

# OUTDOOR CONDENSER BUSHINGS

## Type "O" Oil Impregnated For Oil Circuit Breakers and Transformers

### INSTRUCTIONS

#### 1. PURPOSE

These instructions cover unpacking, handling, installing, testing, and maintenance of Westinghouse Type "O" Condenser bushings. The recommendations contained in them have been tried and found preferable to other methods. Their careful observance will minimize accidents and assure the maximum useful service from the bushings.

#### 2. DESCRIPTION

(a) The type "O" Condenser bushings have an oil impregnated kraft paper condenser inside an oil filled chamber. This chamber consists of a cap, an upper porcelain weather casing, a metal mounting flange, a lower porcelain and a lower porcelain support. All parts are held under pressure from springs in the cap. All joints above oil level are sealed by soldering, brazing or welding. Joints to the porcelain are sealed with cork neoprene gaskets encircled by asbestos neoprene stop gaskets.

The entire chamber is sealed with sufficient air space in the cap to prevent excessive pressures from being built up by thermal expansion of the oil. A sectional view of the bushing is shown in Figure (1).

(b) **Caps.** The caps are constructed as shown in Fig. 4. All parts are either soldered, brazed or welded. The cap is never disassembled but is compressed in a clamp, removed and replaced as a whole (See Paragraph 8e, 9j and 9k).

(c) **Porcelains.** The upper porcelain weather casing and the lower porcelain of the Type "O" bushing are held in place by compression on their ends. The compression is provided by six coil springs located in the cap (See Fig. 4).

The amount of compression has been carefully calculated for bushings of different sizes, and springs of the proper dimensions to provide the contact pressure are supplied in the bushings.

(d) **Filling.** The kraft paper with which the condenser is wound is impregnated and the bushing filled with WEMCO "C" oil leaving sufficient air space so that excessive internal pressures are never built up. The oil is not exposed to any light and there is a limited amount of air in the sealed bushing so that oxidation of the oil is at a minimum. Testing of oil is discouraged, as to refill means opening the sealed plug in the cap. When put in the bushing the WEMCO "C" oil tested 22 Kv or more.

(e) **Flange.** The flange is provided with a receptacle for connection to voltage tap and with an oil sampling valve. The oil sampling valve is not to be used

except when the bushing shows high power factor. (See Fig. 2).

(f) **Oil Gauge.** If it is necessary to replace the glass face or the dial of the magnetic oil gauge, this can be done by removing the rim of the face.

If it is necessary to replace the float the entire gauge may be removed by unsoldering from the cap.

#### 3. STORAGE

Bushings should be stored, preferably in a rack and in a vertical position in a place where they will not be damaged mechanically. No special precautions need be taken as to moisture or temperature. A check of oil height, of power factor and capacitance should be made before putting into service, after prolonged storage.

#### 4. HANDLING, UNLOADING AND UNPACKING

(a) **Shipping.** Whenever practicable, the bushings are shipped in a vertical position rigidly supported in a crate of suitable size by bolting down flange as in service. The ends are free from contact with the crate. Clearances between and around the bushing permit handling any one bushing without bumping other bushings in the crate.

(b) Large bushings and those not shipped on flat cars with other apparatus are packed in boxes and shipped in a horizontal position. They are supported at both ends and on the flange by corrugated card board supports and the box is completely filled around the porcelains at both ends with tamped shavings and saw dust. No moisture proof wrapping is used on the bushings as all parts are weather proof. The packing however, must be protected from the weather.

(c) **Unpacking.** Care should be used in unpacking to prevent the bushings from being injured by tools or parts of the packing case. Use care in handling the bushing to avoid mechanical damage to the porcelains.

General instructions for unpacking are fastened to the outside of the crate.

(d) **Lifting.** The type "O" bushing when in a vertical position is lifted by a rope or steel cable looped around the top under the lifting lugs. When lifting from a horizontal packing case it is desirable to use a double hoist with one lift at the flange and one looped around the top under lifting lugs. The bushings can however, be lifted from a horizontal to a vertical position by lifting with a rope around the top under the lifting

lugs. Keep the lower end on felt or wood, braced to prevent slipping, with porcelain away from the floor. Using the double hoist on the larger bushing is preferred for changing to the vertical.

#### 5. INSTALLATION AND ERECTION

(a) **Cleaning.** Before installing in the apparatus the bushing should be wiped clean of all dust, grease or particles of packing material. This cleaning should be done thoroughly using cloths wrung out of gasoline or carbon tetrachloride and finishing with a dry cloth.

(b) **Installation of Transformer Bushings.** Spare transformer bushings furnished for a given transformer are supplied without cable leads if they are duplicates of those they are to replace. In this case the cable inside the transformer will fit the bushing without alteration. If the bushings are of different design from the bushings they replace, they are furnished with a length of cable brazed into the cable terminal. In order to install such a bushing it will be necessary to cut off the old cable and to splice the new cable to the old one. The spliced joint should preferably be within the condenser tube, provided there is room for such joint. The splice should be brazed or soldered. The location of the splice may be obtained by measuring the length of the bushing and the length of the cable to the surface of the bushing cover boss adding two inches to measurement to give the proper slack in the cable. On most transformers cover bosses are flat though bevel seats may be used. Both sides of the gasket should be covered with gasket cement before installing. If the transformer cover boss has a bevel seat care must be taken to see that the bushing is at right angles to the cover boss so that clearances from the tank and other internal parts are adequate. For flat seat operation the flange bevel ring and gaskets (if supplied) should be removed. The ball or turnip shaped static shield should always be used on the lower end.

(c) **Installation of Breaker Bushings.** The bushings are provided with a removable bevel seat at the flange for their application on breakers (See Fig. 3). This should be removed when the bushing is used on a flat seat cover. When the bevel ring is used a flat gasket coated with cement is applied between the bevel ring and bushing flange and a bevel formed gasket without cement is used between the bevel ring and tank top. When used as a replacement for arc shield type of bushings, the arc shield support and static shield from the

## OUTDOOR CONDENSER BUSHINGS—Continued

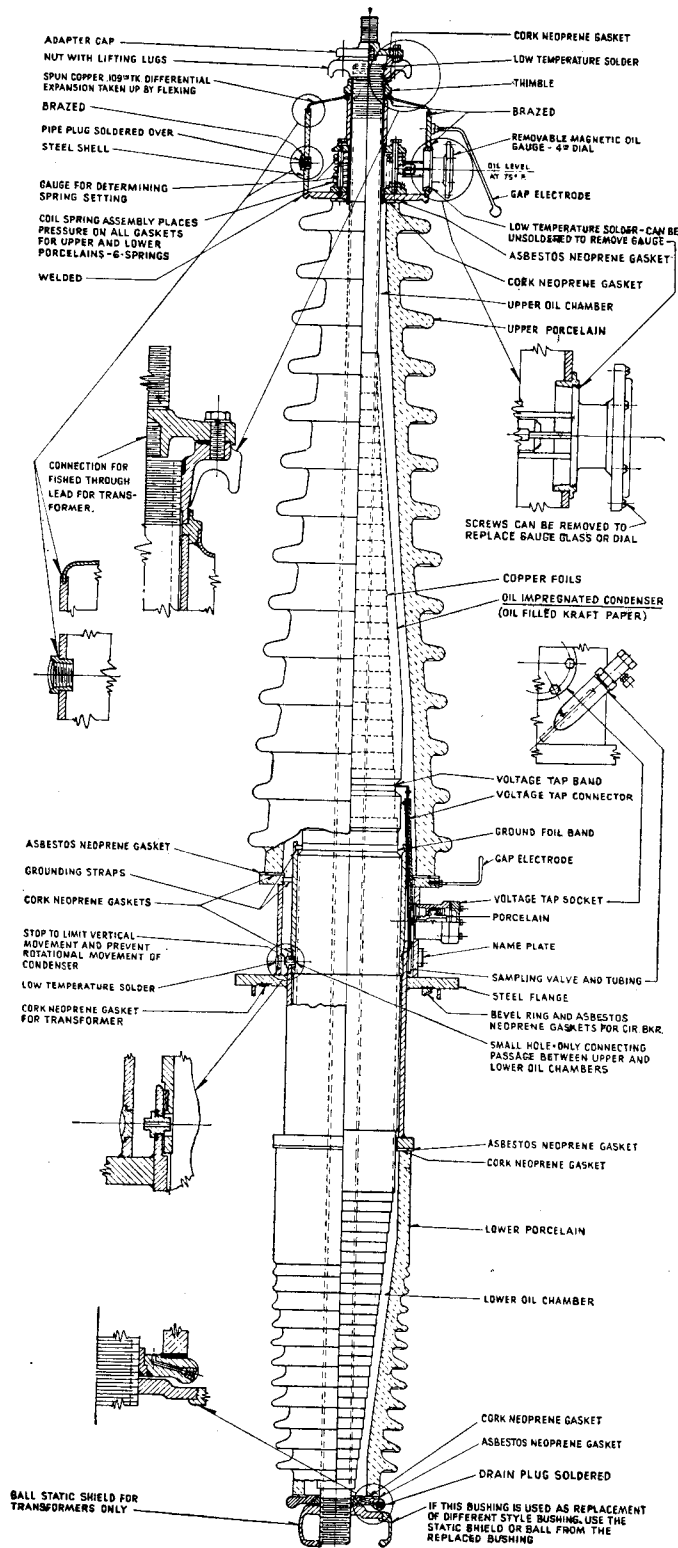


FIG. 1

replaced bushing should be added to the new bushing for circuit breaker applications. Conducting threads should be cleaned carefully.

(d). **Connections.** Outside connections should not throw strains on the bushing.

## 6. ADJUSTING AND TESTING

(a). **Potential Device Connection and Adjustment.** The type "O" bushings are furnished with a two-layer potential tap for use with PB-2 (high capacity) bushing potential devices. By making some modifications, bushings 92-kv. to 161-kv. inclusive, can be used with devices normally designed to operate from a single layer tap. These devices are identified as type PB-1 or PB-11.

(b). The mechanical changes necessary to use the PB-1 or PB-11 devices on two layer tap bushings are illustrated in Fig. 3. These changes are necessary because the receptacles have a porcelain insulator which is not interchangeable with the Moldarta insulator used on earlier bushings. The adapter is required on the bushings to accommodate the flange on the bushing to the union joint connection on lead-in cable. The new contact insert is required in the lead-in cable to accommodate the added length of tap receptacle due to the use of the bushing adapter. To change the contact insert in the lead-in cable, unscrew the present contact insert from the porcelain fitting, pour sufficient tung oil #6008 (in separate can) into the porcelain opening, so that it will be entirely full when the new contact is assembled. Place a new gasket covered with cement #7247 (in separate can) over the end of the insert shank and assemble the contact insert into the porcelain as shown on Fig. 3. Open slot if necessary for good contact. Assemble the lead-in cable into the bushing adapter, use cement #7247 on the gasket, and carefully seal all joints. Fill the assembled tap and adapter chamber with petrolatum sufficiently warmed to flow into the tapped holes provided for this purpose.

(c). The application of the PB-1 or PB-11 device to the two layer tapped bushing requires readjustment of the device to reduce the tap voltage of the bushing to 4000 volts or less. This is accomplished by using more capacity across the secondary terminals of the potential transformer than formerly used. In most cases, there is sufficient condenser capacity available in the device for this purpose; however, in case this is not sufficient, a 5 Mf., 350 volt condenser can be installed in the device housing and connected across the transformer secondary terminals in parallel with the condenser switches A1 to L. The tap voltage of the bushing is determined by measuring the voltage across the mid points of dials #4 and #5, and multiplying by the transformer ratio of the connected taps, as described in Instruction Book 5441. This readjustment should be made with the service burden (or equivalent) connected to the device to

## OUTDOOR CONDENSER BUSHINGS—Continued

obtain the desired secondary voltage and phase angle. The resulting overall performance will be superior to that obtained from the same device when used with the single layer tapped bushing.

(d). **Caution:** The dial arms of dials #4 and #5 should not be left in the "off" position because this will remove the condenser connection from the transformer secondary, allowing the tap voltage to rise and causing arc-over of the potential device protective gap.

## 7. MAINTENANCE

(a). Exposed surfaces including the weather casing and magnetic oil gauge face should be cleaned at regular intervals.

(b). Make power factor and capacitance tests at the end of the first year. It should be noted that the normal inherent power factor of these bushings is so low that the correct values of the bushing power factor may be greatly distorted if either of the porcelain surfaces are dirty or wet and if (when in a circuit breaker) the grids have a high power factor. The high power factor in the grids is not detrimental to the operation in any way except that they give erroneous results on bushing power factor tests. If power factors are higher than expected the surfaces should be cleaned and the grid either shielded or removed. To shield the grid cover on all sides with a screen of metal connected to the contacts. The size of openings in shield should not be over  $2\frac{1}{2}$  inches square. With the clean bushing having grids removed or shielded, the bushing should not have a power factor over  $1\frac{1}{2}\%$ . This is at a temperature of  $50^\circ$

to  $80^\circ$  F. If power factor is over the  $1\frac{1}{2}\%$  the bushing should be removed from service and investigated.

(c). Recheck power factor and capacitance every third year thereafter.

(d). All joints above the oil level are either soldered, brazed or welded and should be permanently tight. Any other leaks will result in the loss of oil and not in the entrance of moisture. The magnetic oil gauges should show "full" when the temperature is around  $20^\circ$  to  $25^\circ$  C. ( $68^\circ$  to  $77^\circ$  F).

(e). Samples of oil should not be taken for oil test unless power factor test casts suspicion on the bushing, as to refill means unsoldering the sealed plug in the cap. When the power factor test indicates that samples should be taken, draw the sample from the sampling valve at the flange.

(f). A sealed hole is provided in the lower porcelain support for removal of oil if the sample from the flange does not test over 15 Kv. in standard test cup. If low dielectric oil is found, a thorough investigation for tightness should be made. If tests are made with air or nitrogen they should be known to be dry and not used at over thirty pounds pressure per square inch. Do not open this sealed hole unless it is proven to be necessary.

(g). A summary of required maintenance is "keep outside clean, watch oil gauge, examine for breakage and oil leaks and make power factor tests periodically."

## 8. DISMANTLING OF THE BUSHING

(a). We anticipate that bushings of this type will rarely have to be rebuilt. Occasionally due to an accident a bush-

ing may be damaged. In such cases the W. E. & M. Co. has adequate facilities for repairing bushings and best results will generally be obtained by returning to the factory.

(b). Remove the bushing from the apparatus.

(c). Set upright. Unsolder pipe plug in edge of lower porcelain support. Unsolder disc over filling plug in cap. Remove pipe plug in lower support and the filling plug in cap and drain oil.

(d). Remove the six bolts holding the adapter cap to the lifting lug nut.

(e). Apply cap clamps, as per Fig. 4 and screw up same until the ends of the gauge rods, visible through the filling plug, are just brought into contact.

(f). With seal broken, invert the bushing, unsolder the lifting lug nut from the condenser tube and from the thimble of the flexible cap and loosen lifting lug nut.

(g). Return to upright position, unscrew nut and lift off cap. To facilitate breaking the gasket seal at the top of the porcelain, it may be desirable to heat the cap to around  $60^\circ$  C. being careful to not heat the porcelain suddenly at any one point. A light hammering with a soft head mallet can also be used to break this seal.

(h). Saw through gaskets at bottom of upper porcelain and remove porcelain. Unbolt voltage tap connection to condenser layer.

(i). Remove cover of cable connection on voltage tap receptacle. Unscrew nut and remove porcelain.

(j). Remove voltage tap insulation after taking out screws holding same.

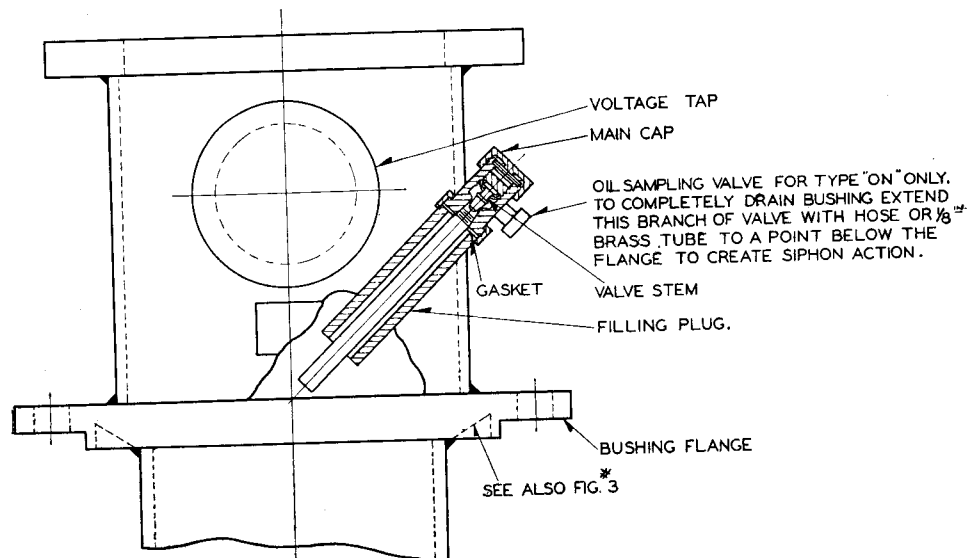


Fig. 2

## OUTDOOR CONDENSER BUSHINGS—Continued

Remove flat spring grounding strap connecting flange to condenser sleeve. Unsolder and unscrew the plug sealing hole above flange rim.

(k). Loosen nut on lower porcelain support after unsoldering.

(l). Invert and remove lower porcelain support and lower porcelain after sawing through the gaskets.

(m). Set the bushing upright, on its flange, in the rack or scaffold. By inserting a socket wrench through the plug hole in the side of the flange, remove the stop which limits vertical movement and prevents rotation of the condenser relative to the flange. Then carefully hoist the condenser (and its steel sleeve) up out of the flange, tapping the flange downward with a mallet if necessary, as it will probably hold on until the condenser has been pulled out about two inches.

(n). While removed from the bushing, the condenser should be kept under oil to prevent absorption of air and moisture.

## 9. REBUILDING OF THE BUSHING

(a). In rebuilding, all surfaces must be thoroughly cleaned and free from oil, and new gaskets must be used in making all joints. It is recommended that these be obtained from the W. E. & M. Co. as the materials used are carefully selected for the purpose and the location for which they are used. In handling the insulating parts of a bushing, extreme care is required to keep them clean and dry. Clean canvas gloves should be worn by the workmen while handling the condenser.

(b). Force condenser with its sleeve into flange thus compressing gasket on sleeve, being sure that the hole for flange stop is lined up with the hole in flange.

(c). Insert flange stop plug through hole in side of flange. Use Varnish #1887 on threads.

(d). Invert and assemble lower por-

celain. The inner cork Neoprene gasket is to be coated lightly with varnish 1887 and allowed to set until the varnish is tacky. The outer asbestos Neoprene gasket has previously been covered by a conducting paint. Parts are to be centered carefully and gaskets partially compressed so that the combined clearance on stop gaskets at the top and the bottom of porcelain is approximately .055. The draining hole in lower support should be soldered shut before assembling in porcelain.

(e). The nut is then soldered to the lower porcelain support and the tube.

(f). Set the bushing upright on its flange. Insert voltage tap insulation and bolt the connector to the strap of the condenser tap. Assemble the voltage tap receptacle as shown in Fig. 3, making sure that the spring on the porcelain is around the core of the connector. Bolt on the cover and fill the receptacle full with petrolatum at 80°C. Do not add more petrolatum after it cools and shrinks as the shrinkage space is needed for future thermal expansion.

(g). Insert flat spring grounding strap from flange to condenser sleeve.

(h). Assemble sampling valve on flange if it has been removed. The tube should be in the bottom of the sump formed in the flange.

(i). Place gaskets and upper porcelain in place treating gaskets same as for lower porcelain gaskets as per paragraph 9d. Center carefully both gaskets and porcelain.

(j). Place cap, still clamped as when removed, in place. The gauge rods visible through the filling hole in flange should be in contact. Screw down the lifting lug nut to come in contact with the cap and compress gaskets from  $\frac{1}{64}$  to  $\frac{1}{32}$ .

(k). Remove clamps from the cap. Solder the lifting lug nut to the thimble of flexible cap and to condenser tube. Insert screw plug and gasket in hole at flange and solder over.

(l). Arrangement should be made to heat the bushing at  $95^{\circ}\text{C.} \pm 5^{\circ}\text{C.}$  This can be done by placing in an oven or by heat applied by low pressure steam or by electric bayonet heaters to the inside of condenser tube.

(m). Test condenser assembly for leakage using nitrogen or air known to be dry and at 30 lbs. per sq. in. pressure. Test for leaks with soapy water.

(n). Apply vacuum to the condenser assembly at the same time the bushing is heated. Continue the drying until a power factor of 0.5% or lower is obtained.

(o). New de-gassed oil of known dryness and dielectric test of 22 Kv. or more is entered without removal of the vacuum. Oil should be vacuum treated before admitting to the evacuated bushing, otherwise it will foam and a portion of the gas will be absorbed by the condenser. This applies if the older condenser is to be rebuilt into the bushing. If a new condenser is to be built in, we would recommend the return of the bushing to Westinghouse Elec. & Mfg. Co. (Circuit Breaker bushings to East Pittsburgh and Transformer bushings to Sharon) as special equipment is necessary to obtain the best impregnation.

(p). With bushing at the temperature of around 70°F. withdraw sample of oil from sampling valve. It should still have a dielectric strength of 22 Kv. or better in a standard test cup. Adjust height of oil to show full on the magnetic oil gauge which should place the oil at the lower edge of the filling plug hole.

(q). Make P.F. and capacitance tests. P.F. should not be over 0.75% with the bushing surfaces thoroughly cleaned. Capacitance should be as per bushing manual T.D. 33-156, Page 8 Par. 19.

(r). Insert plug in filling hole in cap and solder over.

(s). Add adapter cap, with cork Neoprene gasket. Use light coat of varnish #1887 on gasket and apply gasket while varnish is still fresh.

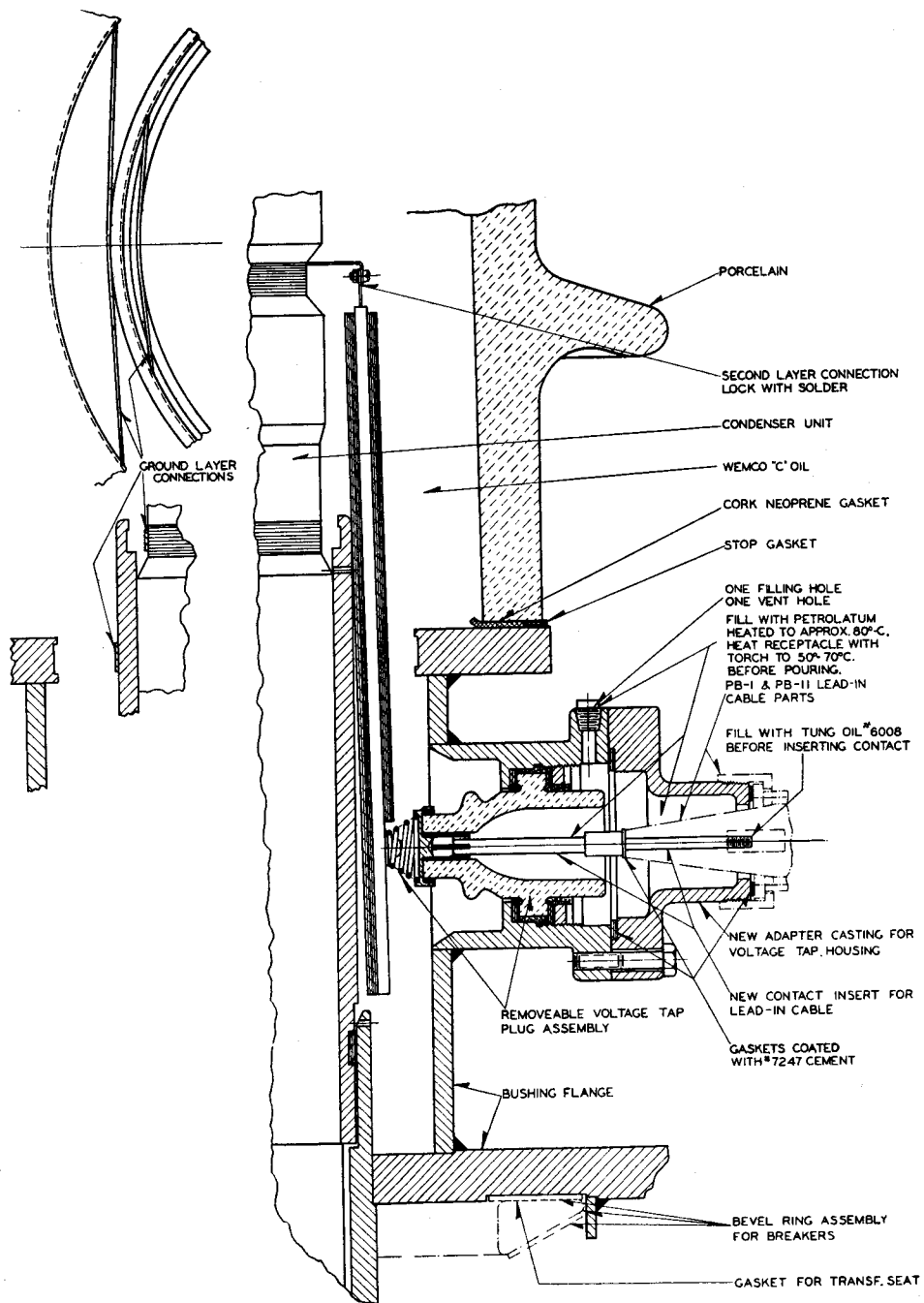


FIG.#3

MECHANICAL CHANGES TO CONNECT THE PB-I OR PB-II NETWORK LEAD TO THE BUSHING TWO LAYER PORCELAIN RECEPTACLE. (SEE INSTRUCTIONS UNDER POTENTIAL DEVICE CONNECTION AND ADJUSTMENT.)

- 1-UNSCREW THE PRESENT CONTACT INSERT FROM THE CABLE LEAD, PLACE SUFFICIENT TUNG OIL #6008 INSIDE THE OPENING SO THAT IT WILL BE ENTIRELY FULL WHEN THE NEW LONG CONTACT INSERT IS IN POSITION. PLACE NEW GASKET COATED WITH #7247 CEMENT OVER LONG CONTACT INSERT AND SCREW IN TO END OF CABLE AS SHOWN. OPEN SLOTS IN END OF CONTACT INSERT IF NECESSARY FOR GOOD CONTACT.
- 2-BOLT NEW ADAPTER CASTING TO THE BUSHING WITH A NEW GASKET COATED WITH GASKET CEMENT #7247 BETWEEN THE TWO PARTS.
- 3-INSERT NETWORK LEAD INTO BUSHING RECEPTACLE AND CONNECT BY SCREWING THE LEAD UNION ON THE END OF THE ADAPTER CASTING WITH A NEW GASKET COATED WITH #7247 CEMENT BETWEEN THE TWO PARTS.
- 4-FILL THE CHAMBER IN THE ASSEMBLY WITH PETROLATUM SUFFICIENTLY WARMED TO FLOW INTO THE TAPPED HOLES AND PARTS OF THE CHAMBER.
- 5-WHEN TYPE "O" BUSHINGS WITH TWO LAYER TAP ARE BEING USED FOR SPARE OR REPLACEMENTS FOR BUSHINGS WITH ONE LAYER TAP THESE PARTS ARE FURNISHED.

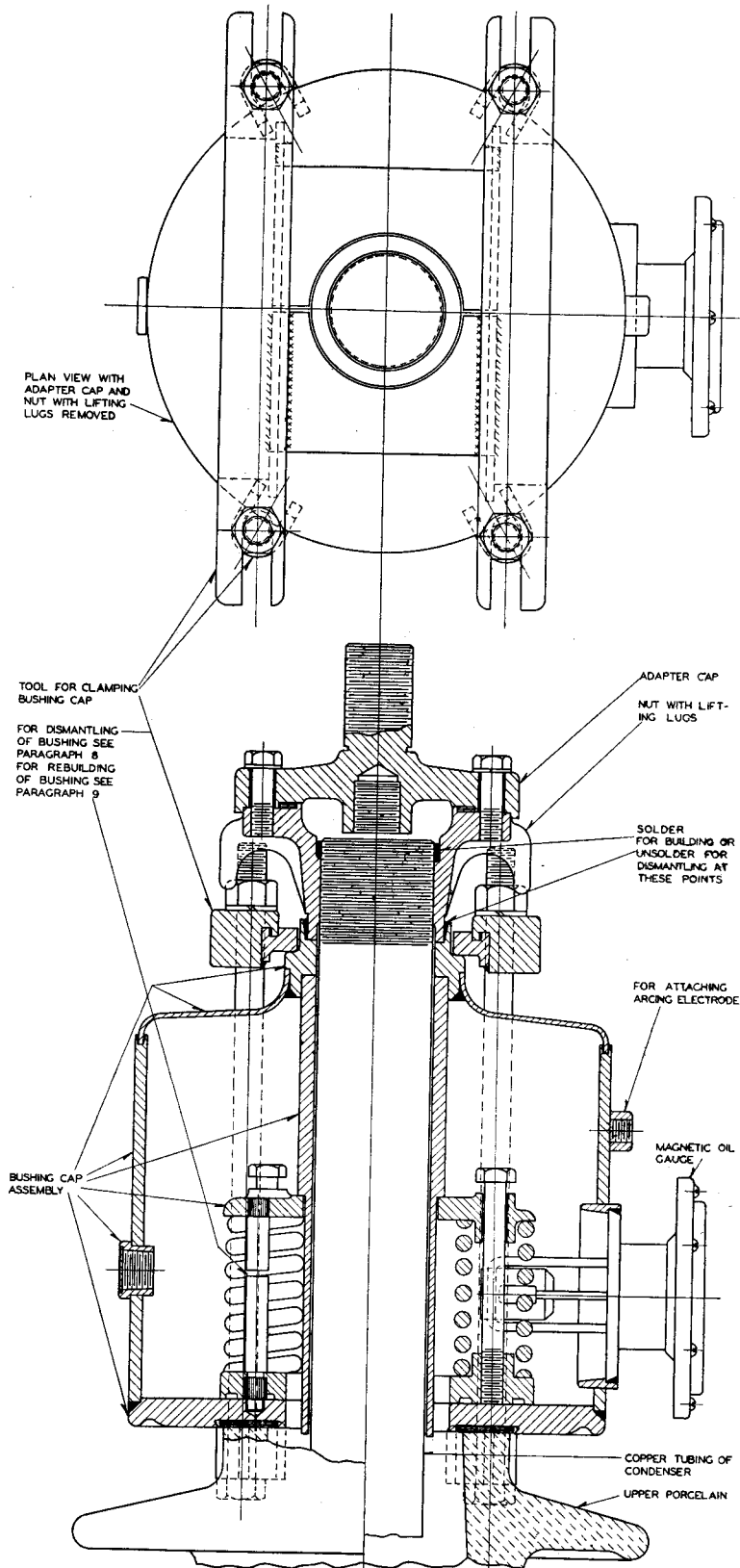


FIG. 4

Westinghouse Electric & Manufacturing Company  
East Pittsburgh, Pa.