INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

HORIZONTAL DRIP-PROOF, TYPE GP SYNCHRONOUS LIFE-LINE GENERATORS AND MOTORS

Frames 580 Through 683 **Sleeve or Ball Bearings**

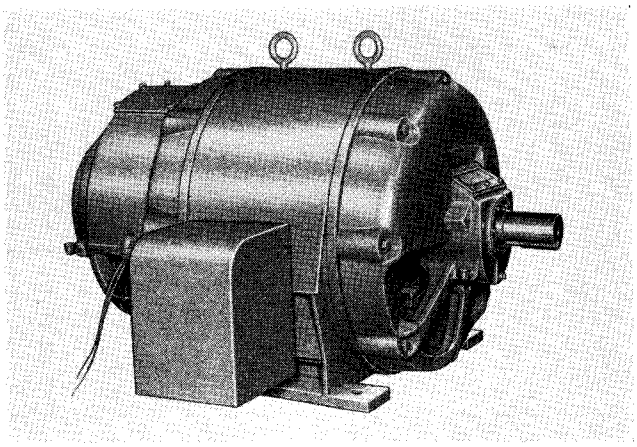

FIG. 1. Open Drip-proof Sleeve Bearing Type GP Life-Line Generator without Exciter

LIFE-LINE TYPE GP SYNCHRONOUS GENERATORS in NEMA frames sizes of the 580 and 680 Series are salient pole synchronous machines designed for small, isolated generating plants and auxiliary or stand-by power plants. Type GP motors are designed for a variety of constant speed applications. The stator core is encased in a specially-designed ventilated splashproof frame. Cast drip-proof end brackets protect the windings from falling chips and dripping liquids. Sheet metal covers may be removed to expose large openings in the front bracket for access to the brushes and slip rings (See Fig. 3).

Warranty. The Corporation in connection with apparatus sold agrees to correct any defect or defects in workmanship or material which may develop under proper and 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 generator (or motor) and make certain that it was not damaged during shipment. Check to see that the nameplate data agrees with the output requirements and with the speed of the driving (or driven) unit. Also, in the case of separately excited machines, check to see that the field voltage and current requirements of the machine agree with the direct current supply provided. (If a direct-connected exciter is supplied as part of the equipment, the generator or motor and exciter will have been coordinated at the factory.)

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

INSTALLATION

Mounting. The generator (or motor) should be located 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°C or 104°F.

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

Conduit Box. The conduit box may be rotated 90° or 180° for use with horizontal conduit or conduit from above. The squeeze connector attached to the front bracket can also be rotated in the same manner.

When the machine is mounted on a bedplate or slide rails for belt adjustment, flexible metallic conduit should be used to protect the leads to the machine. 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° or 90°.

If the conduit box is desired on the opposite side of the machine, the brackets and rotor can be removed and the frame reversed, then reassembled. In order to place the squeeze connector for the field leads on the opposite side, it is necessary to remove the squeeze connector, plug the hole in the bracket, and move the squeeze connector to a new hole on the opposite side of the bracket.

Table No. 1

DIMENSIONS

(Approximate dimensions in inches. Do not use for construction purposes.)

FRAME NO.	HEIGHT (Without Eyebolts)	WIDTH (Without Conduit Box)	LENGTH (Without Shaft Extension)	CENTER-LINE SHAFT TO BASE	WEIGHT IN LBS. Approx.
580	28⅞"	32¼"	46¼"	14½"	2600
581	28⅞"	32¼"	50¼"	14½"	2900
582	28⅞"	32¼"	54¼"	14½"	3200
583	28⅞"	32¼"	58¼"	14½"	3500
680	34 1/16"	38⅛"	54 3/16"	17"	3500
681	34 1/16"	38⅛"	58 3/16"	17"	4000
682	34 1/16"	38⅛"	62 3/16"	17"	4400
683	34 1/16"	38⅛"	68 3/16"	17"	4900

Method of Drive. Machines having the suffix "-S" following the frame number are suitable for direct coupled service only. Machines having the suffix "-C" following the frame number are suitable for the following drives if they are included in the following tables which are based on NEMA recommendations.

NOTE: Coupling halves, pulleys, pinions, or sprockets 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 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.

1. Direct Drive. The driven shaft and the driving shaft must be carefully aligned. The machine should then be doweled to the base.

2. Belt Drive. Mount the machine on the slide rails or bedplate which allows for adjusting the belt tension. Mount the pulley close to the bearing housing, allowing sufficient clearance for rotor end play. Align the pulleys so that the belt runs true, and tighten the belt just enough to prevent slippage. Use a belt wide enough to carry the load without excessive tension. The generator (or motor) should be moved toward the other machine as far as the slots in the rails or bedplate permit.

Table No. 2

BELT DRIVE

FULL LOAD RPM OF GENERATOR OR MOTOR		MAX. KW RATING		MAX. HP RATING	
Above	Including	Flat Belt	V-Belt	Flat Belt	V-Belt
900	1200	50	75	75	125
750	900	75	125	125	200
720	750	100	150	150	250
560	720	150	200	200	300

3. Gear Drive. Mount the machines so as to maintain correct alignment. The gears must mesh accurately to prevent vibration. Mount the gear close to the bearing housing to minimize the overhang, allowing sufficient clearance for rotor end play. Dowel the machine to the base.

Table No. 3

GEAR DRIVE

FULL LOAD RPM OF GENERATOR OR MOTOR		MAX. KW. RATING	MAX. HP RATING
Above	Including		
750	900	30	50
560	750	50	75

4. Chain Drive. Mount the machine on slide rails or a bedplate which allows for adjusting the chain tension. Mount the sprocket close to the bearing housing, allowing sufficient clearance for rotor end play, and align the sprockets accurately.

Table No. 4

CHAIN DRIVE

FULL LOAD RPM OF GENERATOR OR MOTOR		MAX. KW RATING	MAX. HP RATING
Above	Including		
900	1200	75	125
750	900	125	200
720	750	150	250

Electrical Connections. Be sure that the machine nameplate data agrees with the requirements of the load as to voltage, frequency, and number of phases. Connect the machine through a suitable switch and overload protection.

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

Also be sure that the excitation voltage agrees with the field voltage required by the machine. The machine field should be connected to the d-c. excitation source, along with any associated control equipment necessary. Depending on the installation involved, the controls necessary may or may not include a field discharge resistor, generator field rheostat, exciter field rheostat, and voltage regulator.

If the phase sequence of the output voltage of a three-phase generator is not correct or, if motor rotation is wrong, it will be necessary to interchange any two line leads.

OPERATION

(Before starting sleeve bearing machines, see instructions under "Sleeve Bearings" on page 7.) Bring the machine up to rated speed and apply field current to check output voltage, phase sequence, and rotation.

Single Generator. When a generator operates alone, without being paralleled with other generators, the field current is adjusted for each change in load so as to maintain rated voltage. This adjustment can be made by hand, but it is preferable to use a voltage regulator which can keep the voltage constant even though the load varies rapidly.

When a generator operates alone, it should be noted that the starting of motors supplied by the generator output becomes a problem. Because of high starting currents drawn by the motor, the generator voltage drops appreciably. If there are other motors already operating from this generator, the drop in voltage may cause them to stall. Consequently, it is necessary to use a generator with a full load capacity greater than would seem to be necessary. As a general rule, generator full load current should be about five times the full load current of the motor to be started; if reduced voltage motor starting is used, this factor may be reduced.

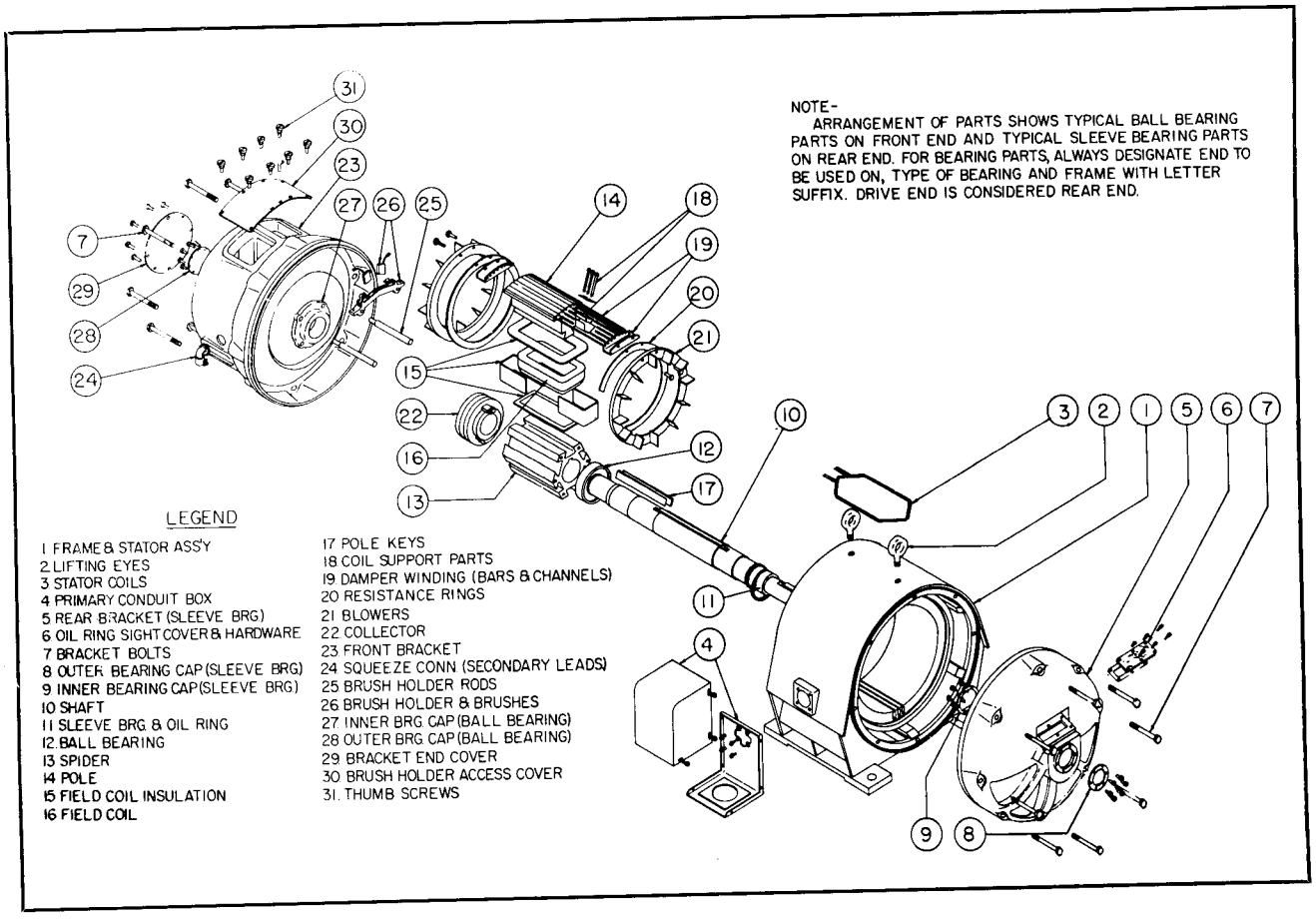

FIG. 2. Drip-proof Type GP Generator

Parallel Generator Operation. Before a generator can be paralleled with another generator or a system, it must be ascertained that the frequencies are the same, the voltages are equal, and the voltages are in phase. (For a polyphase generator, this means that the phase sequence must also be the same.) This can be done by using a voltmeter to check the voltages, and by use of either a synchroscope or a battery of lamps connected in a special circuit arrangement to check the frequency and phase relationship. If all of the above conditions are fulfilled, the generator can be connected to the generator or system already in operation.

Under loaded conditions, it is necessary to meet still other requirements for successful parallel operation. In order that all the generators in parallel will share the load in proportion to their ratings, the speed regulation of the prime movers should be alike. (That is, for a given percentage change in load, the percentage speed change should be the same on all units.) Also, there should be no oscillation of the governors and, in the case of engine driven machines, there should be sufficient flywheel effect to prevent wide speed fluctuations which might occur due to the inherent pulsating torques.

Field current adjustment when operating generators in parallel becomes much more of a problem than in single generator operation. The excitation of any one generator in a large system can be varied considerably while still delivering approximately the same total kilowatt output at constant voltage. Changing the field current in this case changes only the power factor and reactive power output of the machine adjusted. The factors which determine the proper field current for a given load condition are circulating current, overall efficiency, and stability.

Single-Phase Operation. Polyphase generators operated single-phase or at unbalanced loads should be watched carefully for signs of excessive heating. The degree of unbalanced operation permissible will vary with the individual machine; in general, however, 20 to 30 percent of normal current single-phase is usually safe. Generators having adequate damper windings may be operated at higher currents.

Motor Operation. To start and stop motor, refer to instructions furnished with starter. *NOTE: Synchronous motors should never be started with the field circuit open—extremely high voltages induced at standstill will cause dangerous arcing and will damage the machine windings.*

MAINTENANCE

Although Life-Line generators and motors require a minimum of attention in service, they should be inspected at regular intervals to guard excessive (1) dirt, (2) moisture, (3) friction, (4) vibration, (5) brush wear, and (6) grooved, rough, or eccentric slip-rings, which account for 90 percent of all machine failures.

1. Guard Against Dirt. Keep the insulation and mechanical parts of the machine clean. Dust that is free from oil or grease may be removed by wiping with a clean, dry cloth, or preferably by suction. Suction is recommended over blowing out because it eliminates the danger of blowing metal chips, etc., into the insulation and also because of the danger of moisture in the compressed air. Dust may be blown from inaccessible parts with clean, dry air of moderate pressure. Wipe top of access cover before removing it to check brushes and slip rings. Normal brush and slip ring wear will produce a conducting dust that should be removed at regular intervals to prevent accumulation in the windings.

When grease or oil is present, wipe with a cloth moistened (but not dripping) with a petroleum solvent of a "safety type" such as Stoddard solvent or similar materials available under various trade names. When a material is difficult to remove, carbon tetrachloride is more effective than petroleum solvents. (Wear neoprene gloves to prevent skin irritation when using either petroleum solvents or carbon tetrachloride.)

Petroleum solvents are flammable and comparatively nontoxic.

Carbon tetrachloride is nonflammable, but is highly toxic. Suitable ventilation should be provided to avoid breathing vapors. When ventilation is not sufficient to prevent a distinct odor of carbon tetrachloride, a chemical cartridge respirator or gas mask must be used.

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

Standby machines should be run at least once a week to guard against moisture condensation.

Before starting machines which have been subjected to moisture, megger with a 500-volt megger. If resistance is below 2 megohms, dry the winding in an oven or circulate a safe current. Continue drying until resistance rises to 2 megohms or preferably higher. Drying time will depend on size of machine and amount of moisture absorbed.

Where machines are subject to extremely moist conditions or to alternate heat and cold when not in operation, a means of keeping the internal temperature above that of the surrounding air should be used (space heaters or circulating current in the winding).

3. Guard Against Friction. Excessive friction or overheating of bearings is usually traceable 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 coupling, etc.

e. Lack of oil in sleeve bearing.

f. Lack of or too much grease in ball bearings.

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

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

Check to see if vibration from the driving or driven machine or any other nearby machine is being transmitted to the unit.

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

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

NOTE: Torsional Vibration—Since the factors which affect torsional vibration are contained principally in the design of the engine rather than in the design of the generator, responsibility for avoiding torsional vibration trouble in engine-driven sets shall rest with the engine builder.

5. Guard Against Excessive Brush Wear. Excessive brush wear may result from brushes being too tight in the holders. A free sliding fit should be maintained between brushes and brushholders by cleaning both when necessary.

Brushes should make good contact with the slip rings along the whole face of the brush. If necessary, grind the face of the brush by attaching a strip of sandpaper to slip rings with gummed tape on one end and turn rotor slowly by hand. Use care to remove the resulting dust from the machine. Maintain the brush spring pressure at the correct value; this value should be 2 to 3 pounds per square inch for carbon or graphite brushes or 3 to 5 pounds per square inch for metallic graphite brushes, the lower pressure being favored in each case if good brush

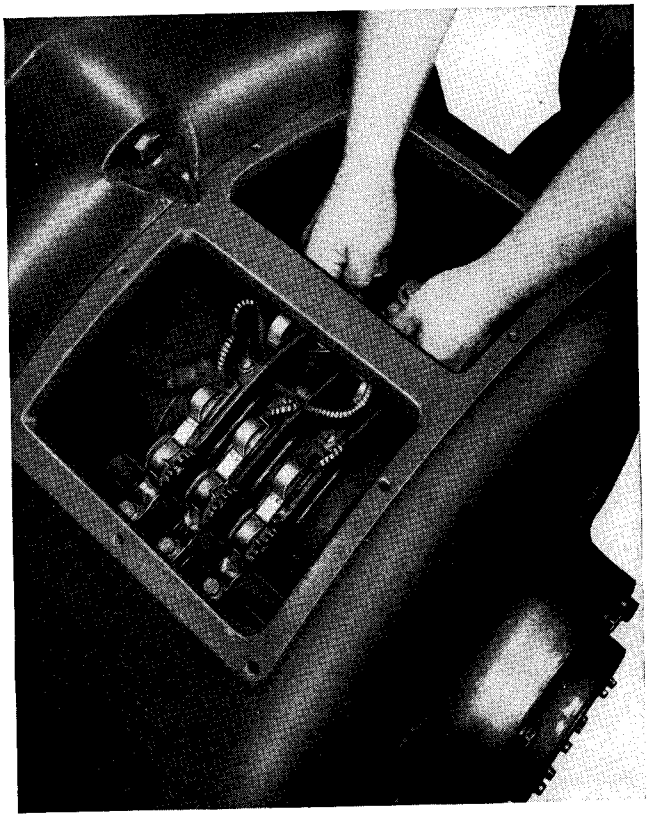

FIG. 3. Typical Brush Rigging

to ring contact is obtained. Each brush should bear equal pressure. NEVER lubricate brushes or slip rings.

Always use the proper size and grade of brush which may be obtained by contacting the nearest Westinghouse Sales Office.

6. Grooved, Rough, or Eccentric Slip Rings. The slip rings should be maintained smooth and true but not necessarily at a bright metallic color. (Brown oxide color indicates good brush and slip ring life.) Grind or turn slip rings if necessary to restore a smooth and true surface.

The collector operation may be improved by occasionally reversing the polarity.

Coils. Do not allow dirt to accumulate on rotor or stator windings. Revarnishing the windings when machines are overhauled will lengthen their life. Suitable varnish may be obtained from the nearest Westinghouse Sales Office. Caution—Do not apply varnish without first removing dirt from the windings.

GREASE LUBRICATED BALL BEARINGS

Inspection. When the machine is installed, make certain the rotor turns easily, particularly if the machine is not installed until some months after

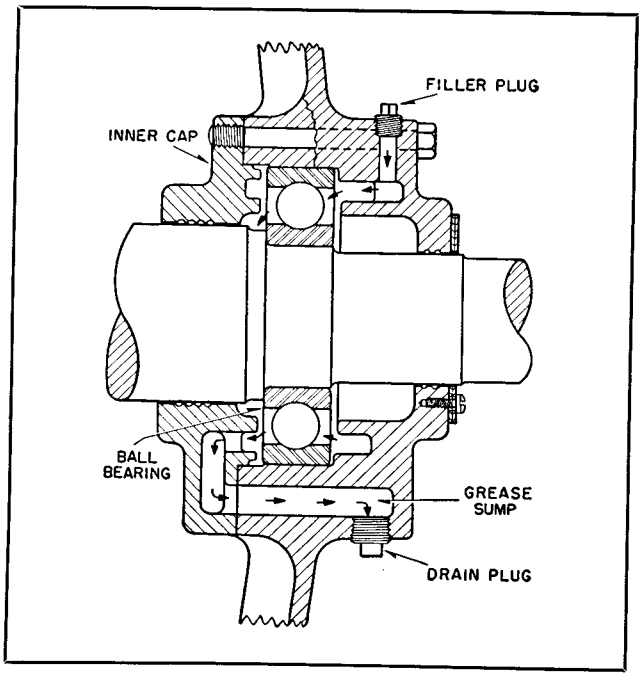

FIG. 4. Typical Ball Bearing (Grease Lubricated)

being shipped. External inspection after the unit is put into operation will determine whether the bearings are operating quietly and without undue heating. Further inspection will not be necessary except at infrequent intervals, probably at greasing periods.

Regreasing. Too much grease will cause churning, overheating, and grease leakage. If grease leakage occurs the bearing has been overgreased or the grease used was not suitable for the particular application.

If high pressure guns are used, great care should be taken to avoid overlubrication.

When shipped from the factory, grease lubricated ball bearing machines have sufficient grease of the right grade to last for a limited period. However, a charge of Westinghouse grease should be added soon after the machine is put in operation and thereafter at suitable intervals, as determined by experience.

As a guide, it is suggested that 4 ounces of grease per bearing be added every 2000 hours of operation. If experience indicates that this quantity results in a surplus of grease in the bearings, the quantity should be reduced. Remove the sump drain plug when greasing to allow the excess grease to run out. For the first several greasings there may be no excess grease; therefore none may run out of the drain plug hole.

Lubricating System. Fig. 4 is a cross section view of a typical grease lubricated ball bearing assembly. New grease is introduced at the top of the bearing farthest from the body of the machine. A sufficient charge will force the old grease through the rolling members and out a partially restricted escape port during operation.

Excess grease is removed from the sump through drain plug openings. See Fig. 4. Periodic greasing and cleaning of the surplus grease sump will prevent damage to the bearings from deteriorated grease and will reduce the need for frequent bearing overhaul.

It is desirable for the most satisfactory service to open the bearing housing once a year, or after every 5000 hours of operation, to check the condition of the housing and grease. If it is difficult to inspect the pulley or pinion end bearing, the condition of the bearing at the opposite end will usually be representative of both. If grease deterioration has occurred or if dirty, the bearing and housing parts should be thoroughly cleaned out and new grease added. Clean with carbon tetrachloride (avoid allowing this liquid to remain on adjacent generator windings). In some cases, it may be necessary to entirely remove the bearing from the shaft to clean it properly. For disassembly of the bearing housing see notes under Removal of Brackets and Removal of Bearings.

WESTINGHOUSE GREASE— ORDERING DATA

8 oz. tube	Style No. 1360 876
1 lb. can	Style No. 1248 911
5 lb. can	Style No. 1248 912
10 lb. can	Style No. 1248 913
35 lb. can	Style No. 1449 558

For grease packed in larger containers please refer to the nearest Westinghouse Sales Office.

DISASSEMBLY OF BALL BEARING MACHINES

Cleanliness. Since ball and roller bearings are sensitive to small amounts of dirt, they must be protected at all times. When necessary to disassemble the bearing housing, first thoroughly remove all dirt from adjacent parts so no dirt will fall upon the bearing or into the bearing housing.

Removal of Brackets. The end brackets can be removed by unscrewing all the bolts that hold the bracket to the frame and the six (6) bolts that hold the inner cap to the bearing housing. Upon removing the brackets, the rotor can be removed.

Removal of Bearings. The bearings can be removed using a wheel puller or similar device. The inner cap should be slid along the shaft away from the bearing so that the puller can be used against the inner race of the bearing. If the bearing is pulled by pressure against the outer race, it will be ruined.

Replacing of Bearings. To replace a bearing on the shaft, be sure that the bearing seat is free of dirt, nicks, or burrs. Heat the bearing in an oven or clean oil bath for 1/2 hour at a temperature of approximately 190°F but not to exceed 212°F at any time. Slip the hot bearing on the shaft and hold in place until bearing has cooled appreciably. Do not tighten lock nuts or assemble in bracket until bearing has cooled.

Mounting or Removing Pulleys or Couplings. In mounting or removing pulleys, couplings, or pinions the bearing must not be subjected to axial pressure, especially hammer blows when these accessories are driven on the shaft with a mallet. Any pressure of this kind should be taken by supporting the opposite end of the shaft against a stop of some kind.

For additional information, methods of locating and correcting troubles and making repairs, apply to the nearest Westinghouse District Office.

SLEEVE BEARINGS

Lubrication. Before starting the machine fill both oil reservoirs through the combination overflow gauge and filling device with best quality clean dynamo oil. (See Fig. 5.) The oil used should have a viscosity of from 180 to 220 SSU (equivalent to S.A.E. #10). No oil should be poured in the top of the brackets through the oil ring slot cover of the bracket.

No oil need be added till the oil drops below the full level, which is 1/8 inch below the top of the overflow gauge. Do not flood the bearings. After oiling, close the cover of the overflow gauge.

If any oil is accidentally spilled on the bracket, it should be wiped off with a rag or waste. This prevents dirt from collecting on the surface of the generator. It also eliminates any possibility of oil getting into the windings which in time could mean an expensive repair job.

The construction of the Sealed Sleeve Bearing is such as to require no "flushing out". At intervals of about two years in average service, or during general overhaul periods, remove the bracket and thoroughly wash out the bearing housings, using hot kerosene oil and compressed air if available.

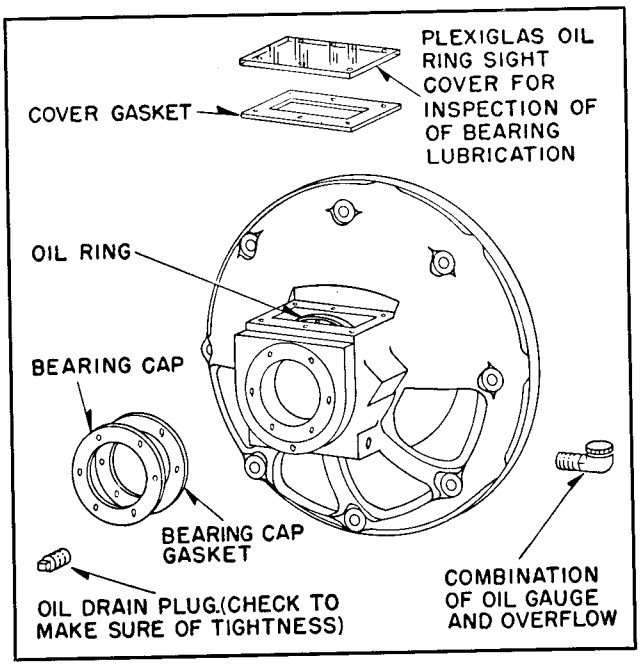

FIG. 5. Detail of Sleeve Bearing Bracket

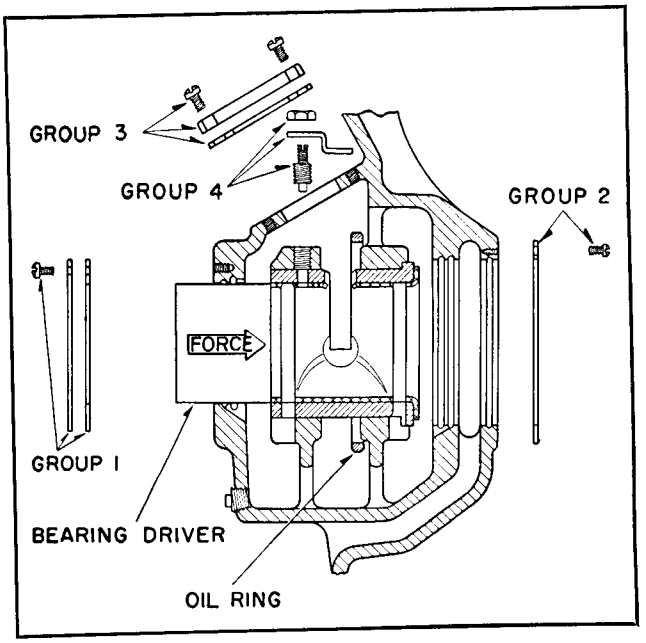

FIG. 6. Detail of Solid Sleeve Bearing

Removing Solid Sleeve Bearings. If it becomes necessary to remove sleeve bearings, proceed as follows:

1. Drain oil by removing drain plugs from bearing housing. See Figs. 5 and 6.

2. Remove oil ring inspection cover. (Group 3 of Fig. 6.)

3. Remove bolts holding the bracket to the frame and force the bracket loose by striking it with a soft mallet or other soft material in a direction parallel to the shaft. Pull bracket off the shaft.

4. Remove bearing locking screw and oil ring keeper. (Group 4 of Fig. 6.)

5. Remove outer and inner bearing caps. (Groups 1 and 2 of Fig. 6.)

6. Turn bracket 180° so that oil ring will drop through oil ring slot in the bearing. Position or hold the oil ring away from the bearing with a piece of wire so that the bearing can be removed without damage to the oil ring.

7. Tap the bearing out toward the inside by placing a bearing driver or rod against the bearing shoulder. See Fig. 6.

8. Replace, reverse the above procedure, except take care to keep the oil ring clear of the bearing as before and preferably assemble the bracket on the shaft upside down so that the oil ring will not be caught and damaged between the end of the shaft and the side of the oil ring slot in the housing. Before bolting the bracket in place, it must be revolved on the shaft to the correct position. After bolting in place check to see that the oil ring revolves with the shaft.

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. 2) and give the complete nameplate reading on the generator or motor for positive identification.

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