I. B. 33-600-2

RECEIVING • OPERATION • ADJUSTMENT

INSTRUCTIONS

SOLENOID OPERATED MECHANISM

Type SA-3

for

Oil Circuit Breakers

WESTINGHOUSE ELECTRIC CORPORATION

SWITCHGEAR DIVISION

EAST PITTSBURGH PLANT • EAST PITTSBURGH, PA.

JULY, 1954

SUPERSEDES I.B. 5567

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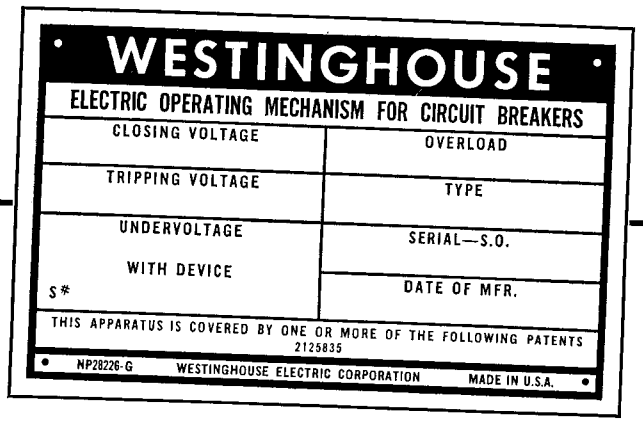
SPECIAL INQUIRIES

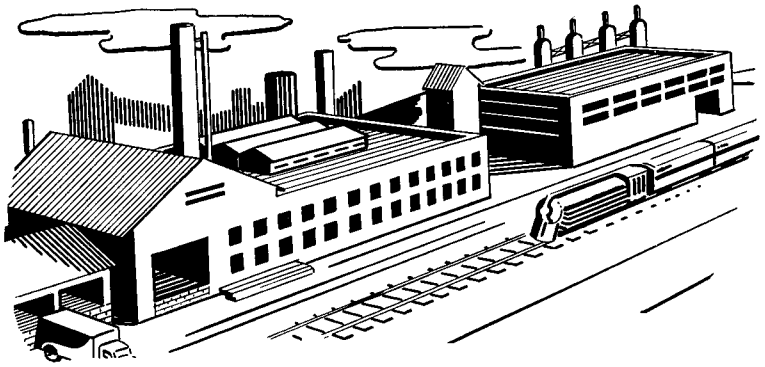
When communicating with Westinghouse regarding the product covered by this Instruction Book, include all data contained on the nameplate attached to the equipment.* Also, to facilitate replies when particular information is desired, be sure to state fully and clearly the problem and attendant conditions giving the figure showing parts in question and using names for the parts as given.

Address all communications to the nearest Westinghouse representative as listed in the back of this book.



* For a permanent record, it is suggested that all nameplate data be duplicated and retained in a convenient location.

LIST OF ILLUSTRATIONS



RECEIVING, HANDLING AND STORING

This mechanism is of the solenoid type. It operates on standard direct current control voltages or, when equipped with a rectifier unit, on alternating current. It is a full automatic mechanism tripping free mechanically in all positions.

Application may be made to any indoor or outdoor breaker within the limit of the power of the mechanism. For indoor service, it is mounted on the foundation or on the breaker structure. For outdoor service it is placed in a weatherproof housing with enclosed connections to the breaker.

A control relay is required to handle the closing coil current. The necessary tripping devices form a part of the mechanism. A two pole rotary switch operates as a cutoff. A six pole or ten pole rotary switch, as specified, controls the signal lights, cuts off the trip coil and provides interlocking contacts. A counter records the number of operations. An indicator, connected to the breaker lever, shows the position of breaker contacts.

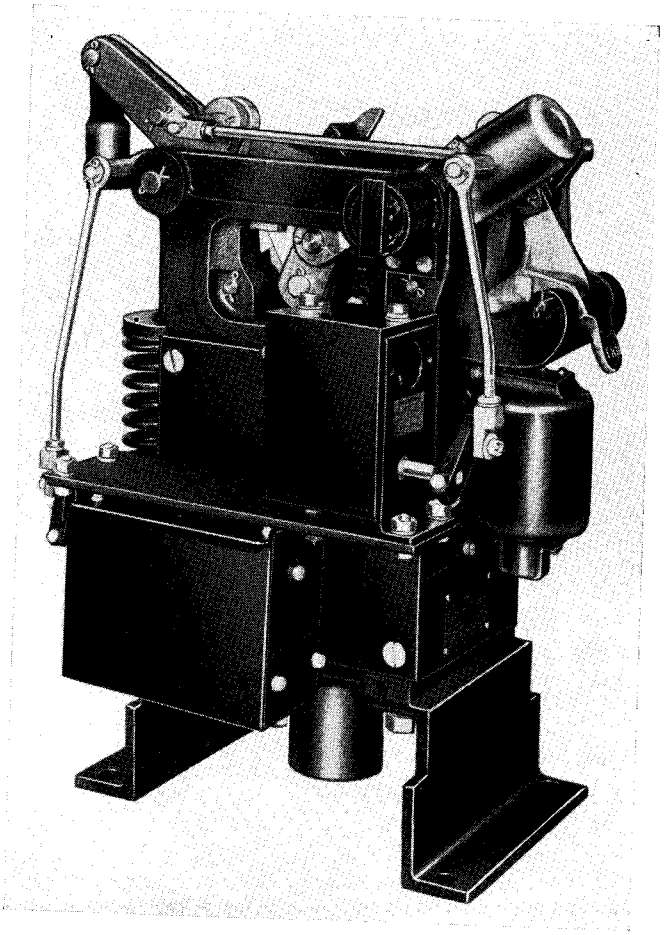


FIG. 1. Solenoid Operating Mechanism, Type SA-3

RECEIVING THE SHIPMENT

Whether the mechanism is shipped as a part of the breaker or separately, it is carefully inspected, tested and packed at the factory and should be received in good condition. It should be inspected immediately upon receipt for damage that may have occurred in shipment. If damage is detected, notify the shipper and the nearest Westinghouse representative immediately.

STORING

If mechanism is to be stored for any length of time, it should be kept in a clean dry place, protected from dirt and moisture. The insulation in particular should be kept dry.

UNPACKING

Unpacking should be done carefully to avoid damage. Care should be taken to remove all parts from the packing material. The instruction book and the identification tags accompanying each mechanism should be kept together and where they are readily accessible during the installation period. After installation is complete the Instruction Book should be placed where it will be available to the maintenance staff. Extra copies can be obtained by a request to any representative of the Westinghouse Electric Corporation.

PART TWO

OPERATION

Figure 2 shows an outline of the mechanism in the closed position with most of the parts named. The mechanism is connected to the circuit breaker through the rod end shown in the position for upward push. For downpull the rod end is attached to the bell crank lever on the opposite side of the fulcrum. The rod end can also be attached to the bell crank lever to provide horizontal push if that is required. The bell crank lever is connected to the trip free lever by the toggle link. The trip free lever lays between the arms of the closing lever and is connected to the closing lever by a pin which also passes through the moving core eye bolt. The closing lever is carried on a fulcrum in the magnet frame. The right hand end of the trip free lever, in Figure 2, is held by the trigger and operates in unison with the closing lever as long as the trigger remains in the latched position.

When the closing coil is energized the moving closing core rises, rotating the closing lever and the trip free lever clockwise, pushing up on the toggle link and thus rotating the bell crank lever counter-clockwise. In the closed position the locking lever slips under the pin through the moving core eye bolt and holds the mechanism closed. When the trigger releases the trip free lever the latter rotates counter-clockwise permitting the breaker attached to the bell crank lever to open. The mechanism is then in the position shown in Figure 3. De-energizing the closing coil permits the moving closing core to drop and pull the levers

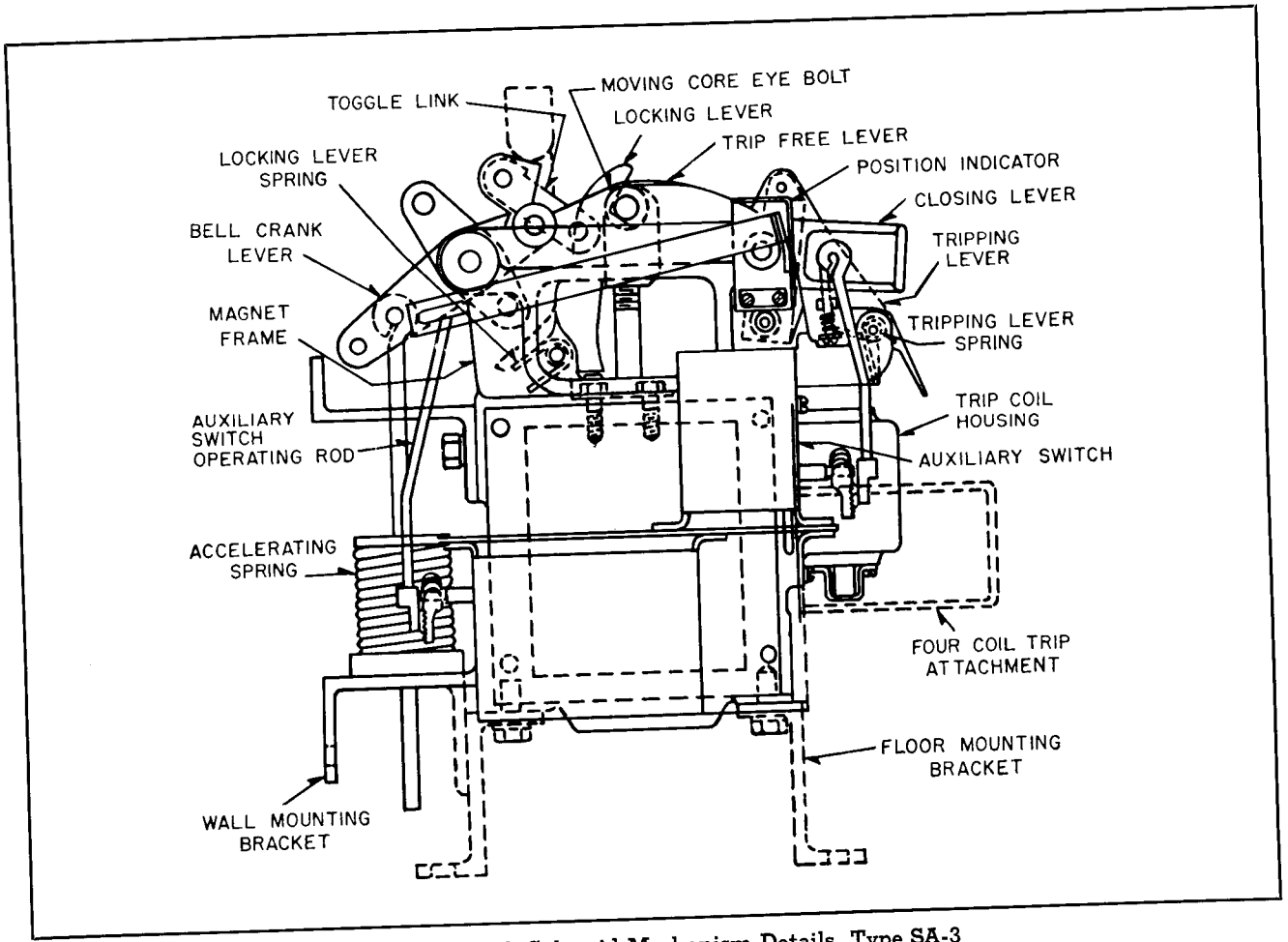


FIG. 2. 3-Inch Solenoid Mechanism Details, Type SA-3

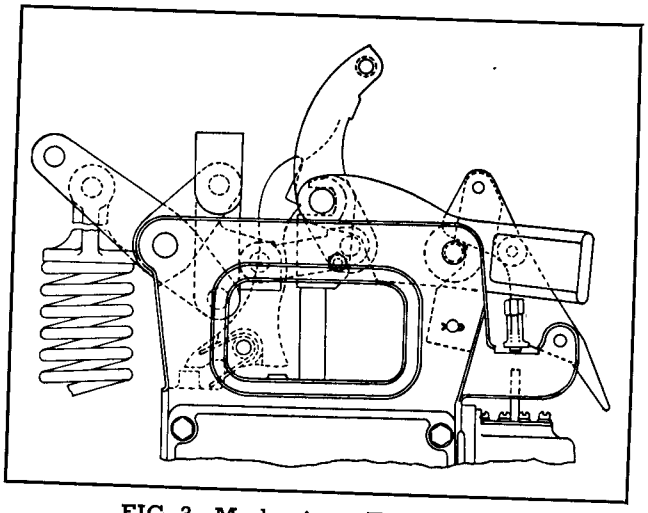


FIG. 3. Mechanism—Tripped Free

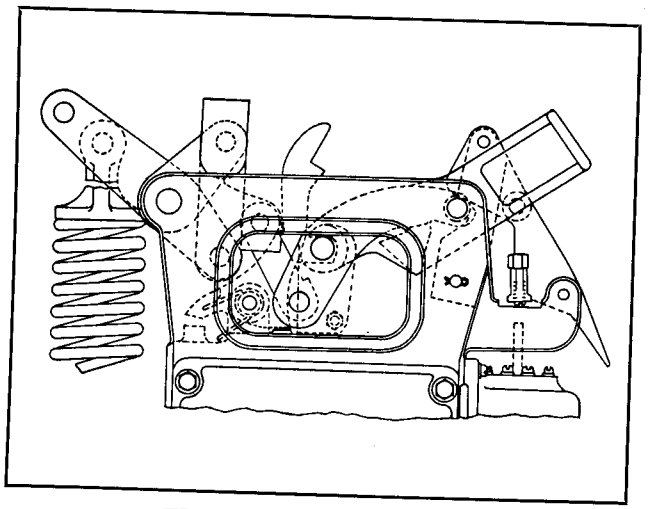


FIG. 4. Mechanism—Open

back into the position shown in Figure 4 ready for another operation.

The trigger is a "slip off" type and would not hold the trip free lever without being held in turn by the over center toggle formed by the trigger links and the tripping lever. The tripping devices act to rotate the tripping lever clockwise to push the toggle back over center and to the point where it no longer holds the trigger. Moving the tripping lever releases the breaker at any position in the closing stroke regardless of whether the closing coil remains energized or whether the manual closing lever is still held.

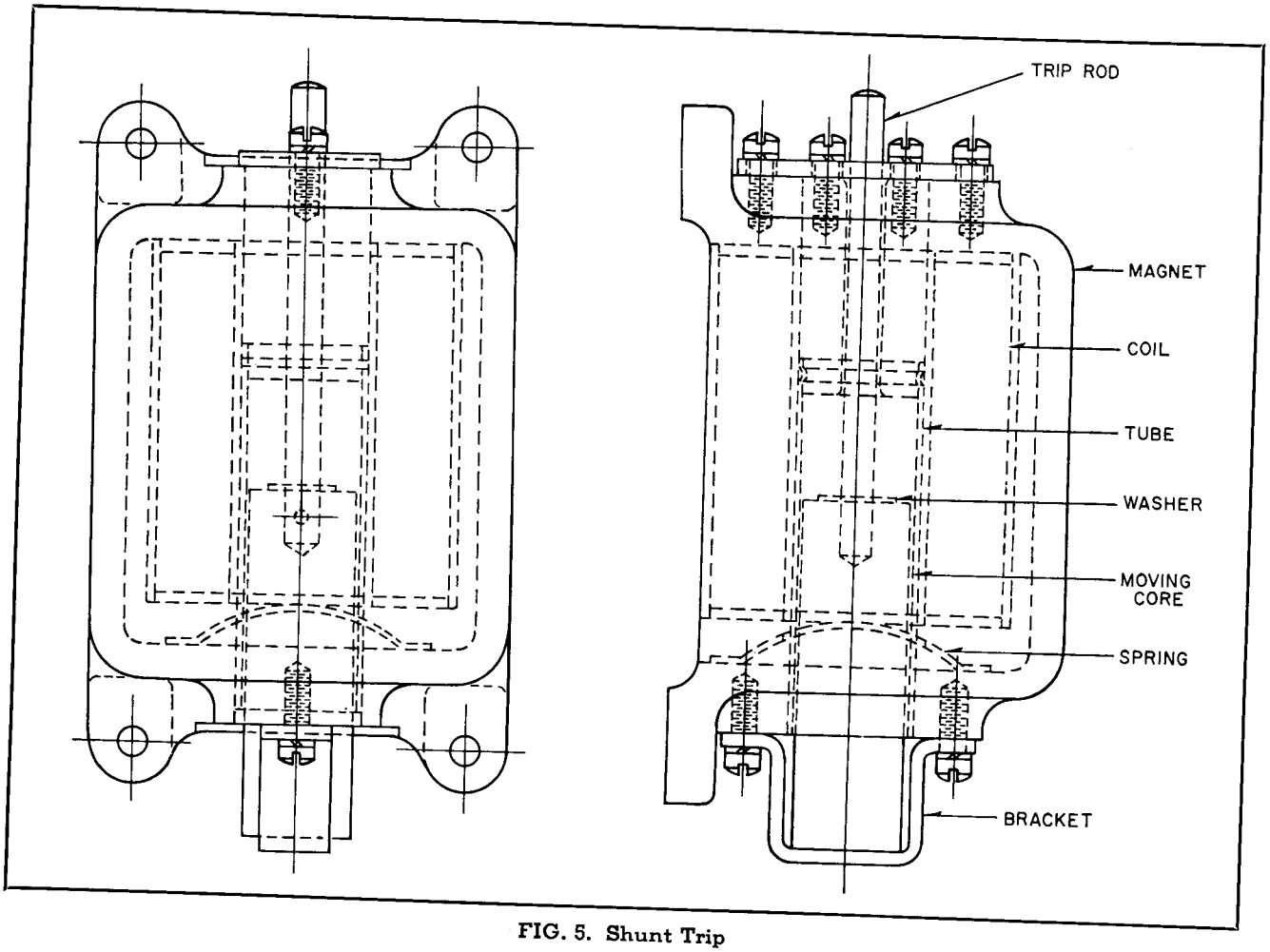


FIG. 5. Shunt Trip

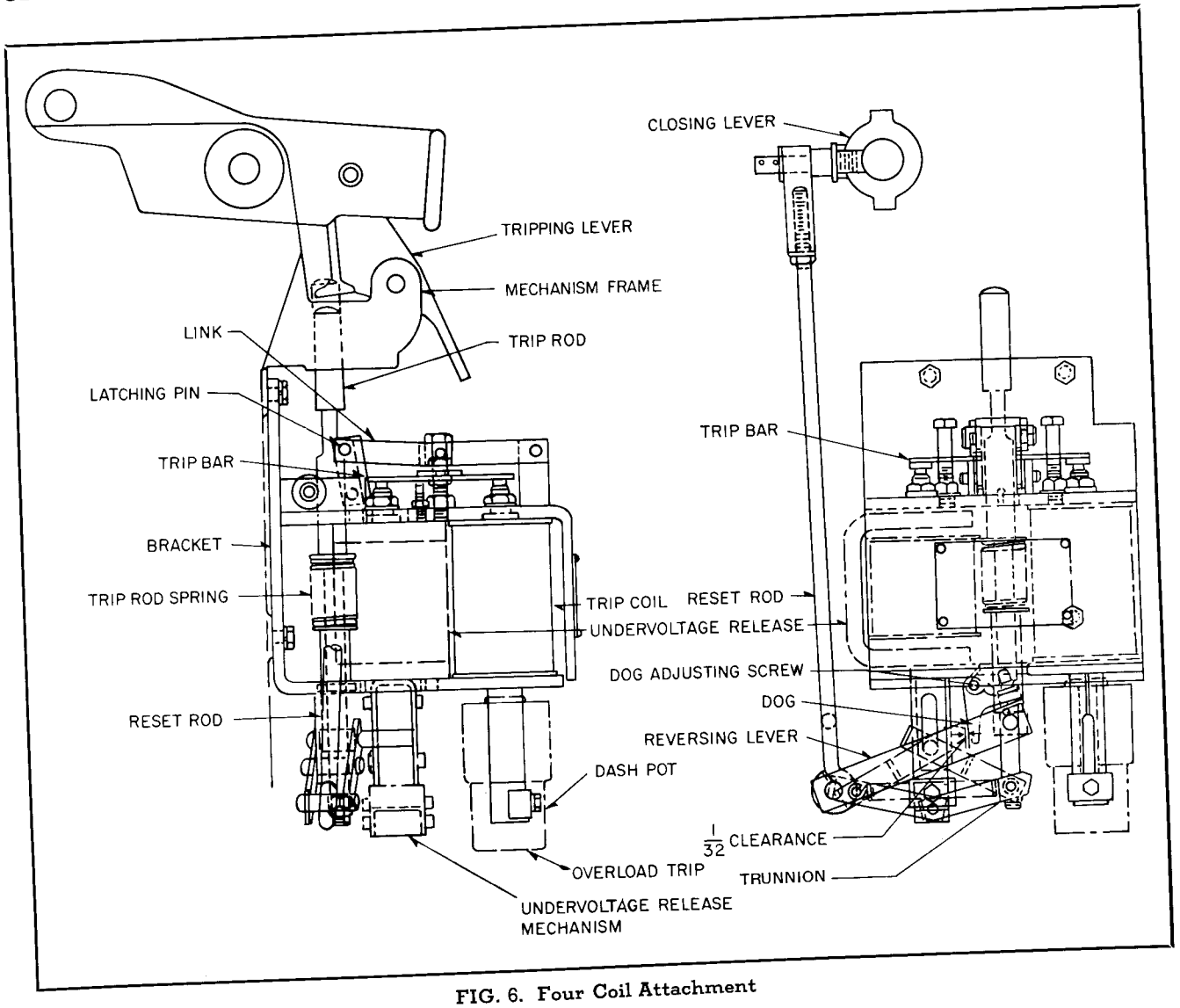


FIG. 6. Four Coil Attachment

An accelerating spring is provided at the left of the mechanism to assist the force of gravity acting on the contacts of the breaker to open them promptly and completely.

Hand closing is provided by means of a removable lever which is inserted in the socket of the closing lever.

STANDARD SHUNT TRIP

The standard shunt trip, as shown in Figure 5, bolts to the end of the magnet frame in such a position that the trip rod on the moving tripping core will strike the tripping lever. The cast iron magnet surrounds the trip coil which in turn surrounds the trip cores. The stationary core is held in place by the brass guide tube which is held by the stirrup which also acts as an open position stop for the moving core. The trip rod carried by the moving core extends through the stationary core and is just long enough to disengage the trigger toggle with 1/16 inch gap between the cores. A brass washer between the cores prevents residual magnetism holding the moving core, after the coil is de-energized.

AUXILIARY SWITCHES

A two pole rotary auxiliary switch connected to the closing lever moves with the closing core and serves to cut off the energy to the closing coil when the end of the closing stroke is reached. The six or ten pole auxiliary switch connected to the bell crank lever moves with the breaker. The first and third contacts are wired in series to interrupt the trip coil circuit when the breaker opens.

FOUR COIL TRIP ATTACHMENT

When tripping from current transformers, or because of low voltage or from shunt tripping by

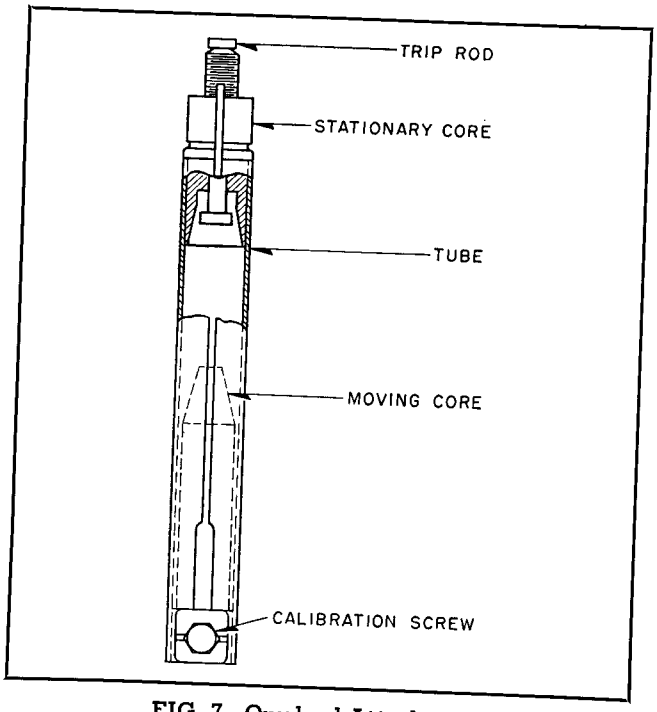


FIG. 7. Overload Attachment

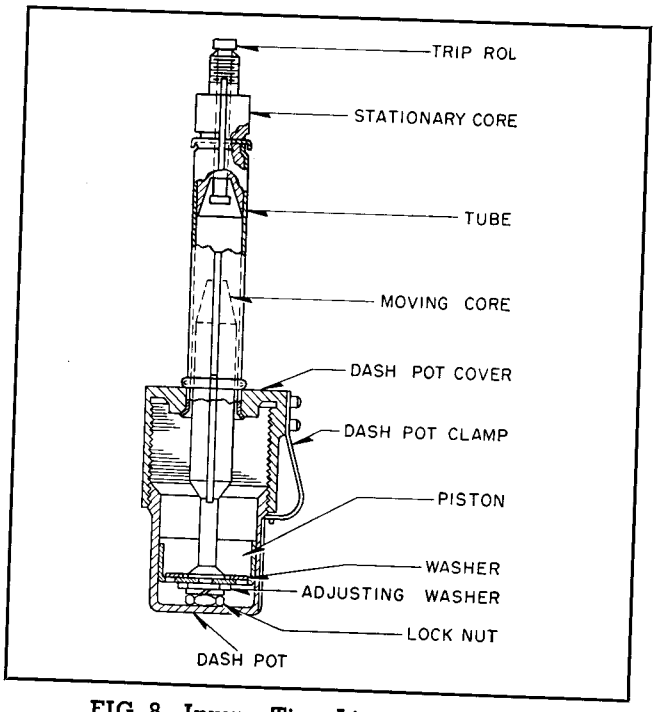


FIG. 8. Inverse Time Limit Attachment

energy stored in a capacitor it is necessary to replace the standard shunt trip with a mechanical relay. This relay is shown in Figure 6. It bolts in the same place occupied by the standard shunt trip with the trip rod immediately under the tripping lever. The bracket has space for four coils. Only one undervoltage trip can be used, always placed in the left rear (when facing trip device). Otherwise any combination up to four coils can be used.

The trip rod is held down by a toggle linkage that engages the notched portion of the trip rod. This linkage consists of a holding link backed up by a pair of toggle links that drop down slightly below center. The ends of the arms of the H bar rest on the trip rods of the individual tripping devices. The raising of any one of the trip rods tilts the H bar causing the adjusting screw in the center to push the toggle links back over center. They no longer hold the locking pin in engagement with shoulder of the trip rod which is then driven upward against the tripping lever by the tripping spring. As the mechanism opens the resetting rod is drawn upward thus, through the reversing lever, pulling the trip rod down and permitting the locking pin to reset backed up again by the toggle links. As the breaker closes the resetting rod is forced down and through the reversing lever and the trunnion pushes up the lower end of the tripping spring compressing it to give the power for the next tripping operation.

SHUNT TRIP

When tripping from a separate source of power a shunt trip assembly as shown in Figure 7 is placed in one of the trip coil positions. The coils may be for different frequency or a-c voltages or different voltage or for use with a capacitor tripping device. When energized the coil pulls the moving trip core up against the trip rod which tilts the H bar.

CAPACITOR TRIP DEVICE

When there is no dependable source of power available for tripping a capacitor trip device as covered in Instruction Leaflet 2634 is included together with special shunt trip coil.

CURRENT TRANSFORMER TRIP

The instantaneous overload trip is like the shunt trip except the device is provided with a means to vary the air gap between the cores. A calibration stamped on the tube indicates the current in the coil to trip at the various settings.

The time delay overload trip is shown in Figure 8. This is used where it is desired to delay tripping on small overloads and get approximate instantaneous tripping on short circuits. A piston type dash pot is attached to the tripping core. The distance between the core is changed by screwing the dashpot up or down in the cover. The piston has a series of holes in the bottom with an adjusting disc to

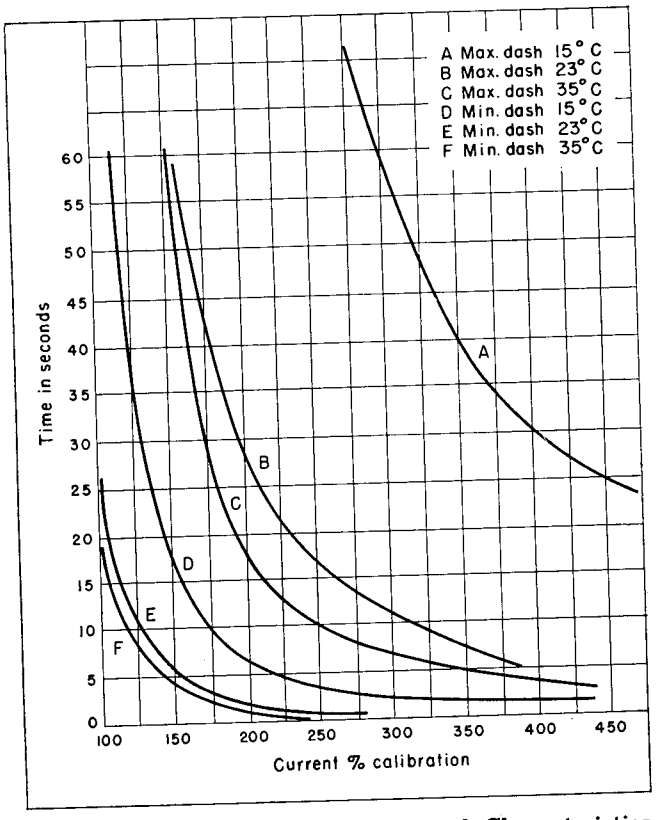


FIG. 9. Approximate Time Overload Characteristics of the Inverse Time Limit Attachment with Standard Dashpot Oil as supplied

cover some of them to vary the time delay. A loose washer provides quick resetting.

The time delay varies with the viscosity of the oil placed in the pot and with the percent overload. Change in temperature changes the viscosity of the oil. Figure 9 shows typical curves of the time delay that may be expected undervoltage trip.

The undervoltage trip is mounted in the left hand rear space of the four coil trip when facing the device. A separate magnetic circuit surrounds the coil. When the coil is energized the upper core is held down against the lower stationary core. A spring biased across the pantagraph just below the magnetic circuit tries to force the moving core upward. When the voltage impressed across the coil falls to less than 40% of normal the pull of the coil is overcome by the force from the spring and the trip rod rises pushing the H bar up. As the breaker opens and the solenoid mechanism retrieves the resetting lever, acting through the reversing lever, pulls the moving core and the pantagraph back down to when there is 1/32 inch clearance or less between the cores. Restoring of normal voltage pulls the cores together. At the end of the retrieving stroke the dog drops into place to hold the pantagraph down as the breaker closes. This dog is pushed out of engagement after the arcing contacts of the breaker have touched and just before the full closed position is reached. This permits connecting the undervoltage to the load side of the breaker.

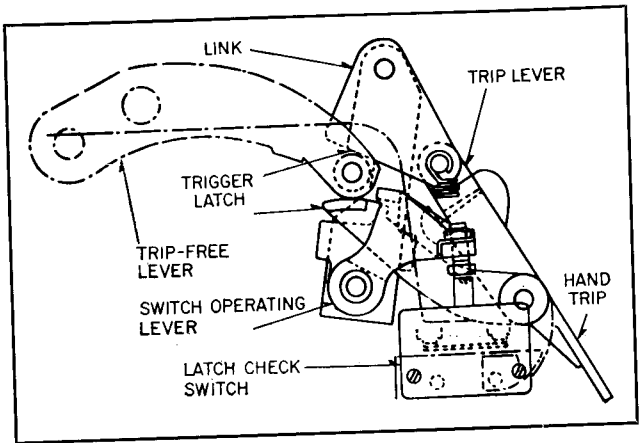


FIG. 10. Latch Check Normal Latched Position

UNDERVOLTAGE RECTIFIER DEVICE

A transformer and rectifier device as covered separately in Instruction Card 3697 is included with each undervoltage which is intended to trip immediately when voltage falls to trip limit.

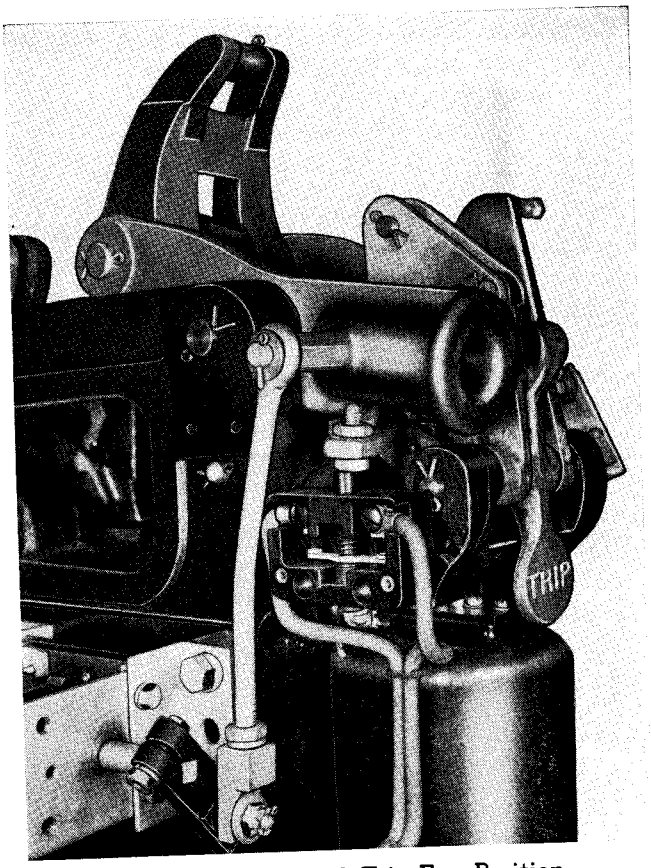


FIG. 11. Latch Check Trip-Free Position

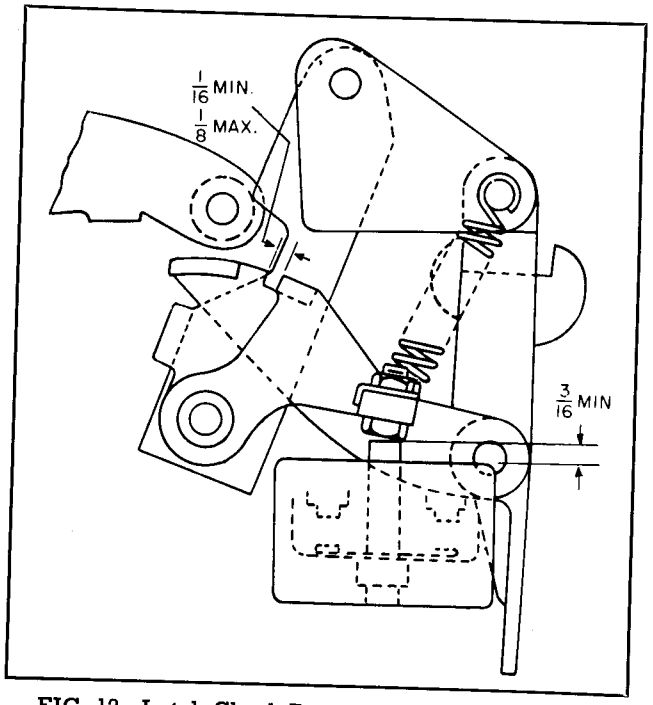


FIG. 12. Latch Check Partially Retrieved Position

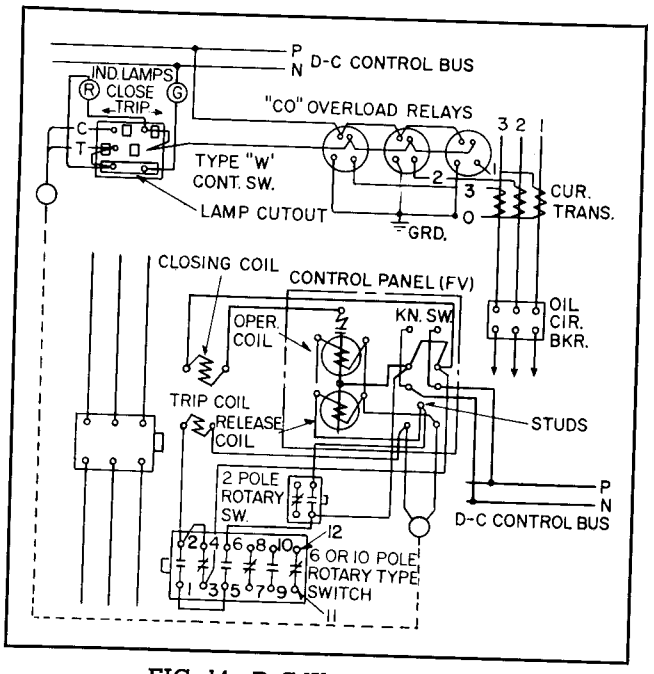


FIG. 14. D-C Wiring Diagram

UNDERVOLTAGE TIME DELAY DEVICE

A transformer, rectifier and capacitor device as covered separately in Instruction Leaflet 2635 is included with each undervoltage which is intended to trip an appreciable time after voltage has fallen to the tripping limit.

LATCH CHECKING SWITCH

The latch checking switch is used primarily where automatic reclosing is contemplated. The reclosing circuit is not completed until the solenoid mechanism levers have reached the retrieved position with the trigger re-engaged. Figures 9, 10, 11 show how the attachment works. When the mechanism opens the trip lever is prevented from returning to the original position by the locking lever. When the trip free lever returns to the retrieved position it depresses the locking lever which releases the switch operating lever which is attached to the trigger. This permits the trigger to reset and the contacts of the switch to make and to set up the closing circuit.

D-C CONTROL PANEL

Figure 12 shows the standard control panel and Figure 13 the diagram used when solenoid is operated from d-c supply.

This scheme includes a Type S-1 trip free control relay. Moving the control switch to the "close" position energizes the operating coil on the relay which closes, energizing the closing coil, and closing the breaker. When the closed position is reached, the release coil is energized through the

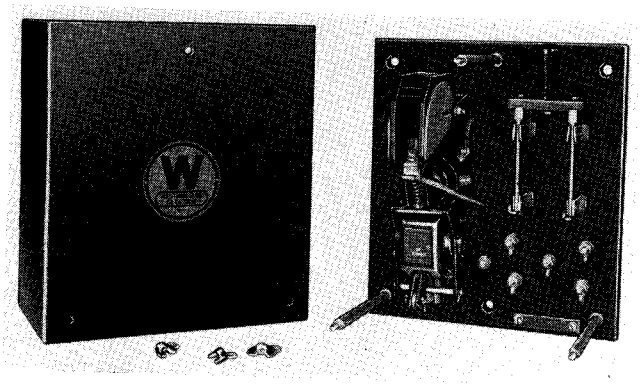


FIG. 13. D-C Control Panel and Cover

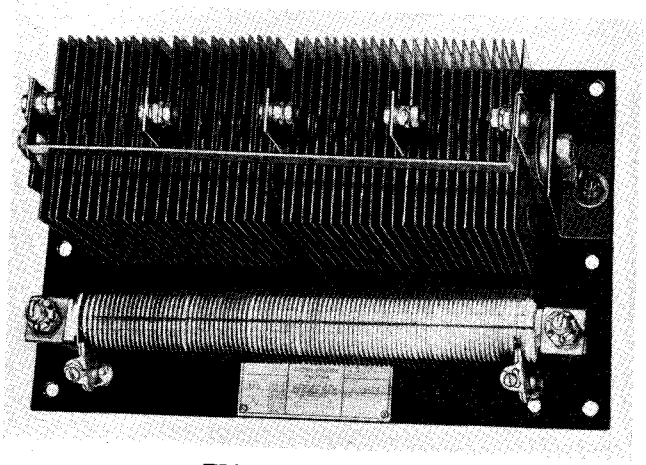


FIG. 15. A-C Rectox

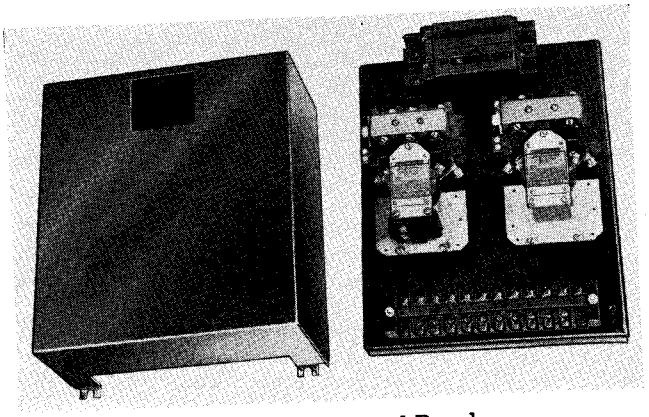


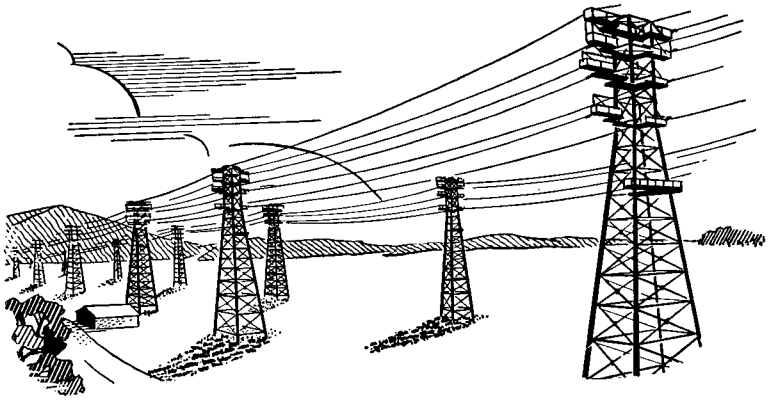
FIG. 16. A-C Control Panel

cut-off contacts of the 2-pole switch which is operated by the closing lever. This releases the latch on the relay and allows it to open its contacts, even though the operating coil is still energized. The relay cannot be closed to energize the breaker closing coil again until the control switch is turned to the neutral position. To trip, the control switch is turned to the trip position energizing the trip coil through the auxiliary switch which is operated by the bell crank lever. As the breaker opens, the trip coil is de-energized by this switch. The 2-pole knife switch is arranged to isolate the breaker from the control circuit.

A-C CONTROL PANEL AND RECTIFIER

The control panel as shown in Figure 16 is furnished when solenoid is operated from a-c. The left hand relay connects the a-c supply to the rectifier. When closed an interlock seals it closed until the control circuit is interrupted. The right hand relay interrupts the control circuit when the solenoid reaches the closed position and an interlock seals the relay closed until the control circuit is interrupted. The control circuit is shown in Figure 17.

The rectifier shown in Figure 15 changes the a-c supply to d-c for the solenoid. It should not be connected to the supply for longer than one second nor required to close the breaker more often than ten times in a five minute period. The resistance in series in the rectifier is used to adjust the output to adapt for use with various breakers requiring different pull on the part of the solenoid. The fuse has a low rating so it will cut the rectifier off the supply if energized long enough to threaten damage to the rectifier and yet to not blow until the solenoid has had time to close the associated breaker. See separate Instruction Leaflet for more detailed information.



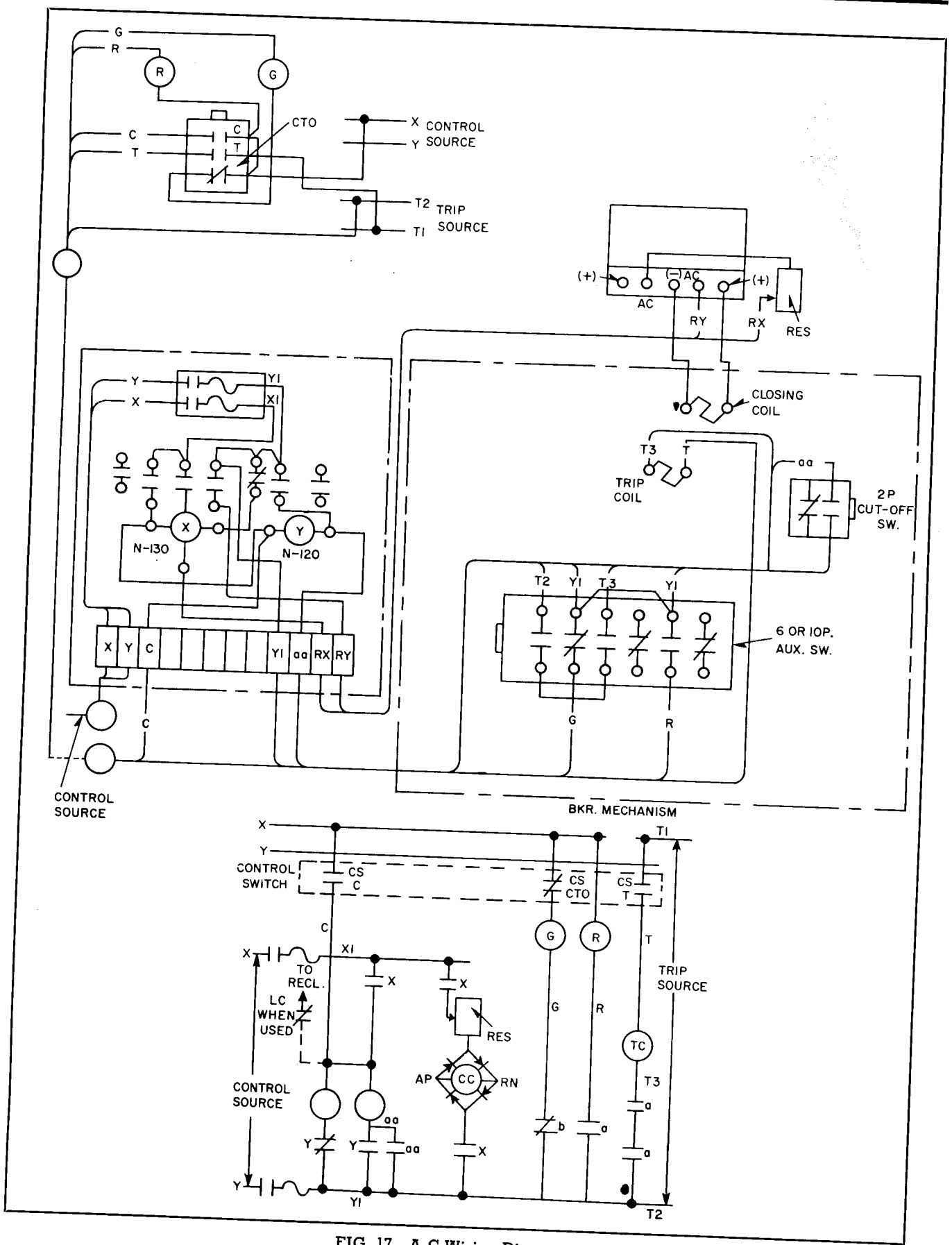


FIG. 17. A-C Wiring Diagram

PART THREE

ADJUSTMENT AND MAINTENANCE

ADJUSTMENT

When preparing to put the solenoid in service the following points must be observed.

Remove the wire ties on the trigger holding the mechanism closed. Be careful not to trip mechanism as parts may move so fast as to injure any person caught by the moving parts.

Connect the mechanism to the breaker. Close slowly with the manual closing lever. When holding latch drops into place the toggle stop in the breaker should be in the closed position as given in the breaker instruction book. Open the mechanism slowly and see that the breaker unit stops in the open position on its bumpers and that the stop on the solenoid is clear.

Close breaker again with the closing lever and trip by raising the trip core slowly. Breaker should be released with approximately 1/16 inch travel left for the moving tripping core.

Close breaker again and trip while holding the manual closing lever. Release manual closing lever after breaker is open. Mechanism should reset ready for a new closing operation. Note if closing lever is released very slowly to the reset position it will stall when almost reset. It must be released completely when roller is about 1/2 inch from touching trigger.

Connect according to diagram and operate from controller several times checking to see that mechanism latches closed and stays closed after the current in the closing coil is interrupted. Check to see that breaker opens when the trip coil is energized and that the coil is de-energized by the auxiliary switch. Check to see that mechanism resets ready for another closure.

Close breaker while holding the cut-off relay open and check to see that closing core pushes linkage up so there is about 1/16 inch clearance at holding latch with coil energized. Do not try this with rectifier. Screw moving closing core into or out of eye bolt to adjust.

Check auxiliary switches to see that figures are in the middle of the moving segments when mechanism is open and when closed. Length of operating rod can be changed to shift position. Length of operating arm can be changed to change travel which is supposed to be 90° total, 45° either side of center. Note 1st and 3rd segments of 6-pole (or 10 pole) switch are longer and are connected in series to take care of the trip coil circuit.

Check to see that 90 volts across the closing coil (for breakers using 125 Volt d-c control) will close and latch the mechanism closed. Check to see that 70 volts across the trip coil will trip the mechanism. When rectifier is used check to see that 180 volts (for breakers using 230 Volt a-c control) will close and latch the mechanism closed. Adjust resistor in series with rectifier so that this test is met and that there is no excessive slam when closed at maximum control voltage.

FOUR COIL TRIP

Check adjusting screw to see that toggle links do not drop more than 1/32 inch below center. Check to see that with mechanism open reversing lever draws trip rod down so latching pin drops into position and toggle links reset. Check to see that with mechanism in closed position trunnion does does not compress tripping springs solid. Check undervoltage, when used, to see that reversing lever pulls strip cores down within 1/32 inch of each other when mechanism opens and releases dog holding pantagraph just before end of closing stroke. Check to see that toggle links and undervoltage do not "slam out" when circuit breaker is closed and when at least 80% of normal control voltage is supplied to undervoltage release coil.

MAINTENANCE

Check mechanism from time to time to see that it remains in good operating condition. Check cotter pins and replace all that are worn or have one broken leg. Replace any pins that show excessive wear. Check adjustments previously given. Fulcrums may be lubricated with light non-gumming oil except where atmosphere is exceptionally dusty. Triggers should be lubricated only with collodial graphite such as "Gun Slick".

Extra copies of this Instruction Book can be obtained upon request to any representative of the Westinghouse Electric Corporation.

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MEDFORD, ORE., 1233 Court St.
MEMPHIS 3, TENN., 825 Exchange Bldg., 130 Madison Ave.
MIAMI 32, FLA., 730 Ingraham Bldg.
MILWAUKEE 2, WIS., 538 N. Broadway
MINNEAPOLIS 13, MINN., 2303 Kennedy St., N.E.
MOBILE, ALA., 1605 Merchants Nat'l Bank Bldg.
NASHVILLE 4, TENN., 401—6th Ave. S.
NEWARK 2, N. J., 1180 Raymond Blvd.
NEW HAVEN 8, CONN., 42 Church St., P.O. Box 1817
NEW ORLEANS 12, LA., 1226 Whitney Bldg., 288 St. Charles St.
NEW YORK 5, N. Y., 40 Wall St.
NIAGARA FALLS, N. Y., 253 Second St.
NORFOLK 10, VA., 915 W. 21st St.
OKLAHOMA CITY 2, OKLA., 120 N. Robinson St.
OLEAN, N. Y., Exchange Nat'l. Bank Bldg., 201 N. Union St.
OMAHA 2, NEBR., 117 North Thirteenth St.
PEORIA 3, ILL., 2800 N. Adams St.
PHILADELPHIA 4, PA., 3001 Walnut St.
PHOENIX, ARIZ., 1110 N. 21st Ave., P.O. Box 6144
PITTSBURGH 30, PA., 306 4th Ave., P.O. Box 1017
PORTLAND 4, ORE., 309 S. W. Sixth Ave.
PROVIDENCE 3, R. I., 51 Empire St.
RALEIGH, N. C., P.O. Box 2146
READING, PA., 524 Court St.
RICHMOND 19, VA., Travelers Bldg., 1110 East Main St.
RIVERSIDE, CALIF., Suite 12, 3614—9th St.
ROANOKE 4, VA., 303 1st St., S.W.
ROCHESTER 11, N. Y., 1 McKee Rd.
ROCKFORD, ILL., 323 South Main St.
RUTLAND, VT., 98 Merchants Row
SACRAMENTO 14, CALIF., 1720—14th St.
SAGINAW, MICH., 221 So. Jefferson St.
ST. LOUIS, MO., 411 North Seventh St.
SALT LAKE CITY 1, UTAH, 235 W. South Temple St.
SAN ANTONIO 5, TEXAS, 115 W. Travis St.
SAN DIEGO 1, CALIF., 525 "E" St.
SAN FRANCISCO 8, CALIF., 410 Bush St.
SAVANNAH, GA., 204 Realty Bldg., P.O. Box 2008
SEATTLE 4, WASH., 3451 East Marginal Way
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SOUTH BEND 4, IND., 216 East Wayne St.
SPARTANBURG, S. C., 331 High Point Road, P.O. Box 289
SPOKANE 1, WASH., North 1023 Monroe St.
SPRINGFIELD, ILL., 607 E. Adams St., P.O. Box 37
SPRINGFIELD 3, MASS., 26 Vernon St.
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TACOMA 2, WASH., 1930 Pacific Ave.
TAMPA, FLA., 608 Tampa St.
TOLEDO 4, OHIO, 245 Summit St.
TRENTON 8, N. J., 28 W. State St.
TULSA 3, OKLA., 600 S. Main St.
UTICA 2, N. Y., 255-257 N. Genesee St.
WALLA WALLA, WASH., Denny Bldg., P.O. Box 182
WASHINGTON 6, D. C., 1625 "K" St., N.W.
WATERLOO, IOWA, 300 West 3rd St.
WATERTOWN, N. Y., 245 State St.
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WICHITA, KANS., 211 So. Main St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
WILLIAMSPORT, PA., 221 Williamsport Bldg., 460 Market St.
WORCESTER 8, MASS., 507 Main St.
YORK, PA., 11 W. Market St.
YOUNGSTOWN 3, OHIO, 25 E. Boardman St.

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BOSTON 27, MASS., 235 Old Colony Ave. (So. Boston)
BRIDGEPORT 8, CONN., 540 Grant St.
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KANSAS CITY 6E, MO., 1300 Oak St.
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MILWAUKEE 9, WIS., 1500 W. Cornell St.
MINNEAPOLIS 13, MINN., 2303 Kennedy St., N. E.
PHILADELPHIA 4, PA., 3001 Walnut St.
PHILADELPHIA 34, PA., Erie Ave. & "D" St.
PITTSBURGH 8, PA., 543 N. Lang Ave.
PORTLAND 12, ORE., 626 North Tillamook St.
PROVIDENCE 3, R. I., 16 Elbow St.
ST. LOUIS 10, MO., 1601 S. Vandeventer Ave.
SALT LAKE CITY 1, UTAH, 235 W. South Temple St.
SEATTLE 4, WASH., 3451 East Marginal Way
SPRINGFIELD 1, MASS., 395 Liberty St.
SUNNYVALE, CALIF. (Sunnyvale Plant), P.O. Box 37
SYRACUSE 4, N. Y., 700 West Genesee St.
UTICA 1, N. Y., 113 N. Genesee St.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.

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BIRMINGHAM 3, ALA., 1407 Comer Bldg.
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DAVENPORT, IOWA, 2212 E. 12th St.
DENVER, COLO., 910 Fifteenth St.
DES MOINES 8, IOWA, 1408 Wlanut St.
DETROIT 32, MICH., 5757 Trumbull Ave., P.O. Box 502
DULUTH 2, MINN., 408 Bradley Bldg., 10 East Superior St.
EL PASO, TEXAS, 718 Mills Bldg.
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HOUSTON 2, TEXAS, 507 Dallas Ave.
HUNTINGTON 1, W. VA., 1029 Seventh Ave., P.O. Box 1150
INDIANAPOLIS 9, IND., 137 S. Pennsylvania St.
JACKSON, MICH., 120 W. Michigan Ave.
KANSAS CITY 6, MO., 101 W. Eleventh St.
LOS ANGELES 17, CALIF., 600 St. Paul Ave.
LOUISVILLE 2, KY., 332 West Broadway
MEMPHIS 3, TENN., 825 Exchange Bldg., 130 Madison Ave.
MILWAUKEE 2, WIS., 538 N. Broadway
MINNEAPOLIS 13, MINN., 2303 Kennedy St., N. E.
NEWARK 2, N. J., 1180 Raymond Blvd.
NEW ORLEANS 12, LA., 1226 Whitney Bldg., 288 St. Charles St.
NEW YORK 5, N. Y., 40 Wall St.
NORFOLK 10, VA., 915 W. 21st St.
OMAHA 2, NEBR., 117 N. 13th St.
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ROANOKE 4, VA., 303 1st St. S.W.
ST. LOUIS, MO., 411 North Seventh St.
SALT LAKE CITY 1, UTAH, 235 W. South Temple St.
SAN DIEGO 1, CALIF., 525 "E" St.
SAN FRANCISCO 8. CALIF., 410 Bush St.
SEATTLE 4, WASH., 3451 East Marginal Way
SPOKANE 1, WASH., N. 1023 Monroe St.
SYRACUSE 4, N. Y., 700 W. Genesee St.
TOLEDO 4, OHIO, 245 Summit St.
UTICA 2, N. Y., 255-257 Genesee St.
WASHINGTON 6, D. C., 1625 "K" Street, N.W.
WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
YOUNGSTOWN 3, OHIO, 25 E. Boardman St.

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