except during closing.

Stored energy operated breakers normally require a single commercial relay for control. This relay is furnished to match the control voltage.

RECLOSING CONTROL (Optional — For Reclosing Applications Only)

The trip latch check system provides the necessary control to perform the reclosing function when the switchgear is equipped with reclosing relays.

The system is comprised of three elements: a magnetic actuator (2, Fig. 19), a non-contacting magnetically operated hall effect switch (sensor) (1, Fig. 19), and a time (delay) module (Fig. 19). The system performs two distinct functions prior to enabling the reclosing operation.

1. It senses that the trip latch has returned to its reset position, and is ready to receive a reclosing operation.
2. Imposes a delay following latch reset to insure the linkage assembly has fully reset and then applies power to the spring release coil.

The non-contacting magnetically operated Hall Effect switch and magnet actuator combine to perform proximity detection of the trip latch tail. The speed of operation and life expectancy of this proximity sensor system is not limited by mechanical actuation as no physical contact between the actuating magnet and hall switch exists. The switch consists of a hall sensor, trigger, and amplifier integrated on a silicon chip. Its complete encapsulation isolates the device from environmental effects.

AUXILIARY SWITCH

Mounted on the breaker, the auxiliary switch is normally used to open the trip circuit when the circuit breaker is opened. As this multi-stage switch operates from the breaker drive bar, circuitry dependent on the position of the breaker, such as indicator lights, etc., is wired through this switch. The individual stages are easily converted to "a" or "b" without disassembling the switch (Fig. 17).

TRIP SOLENOID

Normal electrical tripping (opening) is caused by the trip solenoid (59, Fig. 6) which is designated 52 TC on the schematic of Fig. 16. The trip solenoid is energized by operation of the circuit breaker control switch or the protective relays which are mounted on the switchgear.

CIRCUIT BREAKER OPERATION

Normal — Normal circuit breaker operation is controlled by cubicle mounted controls or other control devices. The closing springs of the stored energy operator will charge as soon as the breaker control is energized. Check the motor cutoff adjustment (Page 9) if springs do not charge.

Opening Breaker — Stored energy operated breakers can be tripped manually by depressing the trip button (Fig. 15) or electrically by energizing the trip circuit. This rotates the latch that allows the closing linkage to collapse and reset.

Closing Breaker — When the springs of the stored energy operator are fully charged, the breaker can be closed manually by pulling the manual close pull rod (72, Fig. 6), or electrically by energizing the closing circuit. This rotates the latch (15, Fig. 6) that allows the springs to close the breaker.

STORED ENERGY OPERATOR — DESCRIPTION OF OPERATION

SPRING CHARGING CYCLE

Energization of the Breaker Control Circuit will cause the spring charging motor (20, Fig. 6) to start charging the closing springs (94, Fig. 6). The spring charging motor (20) will drive the driving pawl (DP, Fig. 6) through an eccentric drive shaft (14, Fig. 6). The driving pawl (DP) will turn the ratchet wheel (51, Fig. 6) counterclockwise one tooth at a time. The holding pawl (HP, Fig. 6) will hold the ratchet in position between driving strokes of the driving pawl (DP). This charging operation will continue turning the ratchet wheel (51) counterclockwise a tooth at a time until the closing springs (94) are fully charged (compressed) and dead center. The motor will drive the ratchet wheel past this dead center position and the closing springs (94) will aid rotation of the ratchet wheel and cams counterclockwise until spring release rollers (SRR, Fig. 6) on the inside surfaces of cams (52 & 53, Fig. 6) engage the closing latch (15, Fig. 6). This arrests the motion of the ratchet wheel (51) and the cams (52 & 53) and holds the operator in the fully charged position. As the cams and ratchet wheel go over center, the motor cutoff switch (10, Fig. 20) is actuated to de-energize the spring charging motor (20). The spring charging motor then coasts to a stop and driving pawl (DP) oscillates freely in the smooth toothless section of the ratchet wheel.

The motor cutoff switch (10, **Fig.** 20) has four functions:

1. It de-energizes the spring charging motor (20, Fig. 6).
2. It opens a contact in the anti-pump relay circuit.
3. It sets up the closing coil circuit.
4. It can be used to energize an indicating light to indicate that the closing springs (94, Fig. 6) are fully charged.

> **NOTE**
>
> The close latch check switch (CLCS, Fig. 6) is in the motor circuit. The close latch check switch monitors the position of the close latch (15) and will prevent charging of the closing springs (94) electrically unless the close latch (15) is in the correct position.

As energy is stored in the closing springs, the four bar linkage (54, Fig. 6) will be positioned by the linkage reset spring (LRS, Fig. 6) which acts to cause cam follower rollers (CFR, Fig. 6) to follow the surface of cams (52 & 53, Fig. 6) until the links are in a reset position, and allowing latch rollers (LR, Fig. 6) to be positioned in front of trip latch (16, Fig. 6).

The charging position of the operator is shown by an indicator (25, Fig. 14).

RECLOSING CONTROL (Optional — For Reclosing Applications Only)

The electronic solid state time delay module works in concert with the trip latch sensor system. The time delay module consists of an electronic timer and an electromagnetic relay. The diagram (Fig. 16) shows the timer module receiving power between terminals 1 and 3. Terminal 3 is connected to the common side of the closing control source. Terminal 1 is connected to the high side of the closing control source through auxiliary contact (52B) and the closing source contact "01/C".

The trip latch sensor system consists of the magnetic actuator (2, Fig. 19) and the Hall Effect switch (1, Fig. 19).

The time delay module is not energized until the closing springs are charged, the breaker is open and the closing source switch "01/C" is closed. When the latch resets at the instant "01/C" closes, the timer module's internal relay with normally open contact operates with no intentional delay (40 ms electro-mechanical delay) to connect the spring release solenoid through timer module terminal 2 to the high side of the closing source initiating the breakers closing sequence.

If the trip latch is not reset at the time the closing source is applied, the timer module will assume a delaying mode of operation. Upon latch reset a predetermined delay will be imposed before the timer's relay closes energizing the spring release solenoid. The complete trip latch check system is not affected by broad variation of closing source voltage. The time delay error caused by temperature extremes of $-40°$ C to $65°$ C is a minus 3% to plus 5%.

BREAKER CLOSING CYCLE

Energizing the closing solenoid (63, Fig. 6) will drive the close latch (15, Fig. 6) away from the spring release rollers (SRR, Fig. 6) on the cams (52 & 53, Fig. 6), releasing the stored energy in the closing springs (94, Fig. 6). The closing springs will drive the ratchet wheel (51, Fig. 6) and the cams counterclockwise at a high rate of speed. The cams will engage the cam follower rollers (CFR, Fig. 6) of the four bar linkage (54, Fig. 6) and drive them forward, causing the four bar linkage to become straight. As the four bar linkage becomes straight, it forces the drive bar (36, Fig. 4) back, causing the bell cranks (37, Fig. 4) to rotate while causing the breaker contacts to close and the opening springs (16, Fig. 5) to be charged. The cams (52 & 53, Fig. 6) drive the four bar linkage (54) over toggle and against the frame, thereby latching the breaker contacts in the closed position.

SPRING RECHARGE AFTER CLOSING

When the closing cycle has been initiated and the cams (52 & 53, Fig. 6) begin to turn, the motor cutoff switch (MCS, Fig. 11) resets itself. A "b" auxiliary switch of the breaker opens, de-energizing the closing solenoid (63, Fig. 6). The close latch (15, Fig. 6) returns to its reset position and the close latch check switch (CLCS, Fig. 6) closes and energizes the spring charging motor (20). The closing springs (94) are then recharged as described earlier.

TRIPPING CYCLE

Energizing the trip solenoid (59, Fig. 6) will drive the trip latch (16, Fig. 6) away from latch roller (LR, Fig. 6) on the four bar linkage (54, Fig. 6). This allows the four bar linkage to collapse and the breaker contacts will open. If the closing springs (94) are in the charged position, the linkage reset spring (LRS, Fig. 6) will immediately reset the four bar linkage (54). If the closing springs (94) are not charged, the linkage reset spring (LRS) will not reset the four bar linkage (54) until just before the closing springs (94) are completely charged.

ELECTRICAL CONTROL

Schematic (Fig. 16)

The normal control for this operator is contained in a control panel (CP, Fig. 11) mounted on the right hand side of the operator. It consists of the motor cutoff switch (MCO, Fig. 11), anti-pumping relay (APR, Fig. 11), and the close latch check switch (CLCS, Fig. 11). The control arrangement schematic diagram is shown in Fig. 16.

Spring Charging

The spring charging motor power is supplied through circuits 3 and 4, Fig. 16. The close latch check switch is closed when the close latch (15, Fig. 6) is in the reset position. The MCO switch contacts are shown with the closing springs discharged. When the control is energized, the motor starts to charge the springs. The MCO switch is operated by roll pin striker (RPS, Fig. 6) mounted in the ratchet wheel. As the ratchet wheel and drive blocks (RW & DB, Fig. 11) charge the springs, the ratchet wheel revolves to the position of full compression, dead center. Beyond dead center position, the springs aid rotation and cause the roll pin striker (37, Fig. 20) to depress the actuator (35, Fig. 20) of the MCO switch, opening the motor circuit and the MCO contact in the anti-pumping relay circuit. The spring charging motor coasts to a stop with the driving pawl (DP, Fig. 6) oscillating freely on the smooth portion of the ratchet wheel.

CLOSING

The standard control schematic for the stored energy operator is shown in Fig. 16. When the close control switch is closed, the circuit from wire 7 through MCO and 52/ to 52b to wire 6 energizes the closing coil, closing the breaker. When reclosing relays are used, the circuit is from wire 7 through MCO and 52Y to 52b through trip latch delay module (timer-TLT) energizing the closing coil, closing the breaker.

As soon as the closing springs are discharged, the MCO switch contact closes to energize the 52Y relay. If the close control switch remains closed, the 52Y relay remains picked up through contact 52Y. The control switch must be released to reset control for another closing operation. This forms the anti-pumping relay circuit which prevents the circuit breaker from reclosing immediately after a trip free operation. If control power is momentarily lost during closing, upon re-energization, the 52Y relay picks up instantaneously through contact MCO maintaining the anti-pumping relay circuit prior to complete spring charging.

Close Latch — Mechanical and Electrical Interlocks

The close latch (15, Fig. 6) must be fully reset to receive the cam mounted spring release rollers at the end of the charging cycle. To insure the close latch is in this fully reset position, an electrical and mechanical interlock is provided.

The close latch check switch (CLCS, Fig. 6) consists of a snap-action type switch mounted in close proximity to the close latch. A striker plate at the tail of the close latch engages the switch's actuator slightly before the fully reset position is achieved and actuates the switch prior to the latch's reaching the fully reset position. At the time of actuation, a contact closes, initiating the charging sequence. The switch operates with very small differential. This sensitivity, coupled with the close latch biased engagement of the spring release rollers, provides a positive sensitive interlock.

The mechanical interlock (Fig. 23) prevents charging of the closing springs if the close latch is not adequately reset. A linkage attached by a clevis to the close latch, extends across the upper portion of the operator on right hand side to the driving pawl mechanism. An extension of the interlock linkage passes above the driving pawl constant force return spring. If the close latch fails to return to a fully reset position, the linkage extension thrusts the driving pawl's return spring outward, preventing the driving pawl's engagement of the ratchet wheel, thus mechanically inhibiting either manual or electrical spring charging.

Racking interlock: (Fig. 12 & 13) Prevents racking the breaker up or down and removal or full insertion into cubicle if breaker is closed. The racking interlock is actuated by the cubicle angle (Fig. 26) or by a cam (Fig. 8) on the clutch assembly which cams against the cam roller on the interlock. When the breaker is open the drive bar (Fig. 11) is in the raised position and the racking interlock is permitted to slide from right to left without interference. When the breaker is closed the drive bar is in the down position and the racking interlock is prevented from sliding from right to left by the stop block (Fig. 12) which cannot pass under the drive bar (Fig. 11). When the stop block hits the drive bar preventing the interlock from sliding the breaker cannot be racked up or down because the cam on the clutch assembly cannot push the cam roller on the interlock out to clear the cam. Since the interlock cannot slide it also prevents the breaker from going into the cubicle past the cubicle angle (Fig. 26): If it is possible to turn the racking crank far enough to trip a closed breaker, the stud (Fig. 22a) is out of adjustment. Check the dimension .38 ± 1/32 inch (Fig. 22a) and adjust if required. Also, check the roll pin (Fig. 22a) to make sure it is set at .50 ± 1/32 inch as shown.

Spring discharge interlock: (Fig. 12) Prevents breaker from going fully into the cubicle or from being withdrawn from the cubicle with the closing springs charged. This interlock is actuated by spring release lever (Fig. 9) or by cubicle mounted angle (Fig. 26). When the interlock is actuated it pushes close latch (Fig. 6, item 15) away from spring release roller (Fig. 6, item SRR) allowing springs to discharge.

ADJUSTMENTS

Adjustments are factory set and checked before and after numerous mechanical operations on every breaker to insure correctness. No adjustment checking should be necessary on new breakers. If a malfunction occurs, check for hidden shipping damage.

The following will help make proper installation and adjustment when replacing a broken or worn part.

CIRCUIT BREAKER TIMING

A comparison of circuit breaker timing at any period of maintenance with that taken when the breaker was new will indicate the operational condition of the breaker mechanism. The normal closing and tripping tolerances are given in item 14 on page 2. If operation exceeds these tolerances, investigation to determine the cause should be initiated.

AUXILIARY SWITCH (Cubicle Mounted — Optional Equipment)

The auxiliary switch actuating rod on breaker (Fig. 22) operates the cubicle mounted auxiliary switch (when furnished) by rotating the drive tubes (Fig. 22). Actuating rod adjustment is covered in Fig. 22.

AUXILIARY SWITCH (Breaker Mounted)

The Type Q-10 auxiliary switch (Fig. 17) is designed so that the individual contacts may be positioned in fifteen degree steps without disassembling the switch.

Using long-nosed pliers, move the rotor contact (16) in the slot of the shell (14), compressing spring (15). This will free the rotor from the retainer (17). Rotate the rotor to the desired position and release. Be sure the rotor springs solidly back against the retainer to fully engage the rotor and retainer teeth.

Racking Interlock Adjustment (Fig. 27)

In down position (view #1, Fig. 27) adjust collar "A" so that point "B" is flush with backplate when roll pin is 0.12 to 0.19 inches from positive stop angle (item 18).

In up position (view #2, Fig. 27) adjust collar "C" so that point "D" is 0.31 inches beyond backplate when ball nut is 0.12 to 0.19 inches from clamp collar. Adjust collar "E" to compress spring 0.25 to 0.38 inches.

TRIP LATCH ADJUSTMENTS

Trip Latch Clearance — To change clearance between trip latch and trip latch rollers, see Fig. 18. Breaker must be open with springs discharged, then loosen "Lower Link Stop" (Fig. 18) and rotate to permit maximum "Lower Trip Link" movement. Adjust all locknuts (20, Fig. 3) on new interrupters only until a 0.030 to 0.060 inch gap appears between the trip latch and latch roller. Rotate lower link stop until it touches lower link and lock in place.

Any adjustment to locknuts (20, Fig. 3) will affect the "B" dimension (Fig. 3).

Important: On new interrupters only (not interrupters which have been in service) the "B" dimension must be 0.675 ± 0.030 inches which should automatically produce a trip latch clearance of 0.030 to 0.060 inches (Fig. 18).

DO NOT ADJUST LOCKNUTS (20, Fig. 3) **on any interrupter which has been in service.**

Trip Latch Bite — Trip latch bite is established by setting the latch tail top surface 0.531 inches below bottom surface of solenoid mounting plate (Fig. 19). Lock securely with jam nut. One turn of adjusting screw will alter the gap 0.062 inches. This setting will produce a latch bite of approximately 1/8 - 1/4 inch as shown in Fig. 19.

TRIP LATCH CHECK SENSOR ADJUSTMENTS (Fig. 19)

This adjustment is to be completed only after establishing the "bite" adjustment described above.

The magnetically operated hall effect switch (sensor) and actuating magnet are to be assembled to the operator. After installation, the unit is to be adjusted by advancing the threaded bushing (1, Fig. 19) through the tapped hole in mounting plate until a gap of .040—.000 + .015 inches is achieved between the surface of the switch and the top of the shrink tubing, holding the magnet actuator (2, Fig. 19) assembly to the trip latch tail. With this gap achieved, the sensor may be locked in place. Important: Torque limit on item 1, Fig. 19 is 60 in. lb.

Functional electrical test on breaker may be made to confirm sensor's operation. The timing module's nameplate and rated voltage should be checked to insure it matches breaker closing control voltage. The timer's delay adjustment has been previously set and **should not be altered.** Remove wire from terminal 2 on timer module and insulate. Open breaker and charge closing springs.

Apply closing voltage and observe light emitting diode (led) adjacent to delay adjustment. The led should be brightly illuminated when the trip latch is fully reset. Depress latch with manual trip lever and observe the led goes out. Release trip lever and the led should come on. This sequence confirms sensor's operation. Do not apply closing control voltage for longer than two minutes while performing this test.

MANUAL CHARGING OF CLOSING SPRINGS

To charge the closing springs manually, disconnect control power before inserting the manual charging crank in the socket located on R.H. side of operator cover (Fig. 13). Turn the crank in a counterclockwise direction to charge the springs.

> **CAUTION**
>
> MAINTAIN A FIRM GRIP ON CRANK
>
> The closing springs are charged through the driving pawl and ratchet wheel and are thereby indexed by the holding pawl. Some springback can occur between tooth positions on the ratchet wheel.

The effort to charge the closing springs will fluctuate and will increase to a peak and then decrease. At the point of least effort an audible click will be heard and the effort to turn the crank will drop to near zero. The mechanism is now fully charged. Remove manual charging crank. The breaker may be closed by pulling the manual close pull rod (72, Fig. 6).

REMOVAL OF CLOSING SPRINGS

The closing springs **may be** quickly and safely removed from the breaker. Remove two of the four bolts holding the spring bearing block at top of the operator (Fig. 9). These bolts should be removed diagonally opposite each other. Insert studs approximately six inches long in place of bolts. Remove the remaining two bolts by shifting the spring load to the six inch long studs. The spring bearing block can then be backed off the studs. To install the closing springs, the reverse procedure should be used. The spring bearing block top surface should be even with the bracket of the frame. The four bolts should be torqued to 50 ft. lbs. **IMPORTANT: Be sure to maintain alignment of backplate (Fig. 9) vertically when replacing spring bearing block. It is also important that the spring release lever mounting bracket be squared with backplate to avoid having release lever hit the closing spring tube.**

If the charging ratchet and cams are to be revolved with springs removed, it is advisable to remove two **aluminum spring drive blocks** (DB, Fig. 11) secured to the ratchet and cam crankpins by retaining rings. If not removed or held essentially in a vertical position, these drive blocks may jam while revolving the cam and ratchet assembly.

Motor Cutoff Switch – The 88 motor control switch assembly (Fig. 20) is factory adjusted. If it should become inoperative the entire unit must be removed and inspected.

Replacement may be necessary.

Motor Cutoff Switch Adjustment – This adjustment is most conveniently performed before installing the charging springs.

Advance ratchet and cam assemblies to position shown (Fig. 20). The holding pawl must occupy the ninth (9) tooth position on the ratchet as counted counterclockwise from area on ratchet periphery which lacks two teeth.

With ratchet in the position described above, adjust the motor cutoff switch horizontally until its actuator makes positive contact with the rollpin striker. Lock switch assembly in this position.

Check lateral movement of actuator. Lateral play at end of actuator (tip) should be no more than 1/16 inch maximum. If adjustment is necessary, snug pivot screw to just bind actuator, and then back off 1/16 to 1/8 turn. Rotate ratchet and cam assembly to insure actuator rides in gap between ratchet and cam without striking or binding.

Close Latch Bite Adjustment (Fig. 21) – Free jam nut (34) and place latch in vertical position. Visual accuracy. Measure "D" directly in line with latch pivot. Reproduce this dimension plus 0.062 inch at the latch face as shown in Fig. 21 by rotating the adjustment screw. Secure jam nut. This adjustment should produce a latch bite of 0.151 to 0.216 inches.

Close Latch Check Switch Adjustment (Fig. 21) – This adjustment is to be performed only after completing the latch bite adjustment described above.

A clearly audible "click" should be heard from the switch as latch is moved 1/32 inch from latch adjustment screw. The latch switch actuator may be bent slightly to obtain switch operation at this point. Maximum permissible bend is 1/8 inch as shown in view "A", Fig. 21

If switch actuator is bent, observe latch fully closed against adjusting screw and make certain the switch actuator has not contacted the switch body. A 1/64 inch clearance should exist as shown in Fig. 21.

Close Latch Mechanical Interlock (Fig. 23) – this adjustment is to be undertaken only after completing the close latch bite adjustment described above.

Adjust actuator rod displacement from support angle to 1.06 ± .015 inches. See detail of adjusting nut "A", Fig. 23.

Insert a 1/4 (.250) drill between close latch and latch adjustment screw as shown.

Check guide bushings to insure they stand off the frame 1/4 inch as shown.

Free nut "B" at base of attachment clevis, and adjust nuts "B" and "C" to depress pawl return spring and pawl until 1/16 to 3/32 inch clearance is obtained between tip of pawl and ratchet teeth. **This clearance is measured during the clockwise rotation of the pawl as its tip is toward the ratchet (power stroke).**

MAINTENANCE

GENERAL

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

Prior to performing any maintenance work, make certain all control circuits are open, and that the breaker has been completely withdrawn from the metal-clad unit.

SAFETY WARNING

BEFORE ANY MAINTENANCE WORK IS PERFORMED, MAKE CERTAIN THAT ALL CONTROL CIRCUITS ARE OPENED AND THAT THE BREAKER IS REMOVED FROM THE SWITCHGEAR UNIT. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE IN THE CLOSED POSITION UNLESS THE BREAKER HAS BEEN LOCKED CLOSED PER FIG. 5, NOTE #1 TO PREVENT ACCIDENTAL TRIPPING. DO NOT WORK ON THE BREAKER OR MECHANISM WHILE THE CLOSING SPRINGS ARE CHARGED.

Always inspect a breaker which has interrupted heavy fault current.

All current carrying joints should be inspected to be sure all contact surfaces are free of protrusions or sharp plane changes.

CONTACT EROSION ("A" = Average Between "A1" & "A2")

A visual check of distances "A1" & "A2" (Fig. 3) with breaker closed will indicate the contact erosion. When distance "A" approaches .030 to .015 inches, the interrupter assembly should be replaced. This distance should be established by measuring both "A1" & "A2" then take an average. This will compensate for any minor tilt in the retaining plate (It. 5). The best measure of erosion rates is to look at the change in the "A" dimension over a series of time-separated intervals. Note: If at any given point the "A" dimension seems to have grown, it may be due to an irregular contact surface. An open-close operation and remeasurement will probably give a different dimension. **Intermediate adjustment is not recommended.**

INTERRUPTER-VACUUM

CAUTION

OBSERVE THE FOLLOWING ITEMS WHEN HI-POTTING THE VACUUM INTERRUPTERS.

- With respect to X-radiation: (No hazardous X-radiation is produced with closed contacts or with open contacts or with open contacts with rated operating voltage applied to them).
- Do not hi-pot the interrupters at voltages higher than listed.
- Test personnel should remain at least six feet away from the interrupter being tested.
- The circuit breaker current carrying parts on the interrupter may retain a static charge after the hi-pot test, so discharge with a grounded probe before handling.

A hit-pot test should be applied to the open interrupter contacts of each individual interrupter on each phase. The voltage should be raised gradually, and the contact gap should sustain 30 kV 60 Hz ac, or 42 kV dc, for one minute for each individual interrupter on each phase.

HYDRAULIC SHOCK ABSORBER (12, Fig. 5)

The shock absorber (12, Fig. 5) should require no adjustment unless an entire vacuum interrupter assembly is being replaced. However, at maintenance checks the shock absorber should be checked for any evidence of leaking and the mounting and assembly hardware should be checked for tightness. If evidence of fluid leakage is found, the shock absorber must be replaced. The shock absorber has a metered volume of fluid and field filling is not recommended.

Opening and Closing Time:

Closing time range .036 to .056 seconds
Opening time range .015 to .023 seconds

Mounting and adjusting hardware should be checked for tightness. Elastic stop nuts (15, Fig. 3) should not be turned, as indicated by the "Note".

INTERRUPTER REPLACEMENT

Replacement interrupters are furnished only as complete assemblies as shown in Fig. 3. This eliminates the need for special field-assemby fixtures and avoids the risk of inadvertent damage to the vacuum interrupter bellows by field assembly.

IMPORTANT

Remove only one complete phase assembly at a time. This leaves the two remaining phases intact and they will serve as the reference required to realign the one phase being replaced. See Fig. 4.

This procedure will also help to minimize chances of damaging interrupter assemblies by accidentally bumping them together.

Following is a step-by-step procedure for removing and replacing the interrupter assembly.

1. Move breaker to a level floor area.
2. Remove barrier assembly to expose the interrupter assemblies. Refer to item 2 page 1 also Fig. 2a.
3. With breaker in the open state, insert racking crank and rotate clockwise. This will drive the racking arms (8, Fig. 5) to the full vertical position. The breaker has now been elevated off the wheels and will be more stable when working on the breaker.

4. Close the breaker. When closed insert a 3/8"-16 x 12" long threaded rod through opening spring as shown for Note #1, Fig. 5. Screw the threaded rod into opening spring guide (34, Fig. 5) tightly. Run locknut up tight against opening spring holder (35, Fig. 5). **Breaker is now locked firmly in the closed position so that it cannot be accidentally tripped open.**

5. Loosen locknuts (23 R.H. & 24 L.H., Fig. 3).

6. Loosen the four hex head cap screws (99, Fig. 4) alternating diagonally so as to relax spring pressure evenly as screws are loosened.

> **NOTE**
>
> It is recommended that a second person hold the interrupter assembly when these cap screws are removed.

7. With second person holding the interrupter assembly steady, back out both adjusting screws (9, Fig. 3) simultaneously by turning clockwise as viewed from top of breaker. This will release adjusting screws from base of connecting rod (Fig. 3) and pivot block (38, Fig. 4). The complete interrupter assembly is now free and can be carefully set aside. Replace the adjusting screws in the pivot block (fine thread end) about two or three turns counterclockwise.

8. To replace this assembly, have second person hold the assembly in position so that adjusting screw (9, Fig. 3) can be started into the base of the insulator simultaneously by turning counterclockwise. The adjusting screws should be turned evenly so as to maintain approximately the same penetration into both pivot blocks as well as into the insulators. This will aid in making final gap adjustment, "A", Fig. 3.

9. When adjusting screws have been well started into pivot blocks and insulators, replace the four cap screws and lockwashers (99 & 103, Fig. 4). Making sure that assembly is located on 13 inch center line (Fig. 4) and in line with the other disconnects (Fig. 4). Tighten to 96 - 136 foot pounds.

10. Turn adjusting screw counterclockwise until either the "A1" or "A2" dimension (Fig. 3) is approximately 1/8 inch. It is not necessary to measure this dimension on both sides of a single tube assembly as there may be a slight difference between them. Do not change the factory settings of the elastic stop nuts (15, Fig. 3). All adjusting to get the 1/8 inch dimension on either side of a single interrupter tube must be done with adjusting screw (9, Fig. 3) only. Now repeat this procedure on the other interrupter of this phase. After the 1/8 inch dimension is obtained, hold adjusting screw tight and secure firmly with the upper and lower locknuts (23 & 24, Fig. 3).

11. Mount adapters for primary contact finger assemblies. For 2000 amp and 3000 amp contact adapters, loosen the socket head locking screw on side of adapter before threading onto the stud on top of interrupters. Coat stud with copper plate grease A-C Part #15-171-455-001. Thread adapter onto stud and run down to base of stud without forcing. Refer to Note #1, Fig. 4 for adapter height adjustment. Be sure to lock firmly in place after adjustment.

    For adapter assembly on 1200 amp unit, coat stud with copper plate grease A-C Part #15-1171-455-001 (Kopr-Shield, Thomas & Betts Cat. No. CP-16). Torque requirements (90 to 110 ft. pounds).

    When spanner wrench 15-171-797-001 and adapter wrench 18-657-902-313 are furnished, the customer is expected to provide a torque wrench (1/2 inch drive with foot pound scale). He will have to modify his dial to accommodate the increased extension of the adapter wrench. The modified dial reading may be calculated using the following expression:

$$D_M = 100\frac{L}{6+L}\text{ foot pounds}$$

    D_M = modified dial reading (foot pounds).

    L = active extension of customers torque wrench (inches).

12. Remove the 3/8 inch rod installed in Step 4. Trip breaker to open. Insert racking crank and turn counterclockwise to lower breaker to its wheels. Continue cranking until racking arms return to position for inserting into cubicle.

13. Hi-pot the vacuum interrupters.

> **CAUTION**
>
> **Do not hi-pot interrupters with open gaps adjusted to values less than 0.50 inch.**

14. Verify the opening and closing times.
15. Replace barrier assembly and bolt in place.

> **CAUTION**
>
> **Be sure primary disconnect fingers have been installed before inserting into cubicle.**

MECHANISM – STORED ENERGY OPERATOR

The circuit breaker mechanism should be inspected and lubricated at 1000 operation intervals. This inspection should check for loose hardware and any broken parts. The control wiring should be checked for loose connections and frayed or damaged insulation. The "close latch check switch" should be checked for mounting tightness. The satisfactory operation of the switch should be assured with a continuity meter and manual manipulation of the switch, and adjusted if necessary.

After 5,000 operations, the operating mechanism should be given a general overhaul and all worn parts replaced. Excessive wear will usually be indicated when adjustments can no longer be satisfactorily made. The general overhaul will require disassembly of the operating mechanism. All bearings and surfaces receiving wear should be examined carefully and relubricated in accordance with lubrication instructions, Figs. 28 thru 30.

CLOSING SPRING REMOVAL

The removal of closing springs will be necessary in order to permit general overhaul of the breaker. These springs may be removed as described on Page 8.

LUBRICATION

> **NOTE**
>
> The contact lubricant supplied with the accessories is intended to be used exclusively on the exposed contacts and must not be used on any part of the circuit breaker mechanism.

Recommended circuit breaker lubrication points are shown in Fig. 28 and 29. The chart (Fig. 30) outlines two methods of lubrication. Refer to this chart for recommended lubricant and points of application. The first method requires no disassembly and is suggested for the prevention of problems which could be created by severe environmental or operating conditions.

The second method follows procedure similar to that performed on the breaker at the factory. Follow this procedure only in case of a general overhaul or disassembly.

It is important that auxiliary switch contacts (16, Fig. 17) are cleaned and lubricated with S-A electrical contact lubricant every 1000 operations.

METHOD FOR CLEANING BEARINGS

Needle and roller bearings are factory lubricated for life and should not require attention. However, the best of greases are affected by time and atmospheric conditions and may require service.

To lubricate these bearings when parts are disassembled, the following procedure is recommended. Clean in solvent, wash in alcohol, spin in light machine oil, drain and repack with Beacon P-325 grease.

DO NOT REMOVE NEEDLE BEARINGS FROM THE RETAINING PART

> **NOTE**
>
> Ball screw of racking mechanism must not be removed from ball nut.
> Brake-bearing must have Torrington name visible away from backplate.

HANDLING INSTRUCTIONS

- Move breaker to installation location with fork lift or crane.
- Carefully remove protective plastic cover and crate.
- Remove ramp pieces nailed to the pallet.
- Remove hold down bolts located on each side of breaker.
- Place ramp pieces in front of the pallet in line with breaker wheels and nail to pallet as shown.
- Slowly roll breaker off pallet.

CAUTION – BREAKERS ARE SHIPPED IN CLOSED POSITION.

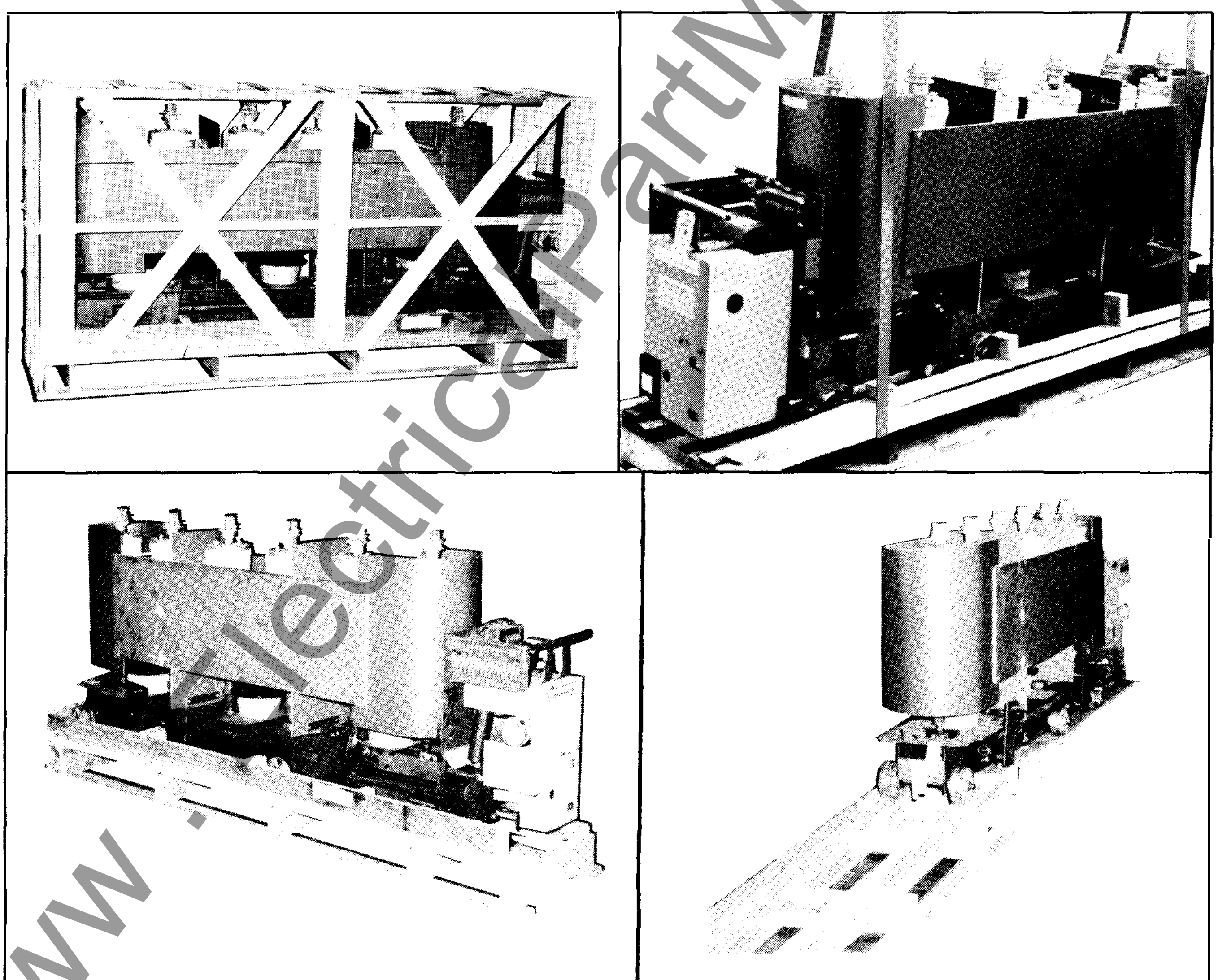


Fig. 1 – Handling Instructions

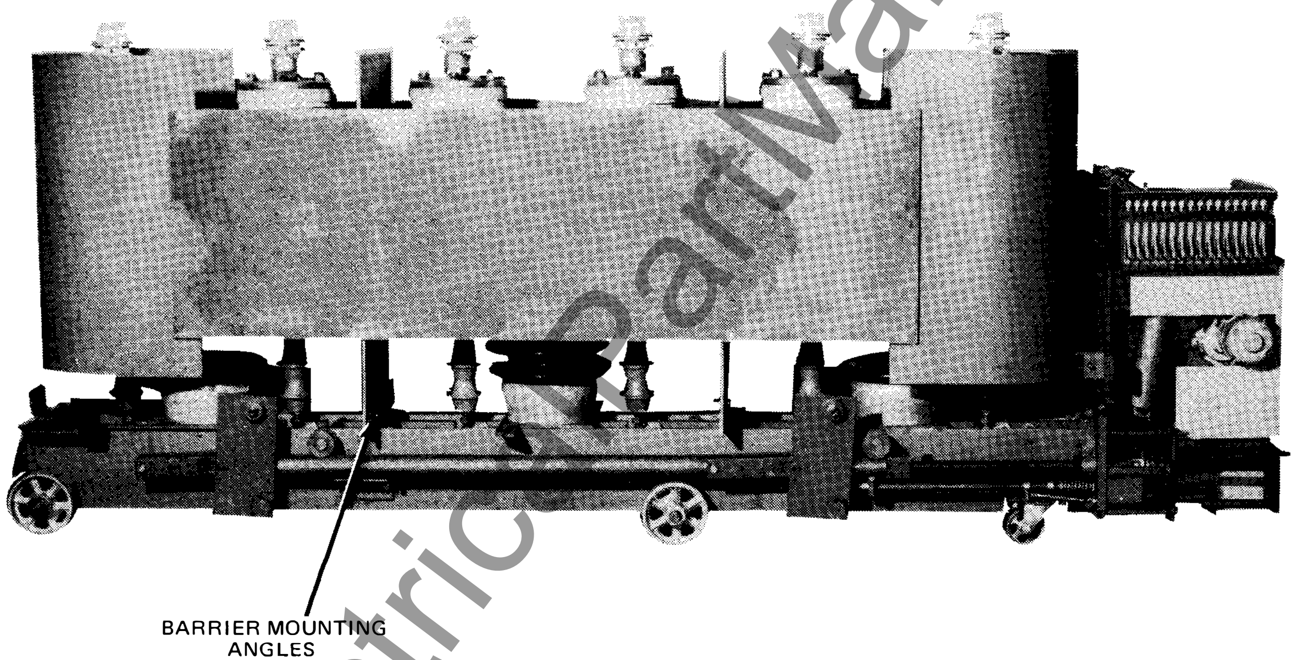


Fig. 2 — VV1500 Vacuum Circuit Breaker

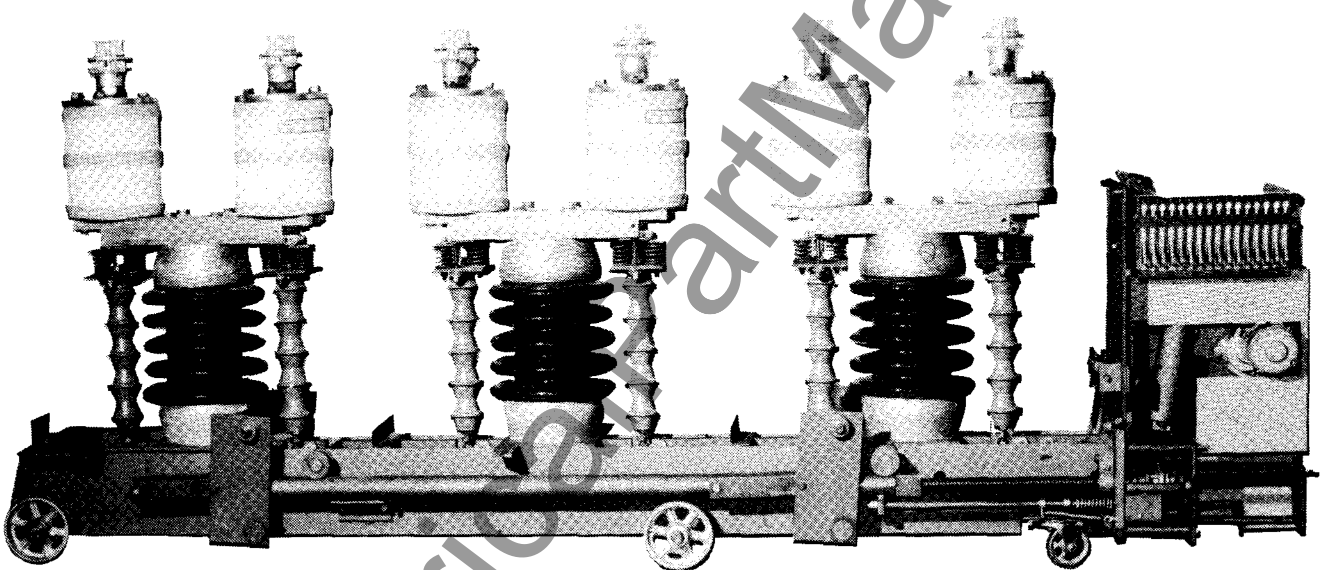


Fig. 2a — VV1500 Vacuum Circuit Breaker Barrier Assembly Removed

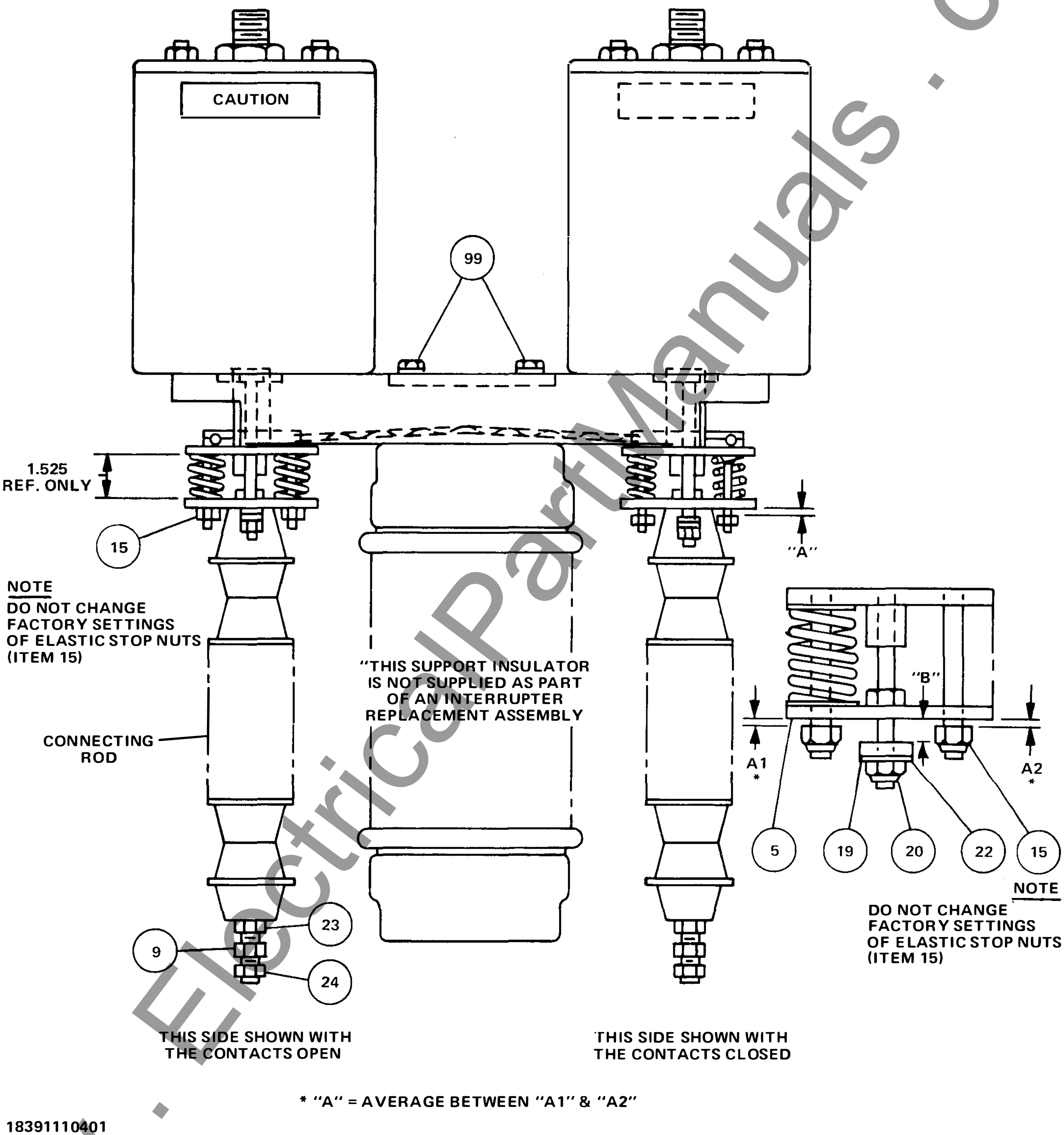
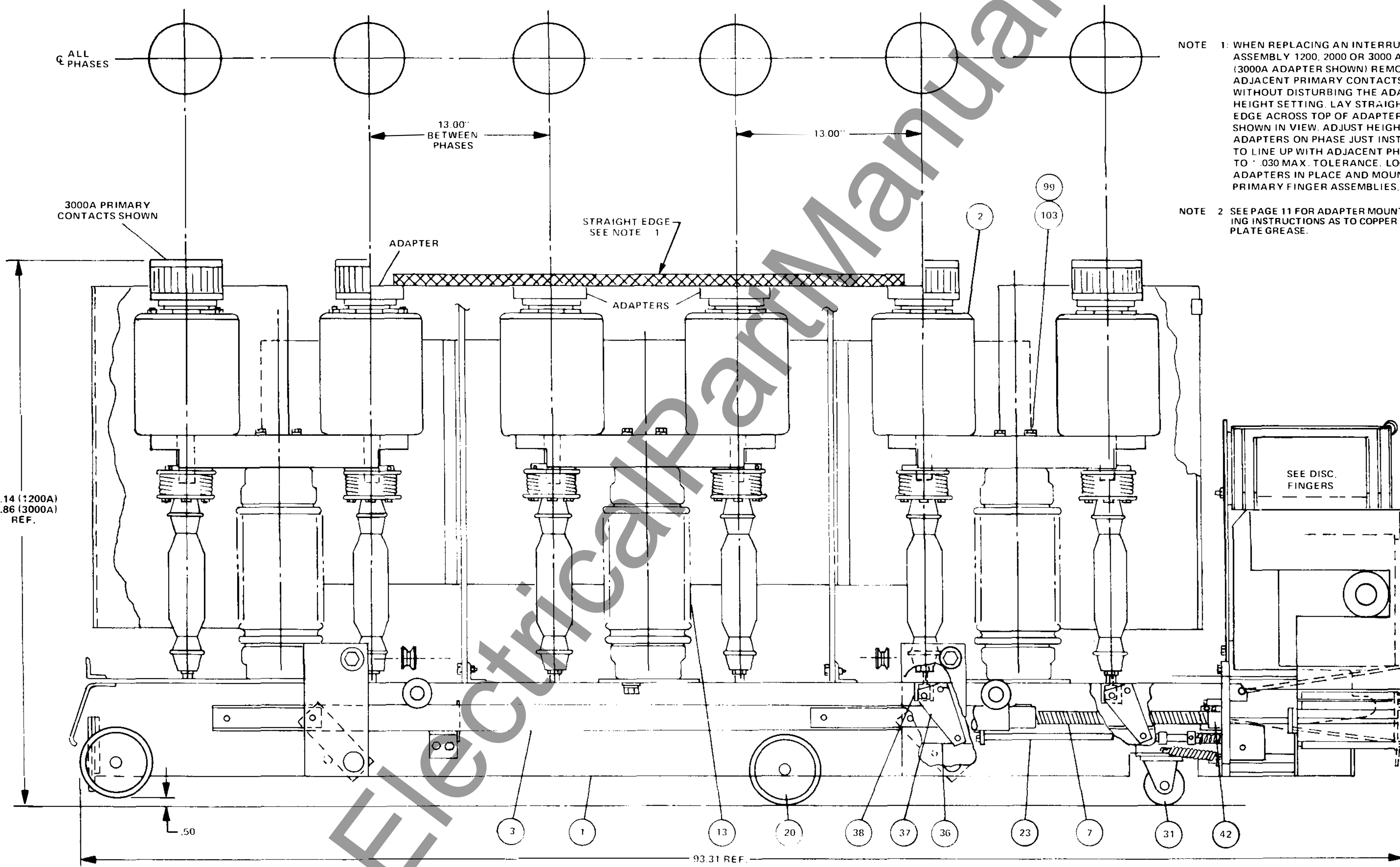


Fig. 3 – Vacuum Interrupter Assembly – One Pole
(1200 Amp Shown)



NOTE 1: WHEN REPLACING AN INTERRUPTER ASSEMBLY 1200, 2000 OR 3000 AMP (3000A ADAPTER SHOWN) REMOVE ADJACENT PRIMARY CONTACTS WITHOUT DISTURBING THE ADAPTER HEIGHT SETTING. LAY STRAIGHT EDGE ACROSS TOP OF ADAPTERS AS SHOWN IN VIEW. ADJUST HEIGHT OF ADAPTERS ON PHASE JUST INSTALLED TO LINE UP WITH ADJACENT PHASES TO ± .030 MAX. TOLERANCE. LOCK ADAPTERS IN PLACE AND MOUNT PRIMARY FINGER ASSEMBLIES.

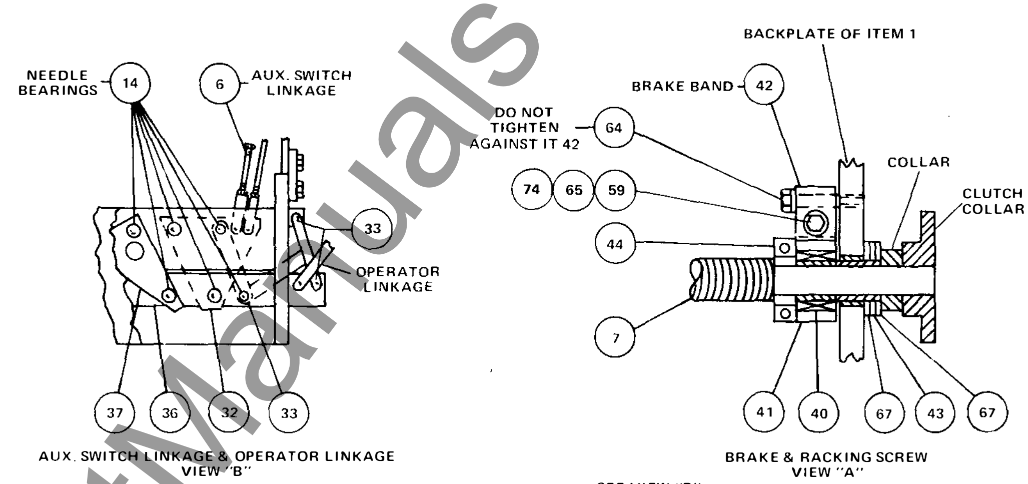
NOTE 2 SEE PAGE 11 FOR ADAPTER MOUNTING INSTRUCTIONS AS TO COPPER PLATE GREASE.

Fig. 4 – Side View – 34.5 kV Vacuum Breaker (Shown with Contacts Open)

NOTE #1: A 3/8-16 x 12" LG. THREADED ROD WITH 2 HEX NUTS AND A LOCKNUT ARE SHOWN AS USED FOR MAINTENANCE ONLY. IMPORTANT: SEE ITEM 4 OF INSTRUCTIONS ON PAGE 11 FOR HOW USED.

REMOVE AFTER MAINTENANCE PERFORMED

IF REMOVAL IS INADVERTENTLY OVERLOOKED, BREAKER CANNOT BE TRIPPED OPEN AND YOU WILL BE UNABLE TO RACK BREAKER DOWN OFF THE RACKING ARMS.



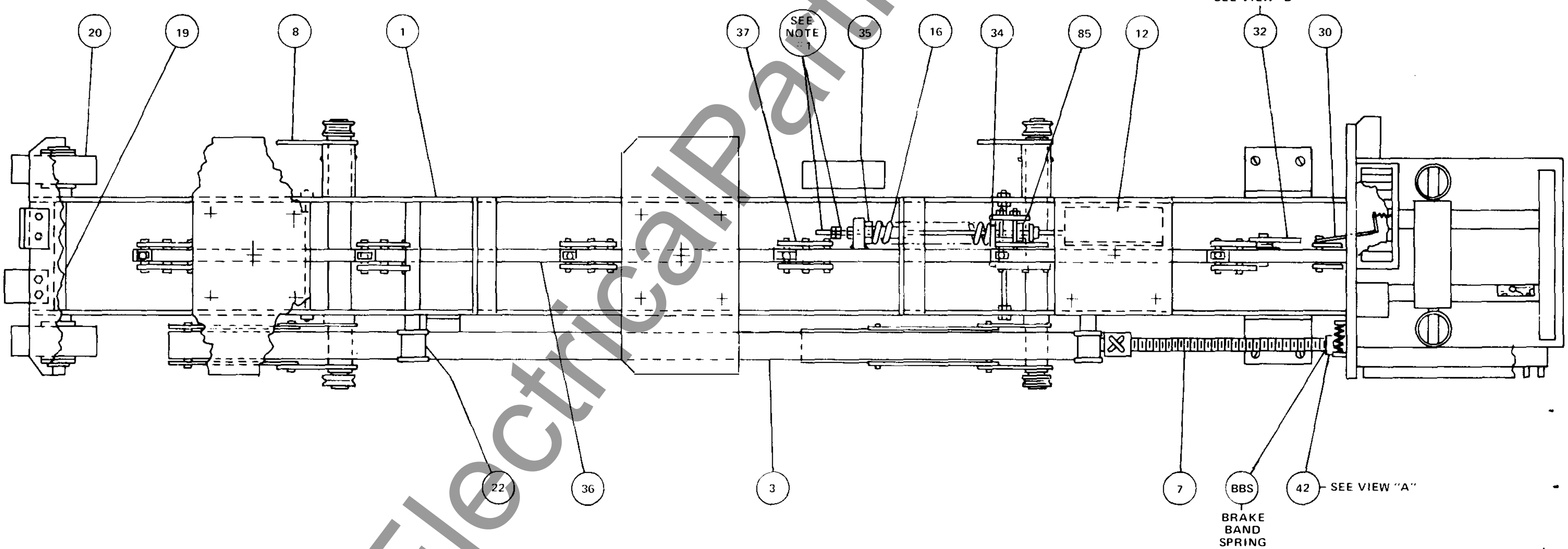


Fig. 5 — Truck Frame Assembly (Plan View)

NOTE: IF CLUTCH SLIPS DURING THE RACKING OPERATION

1. LOOK FOR MISALIGNMENT OR BINDING OF BREAKER IN CUBICLE. ALSO CHECK FOR ANY FOREIGN OBJECT WHICH MAY HAVE BEEN LEFT IN OR ON EQUIPMENT OR POSSIBLY IMPROPER REASSEMBLY AFTER MAINTENANCE.
2. ADJUST CLUTCH BY FIRST STRAIGHTENING HOLDING TAB, THEN ADJUSTING THE TORQUE ADJUSTING NUT SO THAT CLUTCH SLIPS AT 240 TO 260 INCH POUNDS WITH CLUTCH COLLAR HELD FIXED. LOCK ADJUSTING NUT BY BENDING HOLDING TAB BACK OVER THE TOP OF THE TORQUE ADJUSTING NUT.

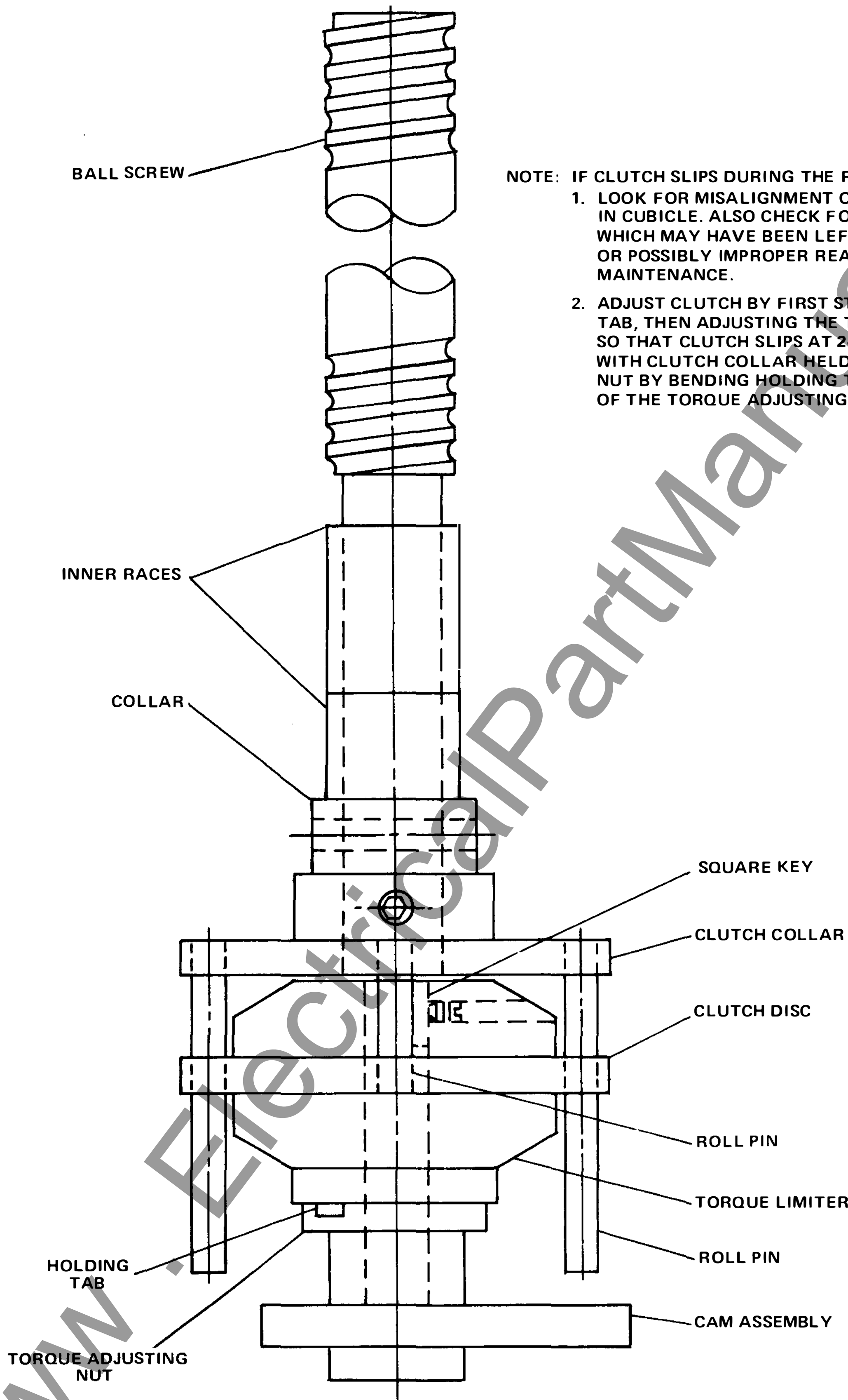


Fig. 7 – Clutch and Screw Assembly

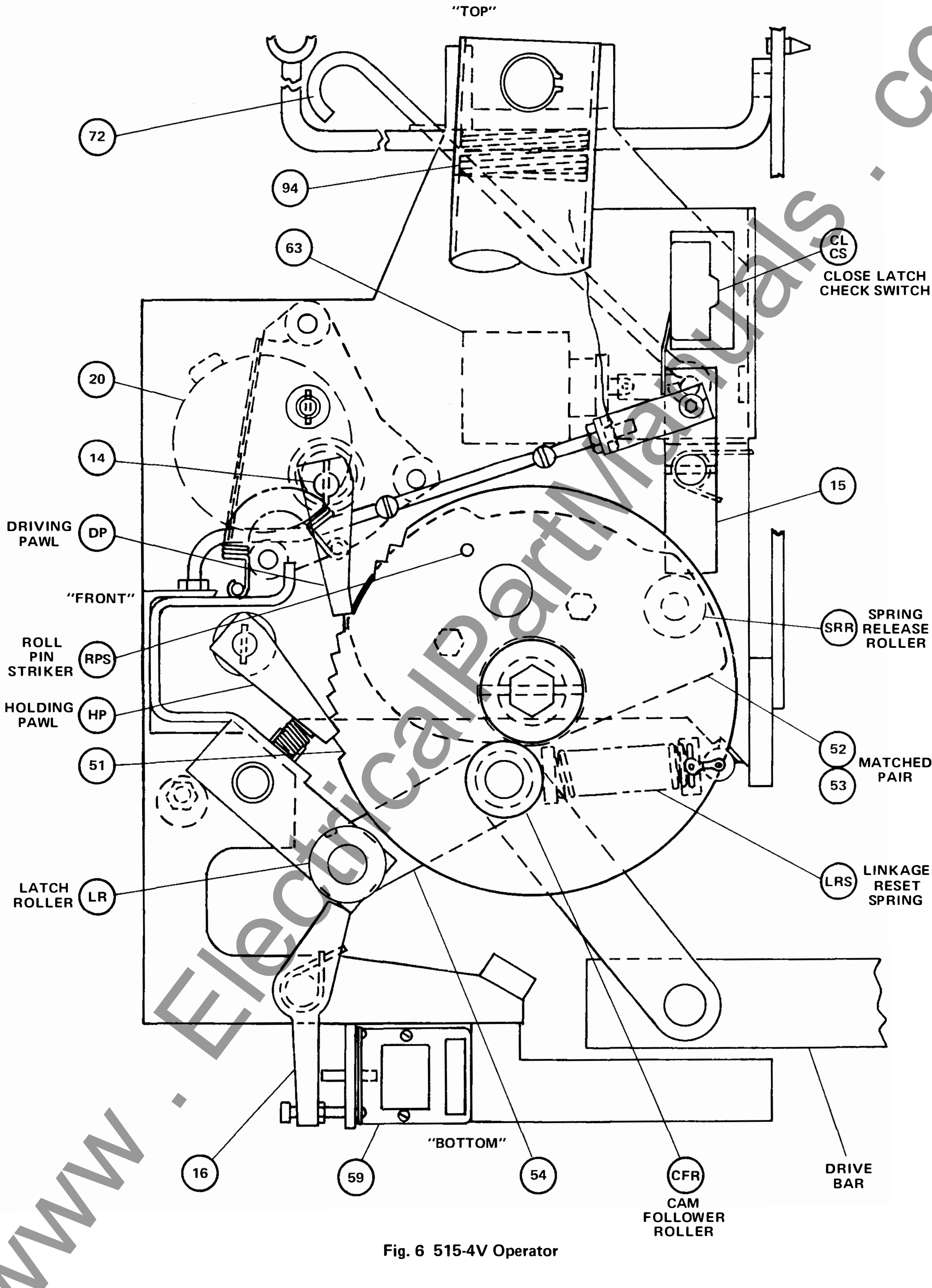


Fig. 6 515-4V Operator

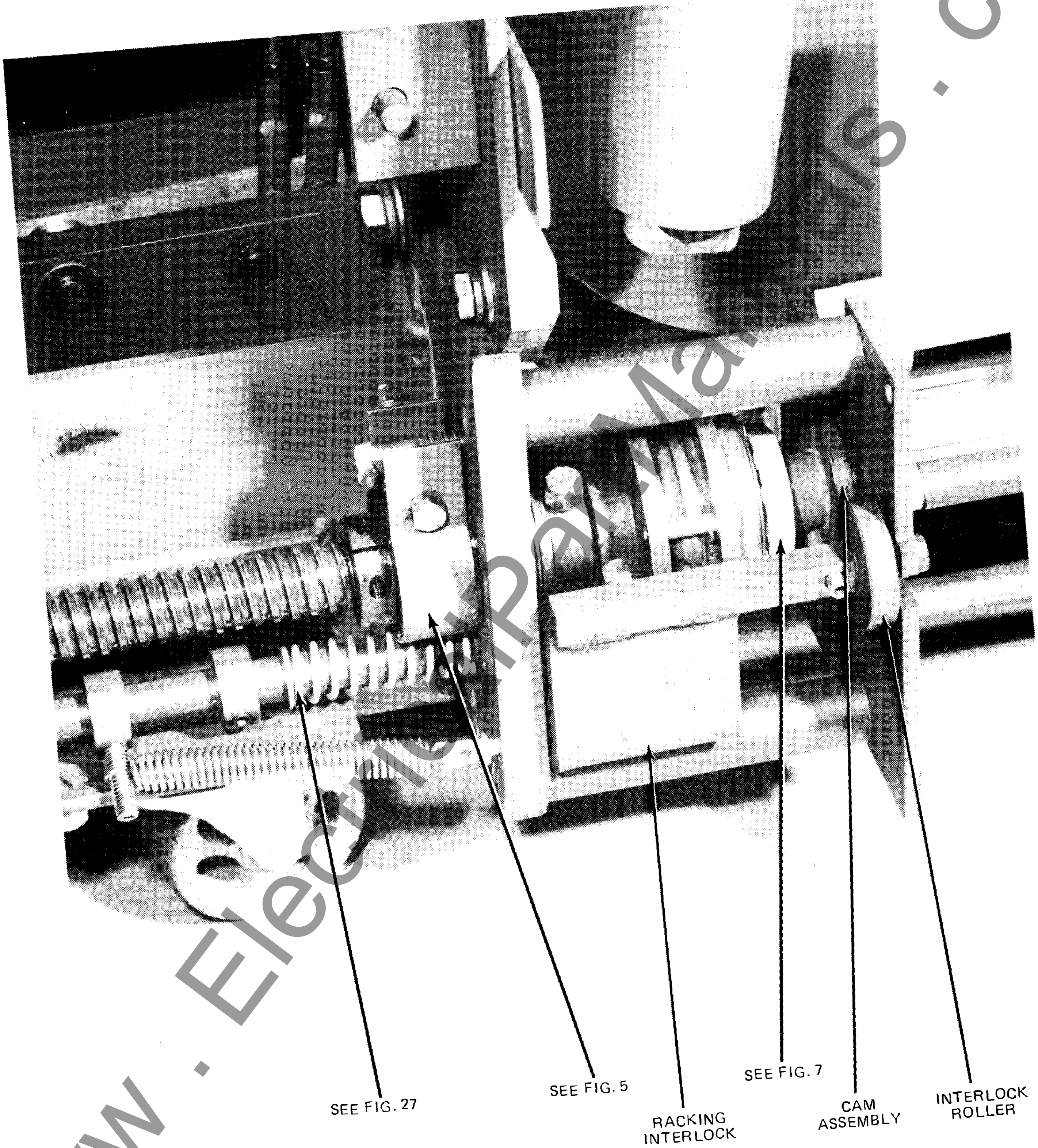


Fig. 8 — Clutch and Brake Assembly

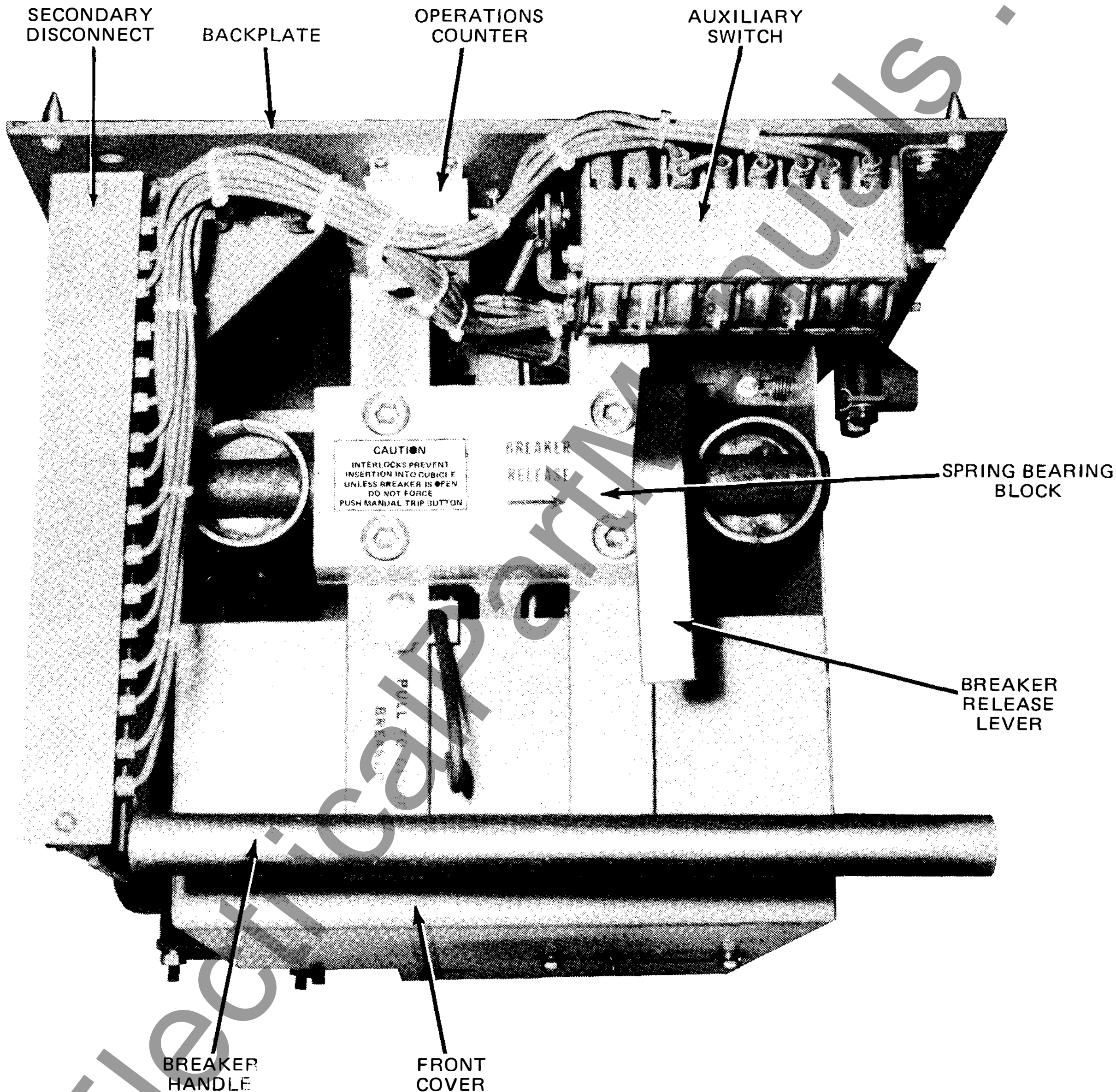


Fig. 9 — 515-4V Operator — Top View

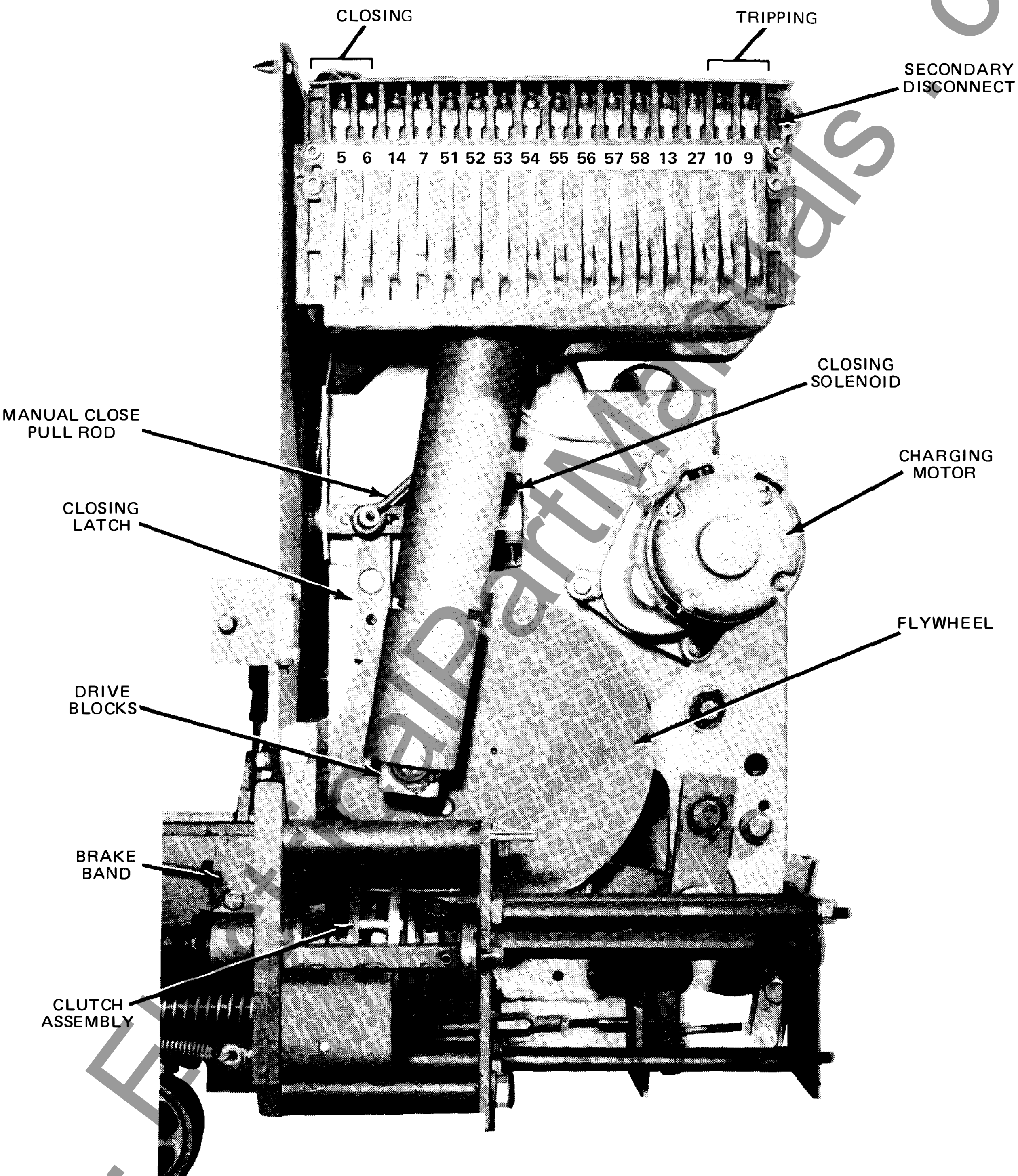


Fig. 10 – 515-4V Operator – L.H. View

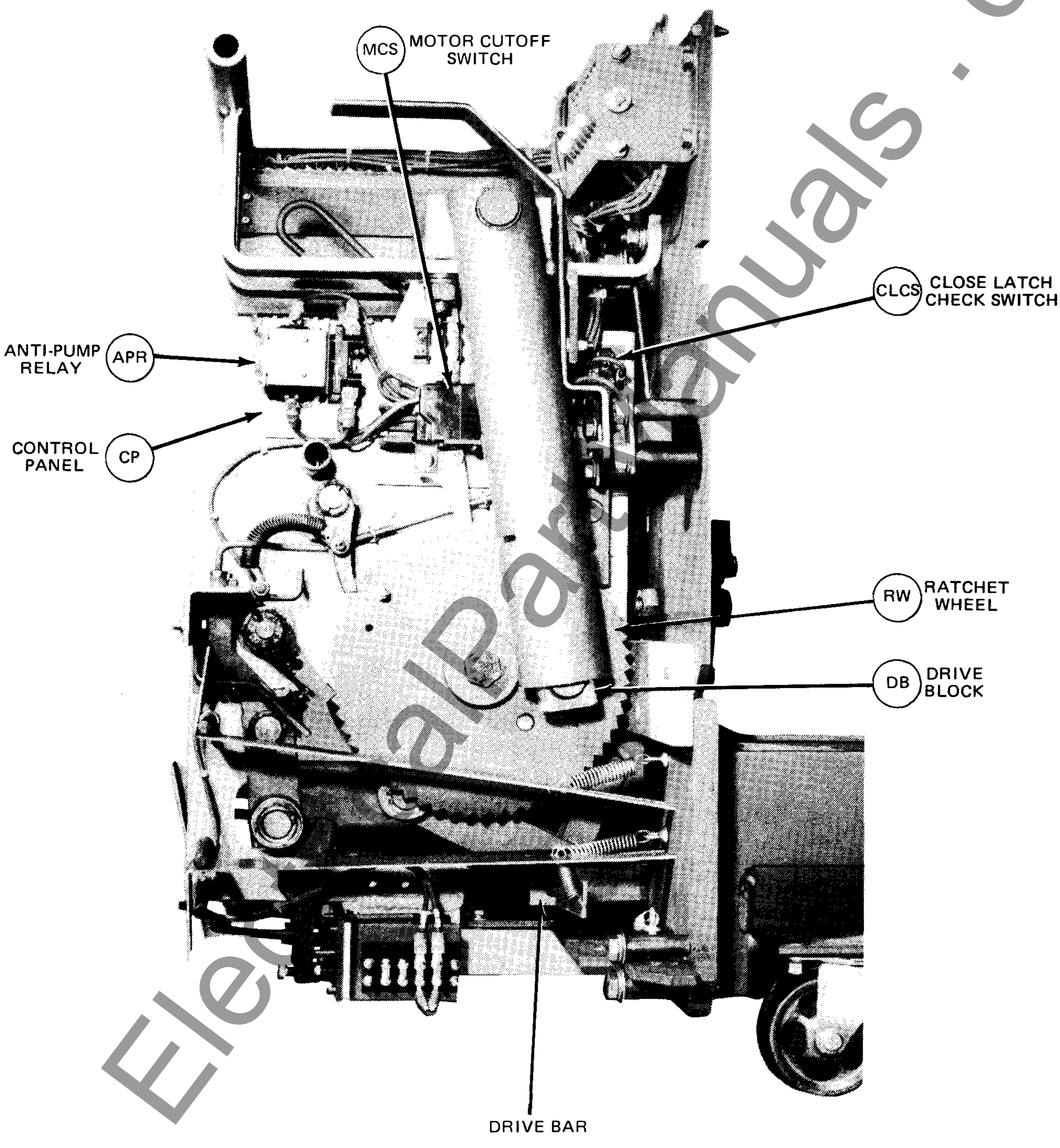


Fig. 11 – 515-4V Operator – R.H. View

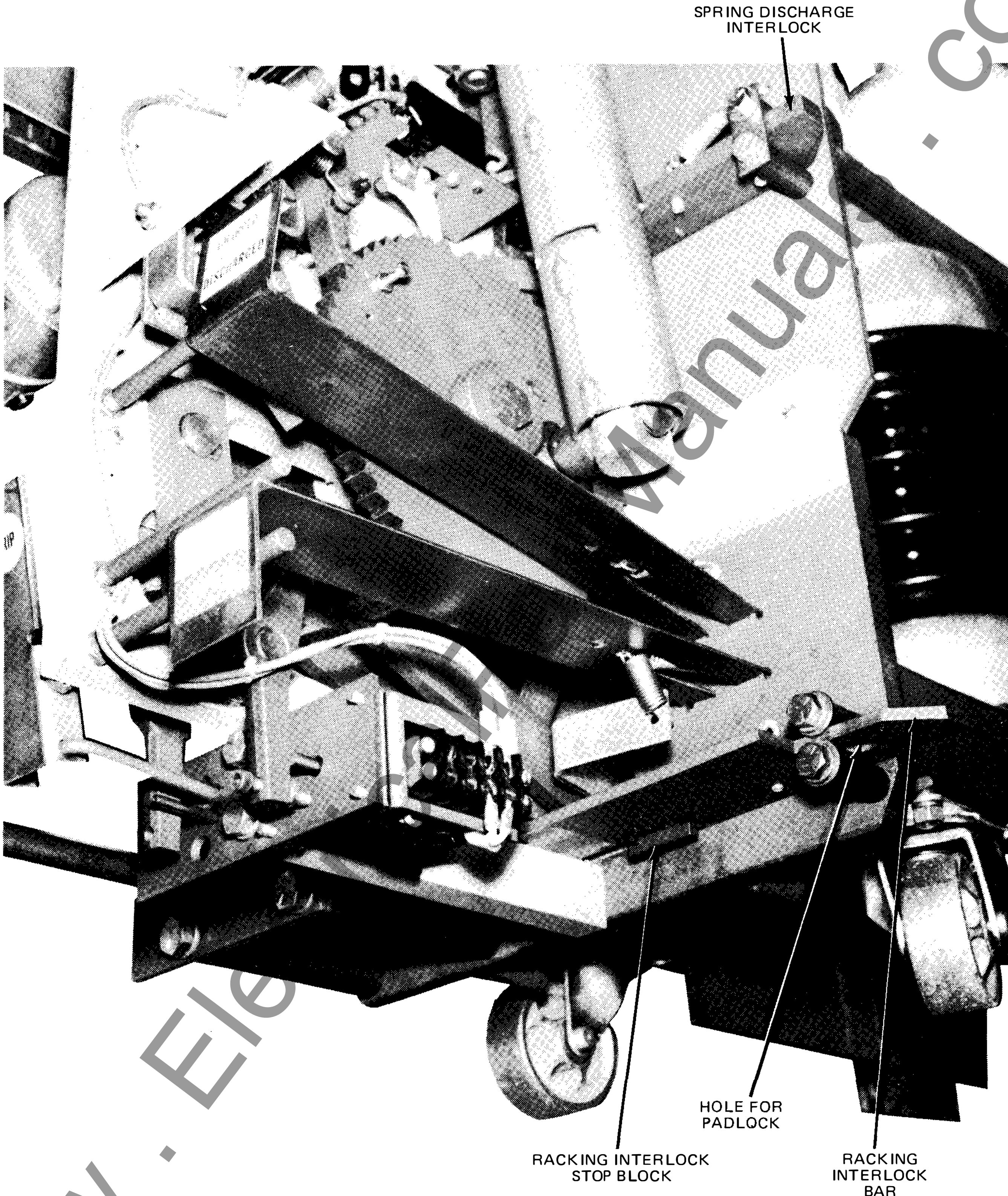


Fig. 12 – 515-4V Operator – R.H. View
(From Below)

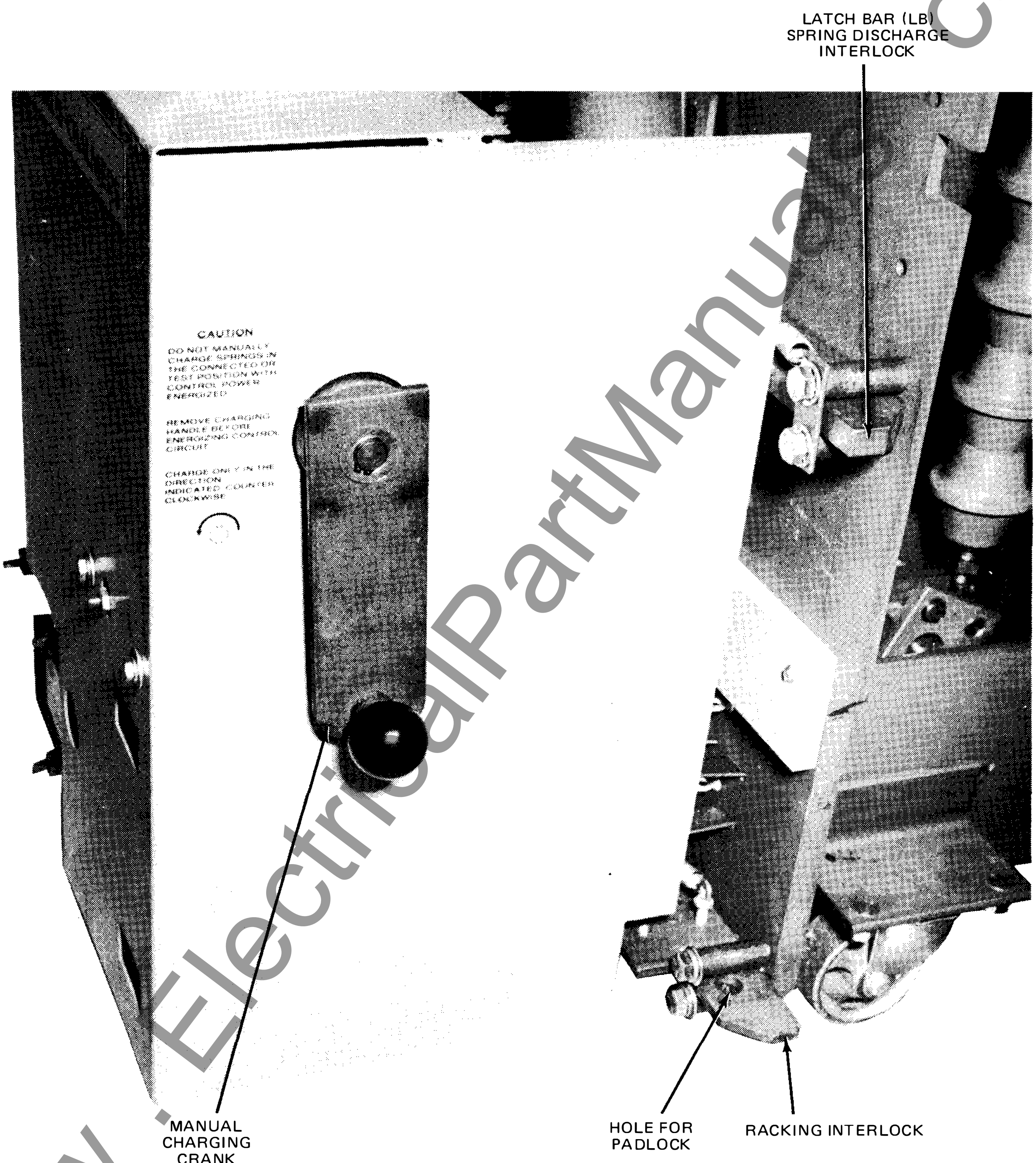


Fig. 13 – 515-4V Operator – R.H. Side View with Cover and Opening for Manual Charge Crank

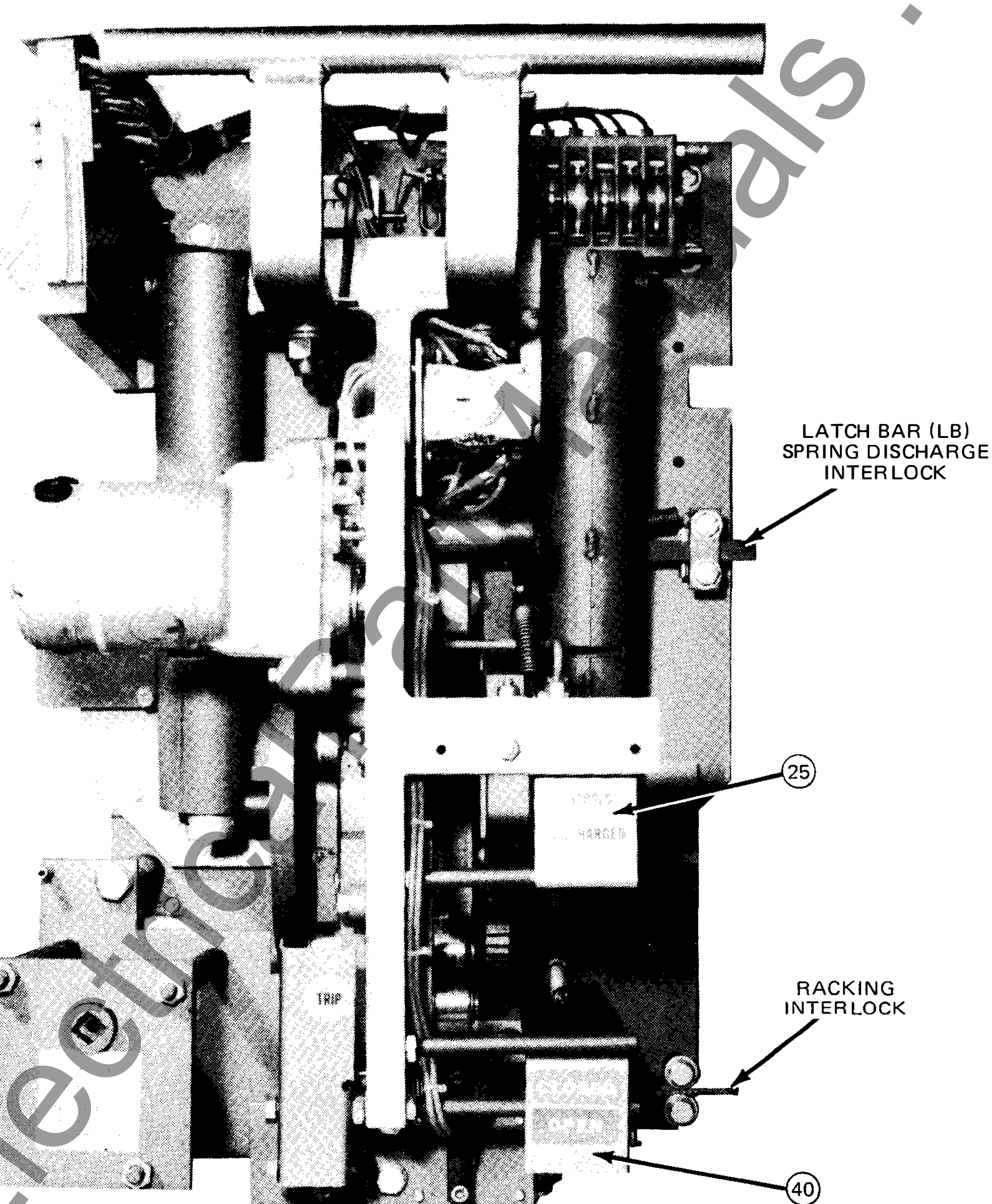


Fig. 14 – 515-4V Operator – Front View

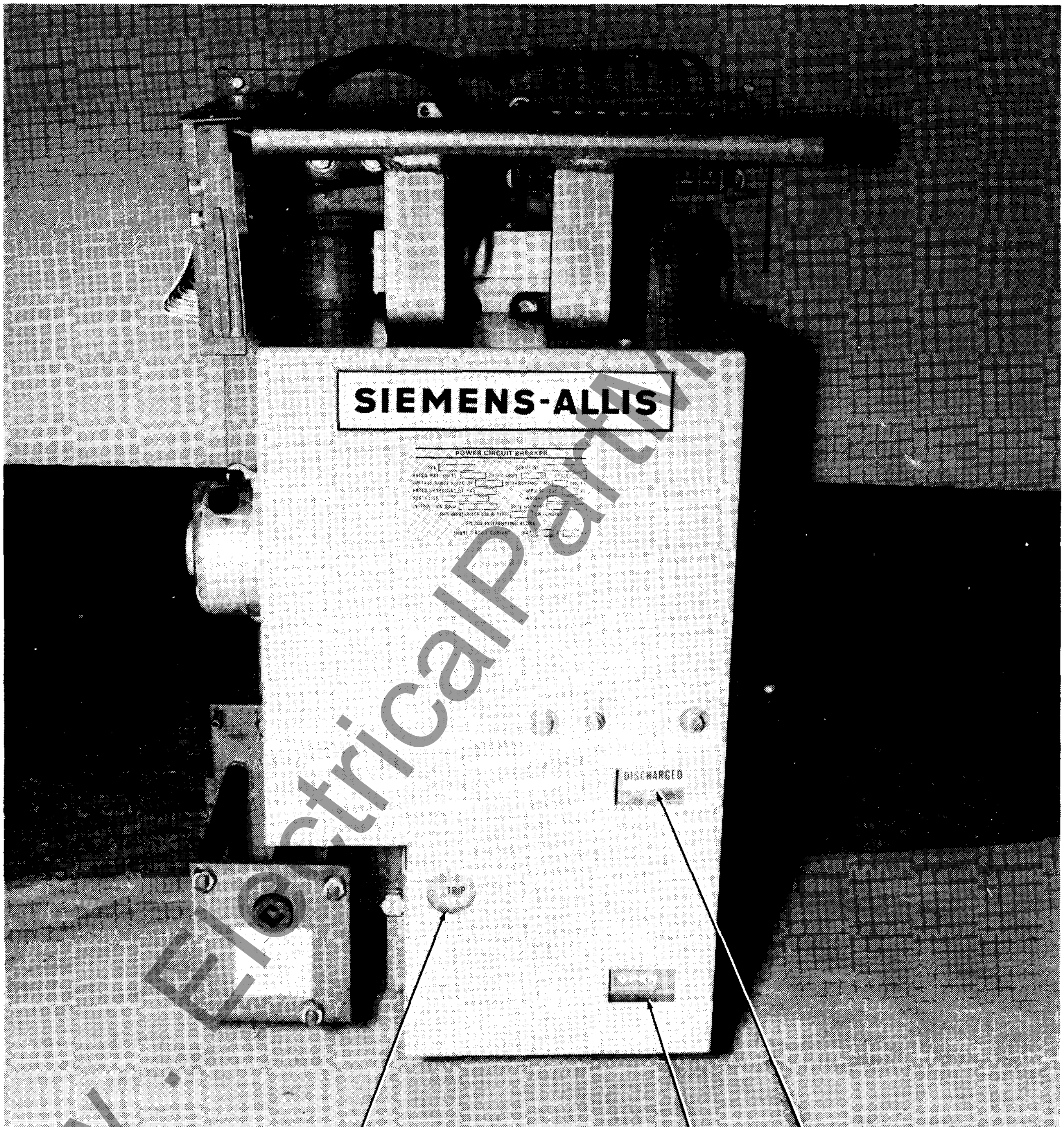
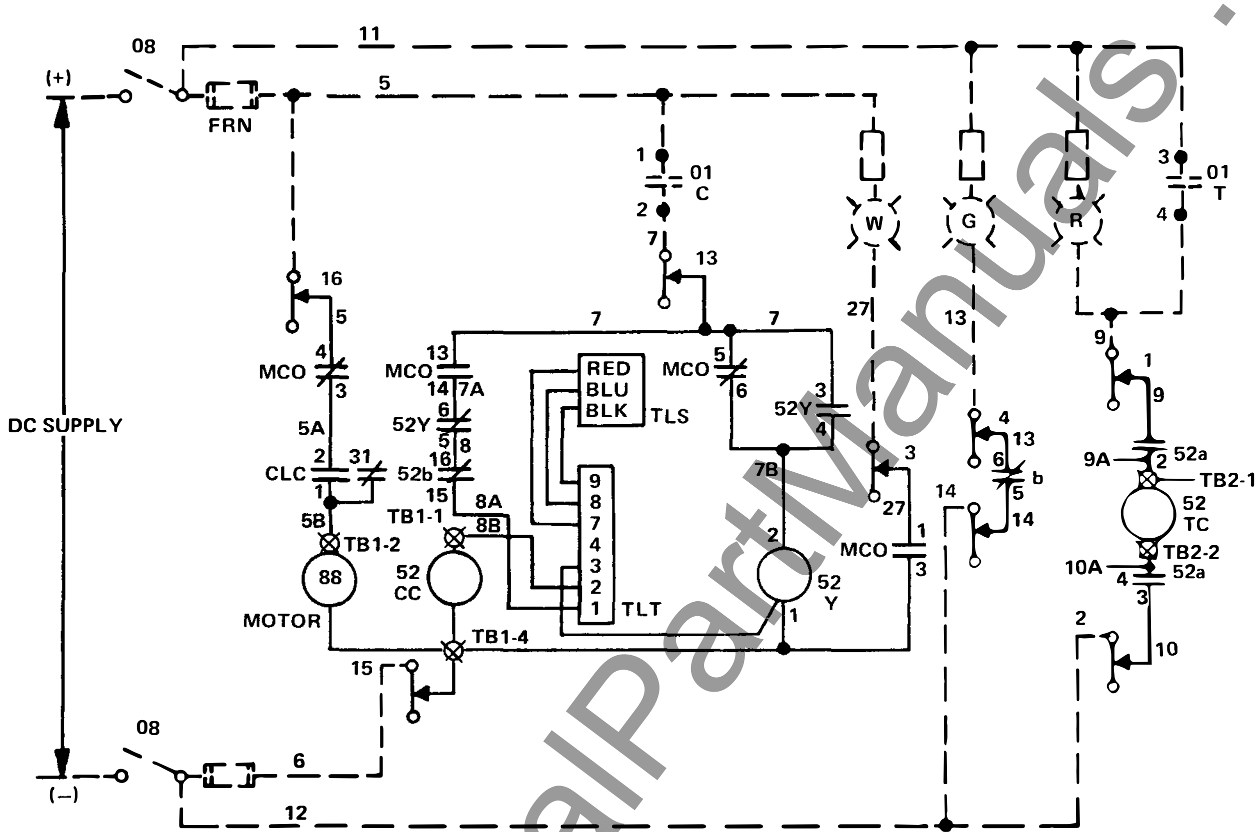


Fig. 15 — 515-4V Operator — Front View with Cover



NOTE: SEE FIG. 10 FOR TERMINAL NUMBERS.

*OPTIONAL ITEMS FURNISHED FOR RECLOSING APPLICATIONS ONLY.

52TC – CIRCUIT BREAKER TRIP COIL
52CC – CIRCUIT BREAKER CLOSING COIL
52Y – AUX. CLOSING RELAY (ANTI-PUMP)
MCO – MOTOR CUTOFF SWITCH
CLC – CLOSE LATCH CHECK SWITCH
*TLS – TRIP LATCH SENSOR
*TLT – TRIP LATCH TIMER
01/C – CONTROL SWITCH – CLOSE CONTACT
01/T – CONTROL SWITCH – TRIP CONTACT
R – RED INDICATING LAMP
G – GREEN INDICATING LAMP
W – WHITE INDICATING LAMP
88 – MOTOR
52a – AUX. SWITCH – OPEN WHEN BREAKER IS OPEN
52b – AUX. SWITCH – CLOSED WHEN BREAKER IS OPEN

Fig. 16 – Control Scheme (Typical)

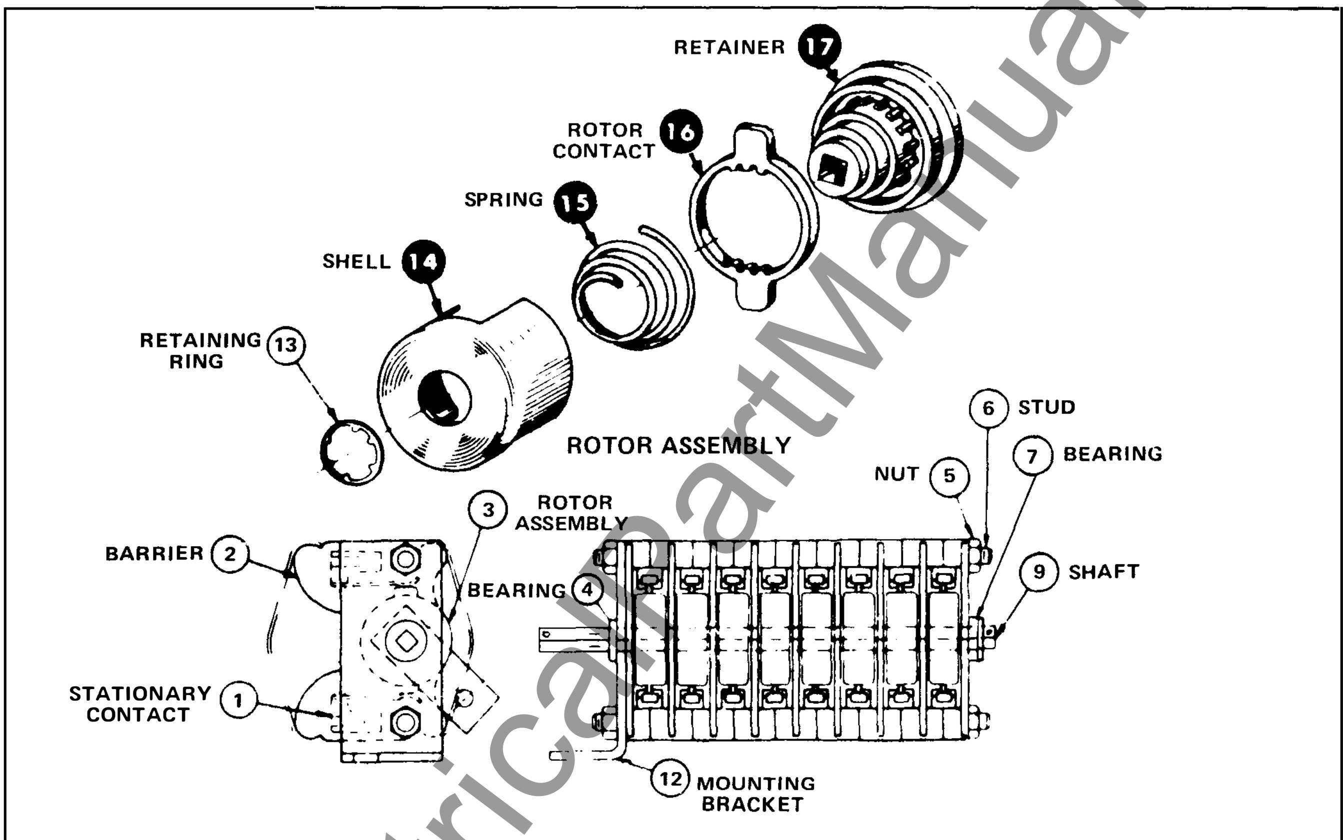


Fig. 17 — Type Q-10 Auxiliary Switch

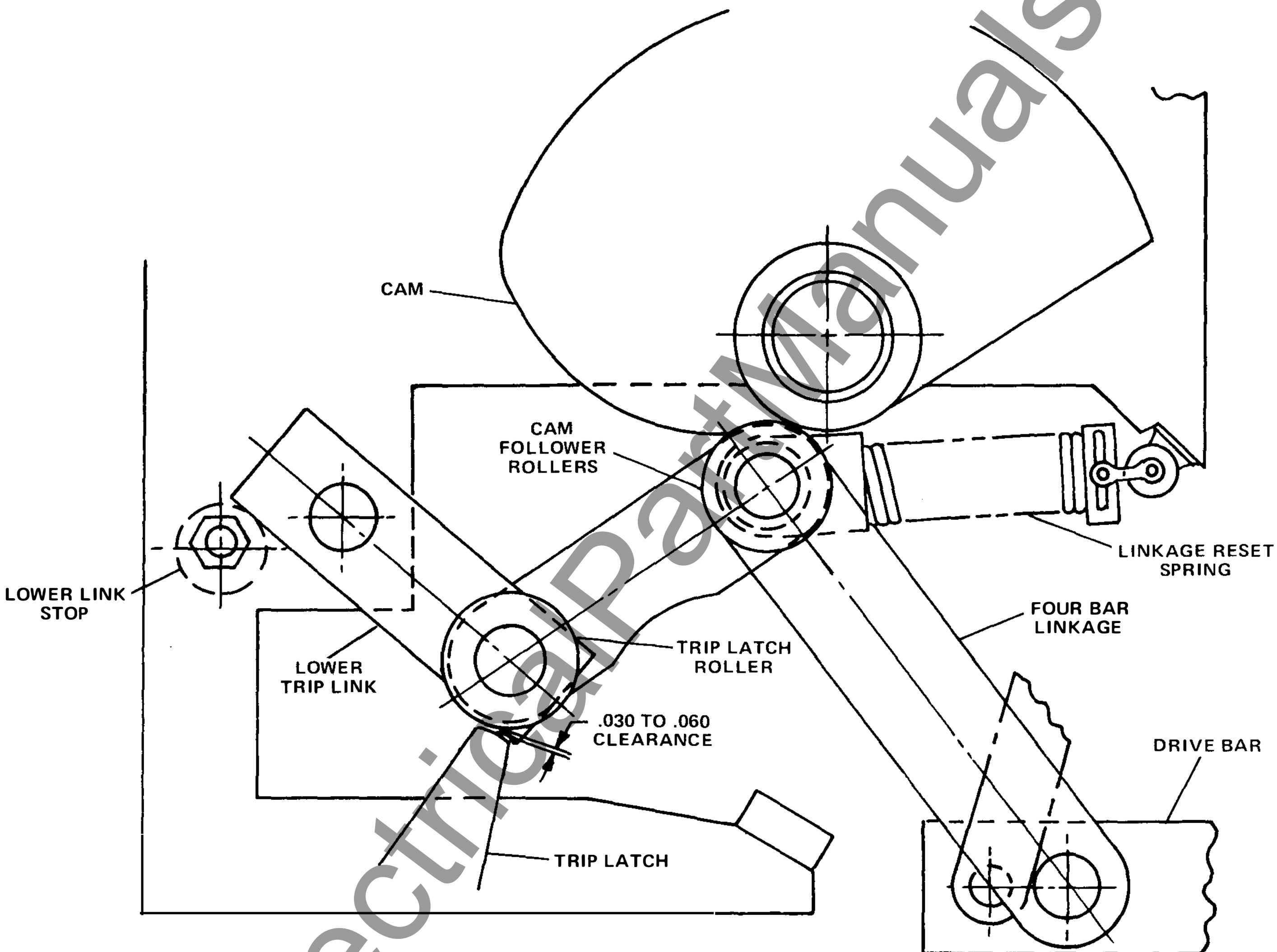
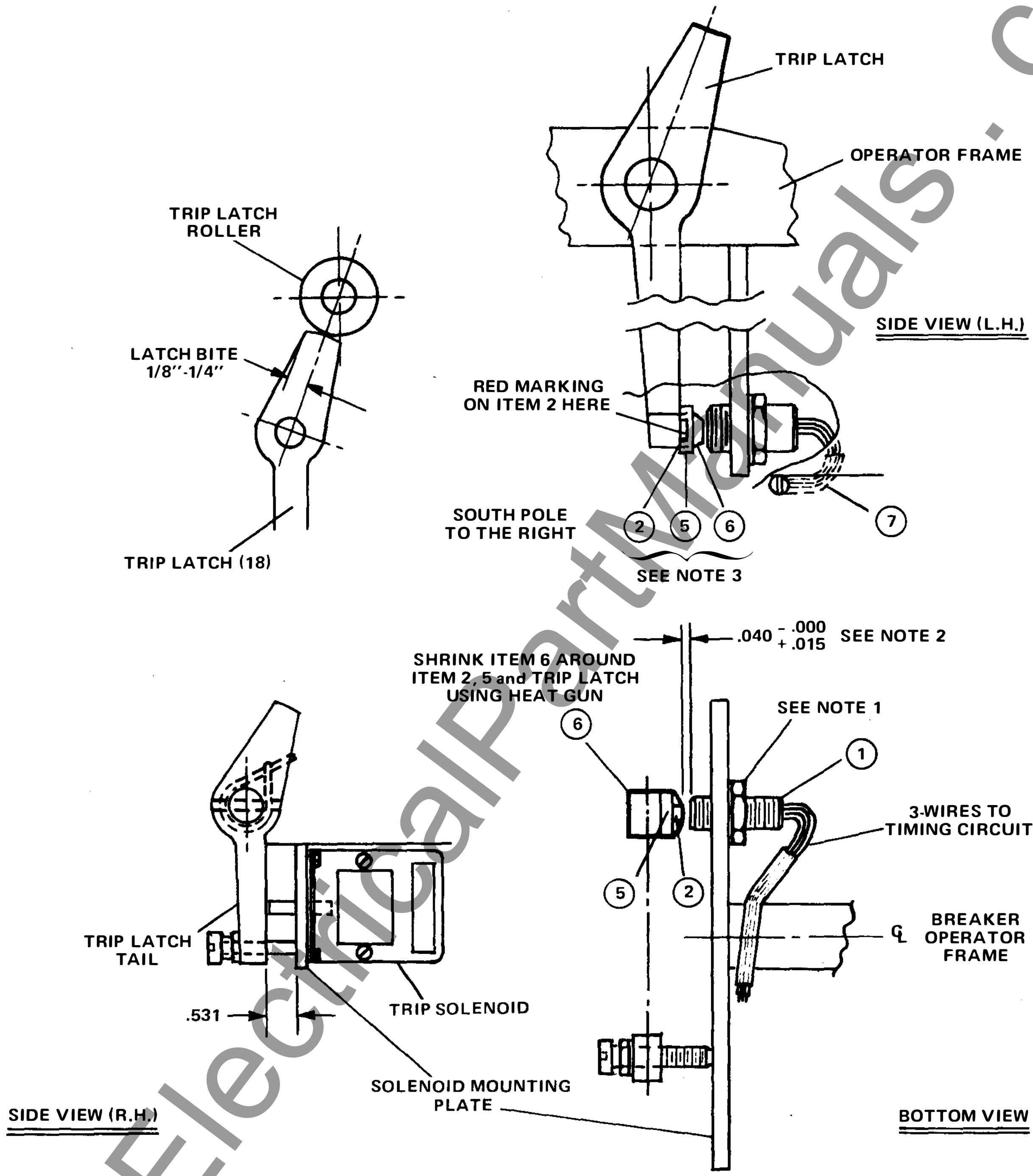


Fig. 18 — Trip Latch Clearance Adjustment



NOTES:
1. TORQUE LIMIT ON ITEM 1 = 60 IN. LBS. LOCKTITE USED ON THREADS
2. SET GAP ONLY AFTER FIRST ESTABLISHING LATCH BITE.
   IMPORTANT: THIS GAP DIMENSION MUST BE BETWEEN THE HALL EFFECT SWITCH BASE AND TOP OF SHRINK TUBING AS SHOWN.
3. PRESS ITEM 2 INTO ITEM 5 BEFORE SHRINKING ITEM 6 ALL AROUND.

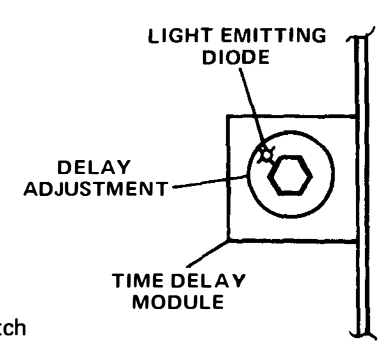


Fig. 19 – Trip Latch Bite and Latch Check Switch

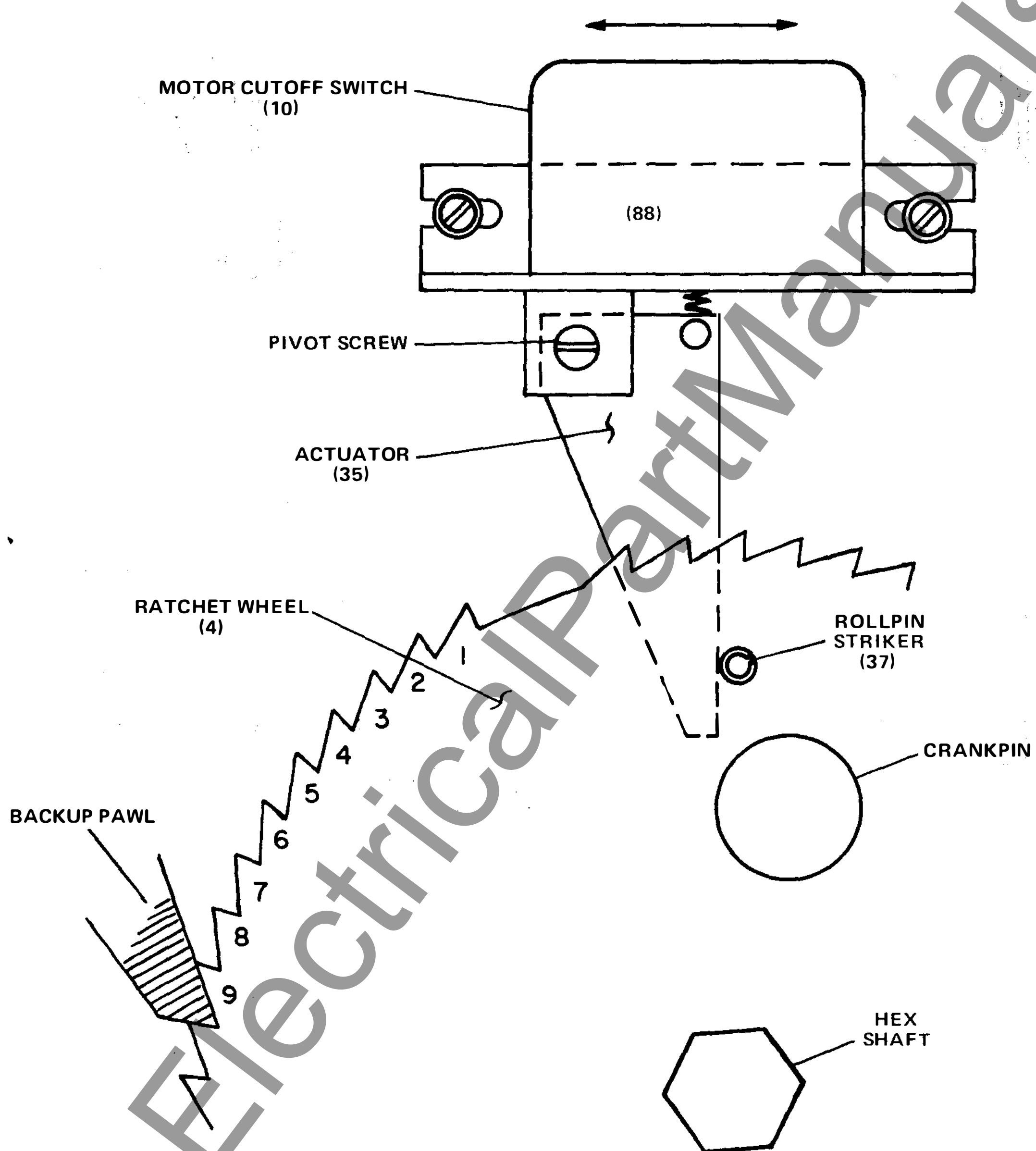


Fig. 20 — Motor Cutoff Switch

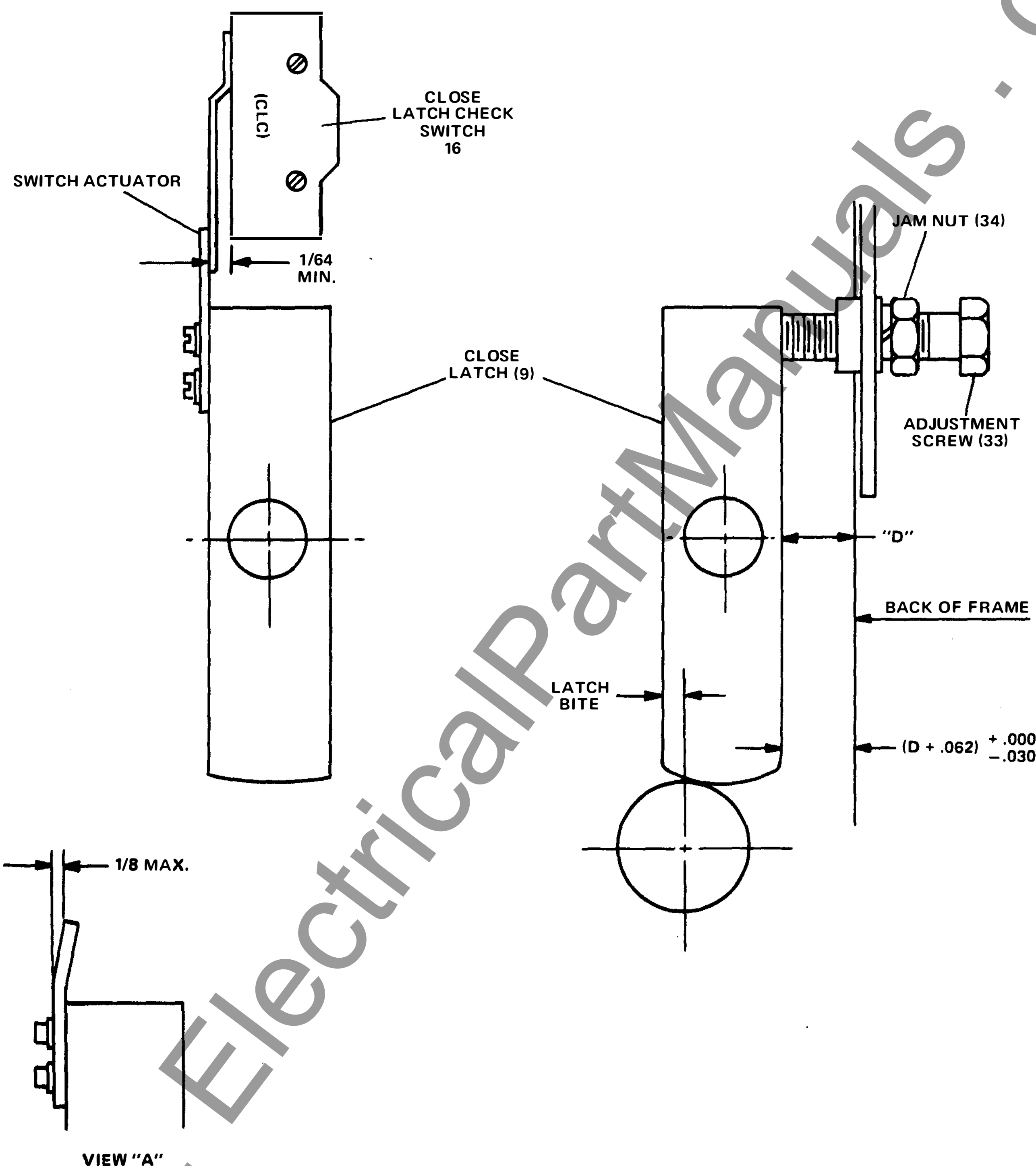


Fig. 21 – Close Latch Bite and Check Switch Adjustments

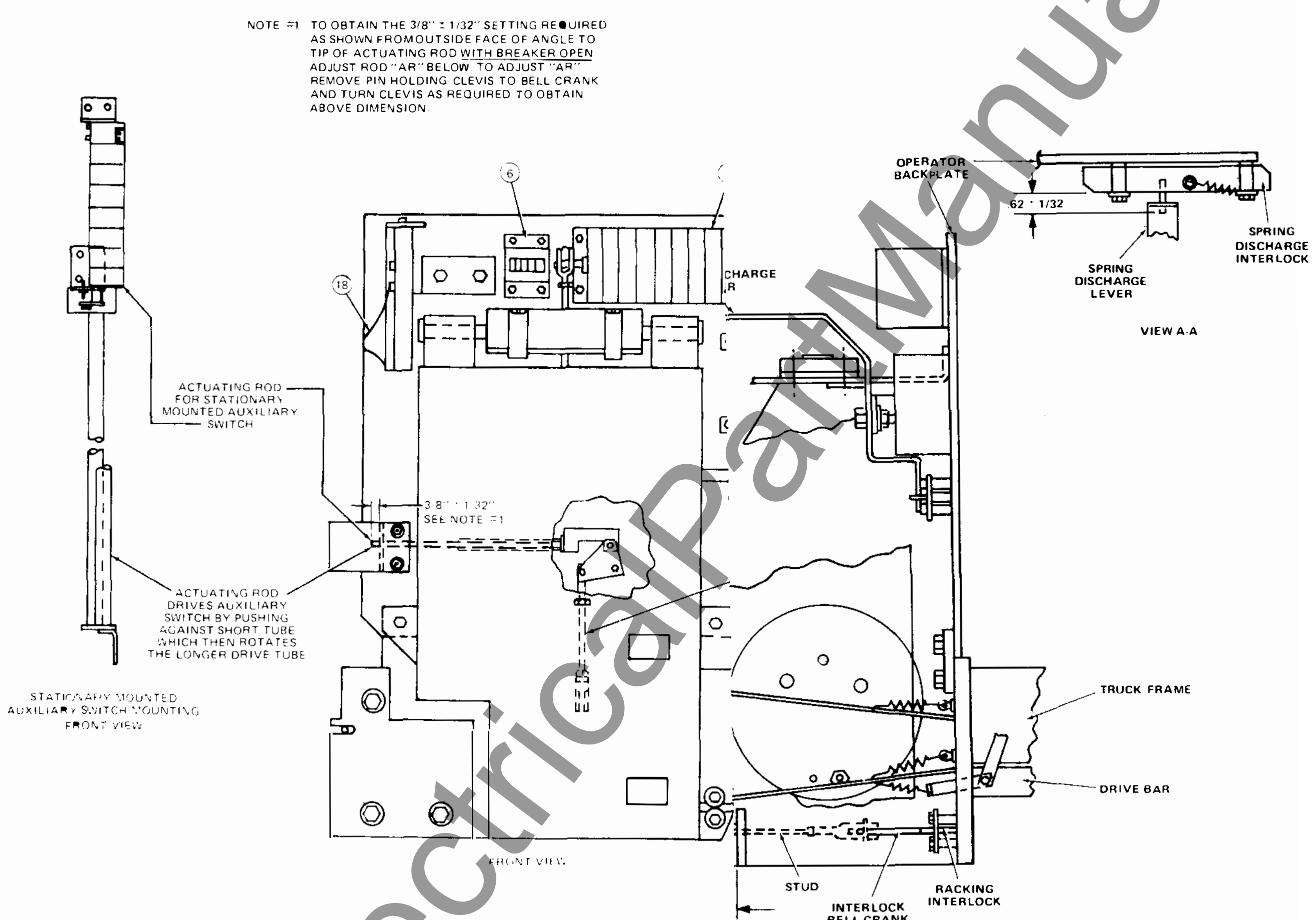
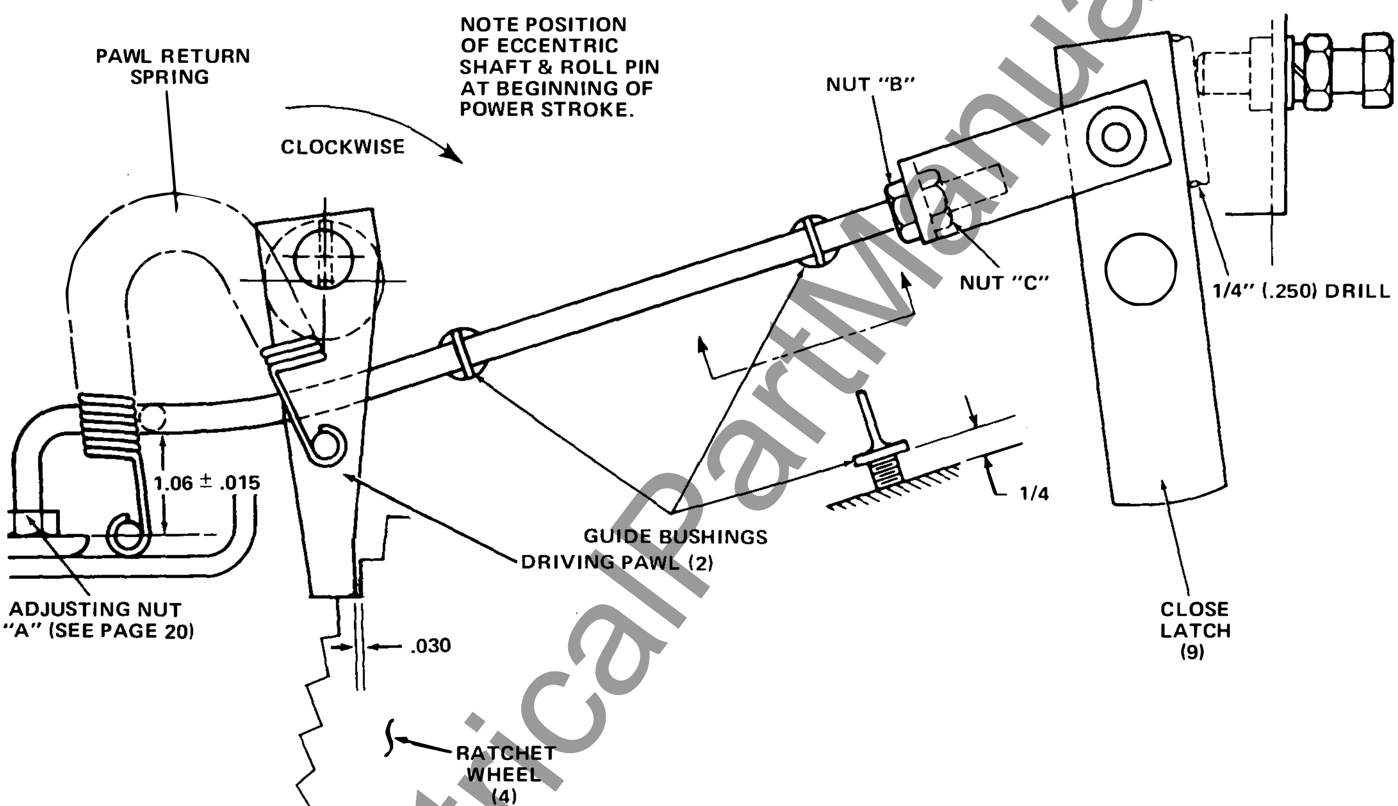


Fig. 22 – Auxiliary Swi
tor Assemblies



REMOVE 1/4 (.250) DRILL, RESTORING LATCH TO ITS NORMAL POSITION. AGAIN ROTATE ECCENTRIC DRIVE SHAFT. THE TIP OF THE DRIVE PAWL SHOULD ENGAGE THE FULL FACE OF EACH RATCHET TOOTH, A CLEARANCE OF .030 BETWEEN THE BASE OF THE TOOTH & THE ENGAGED TIP OF THE DRIVE PAWL.

Fig. 23 – Close Latch Mechanical Interlock

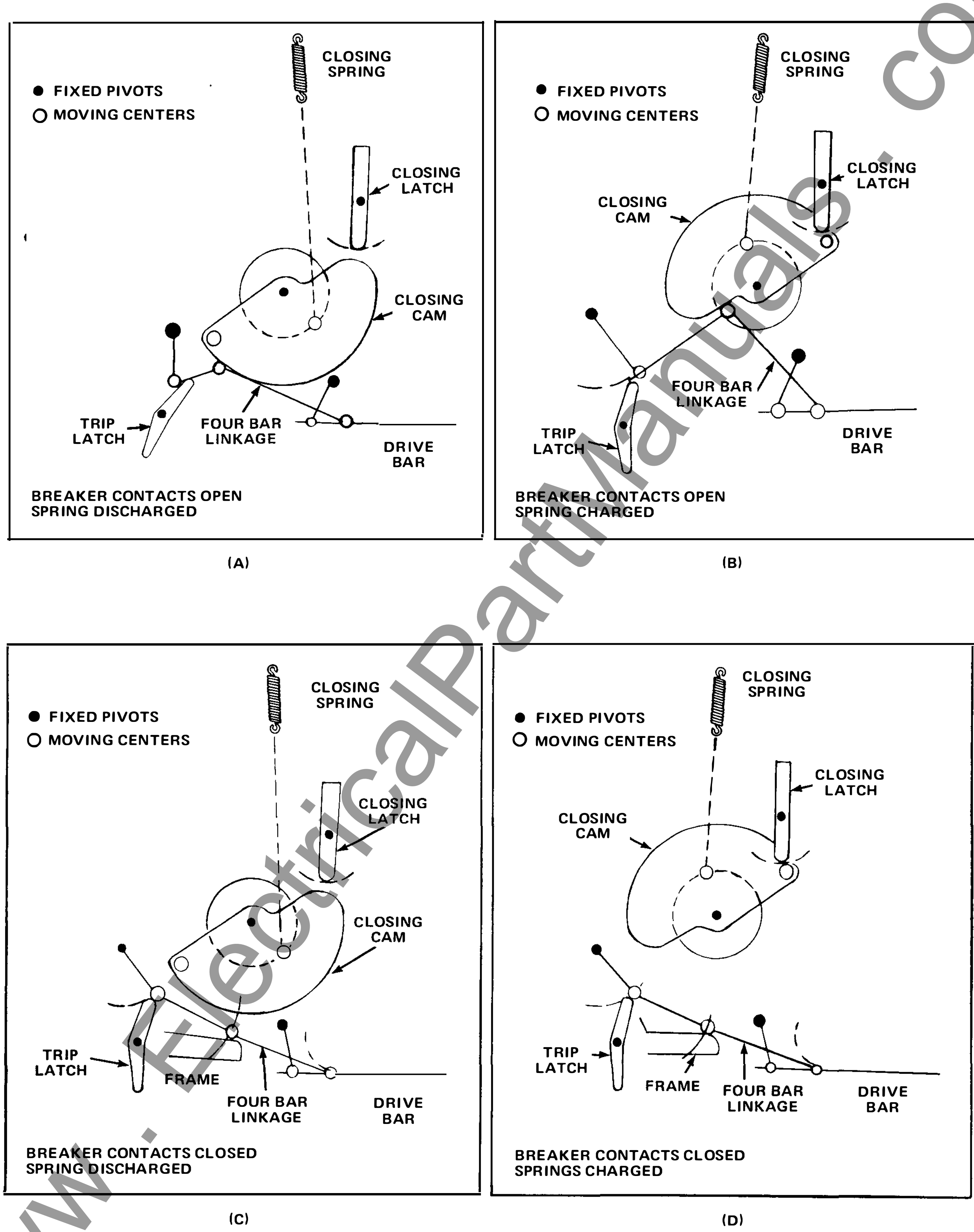
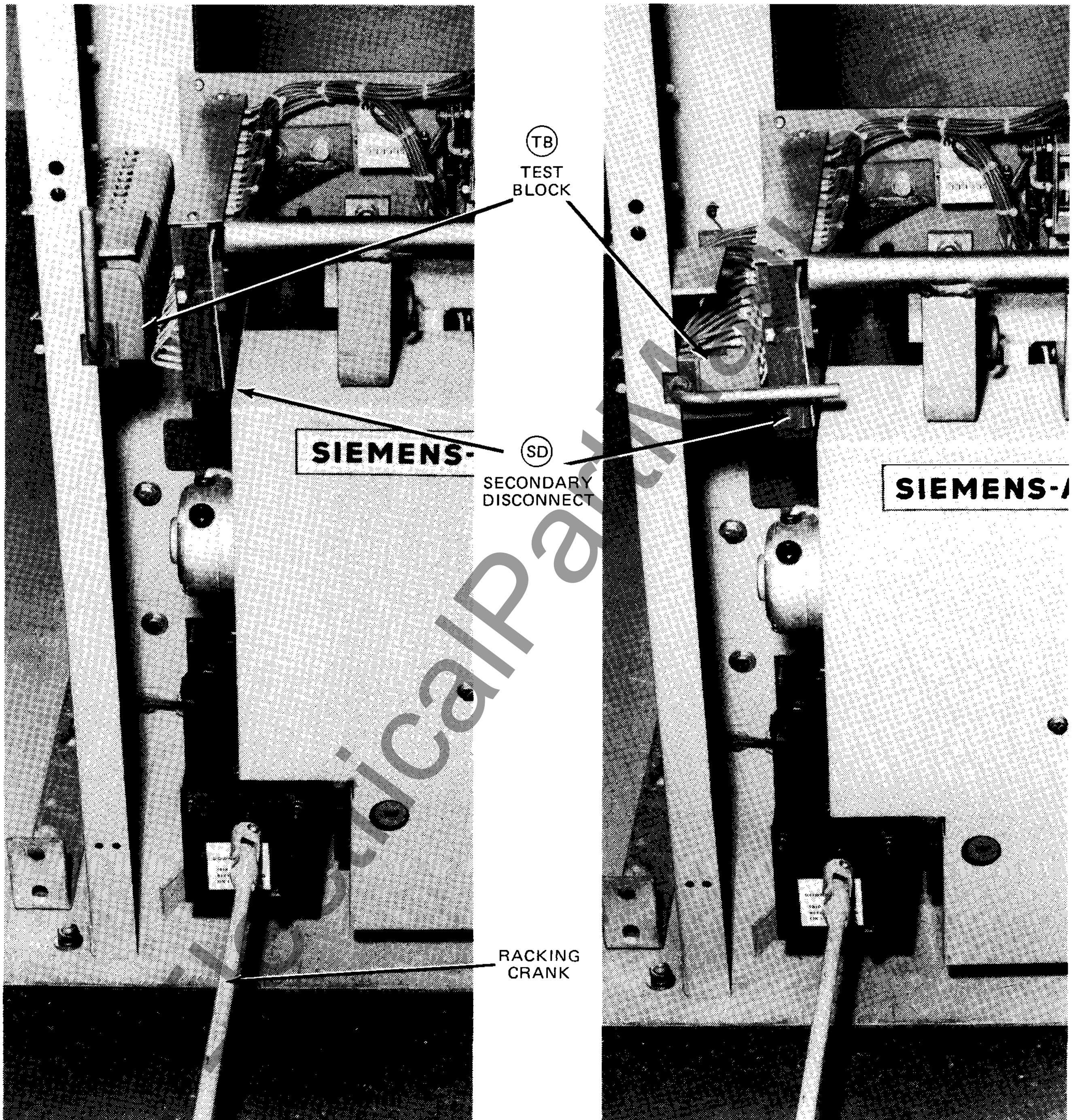


Fig. 24 Sequence of Operation



"A"
TEST BLOCK IN DISCONNECT POSITION

"B"
TEST BLOCK IN CONNECT POSITION

Fig. 25 – Breaker is Shown Racked into Cubicle and in Disconnect/Test Position

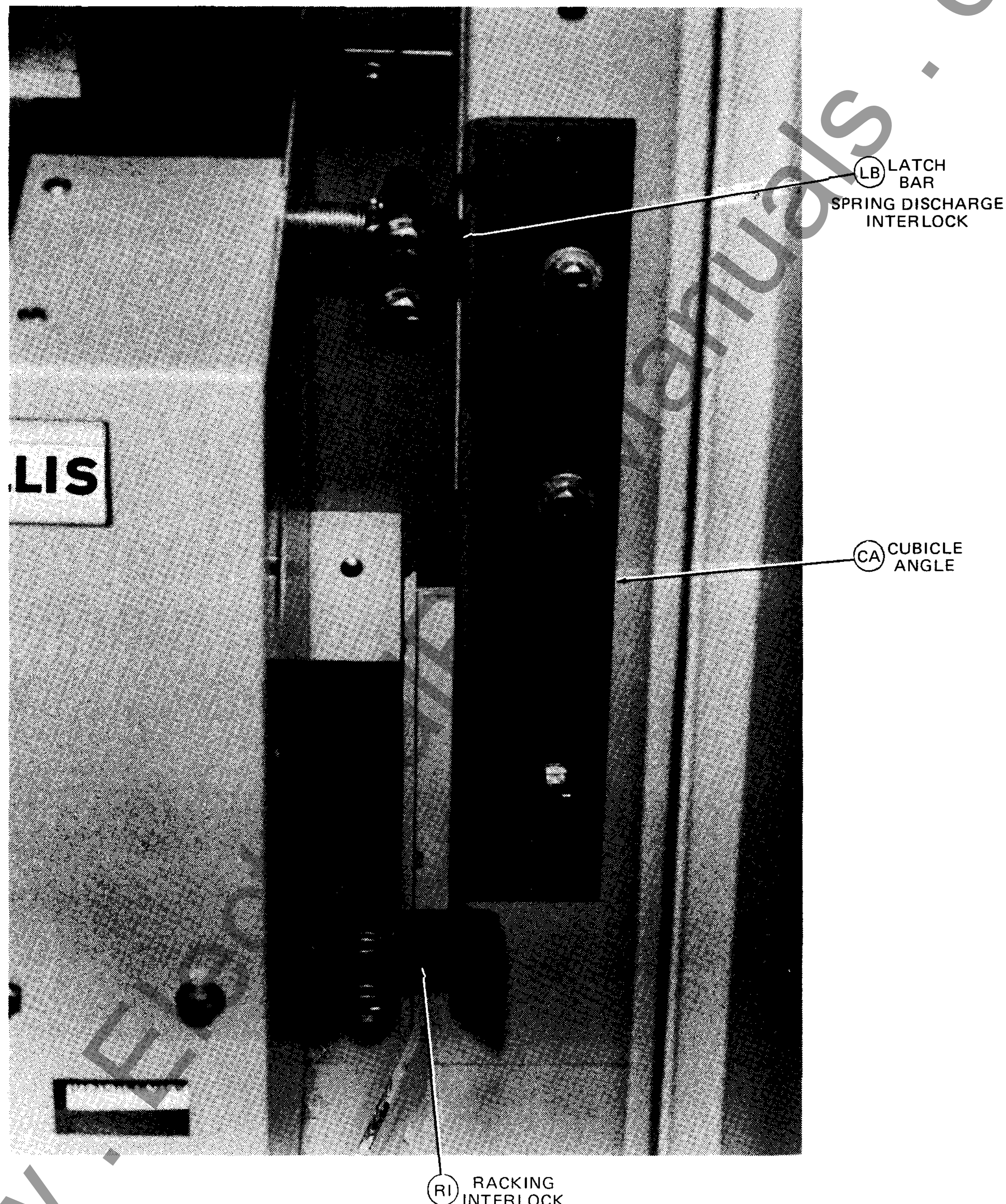


Fig. 26 – Mechanical Interlocks