ALLIS-CHALMERS CONTROLS

INSTRUCTIONS

TYPE "D"
GROUND AND TEST DEVICE
Used With
5-Kv Metal-Clad Switchgear

BWX-6735

18X3090

INDEX

ILLUSTRATIONS

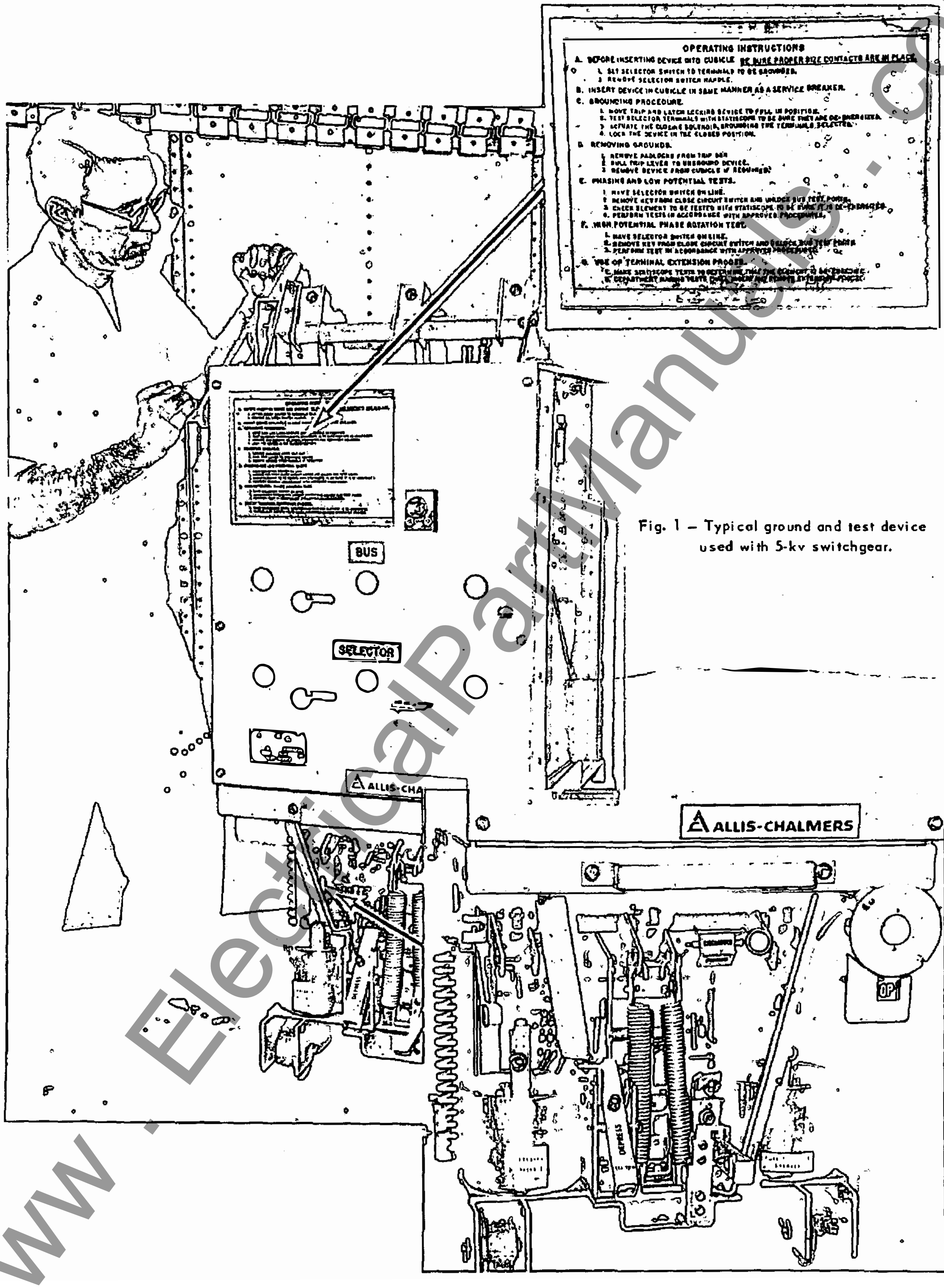


Fig. 1 — Typical ground and test device used with 5-kv switchgear.

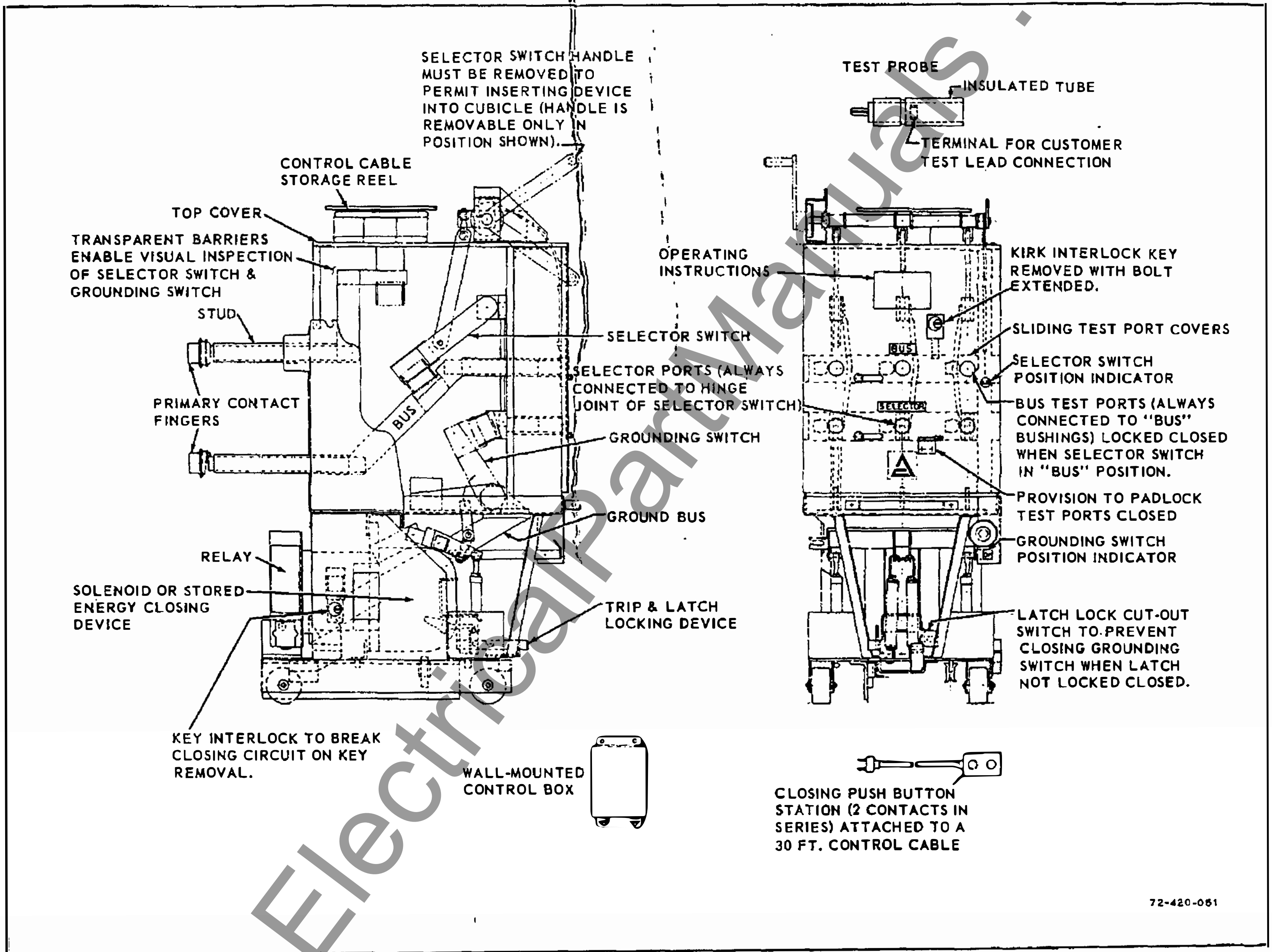


Fig. 2 – Typical 5-kv ground and test device

INTRODUCTION

This instruction manual provides operation and maintenance information for power operated grounding and test devices used with 5-kv metal-clad switchgear.

WARRANTY

The sales contract carries all information on warranty coverage.

DESCRIPTION

GENERAL

This device is suitable for inserting in switchgear enclosures in the space normally occupied by circuit breakers. It contains power operated grounding contacts for grounding either the line or bus connections of the switchgear and manually operated selector switch contacts for pre-selection of line or bus. It also provides test ports for selector switch or bus access, and interlocks to assure maximum safety with convenience of use in any test function.

Furnished, as specified, are 1200 or 2000 amp primary disconnect contacts.

Outer and inner phase barriers are of transparent material to permit visual inspection of selector switch position on all phases.

Position indicator for ground and selector switches.

Top of device is covered to prevent entrance of foreign material or exposure to high voltage parts.

Large, clearly visible labels are used to identify the various parts of the test device.

Control – The selector switch is manually operated. The grounding switch is electrically closed. Tripping is accomplished by the manual "trip lever." Control power is obtained through the normal secondary contacts. Close control is by a portable switch at the end of a 30-foot cord (Fig. 3).

Test Ports – Two sets of test ports (Fig. 4) are provided on the front panel. The upper set is connected directly to the lower or bus studs. The lower set is connected to the hinge of the selector switch which may be in either bus or line position.

Test Probes – Test probes provide means for convenient connection of test leads to the device. Probes are pushed into test ports to establish an electrical connection through pressure contacts. Probes are self-aligning. They can be secured in position by sliding the test port cover to its third position, which also ensures that probes are fully inserted (Fig. 4).

Selector Switch – Operation of the selector switch is by means of a removable handle on the side of the device. This location ensures that the selector switch operation cannot be accomplished while the device is in the switchgear cubicle and that the operating handle must be removed before the device can be inserted in the cubicle. The selector switch shaft locks in each position when the operating handle is removed, assuring full contact pressure in the bus and line positions.

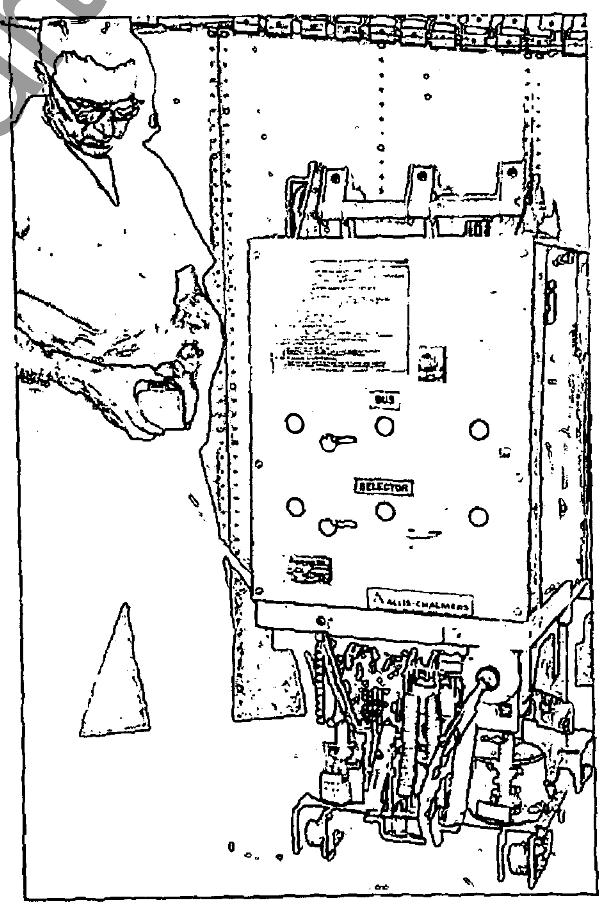


Fig. 3 – Portable push button is used to close the switch.

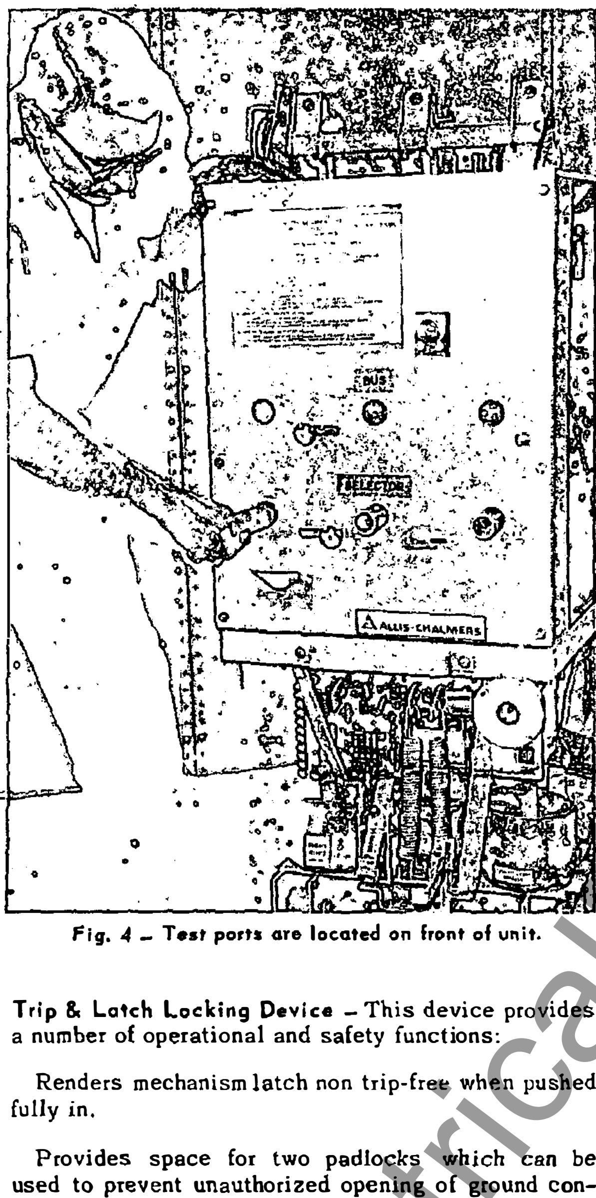


Fig. 4 – Test ports are located on front of unit.

Trip & Latch Locking Device – This device provides a number of operational and safety functions:

Renders mechanism latch non trip-free when pushed fully in.

Provides space for two padlocks which can be used to prevent unauthorized opening of ground contacts or removal of device from switchgear.

Provides electrical cutout to prevent closing of ground contacts if latch is not locked *closed* by being pushed fully in.

Assures that device cannot be inserted or removed from cubicle unless trip and latch locking device is pulled fully out and ground switch is open.

Grounding Switch

The grounding switch is power closed by either a solenoid or a spring operator. The unit is held non trip-free when closing the grounding switch and has the same close and latch capability as the breakers.

INTERLOCKS

Closing Circuit

The closing circuit key interlock is located on the left side of the device. It assures that the grounding blade closing circuit is open whenever the device is used for phasing, low potential testing and high potential phase rotation testing. For operation of the closing mechanism, the key must be turned to the fully engaged captive position. To gain access to the bus ports during phase testing, the key must be removed from the closing circuit key interlock and inserted in the bus port key interlock.

Bus Port

The bus port key interlock is located above the bus ports. It assures that tests made prior to grounding are always made through the selector switch ports which are connected to the selector switch hinge. This interlock prevents accidental testing of the wrong circuit prior to grounding.

1200/2000

The 1200/2000 interlock is located at the rear of the device under the horizontal frame, about 2-3/4 inches above the floor. It is "C" shaped and is supplied in the 1200-amp position. To use the device with 2000-amp primary contacts, remove the two mounting bolts and mount the interlock turned 180 degrees with the "C" shape facing in the same direction as the letter C when looking at the device from the rear. If your operating safety procedures positively guarantee that the device will be used only in the proper switchgear cubicle, the interlock may be removed.

OPERATORS

The switch is closed by the operator straightening a toggle in the four-bar linkage (page 6). The operator is powered by either a solenoid or precharged springs (stored energy).

SOLENOID OPERATOR

A large dc solenoid is used to drive two links of the four-bar linkage to an in-line position, allowing a prop latch to drop behind a toggle roll in the linkage system to hold the breaker closed.

DC Control Relay

The solenoid operator is designed to operate on dc current only. The control relay consists of two relays which may be mounted on a common base. Solenoid current is handled by the main control, or X relay, while the second relay, or Y relay, provides auxiliary control.

AC Control Relay

For alternating current applications, an ac control relay is used to switch the ac input of a silicon rectifier for control of the solenoid. The dc output of the silicon rectifier is connected directly to the solenoid. The control relay consists of two relays which may be mounted on a common base. Alternating current to the rectifier is handled by the main control, or X relay, while the second relay, or Y relay, provides auxiliary control.

Silicon Rectifier

A full wave rectifier is used to convert alternating current to direct current for the dc solenoid in the solenoid operator. This rectifier is designed for intermittent duty and should not be used for any other purpose.

The four rectifiers (diodes) are mounted on heat sinks which are assembled together with a terminal block on a chassis. The diodes are connected to form a full wave, single-phase, bridge. Direction of current flow does not affect solenoid operation. Nominal operating voltage for the rectifier is up to 300 volts ac.

The junctions of these rectifiers can be damaged by overvoltage or heating due to excessive current flowing through them. Protection against switching transients is provided by a suppressor.

STORED ENERGY OPERATOR

The stored energy operator uses charged springs to power the closing operation. Opening is spring-powered also, but not with the same springs used for closing. A stored energy operator consists of three systems: driving, spring linkage and four-bar toggle linkage. These systems are disengaged from each other except while performing their specific functions. For example – the driving and spring linkage systems are completely free of each other except when the spring linkage is being charged. Similarly, the spring linkage and four-bar toggle linkage systems are free of each other except during a closing operation.

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

OPERATION

OPERATING PROCEDURE

a) For Back-Feed Testing or Grounding –

1. Verify that proper primary contact fingers are in place and device interlock is set properly.
2. Set selector switch blades on studs to be grounded. To move switch, insert handle in socket and press in to unlock switch. Rotate handle to full stop position. Remove handle. Verify that shaft is locked in position.
3. Check closing circuit interlock key on lower left hand side of unit. Turn key to fully engaged captive position.
4. Pull out trip and latch locking device.
5. Insert device in cubicle.
6. Push trip and latch locking device fully in.
7. Test selector terminals with statiscope to be sure they are de-energized.
8. Energize cubicle control power circuit. (If unit is stored energy, springs will charge.)
9. Attach close control cable.
10. Depress both control buttons and unit will close grounding circuit.
11. Secure the trip and latch locking device in the grounded position.

b) To Unground and Remove Unit –

12. Remove all test probes if used.
13. Pull out trip and latch locking device to full out position.
14. Depress trip lever to open ground switch.
15. Depress trip lever to full down position and remove unit from cubicle.

c) For Ungrounded Testing –

16. Same as steps 1 and 2, with selector on line setting.
17. Remove key from closing circuit interlock on lower left hand side of unit and unlock bus test port slide.
18. Same as steps 4 and 5.
19. Open test ports by moving slide to right until holes line up.
20. Test terminals with statiscope to be sure they are de-energized.
21. Insert probes.
22. Move slide to right to lock in probes.
23. Perform tests in accordance with approved procedures.

OPERATOR DESCRIPTION
SOLENOID OPERATOR

The primary closing force of this operator (Fig. 5) is supplied by *a dc solenoid*. The iron circuit housing the solenoid consists of the main operator frame – to which the pole head is welded – a helically wound tube and a back plate held in place by four bolts (68). The armature (4), with plunger (6) and cap (19) attached, slides in a non-magnetic tube (5). When the coil (8) is energized, the armature moves toward the pole head. The non-magnetic washer (21) keeps the armature from actual contact with the pole head so that the armature will release rapidly when the coil is de-energized by reducing the effect of the residual magnetism. The armature is returned by a spring around the plunger.

The 4-bar linkage (Fig. 6) consists of links (70, 101, 102 and 73). In normal closing operation, point E is held fixed between stop bolt (75) and trip latch (27). When the closing solenoid is energized, plunger (6) moves forward to rotate link (101) about center E. This forces link (102) to move, rotating arm (73) about its fixed center B. The forward travel of point D carries it past prop latch (97) which holds point D as plunger (6) retracts. The rotation of arm (73) closes the grounding blades and extends the opening springs.

To open the grounding blades, trip latch (27) is rotated about its center G by depressing the tail of the latch. This releases point E, allowing link (70) to rotate about its fixed center F. Links (101 and 102) drop allowing arm (73) to rotate, pulled down by spring (7). As point D drops, it is freed from the prop latch (97). Reset spring (91) pulls D back, lifting point E back of trip latch (27) and resetting the linkage. If the trip latch (27) is rotated at any time during the closing stroke, the linkage will collapse.

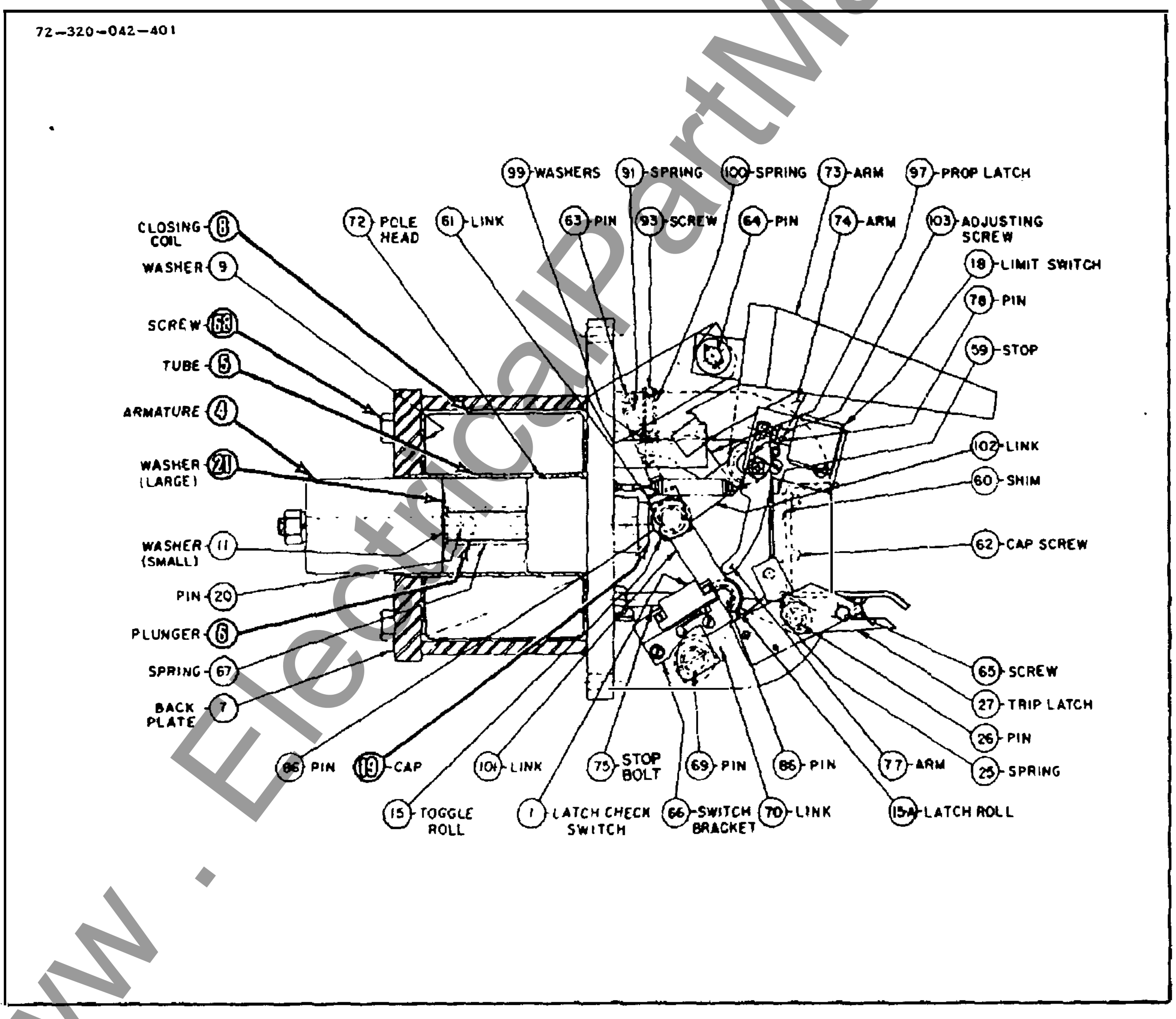


Fig. 5 – Solenoid operator assembly.

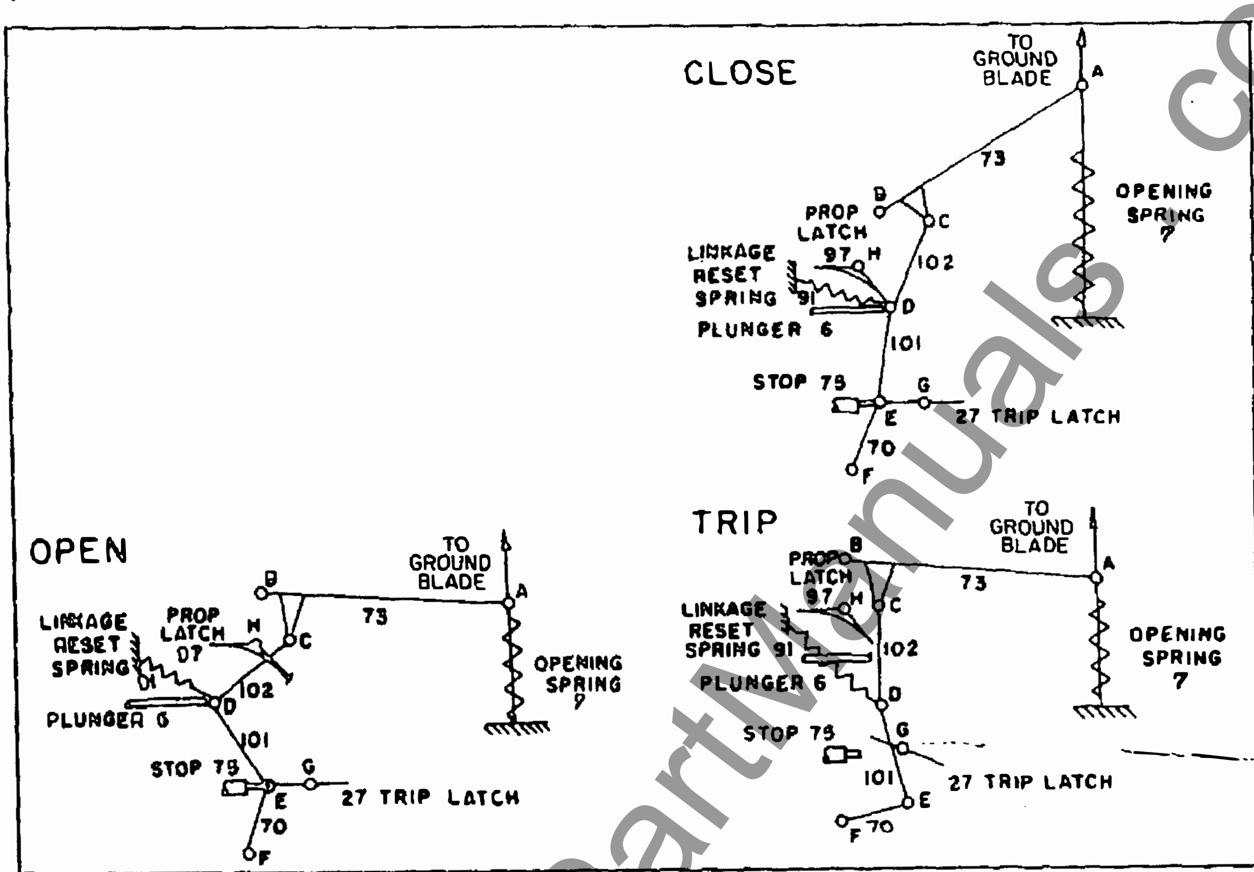


Fig. 6 – Four-bar linkage.

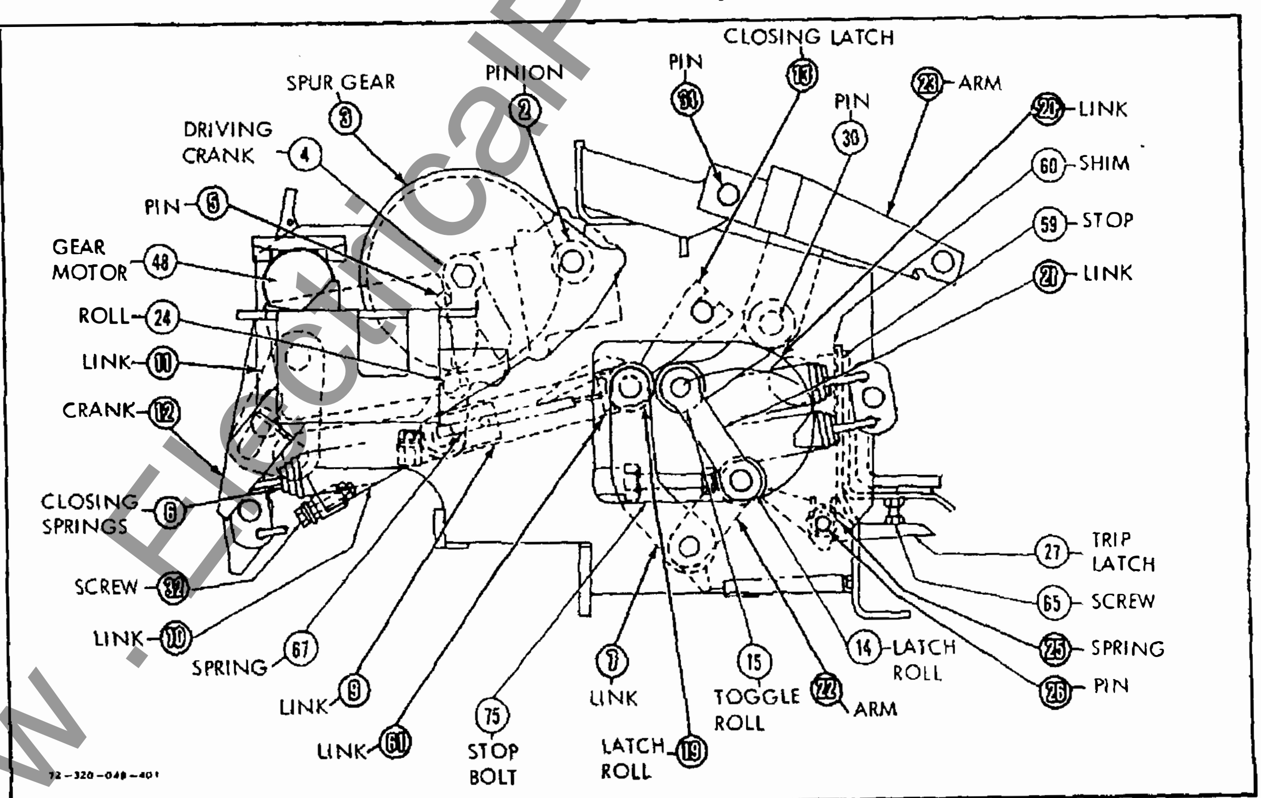


Fig. 7 – Stored energy operator.

STORED ENERGY OPERATOR – (Figures 7A–G)

Fig. A – Breaker Open, Springs Discharged, Motor Running Ready to Charge. The charging motor drives pinion gear (2) which rotates spur gears (3). Pin (5), on the face of the spur gears, engages the free-swinging driving cranks (4) which are rotated into engagement with roll (24).

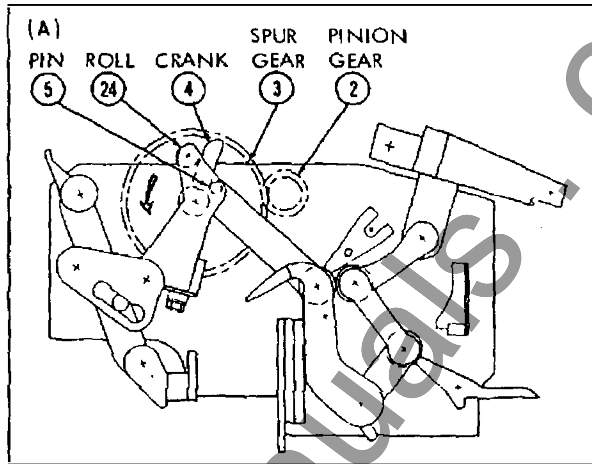


Fig. B – Breaker Open, Springs Partially Charged. Continued rotation of cranks forces link (10) down because link (7) is held in place by latch (13). Link (11) rotates about its fixed center. Link (11), through pin (31), drives crank (12) back, extending the closing springs attached to the lower end of crank (12).

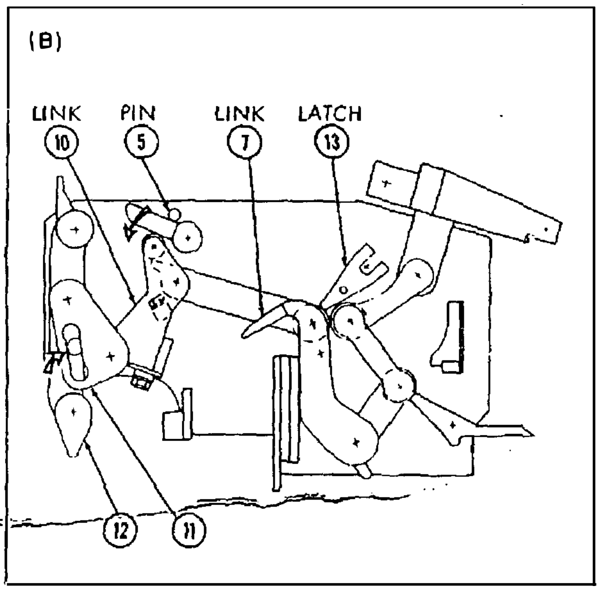


Fig. C – Breaker Open, Springs Charged. As the closing springs become fully extended, cranks (4) push links (9, 10) over toggle and cranks (4) disengage roll (24) and rotate out of the way. The closing springs are fully charged and held by spring release latch (13).

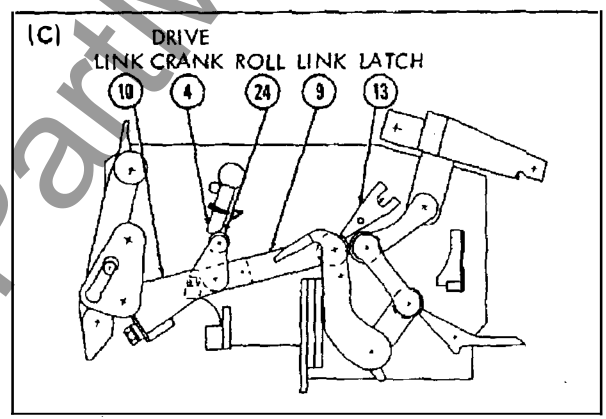


Fig. D – Start of Closing. To close the breaker, the spring release latch (13) is moved up to release latch roll (19). Links (9, 10) drive forward as a unit. Latch roll (19) forces toggle roll (15) forward. This rotates link (21) about latch roll (14) which is held fixed by latch (27).

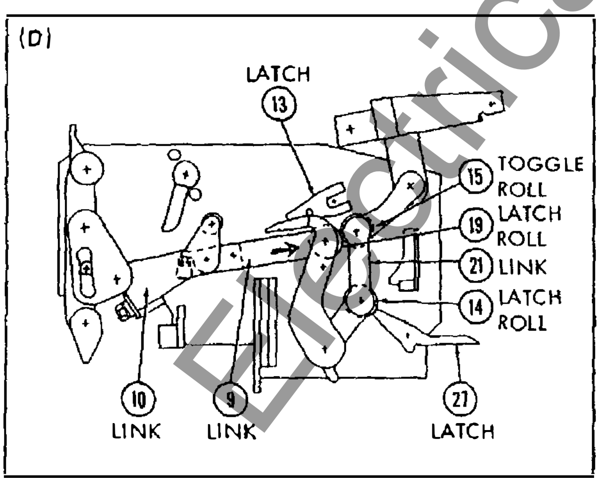
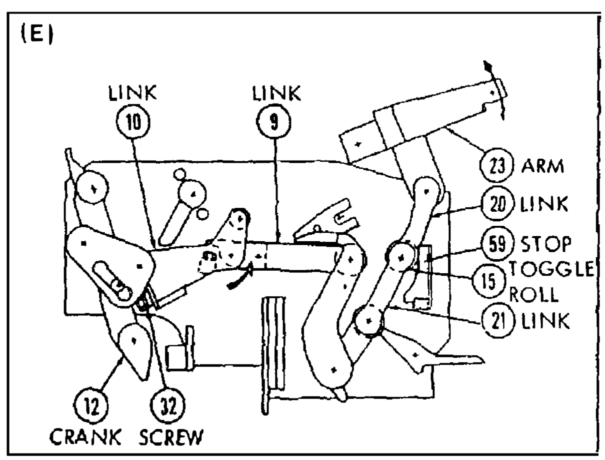


Fig. E – Breaker Closed, Linkage Starts to Collapse. The rotation of link (21) rotates arm (23), through link (20), closing the disconnect blades. Links (20, 21) go over toggle against stop (59), locking the breaker closed. Screw (32) and crank (12) come in contact and force link (10) to rotate, breaking the over toggle between links (9, 10).



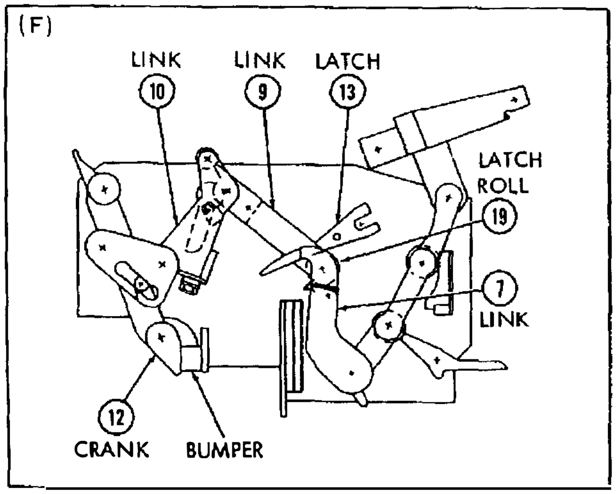


Fig. F – Breaker Closed, Springs Discharged, Mechanism Practically Reset. Crank (12) is stopped by the bumper. Links (9, 10) collapse upward, allowing link (7) to reset. Latch (13) drops ahead of latch roll (19). Unit is set to recharge springs.

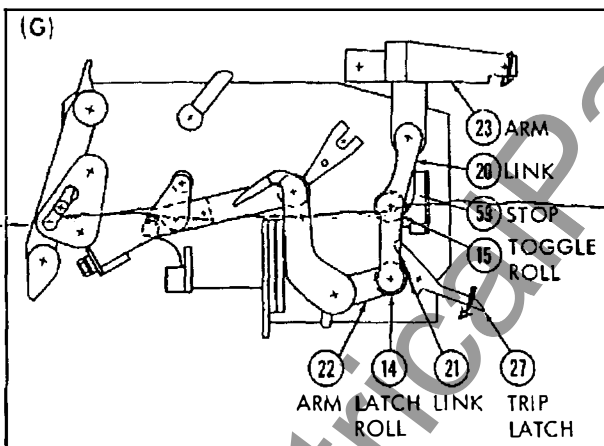


Fig. G – Breaker Opening, Springs Charged. To open the breaker, trip latch (27) is rotated by depressing latch, releasing latch roll (14). Arm (22) rotates about its center, allowing links (20, 21) to drop. This rotates arm (23) about its center, opening the breaker. Toggle roll (15) is forced back by the curve of stop (59), breaking the over toggle of links (20, 21) and allowing them to reset. This rotates arm (22) back into reset position with latch roll (14) back of latch (27).

OPERATOR CONTROL

Solenoid Operator

The normal control (Fig. 8) for this operator has the close and control power from a common source. The solenoid has dc coils designed to give maximum efficiency over the desired control voltage range.

For dc control the normal method is as shown in Fig. 8A. When the close contact (CS-C) is closed, current flow through 52Y1 energizes the 52X relay coil. This closes contacts (52X3 and 52X4) to energize the closing coil (52cc). Contact (52X1) closes to lock in the 52X relay coil. Late in the solenoid stroke, the limit switch contact (52aa) closes, energizing the 52Y relay. The closing of the 52Y2 relay and the opening of the 52Y1 contacts cuts off the 52X3 and 52X4 contacts and the lock-in circuit (X1) of the 52X relay. If the close control remains closed, the 52Y relay is still locked in through contact 52Y2 and must be opened to reset the control for another close.

For ac control, a full-wave, bridge rectifier is used to supply dc to the closing coil. An ac control similar to the dc control scheme is shown in Fig. 8B. The control function is the same as for the dc control. A surge suppressor is furnished across the rectifier to protect against high voltage surges which may destroy the rectifier elements.

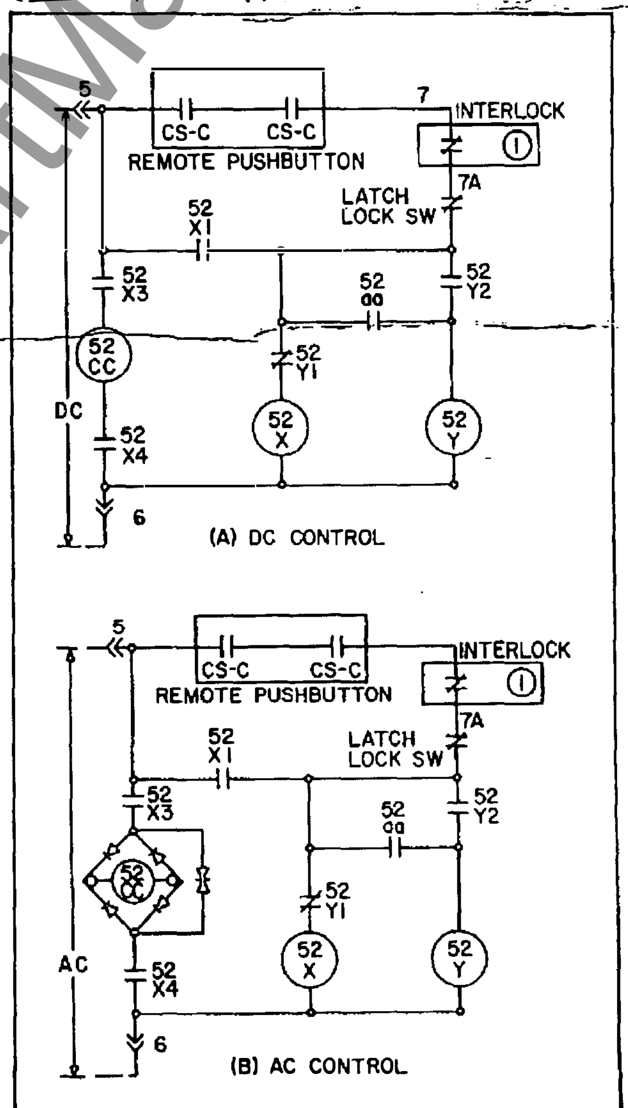


Fig. 8 – Solenoid operator control schemes.

Stored Energy Operator

ıe normal control (Fig. 9) for this operator has been incorporated in one switch assembly located at the rear of the unit.

The main spring charging motor power is supplied through terminals 3 and 4, Fig. 9. The mechanical interlock is a switch operated by the breaker release lever which opens the motor circuit when the lever is depressed. The prop latch check switch is closed when the spring release latch is in reset position. The 88-1 and 88-2 switches are shown with the main closing springs discharged. When the control is energized, the motor starts to charge the springs. The 88-3 switch is operated by cam (2), Fig. 10, on the main gear. As the charging linkage charges the main closing springs, the motor switch cam rotates with the left-hand large gear. When the control is energized the motor starts to charge the springs. Just before the springs are fully charged, the 88-1 and 88-2 switches are thrown by lever (1) which is operated by pin (5), Fig. 10. The 88-1bb switch opens when the springs are fully charged. However, before this switch opens, the 88-3aa switch closes and connects the dropping resistor into the motor circuit. The motor continues to drive the gears until the free swinging cranks on the main gears are almost to the top of the grease. The motor then shuts off (cutoff by the c m operating the 88-3aa switch) and coasts until the cranks go over center and drop out of the way.

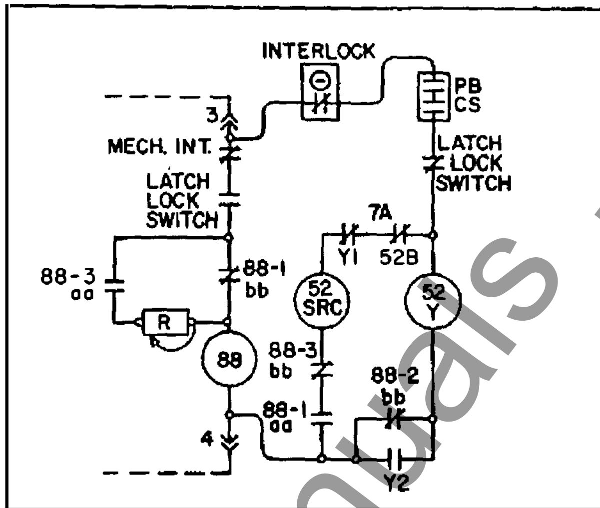


Fig. 9 – Control scheme for stored energy operator.

The 88-1bb contact is in the drive motor circuit and is used to start the motor when the springs are discharged and stop the motor when the springs are fully charged. The 88-1aa and 88-3bb contacts are in series with the close control circuit and keep the circuit open until the springs have been fully charged and the charging motor de-energized.

The 88-2bb contact is in the close control lockout circuit. The 88-2aa is used to energize an indicating light which shows that the springs are fully charged.

The 88-3aa contact introduces a resistor into the drive motor circuit to coast the drive cranks out of the way with a reduced voltage on the motor.

Motor Control Switch

The motor control switch assembly (Fig. 10) consists of two heavy duty toggle switches (6) operated by common linkage (1) from the main closing springs and one heavy duty toggle switch (6) operated by a cam (2) driven by the main gear.

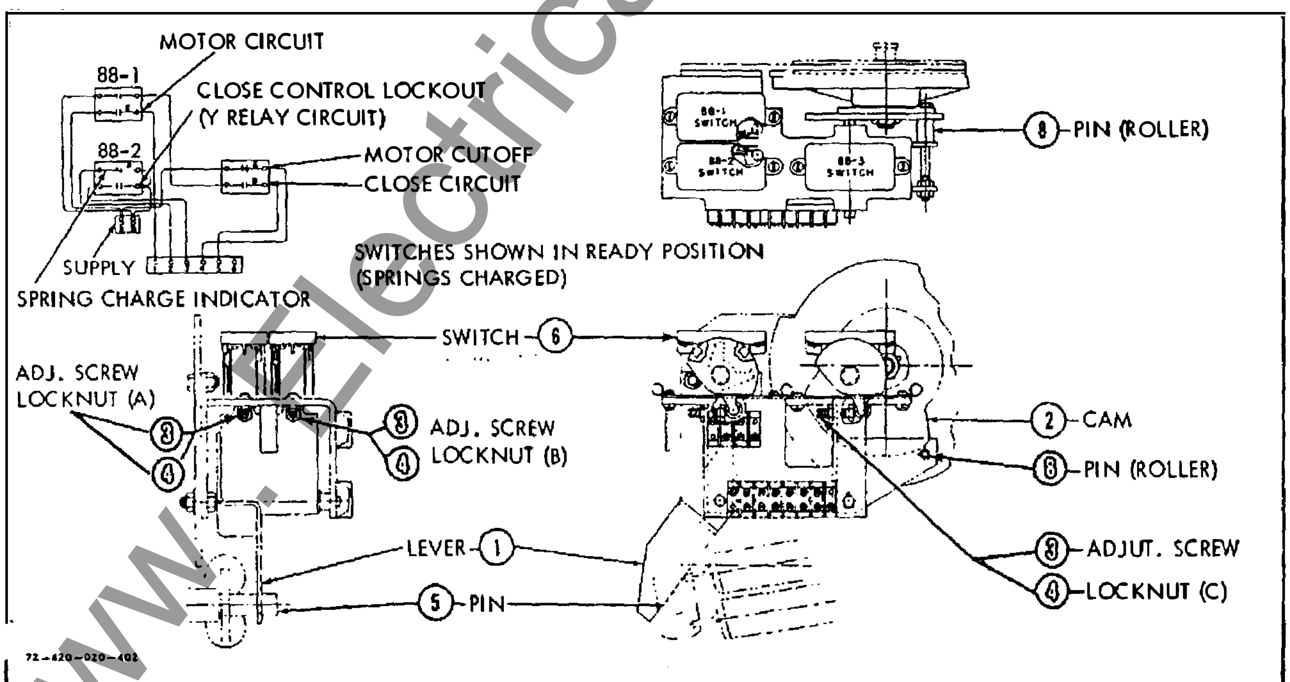


Fig. 10 – Motor control switch assembly for stored energy operator.

As the charging linkage charges the main closing springs, the motor switch cam rotates with the left-hand large gear. Just before the springs are fully charged, the cam (2) throws the 88-3 switch. A split second later, when the springs are fully changed, the 88-1 and 88-2 switches are thrown by lever (1) which is operated by pin (5). Thus, before the 88-1bb switch opens, the 88-3aa switch has closed connecting the resistor into the motor circuit. The motor continues to drive the gears until the free swinging cranks on the main gears are almost to the top of the gears. The motor then shuts off (cut by the cam operating the 88-3aa switch), allowing the cranks to go over center and drop out of the way.

The resistor is adjusted to limit the speed of the unloaded motor. It is factory set to operate the motor at rated and minimum voltage and limit the coast of the motor so that the pin on the gear coasts past top center by not beyond 10 o'clock. With too much resistance the motor will stall. With too little resistance, the motor will coast too far and the cam will reclose the 88-3aa switch and the motor will continue to run.

Spring Release Latch

Fig. 11a shows the spring release latch in the hold position and locked in place by links (W and X) which are over toggle against screw (A). To release the latch, link (X) must be moved upward to invert the toggle. The switch is in the drive motor circuit and is closed when link (X) is against screw (A). Vertical movement of link (X) opens the switch.

When the spring release solenoid is energized (Fig. 11b), the armature moves up with the ram, forcing link (X) up, to break the over toggle condition of links (W and X). Link (X) is rotated to the right, removing the latch from the latch roll to release the closing mechanism. The upward movement of link (X) opens the switch in the drive motor circuit, preventing the springs from charging until link (X) resets to lock switch in position.

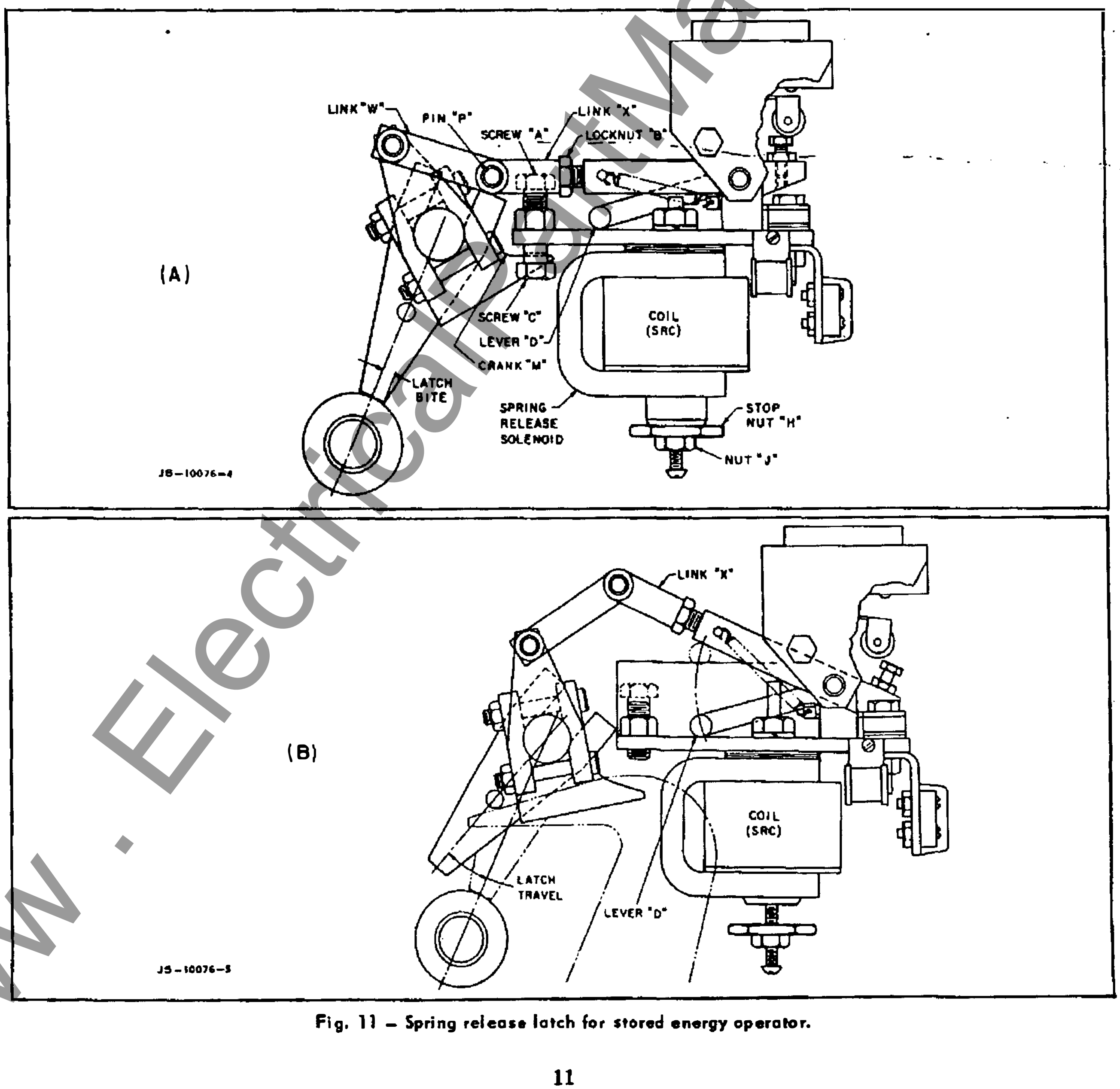


Fig. 11 – Spring release latch for stored energy operator.

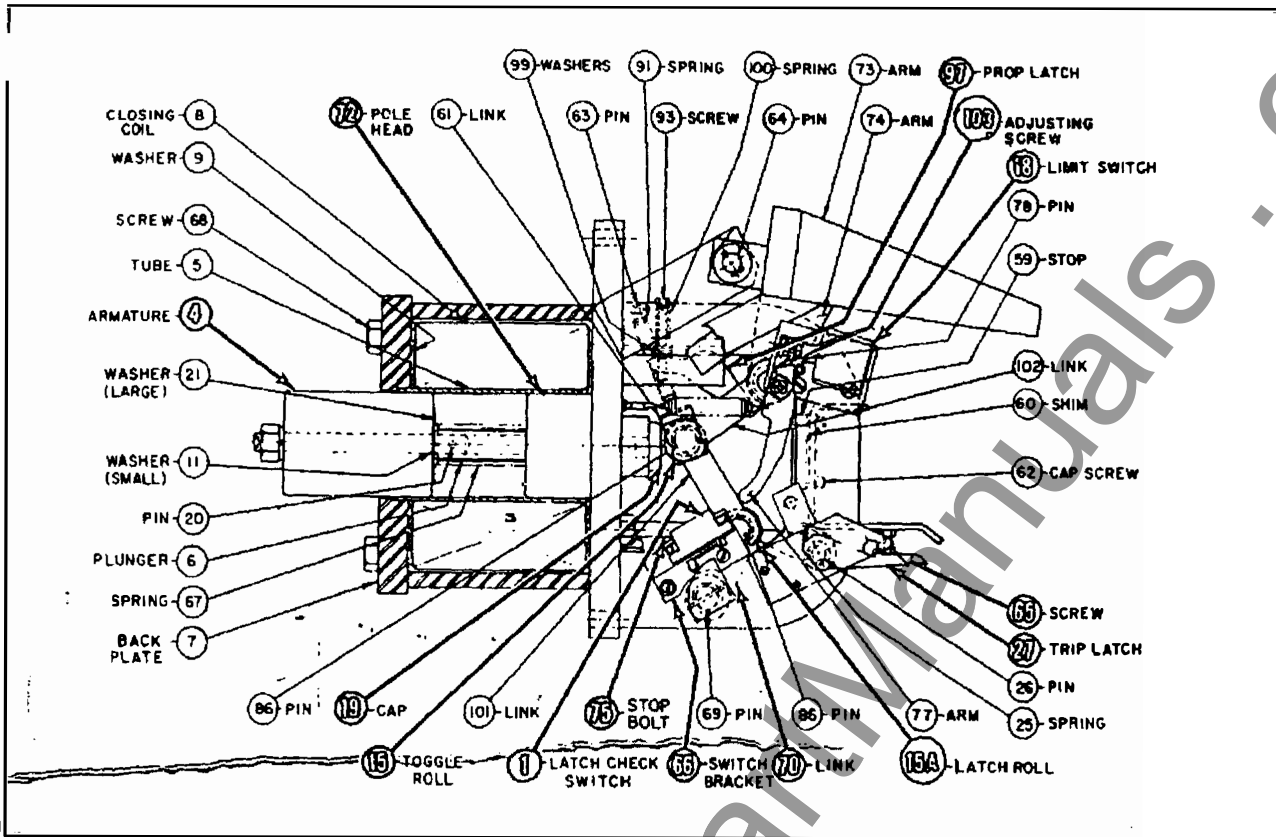


Fig. 12 – Solenoid operator assembly.

ADJUSTMENTS

SOLENOID OPERATOR (Fig. 12)

Latch Roll Clearance – With the ground device open and latch roll (15A) resting against stop bolt (75), the latch roll should clear the trip latch (27) by 1/64 to 3/64 of an inch. Adjustment is made by stop bolt (75).

Trip Latch – The trip latch (27) should engage the latch roll (15A) 1/8 to 3/16 or an inch above the lower edge of the latch face with the breaker closed. This adjustment affects the clearance between the trip pin and trip latch. Refer to tripping solenoid adjustment.

Limit Switch – The limit switch (18) is located on the front of the operator frame and is contacted by an extension of the toggle roll (15) pin within the 4-bar toggle linkage.

Adjust by screw (103). Contact action required by circuit breaker should be at 3/4 to 7/8 inch of the stroke of ram cap (19).

Latch Check Switch – The latch check switch (1) is mounted on the bottom of the operator frame. The switch makes contact near the end of the reset travel of the lower link (70) of the 4-bar toggle linkage.

Adjust by moving switch bracket (66).

STORED ENERGY OPERATOR (Fig. 13)

Main Toggle Roll – When the ground device is in closed position with roll (15) against stop (59), center of main toggle roll (15) should be 3/16 to 5/16 of an inch beyond line of centers of latch roll (14) and pin (30). Adjustment is made by adding or removing shims (60) behind stop (59).

Trip Latch – The trip latch should engage its roll (14) 1/8 to 3/16 of an inch above the lower edge of the latch face. Adjustment is made with screw (65). This adjustment affects the clearance between the trip pin (17A) and the trip latch (27). With the springs charged and the breaker open, the trip latch (27) should clear its latch roll (14) by 1/64 to 3/64 of an inch. Adjustment is made by stop bolt (75).

Manual Charging of Closing Springs – The springs are manually charged by inserting the charging handle into the guide tube to engage the gear motor (48). Turn the handle in the direction shown until the spring linkage is heard to go over toggle. This audible snap indicates that the springs are fully extended (changed). Continue turning handle

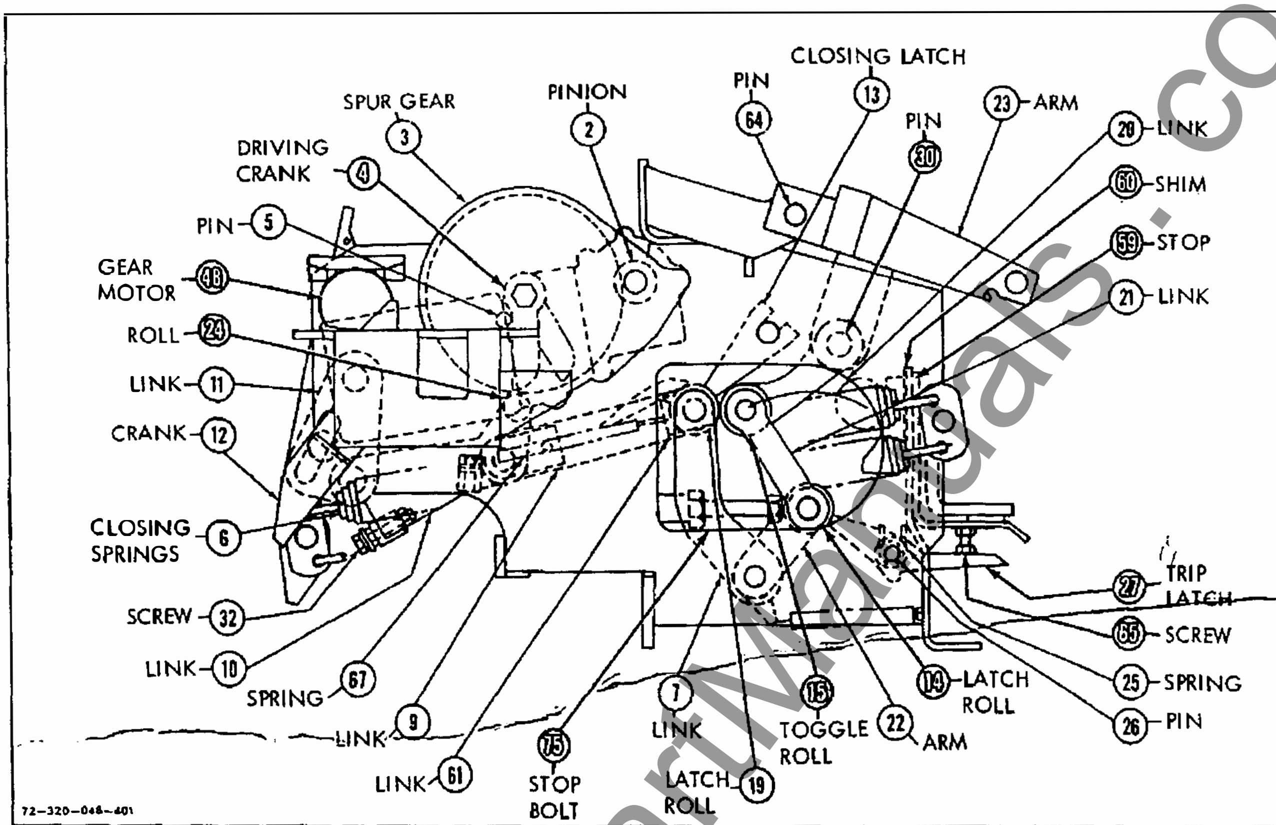


Fig. 13 – Stored energy operator assembly.

(about 95 more turns) to bring driving cranks (4) to their reset position (just past dead center). This removes the cranks from the danger of being hit by roll (24) as the breaker closes. It also correctly positions the cam controlling the 88-3 switch for electrical operation.

Manually Slow Closing – This device can be closed slowly and mechanically held in any position of the closing stroke up to the point of contact touch to make or check adjustments. Insert spring charging handle into guide tube and engage with gear motor (48). Turn handle counterclockwise until resistance is felt. Pull closing lanyard and hold out, continue turning handle. Contacts will move toward the closed position.

CAUTION

As the contacts approach the closed position, check position of cranks (4) on rolls (24). Do not allow cranks to pass by the rolls, causing the contacts to snap open.

Motor Control Switch – The 88 motor control switch assembly (Fig. 10) is factory adjusted and pinned in position. If it should become inoperative, clean contact areas with an electrical cleaning solvent and spray dry silicon lubricant lightly between contact surfaces and pivot points.

If adjustment becomes necessary, follow this procedure:

1. Loosen lock nuts (4).
2. Back off adjusting screws on all three switches.
3. Hand crank unit until pin (8) rests on crown of cam (2) (before springs begin to charge).
4. Turn adjusting screw (3) on 88-3 switch until there is only 1/32 to 1/64 inch travel left. Lock with locknut (4C).
5. Hand crank unit until springs charge and 88-3 switch snaps over just before springs reach the full charged position.
6. Turn adjusting screws (3) on 88-1 and 88-2 switches until they snap over. Lock with locknuts (4A, 4B).
7. Crank unit until 88-3 switch is reset and drive pawls drop over center.
8. Discharge springs.
9. Recharge springs and readjust 88-1 and 88-2 switches, if necessary, to snap over with--or after--88-3 switch.

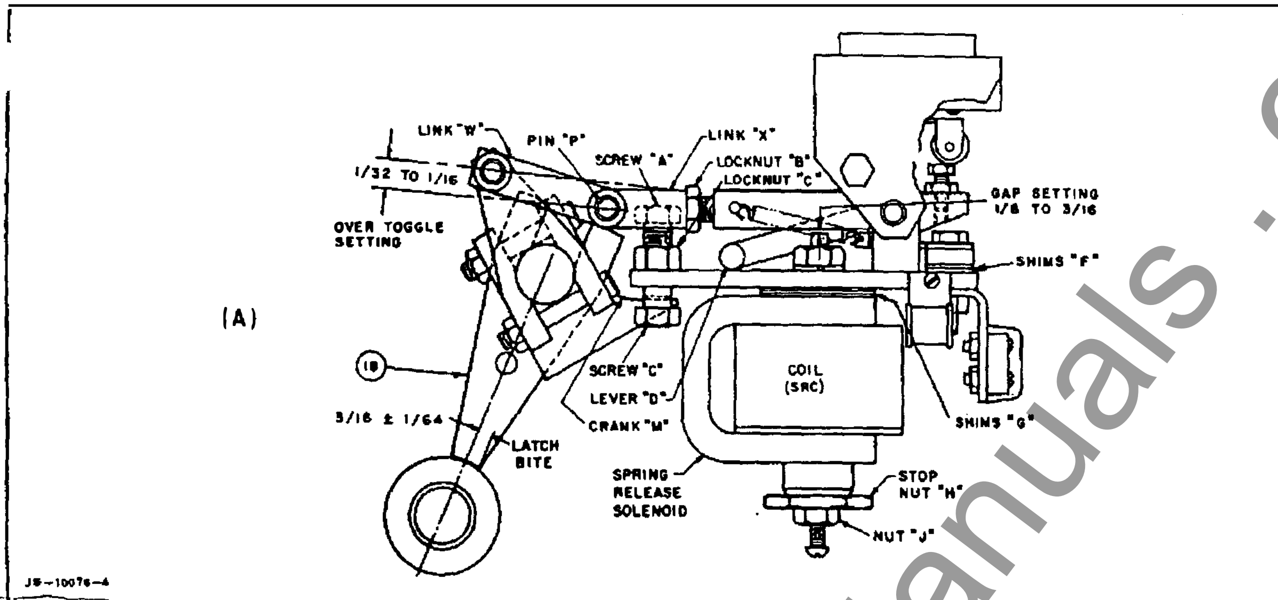


Fig. 14 – Spring release latch and over toggle linkage.

Spring Release Latch and Over Toggle Linkage – To change bite of spring release latch (Fig. 14), disconnect links (W and X) by removing pin (P) and turning screw (A) against crank (M). Check visually to see that bite is 3/16-in., or point of contact at about the center of the latch (18). Lock screw (A) with locknut (C). Adjust link (X), if necessary, so that pin (P) can be easily inserted. To adjust link (X), loosen locknut (B) and rotate the link end to increase or decrease its length.

The over toggle linkage (links W and X) functions to stabilize the position of the spring release latch (18). It is in proper adjustment when the center of pin (P) is 1/32 to 1/16-in. below a line drawn between the pivot points of links W and X. This adjustment is made with screw (C) which acts to position link (X).

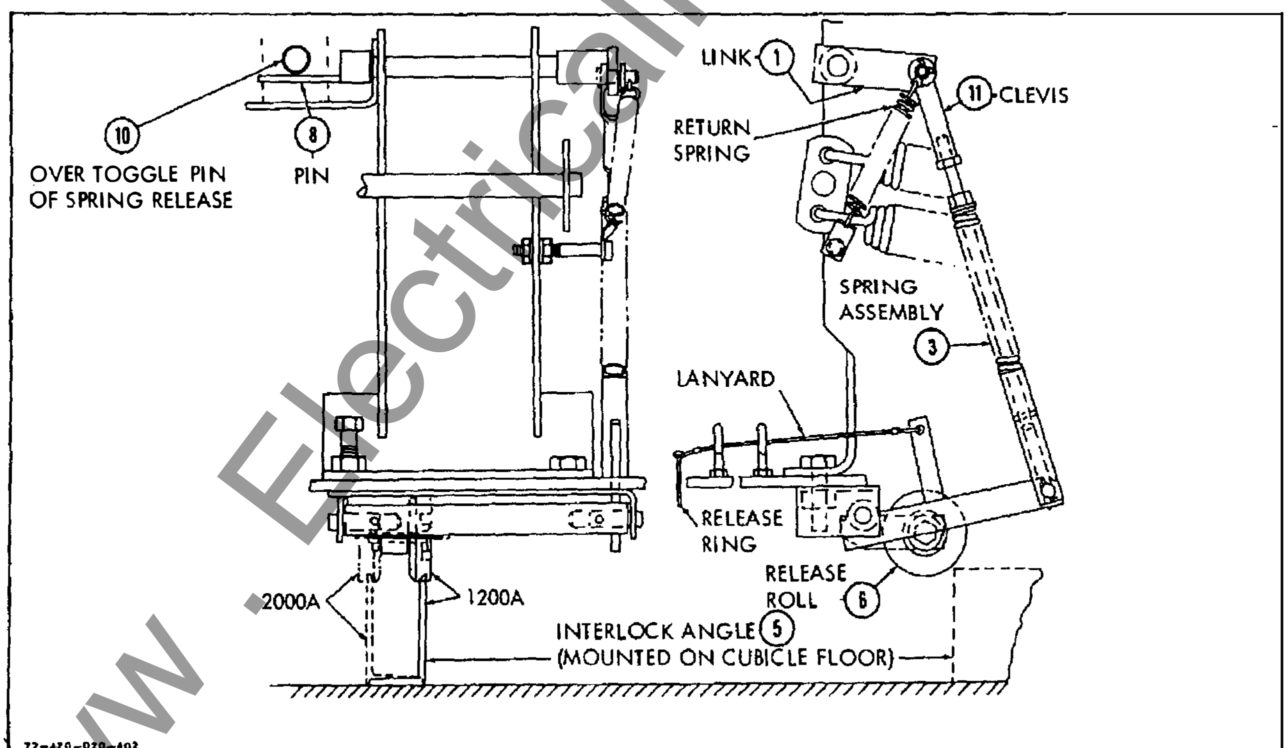


Fig. 15 – Spring release arrangement for stored energy operator.

CAUTION

Over toggle linkage (W, X and Pin P) must be free to move through the toggle position with crank (M) against screw (A) without moving latch (18). Otherwise, excessive load may exceed the output of the spring release coil, preventing the switch from closing.

Spring Discharge – During insertion or removal of the switch from its cubicle, the closing springs of the operator will discharge automatically. This is done by release roll (6) (Fig. 15) passing over interlock angle (5), mounted on the cubicle floor. As the release roll passes over the interlock angle, it rises and pushes up on the spring assembly (3). This causes link (1) to rotate pin (8) which raises lever (D) and link (X) (Fig. 14), releasing the closing springs.

The length of the spring assembly can be increased, or decreased, if necessary, by adjusting clevis (11).

MAINTENANCE

The lubricant supplied with the cubicle accessories is intended to be used only on the cubicle's disconnect contacts and must not be used on any part of the circuit breaker.

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.

When lubrication is necessary, all purely mechanical joints should be given a light film of Beacon P-290 grease. All current carrying joints should be inspected to be sure all contact surfaces are free of protrusions or sharp plane changes. Rub microfine graphite well into contact surfaces and remove any excess. Do not get graphite on insulation. Insulation contaminated by graphite must be replaced.

Needle bearings are packed with a special lubricant and should require no further attention. Bearing pins and other sliding or rotating areas should be wiped with a thin film of Beacon P-290 grease. Greasing should be done carefully because excess grease tends to collect foreign matter which, in time, may make operation sluggish and affect the dielectric strength of insulating members.

Beacon P-290 grease may be purchased through Humble sales offices in Los Angeles, Calif.; Oak Brook, Ill.; Baltimore, Md.; Pelham, N.Y.; Charlotte, N.C.; Memphis, Tenn.; Dallas and Huston, Texas.