Instruction Manual

for INSTALLATION, INSPECTION AND MAINTENANCE

Type TTR-6

ALL-ALUMINUM, GROUP OPERATED
DISCONNECTING SWITCH

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I-T-E IMPERIAL CORPORATION

Installation, Inspection and Maintenance
Type TTR-6 Air Switches

GENERAL

This manual provides instruction for the installation, inspection and maintenance of the Type TTR-6 Outdoor Group Operated Switch.

The major sections are:

I. Mechanical Parts
II. Instruction for Installation
III. Contacts
IV. Switch Maintenance
V. Terminal Surfaces

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-6 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 live parts, 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 live parts assembly needs only occasional inspection.

Blade Fulcrum—This is part of the jaw casting as shown in Fig. 4. This 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 balls, 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. This bearing should never be disassembled.

Bases—These bases are made of aluminum extrusions and are equipped with aluminum insulator spacers. They do not require any maintenance, painting or inspection.

1. Heat-treated aluminum alloy 356-T6 one-piece housing.
2. Stationary and take-up bearing races for stainless steel balls.
3. Neoprene O-ring seal makes contact with finished non-ferrous material, eliminating practically all wear.
4. Adjusting and take-up nut.
5. Forged steel rotor, galvanized.

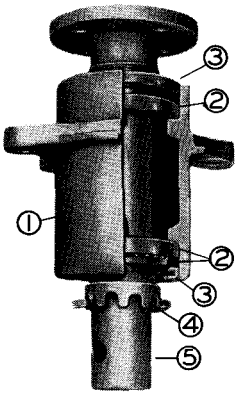


Fig. 2 Rotor Bearing

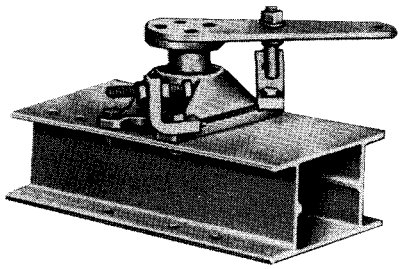


Fig. 3 Section of base showing Rotor Crank Stops

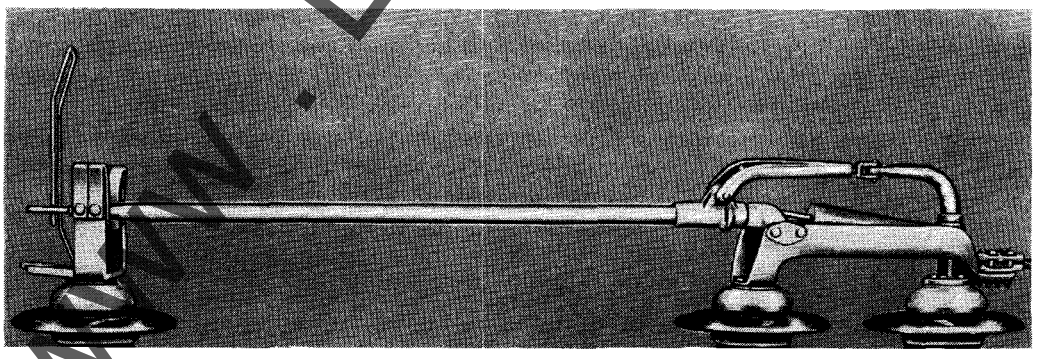


Fig. 1 Switch Current Carrying Parts

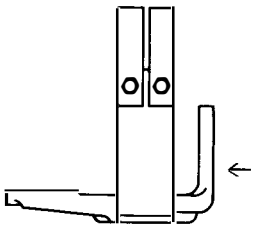


Fig. 4
Blade Fulcrum

BLADE TRAVEL LIMITS

(**A**) **Rotating Crank Stop**—This is the stop arrangement found on the switch base, located near the rotor crank. This stop limits the travel of the rotating insulator, stopping the drive crank and consequently the rotating insulator stack in both the switch open and switch closed positions (Fig. 3). These stops also furnished on offset bearings.

(**B**) **Handle Locking Plate**—At the bottom of the vertical operating pipe is located a lock plate consisting of two castings mounted on the pipe guide plate which can be easily adjusted in a vernier arc to give the required rotation of the vertical operating pipe. This plate acts as a lock for the manual operating handle when it is dropped from operating position. The handle must be raised to horizontal position for operation.

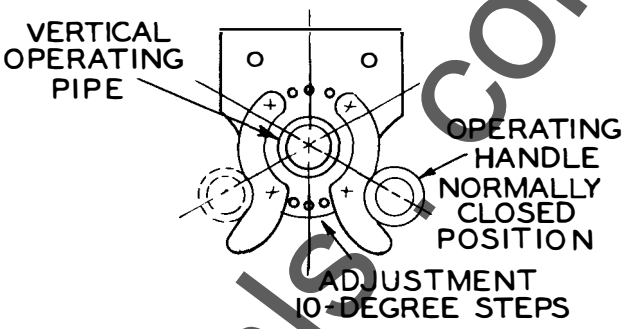


Fig. 5
Operating Handle Lock Plate

SECTION II — INSTRUCTION FOR INSTALLATION

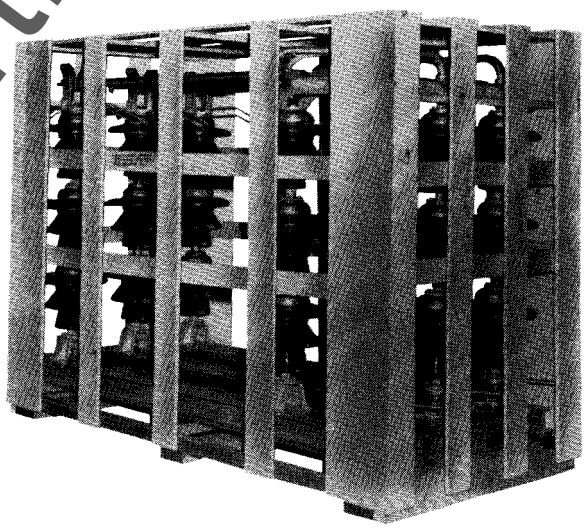


Fig. 6
Three Switch Poles Crated for Shipment

Unpacking Inspection—The TTR-6 switches up to and including the 161 kv are normally shipped completely assembled and adjusted, except for the arcing horns, three poles in a crate, and are ready for installation. 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—Mount each pole unit on the supporting member, level and parallel to each other. In case of a warped structure, shimming under the base may be necessary.

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 straight horn is assembled by screwing into the blade end, until locking nut seats securely against end of blade, (A) Fig. 7. The stationary horn is positioned on the jaw with the saddle clamp, tightening center bolt (B) securely. Light contact pressure over the entire travel of the arcing horn contacts is desired.

Counterbalance—The blades on the TTR-6 switch are counterbalanced. Fig. 8 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 listed on the order.

If it is necessary to change the mounting position of the switch in the field, the counterbalance should also be changed, as described on the next page.

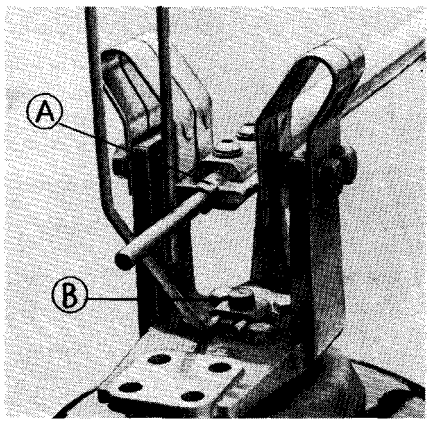


Fig. 7
Arcing Horns

Counterbalance, Cont'd., See Fig. 8.

UPRIGHT TO VERTICAL—Clamp plunger of counterbalance mechanism in the extended position with vice 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 vice grip pliers.

CHANGE TO INVERTED—Clamp counterbalance plunger in extended position with vice 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 vice grip pliers from end of plunger. Remove burrs from the plunger after pliers have been removed.

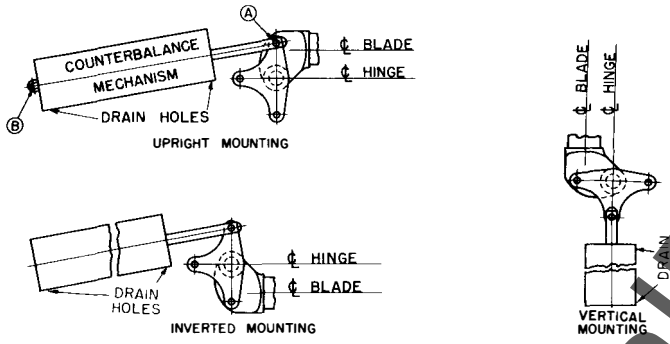


Fig. 8 Position of Blade Counterbalance Mechanism

DISASSEMBLED SHIPPED SWITCHES

Where the single pole units are shipped disassembled they are to be assembled in accordance with the single pole drawings. When the switch is completely assembled, shims (provided) may be required under the jaw stack only (B), Fig. 9, for central entry of the blade into the jaw, in both directions. The jaw hold-down bolts at (A), Fig. 9, 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, Fig. 11. Contact coating should not be removed.

The blade contact end should be perpendicular to the jaw fingers, Fig. 10. Adjustments may be made at the closed-position rotor crank stop, Fig. 3. In this position the blade should rest lightly on the fulcrum (A), Fig. 10. Adjustments can be made by removing pin (B), Fig. 12, and turning the clevis (C) in or out to raise the blade contact up or down in the jaw.

After this blade-closed adjustment is made, open the switch to desired position and set the rotor crank open-position stop, Fig. 3, so that it engages the crank projection, then tighten.

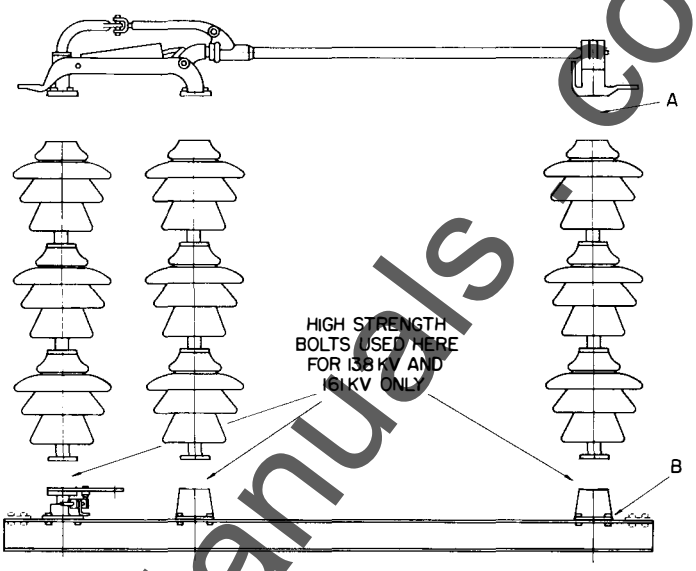


Fig. 9 Current Carrying Parts, Insulators and Base of Switch.

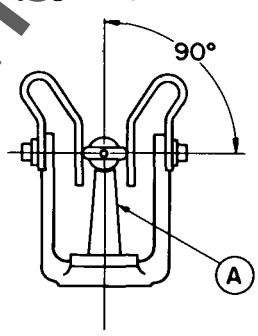


Fig. 10 End View, Showing Correct Position of Blade Contact in Closed Position

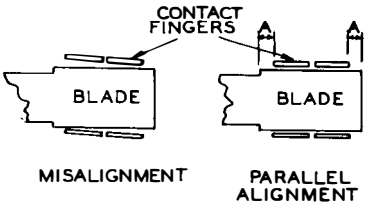


Fig. 11 Top View, Showing Blade Alignment

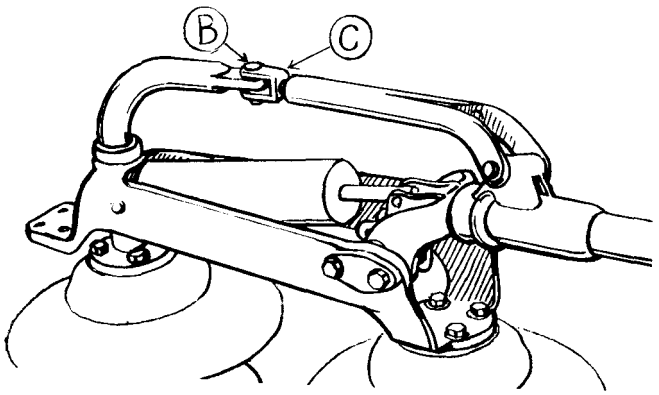


Fig. 12 Blade Operating Parts

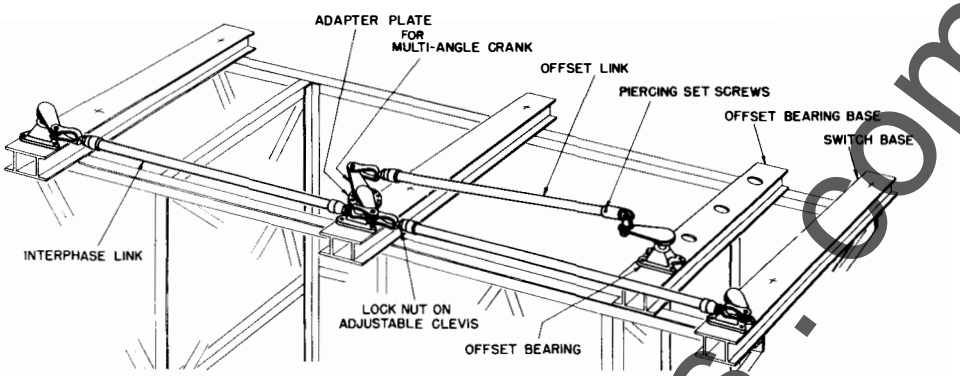


Fig. 13 Operating Mechanism is shown on Standard Support Structure.

INSTALLATION OF OPERATING MECHANISM

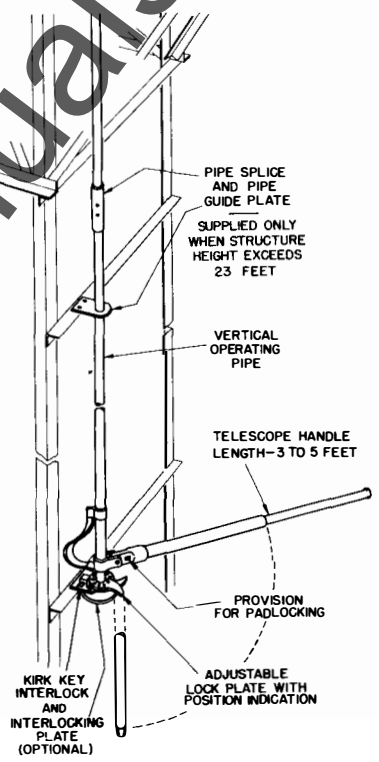
Mounting Interconnecting Rods—With switches in the fully closed position, install interconnecting rods between phases. Lengthen or shorten the rods to suit phase spacing by turning clevis on interconnecting rod. Then lock jam-nut and place cotter pins in clevis pivot pin. On offset bearing rod, cut off pipe if necessary to allow proper connection to overhead clevis, with offset bearing crank set 5° past dead center. Refer to drawing furnished with switch for proper positions. Tighten piercing set screws.

A Multi-Angle Adjustable Crank Fig. 14, is furnished with each bearing mechanism. This crank is supplied on the operating pole unit connected to the offset bearing. It permits 330° angular adjustment with crank location every 10° which results in adjustments to within 5° of the desired position. In some adjustments, the adjustable crank may be in such a position to interfere with the stop projection on the switch crank. If this is the case then remove this projection. The other two poles will regulate the blade travel on this unit. The multi-angle crank should be set so that it forms an angle of approximately 45 degrees with the offset link in either switch position.

Vertical Operating Pipe Assembly—The 2-inch I.P.S. vertical pipe is pre-drilled at one end for a ⅝-inch diameter pin, two of which are shipped, together with a coupling, in a bag, for connection to the offset bearing shaft (or on the pole unit rotor bearing in the case of direct connected switches).

Pipe Splice and Guide Plate—When the length of the vertical operating pipe exceeds 23-feet a pipe splice and a guide plate are furnished and should be installed as shown. The pipe splice and both pieces of pipe are pre-drilled to receive the ⅝ inch diameter pins. The guide plate should not be solidly mounted until after the vertical pipe has been completely installed; then bolts holding the guide plate on the structure should be tightened in order that the hole in the guide plate lines up with the normal position of the pipe so that there is no binding.

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



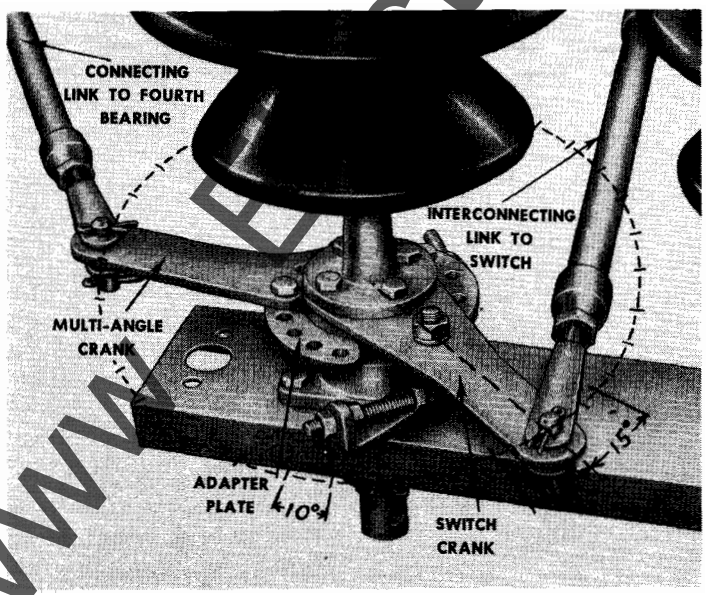


Fig. 14 Operating Pole Multi-Angle Crank

Operating Handle and Lock Plate—Slide handle and lock plate over the end of the vertical operating pipe and fasten the lock plate at the proper location. Recommended height for lock plate is 3 ft. 6 in. above ground. The lower end of the vertical operating pipe should extend through the lock plate at least 3-inches (and may extend as much as 3-feet or more—just so it does not touch the ground or column footing). With the switch in the fully closed position, set the torsional type handle clamp with its center line 4 inches above the lock plate and with the handle one-half the angular travel toward the open position of the lock plate center as you face the plate. Temporarily fasten the handle to the pipe with the set screws. Operate the switch and adjust the stops of the vernier lock plate until they exert pressure against the handle in both the open and closed positions of the switch. This provides a slight torsional wind-up in the operating pipe. Tighten piercing set screws on lock plate, until hole is punched in pipe. The handle, lowered to the closed position, is 3 ft. long but when in the operating position may telescope to 5 ft. in length if required.

SECTION III — CONTACTS

CAUTION—PREVENTATIVE CONTACT COATINGS SHOULD NOT BE REMOVED.

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 area 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 over 30 degrees to provide wiping action before it closes, deflecting the jaw fingers, and then establishing a high pressure line contact.

The current transfer between the blade and hinge is silver-to-copper contact. Slits are cut in the copper end of the tubular blade to provide a multi-finger contact and buttons are pressed into each finger. High pressure contact is created by a back up garter spring, which forces finger buttons against the silvered 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. The 600 and 1200 ampere switches utilize the 1200 ampere hinge pin. If the switch is subjected to a severe fault, then the clevis pin (B), Fig. 12, should be removed, and the blade removed by unscrewing blade assembly off hinge casting, so that the silvered section and buttons can 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. As stated, this is seldom required.

Contact Surfaces and Wear—The high-pressure contact 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.

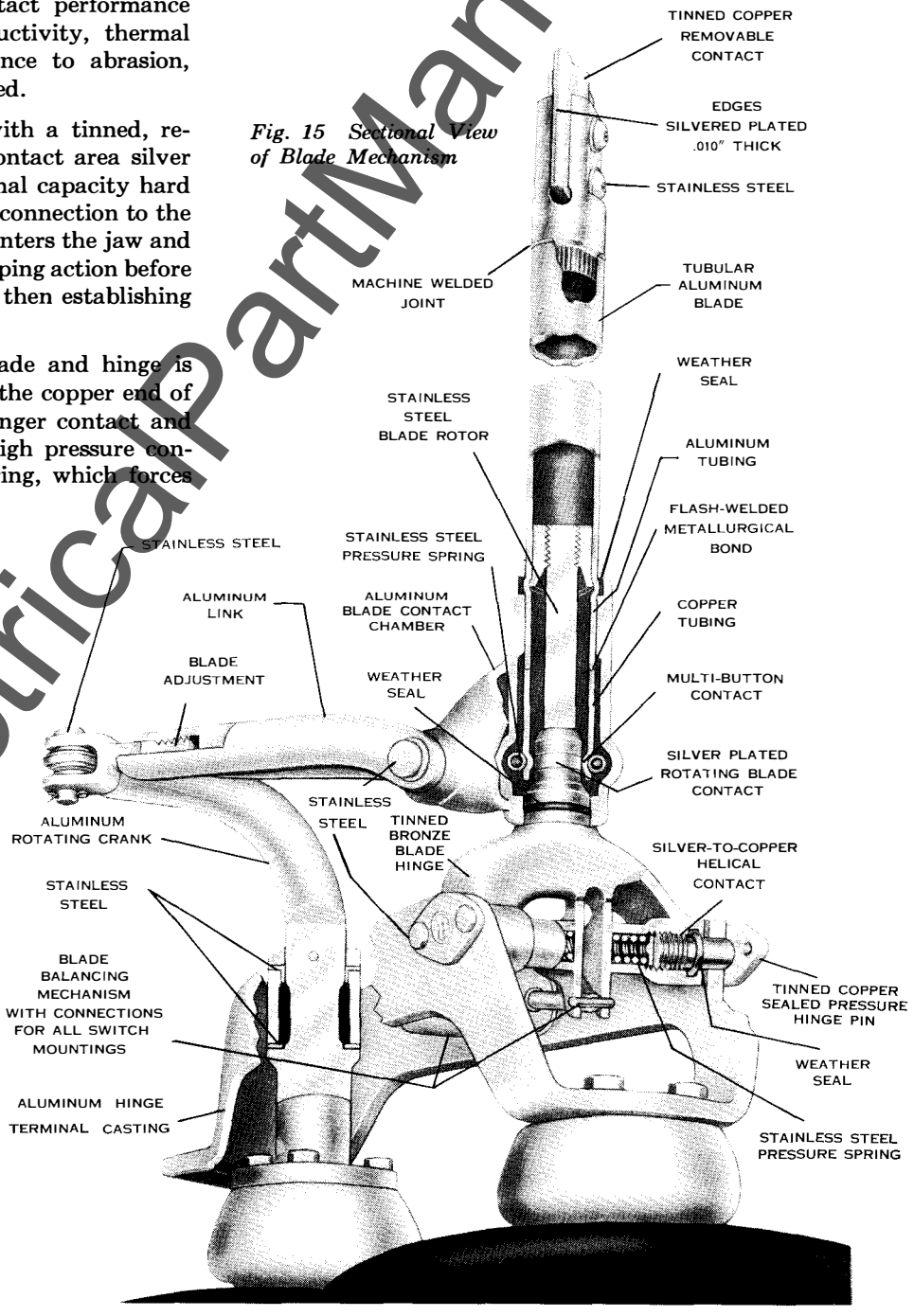


Fig. 15 Sectional View of Blade Mechanism

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.

The contact pressure on the switch jaws is provided by stainless steel backup springs, (Fig. 16). 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 2⅛ inches for the 600 ampere switch and a new jaw gives an opening of $1\frac{15}{16}$ inches therefore giving a total deflection of 3/16 inches. The 1200 ampere blade contact width is 2¾ inches and the jaw opening is 2 5/16 inches, here also giving 3/16 inch deflection or 3/32 inch per each jaw finger. Any reduction in this deflection, of course, reduces the contact pressure.

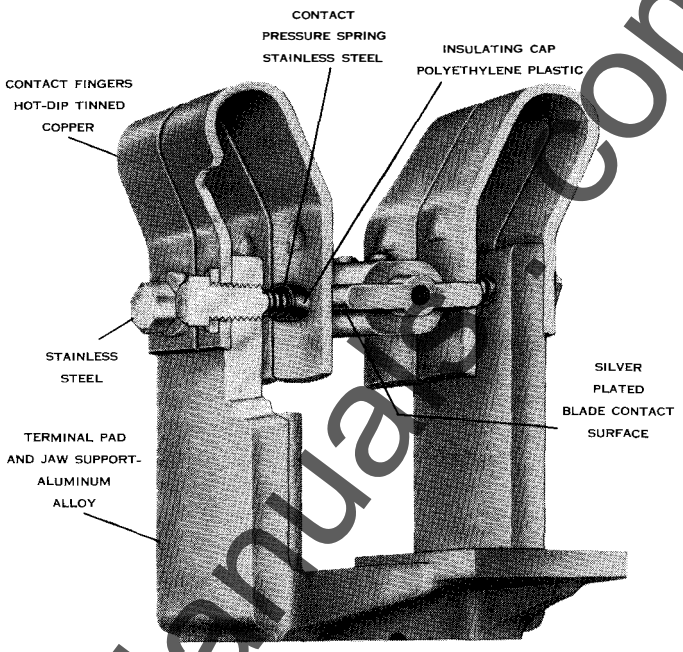


Fig. 16. Jaw Contact Showing Pressure Spring

SECTION IV — SWITCH 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.

Maintenance of 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 emory 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 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.

Maintenance of 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-4 silicone compound is recommended, for it is particularly durable even when exposed to the elements, and retains its viscosity over a wide temperature range.

Maintenance of 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, Fig. 15, 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.

Maintenance of Terminal Surfaces—To recondition or maintain terminal surfaces, follow the same procedure as described in Section V.

SECTION V — TERMINAL SURFACES

Because of the wide acceptance and use of aluminum conductor, the terminal surfaces of TTR-6 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. Add a little more compound and install fittings with bolts finger tight. Alternately and evenly tighten bolts with a torque wrench to the values recommended in Table I.

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.

Bolt Dia.	Lubricated Threads*		Dry Threads	
	In.-Lbs.	Ft.-Lbs	In.-Lbs.	Ft.Lbs.
½"	240	20	420	35
⅝"	480	40	720	60
¾"	720	60	1140	95

Table I

*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.

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Printed in U.S.A.
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