ALLIS-CHALMERS CONTROLS

INSTRUCTIONS

TYPE "F"
GROUND AND TEST DEVICE

Used With

15-Kv Metal-Clad Switchgear

BWX-6738

18X3091

INDEX

ILLUSTRATIONS

KEN COOK TRANSNATIONAL PRINTED IN U.S.A.

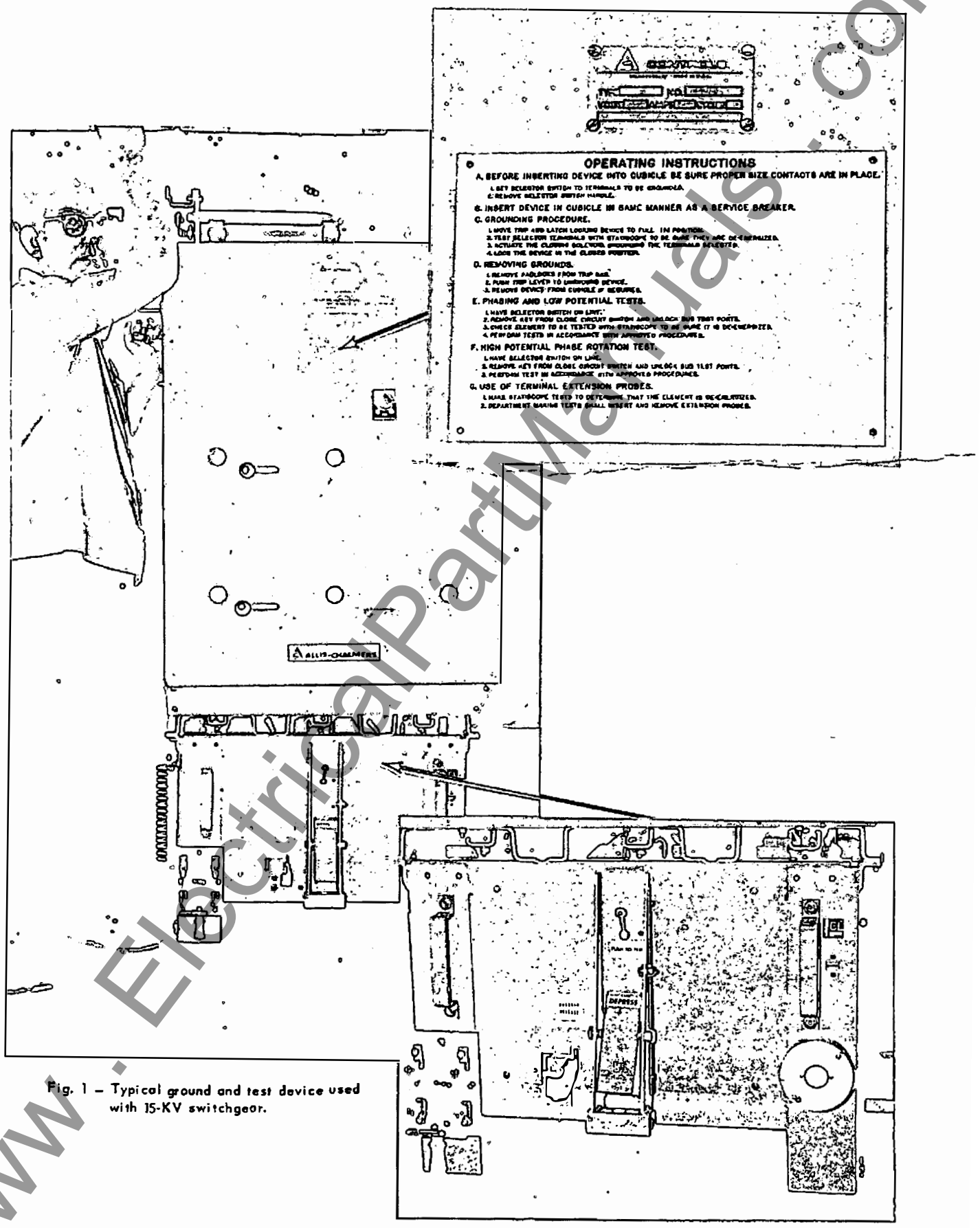


Fig. 1 – Typical ground and test device used with 15-KV switchgear.

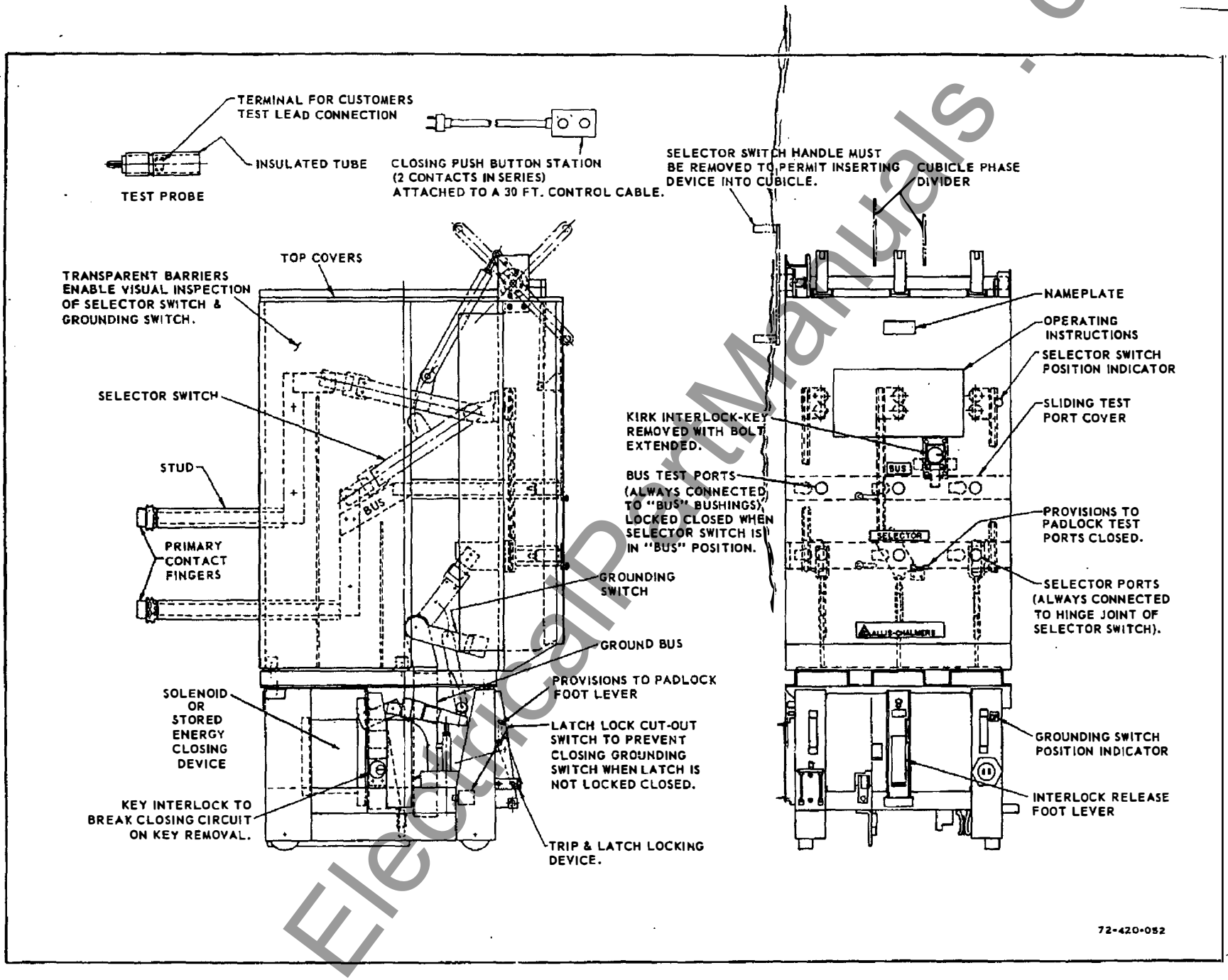


Fig. 2 – Typical 15-KV ground and test device.

INTRODUCTION

This instruction manual provides operation and maintenance information for power operated grounding and test devices used with 15-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, 2000 or 3000 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 & latch locking" device. 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.

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 locks in each position when positioned by the operating handle, assuring full contact pressure in the bus and line positions.

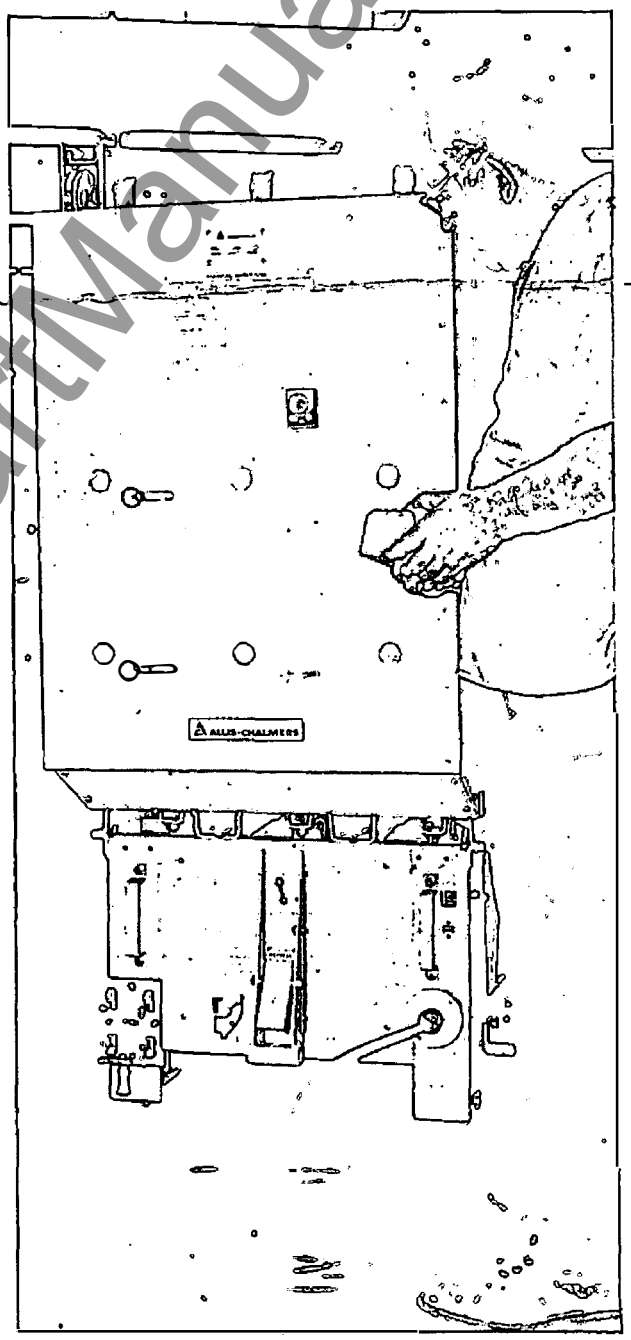


Fig. 3 – Portable push button is used to close the switch.

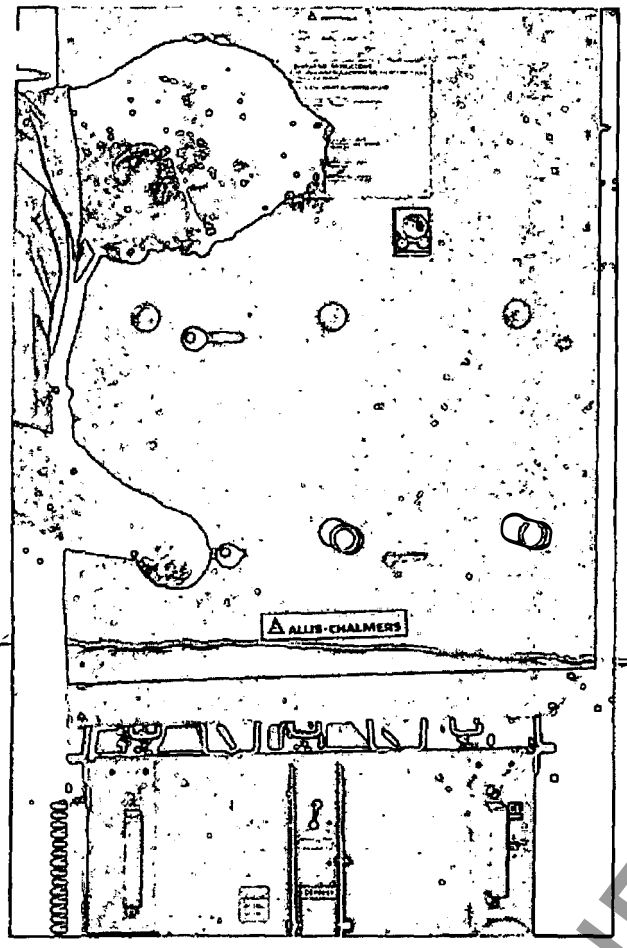


Fig. 4 – Test ports are located on front of unit.

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

Renders mechanism latch non trip-free.

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.

Assures that device cannot be inserted or removed from cubicle unless 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.

OPERATORS

The switch is closed by the operator straightening a toggle in the four-bar linkage (page 5). 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. 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.
2. Check interlock key on lower left hand side of unit. Turn to full "HELD" position.
3. Pull out trip latch locking device.
4. Insert device in cubicle.
5. Close control power switch. (If unit is stored energy, springs will wind up.)
6. Push trip latch locking device in. (May be locked in place with padlock.)
7. Attach close control cable..
8. Depress both control buttons and unit will close.

b) To Unground and Remove Unit –

1. Remove all test probes.
2. Pull out latch lock lever. (All padlocks must be removed before lever can be moved.)
3. Depress "PUSH TO TRIP" rod. To open ground switch depress foot lever too.
4. Remove unit from cubicle.

c) For Ungrounded Testing –

1. Same as above with selector on line setting.
2. Remove key from interlock on lower left hand side of unit and unlock bus test port slide, both slides are now open. Omit steps 5 and 6.
3. Open test ports by moving slide to right until holes line up.
4. Insert probes.
5. Move slide to right to lock in probes.

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

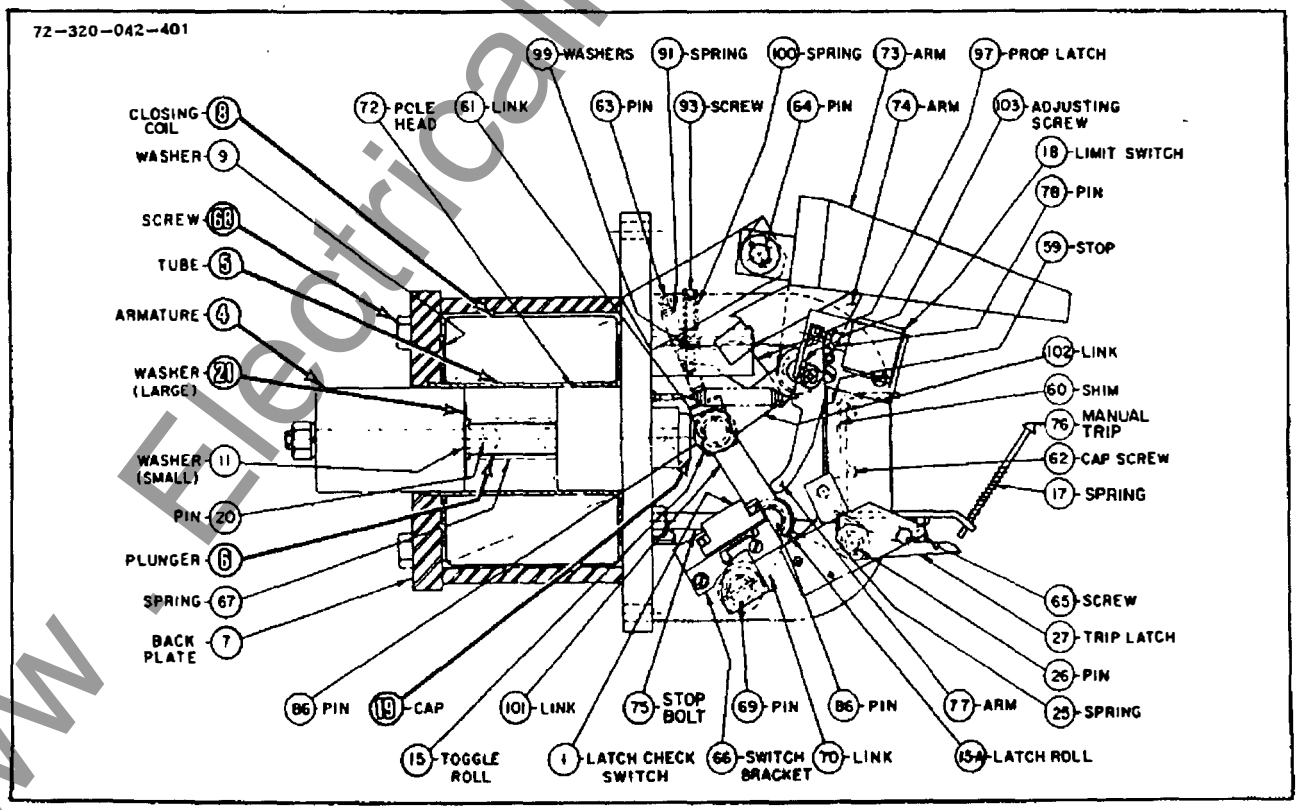


Fig. 5 – Solenoid operator assembly.

(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.

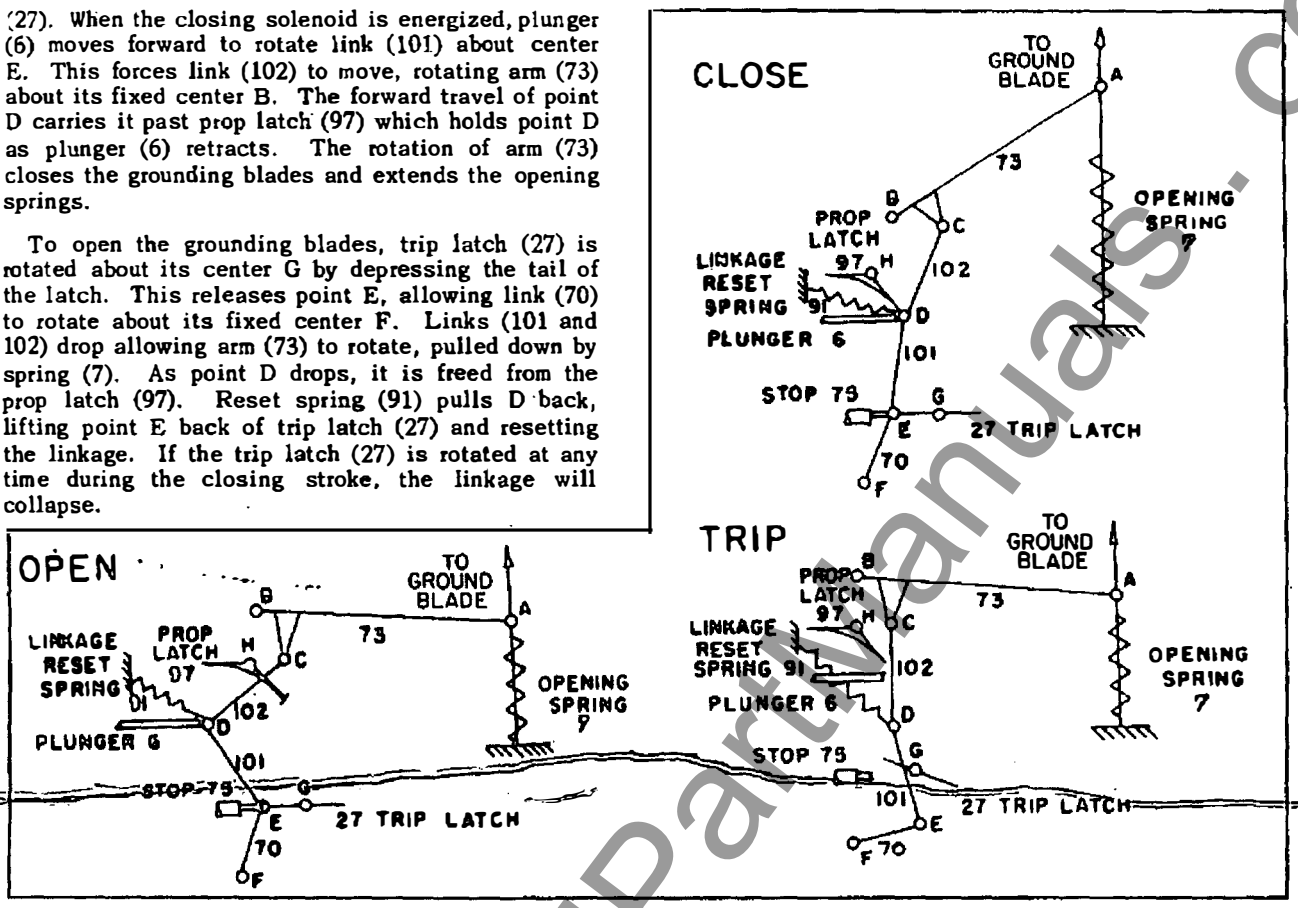


Fig. 6 – Four-bar linkage.

STORED ENERGY OPERATOR – (Figure 7A-H)

Fig. A – Open, springs discharged. Switches (32) released as arm (3) has been released by cam (35). Switch (32) closes motor circuit and cam (12) rotates clockwise.

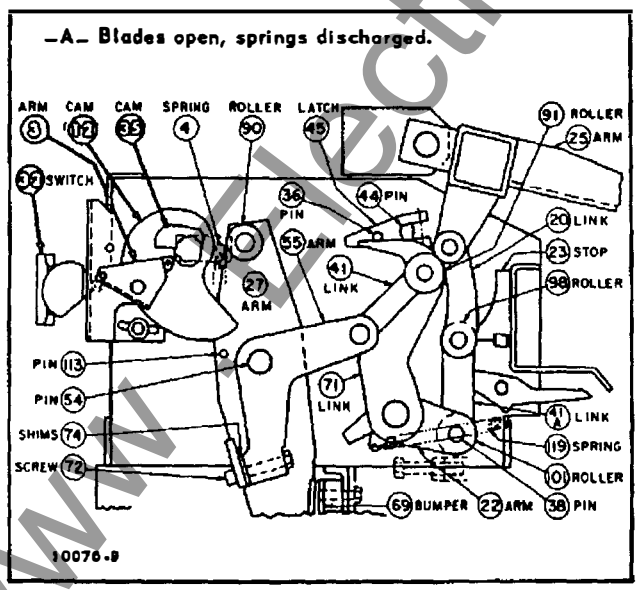


Fig. B – Cam (12) has rotated against roller (90) forcing arm (27) and (55), which are fastened together, to rotate clockwise about pin (54). This compresses the closing springs which are fastened to the lower end of arm (27). The rotation of arm (55) pulls link (71) to the left thru link (41). Spring (119) rotates arm (22), attempting to recouple the 4-bar linkage but is retarded by link (20) riding on roll (91) until link (71) moves to the left. Note: Latch (45) is held from resetting by pin (36), riding on crown of horn of link (71).

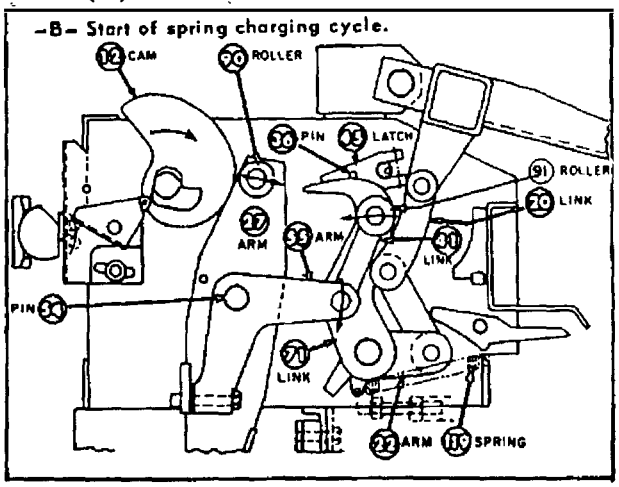


Fig. C – Roller (90) is at crown of cam (12) latch roll (91) is past latch (45), allowing latch to drop in place and the 4-bar linkage has reset with trip latch (2) reset back of roll (101).

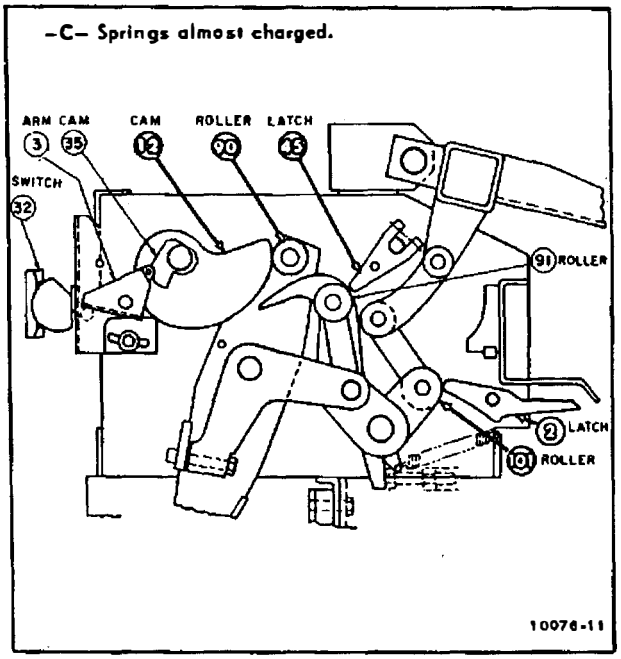


Fig. D – There are teeth cut from the driving gear train so that when cam (12) clears roller (90), the motor drive is disconnected and cam (12) is free. Reset spring (4) continues the rotation of cam (12) until it rests against pin (113), cam (35) rotates with cam (12). When cam (12) rests against pin (113), cam (35) holds the switches (32) in thrown position.

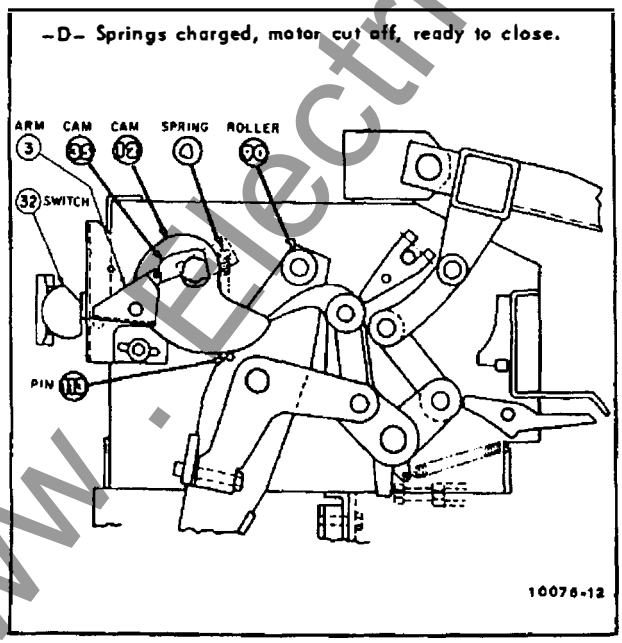


Fig. E – Latch (45) has been rotated to close grounding blades. This releases link (71). Arm (27) rotates counterclockwise as the closing springs force its lower end to the right. Arm (55) thru link (41) forces link (71) to the right. As arm (27) rotates, pin (113) drops away, freeing cam (12) which is rotated by spring (4) allowing cam (35) to release arm (3) and switches (32) which throw over closing motor circuit to recharge springs.

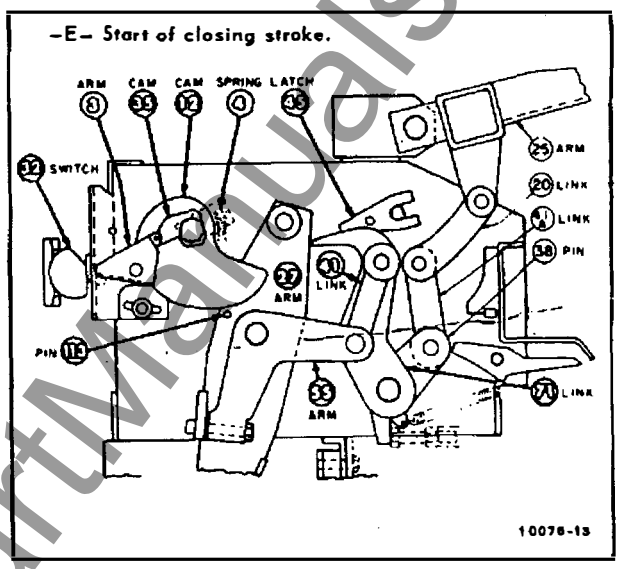


Fig. F – Roller (91), by the swing of link (71), forces roller (98) ahead of it. Link (41A) rotates about pin (38) held by latch (2). Straightening of the toggle framed by links (41A) and (20) raises (25), closing the blades. Links (41A) and (20) go over toggle against stop (23).

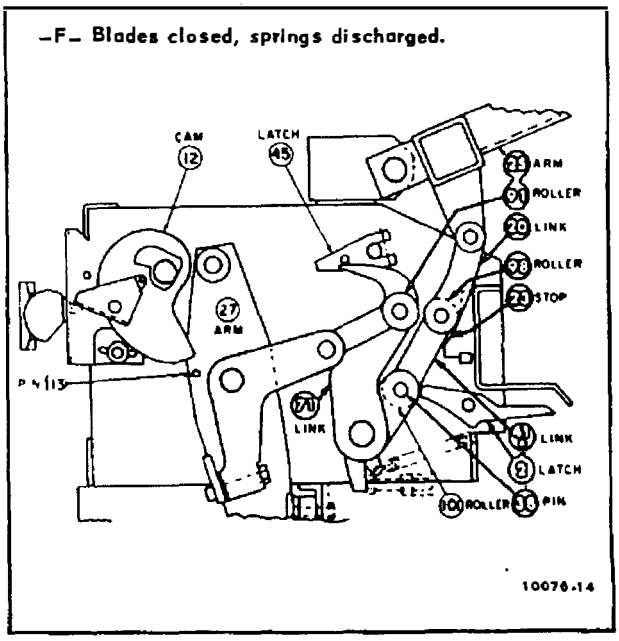


Fig. G – Shows the blades closed and the springs almost charged. The cam (12) has gone by its crown and is easing roller (91) onto latch (45).

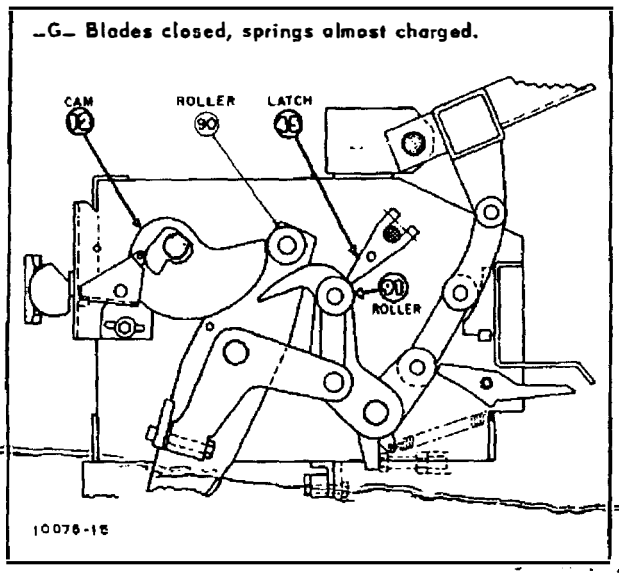
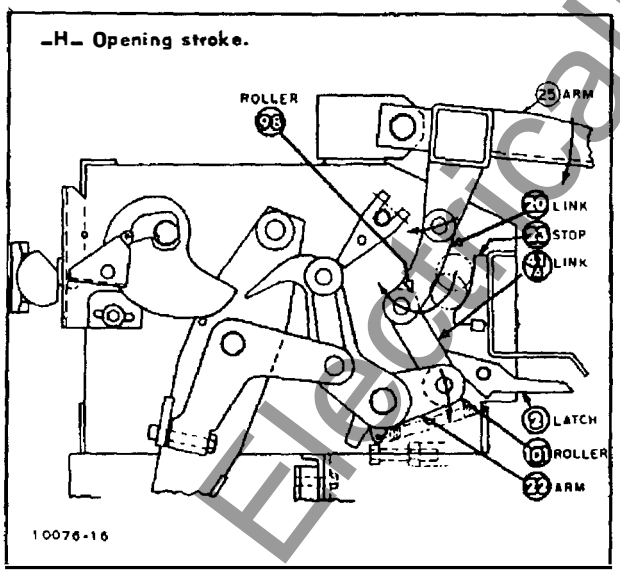


Fig. H – Trip latch (2) has been rotated to release roller (101). Arm (22) rotates about its fixed center, allowing links (41A) and (20) to drop. Shape of stop (23) forces roller (98) back to break the overtoggle between links (41A) and (20), allowing the 4-bar linkage to reset.



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.

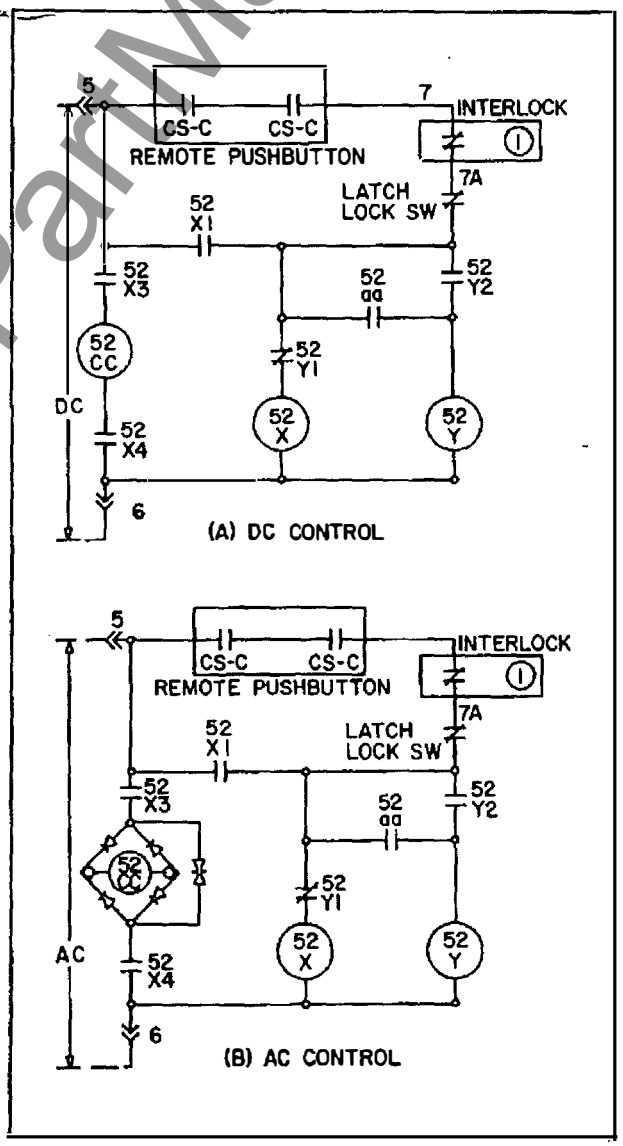


Fig. 8 – Solenoid operator control schemes.

Stored Energy Operator

The normal control (Fig. 9) for this operator has been incorporated in one switch assembly located at the rear of the unit. It consists of two-heavy-duty toggle switches (6) operated by common linkage (4) from the main charging cam (Fig. 10).

The main spring charging motor power is supplied through terminals 3 and 4. The mechanical interlock is a switch operated by a release lever which opens the motor circuit when the lever is depressed. The 88-1 and 88-2 switches are shown with the main closing springs discharged.

As the charging linkage charges the main closing springs, the motor switch cam rotates with the spring charging cam. When the drive disengages, the cam snaps over and the 88-1 and 88-2 switches are thrown, cutting off the motor circuit.

When the control is energized, the motor starts to charge the springs. The 88-1bb switch opens when the springs are fully charged.

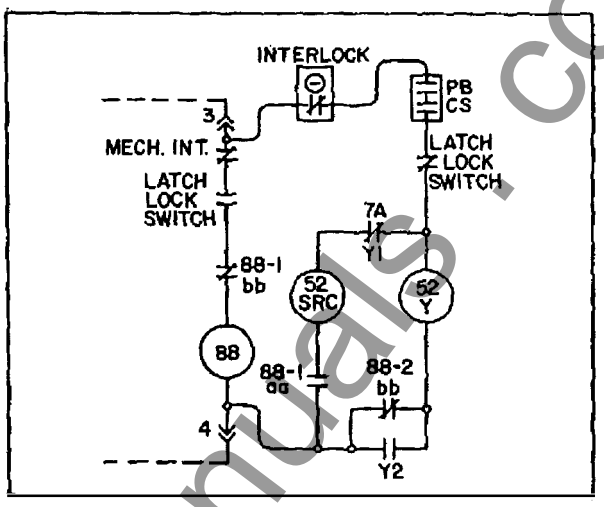


Fig. 9 – Control scheme for stored energy operator.

The 88-2-NC contact is in the close control lockout circuit. The 88-2-NO contact is used to energize an indicating light which shows that the springs are fully charged.

Motor Control Switch

The normal control for the stored energy operator is incorporated into one switch assembly (Fig. 10) located at the rear of the unit. It consists of two heavy-duty toggle switches (6) operated by a common linkage (4) from a motor switch cam (1) on the main charging cam shaft.

The 88-1-NC 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 88-1-NO contact is in the close control circuit and keeps the circuit open until the springs have been fully charged.

As the main charging cam rotates to charge the main closing springs, the motor switch cam rotates. When the closing springs are charged, the driving motor disengages because of the cutout teeth in the main driving gear. A spring rotates the main cam against a stop pin. As the main cam and the motor switch cam rotate again, the motor switch cam throws the common linkage to the 88-1 and 88-2 switches to shut off the motor.

When the closing springs are discharged, the cam is freed and the reset spring rotates the cam shaft to release the spring. Release of the switch closes the spring charge.

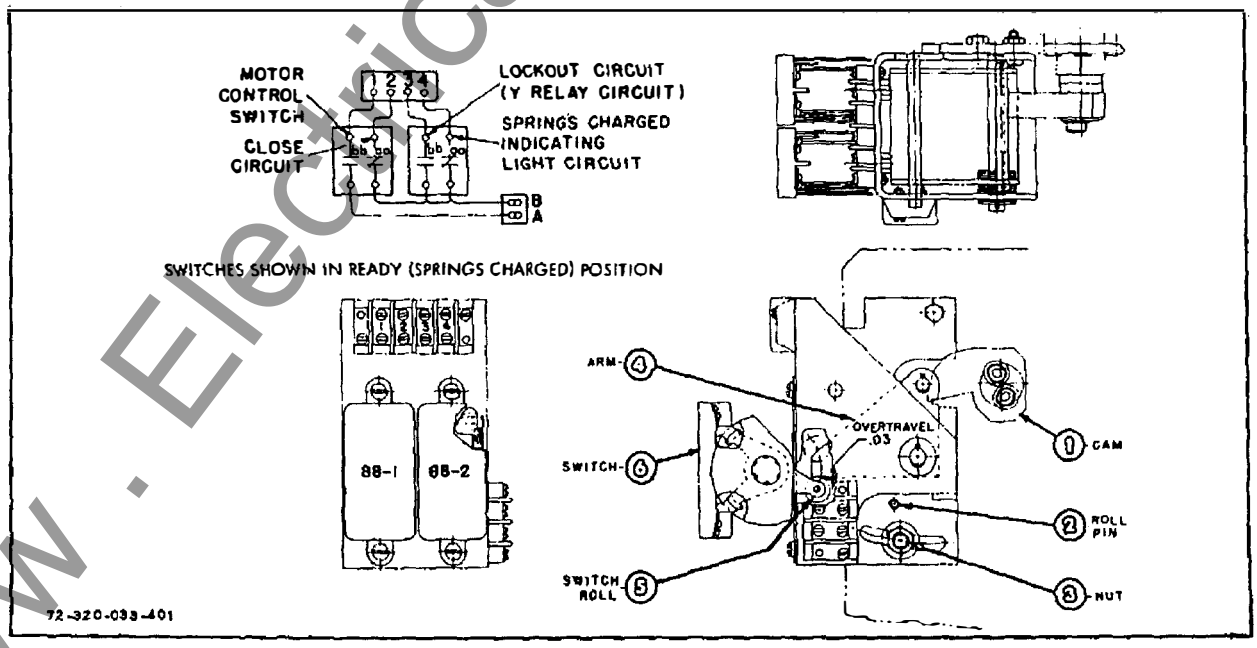
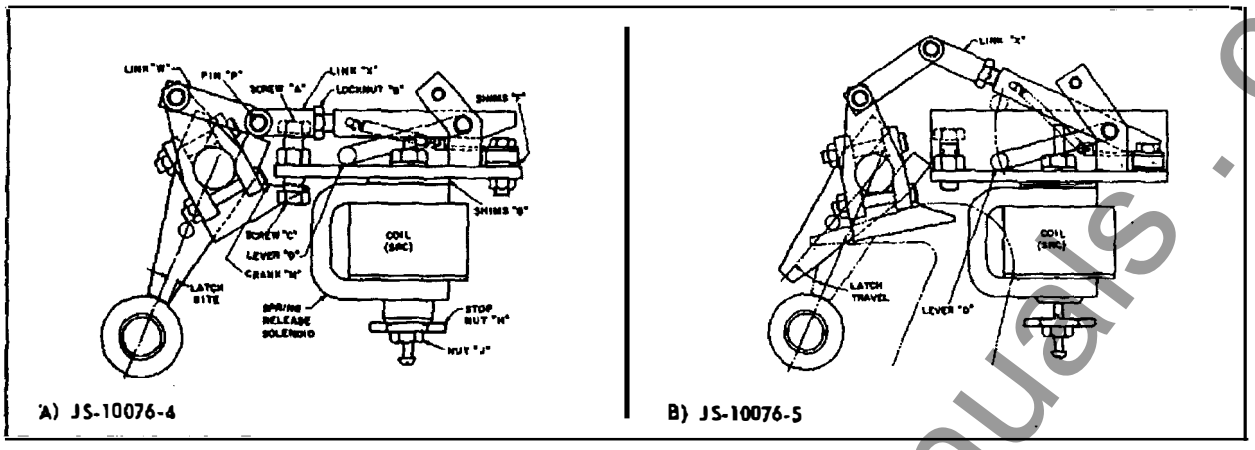


Fig. 10 – Motor control switch assembly for stored energy operator.



A) JS-10076-4

B) JS-10076-5

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

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.

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.

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 of an inch above the lower edge of the latch face with the breaker closed. This adjustment offsets the clearance between the trip pin and trip latch.

Prop Latch – The prop latch (97) is adjusted by shims so that it engages the toggle roll (15) 1/8 to 3/16 of an inch above the lower face of the latch.

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 of an inch 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). The latch check switch may be jumper wired out or omitted if not used for instantaneous reclose.

STORED ENERGY OPERATOR (Figs. 13 & 14)

Main Toggle Roll – When the ground device is in closed position with roll (55) against block (15), center of main toggle roll (55) should be 3/16 to 5/16 of an inch beyond line of centers of latch roll (56) and pin (3). Adjustment is made by adding or removing shims (8).

Trip Latch – The trip latch (9) should engage its roll (56) 1/8 to 3/16 of an inch above the lower edge of the latch face. Adjustment is made by shimming plate (36). With the springs charged and the ground device open, the trip latch (9) should clear its latch roll (56) by 1/64 to 3/64 of an inch. Adjustment is made by screw (7).

Closing Latch – The closing latch (18) should engage its roll (54) 3/16 of an inch above the lower edge of the latch face. See over-toggle latch for adjustment.

Closing Solenoid – The closing (50) solenoid has been adjusted at the factory and should require no further adjustment. If readjustment is required it should be made only when the closing latch bite is in correct adjustment.

The armature should move freely and have no binds. The travel of the armature should be such that slow manual actuation will trip the latch and have 1/32 to 1/16 to an inch overtravel. Adjustment is made by shimming the solenoid with washers on the mounting screws.

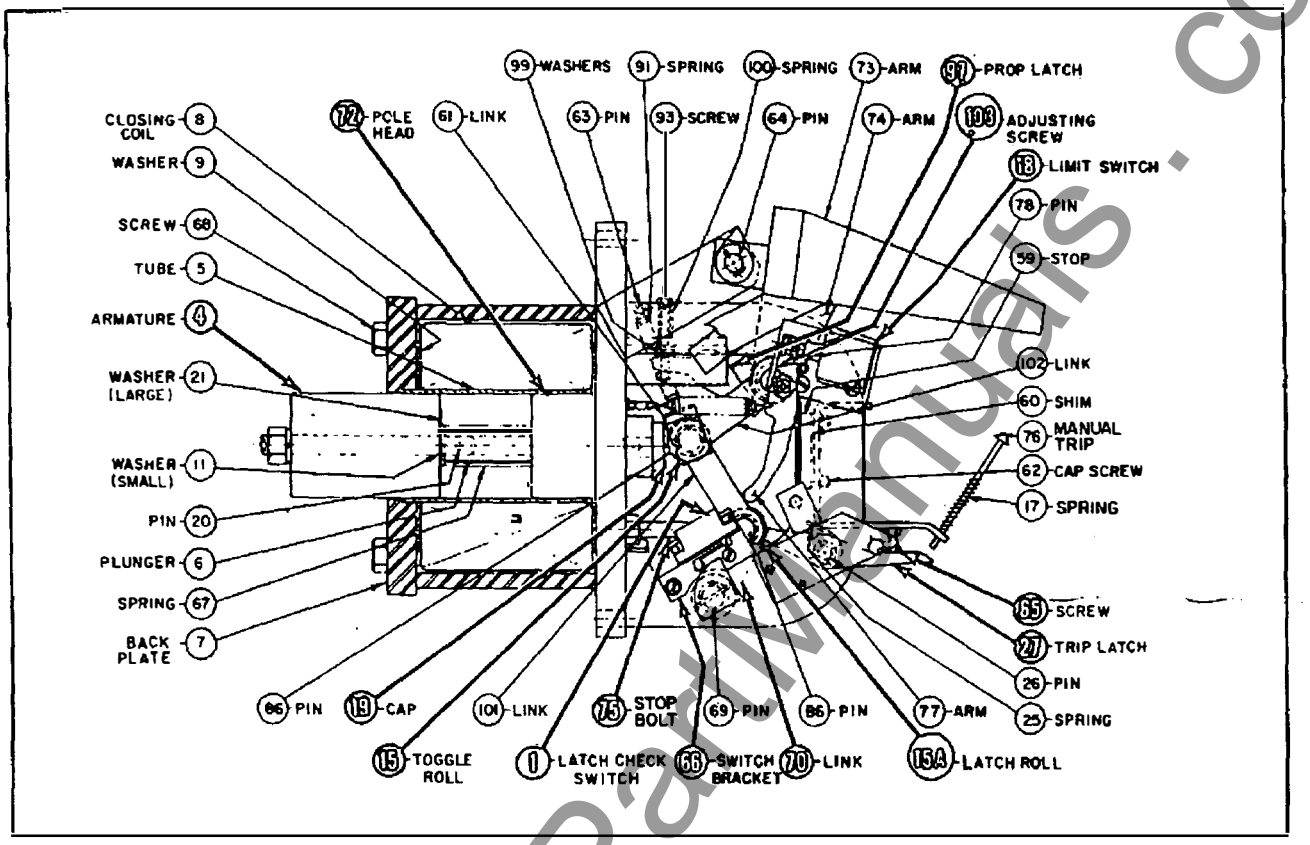


Fig. 12 – Solenoid operator assembly.

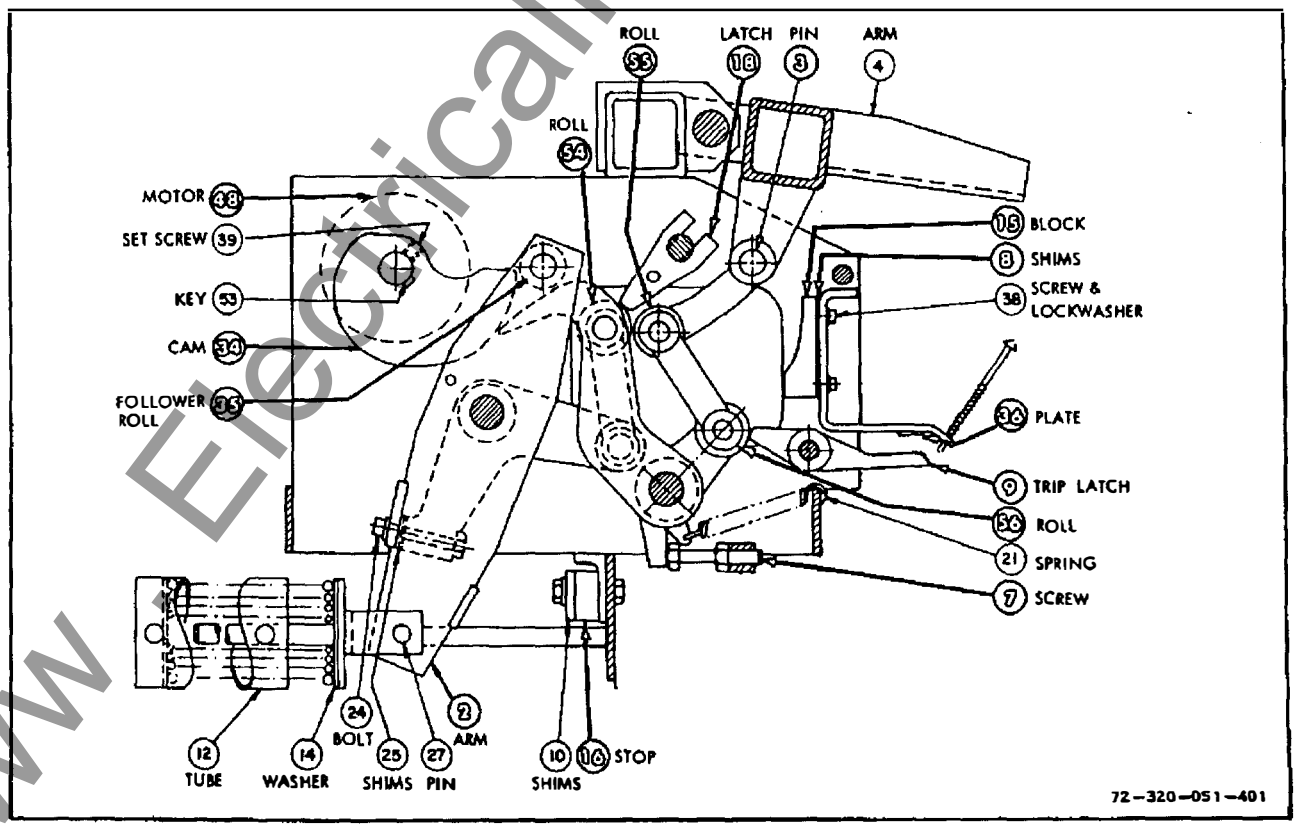


Fig. 13 – Stored energy operator assembly.

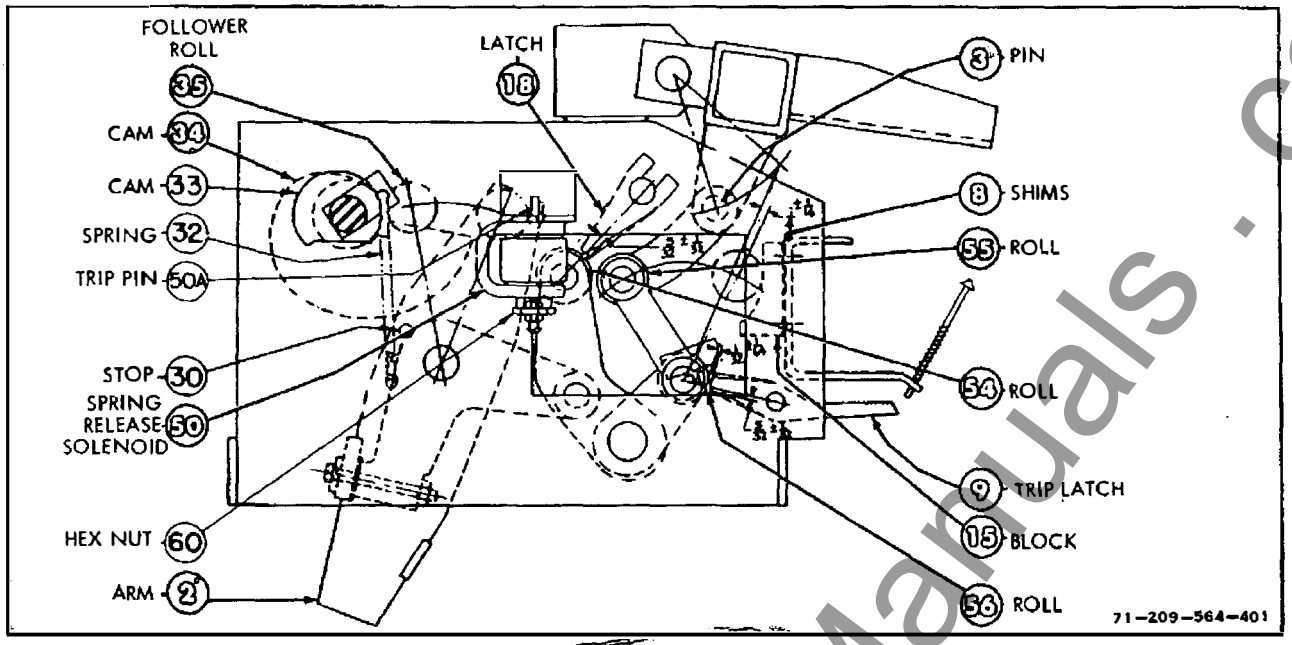


Fig. 14 – Stored energy operator assembly.

Manual Charging of Closing Springs – A charging handle is provided to charge the closing springs manually. Open the control power circuit and engage the charging handle with the coupling on the front of the motor (48). The springs are charged by a counterclockwise rotation of the handle. Full spring compression will be realized by an audible snap as roll (54) drops back on latch (18) when cam (34) clears follower roll (35). Continue to rotate handle until motor coupling rotates freely without load.

Manually Slow Closing the Switch – Manual slow closing the switch is done with a counterclockwise rotation of the charging handle. Rotate handle only to the point where latch (9) drops in front of roll (56). **Do Not Proceed Until You Are Sure That:**

1. Cam (34) is engaged with following roll (35).
2. Latch (18) is not engaged with roll (54).

Switch can now be closed by slowly turning charging handle clockwise. The breaker is fully closed when arm (2) is against stop (16) Fig. 13.

The mechanism can be cranked to any position and held because the motor gears are self-locking.

Spring Release Latch and Over Toggle Linkage – To change bite of spring release latch (Fig. 15), 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 sets to position link (X).

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 (50), preventing the breaker from closing.

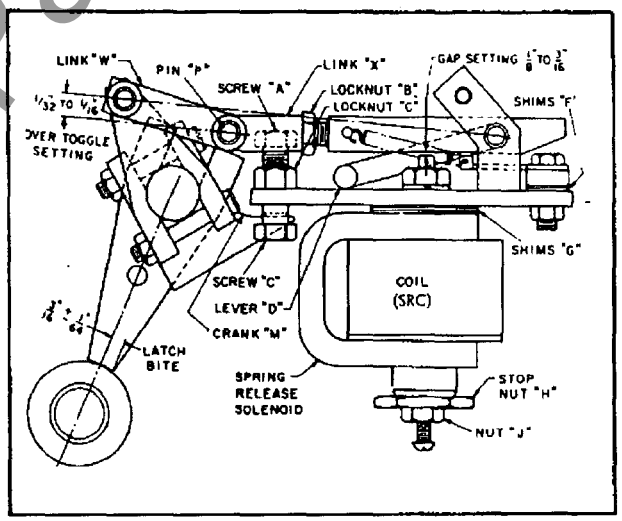


Fig. 15 – Spring release latch and over toggle linkage.

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. 16) 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. 15), releasing the closing springs.

The length of the spring assembly can be increased, or decreased, if necessary, by adjusting clevis (11), Fig. 16.