



RECEIVING

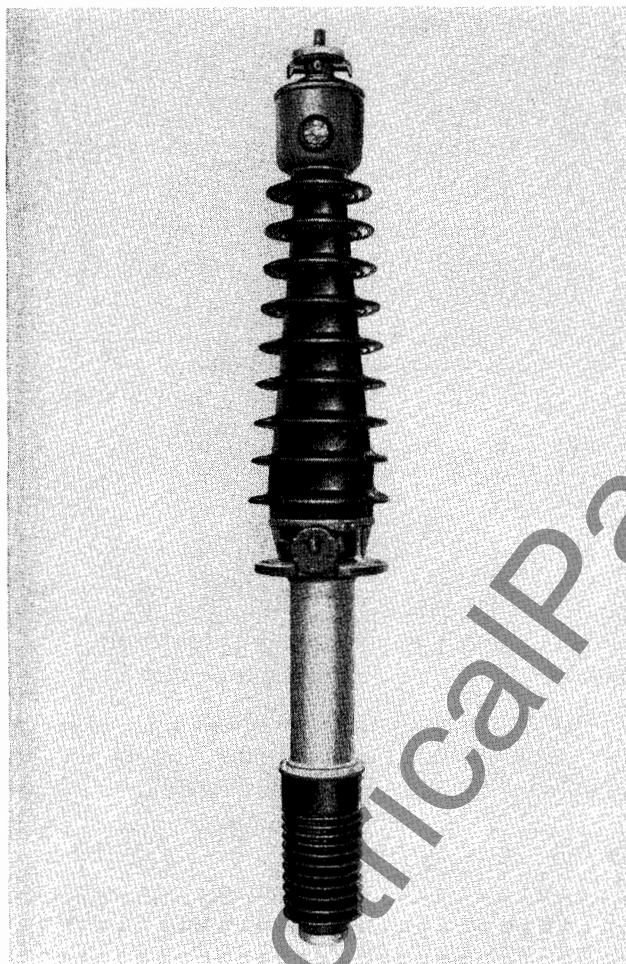
• INSTALLATION

• MAINTENANCE

# INSTRUCTIONS

## OUTDOOR CONDENSER BUSHINGS

Type "O"



**THE TYPE "O" CONDENSER BUSHINGS** are designed for oil circuit breaker and transformer applications.

Westinghouse bushings for circuit breakers are made by the Circuit Breaker Division at East Pittsburgh, Pennsylvania, while transformer bushings are made by the Transformer Division at Sharon, Pennsylvania. For this reason identical and interchangeable bushings will be identified by different drawing numbers or different style numbers. They also will be identified by identical "Key" numbers. A "Key" number is a Westinghouse designation

applied to all bushings which are interchangeable with respect to voltage and current rating, internal dimensions and flange mounting.

These bushings have an oil-impregnated kraft paper condenser inside an oil-filled chamber as shown in Fig. 6. This chamber consists of an expansion bowl, an upper porcelain weather casing, a metal mounting flange, a lower porcelain and a bottom terminal porcelain support. All parts are held under pressure by a spring assembly. The entire chamber is sealed. All joints above oil level are sealed by soldering, brazing or welding. Joints between porcelain and metal parts are made with cork-neoprene sealing gaskets encircled by asbestos-neoprene gaskets and held in compression by the springs in the expansion bowl.

The expansion bowls are constructed as shown in Fig. 6-A. All joints are either soldered, brazed, or welded. Heating of parts is prevented by use of non-magnetic materials and insulating against short circuiting paths in the magnetic field.

The upper porcelain weather casing and the lower porcelain are held in place by compression on their ends. Springs of the proper number and dimensions to provide the desired pressure are supplied in the bushings to meet all test requirements and the maximum operating and shipping requirements of the equipment for which the bushings are designed.

The flange is provided with a voltage tap receptacle and oil valve as shown in Figs. 6-D and 6-E.

The bushing is filled with degassed Wemco "C" oil. Sufficient gas space is left in the expansion bowl to prevent excessive pressures from being built up by the thermal expansion of the oil. The oil is not exposed to light and the expansion space is filled under low pressure with nitrogen so that there is no oxidation of the oil. The oil level reads correctly on the magnetic oil gauge when the bushing is vertical. The reading on the dial will be at a higher or lower level if the bushing is inclined from the vertical position.

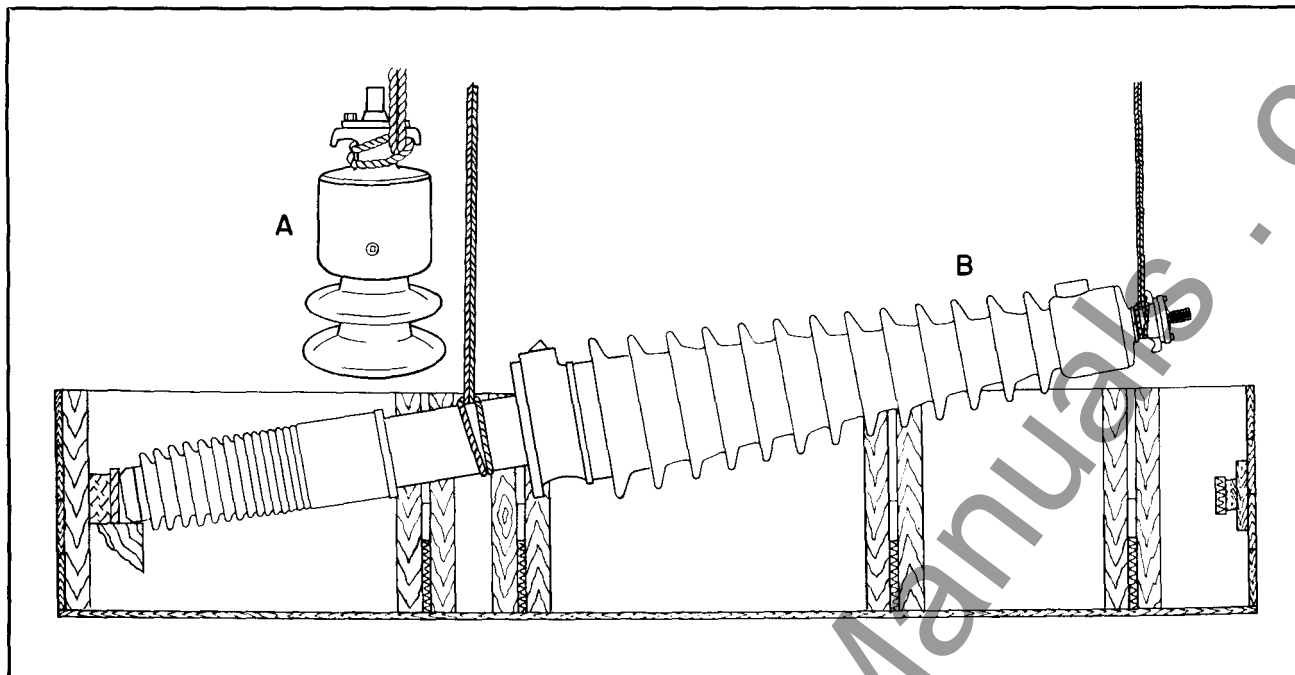


FIG. 1. Lifting Bushing (A) from Vertical Position, (B) from Horizontal Position

## RECEIVING, LIFTING AND STORAGE

**Receiving.** Some bushings are bolted at the flange to a heavy framework and shipped several to a crate in a vertical position. Other bushings are packed in boxes, supported at both ends and on the flange and shipped in a horizontal position.

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

**Lifting.** The type "O" bushing can be lifted from a horizontal to a vertical position and lifted in a vertical position by a rope or steel cable looped around the top nut under the lifting lugs. See A, Fig. 1.

When lifting from the blocking in 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 the lifting lugs. See B, Fig. 1. When upending the bushing keep the lower end on felt or wood, braced to protect threads and prevent slipping and keep porcelain away from the floor.

A recommended method of suspending the bushing at the proper angle for installing is illustrated in Fig. 2.

**Storing.** Bushings should be stored, preferably in a rack and in a vertical position or with the top end at least 18 inches higher than the bottom end, in a place where they will not be damaged mechanically. No special precautions need to be taken as to moisture or temperature. A check of oil height, and of power factor and capacitance should be made

before putting the bushings into service after prolonged storage.

## INSTALLATION

Before installing in the apparatus, wipe the bushing clean of all dust, grease or particles of packing material using cloths wrung out of gasoline or transformer oil and finishing with a dry cloth.

**Installing Transformer Bushings.** Transformer bushings are provided with rounded surface static shields to cover the threads and sharp corners of bottom terminals (See Figs. 6-G and 6-H). These should always be securely in place on the bushing before it is put into the transformer.

Transformer cover bosses (See Fig. 3A) are flat with a recess to retain the gasket and limit its compression. Both sides of the gasket should be covered with gasket cement before it is installed. The bushing should be correctly rotated and carefully centered as it is lowered against the boss so that clearances from internal parts of the transformer are adequate.

Spare bushings furnished for a given transformer are supplied without cable leads if they are duplicates of the bushings to be replaced. In this case the cable inside the transformer will fit the bushing without alteration. If replacement bushings require new cables, they will be furnished as a length of cable attached to a stud terminal. In order to install such a bushing it will be necessary to cut off the old cable and splice the new cable to the old one. The splice

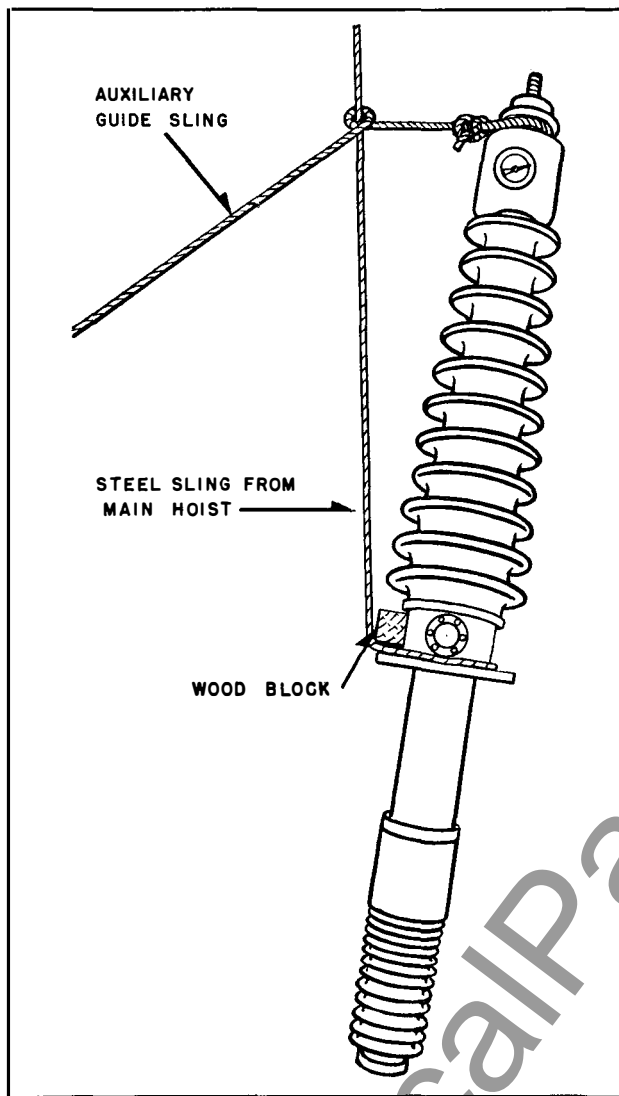


FIG. 2. Method of Suspending Bushing at Angle for Installation

should be brazed or soldered. The spliced joint should preferably be within the condenser tube, provided there is sufficient clearance. The location of the splice may be obtained by measuring the length of the bushing above the bushing cover boss and the length of the cable to the surface of the cover boss. Add two inches to this measurement to give the proper slack in the cable.

Bushings on transformers are supplied with draw-through leads unless the current exceeds the value set by safe thermal considerations, in which case the transformer leads are connected to the lower end of the bushing and the current is carried in the central copper tube. When bushings are removed for shipment on transformers the draw-through leads are coiled up and securely tied to the underside of the blind flange on the bushing boss or to a loop on the underside of the transformer cover conveniently

located near the bushing hole so that the bushing may be installed without lowering the oil level in the transformer.

A stout cord or wire should be fished through the bushing tube and attached to a  $\frac{3}{8}$  bolt screwed into the top threaded hole in the terminal on the end of the draw-through lead. The lead should be drawn taut so that it is free of twists and kinks and the bushing then is slipped over it. If a lead appears to be too short it indicates that something prevents its free passage through the tube and the condition should be cleared.

After the bushing is bolted down, place a drift pin or screw driver through the lower hole in the lead terminal to hold it while the draw cord is removed. Turn the locking nut and the terminal cap (with gasket cemented in place) on the lead terminal and lock the two together. Remove the drift pin and bolt the terminal cap to the cap nut on the bushing.

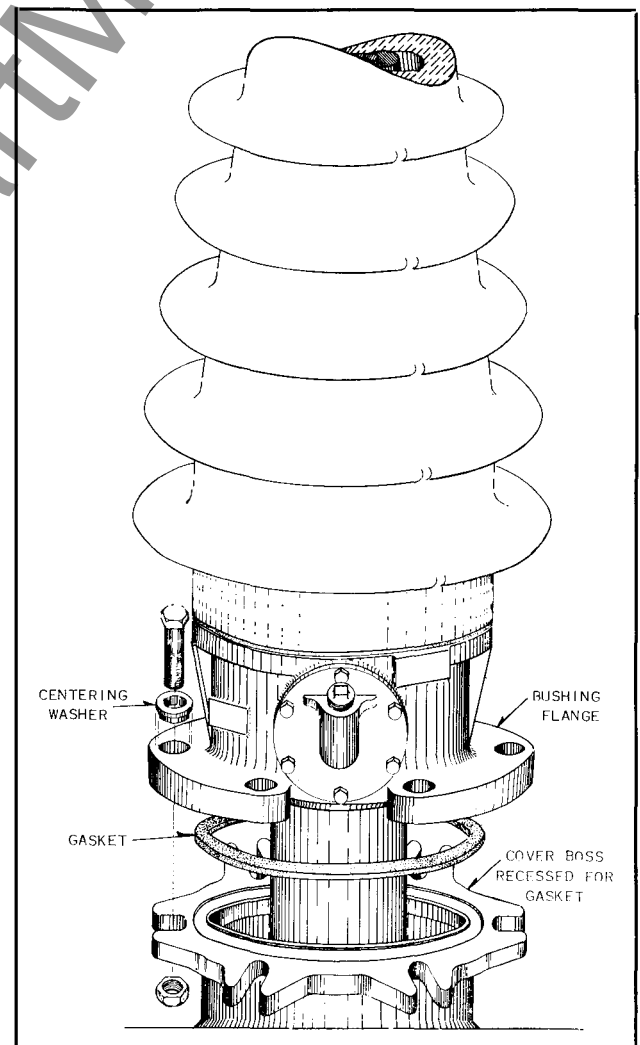


FIG. 3-A. Installing Bushing on Transformer

## CONDENSER BUSHINGS—TYPE "O"

**Installing Breaker Bushings.** See Fig. 3-B. Circuit breaker cover bosses for bushings are flat with a machined groove in the flat surface to retain the bushing gasket. Cement gasket into tank groove and apply vaseline between gasket and the bushing. The vaseline will permit shifting the bushing without damage to the gasket. Three eccentric bushings are used on flange bolts to shift bushing for contact adjustment. Have all bolts tight for final assembly.

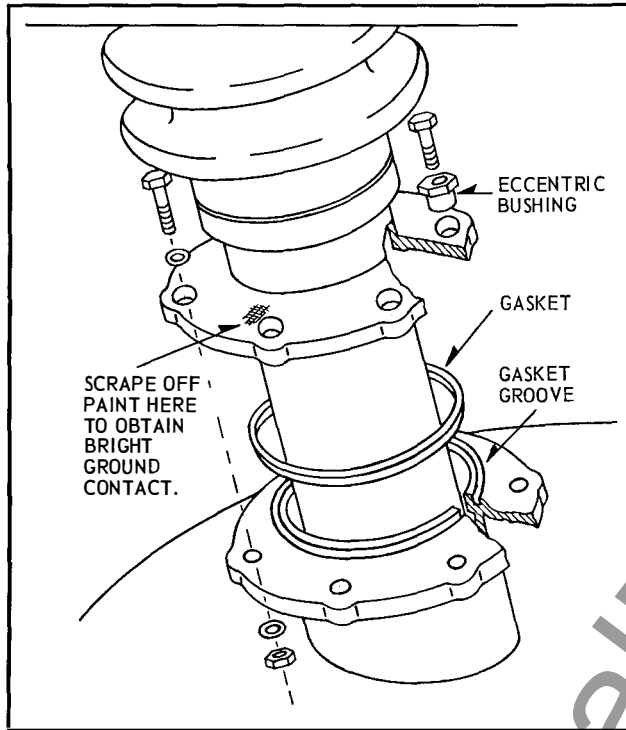


FIG. 3-B. Installing Bushing on Circuit Breaker

**Important.** See that outside connections do not throw strains on the bushing.

**Voltage Tap.** Type "O" bushings are furnished with a voltage tap located at the flange. See Fig. 6-E. The voltage tap receptacle is filled with Wemco "C" oil when potential device is not used, and is filled with petrolatum when the potential device is attached. See Fig. 4. The voltage tap is never grounded and the receptacle should always be filled as specified before putting the bushing in service.

**Potential Device Connection.** Type "O" bushings are furnished with two layer potential tap for use with PB-2 or PBA-2 (high capacity) bushing potential devices. By making some modifications, type "O" bushings can be used with old PB-1 or PB-11 devices normally designed for single layer tap. For these special cases see the Bushing Manual or contact your Westinghouse Representative.

To connect Potential Device Cable (See Fig. 4) remove the cover from the bushing tap receptacle. This will allow approximately 1 pint of transformer oil to drain out. Pack the receptacle with petrolatum and bolt the cable termination in place.

### MAINTENANCE

#### General Maintenance of Bushing

1. Clean all exposed surfaces including weather casing and magnetic oil gauge face at regular intervals.

2. Watch oil gauge. Any abnormal change in oil level indicates a leak in the bushing and should be investigated. The magnetic oil gauge needle should be horizontal when the bushing is vertical and the average temperature of the bushing is approximately 20 to 25°C (68 to 77°F).

#### Power Factor and Capacitance Tests

Where Power Factor testing schedules have been adapted make power factor and capacitance tests the first year and recheck every second year. External damage or the collection of dirt on insulating surfaces may make other occasional tests desirable.

**Important.** 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, if tests are made with the bushing near wet or grounded surfaces, or if external parts are connected to the bushings, such as the interrupter.

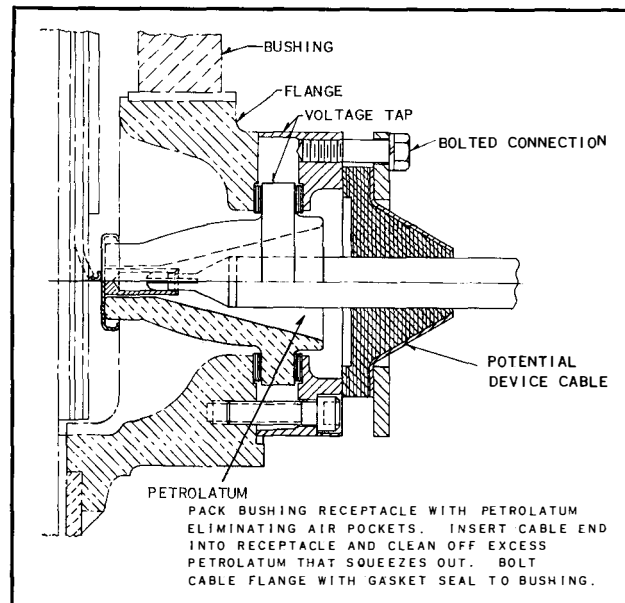


FIG. 4. Voltage Tap Receptacle with Potential Device Cable Connected

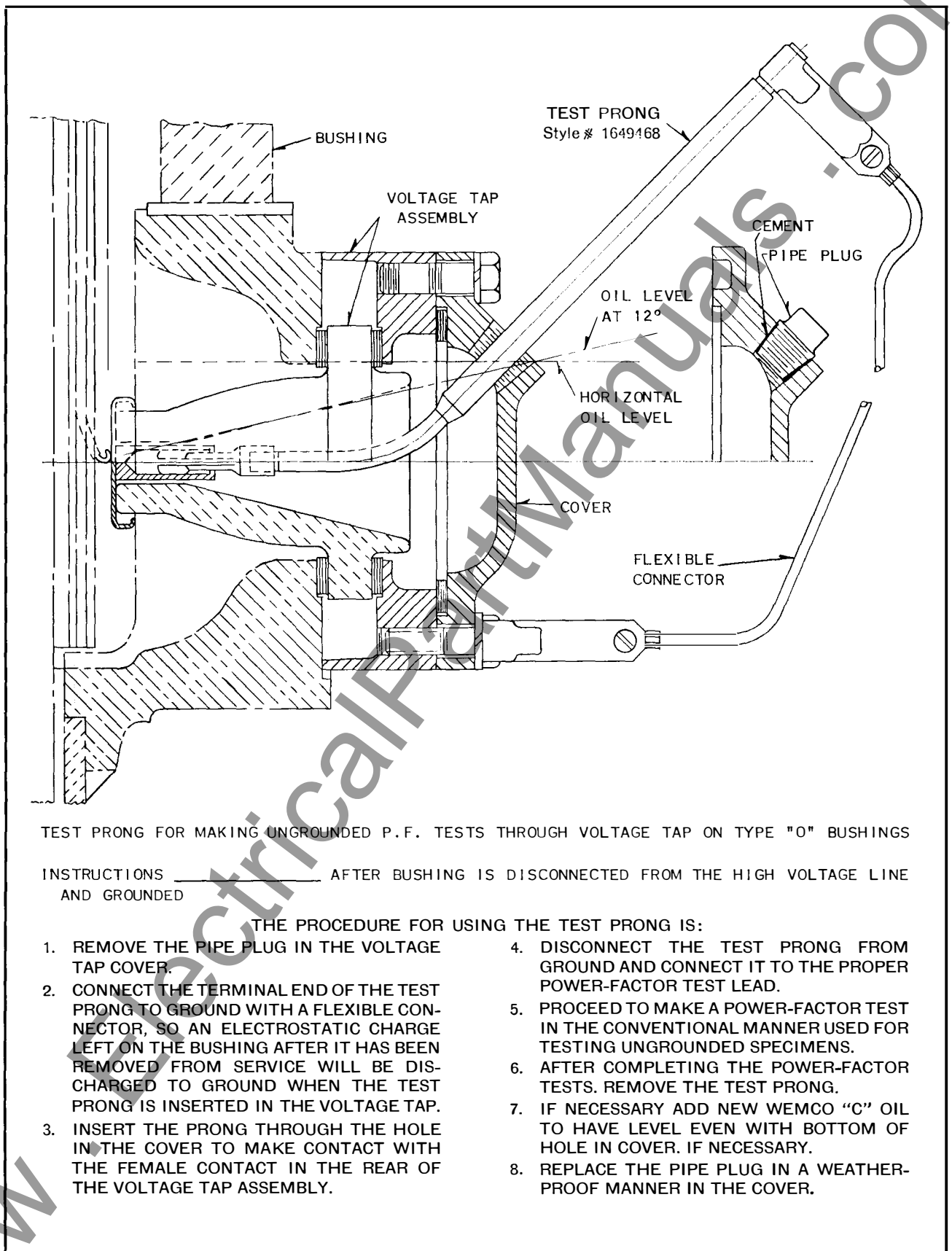


FIG. 5. Test Prong for making Ungrounded Power Factor Tests through Voltage Tap on Type "O" Bushings

Power Factor Tests and capacitance measurements can be made by the "Ungrounded Specimen Method" by connecting to the potential tap (see Fig. 5). This eliminates the necessity for disconnecting the transformer winding, grid, or the line lead from the bushing. Ground the insulated test prong while it is inserted through the pipe plug hole in the cover to dissipate any charge that may be left when contact is made to the potential tap. The power factor and capacitance between the tap and central conductor, and between the tap and the flange can then be measured. After tests the oil level in the receptacle should be adjusted with transformer oil and the pipe plug replaced and sealed.

For more complete information and limits on power factor tests see Westinghouse Bushing Manual, T. D. 33-360.

**Oil Tests.** The type "O" bushing is hermetically sealed with the oil not exposed to light or oxygen, uses no materials harmful to the oil, and has no spots of high voltage concentration. It is therefore strongly recommended that no samples of oil for oil test be taken unless power factor test casts suspicion on the bushing. Sampling removes internal gas pressure and to refill means unsoldering the sealed plug in the cap allowing oxygen to enter.

When inspection or power factor test indicates that samples should be taken, draw the sample from the valve at the flange.

**Important.** If low dielectric oil is found, make a thorough investigation for tightness. Air or nitrogen, if used in testing, should be known to be dry, and not used at over 20 pounds pressure per square inch.

**Summary.** Required maintenance is "keep outside clean, watch oil gauge, examine for loose connection, broken porcelain, oil leaks, and make power factor tests and capacitance measurements periodically."

### DISMANTLING THE BUSHING

Bushings of this type will rarely have to be rebuilt. Occasionally due to an accident a bushing may be damaged. In such cases Westinghouse has adequate facilities for repairing bushings and best results will generally be obtained by returning them to the factory. However, the dismantling procedure is as follows (see Fig. 6):

1. Remove the bushing from the apparatus. Lay bushing on its side on horses having clean cushion-covered tops.

2. Unsolder the disc over the cap pipe plug and remove the pipe plug. Open the oil valve at the flange and allow all oil to drain out. Put a steel plate over the lower end of the bushing tube and clamp it to the bushing flange by from four to eight tie rods. Tighten enough to hold pressure on gaskets of lower porcelain when spring assembly is removed.

**Caution.** These bushings contain oil which is flammable under favorable conditions. Flooding the interior of the bushing with dry nitrogen is recommended just before soldering or unsoldering operations are begun.

3. Through the cap hole take feeler gauge measurement of space between spring plate and gauge rod. Record this measurement for use during reassembly of bushing.

4. After removing the adapter cap, unsolder joints at lifting lug, copper tube and diaphragm shown in Fig. 7.

5. For bushings with copper expansion bowl—(see Fig. 7), after copper diaphragm is removed insert bolts and tighten to compress springs. Unscrew pressure nut, remove gauge float, and take spring assembly from cap.

6. The junction of the cemented gasket to the bowl and the porcelain can best be broken by heating and lightly hammering the bowl. Any prying or wedging at the joints is likely to break the porcelain. The gasket joint at lower end of the top weather casing is broken in a similar manner, or it may be sawed, and the top weather casing removed.

7. If the lower porcelain must be removed, remove the steel plate and tie bolts. Unsolder and unscrew the bottom terminal and remove the lower porcelain. The gaskets joints at top and bottom of lower porcelain are broken as specified for the top porcelain weather casing.

8. Remove the voltage tap insulation between the condenser and the porcelain receptacle.

9. Unscrew the six bolts and remove the voltage tap cover. Remove the four hexagon hollow head screws. Screw six  $\frac{3}{8}$ —16 x 2 bolts in cover holes and turn until the gasket seal is broken around the porcelain receptacle. The porcelain receptacle may then be pried out or removed by cutting the gasket.

10. The condenser may then be removed from the flange.

**Important.** The condenser and tap insulation should be kept in a dry and clean place if they are to be rebuilt back into the bushing within 36 hours. If condenser and tap insulation are to be kept out of the bushing for a longer period of time they should be stored under oil.

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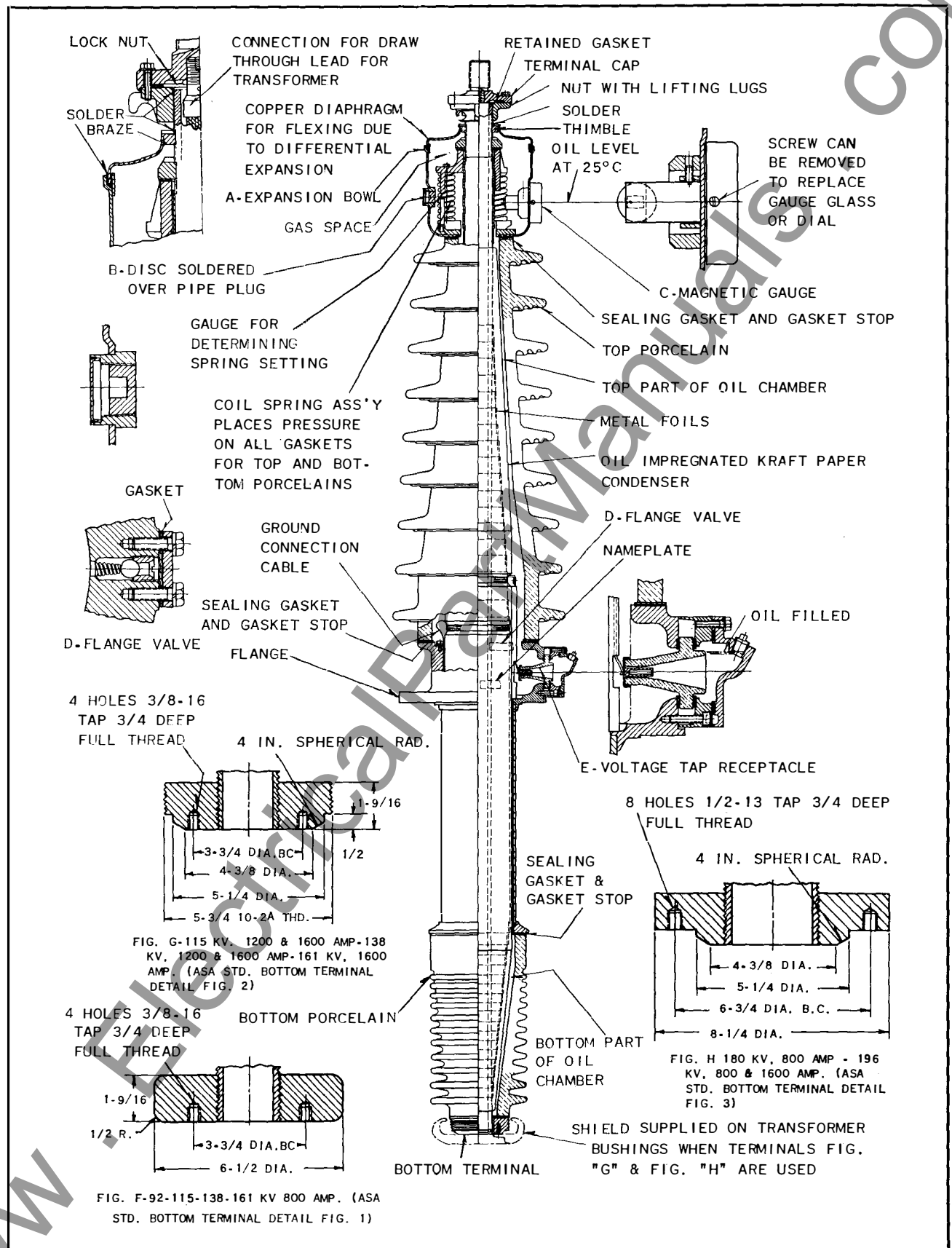


FIG. 6. Sectional View—Condenser Bushing, Type "O"

### REBUILDING THE BUSHING

In rebuilding, all surfaces must be thoroughly clean and free of oil. New gaskets must be used in making all joints. It is recommended that gaskets be obtained from Westinghouse as the gasket materials are carefully selected for their purpose and location.

In handling all parts of a bushing, extreme care is required to keep them clean and dry. Clean canvas gloves should be worn by workmen while handling the condenser. The porcelains should be clean and dry before reassembling.

The procedure for rebuilding the bushing is as follows (see Fig. 6):

1. Place the condenser inside the flange.

2. Place lower porcelain over condenser with gaskets between main flange and porcelain coated with cement.

**Note.** Both cork neoprene sealing gasket and asbestos neoprene stop gasket are applied at ends of upper and lower porcelain with a light even coat of gasket cement (Westinghouse #1887) on both sides. If gaskets tend to slip when pressure is applied, then hold off until the cement is slightly tacky.

3. Place gasket on bottom end of lower porcelain but do not cement at this time. Screw on bottom terminal until flush with end of copper tube lead. Align so two tapped holes in bottom terminal straddle center line of voltage tap. With lower porcelain and gaskets pulled away from the bottom terminal, solder the bottom terminal to the copper tube lead oil tight. In this soldering, as in all other on the bushing, only alcohol and resin flux (Westinghouse 751) should be used. Use no more heat than necessary to make a good solder joint. Use small flame and keep away from porcelains.

4. Now coat gaskets between bottom terminal and lower porcelain with cement and with steel plate and tie rods between lower end of bushing tube and main flange, compress the gaskets so that a .006 inch feeler gauge will not go between the stop gasket and the porcelain. Leave clamps in place until assembly is complete. Before clamping lower porcelain have the center of the voltage tap line up between two tapped holes in the bottom terminal.

5. Assemble the voltage tap insulation, the voltage tap porcelain and gaskets. Connect condenser ground cables tight to flange.

6. Assemble in order the gaskets at bottom of porcelain weather casing, the weather casing, and the gaskets at the top of the weather casing. The stop gasket (neoprene asbestos) should be painted all over with a metallic aluminum paint and dried

previous to this time. All gaskets are coated with gasket cement (Westinghouse 1887) at the time they are applied.

7. Adjust bolts on cap spring to give approximately  $\frac{1}{8}$ " less than measured between gauge rods (x-spacing) before dismantling the bushing. Place the cap in position and tighten with pressure nut (Fig. 7). Remove bolts on spring assembly. It may be necessary to repeat the operation of clamping the springs and adjusting pressure nuts to obtain the desired setting on the gauge rods. Contact your Westinghouse representative if there are any questions about setting of gauge rods or compressing springs.

8. Solder joints at lifting nut, diaphragm, etc., as shown in either Fig. 7 to seal cap.

9. Bake the bushing at 90°C for 8 hours to set the cement.

10. The above applies if the old condenser has a good power factor and is to be rebuilt into the bushing.

**Important.** If a new condenser is required return the bushing to Westinghouse Electric Corporation (circuit breaker bushings to East Pittsburgh and transformer bushings to Sharon), as special equipment is necessary for evacuating, degassing oil and impregnating to insure the best results.

11. Test the bushing assembly for leakage, using nitrogen or air known to be dry, and at 20 pounds pressure per square inch. Test for leaks with soapy water.

12. With the bushing horizontal, fill with Wemco "C" oil through the hole in side of cap. Place pipe plug in filling hole and solder the copper cupped disc over this plug.

13. With the bushing in the vertical position, enter nitrogen through the flange valve at approximately 5 pounds pressure and then adjust the oil level. Repeat until the oil gauge shows the correct level and the nitrogen pressure is 5 pounds, if degassed oil was used, or 3 pounds if non-degassed oil was used in filling.

14. Paint over all joints and possible leak points with whiting. Set the bushing vertical for one day and then horizontal for one day, so that oil will be sure to cover all places where leaks might occur.

15. If no leaks are found remove whiting, and paint, covering the edges of all exposed gaskets and all soldered joints. Add adapter cap with cork neoprene gasket. Use a light coat of cement 1887 on the gasket and apply the gasket while the cement is still fresh.



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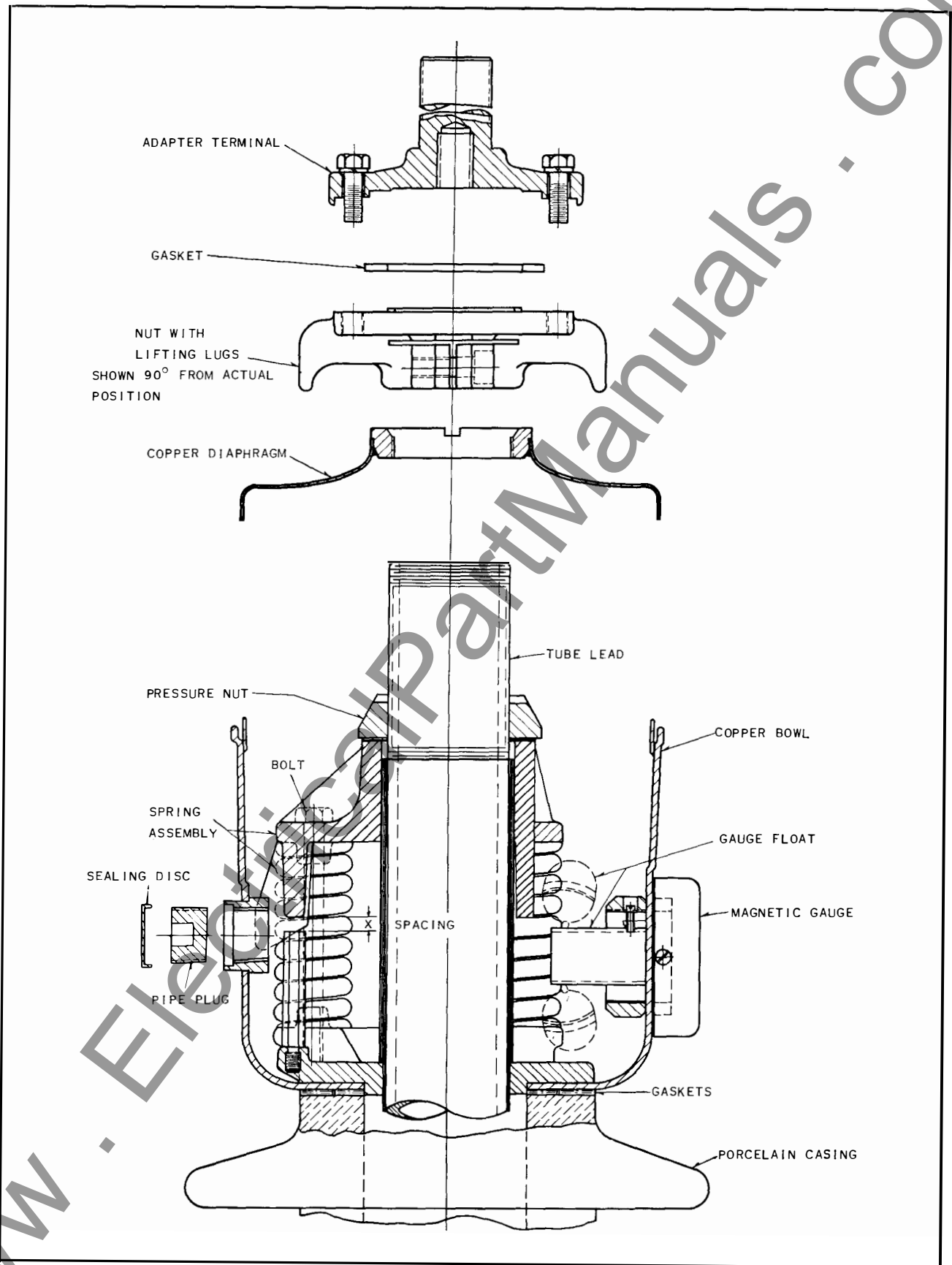


FIG. 7. Sectional View—Bushing Expansion Bowl

## CONDENSER BUSHINGS—TYPE "O"

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### Rebuilding Precautions

The following precautions are to be observed when rebuilding a bushing.

1. Keep the condenser under clean dry oil if it is not assembled back into bushing within 36 hours.
2. Use new clean Wemco "C" oil of not less than 25 KV strength and preferably degassed, for filling the bushing.
3. Keep all materials dry and clean and gasket surfaces free of oil.
4. Carefully clean and tin all surfaces to be sol-

dered. This is the first essential of a good soldered joint.

5. Center the porcelains with the bushing lead and center gaskets with the porcelain.

6. Refill voltage tap with Wemco "C" oil.

7. If facilities are available, give completed bushing standard insulation tests for its class and make power factor and capacitance tests. Make power factor test on condenser before rebuilding and do not rebuild if power factor is over 1 percent. If power factor is high, a new condenser should be wound and the rebuilding done at the factory.



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**MEMORANDUM**

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