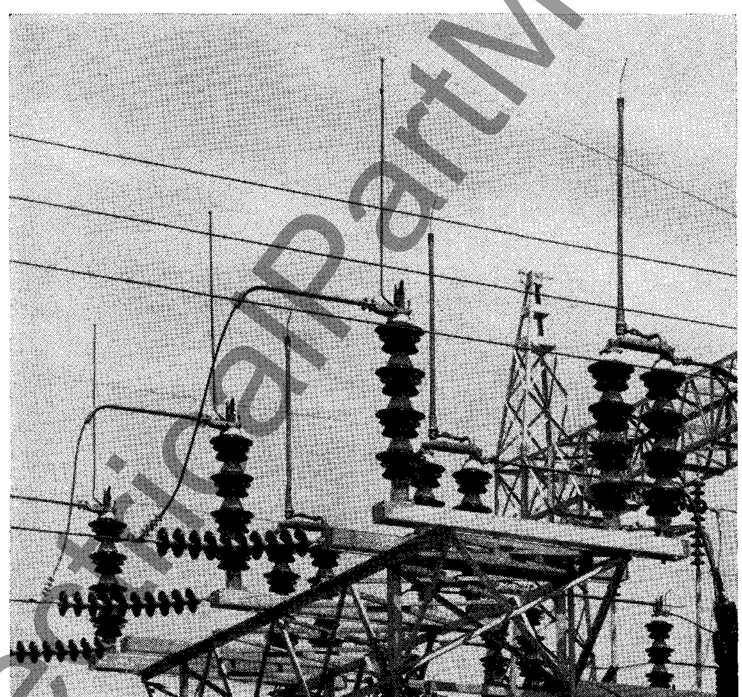
IB-1342A

OUTDOOR AIR SWITCHES

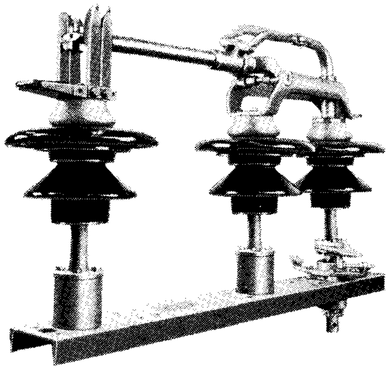
INSTRUCTIONS

TYPES TTR49 AND TTL49
GROUP OPERATED, VERTICAL BREAK SWITCHES
7.2 THRU 230 KV
400 THRU 4000 AMPERES

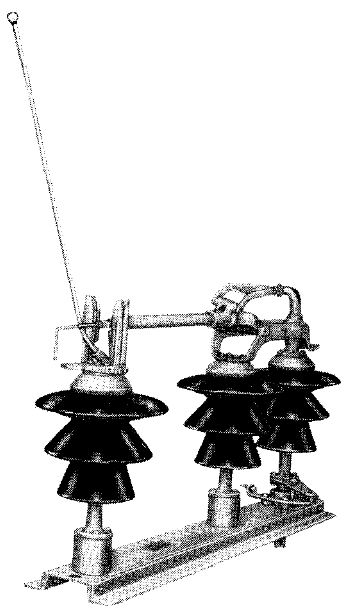


I-T-E IMPERIAL CORPORATION

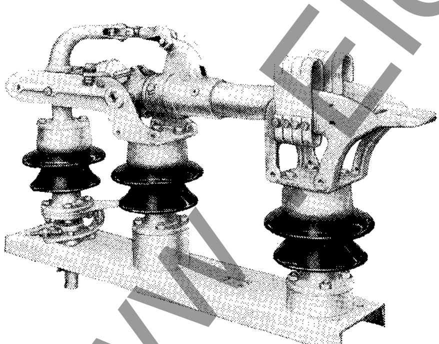
TABLE OF CONTENTS



TTR49



TTL49



HIGH CURRENT TTR49

Installation, Inspection and Maintenance
Types TTR49 and TTL49
Outdoor Group Operated High Pressure Contact Switches

General

This manual provides instructions for the installation, inspection and maintenance of Types TTR49 and TTL49 switches. It consists of five main sections:

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

Switches described in this manual are of the outdoor type, suitable for gang-operation, single throw, single break, vertical opening, three insulator stacks per pole, with one insulator stack rotating. Switches included enter into the following classifications:

(1) 3″ Bolt Circle TTR49 & TTL49

400 Amps.	—7.2 thru 34.5 Kv
600 and 1200 Amps.	—7.2 thru 69 Kv

(2) 5″ Bolt Circle TTR49

600* and 1200 Amps.	—69(H) thru 230 Kv
1600 Amps.	—115 thru 230 Kv
2000 Amps.	—7.2 thru 230 Kv
3000 and 4000 Amps.	—7.2 thru 34.5 Kv

* 5″ B.C. 600 ampere switch not made above 161 Kv.

Design Features

The basic design features of these switches are such that maintenance is kept to an absolute minimum. The rotor bearings are maintenance-free; they are weather-sealed and are unaffected by soot, dirt or smoke contamination, or the hazards of corrosion. Likewise, the Sealed Pressure Hinge Contacts are maintenance-free. These hinge contacts are weather-sealed; are in constant engagement and are unaffected by air contamination or corrosion. In most cases, only the make-and-break contacts and mechanical adjustments will require attention. However, instructions are being included to cover even the more remote conditions which may occur in isolated cases.

SECTION I. MECHANICAL PARTS

Live or Current Carrying Parts— Features have been incorporated in the design of these switches which reduce maintenance and repair of live mechanicals parts to an absolute minimum. These switches are mechanically sound and ruggedly built to perform their mechanical and electrical duties satisfactorily. However, if a live mechanical part should ever require replacement, it is recommended that the replacement part be obtained from the factory.

Bearings —The switch base bearing on which the drive insulator rotates is a weather-sealed, greaseless rotor bearing with stainless steel balls. 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. They should not be disassembled for maintenance. If bearings are ever found defective, it is recommended that they be returned to the factory for replacement.

Bearings require no lubrication. A weather seal, not affected by low temperatures, excludes all moisture and foreign matter.

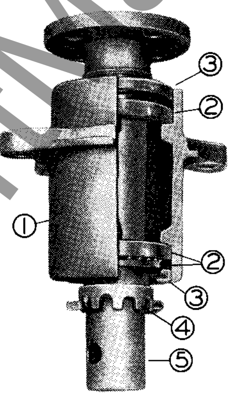


Fig. 1

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.

Stops—For the purpose of identifying the various "stops" they will be referred to as follows:

(a) Rotor Crank Stop— This is the stop arrangement found on the switch base, located near rotor crank. Plan views of this stop arrangement may be seen in Figures 6 and 7, page 5. 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 position. Adjusting bolts (C) and (D) which limit the rotor crank travel are secured solidly to switch base, and a projection (E) fastened to rotor crank strikes these adjusting bolts in the switch open and switch closed positions.

(b) Handle Locking Plate Stop—This so-called "stop" arrangement is found at the bottom of a vertical operating pipe (10) of Fig. 11, page 6. It consists of two aluminum castings mounted on a pipe guide plate and can be adjusted in an arc to give a required rotation of the vertical torsional operating pipe. In reality, it is not a stop, but a lock for the manual operating handle to prevent rotation of the vertical operating pipe until the manual operating handle is raised from its locked position.

Blade Fulcrum—This is item (F) of Fig. 5, below, which is located on the switch jaw base. On former switches this would have been referred to as a "blade stop" casting. But on the TTR49 and TTL49 switches, it is not actually a blade stop. Its purpose is to serve as a blade fulcrum for the beavertail to pry out ice which may be present in the jaw. The mechanics of these switches are such that the blade is accurately controlled throughout its travel and for normal switch operation, a blade stop is not required.

Operating Parts

Operating parts consist of operating pipes, rods, and handles. In general, these parts require little maintenance after installation; such as, cleaning for any corrosion and realigning for wear or sag.

SECTION II. INSTRUCTIONS FOR INSTALLATION.

Unpacking Inspection

All Types TTR49 and TTL49 switches up to and including 46 Kv are normally shipped completely assembled and adjusted, except for arcing horns, and are ready for installation. The bill of material and installation drawings, contained in an envelope should be checked against the total shipment of 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 single pole switches on cross arms, level and parallel to each other. With the jaw hold-down bolts finger tight, close the switch and align the jaw so that both sides of jaw contacts engage the blade beavertail properly. On 3-inch bolt circle switches, shimming may be required to assure central entry of the blade into the jaw. The jaw hold-down bolts should then be tightened with the blade in place in jaw. Jaw and blade contact surfaces should engage in parallel alignment, each finger making a line contact or blade beavertail as shown in Fig. 2. If necessary, loosen insulator cap bolts and rotate jaw base slightly to improve alignment of contacts. CAUTION—CONTACT COATING SHOULD NOT BE REMOVED.

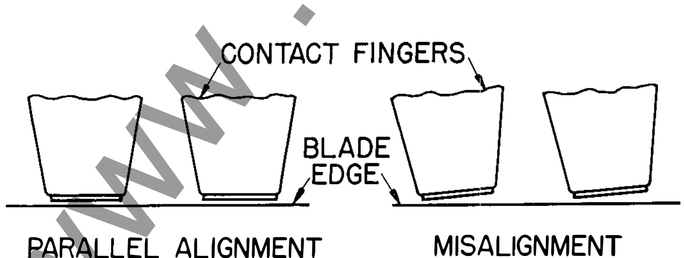


Fig. 2 Proper Alignment of Fingers.

For the 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 shown here, and until recently not found on any other switch, is the LEVELING SCREW. 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. See Fig. 3.

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

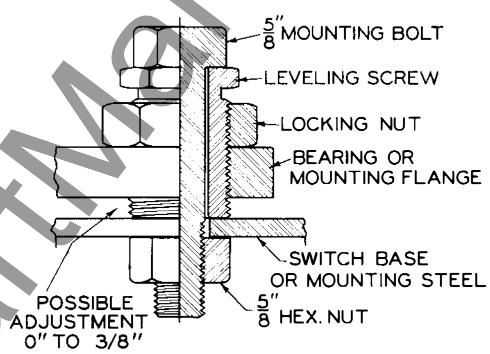


Fig. 3 Leveling Screw Detail 5-inch B.C.

Next, the blade height in the jaw should be examined in the closed position of the switch. With the blade beavertail perpendicular (within $\pm$ 3°) to the jaw contact fingers, the rotor crank stop should be set for the closed position, Figures 6 and 7. In this position the blade should be within ¼ inch of the blade fulcrum casting. Adjustment of correct height of blade in jaw is made by lengthening or shortening the linkage between the switch top crank and the switch blade. This adjustment may be made by removing the pin which connects this linkage to the switch top crank and screwing, in or out, the clevis casting, (L) of Figure 4, of this linkage.

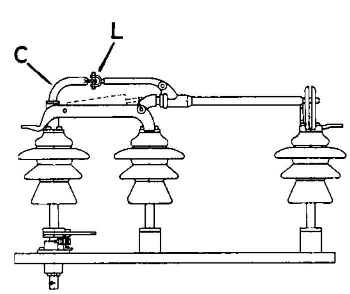


Fig. 4

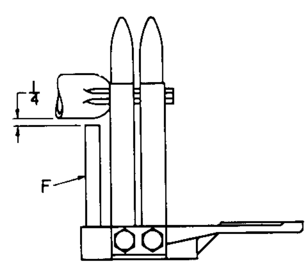


Fig. 5

Lengthening the linkage will lower the blade in the jaw; whereas, shortening the linkage will raise the blade in the jaw.

After the closed position stop of the rotor crank, Figures 6 and 7, has been set and the switch has been adjusted for correct height of blade in jaw and for proper rotation of beavertail, the rotor crank stop must be set for the switch open position. Open the switch so that the blade assumes its proper open position, and then adjust the open position bolt of the rotor crank stop so that it engages the mating projection on the rotor crank.

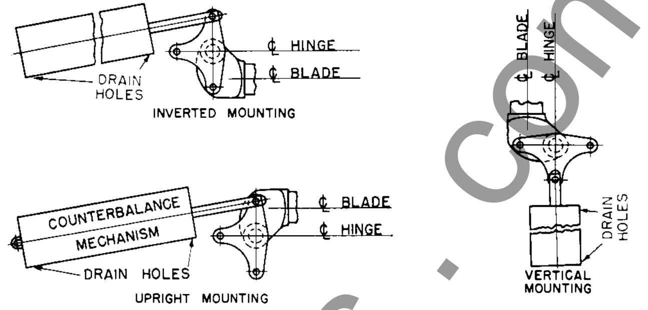


Fig. 8 Position of Blade Counterbalance Mechanism

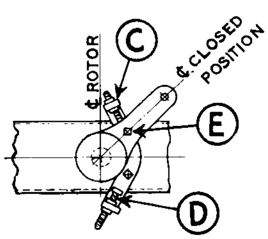


Fig. 6 3-inch Bolt Circle

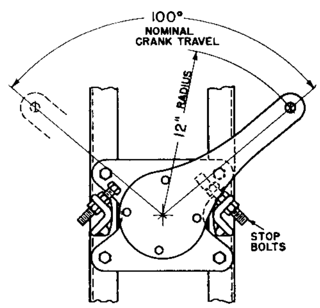


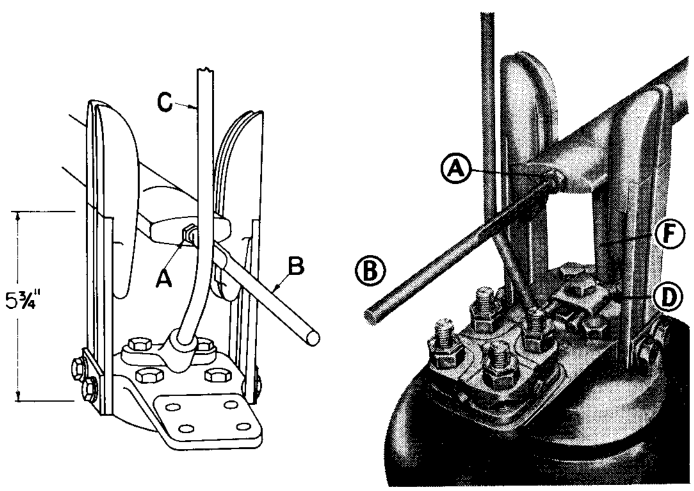
Fig. 7 5-inch Bolt Circle

Arcing Horns— When arcing horns are used on switches, they should be installed and adjusted after mounting switches on the structure. On TTL49 switches, arcing horns are shipped with each single pole. Arcing horns are furnished on TTR49 switches only when horn gap switches are ordered. For 3″ B.C. TTR49 switches, the movable straight horn is assembled by screwing into blade end, until locking nut (A), seats securely against end of blade, stationary horn is positioned on jaw with saddle clamp, (D) of Fig. 9, tightening center bolt securely.

Counterbalance—600 ampere switches, 69 Kv and above, and all higher rated switches, 46 Kv and above, are counterbalanced. For counterbalanced switches, Fig. 8 indicates the proper position of drive pin and proper location of drain holes for the various switch mountings. Unless otherwise specified on customer orders, counterbalanced switches are assembled at the factory for upright mounting.

To change counterbalance in the field (if the occasion arises) from upright to vertical mounting, open switch blade 90° then clamp the plunger of the counterbalance mechanism with vise grip pliers or by some other suitable means. Then loosen Allen set screw in end of plunger, and remove the drive pin which attaches the counterbalance plunger to the blade hinge casting. Change attachment point of plunger on hinge casting to that shown in Fig. 8 for vertical mounting, assemble drive pin, tighten set screw in end of plunger and then remove the vise grip pliers.

To change counterbalance to inverted mounting, clamp counterbalance plunger in extended position with vise grip pliers, loosen screw in end of plunger, and remove drive pin. Then, remove pin at rear end of counterbalance (this pin is ring staked at assembly on 3″ B.C. switches). Position drain holes of the counterbalance housing as shown in Fig. 8 for inverted mounting and re-assemble pin on rear end of counterbalance, staking the pin in place in the frame casting by center-punching or peening. Attach plunger of counterbalance to hinge casting as shown for inverted mounting, assemble drive pin, tighten set screw in end of plunger and then remove vise grip pliers from plunger. Remove burrs from the shaft of counterbalance after pliers have been removed.



TTL49 *TTR49*

Fig. 9 Assembly of Arcing Horns

Arcing horns for TTL49 switches are assembled in essentially the same manner, see Fig. 9. The movable horn (B), is bent outwardly so as to make proper engagement with stationary horn when closing the switch. The stationary horn is bolted to jaw by using two of the four bolts which retain jaw to insulator.

Arcing horns for 5″ B.C. TTR49 switches are installed similarly to 3″ B.C. TTR49 switches, except the stationary horn is mounted on jaw with two ½″ bolts independently of bolt circle hold-down bolts.

Flattened portion of movable horn should engage stationary horn with flattened horn surface bearing against stationary horn as shown in Fig. 10 when the switch is closed. (The flattened portion has been added to movable horns for improved ice-breaking characteristics). The horns should TOUCH LIGHTLY throughout their stroke. Bend stationary horn slightly if necessary to maintain light engagement throughout travel.

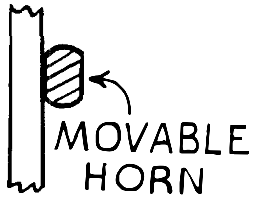
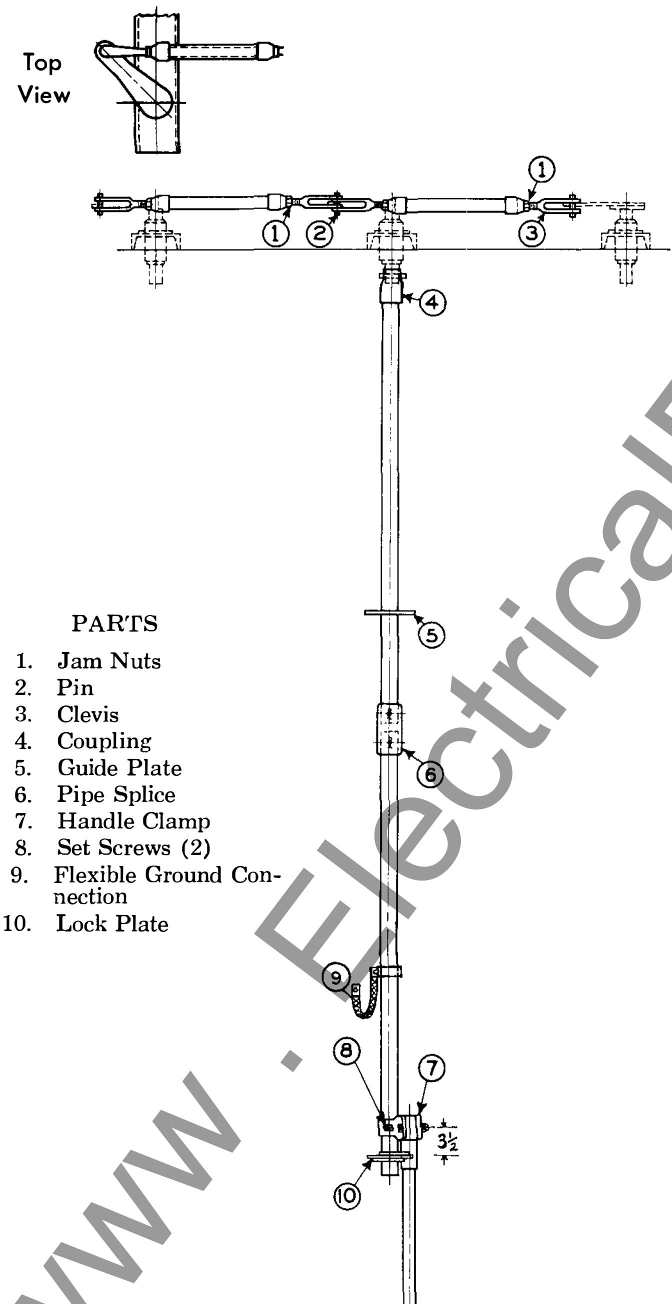


Fig. 10

Installation of Operating Mechanism

Mounting Interconnecting Rods— With switches in fully closed position (cranks against closed position base stops), install phase interconnecting rods beginning with the switch pole to which the vertical operating pipe is to be attached. For fourth bearing mechanisms, begin with the pole nearest the fourth bearing. Lengthen or shorten the rods to suit phase spacing by turning clevis, (3) of Fig. 11. One-half turn of clevis equals 1/16 inch. Then, lock jam nut (1) and install cotter pins.



PARTS

1. Jam Nuts
2. Pin
3. Clevis
4. Coupling
5. Guide Plate
6. Pipe Splice
7. Handle Clamp
8. Set Screws (2)
9. Flexible Ground Connection
10. Lock Plate

Fig. 11 Operating Mechanism

Vertical Pipe Assembly—If the operating mechanism is "Direct" (coupled to one of the pole units as illustrated in Fig. 11) attach pipe coupling (4), and the first section of operating pipe to the switch rotor. If the operating mechanism is "Offset" (with a fourth bearing), a complete drawing showing the assembly arrangement is furnished for each installation, and should be followed in erection. For Offset mechanisms each part is numbered and its location clearly shown on the drawings. Where adjustable multi-angle crank operating mechanisms are used, an instruction manual is furnished.

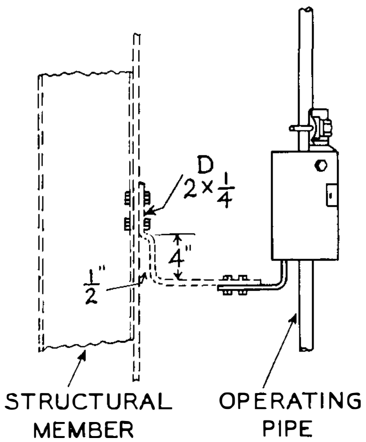
There should be some "wind-up" in the vertical operating pipe in both the open and closed position of the switches. This is accomplished by the proper adjustment of the handle locking plate stops. The rotor crank stops on the bases of the individual switch pole units should engage before the handle is in the locked position.

On reciprocating mechanisms, it is well to have the adjustment so that switches are similarly held in the open and closed position with the operating handle in its corresponding position. This is best accomplished by adjusting the length of interphase connecting rods to take out all "slack" at the extreme limits of travel by forcing the switch rotor cranks against their limit stops.

Guide Plate and Couplings— If more than one section of pipe is necessary, a guide plate (5), Fig. 11, is furnished which should be slipped over the pipe. The pipe splice (6) should be put in place to couple the pipe sections. If additional guide plates are furnished, they should be slipped over the pipe. After the operating pipe and handle have been completely installed, the guide plates should be mounted to hold the pipe in alignment. On reciprocating mechanisms, an intermediate bearing is used in place of the guide plates. On wood poles, it may be necessary to block out from the pole, or gain the pole properly to support the pipe.

Operating Handle and Lock Plate— As illustrated in Fig. 11, slide handle clamp (7) and lock plate (10) over the lower end of the pipe and fasten the lock plate in position at the height desired. Recommended height is approximately 3′-6″ from the ground level. With switches in fully closed position, set the torsion type handle clamp with its centerline 3½″ above the lock plate and with the handle 45 degrees to the right of the lock plate center as you face the plate. Temporarily fasten the handle to the pipe with the set screws (8). Operate the switch and adjust the stops of the vernier type lock plate until they exert pressure against the handle in both the open and closed position of the switch. The vertical operating pipe should be free to rotate when all guide plates are in alignment. If a reciprocating type mechanism is used, install operating handle as shown on mechanism drawing. All up and down adjustments can be made by turning, in or out, the clevis that connects the vertical pipe to the handle.

Ground Connections— A flexible ground connection (9), Fig. 11, should be installed to suit the installation. For multi-revolution mechanisms, the type GRD grounding device is supplied, Fig. 12.



D—Rigid ground connection.

Fig. 12. Type GRD Device
Mounted to prevent rotation of stator, but flexible to minor pipe eccentricity.

Operation— Switches will now operate freely with moderate effort applied to the operating handle. All blades should operate together to the fully closed position. It may be necessary to slightly adjust one or more "open position" stop bolts, Figures 6 and 7, to obtain proper open position of blades. Operate several times to check adjustments. Be sure all blades operate to the fully closed position when the handle is locked closed. Finally, tighten the two stainless steel set screws (8) of Fig. 11, until their dog points pierce the pipe. This will permanently secure the handle to the vertical operating pipe. Note—when looking down on switch, the drive crank, (C) of Fig. 4, should turn clockwise to open and counterclockwise to close.

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 on short circuit currents in accordance with NEMA specifications for short periods of time,—to make or break light charging or load currents without damage,—to establish a renewed contact surface with each engagement of switch blade and jaw, and to break, and if possible, remove ice and contamination.

Contacts on a TTR or TTL switch are mainly four: first, the jaw terminal surface; second, the make-and-break contact between blade and jaw; third, the Sealed Pressure Hinge Contact at the current interchange between the blade and frame casting; and fourth, the frame casting terminal surface. Remarks concerning the jaw and frame casting terminal surfaces will be found in Section IV, titled "Terminal Surfaces".

Contact surface materials throughout this line of switches have been selected with extreme care and the factory processing of switch parts is carefully controlled in an effort to secure the optimum contacts insofar as electrical and thermal conductivity, thermal capacity, proper hardness, best resistance to abrasion, and best resistance to galling are concerned.

The high pressure contact of the blade-rotating type as developed at the make-and-break contact of these switches, fulfills the duties of a "contact" as outlined previously in the most satisfactory manner and with minimum maintenance and repair. The blade end contact, sometimes called the "beavertail", on the TTR49 and TTL49 switches is forged integrally with the hard drawn, high conductivity, tubular copper blade. The jaw contacts are high thermal capacity, silver-surfaced copper fingers backed up with beryllium cobalt copper spring members—copper for its good electrical and thermal conductivity and the beryllium cobalt copper for its strength and resilience. Upon closing a switch, the copper beavertail of the blade rotates into the silver-surfaced jaw contacts, deflecting the upright beryllium cobalt copper jaw members apart and wiping into engagement, thus accomplishing a high pressure spot contact, see Fig. 13. Experience has proved silver-to-copper contact surfaces best for wear resistance.

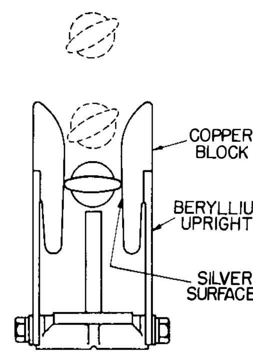


Fig. 13 Blade Rotation and Jaw Construction

The Sealed Pressure Hinge Contact is superior to the jaw contact in that it normally will require no maintenance or repair. All parts of the SPHC (Sealed Pressure Hinge Contact) are properly assembled and adjusted at the factory and require no further adjustments. There is no need to inspect, maintain or repair the internal SPHC, unless the switch has been subjected to a line fault of such severity that the main jaw make-and-break contacts were damaged by the fault. The SPHC is completely enclosed, weather-sealed, lubricated for the life of the switch, and its contacts are of the high-pressure, high-thermal capacity, silver-to-copper type, which remain in constant engagement. Constant contact pressure is supplied to the hinge contact pins by means of non-magnetic, stainless steel springs which are insulated from the current by insulating washers, Figs. 14 and 15.

The internal contacts of the SPHC have been designed with a factor of safety and meet NEMA standards.

The 400, 600, and 1200 ampere switches all utilize the 1200 ampere hinge pin, so that in the lower ratings there is a decided margin of safety in those contacts. The 1600 and 2000 ampere hinge pins are correspondingly larger. Repeated short circuit tests have proved adequacy of all these contacts.

However, if a line fault occurs, where a breaker and/or relaying fails, which burns up considerable equipment and is on for a long period of time, it would be a wise precaution to examine the switch if the jaw make-and-break contacts have been damaged.

There is no need of ever examining the internal contacts unless a fault occurs of such severity that it damages the make-and-break contacts. Then, if there is any question about the internal contacts, the blade assembly may be inspected by removing the pin in the switch top crank and removing the blade from the hinge casting. If this inspection reveals that the internal blade contact buttons together with the silvered surface of the hinge casting are in good condition, and if the switch operates properly, there is no need to inspect the hinge pin contacts. If it becomes necessary to inspect the hinge pin contacts, however, this can be done by removing the stainless steel socket head bolts with a standard Allen wrench. The hinge pins may then be removed by unscrewing them from hinge casting, using a large screw driver or a broken hack-saw blade.

If the particular switch is of the counterbalanced variety, the plunger of the counterbalance assembly should be clamped against the counterbalance housing with the plunger in its fully extended position, before the hinge pins are removed. If facilities for clamping the balance spring plunger in its extended position are not available, the recommended procedure of examining hinge pins would be this: remove one hinge pin only from the hinge casting in the manner explained above, examine it, and then restore it to its properly assembled position. In the same manner, remove and examine the second hinge pin. By this procedure, it will not be necessary to disturb the counterbalance attachment.

Contact Pressure and Wear— The high pressure contact is designed to give a gas-tight seal at the contact surface to prevent oxidation. The copper-to-silver contacts of the TTR49 and TTL49 switches have been thoroughly tested and proved to be the best type for electrical and thermal conductivity, wear and corrosion-resistance.

Under constant usage, contacts may wear so that they may require replacement. In general, experience has shown that on most switches this will not be necessary until after fifteen to twenty years operation. In the worst cases, contact replacement may be necessary as early as seven to ten years. Where switches are used frequently, or under severe contamination or grit conditions, contacts may have to be cleaned frequently. If the contacts can be frequently 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 beryllium cobalt copper jaw uprights. These spring members provide adequate pressure for the contact duty if the contact surfaces are in reasonably good condition. As the contacts wear, or should they become burned, the deflection of the jaws will decrease and a point may be reached where inadequate pressure is applied to the contact surfaces.

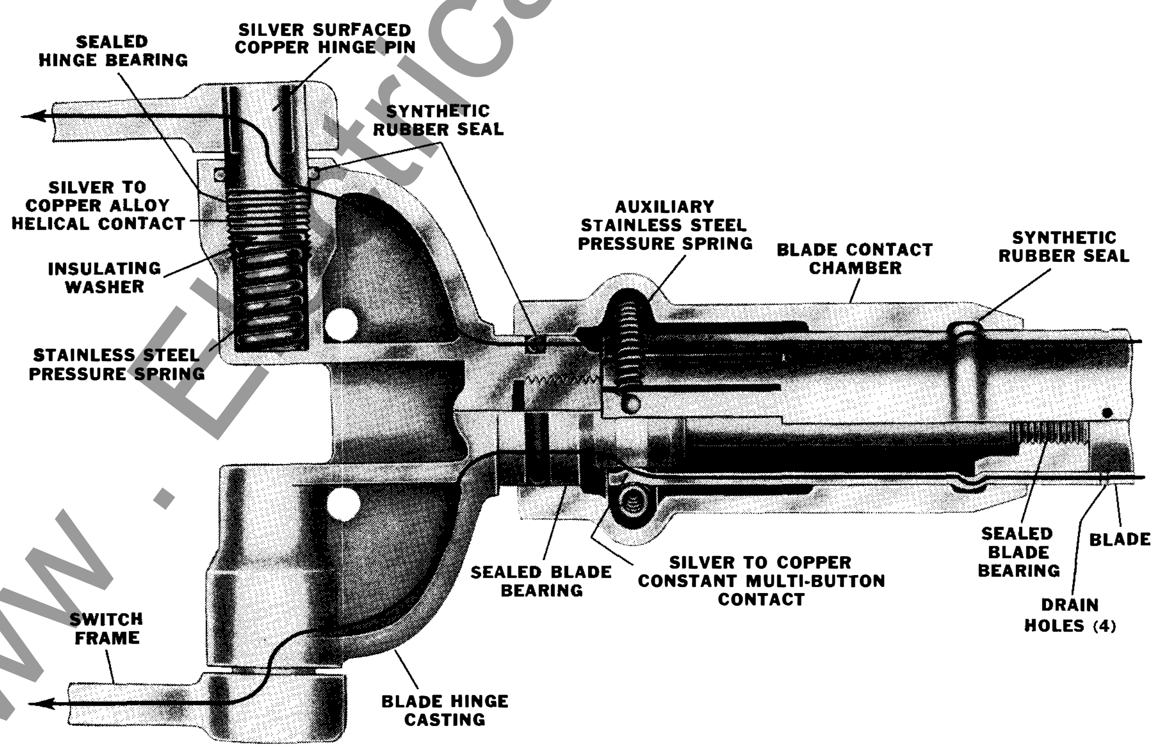


Fig. 14 Cut-away View of Hinge and Blade Contact Chamber, 3-inch Bolt Circle

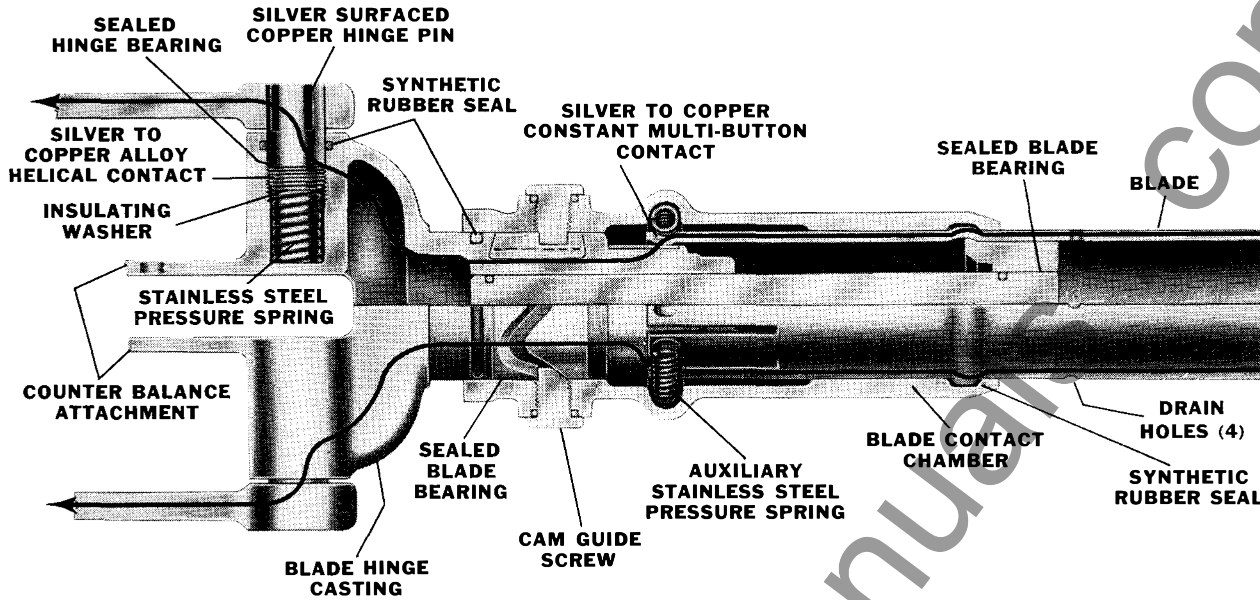


Fig. 15 Cut-away View of Hinge and Blade Contact Chamber, 5-inch Bolt Circle.

Even with contact wear, if the contact surfaces have been smoothed and cleaned, and provided there is at least ⅛″ deflection in the contacts, the switch contacts should be adequate for placing back in service. This ⅛″ is measured by calipering the jaw contact with the blade out of the jaw, calipering at the point of engagement with the beavertail, and comparing that reading with the width of the beavertail. The beavertail width for 400 and 600 ampere, 3″ B.C. switches is nominally 2¼″ when forged and a new jaw is nominally 2-1/16″ when manufactured, giving a total contact deflection of 3/16″, or 3/32″ deflection for each jaw finger with the switch closed. For 1200 ampere, 3″ B.C. and for the high voltage 5″ B.C. switches, the beavertail width is nominally 2¾″, the total contact deflection is nominally 3/16″ and the deflection for each jaw finger with the switch closed is 3/32″. On a switch that is being maintained, if this deflection in the contacts is ⅛″ or more, the contacts are entirely adequate.

These recommendations are made on the expectancy of carrying normal current and short circuit capacity. If a switch is in service and the total contact deflection is slightly under ⅛″, say 1/10″, the switch will still be usable but may overheat when subjected to full load currents and short circuits.

SECTION IV. SWITCH MAINTENANCE

Although our policy is to produce outdoor switches requiring a minimum of maintenance, a certain amount of care and inspection is required. Recognition of this fact is general in the industry and we are including the NEMA recommendations.

NEMA Recommendations for Care of Outdoor Air Switches

"An air switch is not equipped with isolating switches to allow it to be serviced at frequent intervals. This does not indicate, however, that an air switch needs no care or inspection. The frequency of inspection will necessarily be a function of the atmospheric conditions at a given switch location and the frequency of operation. In non-corrosive atmospheres, a switch may operate satisfactorily for many years without care, while in a severe atmosphere such as is encountered at power plants and industrial sites, maintenance may be required in a matter of months. This service interval must be determined by the user.

"The following points require special attention:

1. Be sure that the switch is disconnected from all electric power before it is serviced.
2. After power has been disconnected from the switch, ground leads or their equivalent should be attached to both sides of the switch.
3. Where abnormal conditions, such as salt deposits, cement dust or acid fumes prevail, clean the insulators in order to avoid flashover which might result from the accumulation of foreign substances.
4. Examine the contacts. Check to determine that they are aligned and that contact surfaces bear with a firm uniform pressure. Check contact surfaces. If it is known that the switch carried a heavy short-circuit current, special effort should be made to inspect the switch at the earliest possible time. This is especially important if the switch contacts are badly corroded since the ability of the switch to carry rated short-circuit currents is seriously

impaired if the contacts are not properly maintained. Replace any pitted or burned contacts. If pitting is of a minor nature, smooth down the surface of the contacts with clean fine sandpaper (not emery) or in accordance with the manufacturer's recommendations.

5. See that bolts, nuts, washers, cotter pins and terminal connections are in place and tight. If the switch is group operated, interphase linkages, line operating parts, rods, levers, bearings, etc., should be cleaned and lubricated as required according to the manufacturer's directions; check for the simultaneous closing of all blades and for complete contact in the closed position.
6. When the switch cannot be disconnected from power, hot stick servicing should be used to as great an extent as possible.
7. Where periodic maintenance of any kind cannot be made, it should be recognized that the life of the switch contacts may be affected. In these cases, when a switch operation is made, it is recommended that the switch be opened and closed several times instead of just once in order to clean the contacts more effectively."

(NEMA Pub. SG6-1960, Part 9, page 3)

Maintenance of Exposed Jaw Contacts

Contact maintenance will vary considerably, dependent upon the type of atmosphere to which the contacts are exposed. For heavy industrial areas, particularly near coke ovens where tarry products are in the atmospere, contacts tend to become coated with a heavy flintlike film. Where contacts are subjected to chemical or cement plant dust and the like, a hard coating may be deposited which is insulating in characteristic and which cannot be removed in the usual course of switch operation. For the more normal application, the operation of the switch once every three months should be sufficent to keep its contacts in good condition when combined with an annual maintenance program. In many cases, two or three operations per year may prove adequate; and in some cases, users report only one operation per year. The user can best judge his maintenance procedure after gaining experience in operating switches under prevailing conditions.

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

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

It is recommended that parts be returned to the factory for repairing major damages. If the jaw contact is burned or worn sufficiently that it should be repaired, it is recommended that the jaw contact members be replaced with new ones. Each jaw member or finger is bolted to the jaw base. Removing the bolts will permit removal of jaw members making them readily replaceable with new ones.

In ordering parts or in correspondence regarding these switches, please state the voltage and current rating and the serial number. This data is indicated on the name plate.

In general, contacts in good condition, coated with a lubricant as described above, improve with frequent operation, although the lubricant should be renewed at regular intervals, perferably yearly.

Maintenance of Operating Mechanism Linkages

In general, operating mechanism linkages require no maintenance. Bearings at vital points are weather-sealed and greaseless, requiring no lubrication. Exposed bearings, such as the pinned connection of the rotor crank to the interphase connecting rods and the vertical operating pipe guide plates, should receive special attention particularly in areas where atmospheric contamination is abnormally great or where operation under sleet conditions is common. Any number of lubricants might be suitable for application at these points. Dow Corning DC-4 silicone compound is recommended. This compound is practically inert, very durable even when exposed to the elements, and retains its viscosity over a very wide temperature range.

Maintenance of Blade Contact Chamber

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

After conducting a series of comprehensive comparative tests at the factory, it was concluded that benefits could be derived by using Dow Corning DC-44 medium consistency silicone grease to replace Grade-E NO-OX-ID in the blade contact chamber, Figs. 14 and 15, of the TTR49 and TTL49 switches. Some of the benefits are reduced operating effort at temperatures of 10°F and below, and improved reliability of proper switch operation at these low temperatures as added insurance against ice locking.

Accordingly, all type TTR49 and TTL49 switches shipped since February 1, 1954 have the blade contact chamber greased with Dow Corning DC-44 medium consistency silicone lubricant. Users of switches shipped prior to February 1, 1954 and located in areas where sub-freezing temperatures are prevalent may derive the benefits of this new lubricant by substituting it for the Grade-E NO-OX-ID at a future maintenance period.

Instructions for the application of grease and revamping of older switches to bring them in line with current production are available from the factory.

SECTION V. TERMINAL SURFACES

Both the jaw and hinge end terminals employ four ½" bolts on 1¾" x 1¾" centers which permit NEMA standard 600 or 1200 ampere clamping and the Type "UC" universal terminal clamp. Where ½" bolts are used, the clamping pressure is sufficient to keep the contact area adjacent to the bolts entirely clean. To recondition or maintain such terminal surfaces, all that is required is light abrading with steel wool.

All terminal areas should have bright metallic surfaces after cleaning and preferably should be coated with NO-OX-ID, Grade A Special, in making the new connection. This special grade of NO-OX-ID is a soft, greasy type, designed for brush application, and does not require heating the surfaces upon application. Bolts should be drawn up tightly to insure adequate contact pressure. These special precautions will be well justified by added years of trouble-free service.

SWITCH JAW ASSEMBLIES AND RATINGS

3-inch Bolt Circle

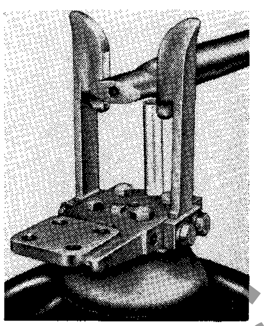


Fig. 16.
400 & 600 Amp. Cont., 20,000 Amp. Mom.

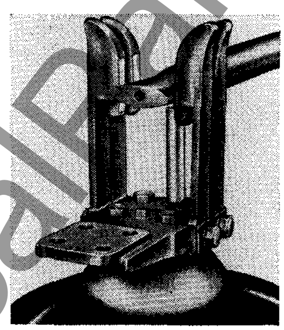


Fig. 17.
600 & 1200 Amp. Cont., 40,000 Amp. Mom.

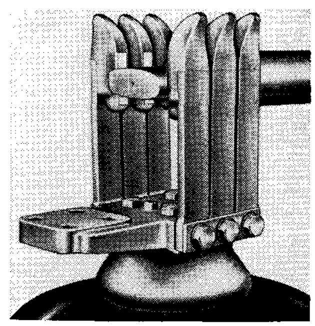


Fig. 18.
1200 Amp. Cont., 61,000 Amp. Mom.

5-inch Bolt Circle

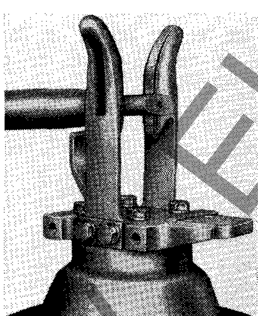


Fig. 19
600 Amp. Cont., 20,000 Amp. Mom.

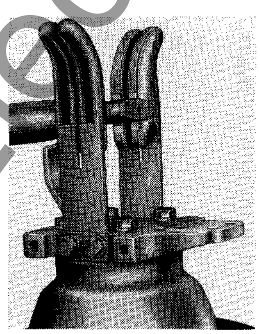


Fig. 20
600 & 1200 Amp. Cont., 40,000 Amp. Mom.

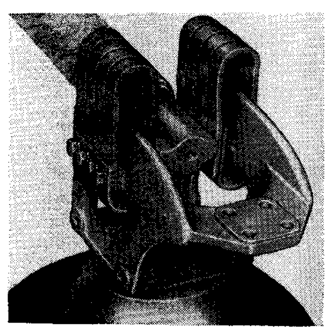


Fig. 21
6 Fingers — 1200 Amp. Cont., 61,000 Amp. Mom.
8 Fingers (Shown) — 1600 & 2000 Amp.Cont., 70,000 & above Amp. Mom.

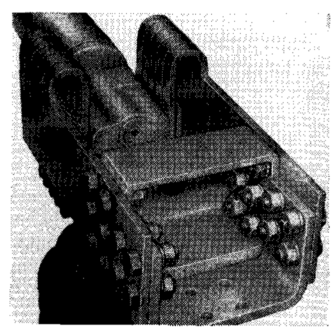


Fig. 22
3000 & 4000 Amp.Cont., 120,000 Amp. Mom.

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