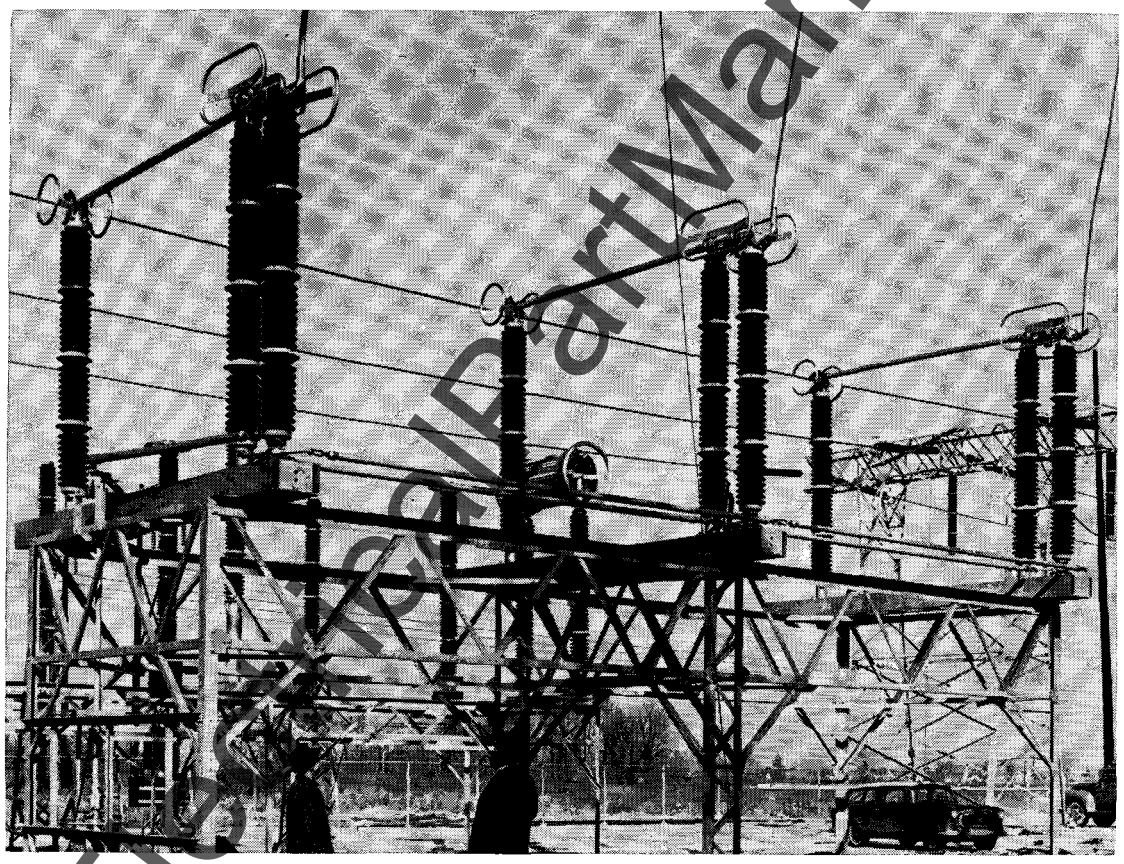
IB-1240-4A

OUTDOOR AIR SWITCHES

INSTRUCTIONS

115 — 345-KV, 1600-AMPERE TTR GROUP OPERATED, VERTICAL BREAK



4771C

ITE Imperial Corporation

TABLE OF CONTENTS

This manual provides instruction for the installation, inspection and maintenance of the 345-kv, 1600-ampere TTR outdoor group-operated switch.

The major sections are:

Disconnecting switches described in this manual are suitable for group operation, single throw, single break, vertical opening, 3 insulator stacks per pole, one stack rotating.

DESIGN FEATURES

The basic design features of TTR switches eliminate many of the normal maintenance problems. All movable parts of electrical apparatus are continually subjected to some disorder due to the hazards of weather and circuit faults. Switch parts described on the following pages will include any maintenance procedure that occasional inspection may indicate.

SECTION I MECHANICAL PARTS

CURRENT-CARRYING PARTS

The current-carrying parts (Fig. 1), which serve both mechanical and electrical functions, are ruggedly built to minimize the usual field attention. The high-strength, high-leverage, blade-operating crank and connecting link are pivoted on stainless-steel pins, and all fasteners are stainless steel. With factory adjustment, this assembly needs only occasional inspection.

BLADE FULCRUM

This is part of the jaw casting and is often referred to as the blade stop but actually its purpose is to serve as a blade fulcrum for the blade contact to pry out ice which may be present in the jaw. The mechanics of this switch are such that the blade is accurately controlled throughout its travel, and for manual operation a blade stop is not required.

BEARINGS

The drive insulator rotates on a weather-sealed, greaseless rotor bearing which contains two sets of stainless-steel ball bearings, (Fig. 2). These bearings have synthetic rubber seals which function on either copper alloy or aluminum surfaces, excluding dirt and moisture from the internal ball bearing races. No maintenance is required such as lubrication, etc.

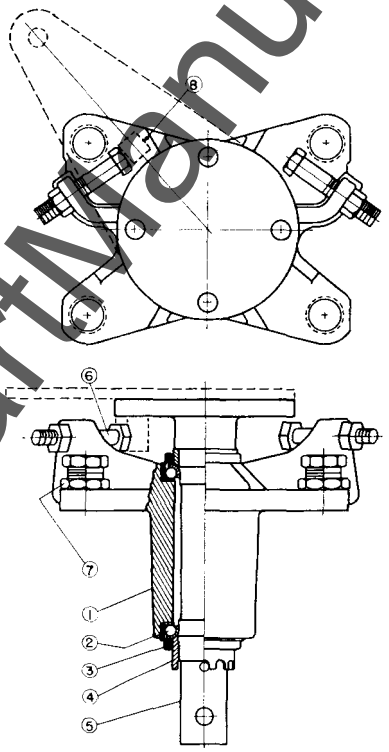


Fig. 2. Rotor-bearing assembly

1. Heat-treated, cast-aluminum alloy 356-T6 housing.
2. Stainless-steel ball bearings.
3. Neoprene O-ring seal makes contact with finished material, eliminating practically all wear.
4. Adjusting and take-up nut.
5. Forged steel rotor, galvanized.
6. Adjustable stop-bolt for limiting rotor travel.
7. Leveling adjustment screw. (Fig. 4)
8. Rotating crank stop.

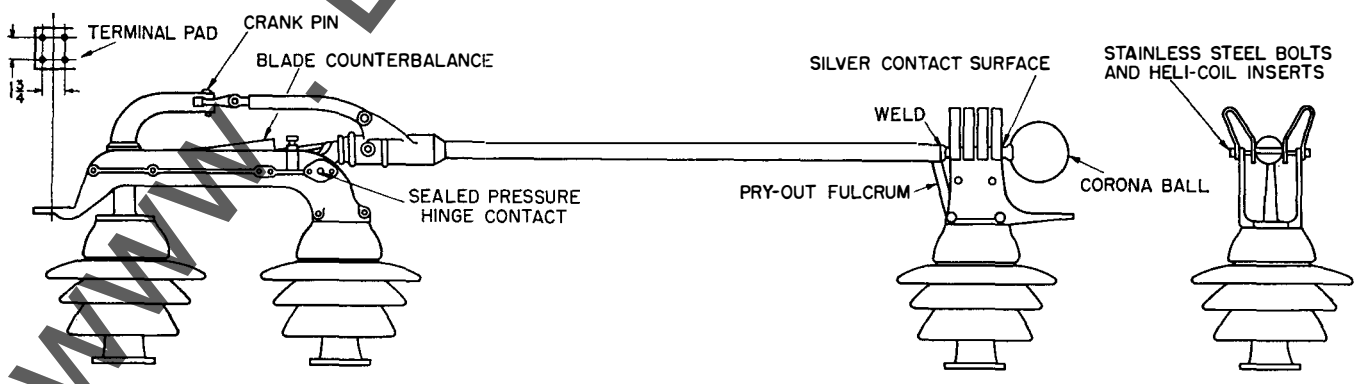


Fig. 1. Assembly of current-carrying parts, 345-kv assembly shown.

ROTATING CRANK STOP

This is the stop arrangement found on the rotor crank. This stop limits the travel of the rotating insulator, (Fig. 2 and Fig. 9) stopping the drive crank and consequently the rotating insulator stack in both the switch-open and switch-closed positions. These stops also furnished on offset bearings.

SECTION II INSTALLATION

UNPACKING INSPECTION

The Packing List and Instruction Drawings contained in an envelope should be checked against the total shipment of the switch pole units, operating links, and mechanisms for completeness, and to aid the installation procedure. Any damages or shortages should be reported immediately to the carrier and proper claim entered.

INSTALLATION AND ADJUSTMENT

Assemble each pole unit (Fig. 3), mount each pole unit on the supporting member, level and parallel to each other, and in the positions shown on operating mechanism drawing supplied.

For higher voltage switches, the increased spacing and height of parts require a ready adjustment to the inequalities and deflections of mounting surfaces. Shims, shim plates and other less accurate adjustments are difficult and sometimes impossible to handle on the installation.

An important feature, and until recently not found on any other switch, is the LEVELING SCREW (Fig. 4). It is used to provide a high degree of accuracy, without the use of shims, to align the insulator stacks of the complete switch. The fine thread, individual screw adjustment regulates this accuracy to a fraction of a degree. When adjustment is completed, a locking nut is tightened against bearing or mounting flange for permanent setting.

Variations in heights of insulator stacks, or their angle to the mounting surface can be easily and quickly corrected.

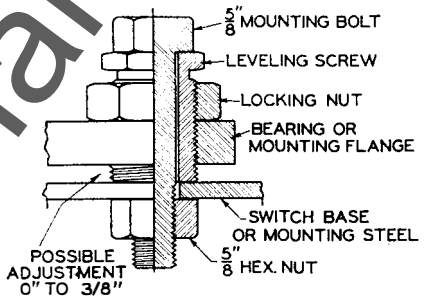


Fig. 4. Detail of leveling screw.

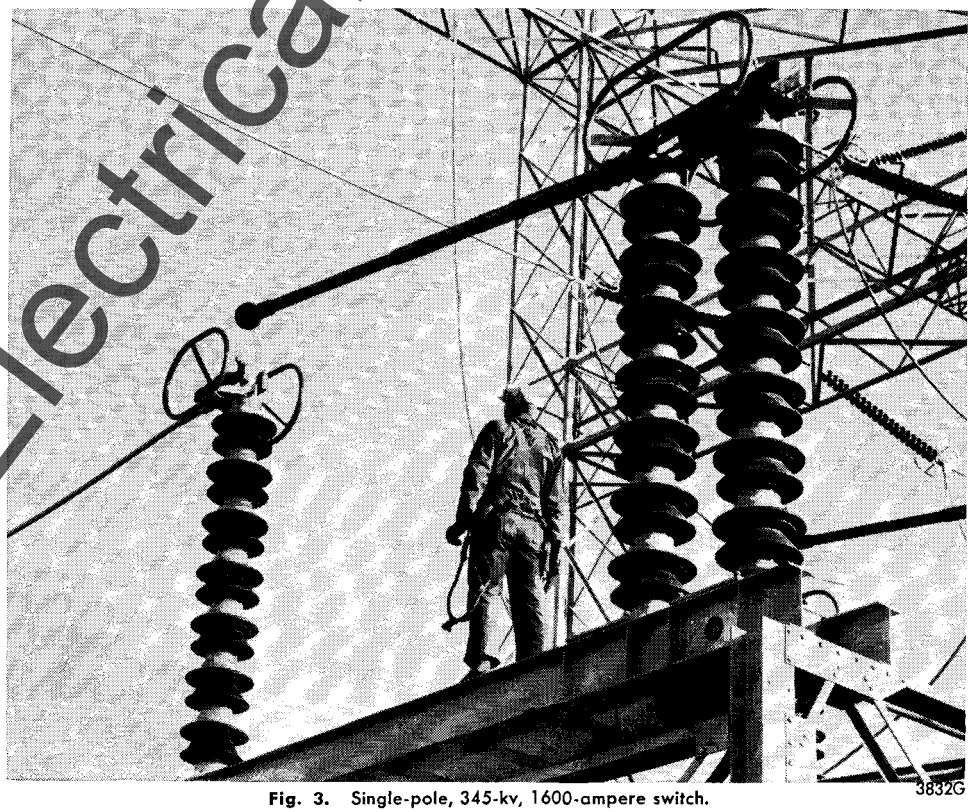


Fig. 3. Single-pole, 345-kv, 1600-ampere switch.

ARCING HORNS

When arcing horns are used on switches they should be installed and adjusted after mounting the switches on the structure. Arcing horns are furnished only when horn gap switches are ordered. The movable horn is assembled to the blade end and also serves as a corona shield. The stationary horn is positioned on the jaw with the saddle clamp, tightening center bolts securely (Fig. 5). Light contact pressure over the entire travel of the arcing horn contacts is recommended.

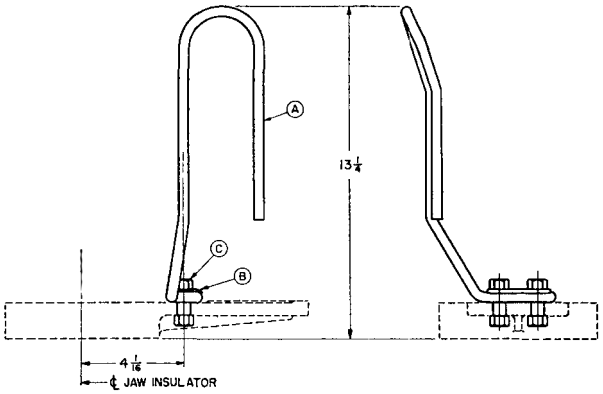


Fig. 5 Stationary arcing horn (500-kv switch), A) stationary horn, B) horn clamp, C) stainless-steel bolt and nut.

COUNTERBALANCE

The blades are counterbalanced. Figure 6 shows the proper connections, and the proper location of the drain holes for the various switch mountings. The counterbalances are assembled at the factory for the mounting positions as required for each installation.

If it is necessary to change the mounting position of the switch in the field, the counterbalance should also be changed, as described below:

UPRIGHT TO VERTICAL — Clamp plunger of counterbalance mechanism in the extended position with vise grip pliers or by some other suitable means. Then loosen Allen set screw in end of plunger and remove the drive pin (A) which attaches the counterbalance plunger to the blade hinge casting. Change attachment point of plunger on hinge casting to that shown for vertical mounting, assemble drive pin, tighten set screw in end of plunger and then remove the vise-grip pliers. Remove burrs from the plunger after pliers have been removed.

CHANGE TO INVERTED — Clamp counterbalance plunger in extended position with vise-grip pliers, loosen screw in end of plunger, and remove drive pin (A). Then, remove pin (B) at rear end of counterbalance. Position drain holes of counterbalance housing as shown for inverted mounting and assemble pin at rear end of counterbalance, replacing the cotter pin. Attach plunger of counterbalance to hinge casting as shown for inverted mounting, assemble drive pin, tighten set screw in end of plunger and remove vise-grip pliers from end of plunger. Remove burrs from the plunger after pliers have been removed.

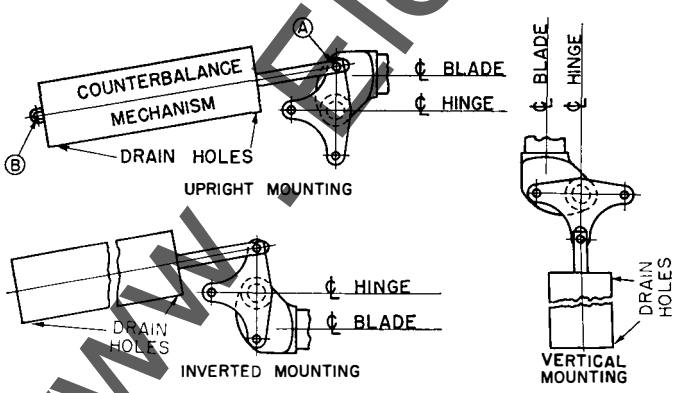


Fig. 6. Positions of blade counterbalancing mechanism.

JAW ALIGNMENT

The jaw hold-down bolts (B, Fig. 7) should be finger tight so that the jaw aligns itself, or can be adjusted to assure that the blade engages both sides of the jaw fingers properly. Jaw hold-down bolts should be tightened down when proper adjustment is made and a parallel line contact is made by the blade on each of the jaw fingers. Contact coating should not be removed.

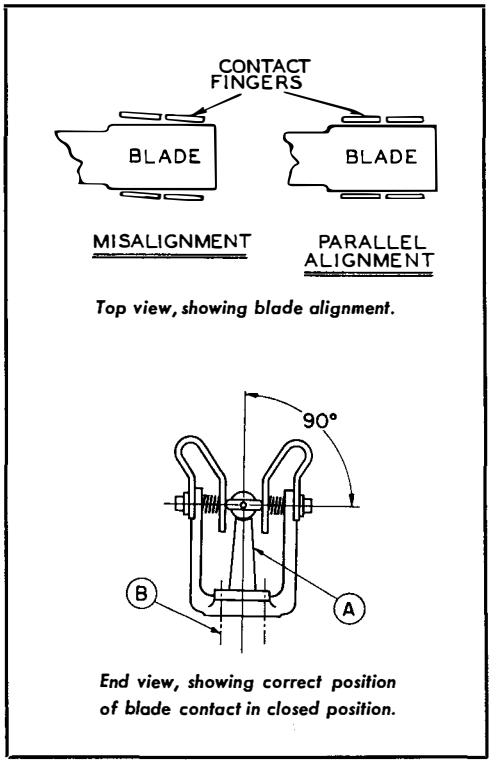


Fig. 7.

The blade contact end should be perpendicular to the jaw fingers, (Fig. 7). Adjustments may be made at the closed-position rotor crank stop. In this position, the blade should rest lightly on the fulcrum (A, Fig. 7). Adjustments can be made by removing crank pin, (A, Fig. 10), and turning the clevis (B, Fig. 10) in or out to raise the blade contact up or down in the jaw.

After this blade-closed adjustment is made, set the rotor crank closed-position stop, at base of rotating stack, so that it engages the crank projection, then tighten. Open the switch to desired position and set the rotor crank open-position stop (Item 6, Fig. 2).

INSTALLATION OF OPERATING MECHANISM

OPERATING BASE

After the single-pole switches have been completely assembled and adjusted and mounted in their proper location, as shown on operating mechanism drawing supplied, the operating base should be installed.

VERTICAL OPERATING PIPE ASSEMBLY

The 2-inch I.P.S. vertical pipe is pre-drilled at one end for a ⅝-inch diameter pin, for connection to the offset bearing shaft, (Fig. 9). The coupling and necessary pins are supplied with the vertical pipe.

GROUNDING

This is accomplished by use of a clamp on the vertical operating pipe attached to a flexible strap for connection to the structure or ground cable.

OPERATING DEVICE

A worm gear mechanism (Fig. 9) is supplied for manual operation. Remove the stop and position indicators, which are held in place with Allen set screw. Slip ground strap clamp onto operating pipe and mount the worm gear mechanism (see operating mechanism drawing). Tighten set screws on the top coupling of the mechanism until the operating pipe is pierced. For remote operation, an electric motor mechanism can be used, (Fig. 8).

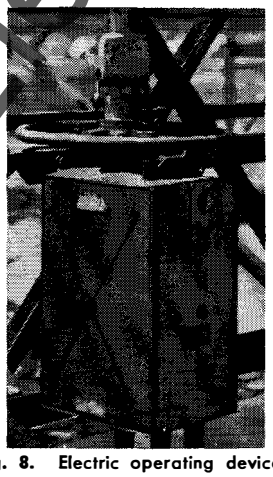


Fig. 8. Electric operating device.

MOUNTING INTERCONNECTING LINKS

First, connect the offset connecting link from the crank of the operating base to the crank of the single pole indicated on Figure 9. Lengthen or shorten this link, by turning clevis (A) on the end of link, as required to open and close the single-pole switch to the stop positions previously set.

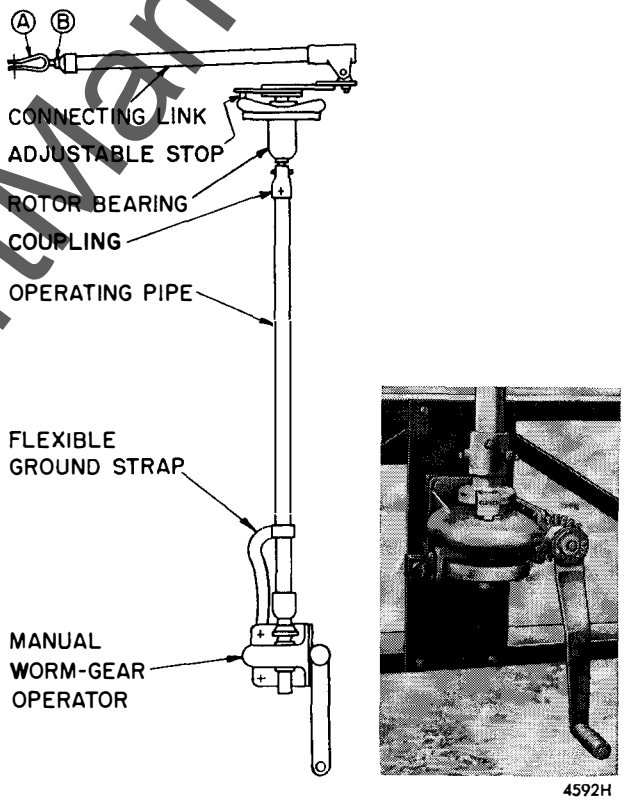


Fig. 9. Manual operating mechanism. Detail of worm gear operator.

With all switches in the fully closed position, install interconnecting links between phases. Lengthen or shorten the links to suit phase spacing by turning clevis (A) on interconnecting link. Operate three-pole switch and check to see that all phases meet both their open and closed-position stops. Additional adjustment of interphase links may be necessary. Then lock jam-nuts (B) and replace cotter pins in clevis pivot pins.

After the switch is completely adjusted and the base stops are set on the single-pole units, adjust the "stop and position indicators" on the worm gear mechanism to their proper positions.

SECTION III CONTACTS

The word contact as used in this manual will signify a current interchange surface between two or more current conducting members. The duties of a contact are to carry normal rated current without overheating, to carry heavy overloads or short-circuit currents in accordance with NEMA specifications for short periods of time, to establish a renewed contact surface with each engagement of switch blade and jaw, and to break and remove ice and contamination.

On this switch, aside from the terminals, there are three contact engagements. These are the contacts between the blade and jaw, blade and hinge casting, and the sealed pressure hinge contact between the hinge and tie casting.

The contact surface materials, which are silver-to-copper, have been selected, along with careful factory processing to secure the optimum contact performance insofar as electrical and thermal conductivity, thermal capacity, proper hardness, best resistance to abrasion, and best resistance to galling are concerned.

The blade contact end is provided with a tinned, removable copper section which has its contact areas silver plated. The jaw contacts are high-thermal-capacity hard-drawn copper with tinned surface for its connection to the aluminum casting. In closing, the blade enters the jaw and then rotates 50 degrees to provide wiping action before it closes, deflecting the jaw fingers, and then establishing a high-pressure line contact.

CURRENT TRANSFER

The current transfer between the blade and hinge is silver-to-copper contact (Fig. 11). Slits are cut in the end of the tubular blade to provide a multi-finger contact, and silver buttons are welded into each finger. High pressure contact is created by a back up garter spring, which forces finger buttons against the contact area on the hinge casting.

The sealed-pressure hinge contact is superior to the jaw contact in that it is not separable, and normally will require no maintenance or repair. All parts have been factory assembled and adjusted and require nothing further in the field unless they have been subject to a line fault of such severity that the main jaw make-and-break contacts were damaged by the fault. This contact has been successfully tested up to 2½ times its rated momentary value, and is completely enclosed, weather sealed, and lubricated for the life of the switch. Its physical contact is a high-pressure, high-thermal-capacity, silver-to-copper type, which remains in constant engagement. If the switch is subjected to a severe fault, then the crank pin, (A, Fig. 10), (also Fig. 1), should be removed, and the blade removed by unscrewing trunnion

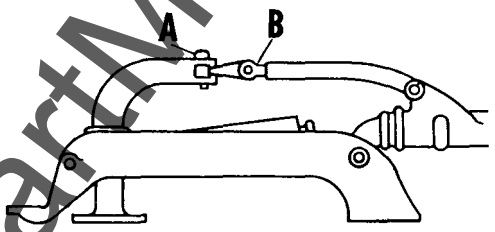


Fig. 10. Blade operating mechanism.

cam guide screws, (Fig. 11), and sliding blade off the hinge casting. Care should be taken to prevent the hinge from snapping to another position when the blade is removed, due to the action of the counterbalance spring. To accomplish this:

(1) Remove blades from upright mounted switches in the open position;

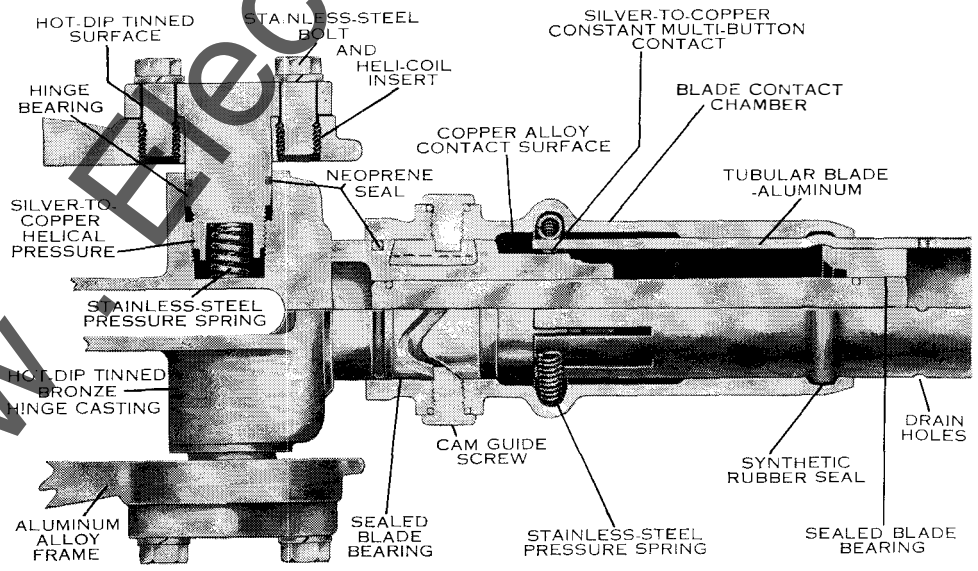


Fig. 11. Sectional view, showing hinge-pin and blade-contact construction.

(2) Remove blades from vertical mounted switches in the **closed** position.

(3) Remove blades from inverted mounted switches in the **closed** position, first blocking the counterbalance plunger with vise-grip pliers or some other suitable means.

The contact section and silver buttons can then be inspected. If these are in good condition there is no need to inspect the hinge pins. However, if necessary, the hinge pins can be removed, one at a time, by removing the stainless-steel bolts, and unscrewing the hinge pin. (See Fig. 11)

CONTACT SURFACES AND WEAR

The high-pressure jaw contact (Fig. 12) is designed to give an air-tight seal at the contact surface to prevent oxidation. Silver-to-copper contacts have been thoroughly tested and proven to be the best type for electrical and thermal conductivity, wear and corrosion resistance.

Under constant usage, contacts may wear so that they eventually may need to be replaced. In general, experience has shown that on most switches, contacts will last for 20 years or more. In the worst cases, contact replacement may be necessary as early as 10 years. Where switches are used frequently, or under severe contamination or grit condition, contacts may have to be cleaned periodically. If the contacts can be periodically maintained, they will not abrade so severely and a longer contact life may be expected.

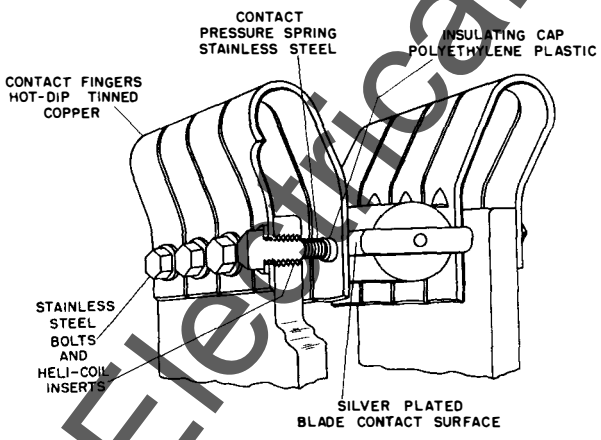


Fig. 12. Jaw contact-finger assembly, 70,000 ampere momentary

The contact pressure on the switch jaws is provided by stainless-steel backup springs. Under normal conditions even with contact wear, if the contact surface has been smooth and clean, and provided there is at least a total of one-eighth inch contact deflection, the contacts are adequate. This one-eighth inch is measured by calipering the jaw contacts with the blade out of the jaw and comparing that reading with the width of the blade contact end. The blade contact width is normally 3/16" wider than the jaw opening, giving 3/16" deflection or 3/32" per each jaw finger. Any reduction in this deflection, of course, reduces the contact pressure.

SECTION IV MAINTENANCE

Although the I-T-E policy is to produce outdoor switches to give good service with a minimum of maintenance, a certain amount of care and inspection is recommended, especially in areas having contaminated atmosphere. The recommended maintenance is similar to that listed in the NEMA Standards. First, it is important that the insulators are always clean. It is also important that the contacts be examined to see that they are aligned, clean, and bear with a firm uniform pressure. If the contacts are pitted, or burned to some extent, they should be removed and replaced. All the bolts, nuts, cotter pins, etc., should be checked to see that they are tight and that the operation of the switch is the same as it was when initially installed.

EXPOSED JAW FINGERS

Under normal service the jaw contacts should be examined and maintained at least once a year, depending upon the type of atmosphere to which they are exposed.

Periodic maintenance should consist of cleaning the contact surfaces thoroughly by carefully scraping off any contamination or deposit and sanding the surface to a smooth finish with clean fine emery paper, being careful to wipe off evidence of sand. With the contact surfaces entirely clean, a coating of lubricant should be applied. The lubricant may either be NO-OX-ID, Grade 2W* or Dow Corning DC-44 medium consistency silicone grease. Further details and experience on silicone lubricants will be discussed later under "Blade Contact Chamber."

The jaw contact fingers and the blade contact end are bolted in place so that they can be easily removed if required. In ordering parts or in correspondence regarding these switches, please state the voltage and current rating and serial number of the switch. This data is indicated on the nameplate.

OPERATING MECHANISM LINKAGES

In general, operating linkages require no maintenance. The bearings and the vital points are weather sealed and greaseless, requiring no lubrication. Exposed bearings, such as the pin connection of the rotor crank to the interphase connecting rods and guide plates should receive special attention particularly in areas where atmosphere contamination is abnormally great or where operation under sleet conditions is common. Any number of lubricants may be suitable for application at these points. Dow Corning DC-44 silicone compound is recom-

*No-ox-id greases can be purchased from the Dearborn Chemical Co., 310 South Michigan Avenue, Chicago, Ill. Silicone compounds and greases can be purchased from Dow Corning, 592 Saginaw Road, Midland, Michigan.

mended, for it is particularly durable even when exposed to the elements, and retains its viscosity over a wide temperature range.

BLADE CONTACT CHAMBER

Considerable progress has been made in recent years to develop lubricating greases and compounds which do not solidify at sub-freezing temperatures. Notable in this field are silicone greases and compounds.

After conducting a series of comprehensive comparative tests at the factory it was concluded that benefits could be derived by filling the contact chamber at the hinge, with Dow Corning DC-44 medium consistency silicone grease. This provides the benefit of reduced operating effort at temperatures of 10°F. and below, and improves reliability of switch operation at these low temperatures as added insurance against ice locking.

SECTION V TERMINAL SURFACES

Because of the wide acceptance and use of aluminum conductor, the terminal surfaces of TTR switches are aluminum to provide an easy current transfer surface. In cases where copper conductor is used, it is recommended that a tinned terminal clamp be bolted to the aluminum switch terminal pad.

Both the jaw and hinge-end terminals have standard NEMA drilling with 9/16-inch holes on 1¾-inch by 1¾-inch centers, which permits the use of NEMA standard terminal clamps. With the use of half-inch bolts, the clamping pressure is sufficient to keep the contact area adjacent to the bolts entirely clean.

An instruction tag is attached to the terminal clamps shipped with the switches for making aluminum connections as follows: (1) Clean all contact surfaces of conductors and fittings with a stiff wire brush to remove heavy oxide coatings until they become a typical fresh aluminum color. (2) Immediately coat these contact areas with a liberal amount of corrosion inhibitor such as NO-OX-ID Grade A Special, or Alcoa No. 2 Electrical Joint Compound. (3) Abrade the contact surface again, this time through the applied compound with a stiff wire brush. CAUTION — Do not remove the compound.

In making copper-to-aluminum connections: (1) Prepare all aluminum contact surfaces as described above. (2) Do not abrade or wire brush the plated surfaces, a few light rubs with fine steel wool before greasing is sufficient. (3) Make connections and tighten bolts.

RECOMMENDED TORQUE FOR ALUMINUM BOLTS

Bolt Dia. Inches	Lubricated Threads*		Dry Threads	
	In.-Lbs.	Ft.-Lbs.	In.-Lbs.	Ft.-Lbs.
½	240	30	420	35
⅝	480	40	720	60
¾	720	60	1140	95

*I-T-E normally applies a lead base type of lubrication, dark gray in color, to the threads of the aluminum bolts on the aluminum connectors.