

Subway Distribution Transformers

INSTRUCTIONS

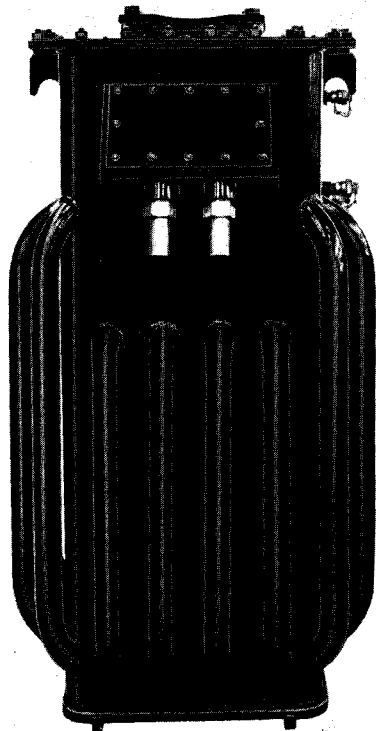


FIG. 1—SUBWAY DISTRIBUTION TRANSFORMER
LOOKING AT HIGH VOLTAGE SIDE



FIG. 2—SUBWAY DISTRIBUTION TRANSFORMER
LOOKING AT LOW VOLTAGE SIDE

GENERAL

The Subway Type Distribution Transformers are especially designed for use in underground vaults or basements where submersion may occur. A typical transformer is shown in Fig. 1 and 2. The transformers are usually shipped complete with oil and it is only necessary to make an inspection after unpacking, before placing in service. Only an occasional inspection of the oil and check on the operating temperature is required.

INSTALLATION

Unpacking—After the transformer is unpacked, examine carefully to see that no damage has been done 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.

Moisture—If an inspection shows that the transformer has absorbed moisture, it should be dried before installing. Refer to Instruction Leaflet 3150.

Oil—To impart to the windings 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 25°C. oil level.

Ordinarily, all standard and special Subway 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 "25°C. Oil Level", it should be restored by the addition of "WEMCO C" oil.

Where instructions have been given by the customer to ship dry, fill the case with "WEMCO C" oil to the 25°C. oil level or to the oil level mark on the gauge. Never operate transformer with oil level below this point, or unless oil appears in the gauge. 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.

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 on care of oil see Westinghouse Instruction Book 5336.

GROUNDING AND MAKING CONNECTIONS

No matter what the type of floor or foundation on which the transformer is to rest, the tank should be definitely and permanently grounded by connect-

SUBWAY DISTRIBUTION TRANSFORMERS—Continued

INSTRUCTIONS—Continued

ing a lead to the grounding connection provided for that purpose near the bottom of the tank.

Terminal board, tap changer and other connections should never be changed with voltage on the transformer. Do not make any connections except those indicated on the diagram or the diagram nameplate shipped with the transformer.

Any lead or connector not in use should be insulated from all other leads and connectors and from ground.

PIPE FITTINGS

If it is necessary to remove any valves, plugs, etc. at installation, care should be taken to prevent damage to the threads. Before installing any pipe fitting the threads should be thoroughly cleaned to remove dirt, grease, etc. After cleaning, apply cement S#1150419 to the threads of each fitting. Immediately screw the proper fittings together tightly.

PRESSURE TESTING

All Subway Transformers are pressure tested at the factory and shipped free of leaks. After installation and before voltage is applied, it is desirable to pressure test each transformer, especially if any fittings or covers have been removed and replaced during the installation. Dry compressed nitrogen or air should be used at a test pressure of 7 lbs. per square inch for a period of six hours. It is suggested that the air space above the oil be blown out with nitrogen, all vents closed and the pressure test applied. The test pressure can best be limited by the use of a regulating valve on the nitrogen cylinder.

OPERATION

Primary Connections—Transformers are shipped connected for the highest voltage.

Tap Changers—In case the transformer is equipped with a tap changer, do not operate the tap changer unless the transformer is de-energized. 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 name plate, 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 that a positive contact has been made.

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 may enter the tank. Refer to section on gaskets.

Name Plate—The transformer name plate gives Kv-a, capacity, voltage, frequency, polarity, percent impedance, gallons of oil required to fill, style or shop order number, serial number, and in most cases, a diagram of connections.

In many instances where a diagram name plate is supplied with a transformer of double voltage rating, the double voltage rating will be indicated in the space for voltage rating, and the connection table will show only the NORMAL full voltage with taps. In such instances the tap voltage for the higher rating will be higher in the same ratio as the full winding voltages.

PARALLEL OPERATION

When transformers are banked in multiple and distributed along the line the line drop will usually compensate for difference in regulation. When transformers placed in one vault or adjacent vaults 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.

MAINTENANCE

Gaskets—Gaskets used on Subway Distribution Transformers are made from a high grade of cork and, it is recom-

mended, in replacing any gaskets that they be made of cork. Before replacing a gasket, all gasket surfaces should be thoroughly cleaned free of rust, oil, grease, paint or other foreign materials. The cleaning may be done by scraping or wire-brushing and then wiping the gasket surface with denatured alcohol.

Gasket cement S#1150419 should always be used in applying gaskets. Thoroughly brush the cement on the tank surface and on all sides of the gasket. Allow the cement to dry until tacky or for approximately 15 minutes. Apply a second coat of cement to all surfaces and place the gasket and cover in their proper position. The gasket surface should then be bolted together under uniform pressure.

Oil—The oil should be tested for dielectric strength and the presence of sludge. If there is an indication of moisture or sludge formation, the oil should be tested further and treated as described in Instruction Book 5336. If tests show the oil to be in bad condition an inspection should be made on the inside of the tank for possible cause of the trouble.

RENEWAL PARTS

In case renewal parts are required give a description of the parts required together with the serial, style or stock order number as given on the nameplate.

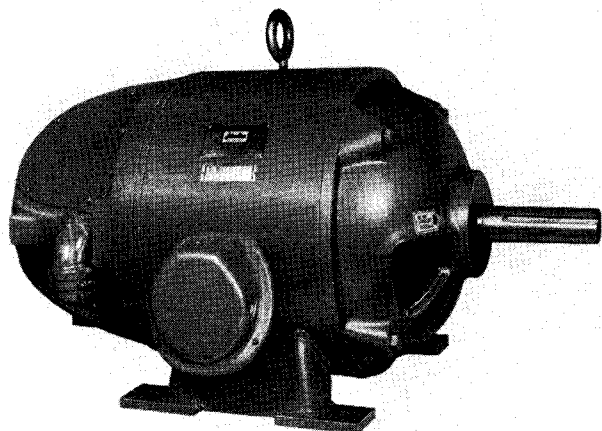
SERVICE

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, and any abnormal conditions. The shop order or style number with serial number should be included.



INSTALLATION • OPERATION • MAINTENANCE INSTRUCTIONS

WOUND ROTOR *Life-Line** MOTORS DRIP-PROOF, TYPE CWP AND CIP (Frames 364 Through 507 with Ball Bearings)



LIFE-LINE Type CWP and CIP Motors, frames 364 through 507, are wound rotor motors designed for a wide variety of applications. End brackets protect the windings from falling chips and dripping liquids, and provide support for the ball bearings.

Warranty. The Corporation in connection with apparatus sold agrees to correct any defect or defects in workmanship or material which may develop under proper or normal use during the period of one year from the date of shipment, by repair or by replacement f.o.b. factory of the defective part or parts, and such correction shall constitute a fulfillment of all the Corporation's liabilities in respect to said apparatus, unless otherwise stated in the quotation.

Any defects that may develop should be referred to the nearest Westinghouse Sales Office for complete servicing information.

RECEIVING

Unpack the motor and make certain that it was not damaged during shipment. Turn the shaft by hand to see that it turns freely.

Check to see that the nameplate data agrees with the voltage and frequency of the power supply provided for the motor.

The shaft extension is coated with a slushing compound to prevent rusting during shipment and storage. This slushing compound may be removed by wiping with any petroleum solvent, such as benzine, gasoline, turpentine, Stoddard solvent, etc. See precaution under "Maintenance", page 3, for use of these solvents.

INSTALLATION

Mounting. Locate the motor in a place that is clean, dry and well-ventilated. If protecting shields or guards are used, they must not obstruct the free flow of air around the motor. The external air temperature should not exceed 40 degrees C or 104 degrees F.

Fasten to a rigid foundation using bolts or screws of the largest size permitted by the drilling in the mounting feet. The motor must rest evenly on all mounting pads.

For wall or ceiling horizontal mounting, the motor end brackets may be rotated 90 or 180 degrees to offer greater protection from falling objects or dripping liquids.

Methods of Drive. Motors having the suffix "-s" following the frame number are suitable for direct coupled service only. Motors having the plain frame numbers may be operated with any of the following drive methods:

1. Flat Belt Drive. Mount the motor on the slide rails or bedplate, which allows for adjusting the belt tension.

Mount the motor pulley so that the inner face of the pulley is in line with the shoulder on the shaft extension.

Use a belt wide enough to carry the load without excessive tension. Wide, single ply belts are preferable to double ply belts due to the lower bearing pressures that result.

The smallest pulley should not be less in diameter than that recommended by the belt manufacturer for the belt used, and in no case less in diameter than indicated in Table No. 1.

LIFE-LINE MOTORS

Align the pulleys so that the belt runs true, and tighten the belt just enough to prevent slippage. Where the pulleys are not of approximately the same diameter, the distance between shaft centers should be greater than twice the diameter of the larger pulley. For short center distances, an idler pulley or a V-belt drive should be employed.

Table No. 1
PULLEY SIZE FOR FLAT BELT DRIVES

MOTOR FRAME	PULLEY DIMENSIONS	
	MIN. DIAM. (Inches)	MAX. WIDTH (Inches)
364	6	9 $\frac{3}{4}$
365	7	11
404	7	11
405	9	12
444	9	13
445	11	13

2. V-Belt Drive. Mount the motor on the slide rails or bedplate, which allows for adjusting the belt tension.

Mount the motor sheave close to the bearing housing allowing sufficient clearance for rotor end play.

The smallest sheave should not be less in diameter than that recommended by the belt manufacturer for the belt used, and in no case less in diameter than indicated in Table No. 2.

Sheaves should be carefully aligned to prevent any axial thrust on the bearings. Belt tension should be just sufficient to eliminate excessive sag in the slack side of the belt. V-belts do not require as much tension as flat belts.

Table No. 2
SHEAVE SIZE FOR V-BELT DRIVES

MOTOR FRAME	SHEAVE DIMENSIONS	
	MIN. PITCH DIAM. (Inches)	MAX. WIDTH (Inches)
364	4 $\frac{1}{2}$	9 $\frac{3}{4}$
365	5 $\frac{1}{4}$	11
404	5 $\frac{1}{4}$	11
405	6 $\frac{3}{4}$	12
444 (1200 RPM and below)	6 $\frac{3}{4}$	13
445 (1200 RPM and below)	8 $\frac{1}{4}$	13

3. Chain Drive. Mount the motor on the slide rails or bedplate, which allows for adjusting the chain tension.

Mount the motor sprocket close to the bearing housing, allowing sufficient clearance for rotor end play, and align the sprockets accurately.

4. Gear Drive. Mount the motor and driven unit so as to maintain accurate alignment. The gears must mesh accurately to prevent vibration.

Mount the motor gear close to the bearing housing to minimize the overhang, allowing sufficient clearance for rotor end play.

Dowel the motor to the base.

5. Direct Drive. The motor shaft and driven shaft must be carefully aligned.

Dowel the motor to the base.

Note: Pulleys, pinions or coupling halves should have a close sliding fit on the shaft extension and must be securely locked to avoid hammering out in operation. If it is necessary to drive the part into position, it is important, on ball bearing motors, that the end of the shaft opposite the extension be backed up so that the force of the blow is not taken in the bearing. Use a pinion puller for removing tight pulleys.

Electrical Connections. Be sure the motor is connected as shown on the nameplate diagram, and that the power supply (Voltage, Frequency and Number of Phases) corresponds with the nameplate data.

Connect to the power supply through a suitable switch and overload protection.

Install all wiring and fusing in accordance with the National Electric Code and local requirements.

To change the direction of rotation on three-phase motors, interchange any two line leads.

To change the direction of rotation on two-phase motors, interchange the line leads of either phase.

Conduit Box. The conduit box may be rotated 90 or 180 degrees for use with horizontal conduit or conduit from above.

When the motor is mounted on a bedplate, or on slide rails for belt adjustment, flexible metallic conduit should be used to protect the leads to the motor. In making this connection a squeeze connector should be used for attaching the flexible conduit to the conduit box. Squeeze connectors may be straight, 45 degrees or 90 degrees.

OPERATION

Run the motor without load to check the connections and direction of rotation.

The motor will operate satisfactorily with a 10 percent variation in voltage, a 5 percent variation in frequency or a combined voltage and frequency variation of 10 percent, but not necessarily in ac-

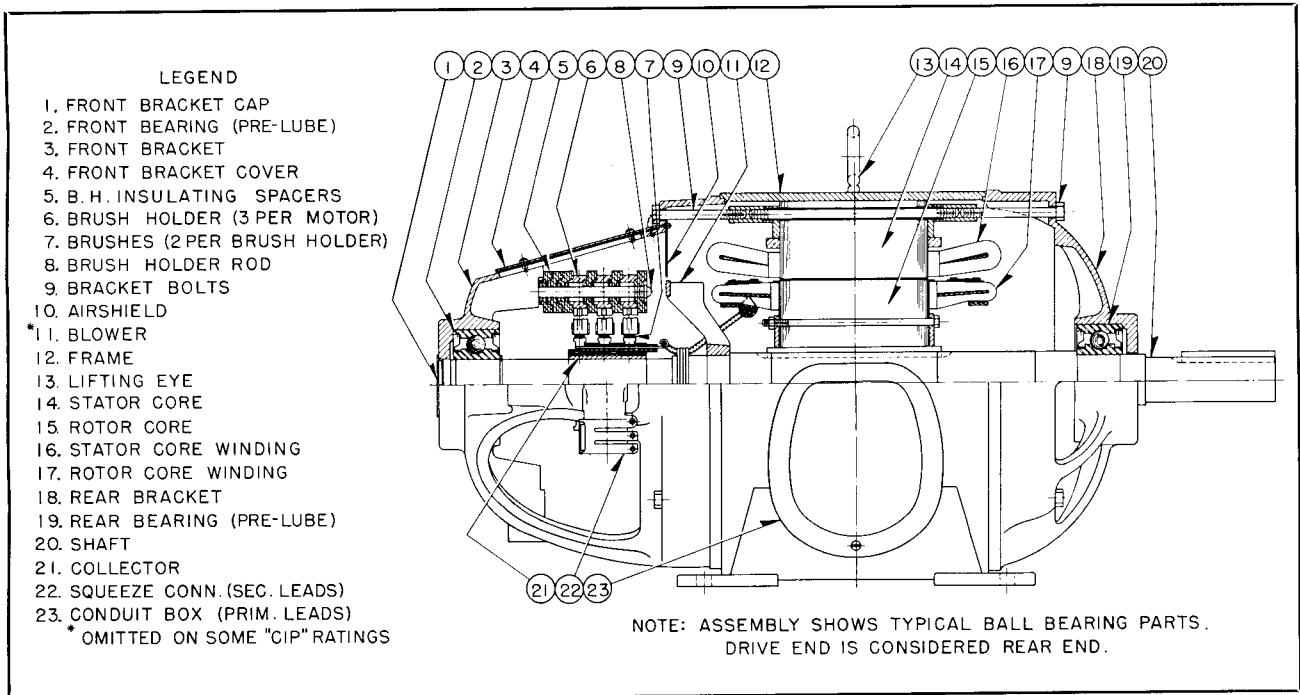


FIG. 1. Sectional View—Wound Rotor Life-Line Motor

cordance with the standards of performance established for operation at normal rating.

MAINTENANCE

Inspection. Although Life-Line motors require a minimum of attention in service, they should be inspected at regular intervals to guard against excessive (1) dirt, (2) moisture, (3) friction and (4) vibration, which account for 90 percent of all motor failures.

1. Guard Against Dirt. Keep the insulation and mechanical parts of the motor clean. Dust that is free from oil or grease may be removed by wiping with a clean, dry cloth, or preferably, by suction. Dust may be blown from inaccessible parts with clean, dry air, using not more than 30 to 50 pounds pressure. Use care to prevent personal injury from the air hose; use goggles to avoid eye injury from flying particles.

When grease or oil is present, wipe with a cloth moistened (but not dripping) with a petroleum solvent such as Stoddard solvent or a "safety type" solvent available under various trade names.

Caution: Petroleum solvents are inflammable.

2. Guard Against Moisture. Drip-proof motors should always be guarded against the accidental intrusion of water from splatter or splashing.

The insulation resistance of stand-by motors should be checked with a "megger" at regular intervals to detect the presence of moisture in the windings. If the insulation resistance shows an appreciable decrease, the windings should be dried out by any suitable means before applying power to the motor. This is particularly important in installations where the ambient temperature is subject to frequent, sharp fluctuations, or where the atmosphere is unusually damp. For less severe locations, running stand-by motors at least once a week should protect the windings from moisture absorption or condensation.

Before motor windings are blown out with air, make sure that water has not condensed in the air line.

3. Guard Against Friction. Excessive friction or overheating of bearings is usually traced to one of the following causes:

- a. Excessive belt tension.
- b. Poor alignment causing excessive vibration or binding.
- c. Bent shaft.
- d. Excessive end or side thrust due to gearing, flexible couplings, etc.

4. Guard Against Vibration. To avoid failures due to vibration, a few simple checks should be made regularly.

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Check for misalignment such as may be caused by foundation settling or heavy floor loading. These may be causing vibration through misalignment.

Check to see if vibration from the driven machine is being transmitted to the motor.

Check for excessive belt or chain tension or the push-apart effect inherent in spur gears.

Check the motor mounting bolts and bracket bolts to be sure they are tight.

Coils. Revarnishing the windings when motors are overhauled will lengthen their life. Suitable varnish may be obtained from the nearest Westinghouse Sales Office.

Bearings. Most of the bearings used in Life-Line motors are packed at the factory with the proper amount of lubricant. No further lubrication is needed for the normal life of the bearings.

Bearings from several suppliers are used in Life-Line motors; for a given size motor, the bearings of all suppliers are interchangeable. The details of the seal construction vary somewhat depending upon the bearing manufacturer, but each type of seal is equally effective in keeping out foreign material and retaining the lubricant. A typical seal construction is shown in Fig. 2.

Motors having non-sealed bearings are provided with grease plugs, fittings or grease cups. Additional grease should be added every four to six months. Avoid overgreasing and entrance of any dirt. The grease drain should always be open when adding grease. An estimate of the maximum amount of grease that should be added is given in Table No. 3.

TABLE NO. 3

SHAFT EXTENSION DIAMETER (Inches)	AMOUNT OF GREASE TO BE ADDED (Cubic Inches)
$\frac{3}{4}$ to $1\frac{1}{4}$ "	1 cu. in.
Above $1\frac{1}{4}$ to $1\frac{7}{8}$ "	$1\frac{1}{4}$ cu. in.
Above $1\frac{7}{8}$ to $2\frac{3}{8}$ "	$2\frac{1}{2}$ cu. in.
Above $2\frac{3}{8}$ to 3"	4 cu. in.

1 oz. = $1\frac{1}{4}$ cu. in.

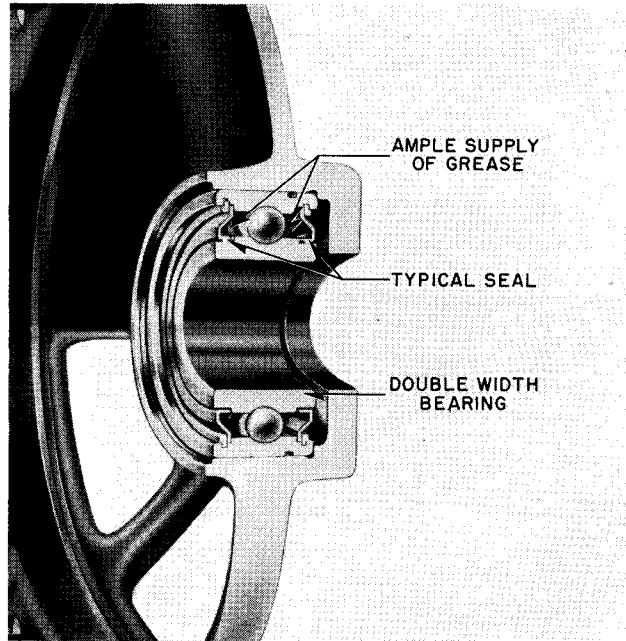


FIG. 2. Sectional View—Prelubricated Ball Bearing

Brushes. The brushes should make good contact with the slip rings along the whole face of the brush. If necessary, grind new brushes in with fine sandpaper. Maintain a free sliding fit between the brushes and the brushholder by cleaning both thoroughly when necessary.

Maintain the brush spring tension at the correct value, determined by the grade of brushes and the local service conditions. Make the pressure as low as consistent with good brush slip ring contact. A correct pressure per square inch is between two and three pounds for carbon or graphite brushes, and between three and five pounds for metallic brushes. Each brush should bear equal pressure. Do not use lubricants. Use the correct grade of brushes which may be obtained from the nearest Westinghouse dealer.

Slip Rings. The slip rings should be maintained smooth and true. Grind or turn them if necessary to restore a smooth and true surface.

RENEWAL PARTS

Renewal Parts information may be obtained from the nearest Westinghouse Sales Office. Be sure to name the part or parts required (see Fig. 1) and give the complete nameplate reading on the motor for positive identification.



WESTINGHOUSE ELECTRIC CORPORATION
BUFFALO PLANT • MOTOR AND CONTROL DIVISION • BUFFALO 5, N. Y.

Printed in U.S.A.