power circuit breakers

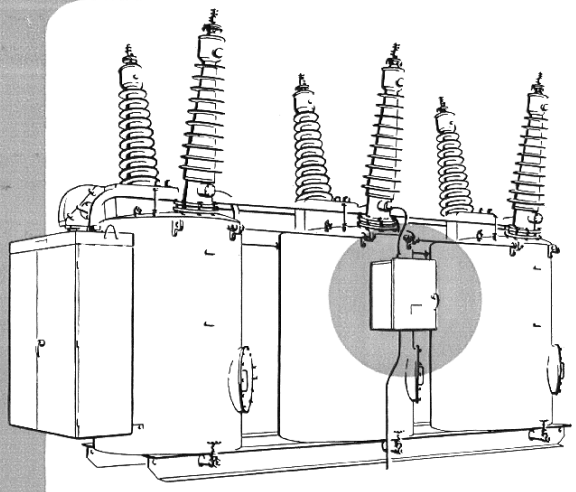
bushing potential device · type PBA-2

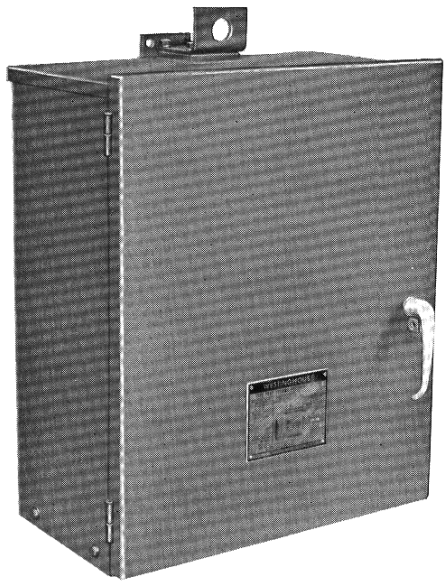
for use on transformer and circuit breaker bushings 115 kv and above

descriptive bulletin

33-357

page 1





application

The condenser bushing potential device is a means for securing small amounts of 60 cycle power at 115 volts (and 66.4 volts) from high voltage lines through the medium of the condenser bushing. For 115 kv and higher voltages this device is the most economical means of securing such small amounts of power.

This device provides a low voltage output which is substantially proportional to the system line-to-ground voltage and in phase with it. This output is commonly used to energize synchroscopes, voltmeters, and voltage responsive relays. The device accuracy is not adequate for use with metering instruments where revenue is involved.

In combination with type O bushings (or other modern Westinghouse bushings), it is an effective means of obtaining potential to operate relays, indicating instruments, and synchronizing devices. The potential devices are suitable for use on transformer and circuit breaker bushings of 115 kv and higher rating.

advantages

accessible terminal block: All burden connections and all adjustments are made on the panel.

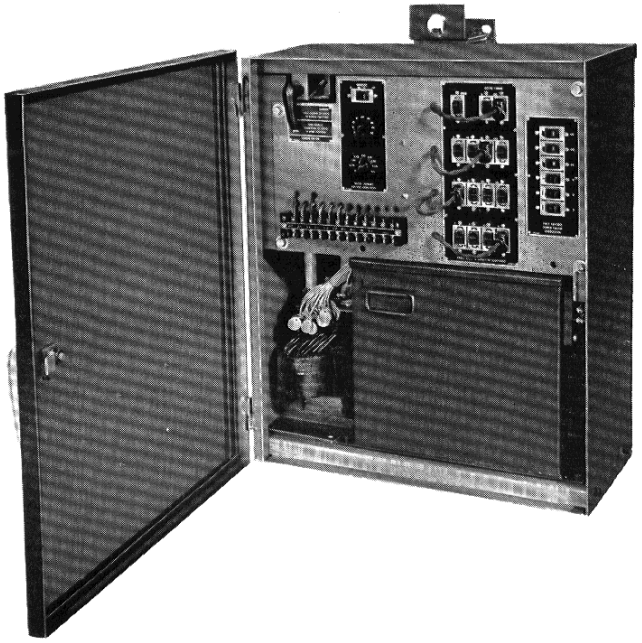
separate ratio and phase angle

tapped capacitor: Included for power factor correction.

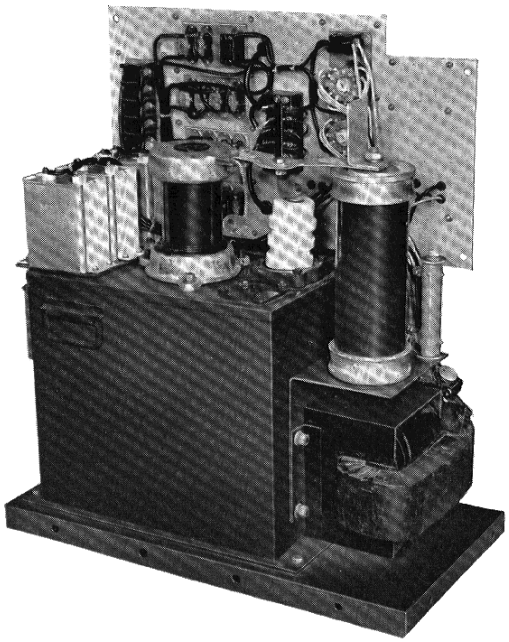
output transformer provides: 115 and 66.4 volt taps on main transformer; also 115 and 66.4 volt taps on insulated secondary for broken delta connection for ground detection.

safety feature: Protection gap and ground switch provided on transformer primary.

August, 1955
supersedes descriptive bulletin 33-766 dated October, 1951
mailed to: E/279-280/DB; C26-5Z



type PBA-2 bushing potential device with cover open—front view



type PBA-2 bushing potential device with cover removed—rear view

design features

The potential device consists of a high reactance transformer, a protection gap, a ground switch for the high reactance transformer primary, an auxiliary autotransformer with taps, and a terminal block to which power factor capacitance and all output voltages and connections are made. All electrical adjustments of this device are made on the panel, which is readily accessible for ease and speed of adjustment. The cover of the device opens to allow access to the panel without the use of tools. All internal connections to the panel are made with insulated copper wire. A heater, for connection to an external power source, is provided to reduce condensation within the housing whenever circumstances require it.

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

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

connections: An insulated cable with ground sheath is furnished with fittings to connect to a bushing tap. This cable is 33½ inches long, flange to flange, for circuit breakers 115 kv to 230 kv, and 48 inches long for all 330 kv circuit breakers and for specials. Transformers generally employ non-standard lengths.

protective gap and grounding switch

A protective gap and grounding 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 on the device, or by surges on the high tension line. The operation of the protective gap in no way affects the long life of the equipment.

Normally, the ground switch is open, but may be closed for short periods to remove voltage from the potential device during inspection and adjustment. The switch should not be left in the closed position as this short-circuits two condenser layers in the bushing and the potential device in not energized.

tests

These tests are made on each bushing potential device:

- **breakdown voltage of transformer primary gap**
- **insulation and ratio of potential transformers**
- **capacitance measurements of power factor correction capacitors**
- **insulation on assembled potential device network and wiring**
- **reactance of transformer**

adjustment and performance

The bushing potential device provides for the correction of lagging burden power factors to unity. Corrective capacity is available and is so tapped as to provide correction in steps not greater than 3.0 volt-amperes.

The voltage ratio of the potential device is adjustable in steps not greater than one percent of normal voltage. The phase angle is adjustable between plus and minus five degrees of in-phase position and ratio is adjustable to give from 0.95 to 1.05 of rated output voltages. Phase angle adjustment is in steps no greater than one degree.

With normal primary voltage, the total variation of the ratio correction factor will not be more than twelve percent and the variation of the phase angle will not be more than eight degrees over a range of burden from zero to 100 percent. With constant rated burden, the total variation of the ratio correction factor will not be more than five percent and the variation in phase angle will not be more than five degrees over a range of five percent to 100 percent of normal rated line-to-ground voltage.

The device performance is substantially linear for overvoltages up to 1.73 times normal line-to-ground voltage.

Device adjustments are made using a reference voltage of known phase-angle position relative to the line-to-ground voltage of the system at the installation. Once adjusted the device will hold its ratio and phase angle adjustment either until the burden is changed or some element of the device may be damaged.

Short circuiting of the output terminals will cause the protective gap to flash, but will cause no damage to the equipment.

specifications

style	rated circuit: kilovolts	rated line to ground: kilovolts	rated output: watts	secondary voltages: main and auxiliary winding volts	total power factor correction: volt-amps	maximum range of adjustment: ratio %	maximum range of adjustment: phase angle degrees	minimum tap steps no greater than: ratio %	minimum tap steps no greater than: phase angle degrees
1743 247	115	66.4	25	115/66.4	93	±5	±5	1	1
1743 247	138	79.7	35	115/66.4	93	±5	±5	1	1
1743 248	161	93.0	45	115/66.4	141	±5	±5	1	1
1743 248	230	133.0	80	115/66.4	141	±5	±5	1	1
....	287.5	166.0	100	115/66.4	141	±5	±5	1	1
....	330	199.0	120	115/66.4	...	...	...	.	.

cables: 33½ inch style no. 1743 073—48 inch style no. 1743 237 (used with 287.5 and 330 kv only)

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 above at 100 percent voltage, with rated burden.

percent primary voltage	percent 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 above at 100 percent burden, applied voltage at rated value.

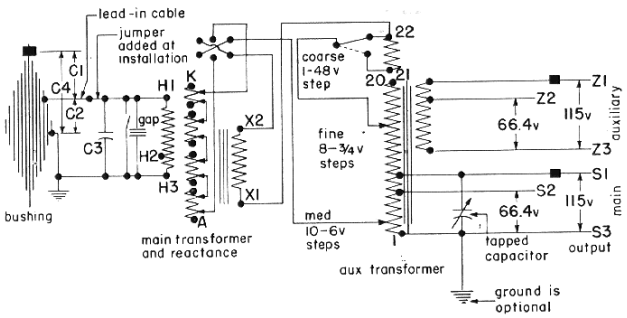
percent burden	percent ratio	phase angle degrees
100	±1	±1
50	±6	±4
0	±12	±8

bushing potential device • type PBA-2

ratings

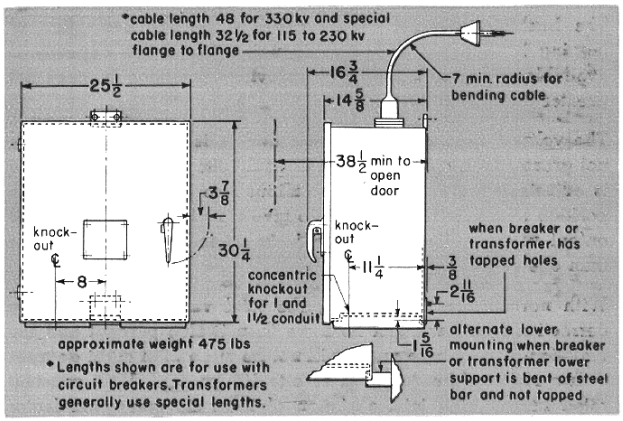
Each potential device has a total output rating shown in the tabulation on page 3, when used in combination with a Westinghouse bushing having the voltage rating indicated, when the combination is energized at its nominal line-to-ground voltage. When thus energized in conjunction with a bushing, secondary voltages of 66.4 and 115 are available for relays, etc. A second winding, insulated from first, also provides voltages of 66.4 and 115 for use with broken delta connection of ground relays. Suitable terminals are provided for making connections to these voltages.

schematic diagram



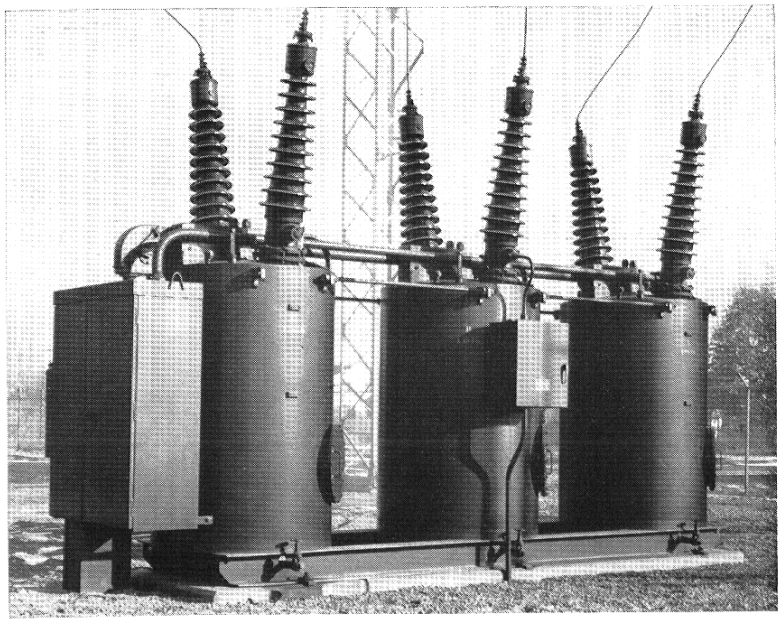
dimensions

in inches



maintenance

The bushing potential device is a piece of static equipment and requires no maintenance other than to see that the heater is energized when it is required, to see that the paint finish is kept in good condition and to be sure no extraneous objects rest on the lead-in cable.



type GM oil breaker with PBA-2 bushing potential device mounted on No. 2 pole unit

further information:

prices | price list 33-320

Westinghouse Electric Corporation
switchgear division: East Pittsburgh plant • East Pittsburgh, Pa.
printed in U.S.A.