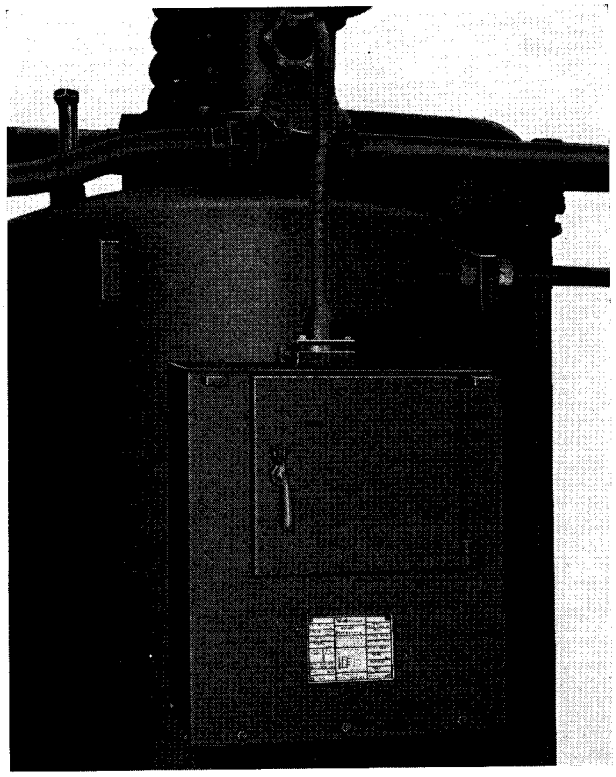
Type PBA
Condenser Bushing
Potential Device

INSTRUCTION BOOK

INSTALLATION

OPERATION MAINTENANCE



THE TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE MOUNTED ON AN OIL CIRCUIT BREAKER

Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pa.

I. B. 33-766

INDEX

Description

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE

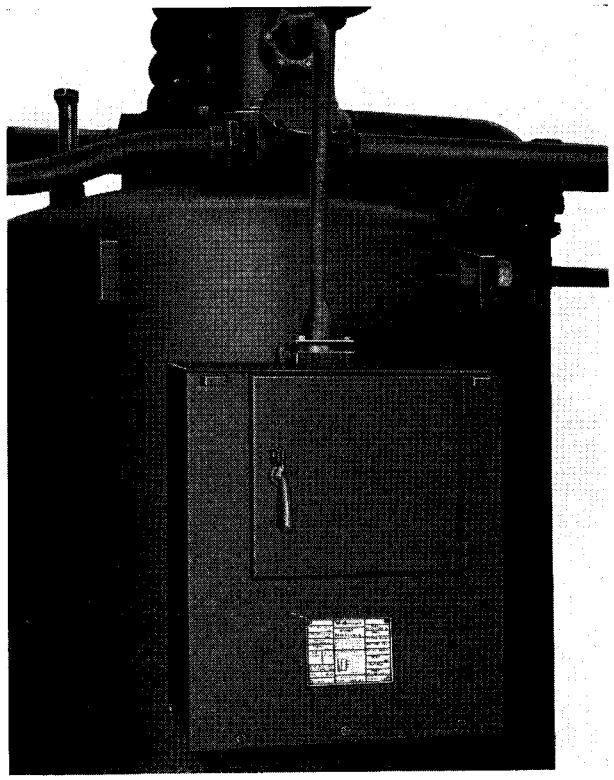


FIG. 1—TYPE PBA POTENTIAL DEVICE MOUNTED ON A CIRCUIT BREAKER

General

The PBA potential device in combination with type "O" bushings (or other modern 2 layer tap condenser bushings) is an effective means of obtaining potential for many forms of relaying, indicating instruments, synchronizing etc. The potential devices are suitable for use on transformer and circuit breaker bushings 115 kv. and above.

Description of Potential Device

The potential device consists of a high reactance transformer, see figures 2, 3, 4 and 7, a protection gap and ground switch for the high reactance transformer primary, an auxiliary auto-transformer with taps, a power factor correction capacitor with taps and a terminal panel to which power factor capacitance and all output voltages and connections are made. All electrical adjustments of the device are made on this panel which is readily accessible for ease and speed of adjustment. The panel cover is hinged and fastened in such a manner as to allow opening without the use of tools. All internal connections to the panels are made with insulated copper wire.

Each potential device is complete with lead-in-cable for use with two layer condenser bushings. Sufficient range of adjustment, for both ratio and phase angle, will be provided so that with permissible variations in the capacitance of the bushings the performance requirements will be met.

Ratings

Each potential device will have a total output rating as shown in Table I when used in combination with the condenser bushing rating indicated and energized at its nominal line to ground voltage. When the condenser bushing is energized at its nominal line to ground voltage, a secondary voltage of 66.4 volts will be available for operation of relay and indicating instruments, a secondary voltage of 115 volts will be available for the same purpose and a third 115 volt separate secondary will be available for broken delta connection of ground relays. Suitable terminals are provided on the adjusting panel for making connections to these voltages.

Adjustment and Performance

The devices provide correction of lagging burden to unity power factor when desired. Sufficient corrective capacity is available and so tapped as to provide correction as indicated in Table I in steps not greater than 2.5 volt amperes.

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE—Continued

The voltage ratio of the potential device will be adjustable in steps of not greater than 1% over a load range of zero to 100%. The phase angle will be adjustable between minus 5 degrees and plus 5 degrees and the range of voltage taps will be such that the ratio correction factor may be between 0.95 and 1.05 for any load up to the rated load of the device. This requirement will be met for any and all corrected power factors of the burden between 0.95 leading and 0.95 lagging. With normal primary voltage, the total variation of the ratio correction factor will not be more than 12% and the variation of the phase angle will not be more than 8 degrees over a range of burden from zero to 100%. With constant rated burden, the total variation of the ratio correction factor will not be more than 5% and the variation in phase angle will not be more than 5 degrees over a range of 5% to 100% of normal rated line to ground voltage.

Protective Gap and Grounding Switch

A protective gap and ground switch are provided with the potential device. The protective gap functions to prevent excessive voltages being impressed on the bushing tap and the potential transformer. These excessive voltages may be caused by overload or short circuit on the potential device or impulse surges on the high tension line. The operation of the protective gap in no way effects the long life of the equipment. Normally the ground switch is open, but may be closed for short periods of time to remove voltage from the potential device during inspection and adjustment if desired. The switch should not be left in the closed position as this short circuits two condenser layers in the bushing and the potential device is not organized.

Mounting

The Bushing Potential Device housing is equipped with mounting brackets suitable for mounting on a circuit breaker or power transformer tank equipped with potential device mounting pads.

Connections

A varnished cambric insulated lead covered cable with suitable fittings is furnished for making the connection between a two layer tap condenser bushing and the potential device. The length of the cable between flanges is 33½".

Tests

The following tests are made on each bushing potential device:

(1) Breakdown voltage of transformer primary gap.

(2) Insulation and ratio of potential transformers.

(3) Capacitance measurements of power factor correction capacitors

(4) Insulation on assembled potential device network and wiring.

TABLE I

STANDARD VOLTAGE RATINGS, RATED WATTS OUTPUT, SECONDARY VOLTAGES AND RANGE AND STEPS OF ADJUSTMENT

Rated Circuit Kilovolts	Rated Line to Ground Kilovolts	Rated Output Watts	Secondary Voltages Main Winding Volts	Secondary Voltages Auxiliary Winding Volts	Total P.F. Correction Volt Amps.	Max. Range of Adjustment Ratio %	Max. Range of Adjustment Phase Angle°	Maximum Tap Steps Ratio %	Maximum Tap Steps Phase Angle°
115	66.4	25	115/66.4	115	20	±5	±5	1	1
138	79.7	35	115/66.4	115	28	±5	±5	1	1
161	93.0	45	115/66.4	115	36	±5	±5	1	1
230	133.0	80	115/66.4	115	64	±5	±5	1	1
287	166.0	100	115/66.4	115	80	±5	±5	1	1

RATIO AND PHASE ANGLE PERFORMANCE

Maximum Ratio and Phase Angle Deviation with Variation of Applied Voltage where Device is Initially Adjusted Within the Limits Shown at 100% Voltage.

% Primary Voltage	% Ratio	Phase Angle Degrees
110	±1	±1
100	±1	±1
25	±3	±3
5	±5	±5

Maximum Ratio and Phase Angle Deviation with Variation in Burden When Device is Initially Adjusted Within the Limits Shown at 100% Burden.

% Burden	% Ratio	Phase Angle Degrees
100	±1	±1
50	±6	±4
0	±12	±8

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE—Continued

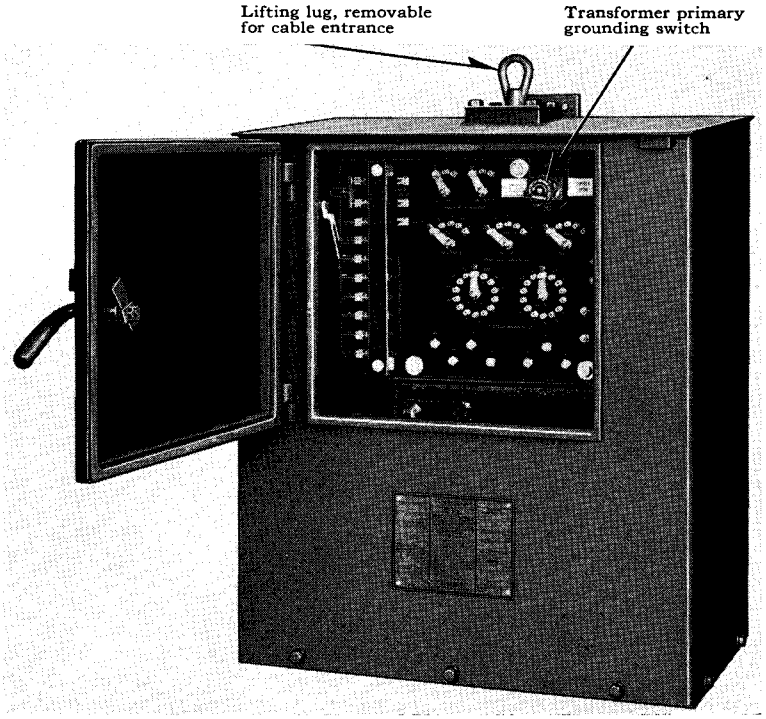


FIG. 2—POTENTIAL DEVICE WITH DOOR OPEN SHOWING ADJUSTING PANEL

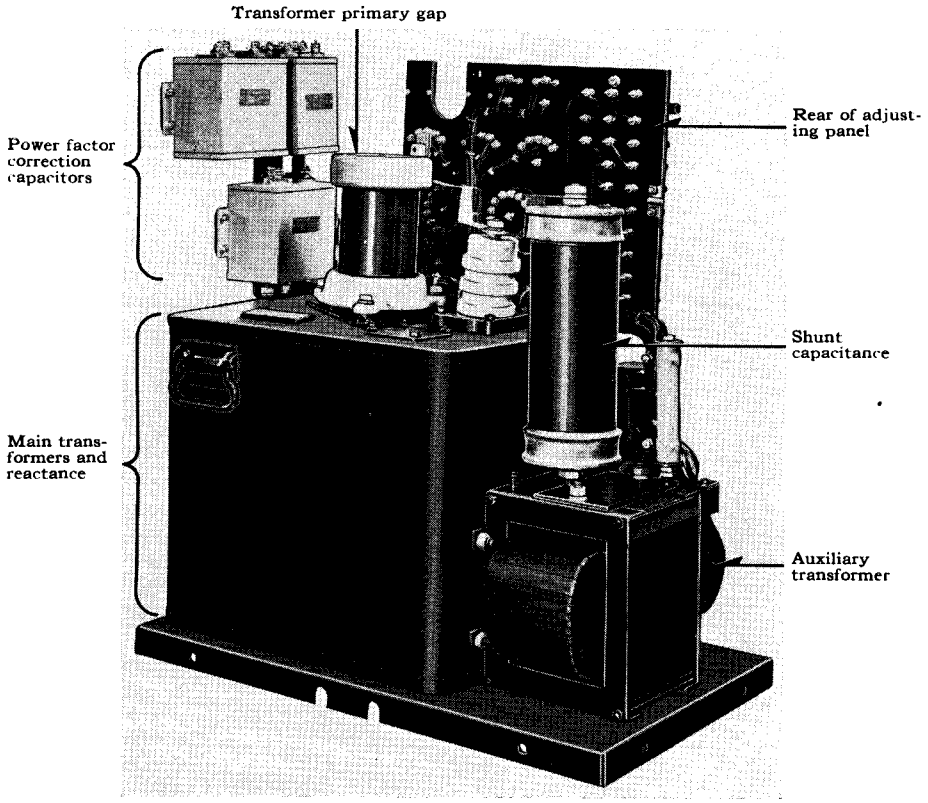


FIG. 3—NETWORK REMOVED FROM HOUSING, REAR VIEW

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE—Continued

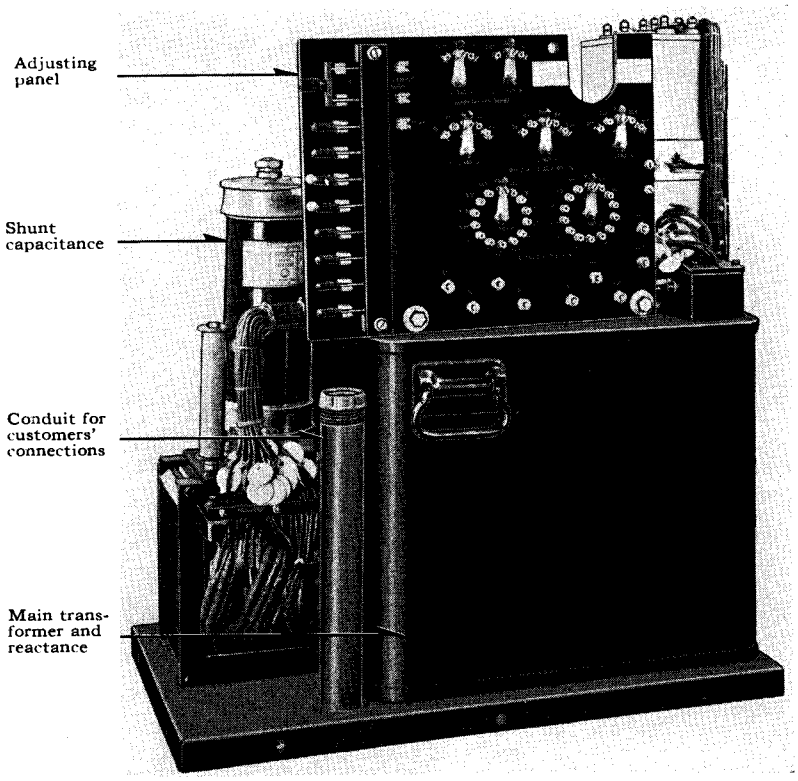


FIG. 4—NETWORK REMOVED FROM HOUSING, FRONT VIEW

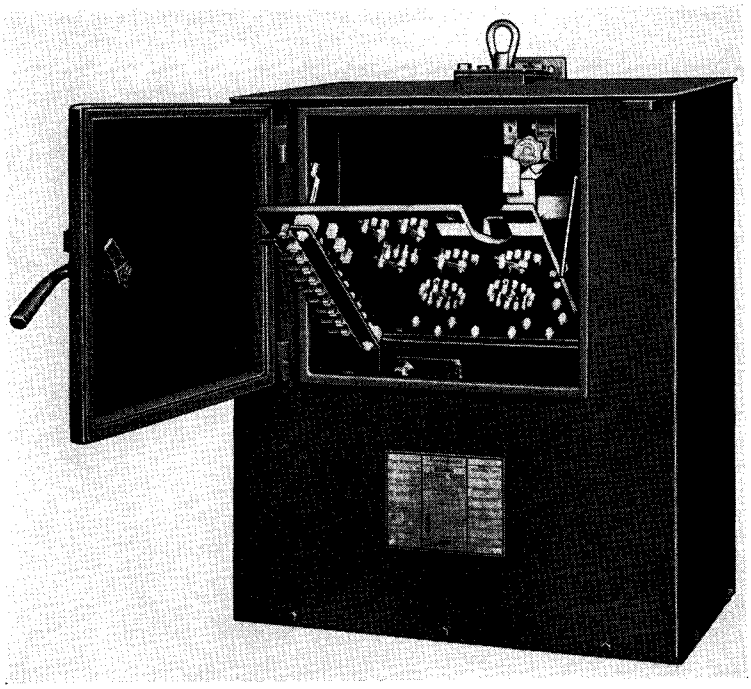


FIG. 5—BUSHING POTENTIAL DEVICE WITH ADJUSTING PANEL IN OPEN POSITION

Westinghouse

Type PBA

Condenser Bushing Potential Device

INSTALLATION, OPERATION AND MAINTENANCE

PURPOSE

The Condenser Bushing Potential Device when properly installed and adjusted provides an economical source of low voltage energy for the operation of instruments and relays. The device operates from a high voltage condenser bushing. The care which should be exercised in installation and operation for the safety of personnel cannot be over-emphasized.

Unlike the ordinary potential transformer the magnitude and phase position of the secondary voltage of the device are adjustable over a wide range. For correct operation of the instrument or relays that are energized by the device it is essential that it be adjusted as described in this book.

This is a static device and, while little maintenance is required, the life and service of the device may be improved by periodic inspection and occasionally refinishing.

It is the purpose of this instruction book to aid in the proper use and maintenance of this equipment. Requests for additional information will be welcomed by Westinghouse.

DESCRIPTION OF APPARATUS

CONSTRUCTION

The potential device network is mounted in a sheet steel outdoor housing. A lead-covered cable with fittings for ease of installation is provided for connecting to the potential tap of a condenser bushing. The condenser bushing may be a terminal of a circuit breaker or of a power transformer or may be mounted in a separate tank.

The potential device utilizes the condenser bushing as a capacitance voltage divider. The condenser bushing consists of a conductor surrounded by alternate layers of insulating and conducting material. The conducting layers may be considered the electrodes of a number of condensers connected in series between the bushing conductor and the ground flange. The various conducting layers are so proportioned so that the voltage stresses are practically equal across each insulating layer. The Type PBA Condenser Bushing Potential Device is designed to operate with a bushing having a potential tap on the second conducting layer from the ground flange. This tap is provided as standard equipment on all condenser bushings rated at 92 kv. and above.

The potential device network contains a grounding switch, an enclosed protective gap, adjustable reactance transformer, a voltage adjusting transformer, a burden power-factor correction capacitor, and a heater resistor.

The GROUNDING SWITCH connects the voltage tap on the condenser bushing to ground and de-energizes all apparatus in the potential network housing. It may be closed when making any adjustments on the device. It should not be closed continuously because this overstresses the insulation in the bushing between the line and tap.

The PROTECTIVE GAP is also connected from the tap to ground. It functions when an overload is placed on the secondary terminals of the device, thereby protecting the bushing. Also, the gap functions upon abnormally high line voltages such as might be caused by lightning or switching, thus protecting the equipment connected to the secondary of the device. The operation of the protective gap is in no way detrimental to the long life of the equipment.

The VARIABLE REACTANCE TRANSFORMER is used to adjust the phase position of the output voltage of the device. The inductive reactance of the transformer cancels the capacitive reactance of the bushing source. The transformer has sufficient reactance so that the device output voltage may be adjusted to be in phase with the line-to-ground voltage on the bushing. The reactance is varied by taps on a winding placed in the leakage flux path. This winding may be connected to either buck or boost the reactance and has sufficient taps to permit accurate adjustment of the phase position of the output voltage.

The AUXILIARY TRANSFORMER is provided with sufficient taps to permit accurate adjustment of the output voltage.

The leads from the transformers terminate on dial switches on an ADJUSTING PANEL so that adjustments may be quickly and easily made. Terminals are provided at the bottom of the adjusting panel and a conduit connection in the bottom of the housing for the leads to the instruments or relays which are to be energized by the device. These leads may be handled and insulated in the same manner as the leads from the secondary of any standard potential transformer.

Since many of the instruments and relays that are used in connection with potential devices have lagging power factor, an adjustable POWER FACTOR CORRECTION CAPACITOR is provided in the device housing. The leads from the capacitor are brought to knife switches on the adjusting panel for ease of adjustment.

APPLICATION

The Condenser Bushing Potential Device is applicable for voltage indication, frequency indication, synchronizing, and relay operation. The device may be applied on standard bushings with two-layer voltage tap on circuit breakers, power transformers, or in separate tanks with limitations in burden, depending on primary voltage as given in Table I.

TABLE I

Permissible Burdens

Bushing Class	Operating Voltage	Maximum Burden
115 kv.	66.4 kv.	25 V.A.
138 kv.	79.7 kv.	35 V.A.
161 kv.	93.0 kv.	45 V.A.
230 kv.	133.0 kv.	80 V.A.
287 kv.	166.0 kv.	100 V.A.

If the burden power factor is lagging, as is the case with many relays and certain types of indicating instruments, the effective burden on the device may be reduced by adding power-factor correction capacitance which is provided in the device to improve the burden power factor.

Parallel Operation

In case greater secondary burdens than one device will handle are to be used, two potential devices operated from two condenser bushings can be used in parallel on one phase of the high-voltage system. When using this arrangement, it is possible to carry a burden of twice the rating of one device. If the two devices whose secondaries are paralleled are connected to bushings of one pole unit of a high-voltage circuit breaker, provisions should be made for opening the paralleled secondaries when the breaker is in the "open" position. This arrangement is necessary because the device on the line side of the breaker would otherwise feed back into the device on the bus side.

Synchronizing

One desirable application of this device is for synchronizing across a circuit breaker using two potential devices, one on the line and one on the bus side. On systems not solidly grounded where there is a possibility of neutral shift, phase-to-phase synchronizing should be used. This may be accomplished by using two potential devices in series on each system to indicate line-to-line instead of line-to-ground voltage.

Relay Operations

The potential device is adaptable to most relay protection schemes requiring a voltage source. The secondaries of three devices in a three-phase installation may be connected in wye or delta to supply potential for directional phase or ground relays. The device is equipped with a multiple secondary to provide simultaneously 115 volts and 66.4 volts and 115 volts from a separate ungrounded winding. The first two values are obtained from secondary terminals S_1-S_3 and S_2-S_3. These windings may be connected in wye with devices in a three-phase installation. A ground terminal (Gr) is provided on the panel of each device to facilitate making the wye connection. The separate ungrounded winding, Z_1-Z_2, provides 115 volts and may be used in a delta connection to obtain residual voltage for the operation of directional ground relays. All three windings, S_1-S_3, S_2-S_3, and Z_1-Z_2, can be loaded simultaneously provided the combined burden does not exceed the rating of the device.

SAFETY FOR PERSONNEL

A condenser bushing which has been energized may have energy stored which should be drained off before handling. Before installing a potential device, the line terminal and also the tap of the bushing should be connected to ground and the line terminal connected to the tap to be sure the bushing is discharged.

After the potential device is in operation, the voltage applied to the primary of the network from the bushing tap is approximately 7000 volts. The ground switch should be closed to remove this voltage only when making any adjustments inside the housing.

HANDLING, UNLOADING, and UNPACKING

Upon receipt of the condenser bushing potential device, the first step is to make a thorough inspection to see that no parts appear to have been broken, bent, or otherwise damaged during shipment. Particular attention should be paid to the condenser bushing tap and the plug connector on the lead-in cable. Any damage which has occurred should be

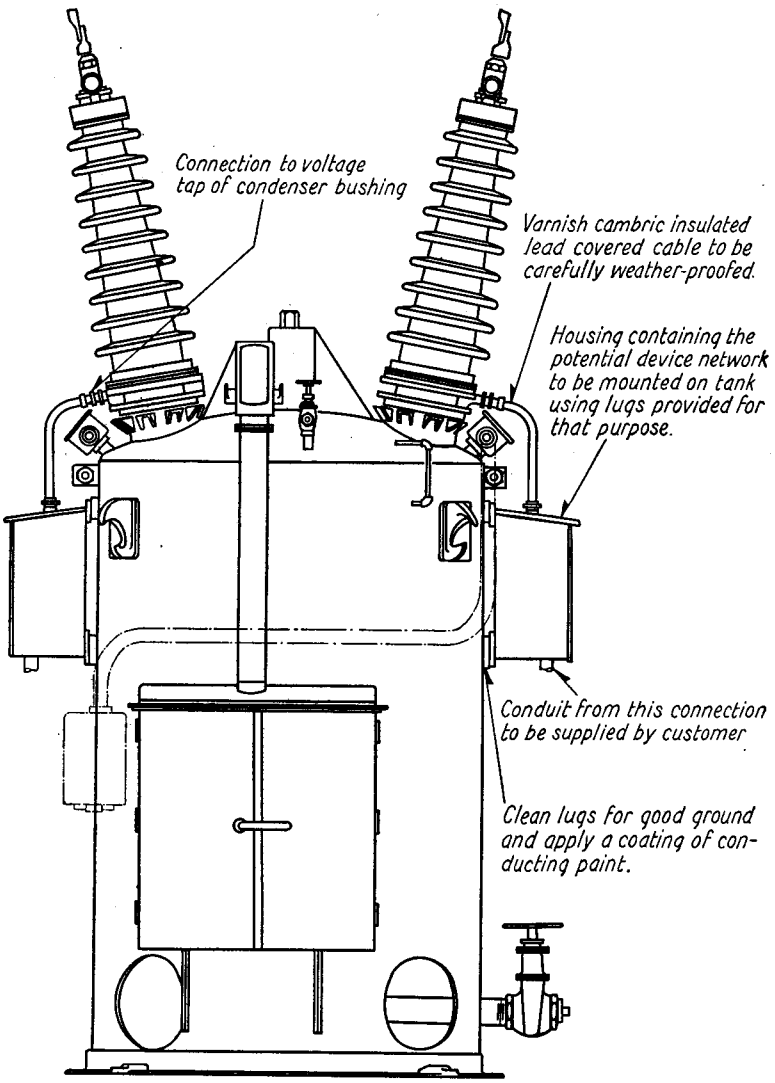


FIG. 1—CONDENSER BUSHING POTENTIAL DEVICE MOUNTED ON BREAKER TANK

taken care of by restoring the parts to their original condition or obtaining replacement parts from the manufacturer. Claims for damage during shipment should be taken up at once with the transportation company.

INSTALLATION

The Condenser Bushing

The Condenser Bushing Potential Device is composed of two main parts; namely, the condenser bushing and the potential device network. The condenser bushing is usually a part of a circuit breaker or other high-voltage apparatus and should be installed in accordance with instructions pertaining to the particular apparatus. The voltage tap on the bushing must extend outwards toward the potential device housing, as shown in Figure 1, to permit proper assembly of the lead-in cable which is furnished with each housing.

The Potential Device Network

The potential device network housing is equipped with lugs for mounting on a circuit breaker or transformer tank. The surface of these lugs which comes in contact with the tank is finished with a conducting paint. The mounting pads on the tank should be thoroughly cleaned and given a coating of conducting paint to assure a good ground connection.

When the potential device network housing is received, the opening for the lead-in cable is covered by a square steel plate on which is mounted a lifting eye. The housing may be lifted into place with a block and tackle, chain hoist, or crane using this eye. The weight of the network and housing is approximately 460 pounds.

After the housing is bolted in place, the four bolts holding the coverplate with its lifting eye should be removed to uncover the cable entrance. The coverplate and eye should be saved to provide means for lowering the device in case it is ever desirable.

POWER CONNECTIONS

The connection between the bushing tap and the potential network housing is made with a varnished cambric insulated, lead-covered cable with suitable couplings and gaskets, as shown in Figure 2.

Before the cable assembly is shipped, it is tested electrically and mechanically. When the cable is received, a careful inspection should be made to be sure that the cable was not damaged in shipment.

The housing end of the lead-in cable should be installed first. The gasket supplied with the cable should be coated on both sides with the weather-proofing cement supplied for the purpose. Apply a similar coating to all flanged surfaces and assemble the flange in place carefully tightening the bolts to insure a weather-proof seal. The cable should then be carefully bent WITH RADIUS NOT LESS THAN 6 INCHES so that the bushing end of the cable may be inserted in the tap on the bushing. The gasket on the bushing end of the cable should be treated with cement the same as the housing gasket. When the coverplate is removed from the bushing tap, the tap hole will be filled with petrolatum (commercial vaseline). This should be removed and the cable assembled in place. After assembly, the petrolatum should be heated to the melting point and poured into the filling plug on the top of the bushing tap. Sufficient time should be allowed in filling the chamber to prevent the formation of air pockets.

The entire cable assembly should be given a coat of weather-proof paint as a further protection against the weather. The housing end of the cable should be connected to the high-voltage bus, which connects the protective gap and the auxiliary capacitor, with the flexible lead provided. One end of this lead will be bolted to the bus when the device is received.

CONTROL WIRING

After the potential device is assembled in place, a conduit should be installed to take the secondary leads. The conduit should be coupled to the conduit fitting on the bottom of the network housing and the leads connected to the desired secondary terminals.

ADJUSTMENT

Determination of Reference Potential

Since both the magnitude and the phase angle of the secondary voltage of the device are affected by the choice of setting, it is necessary to obtain a known reference potential as a basis of comparison. This reference potential should

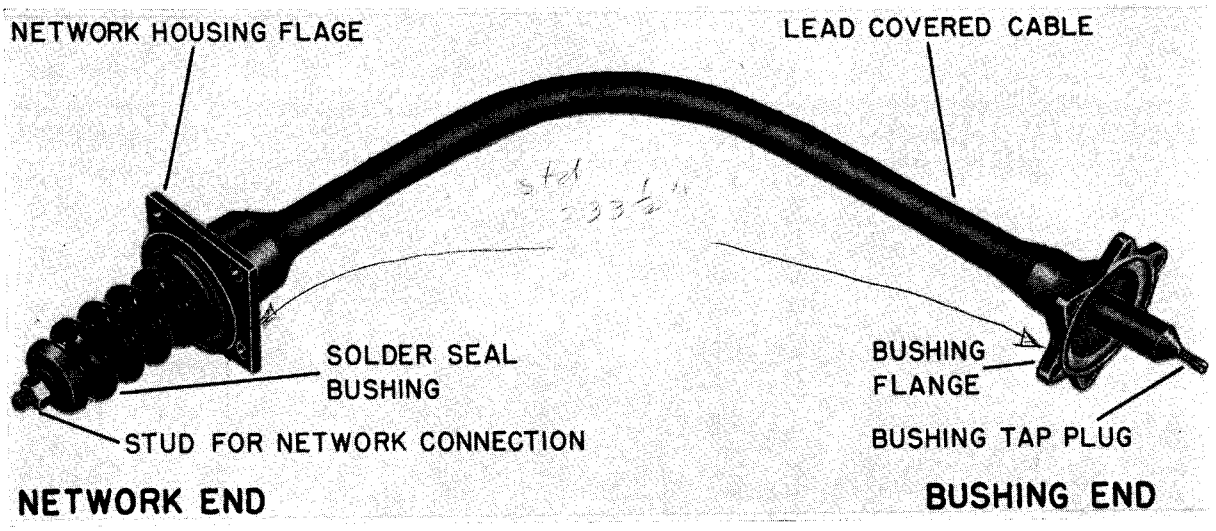


FIG. 2—LEAD IN CABLE ASSEMBLY

WESTINGHOUSE BUSINESS ADDRESSES

Headquarters—306 4th Ave., Pittsburgh 30, Pa., P.O. Box 1017

*AKRON 8, OHIO, 106 South Main St.
*ALBANY 4, N. Y., 456 No. Pearl St.
*ALLENTOWN, PA., 522 Maple St.
*APPLETON, WISC., 340 W. College Ave., P.O. Box 206
*ASBURY PARK, N. J., 601 Bangs Ave., Room 708, Electric Bldg.
¶#†*ATLANTA 2, GA., 1299 Northside Drive, N.W., P.O. Box 4808
xATTICA, N. Y.
*†AUGUSTA, MAINE, 9 Bowman St.
*BAKERSFIELD, CALIF., 2224 San Emedio St.
¶*BALTIMORE 2, MD., 118 E. Lombard St.
†BALTIMORE 24, MD., 4015 Foster Ave.
xBALTIMORE 3, MD., 2519 Wilkens Ave.
①†BATON ROUGE, LA., 555 Choctaw Drive
*BEAUMONT, TEXAS, 1213 American National Bank Bldg.
*BINGHAMTON 62, N. Y., Suite 704, Marine Midland Bldg., 86 Court St.
*BIRMINGHAM 2, ALA., 1407 Comer Bldg.
¶*BLUEFIELD, W. VA., Appalachian Elec. Power Co. Bldg., P.O. Box 804
¶*BOSTON 10, MASS., 10 High St.
†#BOSTON 27, MASS., 235 Old Colony Ave., So. Boston, Mass.
¶*†BRIDGEPORT 8, CONN., 540 Grant St.
¶*BUFFALO 3, N. Y., 814 Ellicott Square
#BUFFALO 13, N. Y., 960 Busti Ave.
†BUFFALO 10, N. Y., 1132 Seneca St.
*BURLINGTON, VT., 208 Flynn Ave.
*BUTTE, MONTANA, 52 East Broadway
#BUTTE, MONTANA, 50 East Broadway
*CANTON 2, OHIO, 901 First National Bank Bldg., 120 W. Tuscarawas
xCANTON 4, OHIO, Canton Ordnance Division, P.O. Box 710
*CEDAR RAPIDS, IOWA, 361 21st St., S. E., P.O. Box 148
①*CHARLESTON, S. C., 89 G. Smith St., P.O. Box 303
*CHARLESTON 23, W. VA., 610 Union Bldg., P.O. Box 911
*†#CHARLOTTE 1, N. C., 210 East Sixth St.
*CHATTANOOGA 2, TENN., Volunteer State Life Bldg., Georgia Ave. & East Ninth St.
¶*CHICAGO 6, ILL., 20 N. Wacker Drive, P.O. Box B
†CHICAGO 9, ILL., 221 W. Pershing Road, P.O. Box 1103
#CHICAGO 23, ILLINOIS, 3201 S. Kedzie Ave.
①¶*†CINCINNATI 2, OHIO, 207 West Third St.
¶*xCLEVELAND 1, OHIO, 1216 W. Fifty-Eighth St.
†CLEVELAND 2, OHIO, 5901 Breakwater Avenue, Station A
#CLEVELAND 14, OHIO, 1748 E. 22 Street
*COLUMBUS 15, OHIO, 85 E. Gay St.
*DALLAS 1, TEXAS, 209 Browder St.
#DALLAS 2, TEXAS, 1712 Laws St.
*DAVENPORT, IOWA, 206 E. Second St., P.O. Box 55
*DAYTON 2, OHIO, 30 North Main St.
¶*DENVER 2, COLORADO, 910 Fifteenth St.
#DENVER 2, COLORADO, 1700 Sixteenth St.
†DENVER 4, COLORADO, 988 Cherokee St.
xDERRY, PA.
*DES MOINES 8, IOWA, 1400 Walnut St.
¶*†#DETROIT 31, MICH., 5757 Trumbull Ave., P.O. Box 828
¶*DULUTH 2, MINN., 10 East Superior St.
x#EAST PITTSBURGH, PA.
*EL PASO, TEXAS, Oregon and Mills St.
#EL PASO, TEXAS, 450 Canal St.
†*EMERYVILLE 8, CALIF., 5915 Green St.
#EMERYVILLE 8, CALIF., 46th & Adeline Sts.
*ERIE, PA., 1003 State St.
*EVANSVILLE 8, IND., 201 N. W. First St.
#*†FAIRMONT, W. VA., 10th and Beltline, P.O. Box 1147
*FORT WAYNE 6, IND., 1010 Packard Ave.
*GARY, IND., 846 Broadway
①*GRAND RAPIDS 2, MICH., 148 Monroe Ave., N.W.
*GREENSBORO, N. C., Apartment I-7, Country Club Apartments, P.O. Box 1828
*GREENVILLE, S. C., 106 W. Tallulah Drive, P.O. Box 1591
*HAMMOND, IND., 235 Locust St.
*HARTFORD 3, CONN., 36 Pearl St.
*HONOLULU, T. H., Hawaiian Elec. Co., Agt.
¶*HOUSTON 2, TEXAS, 1314 Texas Ave.
#HOUSTON 2, TEXAS, 2301 Commerce Ave.
†HOUSTON 2, TEXAS, 2315 Commerce Ave.
¶†*#HUNTINGTON, W. VA., 1029 Seventh Ave., P.O. Box 1150
¶*INDIANAPOLIS 9, IND., 137 S. Penna. St.
†INDIANAPOLIS 2, IND., 551 West Merrill St.
*JACKSON, MICH., 212 West Michigan Ave.
*JACKSONVILLE 3, FLA., 37 South Hogan St., P.O. Drawer K
#*†JOHNSTOWN, PA., 107 Station St.
¶*KANSAS CITY 6, MO., 101 W. Eleventh St.
#KANSAS CITY 8, MO., 2020-2024 Walnut Street, c/o Walnut Warehouse, Inc.
*KNOXVILLE 8, TENN., Gay & Clinch St.
LESTER 13, PA., Merchant Marine Plant, P.O. Box 9177, Phila., Pa.
xLIMA, OHIO
¶*†#LOS ANGELES 13, CALIF., 420 So. San Pedro St.
*LOUISVILLE 2, KY., 332 West Broadway
xLOUISVILLE 9, KY., P.O. Box 1860
*MADISON 3, WISC., 1022 E. Washington Ave.
xMANOR, PA., Benolite Corporation
xMANSFIELD, OHIO, 246 E. Fourth St.
*MEMPHIS 3, TENN., 130 Madison Ave.
*MIAMI 4, FLA., 11 N. E. Sixth St., P.O. Box 590
¶*MILWAUKEE 2, WISC., 538 N. Broadway
†MILWAUKEE 3, WISC., 424 North Fourth St.
¶†*#MINNEAPOLIS 13, MINN., 2303 Kennedy St., N.E.
*MONROE, LA., 1107 N. 2nd St., P.O. Box 1851
*NASHVILLE 3, TENN., 219 Second Ave., N.
*NEWARK 2, N. J., 1180 Raymond Blvd.
#NEWARK 5, N. J., 536 Ferry St.
xNEWARK 1, N. J., Plane & Orange Sts.
†NEWARK 1, N. J., Haynes Ave. & Lincoln Hwy.
*NEW HAVEN 8, CONN., 42 Church St., P.O. Box 1817
¶*NEW ORLEANS 12, LA., 333 St. Charles St.
xNEW PHILADELPHIA, OHIO, Power Train Div., 406 Mill Ave., Drawer 912
¶*NEW YORK 5, N. Y., 40 Wall St.
*NIAGARA FALLS, N. Y., 253 Second St.
*NORFOLK 1, VA., 2600 Hampton Boulevard, P.O. Box 2120
①#NORWOOD, OHIO, Mentor & Houston Aves.
*OKLAHOMA CITY 2, OKLA., 120 N. Robinson Street
*OMAHA 2, NEB., 409 South Seventeenth St.
*PEORIA 2, ILL., 418 S. Washington St.
¶*†#PHILADELPHIA 4, PA., 3001 Walnut St.
*PHOENIX, ARIZONA, 11 West Jefferson St.
xPITTSBURGH, PA., Nuttall Work, 200 McCandless Ave.
¶z*PITTSBURGH 30, PA., 306 4th Ave., Box 1017
†PITTSBURGH 8, PA., 543 N. Lang Ave.
#PITTSBURGH 6, PA., 6526 Hamilton Ave.
¶*PORTLAND 4, OREGON, 309 S.W. Sixth Ave.
†PORTLAND 12, ORE., 626 North Tillamook St.
#PORTLAND 9, ORE., 1518 N.W. Marshall St.
¶*†PROVIDENCE 3, R. I., 16 Elbow St.
*RALEIGH, N. C., 803 North Person St., P.O. Box 2146
*RICHMOND 19, VA., 301 S. Fifth St.
*ROCHESTER 7, N. Y., 1048 University Ave.
*ROCKFORD, ILL., 130 South Second St.
*SACRAMENTO 14, CALIF., Rooms 411 & 412 Ochsner Building, 719 K St.
¶*ST. LOUIS 1, MO., 411 North Seventh St.
†ST. LOUIS 2, MO., 717 South Twelfth St.
#ST. LOUIS 1, MO., 710 N. Twelfth Blvd., c/o Central Terminal Co.
§*SALT LAKE CITY 1, UTAH, 10 West First South St.
†SALT LAKE CITY 7, UTAH, 346A Pierpont Ave.
①#SALT LAKE CITY 11, UTAH, 235 West South Temple St.
*SAN ANTONIO 5, TEXAS, 115 W. Travis St.
*SAN DIEGO 1, CALIF., 861 Sixth Ave.
¶*SAN FRANCISCO 4, CALIF., 1 Montgomery St.
§SAN FRANCISCO 3, CALIF., 1355 Market St.
¶#†*SEATTLE 4, WASH., 3451 East Marginal Way
§SEATTLE 4, WASH., 1051 First Ave., So.
xSHARON, PA., 469 Sharpsville Ave.
*SIOUX CITY 17, IOWA, 2307 Kennedy Drive
*SOUTH BEND 4, IND., 216 East Wayne St.
xSOUTH PHILA. WKS., Essington 13, Pa. First-class mail, P.O. Box 7348, Phila. 1, Pa.
*SPOKANE 1, WASH., 158 S. Monroe St., Box 2130
*SPRINGFIELD, ILL., 601 E. Adams St., Box 37
¶*†SPRINGFIELD 1, MASS., 395 Liberty St.
xSPRINGFIELD 2, MASS., 653 Page Boulevard
xSUNBURY, PA., 1354 Susquehanna Ave.
*SYRACUSE 4, N. Y., 420 N. Geddes St.
†SYRACUSE, N. Y., 961 Genesee St.
*TACOMA 2, WASH., 1115 "A" St.
*TAMPA 1, FLA., 417 Ellamae Ave., Box 230
*TOLEDO 4, OHIO, 245 Summit St.
xTRAFFORD, PA.
*TULSA 3, OKLA., 303 East Brady St.
¶*†#UTICA 1, N. Y., 113 N. Genesee St.
¶*WASHINGTON 6, D. C., 1625 K Street, N.W.
*WICHITA 2, KANSAS, 233 S. St. Francis Ave.
†¶*WILKES-BARRE, PA., 267 N. Pennsylvania Ave.
*WILLIAMSPORT 1, PA., 348 W. Fourth St.
*WORCESTER 8, MASS., 507 Main St.
*YORK, PA., 137 So. George St.
*YOUNGSTOWN 3, OHIO, 25 E. Boardman St.

Where address and P.O. box are both given, send mail to P.O. box, telegrams to address indicated.

WESTINGHOUSE AGENT JOBBERS

Westinghouse Electric Supply Company—Headquarters—40 Wall St., Wall St. Station, P.O. Box 25, New York 5, N. Y.

Fully equipped sales offices and warehouses are maintained at all addresses.

ALBANY 4, N. Y., 454 No. Pearl St.
ALLENTOWN, PA., 522 Maple St.
ATLANTA 2, GA., 1299 Northside Drive, N.W.
AUGUSTA, MAINE, 90 Water St.
BALTIMORE 2, MD., 40 South Calvert St.
BANGOR, MAINE, 175 Broad St.
BINGHAMTON 60F, N. Y., 87 Chenango St.
BOSTON 10, MASS., 88 Pearl St.
BURLINGTON, VT., 208 Flynn Ave.
BUTTE, MONTANA, 50 East Broadway
CHARLOTTE 1, N. C., 210 East Sixth St.
CHICAGO 7, ILL., 113 North May St.
§CINCINNATI 6, OHIO, 2329-2331 Gilbert Ave.
CLEVELAND 3, OHIO, 6545 Carnegie Ave.
COLUMBIA A, S. C., 915 Lady St.
CORPUS CHRISTI, TEXAS, North end of Mesquite St.
DALLAS 2, TEXAS, 405 No Griffin St.
DAVENPORT, IOWA, 402 E. Fourth St.
DES MOINES 8, IOWA, 1400 Walnut St.
DETROIT 2, MICH., 547 Harper Ave.
DULUTH 2, MINN., 308 W. Michigan St.
ERIE, PA., 1013 State St.
EVANSVILLE 8, IND., 201 B. W. First St.
FORT WAYNE 2, IND., 612 S. Harrison St.
FORT WORTH, TEXAS, 210 Jones St.
GRAND RAPIDS 2, MICH., 511 Monroe Ave., N.W.
GREENVILLE, S. C., 226 Pendleton
HOUSTON 2, TEXAS, 1903 Ruiz St.
INDIANAPOLIS 9, IND., 137 S. Pennsylvania St.
JACKSONVILLE 3, FLA., 37 South Hogan St.
LOS ANGELES 54, CALIF., 905 East Second St.
MADISON 3, WISC., 1022 E. Washington Ave.
MEMPHIS 1, TENN., 366 Madison Ave., Box 157
MIAMI 4, FLA., 11 N. E. Sixth St.
MILWAUKEE 2, WISC., 546 N. Broadway
MINNEAPOLIS 1, MINN., 215 South Fourth St.
NEWARK 5, N. J., 49 Liberty St.
NEW HAVEN 8, CONN., 240 Cedar St.
①zNEW YORK 5, N. Y., 40 Wall St., Wall St. Sta., P.O. Box 25
①*#NEW YORK 13, N. Y., 150 Varick St.
NORFOLK 1, VA., 2600 Hampton Blvd., P.O. Box 2120
OAKLAND 7, CALIF., Tenth & Alice Sts.
OKLAHOMA CITY 2, OKLA., 850 N. W. 2nd St.
OMAHA 2, NEB., 117 North Thirteenth St.
PEORIA 2, ILL., 412 S. Washington St.
PHILADELPHIA 7, PA., 141 North Eleven St.
PHOENIX, ARIZONA, 315 West Jackson St.
PITTSBURGH 19, PA., 575 Sixth Ave.
PORTLAND 9, OREGON, 134 N. W. Eighth St.
PROVIDENCE 1, R. I., 66 Ship St.
RALEIGH, N. C., 319 W. Martin St.
READING, PA., 4th and Elm Sts.
RICHMOND 19, VA., 301 South Fifth St.
ROANOKE, VA., 726 First St., S. E.
ROCHESTER 7, N. Y., 1048 University Ave.
SACRAMENTO 14, CALIF., Room 413 Ochsner Building, 719 K St.
ST. LOUIS 2, MO., 1011 Spruce St.
①ST. PAUL 1, MINN., 253 E. Fourth St.
SALT LAKE CITY 11, UTAH, 235 West South Temple St.
SAN ANTONIO 6, TEXAS, 1211 E. Houston St., P.O. Box 1700
SAN FRANCISCO 1, CALIF., 260 Fifth St.
SEATTLE 4, WASH., 1051 First Ave., So.
SIOUX CITY 4, IOWA, 1005 Dace St.
SPOKANE 8, WASH., 152 So. Monroe St.
SPRINGFIELD 3, MASS., 46 Hampden St.
SYRACUSE 4, N. Y., 961 W. Genesee St.
TACOMA 2, WASH., 1115 "A" St.
TAMPA 1, FLA., 417 Ellamae St.
TOLEDO 2, OHIO, 1920 N. Thirteenth St.
TRENTON 10, N. J., 444 S. Broad St.
TULSA 3, OKLA., 307 East Brady St.
UTICA 1, N. Y., 113 N. Genesee St.
WASHINGTON, D. C., 1216 "K" St., N.W.
WATERLOO, IOWA, 328 Jefferson St.
WHEELING, W. VA., 1117 Main St.
WICHITA 2, KANSAS, 233 So. St. Francis Ave.
WILLIAMSPORT 1, PA., 348 W. Fourth St.
WILMINGTON, DEL., 216 E. Second St.
WORCESTER 4, MASS., 17 Mulberry St.
YORK 2, PA., 143 S. George St.

Other Than Westinghouse Supply Company

AKRON 8, OHIO, The Moock Electric Supply Co.
BIRMINGHAM 2, ALA., Moore Handley Hdw. Co.
BLUEFIELD, W. VA., Superior-Sterling Co.
BUFFALO 2, N. Y., Buffalo Electric Co., Inc.
CANTON 2, OHIO, The Moock Electric Supply Co.
‡CHATTANOOGA, TENN., Mills & Lupton Supply Co.
CHICAGO 6, ILL., Hyland Electrical Supply Co.
COLUMBUS 16, OHIO, Pixley Electric Supply Co.
†DENVER 17, COL., The Mine & Smelter Supply Co.
†EL PASO, TEX., The Mine and Smelter Supply Co.
HUNTINGTON, W. VA., Banks Miller Supply Co.
KANSAS CITY 8, MO., Columbian Elec'l. Co.
KANSAS CITY 8, MO., Continental Elec. Co.
LEXINGTON 31, KY., Tafel Elec. & Supply Co.
LOUISVILLE 2, KY., Tafel Electric & Supply Co.
MONROE, LA., Monroe Hardware Co., Inc.
NASHVILLE 2, TENN., Tafel Electric Supply Co.
§NEW ORLEANS, LA., Monroe Hdw. Co., Inc.
§NEW YORK 10, N. Y., Times Appliance Co., Inc.
SAN DIEGO, CALIF., The Electric Supplies Distributing Co.
SCRANTON 9, PA., Penn Electrical Eng'nrg. Co.
YOUNGSTOWN 1, OHIO, The Moock Electric Supply Co.

* Sales Office † Mfg. and Repair Shop x Works
# Warehouse § Merchandising Products Only
z Headquarters ¶ District Eng. and Service Dept.

①Changed or added since previous issue.

May, 1944
Supersedes Issue dated January, 1944

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE—Continued

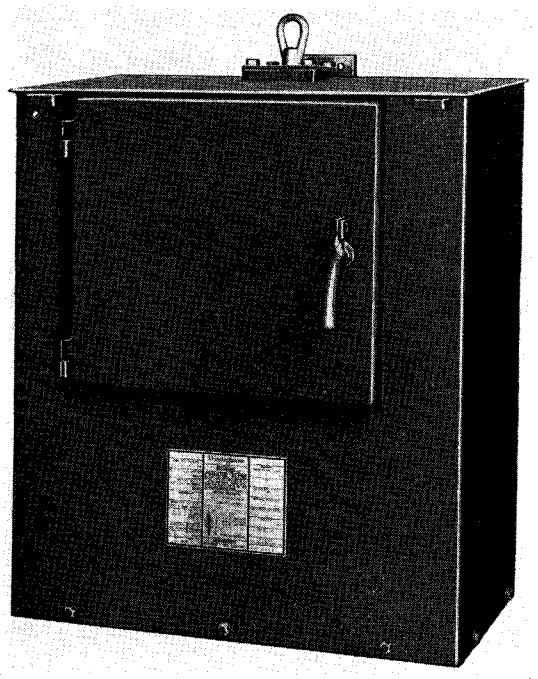
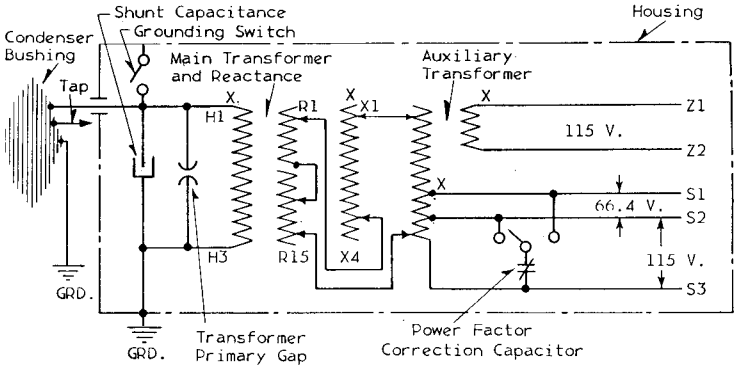


FIG. 6—BUSHING POTENTIAL DEVICE

SCHEMATIC DIAGRAM



X Indicates Points of Same Instantaneous Polarity

FIG. 7—SCHEMATIC DIAGRAM OF POTENTIAL DEVICE

TYPE PBA CONDENSER BUSHING POTENTIAL DEVICE—Continued

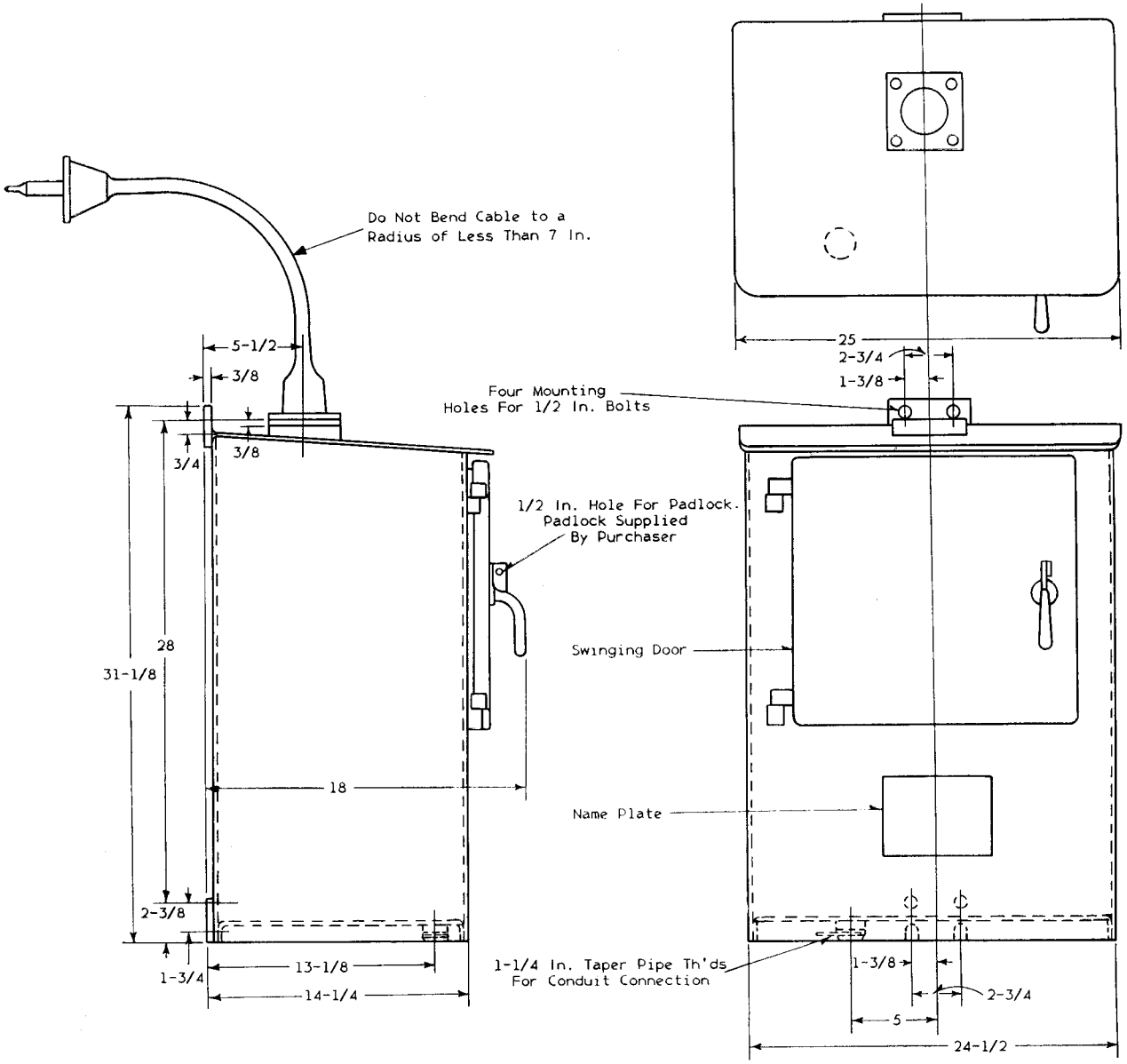


FIG. 8—OUTLINE DIMENSIONS OF TYPE PBA POTENTIAL DEVICE. ADAPTER PLATES CAN BE FURNISHED SO THAT THE PBA POTENTIAL DEVICE CAN BE INSTALLED ON BREAKERS AND TRANSFORMERS EQUIPPED WITH MOUNTING PADS FOR PB-2 POTENTIAL DEVICES

Dimensions are for reference only. For official dimensions refer to the nearest Westinghouse Sales office.

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