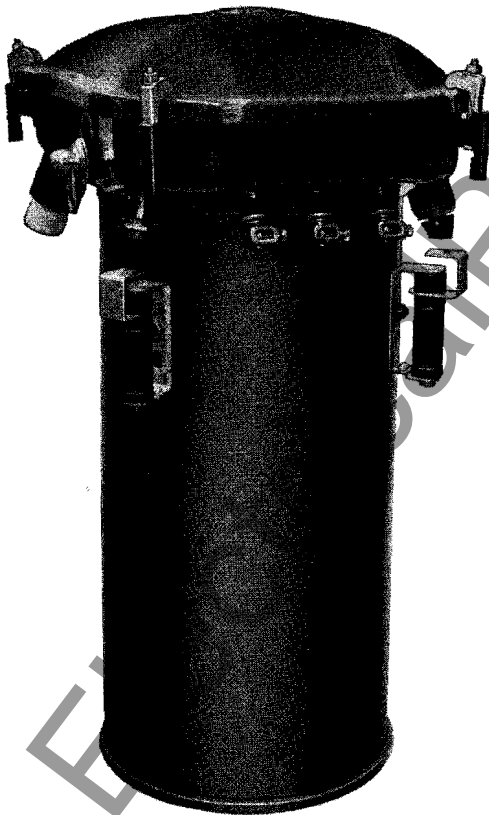


This Instruction Book Supersedes Instruction Cards 116, 2339, 2447, 2448, 2462, 2652 and I.B. 5922.
It is suggested that operators keep older INSTRUCTIONS on file for older transformers in service.

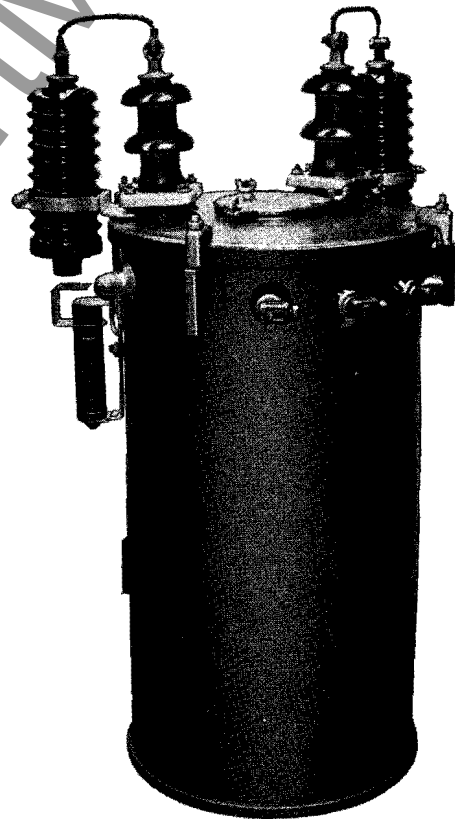
Installation and Operation
of
Westinghouse
Distribution Transformers

Completely Self-Protecting (CSP); Surge Protected (SP);
and Conventional (S)

Pocket Mounted H. V. Bushings—Cover Mounted H. V. Bushings



CSP Transformer with Two Pocket Bushings

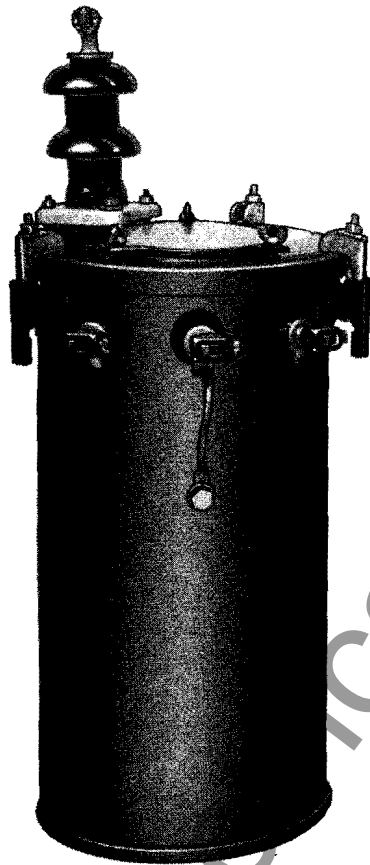


CSP Transformer with Two Cover Mounted Bushings

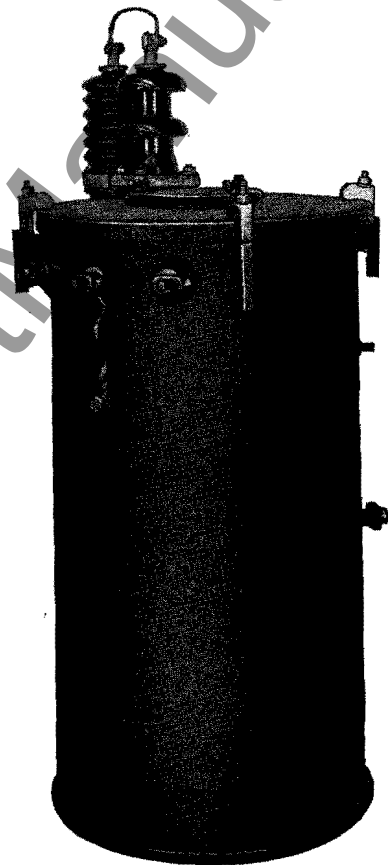
Westinghouse Electric & Manufacturing Company

Sharon, Pa., and Emeryville, Calif.

I.B. 5922-1
Filing No. 46-000



Conventional Transformer with
One Cover Mounted Bushing



SP Transformer with One Cover Mounted Bushing

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Completely Self-Protecting (CSP); Surge Protected (SP);
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Section I

GENERAL INSTRUCTIONS

Unpacking—After the transformer is unpacked, examine carefully to see that no damage has occurred during shipment and that all parts are in perfect condition. If a defect is discovered, a claim should be made at once against the transportation company.

Nameplate—The transformer nameplate gives its Kv-a. rating, voltage, phase, frequency, polarity, percent impedance, type, style number, serial number, and in most cases, a diagram of connections. In communicating with the Company, designate the transformer by style, including sub-letter, and serial number.

There is a space on the nameplate pad below the nameplate of the smaller standard units which may be used for attaching user's data. These holes in the pad may be tapped for 6-32 machine screws or #4 self-tapping screws may be used. Screws should be $\frac{5}{16} \pm \frac{1}{16}$ long.

Moisture—If an inspection shows that the transformer has absorbed moisture, it should be dried before installing.

Oil—To impart to the winding a high initial dielectric strength comparable to that attained only by long periods of operation in oil, the transformers are vacuum oil treated in "WEMCO C" oil in their own tanks. During subsequent manufacturing operations, this oil is not disturbed. Prior to shipment a sufficient quantity of "WEMCO C" oil is added to fill the tanks to the cold oil level.

Ordinarily, all standard and special S, SP, and CSP transformers are shipped filled with oil. Upon arrival, they should be inspected and if for any reason the

oil level is found to be lower than the marked "Cold Oil Level", it should be restored by the addition of "WEMCO" C oil.

Where instructions have been given by the customer to ship dry, the case should be filled before installation with "WEMCO" C oil to the cold oil level mark on the inside of the tank, or to the oil level mark on the gauge glass. Never operate transformer with oil level below this point, or unless oil appears in the gauge glass. This Company will not be responsible for transformers operated in oil of an unknown quality. The transformer may be filled with oil either before or after mounting, as desired.

When the transformer is shipped dry, it is sometimes necessary to add oil a short time after the transformer has been installed, due to the fact that the insulation will absorb a certain amount of oil. It may be found necessary to replenish the oil from time to time during operation in order that the oil level may be kept constant. When the transformer oil is being replenished, care should be taken that no moisture gets inside the tank. For further information see Westinghouse Instruction Book 5336.

Primary Connections—Transformers are shipped connected for the highest voltage, unless ordered otherwise.

Tap C hangers—Tap changers should not be operated unless the transformers are disconnected from the line. To guide the operator in the selection of the desired voltage ratio, either the base is provided with raised numerals corresponding to the position numbers on

the diagram nameplate, or the handle is provided with a pointer indicating the position of the contactor. The positive snap of the tap changer into position guides the operator and assures a positive contact.

Replacing the Cover—Care should be exercised in putting on the cover. If the gasket is not properly in place, or the cover not securely bolted, moisture in the form of rain or snow may be driven or sucked into the tank.

Parallel Operation—When transformers are banked in multiple and distributed along the line on different poles the line drop will usually compensate for difference in regulation. When transformers mounted on the same pole are operated in multiple, the transformer having the best regulation will take more than its share of the load. It is advisable, when operating transformers under conditions where it is probable that the load may not be properly distributed to take the current readings to determine their exact distribution.

Service—Information as to the service rendered by transformers will be of value in improving the design and performance of future distribution transformers. In case any trouble is experienced with transformers, please notify the nearest Westinghouse Sales Office, giving full particulars relative to the nature of the trouble and the conditions under which the trouble occurred, including the load carried, length of service, type of service supplied, connections, any abnormal conditions, the style and serial number of the transformer.

Section II

INSTRUCTIONS FOR MOUNTING TRANSFORMERS

Transformers rated 100 Kv-a. and smaller, 5000 volts and lower, or 50 Kv-a. and smaller, 6900 to 15,000 volts, may be mounted on poles. Larger ratings are designed for platform mounting only.

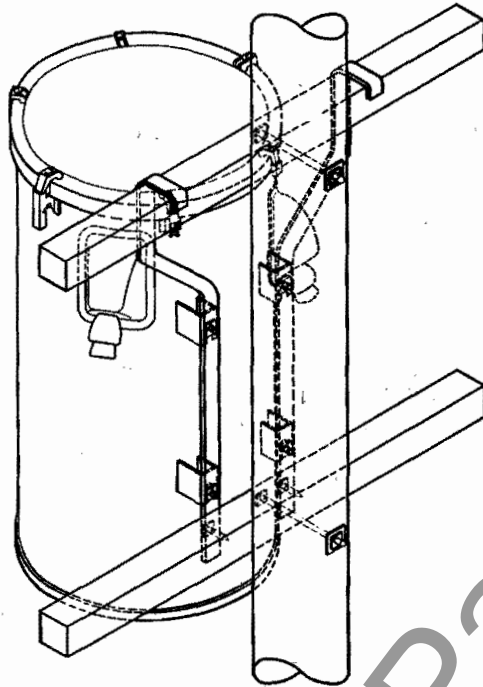


FIG. 1—TRANSFORMER MOUNTING USING "HANGER IRONS".

Where two crossarms are used for mounting the transformer on a pole, two different types of hangers are used. For the larger units "hanger irons" such as shown in Fig. 1 are available. For the smaller units "T Crossarm hangers", such as shown in Fig. 2, are available as standard. If desired, however, "hanger irons" with adapters, as shown in Fig. 3, are available for the smaller units.

It will be found convenient to fasten the hangers to the transformers before raising from the ground. The transformer can then be lifted by lugs on the side of the upper portion of the case, provided for that purpose. It should be lifted slightly above the upper crossarm when the hooks on the hanger can be made to engage the upper crossarm by lowering the transformer. The lower portion of the hanger will rest against the lower crossarm and hold the transformer in a vertical position.

On the smaller units, the lower crossarm may be omitted where desired and only one crossarm used. The "T Crossarm hanger", together with a "kicker" is then employed as shown in Fig. 4. The Kicker rests directly against the

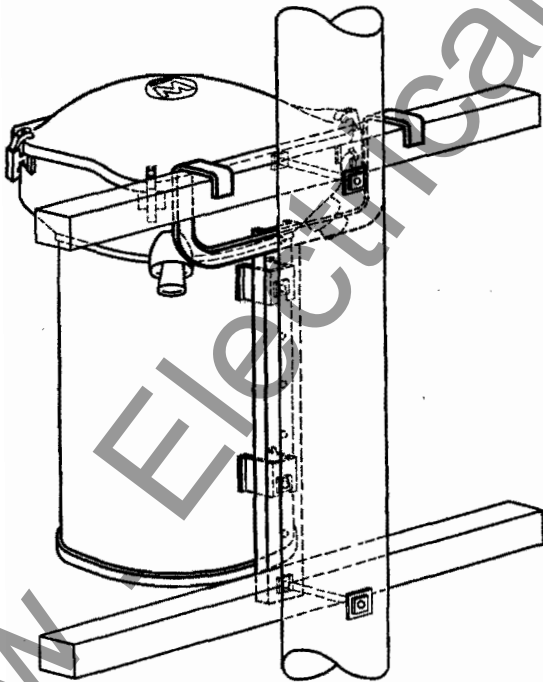


FIG. 2—TRANSFORMER MOUNTING USING "T CROSSARM HANGER".

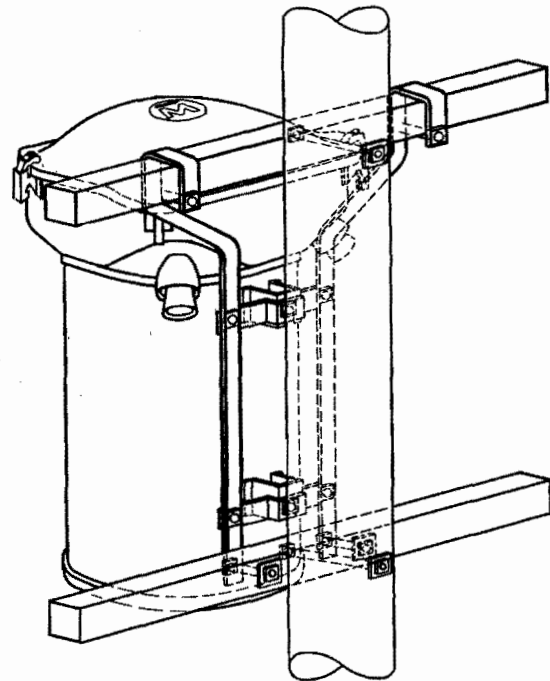


FIG. 3—TRANSFORMER MOUNTING USING "T CROSSARM HANGER" AND ADAPTERS.

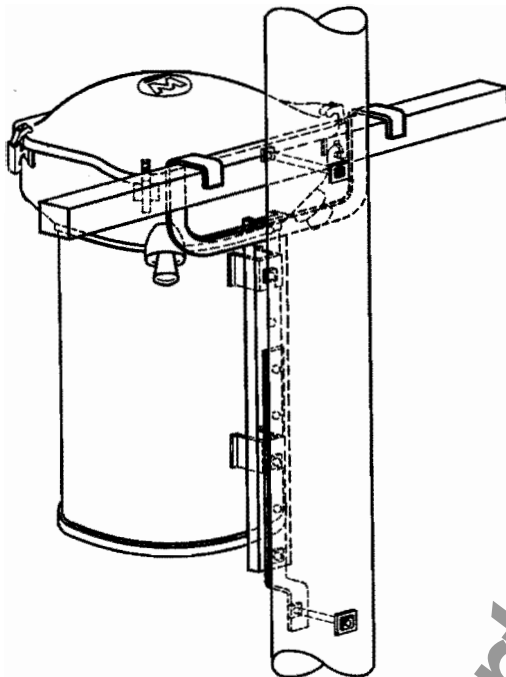


FIG. 4—TRANSFORMER MOUNTING USING "KICKER" TO REPLACE LOWER CROSSARM.

pole and thus keeps the transformer in a vertical position.

On the smaller units, particularly on CSP transformers where no auxiliary equipment on the pole is necessary, it is often desired to eliminate crossarms entirely. To do this, locate $\frac{5}{8}$ " or $\frac{3}{4}$ " dia. (depending on size of transformer) through bolts (with square head) at the proper points on the pole to engage the vertical mounting slots in the transformer hanger lugs. The head of the bolt should be on the side of the pole where the transformer is to be mounted. It is recommended that a flat washer be used between the hanger lug and the pole and a square washer and nut should be installed on the opposite side of the pole. The nut should be left sufficiently loose that a space sufficiently large for the transformer hanger lug is left between the pole and the bolt head. The transformer should then be lifted and the mounting slots in the hanger lugs hooked over the bolt heads after which the nuts on the through bolts should be tightened.

Always mount transformers vertically to assure that terminal blocks, circuit breakers, and protective links are under oil.

The above instructions are applicable to transformers either with pocket mounted or cover mounted high voltage bushings.

Section III INSTRUCTIONS FOR MAKING HIGH VOLTAGE CONNECTIONS FOR POCKET BUSHING TRANSFORMERS

When installing a transformer, the amount of protective apparatus required depends on the type transformer. The CSP transformer is completely self-protected and requires neither lightning arresters nor fuse cutouts. The SP transformer is surge protected and does not require lightning arresters, but fuse cutouts should be provided. The conventional transformer should be provided with both lightning arresters and fuse cutouts. Hot line clamps may be advantageously used, particularly for CSP transformers, for connecting the transformer to the high voltage lines.

Transformers with two fully insulated high voltage bushings, (Class A)—for use on Delta systems.* Connect the H.V. terminals to the H.V. lines.

Transformers with one fully insulated high voltage bushing and one neutral high voltage bushing (Class B-1) for

use on 3-phase 4-wire system with grounded neutral. Connect the fully insulated bushing to the phase line and the neutral bushing to the neutral line which may be grounded at each pole or at the substation only. A pad is provided on the rear of the tank so that

a bolt may be inserted for convenient grounding of the H.V. neutral to the tank if desired. To use this pad, pry out the thread protector with a sharp tool.

On SP and CSP transformers of this type, only one De-ion Gap for lightning

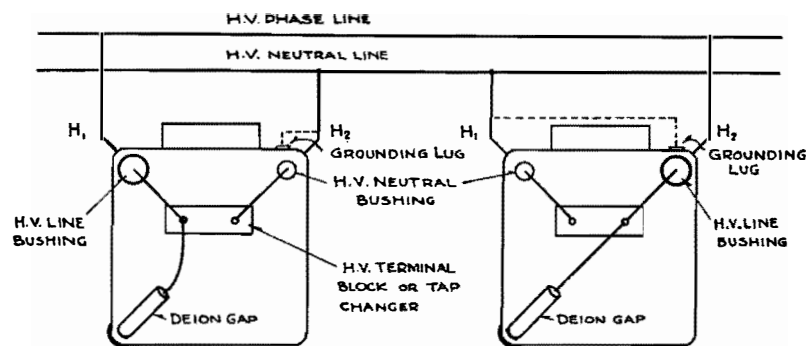


FIG. 5—METHOD OF INTERCHANGING LINE AND NEUTRAL BUSHINGS AND RECONNECTING DE-ION GAP.

*These transformers may also be used on 3-phase, 4-wire grounded neutral circuits, although the investment may be limited to the actual requirements by using Class B-1 or Class B-2 for such circuits.

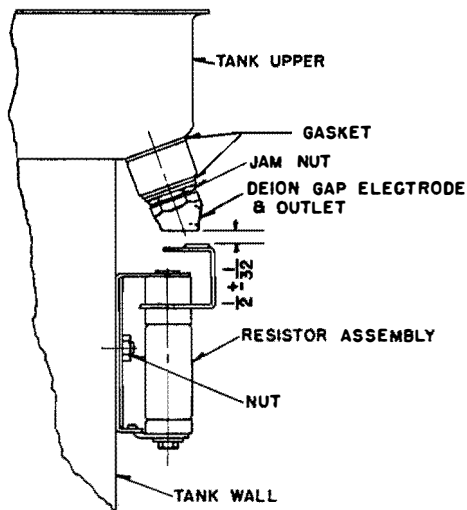


FIG. 6—RESISTOR ASSEMBLY

protection is provided. This gap is connected internally at the terminal block, when shipped, to the fully insulated bushing lead as shown on the nameplate. It may be desirable, for convenience of mounting and connecting to the supply lines, to interchange the line and neutral outlets of the transformer. It is then necessary to interchange the H.V. bushings and in the case of CSP or SP transformers to reconnect the De-ion Gap lead to the new line lead at the terminal block or tap changer. The 2400 volt line and neutral bushings are the same except the neutral has a removable gap to give a lower flashover. Therefore, to interchange line and neutral bushings for 2400 volt transformers, it is necessary only to

interchange this gap and reconnect the De-ion Gap. See Fig. 5.

When, and if, bushings and De-ion Gap connections are interchanged, it is recommended that a new nameplate be secured from the factory.

If it is desired to use these transformers on a Delta supply system, remove the neutral bushing and replace it with a standard bushing of the proper voltage class. To make neutral bushings good for 2400 volt service, merely remove the gap from the bushing. In the case of SP or CSP transformers, also remove the plug from the unused De-ion gap hole, mount a De-ion gap of the proper voltage class in the opening, and install a resistor assembly as shown in Fig. 6.

When a second De-ion Gap is added, it should be located symmetrically with respect to the centerline of the transformer as shown in Fig. 7, and with the distance $a' = a$, where a = distance between end of existing gap and tank upper as received from the factory. If a second De-ion Gap is added to a CSP or SP transformer, it is recommended that a new nameplate be secured from the factory.

Transformers with one fully insulated H.V. bushing, the other end of the H.V. winding being grounded internally to the tank. (Class B-2). For use on 3-phase, 4-wire systems with grounded neutral. In these transformers, the L.V. neutral is also grounded to the tank externally. On CSP and SP transformers, the De-ion Gap is connected to the terminal of the fully insulated bushing. Connect this bushing directly to the phase line. The tank should be connected to the neutral line and should also be solidly grounded at the same pole.

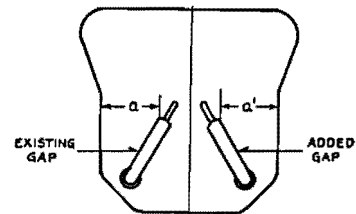


FIG. 7—WHEN ADDING A DE-ION GAP, IT SHOULD BE LOCATED SYMMETRICALLY WITH RESPECT TO CENTERLINE OF TRANSFORMER.

Section IV

INSTRUCTIONS FOR MAKING HIGH VOLTAGE CONNECTIONS FOR COVER BUSHING TRANSFORMERS

When installing a transformer, the amount of protective apparatus required depends on the type transformer. The CSP transformer is completely self-protected and requires neither lightning arresters nor fuse cutouts. The SP transformer is surge protected and does not require lightning arresters, but fuse cutouts should be provided. The conventional transformer should be provided with both lightning arresters and fuse cutouts. Hot line clamps may be advantageously used, particularly for

CSP transformers, for connecting the transformer to the high voltage lines.

Transformers with two fully insulated high voltage bushings (Class A)—for use on Delta systems.* Connect the H.V. terminals to the H.V. lines.

Transformers with one fully insulated high voltage bushing and one neutral high voltage bushing (Class B-1) for use on 3-phase 4-wire system with grounded neutral. Connect the fully insulated bushing to the phase line and the neutral bushing to the neutral line which may be grounded at each pole

or at the substation only. A pad is provided on the rear of the tank so that a bolt may be inserted for convenient grounding of the H.V. neutral to the tank if desired. To use this pad, pry out the thread protector with a sharp tool.

On SP and CSP transformers of this type, only one De-ion gap for lightning protection is provided. This gap is connected externally to the fully insulated bushing. It may be desirable, for convenience of mounting, to interchange the line and neutral outlets of the trans-

*These transformers may also be used on 3-phase, 4-wire grounded neutral circuits, although the investment may be limited to the actual requirements by using Class B-1 or Class B-2 for such circuits.

former. It is then necessary to interchange the line and neutral bushings and to move the De-ion Gap to the other bushing. These changes may easily be made by removing nuts on the bushing mounting studs. See Fig. 8. The De-ion Gap resistor should also be moved whenever a De-ion Gap is moved.

Transformers with one fully insulated high voltage bushing, the other end of the high voltage winding being grounded internally to the tank. (Class B-2). In these transformers, the L.V. neutral is also grounded to the tank externally. On SP and CSP transformers, the De-ion Gap is connected to the fully insulated high voltage bushing and this in turn should be connected to the phase line. The tank should be connected to the neutral wire and should also be solidly grounded at the same pole.

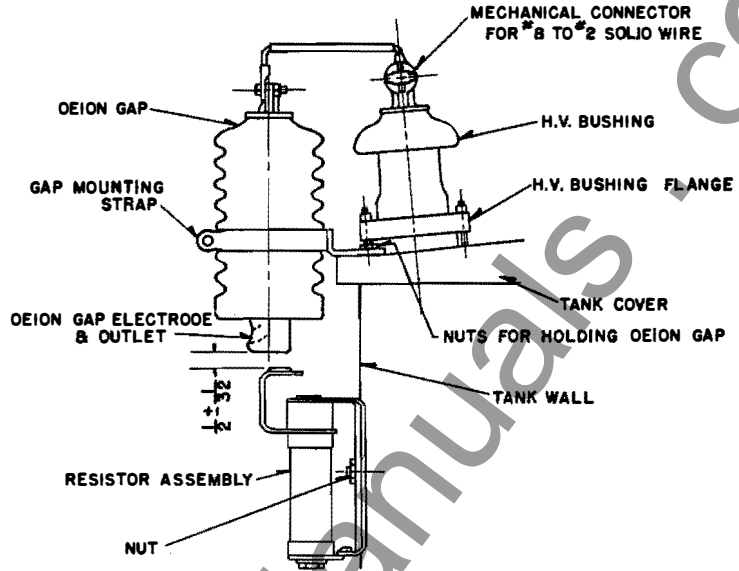


FIG. 8—EXTERNAL DE-ION GAP MOUNTING

Section V

INSTRUCTIONS FOR MAKING LOW VOLTAGE CONNECTIONS

Refer to diagram nameplate and connect L.V. terminals to service lines to secure the desired voltage. Where the 3-wire connection is used, the neutral should be grounded. When a 2-wire connection is used, one of the leads should be grounded where conditions permit.

If leads are reconnected at the L.V. bushings to secure 2-wire service, care

should be used to maintain at least 1" clearance between live parts and at least 1" clearance (on pocket bushing transformers) from live L.V. terminals to the elbow of the De-ion Gap.

Standard 1½ Kv-a. transformers without taps are furnished with only two L.V. outlet terminals which are

connected at the factory for 120 volt operation.

If standard CSP transformers are to be used to supply a combined 3-phase load and a single phase 3-wire load, it is important that only two transformers connected in open delta be used. The reason for this is shown by Fig. 9. Should an overload cause circuit breaker a-a' in transformer A to trip, then line wires (1) and (3) would still be fed by transformers B and C. The neutral (2) would float in potential and voltages (1)-(2) and (2)-(3) would be determined only by load impedances. Transformer C, shown dotted, should therefore be omitted and transformers A and B used in open delta.

On combined 3 phase loads and single phase 2-wire loads, three CSP transformers may satisfactorily be used in a bank.

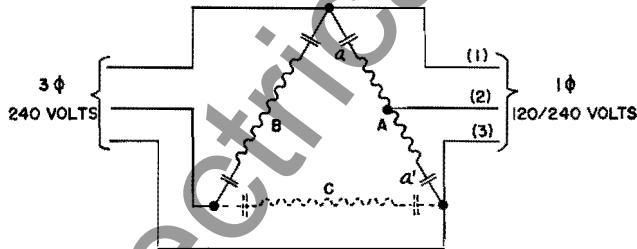


FIG. 9—CSP CONNECTIONS FOR COMBINED SINGLE PHASE 3-WIRE AND 3-PHASE LOADS. USE OPEN DELTA CONNECTION OMITTING DOTTED TRANSFORMER.

Section VI

INSTRUCTIONS FOR GROUNDING TANKS

In the "3-Point" method of lightning protection, as used on all CSP and SP transformers, the De-ion Gaps discharge to the tank in case of a lightning surge. To relieve the tank of this discharge, CSP and SP transformers having 2 fully

insulated H.V. bushings and those having one fully insulated H.V. and one neutral H.V. bushing are supplied with a discharge gap, as it is assumed that most of these tanks will not be grounded. In case such transformers are to have

their tanks grounded, the discharge gap is not necessary. (Discharge gaps are not provided with conventional, S, transformers.)

All transformers with one H.V. bushing only are supplied with means for

