*GEI-25026A

INSTRUCTIONS

GE-1220-E1 TRACTION MOTOR

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2-50(200)

TK-2042

GENERAL ELECTRIC

*Supersedes GEI-25026

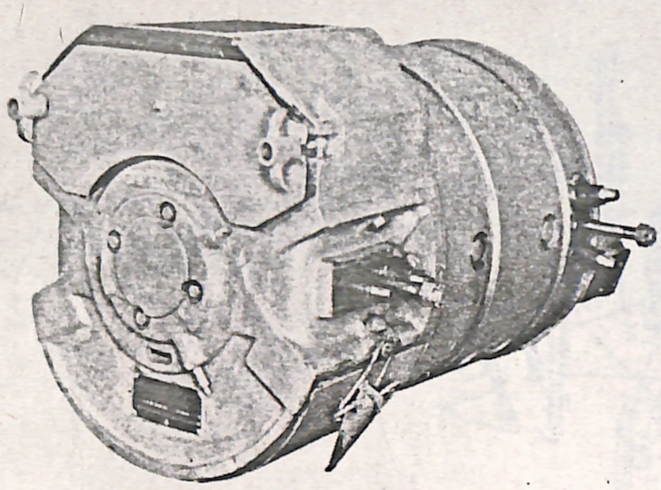


Plate A-123964 GE Transportation D-C Motor, Type GE-1220-E1, Commutator end view.

MAINTENANCE DATA

MOTOR RESISTANCES AT 25 C

Exciting Field	0.0506 ohm
Commutating Field	0.0214 ohm
Armature	0.0483 ohm

LIMITS OF BEARING WEAR

Ball bearing at commutator end and roller bearing at the drive end. There are no measurable wear limits. Rough or noisy operation indicates dirt or serious wear, either of which is sufficient reason for bearing removal for cleaning or replacement.

BRUSH DATA (Duplex Type)

Pressure	5 to 6 lb
Size	1 1/2 in. by 5/8 in. by 2 in. long

COMMUTATOR SIDE MICA

Thickness	0.045 in.
Grooving Depth	3/64 in.

COMMUTATOR DIAMETER

New	7 in.
Minimum permissible	6 5/8 in.

BEARING GREASE CAPACITY (60 per cent full)

Commutator End	1 1/2 oz
Pinion End	1 1/2 oz

WEIGHT OF MOTOR

Motor Complete	715 lb
Armature Only	215 lb

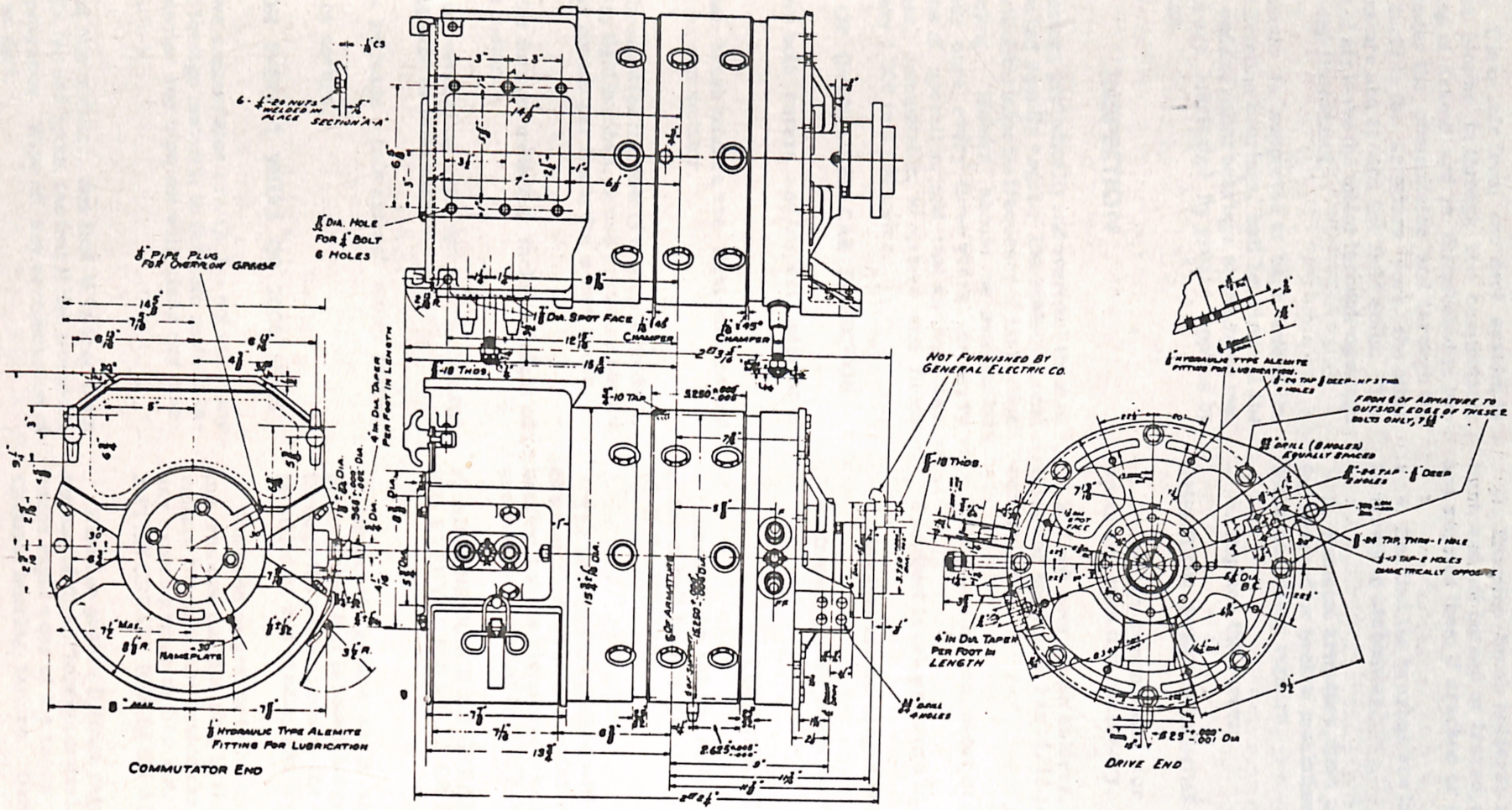
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DESCRIPTION

This is a four-pole, direct-current, commutating-pole motor. It is ventilated by blowers mounted on

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.



MADE FROM TT-6751981

Plate A-118626 Outline GE-1220-E Motor.

the M-G set. Clean air from car duct system is forced by the blower in through the commutator opening at top of frame and is distributed in two paths, one under the commutator and through the longitudinal ducts in the armature core, the other over the armature and around the field coils. The two streams of air leave the motor through openings in the drive-end framehead.

The armature is supported at each end of the motor by antifriction bearings, ball bearings at the commutator end and roller bearings at the drive end. The bearings are lubricated by grease applied by grease fittings.

INSPECTION

Inspect motors periodically and overhaul them at less frequent but equally regular intervals. Local conditions will determine the frequency of inspection and overhauling. Motors should be overhauled approximately once every three years, or every 160,000 miles of operation, and that an inspection of the brushes, commutator, armature and fields be made every 1,000 to 2,000 miles.

INITIAL OR OVERHAULED CAR INSPECTION

1. Remove both covers and inspect interior of motor.

2. See that brush holders are tight and located 1/16 inch from commutator.

3. Check brushes for freedom of motion in holders. Sand down any tight brushes. Brush pressure should be five to six pounds per finger for a new brush.

4. Look for foreign material, including signs of water in the motor.

5. See that ventilating openings are not closed with masking tape or otherwise.

6. Do not let leads chafe against motor frame.

7. Replace covers.

INSPECTION EVERY 2 WEEKS OR 2000 MILES

1. Remove commutator covers. Do not allow any oil, dirt, or foreign material to fall into motor. Inspect the interior and blow out with clean dry compressed air.

2. Inspect commutator. See that it is free from copper beads, burned spots, and that it has a smooth, polished appearance. Wipe off any accumulation of oil, grease or dirt.

3. Examine brush holders; see that shunts are tight, and not burned or frayed; clean the insulators and replace them if cracked or broken.

4. See that the brushes are in good condition and fit freely in carbonway.

5. Examine armature, field coils and connections for charred or broken insulation or other injuries. Make necessary repairs.

6. Replace the covers.

INSPECTION EVERY 2 MONTHS OR 10,000 MILES

1. Inspect commutator for roughness and flat spots and sand it if necessary.

2. Look over brush holders, tighten all connections and see that it has 1/16 inch clearance from commutator.

3. Replace broken, short or burned brushes.

4. Adjust brush pressure to five to six pounds.

5. See that cradle hanger bolts are tight.

6. Inspect grease seals for excess grease.

LUBRICATION

Lubricate the ball and roller bearings with a good grade of ball bearing grease such as Type EWM-3S (G-E No. D6A2A5).

The bearings are packed with grease when motor is assembled. The commutator end which is a ball bearing and the pinion end which is a roller bearing are each surrounded by 1 1/2 ounces.

ADD ONE OUNCE OF GREASE TO EACH BEARING EVERY 50,000 MILES OR ONE YEAR.

Inspect the grease seals at regular inspection periods, and if it is found that grease is being forced through the seals, reduce the amount of grease to be added or add grease less frequently.

When adding grease to the commutator-end bearing, remove the pipe plug in the bearing housing to relieve the pressure inside the bearing and permit any excess grease to flow out. REPLACE PLUG AFTER GREASE HAS BEEN ADDED.

Examine grease fittings regularly. A very small amount of dirt or foreign material in the bearing will cause rapid wear of the races which will result in ultimate bearing failure. Damaged fittings allow

dirt to enter the bearing. Before greasing all fittings should be wiped clean to prevent dirt from being forced into the bearing with the grease. Keep the bearing greased and clean, close containers and where Alemite guns are used, they should be kept free from dirt. Never use dirty grease. If the bearing cap is removed for any reason, extreme care must be taken to prevent dirt from entering the bearing housing.

The bearings and bearing grease chambers contain the correct amount of grease when they leave the factory and it should not be necessary to repack the grease chambers between overhaul periods. The amount of grease to be added to the bearings between overhaul periods will vary with climate, severity of service and frequency of additions. In most cases it will have to be determined by experience. The tendency to overgrease is the cause of many armature bearing failures. Excessive greasing causes overheating of the bearing and results in the separation of the oil and the grease leaving a soapy residue. This soap will accumulate around the balls or rollers and cause them to skid on the races.

The grease used should not separate at high bearing speeds and will maintain its viscosity under a wide variation of operating temperatures. Such grease should also have a high melting point and be free from abrasive matter, graphite, acid and alkali.

OVERHAULING

To obtain satisfactory service, the traction motors should receive a complete overhauling every 160,000 miles or three years. Experience will determine when this should be done, and local conditions will decide the most suitable time. Overhauling consists of reconditioning the insulation and replacing worn or damaged parts that are not accessible when the machines are on the car.

Perform the following operations when the machines are removed from the car:

1. Dismount machine. Remove coupling hub with a puller.

2. Remove and clean armature.

3. Blow out dust and dirt with dry compressed air, and wipe off grease and oil with a rag wet with carbon tetrachloride.

4. Dip and bake armature.

5. If commutator is rough or burned, turn and polish in a lathe. If commutator is not too bad, stoning will produce satisfactory surface.

6. Replace segments if necessary. Refer to "Commutator Repairs".

7. Tighten bars.

8. Groove side mica well below brush surface of commutator.

9. Blow out and clean interior of motor using carbon tetrachloride to remove oil and grease.

10. Clean out frameheads and bearing housings.

11. Remove bearings and clean out all the old grease, using kerosene, safety solvent, or other petroleum solvent. Examine for looseness and damage.

12. Inspect gaskets under bearing cap. Replace defective gaskets with new ones.

13. If field coils and cables are tight and in good condition, give them two coats of Glyptal No. 1201 red enamel. If necessary to remove coils, dip and bake them before replacing.

14. Reassemble armature in motor and mount coupling hub.

15. Examine brush holders to see that brush-holder studs and working parts are in good condition.

16. Tighten pole-piece bolts.

17. To keep water out of countersinks into which top pole-piece bolts fit in the motor, fill countersinks with G-E No. 837 compound until they are flush with outside of the frame.

18. On assembling, check that all nuts and bolts are tight, covers fast, and bearings filled with fresh grease.

DISASSEMBLY

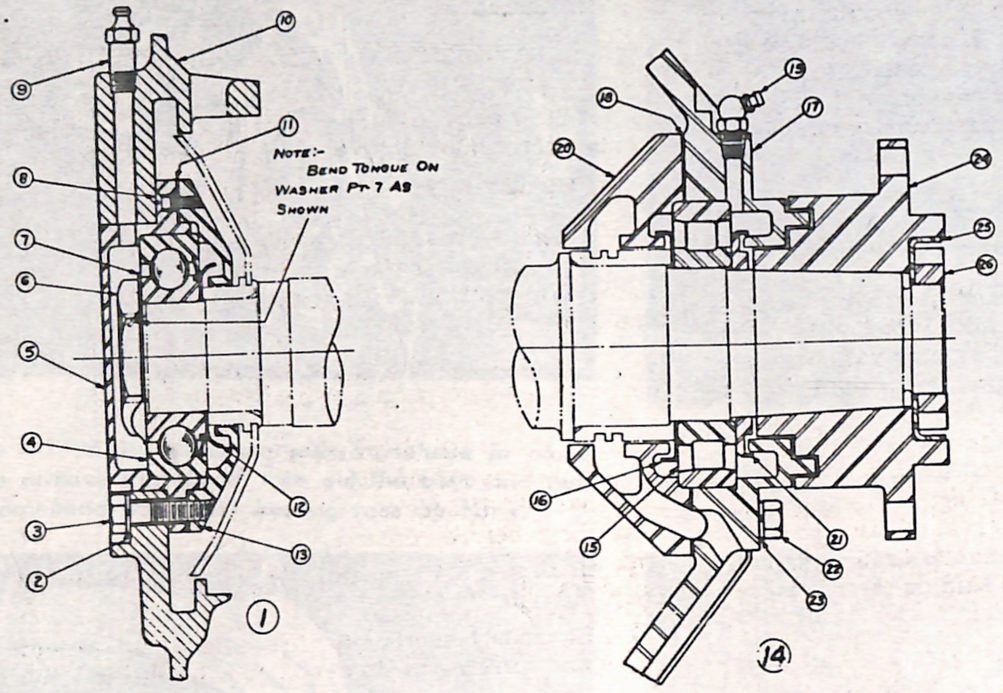
Remove motor from car truck and place on bench to facilitate handling.

1. Remove the commutator covers from the frame and lift the brushes from the commutator. Wrap cardboard or heavy paper around the commutator to protect it from damage during disassembly.

2. Remove bolts from both commutator-end bearing housing and drive-end framehead.

3. Force armature toward the drive end by means of jackscrews in the framehead. If the use of the jackscrew does not completely release the armature, tap on the commutator-end bearing housing using a piece of fiber or some such material to protect the housing. Tap on the edge of housing and not on center as it is liable to dish in and foul on end of armature shaft. Place the armature on the bench, preferably in a cradle, to support it for subsequent operations. When the armature is on the bench, remove the bearings from the shaft, using the pullers furnished.

4. To remove pinion nut on the drive end of the shaft refer to Fig. 11, Plate A-118660.



26 NUT
25 LOCKWASHER
24 COUPLING HUB
23 LOCKWASHER
22 CAP SCREW
21 RETAINING RING
20 BEARING CAP
19 ALEMITE HYDRAULIC FITTING
18 GASKET
17 FRAME HEAD
16 FLINGER RING
15 ROLLER BEARING
14 BEARING ASSEMBLY
13 BEARING CAP
12 FLINGER RING
11 GASKET
10 FRAME HEAD
9 ALEMITE HYDRAULIC FITTING
8 MACHINE SCREW FLAT HEAD
7 LOCKWASHER
6 NUT
5 BEARING HOUSING
4 BALL BEARING
3 CAP SCREW
2 LOCKWASHER
1 BEARING ASSEMBLY

MADE FROM P-4748308

Plate A-118628 Bearing assembly of GE-1220 Motor.

5. To remove coupling hub, use a puller as shown in Fig. 12 of Plate A-118660. Do not use wedges between hub and bearing cap. In order to prevent damage to antifriction bearings, avoid unnecessary heavy blows with a sledge on the puller. With the puller in place and with a strain on the hub, apply a flame evenly and sparingly. For removal of the drive-end bearing, see Fig. 13 and 14, removal of commutator-end bearing Fig. 15, terminal plug Fig. 17. These figures are shown on Plate A-118660.

REMOVING BALL BEARINGS (COMMUTATOR END)

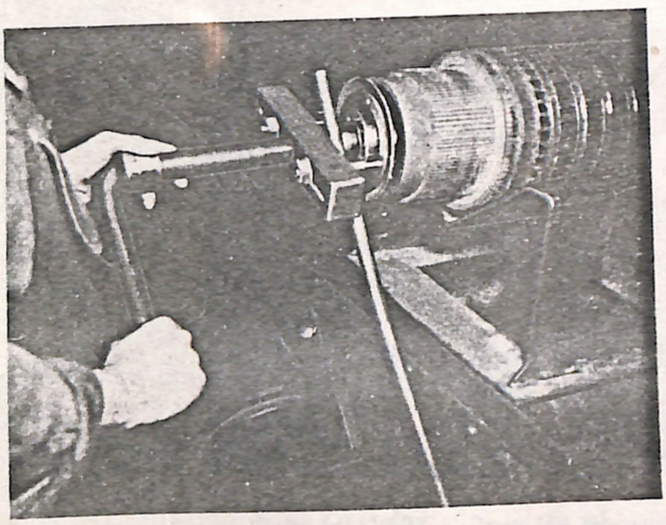


Plate A-118629 Attach bearing puller to inboard cap.

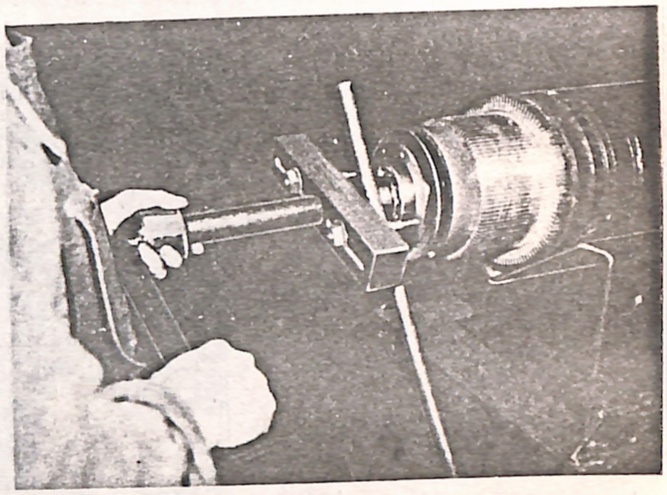


Plate A-118630 Draw inboard cap and bearing o long shaft.

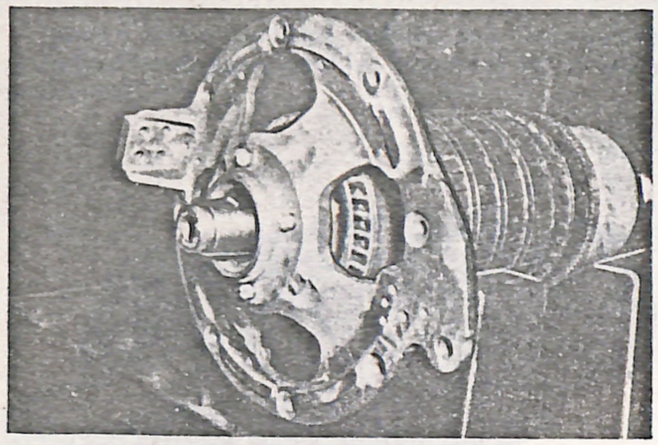


Plate A-118631 Armature with framehead in place. To remove framehead take out the bolts and pull framehead with outer bearing race by hand.

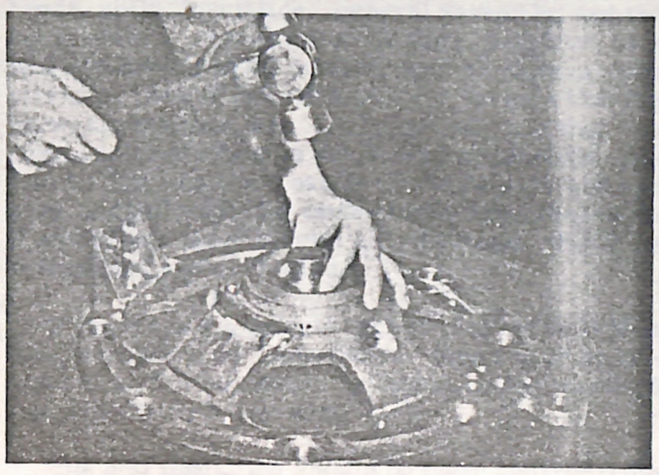


Plate A-118632 Remove the outer bearing race with a special tool.

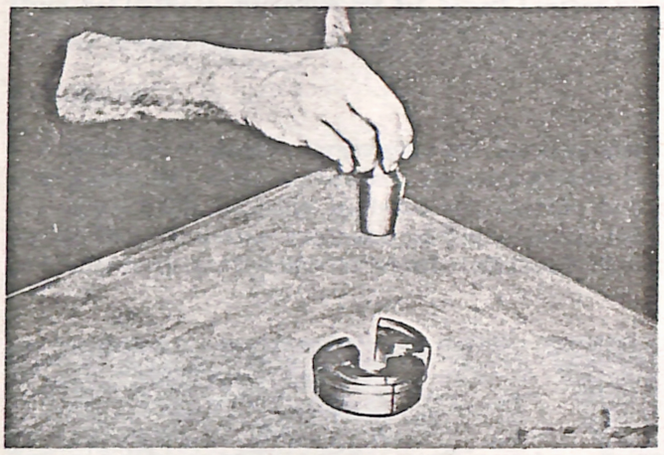


Plate A-118633 Tool used to remove the outer bearing. race from framehead.

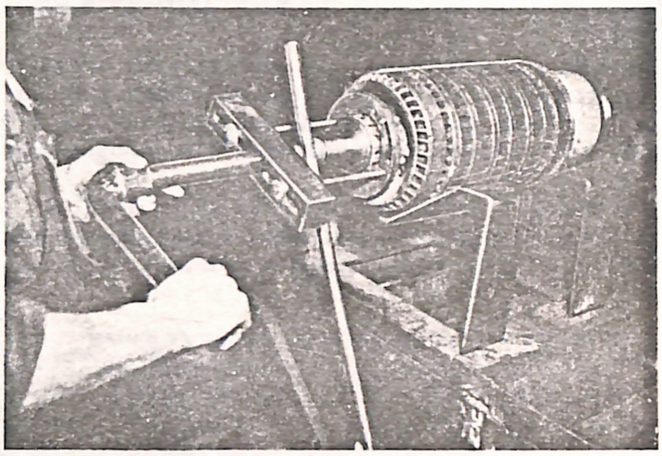


Plate A-118634 Attach puller to inboard cap. Draw cap and inner bearing race along shaft.

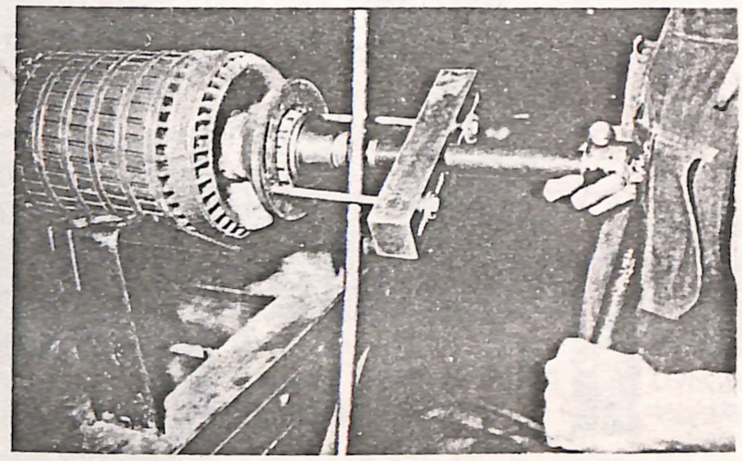


Plate A-118635 Draw the inboard cap and inner bearing race along the shaft.

ARMATURES

When a motor is being overhauled, remove the armature for cleaning, testing, repairing and varnish treatment.

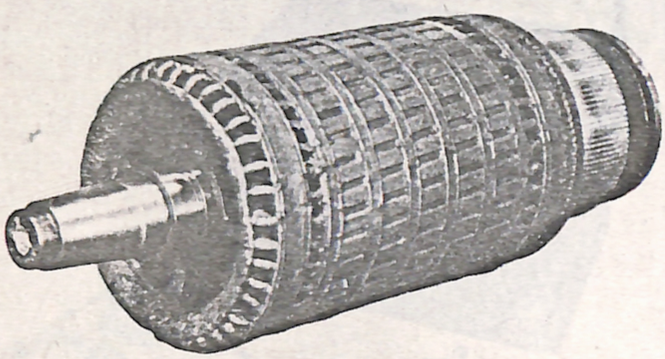


Plate A-118641 Armature for GE Direct Current Railway Motor, Type GE-1220-A.

CLEANING

Clean the armature thoroughly by blowing it out with clean, dry compressed air. Remove grease and oil with a cloth dipped in carbon tetrachloride or its equivalent. Do not use too much carbon tetrachloride, or it will soak into the insulation with injurious effect.

Thoroughly examine the condition of armature bands, coils, insulation, general assembly, and the commutator. Examination of the commutator may indicate defects in the winding such as short or open circuits. See illustration below. Be sure that the core laminations are not damaged, and that the commutator surface is not scored or otherwise injured. The armature bands should be tight and secure, and the soldering on the bands should be intact. If solder has been thrown off, the cause should be determined and corrected.

If there are any defects such as charred or brittle band insulation, or loose bands, they should be removed and the armature rebanded, using standard General Electric material.

The coil insulation should be clean and free from blisters, flakes, or cracked varnish surface. The armature should be given a varnish treatment while it is out of the frame.

HIGH-POTENTIAL TEST

When the armature has been thoroughly cleaned, measure insulation resistance with a megohmmeter. Insulation resistance should measure not less than one megohm before the high-potential test is applied.

If there is no external indication of failure and the megohmmeter indicates more than one megohm insulation resistance, apply high-potential test (1500

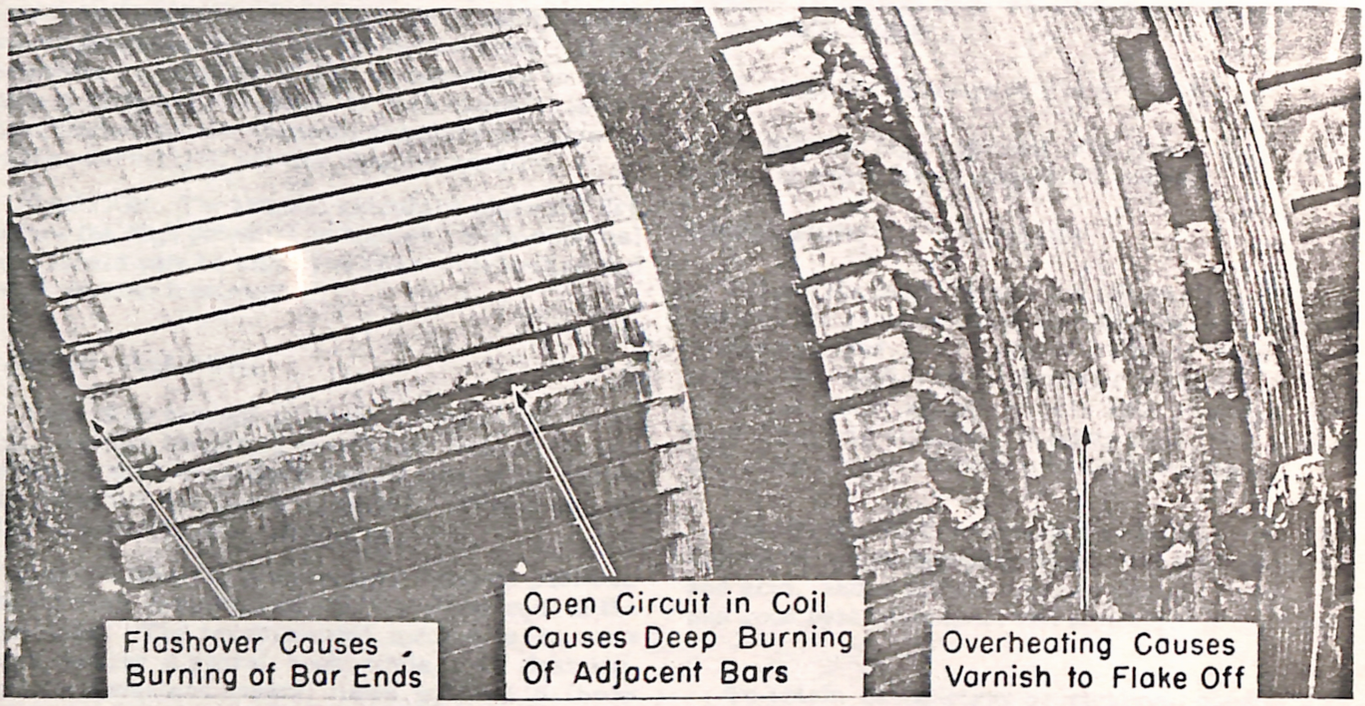


Plate A-118642 Overheating caused solder to melt out of this armature. Resulting open circuit in one coil caused burning of the two adjacent commutator bars.

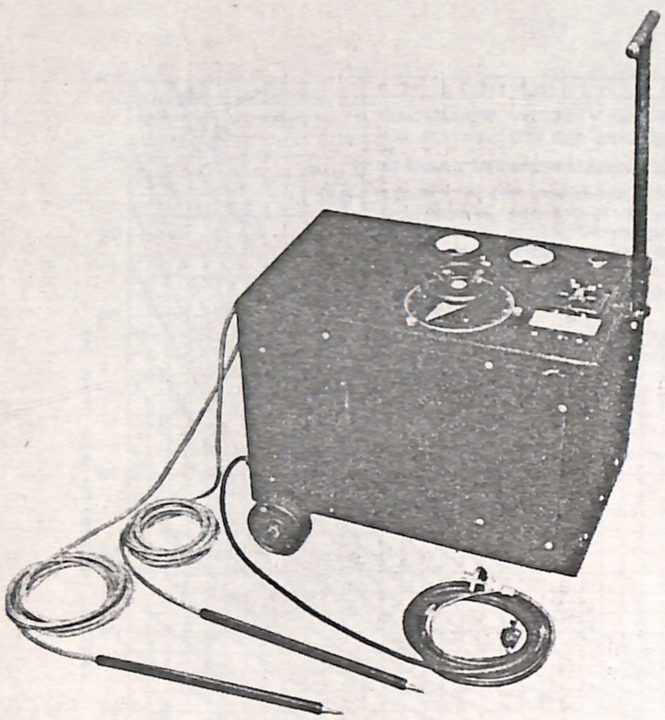


Plate A-118643 GE portable high voltage testing set. For information on other testing equipment see the GE Instrument Catalog, GEA-602.

volts a-c for one minute between the conductors and the core. Apply the voltage between the armature shaft and the commutator surface. If a partial ground exists, its location can usually be detected by smoke when application of the voltage is sustained. If the armature is grounded, it may be necessary to completely strip and rewind it. In such cases, it is recommended that the complete armature be returned to the nearest G-E service shop for repairs.

CAUTION: The armature should be clean and dry before the high potential is applied. High-potential test should only be employed after overhauling and after varnish treatment.

VARNISH TREATMENT

Even if no grounds or short circuits are found, the armature insulation may be so weak from age or wear that a breakdown may be imminent. Give the armature the following varnish treatment each time a motor is overhauled.

Dip and bake the armature in a vertical position, the varnish draining toward the drive end of the armature. The recommended method is to use a hoist having a swivel hook; while it is draining, spin the armature several times by hand to throw off the excess varnish. After each dipping, set the armature at an angle of 45 degrees and allow to drain for five minutes, after which wipe off all varnish from the end of the shaft that has been immersed.

When the condition of the insulating varnish on the armature is such that treatment is necessary, or if the banding is loose, the following procedure should be followed:

1. Wipe clean with cloth dipped in carbon tetrachloride or equivalent.

2. Remove bands and banding base insulation, if necessary.

3. Bake armature for six to eight hours at a temperature of 110 C (230 F).

4. While hot, dip in Glyptal No. 2480 varnish at room temperature. Armature should remain in varnish for five minutes or until bubbles cease to rise.

5. Drain and bake 18 hours at 140 C (284 F).

6. Measure the insulation resistance while the armature is hot. The armature should be baked until the insulation resistance is at least 1/2 megohm.

7. Cool armature and replace banding insulation and reband. Refer to Armature Insulation Drawing. Use a high-temperature solder in soldering the binding wire. General Electric B20D6 solder is used in the factory; use this or similar material (97.5 per-cent lead, 2.5 per-cent silver) in rebanding.

8. Dip armature in Glyptal No. 1201 red enamel to provide the outside finish. Drain and be sure to remove all enamel from the shaft, using a rag soaked in GE-1500 thinner.

9. Bake for 18 hours at 140 C (284 F).

Repeat the high-potential and bar-to-bar tests after the armature is dipped and baked.

PREPARATION OF VARNISHES

Glyptal No. 2480 varnish and Glyptal No. 1201 red enamel are recommended for dipping and baking armatures and field coils of rotating apparatus. Glyptal No. 2480, a clear synthetic varnish, has high heat endurance, ability to penetrate windings, and high dielectric strength. It bonds well, and is used to fill the fibrous structure of the insulation.

Glyptal No. 1201, synthetic red enamel, has excellent film building properties, is resistant to oil and acid, and is used to provide surface finish. It has good heat endurance, and dielectric properties.

To obtain satisfactory penetration, bonding and curing with these finishes, it is essential that their viscosity be correct. The G-E Zahn viscosimeter is recommended for measuring the viscosity because of its convenience, accuracy and low cost.

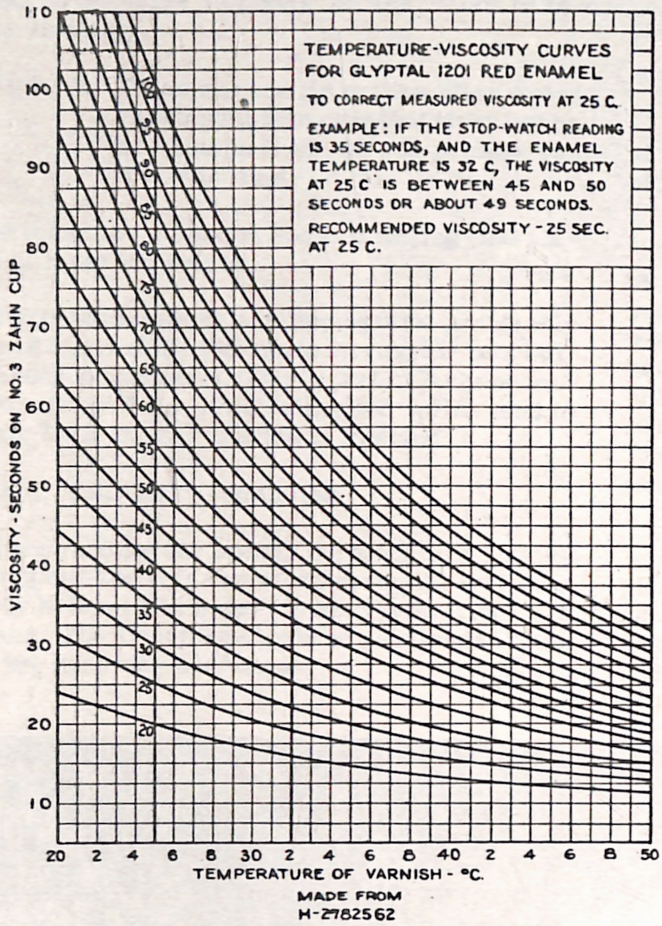


Plate A-118682 Temperature-Viscosity curves for Glyptol 1201 Red Enamel.

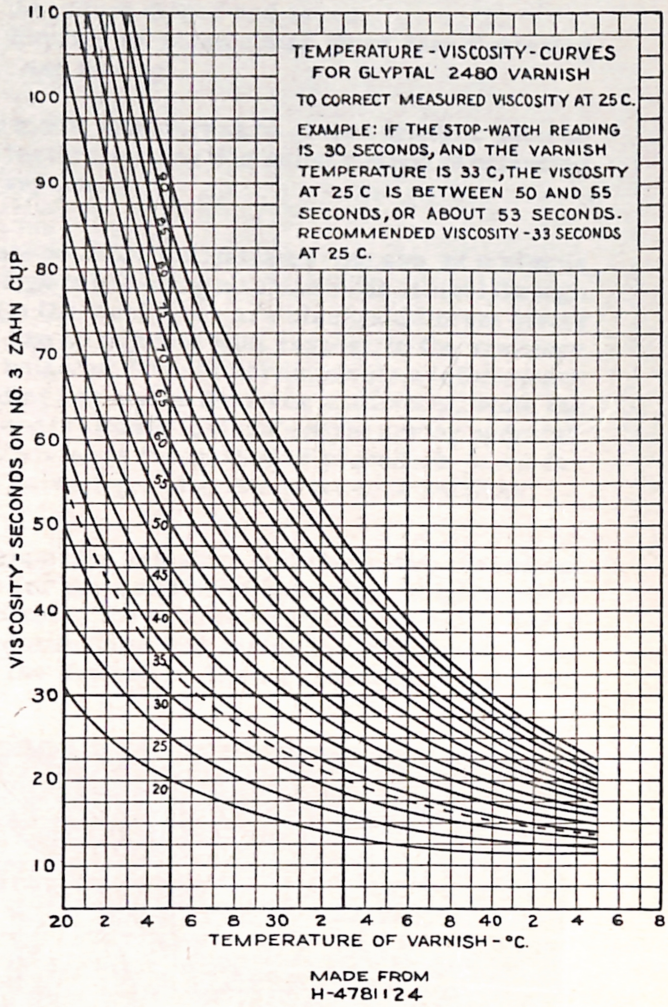


Plate A-118684 Temperature-Viscosity curves for Glyptol 2480 Varnish.

The equipment necessary to measure viscosity is as follows:

a. Thermometer to measure temperature.

b. Stop watch

c. Zahn viscosimeter, Cat. 5102111G3, for both Glyptal No. 2480 varnish and Glyptal No. 1201 red enamel.

d. Curve sheets for correcting viscosity to 77 F or 25 C.

Curve H-4781124 for Glyptal No. 2480 varnish.
Curve H-2782562 for Glyptal No. 1201 red enamel.

Method of measuring viscosity follows:

a. Mix material thoroughly and allow to settle for a few minutes to eliminate trapped air.

b. Immerse viscosimeter cup and let it remain for about a minute to allow it to assume the temperature of material.

c. Raise cup quickly by ring in end of handle and start stop watch at instant cup leaves surface of liquid.

d. Stop the watch at instant draining column first breaks from cup.

e. The number of seconds measured is viscosity at temperature of material.

f. Correct viscosity as measured, to viscosity at 25 C (77 F) by using curve Plate A-118684 for Glyptal No. 2480 varnish and curve Plate A-118682 for Glyptal No. 1201 red enamel. The viscosities desired on these materials for treatment of armature are as follows:

Glyptal No. 2480 - 33 seconds at 25 C with No. 3 Zahn cup.
Glyptal No. 1201 - 25 seconds at 25 C with No. 3 Zahn cup.

g. If measured viscosity is not correct at 25 C (77 F) as shown on curve, correct it by addition of solvents to decrease viscosity or new stock to increase viscosity.

CAUTION: Clean cup and its orifice after every reading and take care that stray lumps or skins in liquid do not prolong cup draining time.

Use toluol as a solvent for controlling the viscosity of these materials.

Agitate these materials in dipping tank, preferably by use of a circulating pump, to thoroughly mix solvent throughout solution. This is particularly necessary for Glyptal No. 1201, since the solids tend to separate from thinner if allowed to stand.

DYNAMIC BALANCE ARMATURE

At free running car speed, the armature rotates at high speed and it is therefore essential that it be properly balanced in order to keep vibration at a minimum. The armature should be rebalanced after any of the following operations.

1. Armature rewound or armature coils repaired.
2. Armature rebound.
3. Armature dipped and baked.
4. Repairs to commutator other than tightening and turning.

All motor armatures are given a dynamic balance at the factory; employ this same method of balancing after repairs.

Plate A-118386 illustrates the use of a simple pivot-type of balancing machine made of steel through out. On the steel tubes are clamped fulcrum pivots which can be adjusted with respect to the armature being balanced. These fulcrum pivots are the means of holding one end of the rotor stationary, while the other end is allowed to vibrate on the spring pedestal. The following is the method of procedure when dynamic balancing, using this pivot-type machine.

Examine the armature and choose two convenient planes for the addition of balancing weights. For convenience, the balance weights are usually added to the commutator end inside the commutator cap and at the fan end in the air passages of the fan.

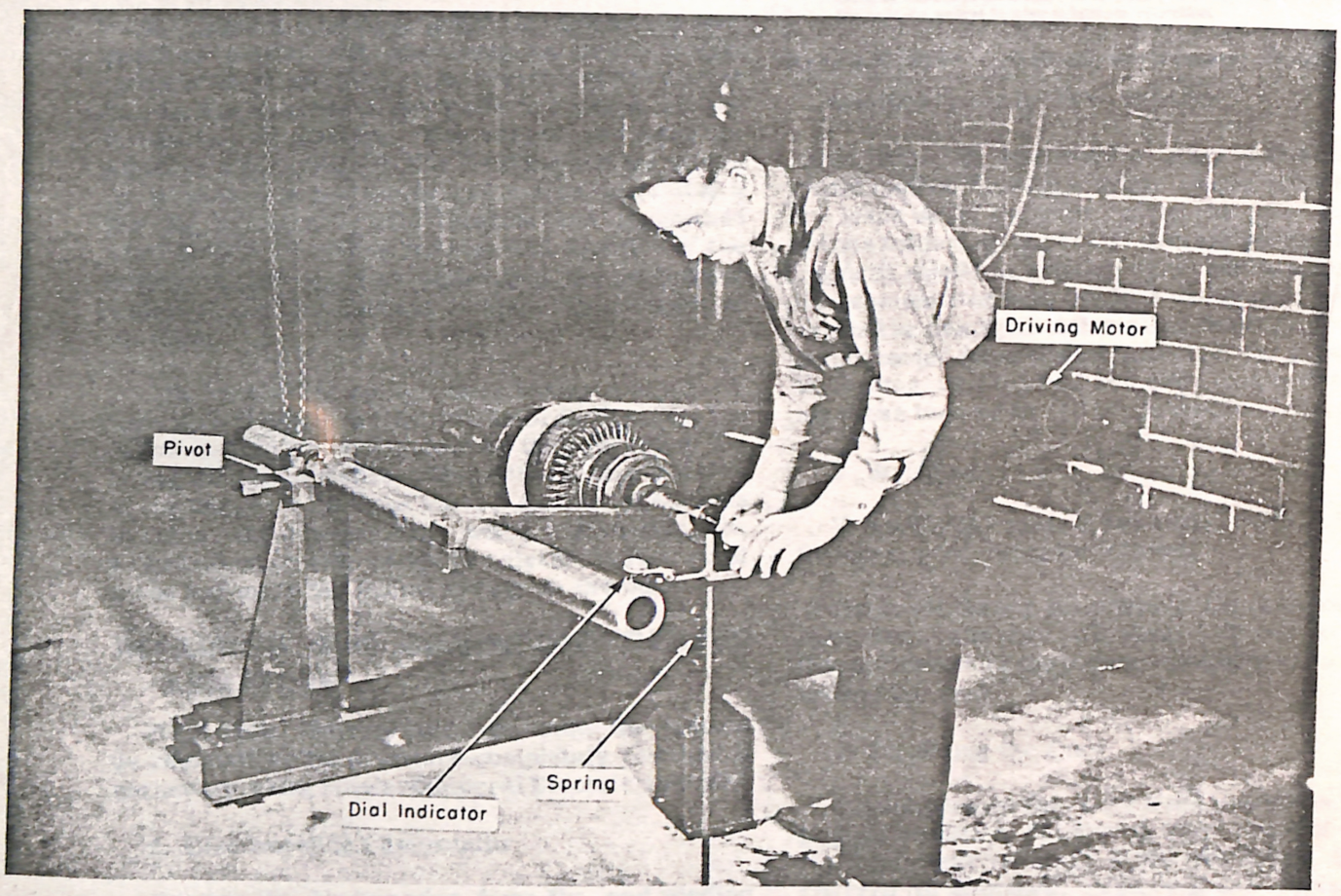


Plate A-118386 Method of Dynamic Balancing an armature using a Dial Indicator.

The machine is arranged to pivot the frame in either of the two selected pivot planes; the pivot plane decided upon must coincide with one of the balancing planes already chosen. The frame is supported in a horizontal position by a helical spring under the heavy end, stiff enough to give the frame a natural frequency of several hundred oscillations per minute. A dial indicator is supported so that its sensitive point rests on the frame at the vibrating end. The trial and error method is used for locating the position and determining the amount of balance weight, as follows:

When an armature is being balanced, the fulcrum pivots are placed in line with one of the planes in which the balancing weights are to be attached to the armature. Then the other end, which is allowed to vibrate, is marked in four positions, 90 degrees apart, and a weight of approximately the amount of unbalance expected on this end is attached to one of these positions. The maximum vibration is recorded at a speed approximately 25 per cent above the natural frequency of the spring and support. Repeat this procedure for the other three positions, which were marked on the end of the armature, by moving the weight and recording the maximum vibration. Care must be taken to bring the armature to the same speed for each trial.

By drawing a simple graph of magnitude and position weight, with magnitude as ordinate and position weight as abscissa, the location of the weight can be closely determined. Refer to Plate A-118394 for further explanation. The weight can then be attached temporarily at this location and increased or decreased in magnitude and moved angularly a few degrees until the best location and magnitude are determined. When the size and location of the balance weight has been established, the permanent weight should be secured in place by welding or riveting.

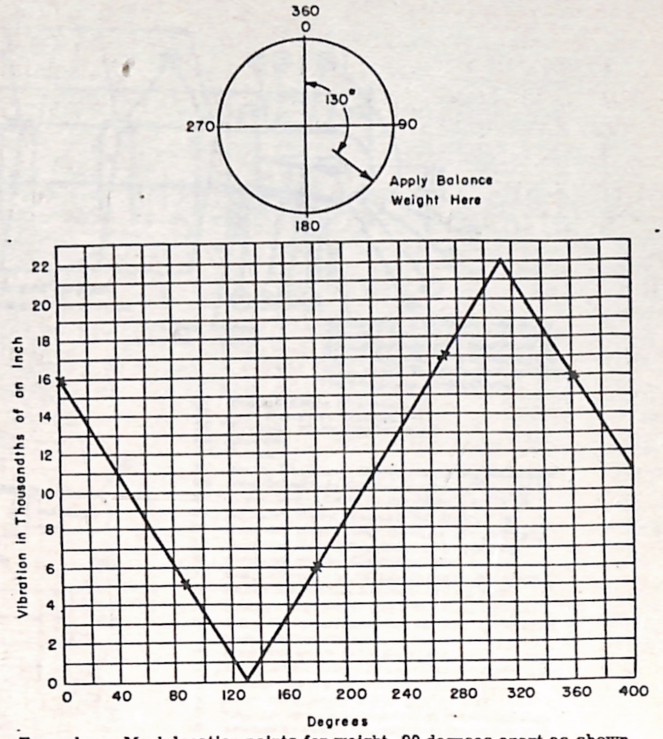
After one end of the armature has been balanced, turn the armature end-for-end in order to allow the unbalanced end to vibrate during the process of locating the amount and location of the balance weights in the manner described above. Another method is to use a second pivot plane without disturbing the armature and cradle except to release the first pivot plane and move the helical spring to the other end.

REPAIRING AND REWINDING GE-1220 ARMATURE

If the tests indicate defective coils, they should be replaced; or the armature completely rewound if necessary, using standard General Electric material.

1. Disconnecting Commutator

Remove the binding wire from the end winding nearest the commutator and take off the outside insulation over the coils. Then disconnect the coil



Example: Mark location points for weight, 90 degrees apart as shown. With weight at each point, measure vibration with dial indicator in thousandths of an inch; in above case the indicator reads 16 at 0° and 360°, 5 at 90°, 6 at 180° and 17 at 270°. Plot points and draw line through them to intercept base line. This point, 130 degrees, indicates location for balance weight to give minimum vibration.

Plate A-118394 Method of Dynamic Balancing an Armature using a Dial Indicator.

leads from the commutator (this may be done by "cold method", using a wedge shaped drift to force the leads out of the cups; or by the "hot method", using a soldering copper). If the cold method is used, the drift should be slightly narrower than the slot in the commutator bar, so that the copper segments will not be damaged. After all of the leads have been disconnected from the commutator, the ground may be located, as each coil and each commutator segment can then be tested for insulation from ground.

2. Stripping

If trouble is found in the coils, strip them from the core, proceeding as follows:

Raise all the top members of the coils out of the slots first, and then pull them back one at a time, thereby removing the bottom members in succession around the core.

3. Insulating the Core

Do not remove the core head insulation if found in good condition, but give it a few coats of Glyptal No. 2450 clear varnish. If the insulation is badly charred or damaged, remove it and replace with new core insulation as shown on the insulation drawing.

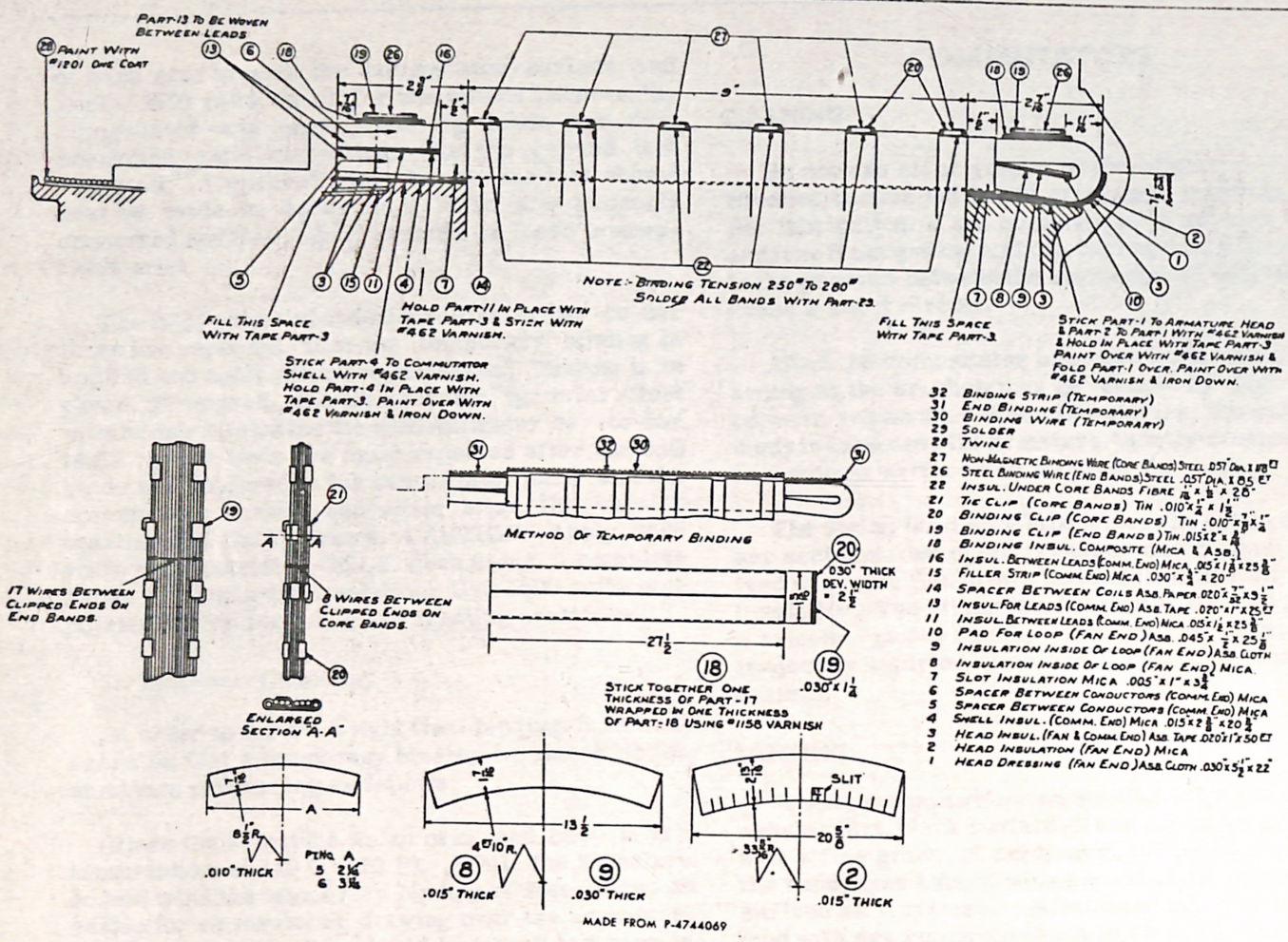


Plate A-118644 Armature Insulation of GE-1220 Motor.

4. Tests Before Rewinding

Before starting to rewind the armature, test the commutator as described under COMMUTATOR.

5. Rewinding (See Motor Connections)

Before starting to assemble the coils on the core, locate a commutator bar, the center of which lines up with the center of a slot.

Refer to connection diagram for method of connecting armature winding.

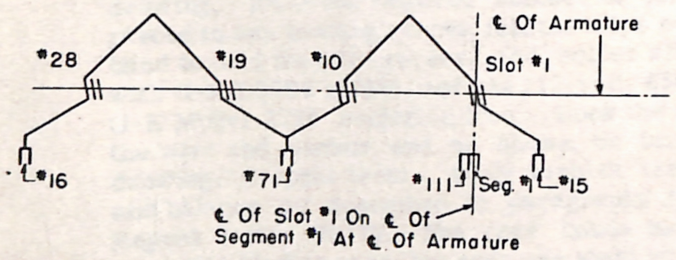


Plate A-125422 Armature winding Diagram for GE-1220 Motor.

When assembling the coils on the core, place the bottom side of the first coil in slot No. 1 and the top side of the same coil in slot No. 10 counting to the left facing the commutator. Then place lead in the commutator bar as shown on the connection diagram. Next, assemble the coils in succession around the core, setting the bottom sides of the coils down into the bottom of the slot and pulling the top sides of the coils back into their proper slot, but not setting them all the way down. After about 40 per cent of the coils have been assembled, all of them may be set into the slots as far as they will go.

While assembling the coils on the core, place pieces of the standard cut insulation in the positions called for on insulation drawing.

6. Tests During and After Rewinding

After the new coils have been placed in the slots and the bottom coil leads connected to the commutator, the armature is tested for short circuits between coils and for ground between coils and core. The short circuit test is a bar-to-bar test made with 220-volt, direct-current, with lamps in series. To make the high-potential or ground test, wrap a piece

of bare wire around the commutator surface and apply 2500 volts (a-c) for one minute between the commutator and shaft. The top leads are next connected to the commutator and the ground test repeated. A millivoltmeter bar-to-bar test should next be made to ascertain if leads are properly connected and if any short circuits or loose connections exist.

The high-potential and millivoltmeter bar-to-bar tests are repeated after the temporary binding is applied and again after the permanent binding is in place. If desired, the transformer (growler) test may be substituted for the millivoltmeter bar-to-bar test. These tests are again repeated after the coil leads are soldered in the commutator ears and the commutator turned, and again after the varnish treatment of the armature. CAUTION: Apply 2500 volts high potential ONLY when using a complete set of new coils and insulation. Use 1500 volts high potential when repairing and treating armature.

7. Temporary Binding

In order to insure a tight final binding, it is first essential that a temporary binding be placed on the armature proceeding as follows:

Place the armature in an oven and heat it to a temperature of 110 C (230 F). While the armature is hot, wind the temporary binding of steel wire, as called for on insulation drawing over the armature. The temporary binding should be wound at a tension of 250 to 400 pounds. After the armature has cooled to room temperature, repeat high-potential and bar-to-bar tests.

Solder leads in commutator ears using pure tin solder.

8. Permanent Binding

After the armature has cooled to room temperature, the temporary binding is taken off and the permanent binding put on the armature. The permanent binding should be wound at a tension of 250 to 280 pounds. The band insulation, the band clips and binding wire should be as called for on insulation drawing. When the required number of turns are placed in any banding groove, fold the clips over the band to hold the wire secure, and solder all bands with G-E B20D6 solder, and use 115-volt, 650-watt, G-E Model 3774 soldering iron. Hook the ends of the wire and anchor end as shown on insulation drawing. Repeat tests. Apply varnish treatment and balance as described in paragraphs 3 and 5. Repeat tests. NOTE: The core bands use non-magnetic binding wire; the ends use steel wire.

9. Commutator

See REPAIRS under COMMUTATORS.

COMMUTATORS

CLEANING

Do not use oil or grease on the commutator. The brushes contain sufficient graphite to maintain proper lubrication. If the commutator is not kept clean and free from grease and oil, carbon dust will collect in the grooves between the segments and will tend to cause a short circuit.

After the commutator becomes worn, burning or arcing at the brushes may be caused by high mica between segments. When this occurs, the only remedy is to remove the armature, turn the commutator to a smooth surface and undercut the mica.

The string band should be wiped clean, to remove any accumulation of oil, grease or carbon dust which tend to create flashovers that result in failure of the insulation. The string band should at all times have a smooth, glossy finish, which can be secured by frequently applying a coat of Glyptal No. 1201 red enamel.

SANDING

When the commutator shows slight signs of roughness or dirt, black surface, it can easily be polished with a fine grade of sandpaper, 00 or finer. Hold the sandpaper backed with a wood block against the surface as it rotates. After sanding, blow out the dust with dry compressed air to clean the sand from the slot between the segments.

CAUTION: Use sandpaper only on a commutator.

GRINDING

When the commutator surface is pitted or burned, the usual practise is to grind it smooth with a commutator stone.

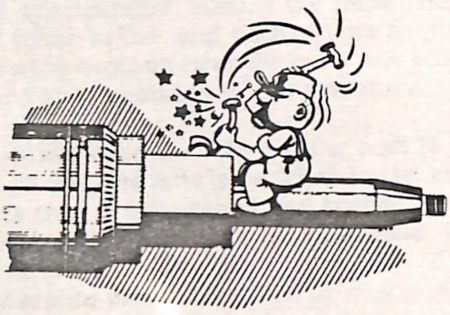
Do not consider this resurfacing as an overhaul on the commutator, but merely as a means of keeping the machine in service between overhaul periods.

A suitable stoning fixture with finish grade stone (not carborundum nor emery) has been devised. The illustration shows such a fixture in grinding position without removing the machine from the vehicle, since it is only necessary to remove one brush holder. The fixture should be adapted for bolting in place by means of studs which are similar to brush-holder studs. Leave only two brushes on the commutator on the side away from the operator for braking power.

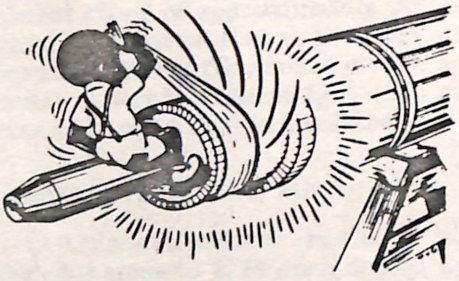
Care must be taken to see that this grinding operation does not leave the commutator out of round. The permissible eccentricity for the GE-1220 commutator is 0.001 inch. Precautions must be taken



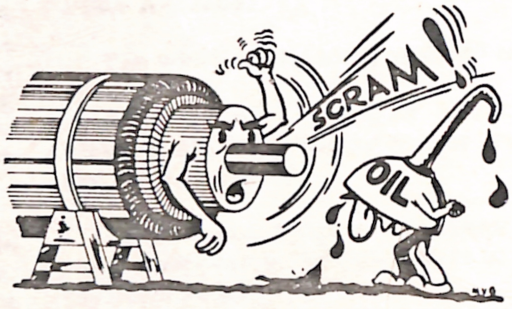
Plate A-99403 Using Button Control-stoning Commutator in P.C.C. Car Motor.



1. Keep the mica segments of the commutator undercut to the correct depth, as indicated in Table.



2. Keep the surface of the commutator clean and smooth. Sand or stone it when signs of roughness or dirt appear, and if it becomes badly worn or burned, it should be turned and polished.



3. Allow no oil or grease to come in contact with the commutator surface or carbon brushes.

4. Keep the string band clean, and frequently apply a coat of Glyptal No. 1201 red enamel to maintain surface finish.

Plate A-120762 Rules for proper maintenance.

to prevent the copper dust from entering the windings, by using a cardboard shield or similar device; it is also recommended that the fan outlet be covered to prevent the fan from sucking the dust into the machine.

After the grinding is completed, clean the slots and remove any burrs on the commutator bars. Blow out the motor well with dry compressed air to remove all dust from grinding.

TURNING

If the commutator is badly worn or burned, turn the commutator in a lathe. Remove only enough copper to give a uniform surface, after which recut the side mica between segments. Polish and clean the commutator surface.

Whenever possible, turn the commutator by supporting the armature in its own bearings. If the armature is held on lathe centers, be sure that these centers are true with respect to the bearing seats.

Before turning a commutator, make a suitable covering to keep the chips and dust from working into the armature. This covering can best be made as follows:

Take a strip of cloth several inches wider than the length of the end connection, and long enough to encircle the commutator. Wrap this cloth around the commutator, binding the inside edge with a cord as close to the end connections as possible. Then turn the cloth up over the cord and bind with another cord to the outside of the armature.

Make sure that the turning post is so set that the ways are absolutely parallel to the commutator and that they are fastened and braced securely. Use a side-cutting tool with point ground to about 1/16-inch radius. Give the cutting side of the point considerable more rake than is customary for working iron and steel. Have the tool sharp enough to make a clean, smooth cut without dragging copper over the mica.

While turning the commutator, run it at a peripheral speed of approximately 300 feet per minute, which is about as fast as the tool will cut without burning. With a file, round off the ends of the commutator bars to at least 1/16-inch radius, while the commutator is still in the lathe.

UNDERCUTTING THE MICA

After a commutator has been turned, undercut the side mica to 3/64-inch depth. Special saws are available for this purpose, and care must be taken not to cut the slots too wide. Remove the sharp edges of the commutator bars with a hand scraper or a knife. Do not bevel the edges of the segments. Clean out the slots to remove all mica chips and fins,



Plate A-118647 A simple tool for cleaning out commutator slots can be made from a worn out hack saw blade.

and be sure that no copper chips remain in the slot. A satisfactory tool for this operation can be made from a piece of a worn-out hacksaw blade. See Plate A-118647.

The width of the mica is 0.045 inch.

After the mica has been undercut and the slots cleaned out, the commutator is ready for grinding and final polishing.

After a commutator has been turned and the mica undercut, grind the surface to provide a smooth polished finish.

TIGHTENING

It is important that the segments be clamped as tightly as possible, so that they will not become loose in service. Test for loose bars by tapping them with a light hammer.

If the bars should become loose, this looseness can be corrected by tightening the commutator nut. However, this tightening is an operation which requires extreme care. This tightening requires 16 tons pressure at 100 C, using a 48-inch wrench.

TK-978

REPAIRS

In making all repairs to the commutator, care should be taken to keep all parts clean and free from dust and foreign material. Careful work is essential for the best results.

cess and in addition the commutators should be seasoned in a spin stand.

1. Assemble steel, copper and cones, tighten at eight tons cold (use 48-inch wrench).

2. Remove the binding wire.

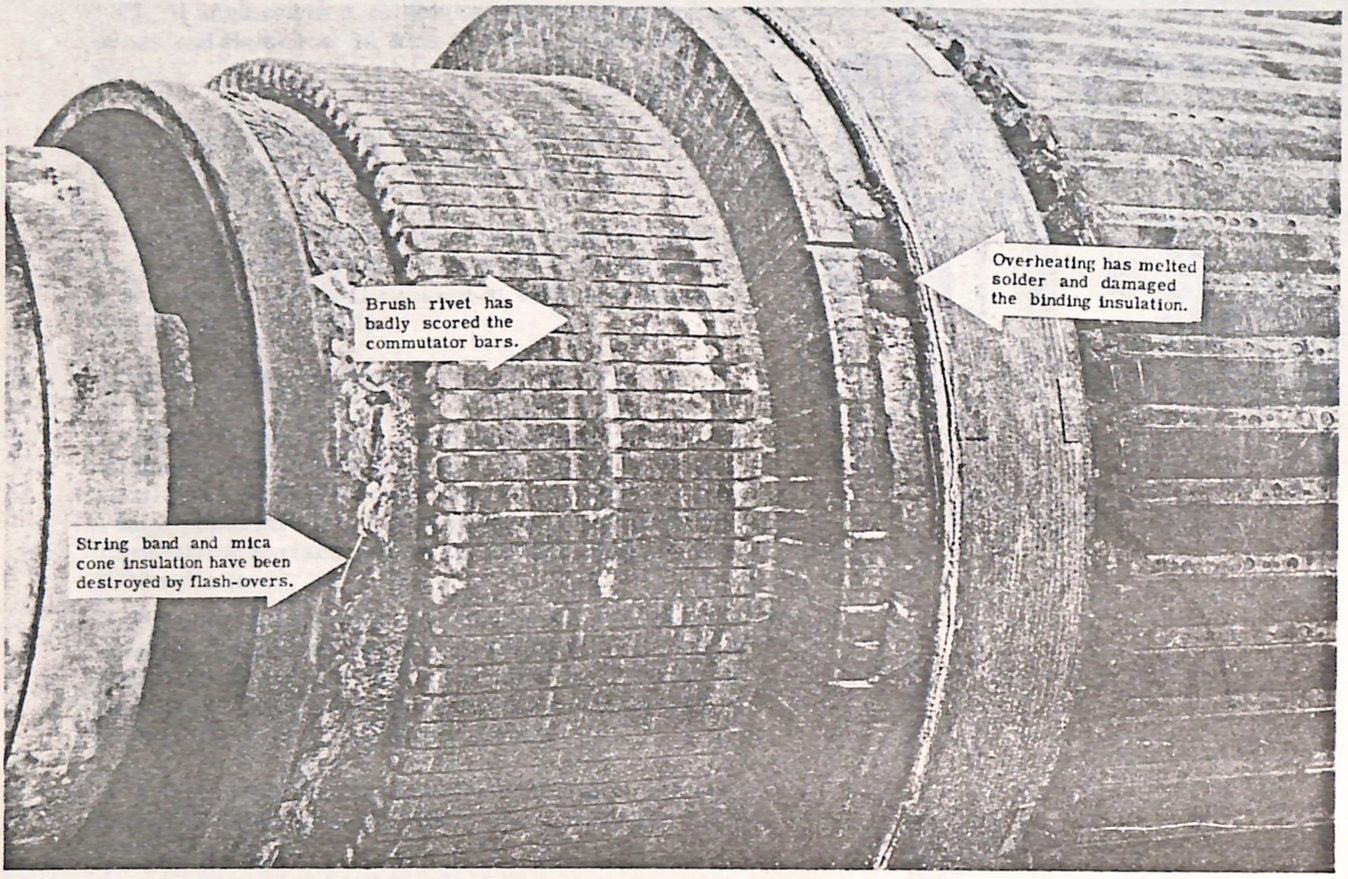


Plate A-118648 Armature damaged by brushes being allowed to wear down until the brush rivet scored the commutator surface.

In case it is found necessary to replace a commutator, a set of segments, side mica or cones, a complete seasoning cycle must be performed on the commutator after assembly on the armature core and after armature has been rewound. This seasoning consists of a series of cycles of spinning, heating, pressing, etc., for the purpose of setting the mica insulation to produce a tight commutator. This should not be attempted unless there are proper facilities and a trained personnel for doing this work; otherwise these repairs should be sent to the nearest General Electric Service Shop, since these are high-speed commutators which require exacting heat treatment and seasoning after repairs or rebuilding.

Seasoning a commutator requires baking, pressing and tightening in accordance with the following pro-

3. Heat to 100 C, press and tighten at four tons. Use 48-inch wrench.

4. Bake in 160-C oven for ten hours, press and tighten at 16 tons at 100 C, using 48-inch wrench.

5. Bake in 160-C oven for ten hours, press and tighten at 16 tons about 100 C, using 48-inch wrench.

6. Repeat item (5).

7. Test bar to bar at 400 volts.

8. Static balance.

9. Inspect and hi-pot at 4500 volts, test bar to bar at 400 volts.

10. Assemble on armature core.

11. If a soldering pot is used before soldering, back off ring nut one-third turn at 16-tons pressure. This need not be done if the leads are soldered into the commutator using the hand soldering method.

12. If soldered in a soldering pot, after soldering, press and tighten at 16 tons at 100 C. Use 48-inch wrench.

13. After dipping and baking, press and tighten at 16 tons at 100 C using a 48-inch wrench.

14. Season the commutator as an armature, heating the commutator to 140-150 C in 15 minutes at 500 rpm. Cool to 40-50 C running at 4500 rpm. Repeat for a total of two cycles.

TESTING AFTER REPAIRS

After the coils and head insulation have been stripped from the armature, a piece of bare wire should be wrapped around the commutator. Apply a high-potential test for one minute between the commutator surface and the armature shaft. Use 2500 volts (a-c).

Before applying high-potential test, be sure that cone insulation outside of cap and shell is dry and free from oil or dirt. Bake commutator (assembled on core) at 110 C for approximately eight hours to be sure there is no moisture present.

A bar-to-bar test of 220 volts with lamps in series should be made to ascertain if short circuits exist between bars.

BRUSH HOLDERS AND BRUSHES

When brush holders have been removed from the frame, clean them by wiping off the bodies, insulators, etc., with carbon tetrachloride. Carefully examine the bodies for worn, burned or corroded spots. If flashovers have occurred, tell-tale marks will be left on the brush holders. Clean these burned or beaded spots with a file.

Inspect brush-holder springs, spring tips and copper shunts; repair or replace defective parts. Spring tips should be securely riveted to the springs and the copper shunts should be securely fastened to the brush-holder body.

The springs are supported in formed-steel spring holders which are riveted to the body casting. Examine the hole in the spring holder for the lever pin for excessive wear; if the pin is too sloppy in the holder, replace the spring holder using copper rivets in the reassembly.

Check the spring mechanisms for correct brush pressure. With a new brush, the pressure should be approximately 5 1/2 pounds. Fig. 1 on Plate A-118840

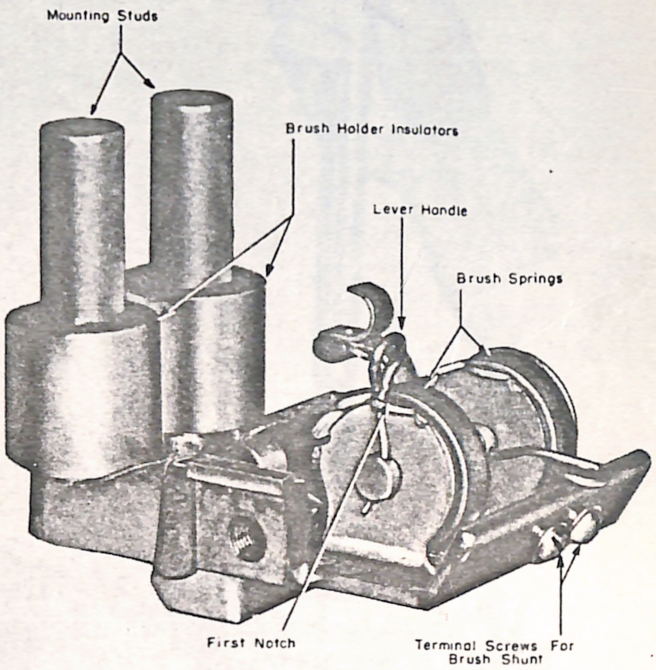


Plate A-125393 Type GE-1220 Brush Holder.

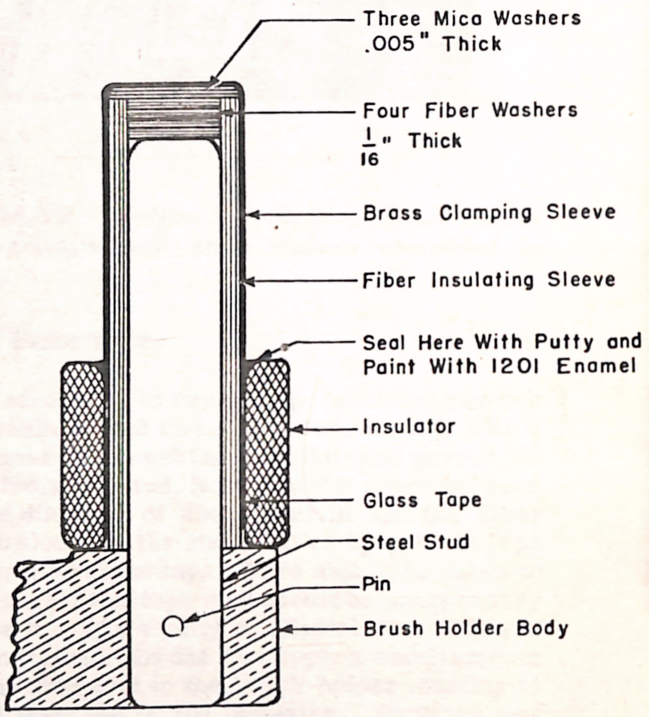


Plate A-120741A Cross section of fiber-insulated Stud.

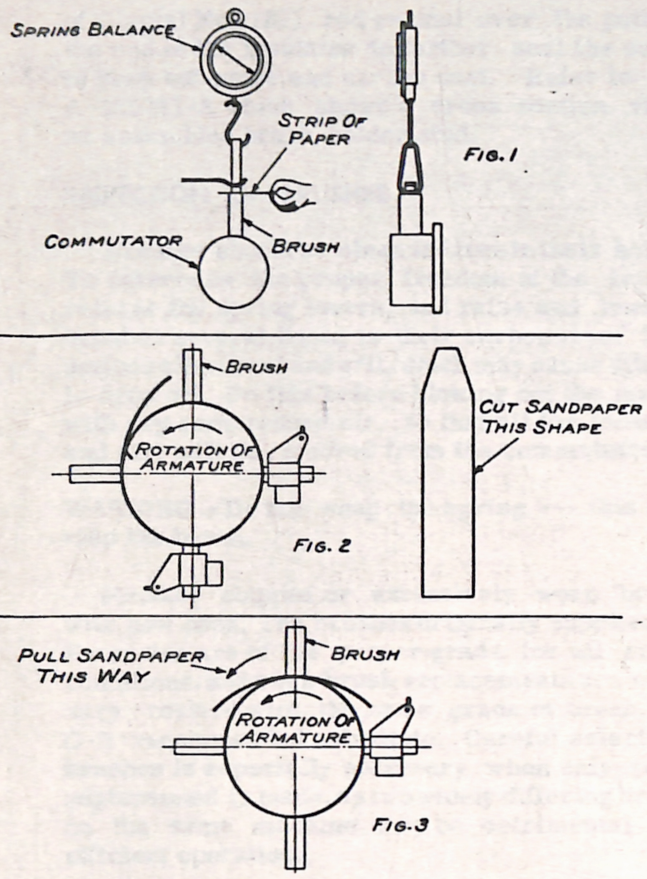


Plate A-118840 Method of sanding and obtaining brush pressure.

shows the correct method of measuring spring pressure; the spring balance commonly used for this purpose is a fish scale of 10 or 15 pounds capacity. The method of checking brush-holder spring pressure with brush holders assembled in the motor is shown in Plate A-118778.

Smooth up the brush carbonway with a fine file and then check for size with a new brush; if the side clearance is more than 0.025 inch, replace the brush-holder body.

Clean off the porcelain insulators and examine them for cracks, chipped surface or burnt spots. Replace damaged insulators. When the insulator is assembled on the stud, seal the clearance between the stud and inside diameter of insulator with a putty made by mixing Glyptal No. 1201 red enamel and talcum powder. This seal prevents the entrance of water, dirt or carbon dust in the space between the stud and porcelain, which would destroy the insulating effect of the porcelain. After long service, this seal may become broken, in which case, repair it at once. Often a brushing with Glyptal No. 1201 red enamel will be sufficient to close the small cracks which have developed.

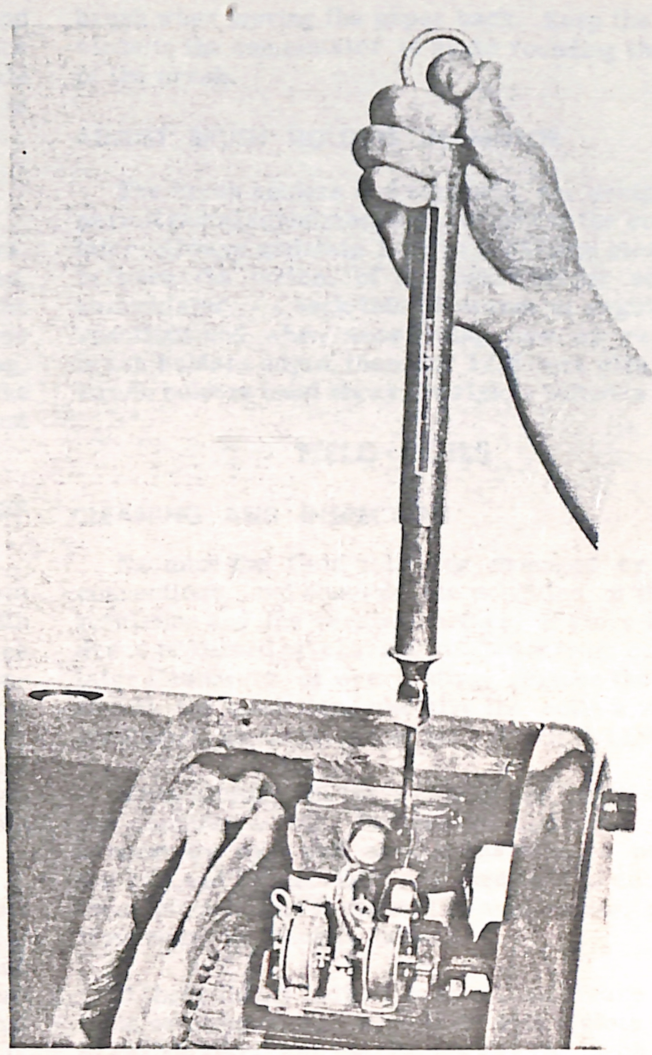


Plate A-118778 Method of checking Brush Holder spring-pressure with Brush Holders assembled in motor.

REPLACE INSULATOR

When necessary to replace an insulator remove the old insulator and clean the stud. A tap with a light hammer will break the porcelain and permit its removal from the stud. Note that the space between the inside diameter of the porcelain and the fiber insulation sleeve on the stud is filled by several laps of impregnated glass tape. Care should be taken to avoid damage to this tape so it should be unnecessary to replace it. Mix a putty of Glyptal No. 1201 red enamel and talcum powder and apply a small amount around the stud next to the brush-holder casting to seal the lower end of the insulator. Push the new insulator on the stud, glazed end down, until it touches the body casting. Fill in with the putty around the stud at the top of the porcelain to seal the opening between the two. After putty has set, brush on a coat

of Glyptal No. 1201 red enamel over the putty and the end of the insulator to further seal the surface to keep out water and carbon dust. Refer to Plate A-120741-A which shows a cross-section view of an assembled brush-holder stud.

INSPECTION OF BRUSHES

Brushes should be clean and free in their holders. To determine the proper freedom of the brushes, release the spring levers, and raise and lower the brushes several times in their carbonways. These actions allow sand and grit, which may cause sticking, to drop out. Do this before blowing out the machine with dry compressed air, so that all the loose dust and dirt will be removed from the commutator.

WARNING - Do not snap the spring --- this might chip the brush.

Replace chipped or excessively worn brushes with new ones. The brushes originally supplied with the motor are of the proper grade for all service conditions, and when brush replacements are necessary, replace with the same grade of brush, or a G-E recommended substitute. Careful selection of brushes is especially necessary when only partial replacement is made, as two widely differing brushes on the same machine may be detrimental to its efficient operation.

Never allow brushes to be worn down so short that there is danger of the lever striking the bottom of the slot or window in the carbonway. Also at each inspection be sure that there is sufficient brush length left to last until the next inspection, without any danger of the brush clip striking the surface of the commutator. Replace any brushes worn within 3/8 inch of the steel clip.

SANDING BRUSHES

When new brushes are installed, carefully fit them to the commutator by sandpapering; first, by using a coarse grade of sandpaper and then followed by a fine grade. Poor commutation will result from a poor brush fit.

When it is necessary to fit an entire set of brushes, refer to Fig. 2 on Plate A-118840 for the method recommended. Cut a strip of sandpaper the width of the commutator and of sufficient length to wrap one and one-quarter times around the circumference. Insert the small end in a slot between segments, and wrap the paper around the commutator so that by rotating the armature in the proper direction, the paper will be held in place by the friction of the brushes.

If only a few brushes are to be fitted, Fig. 3 on the same sketch illustrates a similar method. Draw the sandpaper in the direction of rotation and lift the brush when moving the paper back. Keep the paper close to the commutator tc avoid rounding the edge of the brush.

ADJUST BRUSH HOLDERS IN MOTOR

The brush holders and supports are designed to permit radial adjustment with respect to the commutator. Always maintain 1/16 to 3/32-inch clearance between the bottom of the brush holder and the commutator. Check this clearance at regular inspections and when assembling new or repaired brush holders adjust them for 1/16-inch clearance. Brush holders must always be rigidly bolted in place.

FIELD COILS

CLEANING AND INSPECTION

Examine the field coils for damaged or loose connections, and observe the condition of the coil insulation and the varnish surface. If there is evidence of burned or charred insulation from commutator flashovers or overheating, remove the coils, repair the insulation, and give the coils a varnish treatment, as described under OVERHAULING.

When blowing out the inside of the machine with dry compressed air, be sure to clean the spaces between the coils and around the corners between the coil and frame. Dirt and dust tend to collect in these places, and if allowed to accumulate, may in time cause an electric failure.

If there is any indication of oil or grease on the coils or connections, wipe it off with a cloth dipped in carbon tetrachloride. Do not use too much tetrachloride or it may soak into the insulation with injurious effects.

OVERHAULING

When the machine is being overhauled, remove the armature and clean the frame and field coils. If the condition of the varnish and insulation appears to be satisfactory, after cleaning, it may not be necessary to remove the coils from the frame, when overhauling the generators or motors. In this case, paint or spray the complete inside frame assembly with Glyptal No. 1201 red enamel, and bake it in oven for eight hours at 120 C (248 F). If facilities are available, dip the motor frames in the enamel while they are hot to insure a good enameled surface over all insulation, especially on the connections. Then use a solvent and wash off the outside of the frame and bake the complete frame assembly in the oven. For detailed method of procedure, refer to Paragraph 5 "Assembly in Frame".

After the coils have cooled to room temperature, apply high-potential test. See HIGH-POTENTIAL TEST below for instructions.

TESTS

HIGH POTENTIAL TEST

Before removing the field coils from the frame, they should be thoroughly cleaned and insulation-to-ground test applied. Dirt may cause a breakdown under the high-potential test.

Apply high-potential of 1500 volts alternating current for one minute between field coil circuits and frame.

If a coil becomes grounded, remove and repair it by reinsulation.

TEST FOR SHORT CIRCUITS

There are three accepted methods of testing for short circuits inside field coils. Each method varies in degree of accuracy.

RESISTANCE METHOD

This method consists of measuring the resistance and temperature of the coil. If the resistance is 5 per cent less than the standard, at a corresponding temperature, there may be a short circuit between turns, and the coil must then be replaced with a new one. The resistance increases approximately one per cent with each 2.5 C (4.5 F) increase in temperature. This is the least accurate method.

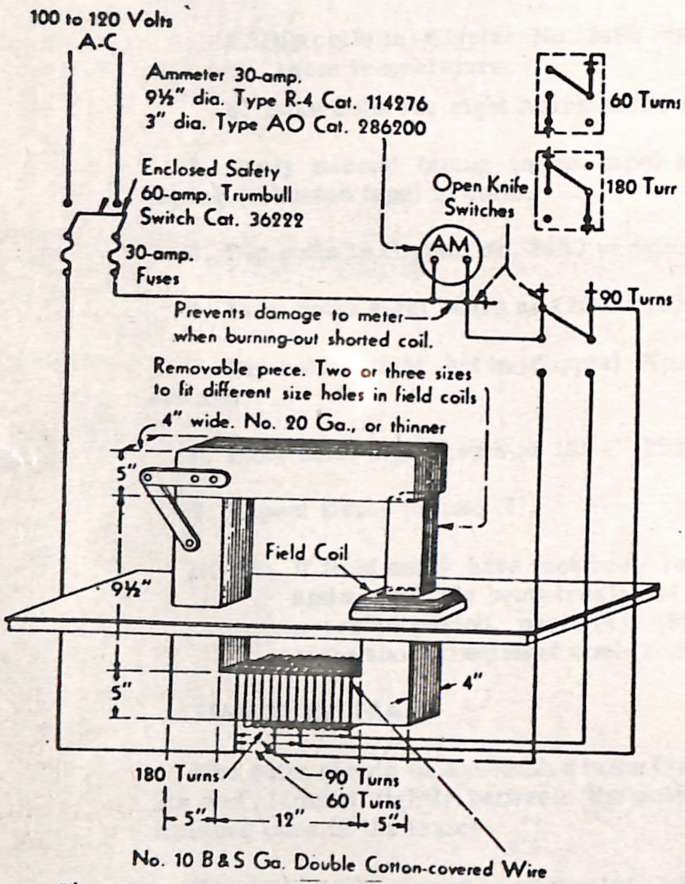


Plate A-118650 Growler test for field coils.

GROWLER TEST

The most common method of testing for short circuits in field coils is the growler test, and many repair shops are now equipped with a transformer or growler for this purpose. The growler test is a very simple and effective method, since no accurate electrical measurements are required. The diagram illustrates the connections and method of use of the growler.

Apply pressure to the field coil when it is being tested, in order to approximate actual conditions when it is clamped in the frame. If pressure is not applied, the coil may show no defect on test, but may give trouble from short circuited turns when clamped between the pole tips and the inside surface of the frame.

With the test in operation, after adjusting the knife switches for the desired number of turns on the transformer, place the removable portion of the core in place, but without the field coil. Note the deflection of the ammeter, which indicates the value of primary current. Open the line switch and place the coil in position around the transformer core; close the switch to reapply voltage to the transformer. If the ammeter shows the same deflection as before, the coil is free of short-circuited turns; if there is a short circuit, a much heavier current would flow in the primary coil of the transformer, and would be indicated by a greater deflection of the ammeter.

IMPEDANCE TEST

Standard Impedance

	Amps	Volts Max.	Volts Min.
Exciting Field	12	40	36
Commutating Field	24	15.5	14.0

The recommended method of testing series motor fields, is the impedance test, which is fundamentally the same as measuring resistance. A voltmeter and ammeter are used for this test. However, 25 or 60-cycle a-c voltage is used, and by holding a stated current through the coil, the voltage drop is measured and compared with the standard. While one or two short-circuited turns make no appreciable change in the resistance of a field coil, a single short-circuited turn makes a definite difference in the impedance.

One advantage of the impedance test is that it can be made with the armature either in the motor or out of it. This permits testing the coils for short circuits without disassembling the motor. When making the test, the brushes should be lifted, otherwise the armature coils are short circuited.

It is not advisable to make an impedance test of generator shunt field coils. Because of the large

number of turns of small wire, a very high voltage would be required to obtain a sufficient voltage drop between turns. This high voltage would damage the coils, and if a lower voltage were used, the current would be so small that the variation in value would not be noticeable. For the above reason, this test is only practical for motor field coils.

When a complete field measures low impedance, the bad coil is located by measuring the voltage drop across each coil, until the faulty one is located. Standard impedance is usually based on 60 cycles, and is measured with the armature in the motor, the brushes lifted, and the coils hot after a long run.

If necessary to remove the coils, disconnect the cables and remove the pole-piece bolts. Remove the coils and poles through the end of the frame and thoroughly clean the coil to remove any dirt, oil or grease.

VARNISH TREATMENT

Where individual coils only are being replaced in an assembled frame, the following treatment should be given completely reinsulated field coils.

1. After leads have been insulated and first taping of asbestos tape applied to the coils.

   a. Dip coils in Glyptal No. 2480 varnish at room temperature.

   b. Bake coils for eight hours at 125 C (257 F).

2. Apply second taping (mica tape) and third taping (asbestos tape) to coils.

3. Dip coils in Glyptal No. 2480 varnish.

4. Bake coils eight hours at 125 C (257 F).

5. Dip coils while hot in Glyptal No. 1201 red enamel.

6. Bake coils eight hours at 125 C (257 F).

7. Repeat items (5) and (6).

NOTE: If field coils have not been reinsulated and are merely being treated at a regular overhaul period, parts (4), (5), and (6) of the above treatment would be sufficient.

ASSEMBLY IN FRAME

The coils should be assembled in the frame while hot and clamped tightly between the pole tips and finished bore of the frame.

The field coils should be connected as shown in the connection diagram.

In order to determine if the coils have been properly connected the relative polarity of the poles may be checked by exciting the field circuit. Adjacent poles of the same field circuit should be of opposite polarity; this can be observed by means of a compass.

Field coil connections should be insulated by packing No. 2 black putty around the terminal, three tapings half-lapped No. 1782 Glyptal cloth tape and one taping half-lapped of cotton tape of G-E No. A2A1D14. Then apply Glyptal No. 1201 red enamel.

After the coils have been assembled in the frame and all the connections have been made and insulated, the frame assembly should receive the following treatment:

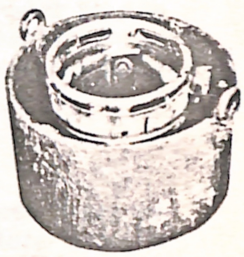
1. Place the coiled frame in oven and bake for 4 to 5 hours at 125 C (257 F).

2. Remove from oven and using a suitable dipping fixture, fill the inside of the coiled frame with Glyptal No. 2480 varnish making sure that the varnish extends well over the coil connections. Plate



Fig. A

Fig. A-Fixture used in dipping GE-1198 coiled magnet frame showing the felt seal in bottom.



ig. B-Coiled frame assembled in fixture ready for dipping.

Fig. B

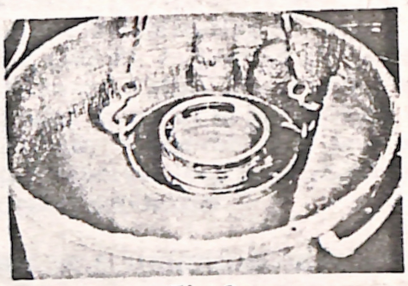


Fig. C

Fig. C- Fixture and frame in varnish tank. Note varnish covering the coils and connections.

Plate A-99417 Method of dipping motor frames.

TK-984

A-99417 illustrates the method used in the factory to dip the frame without getting varnish on the outside of the barrel.

3. Return to oven and bake for 16 to 24 hours at 125 C (257 F).

4. Remove from oven and using the same procedure as described in paragraph (2) fill the inside of the frame with Glyptal No. 1201 red enamel.

5. Bake in oven for 16 to 18 hours at 125 C (257 F).

After the completion of this treatment, the high-potential and short-circuit tests on the field coils should be repeated.

BEARINGS

ARMATURE

The armature is supported on antifriction-type bearings, ball bearings on the commutator end and roller bearings on the pinion end.

CORROSION

The principal cause of corrosion is water. Precautions must be taken to prevent moisture from entering the bearing assembly. Take particular care when the bearings are removed and cleaned, to keep a coating of oil or grease on the rolls at all times.

OVERHAULING

When the machine is disassembled for regular overhaul and the armature has been removed, thoroughly clean the bearings and examine them for wear or defects.

CLEANING

Remove the bearings and clean out all the old grease, using kerosene, safety solvent, or other petroleum solvent. NEVER CLEAN BEARINGS WITH CARBON TETRACHLORIDE. Immediately after cleaning the bearings, dip them in a light mineral oil (about SAE-10) bath heated to 95 C. This hot oil removes any moisture and insures that a film of oil protects all parts of the bearing from corrosion. Immediately after this hot-oil dip, wrap the bearings in oiled paper and place them in a clean, dry storage place until ready to reassemble in the machine.

In addition to cleaning the bearings, thoroughly wash out the bearing housings with kerosene or petroleum spirits, being sure to remove all the hardened grease from both the front and back grease chambers.

After the bearings have been cleaned, give them a visual inspection and check for defects, by rotating them in the hand and feeling for grit or binding. Inspect the cages for loose rivets, and examine for defective balls, rollers, or retainers.

Inspect the inner and outer race for defects, such as pitting or excessive wear. Do not take the cages apart. Do not use compressed air on the bearings, because it may contain moisture which would cause corrosion. If any defect whatsoever is observed, reject the bearing.

The inner race should be a shrink fit on the armature shaft, and the outer race should be a push fit in the outer housing. If the bore of the inner race is so worn that a satisfactory fit on the shaft cannot be obtained, the bearing should be rejected. If the outer diameter of the bearing is so worn that it is loose in the housing, the bearing should be rejected. Do not interchange the inner and outer races of different makes of bearings.

GREASE RETAINERS

At every overhaul period, inspect the gaskets used under the bearing caps and if they are defective, replace them with gaskets made of 0.021 inch thick Vellumoid packing, or its equivalent. It is important that the proper thickness of packing be used, as this affects the clearance between the outer race of the bearing and the housing or bearing cap.

The commutator-end ball bearing outer race is clamped in the bearing housing and locates the armature and takes the end thrust. The drive-end bearing is a roller bearing and floats.

NEW BEARINGS

New bearings should not be removed from the original packing until immediately before they are to be used. Unwrap the bearings in a clean dry place and remove the packing grease by washing the bearings thoroughly in kerosene or some similar petroleum solvent. Dry the parts well, and dip them into a light grade of lubricating oil, about SAE-10, heated to 95 C (203 F), to prevent corrosion. Keep bearing parts covered at all times with clean rags, paper, or similar material to prevent the entrance of dirt, chips, etc. When ordering new bearings, order from the General Electric Company to be sure of obtaining exact duplicates.

PRECAUTIONS FOR HANDLING NEW BEARINGS

1. Be careful not to damage the bearing.

2. Do not allow any dirt to get into the bearing.

3. Be sure your hands and tools are clean.

4. Provide a clean paper on which to lay the bearing.

5. After removal of a bearing, wash it in kerosene, dip it into hot oil and wrap in oiled paper.

6. Do not clean the bearing with carbon tetrachloride; use some form of petroleum spirits, such as kerosene.

7. Do not use compressed air on a bearing; it may contain moisture which would cause corrosion.

8. Before assembling the bearing on the shaft, be sure that the shoulders on the shaft are not burred or have rough edges.

9. Be sure that the bearing fit on the shaft is smooth and not scored.

10. Do not use a hammer against the outer race.

11. Do not use a cold chisel and hammer to free the inner race from the shaft.

12. Never heat any part of a bearing over 135 C (275 F).

13. When lubricating, use only fresh, clean grease, which is free from dirt, grit, moisture, or foreign material.

ASSEMBLY

Drive-End Bearing Assembly

a. Assemble gasket 18 and bearing cap 20 on shaft.

b. Fill 60 per cent of available space with grease.

c. Heat inner flinger 16 and bearing inner raceway with rolls in oven to approximately 125 C (257 F) and assemble on armature shaft.

d. Allow bearing to cool, then pack grease around rolls (fill approximately 60 per cent of space with grease).

e. Heat retaining ring 21 to approximately 125 C (257 F) and assemble in place.

f. Heat outer raceway of roller bearing 15 to 60 C and drop it into framehead 17.

g. Fill grease chamber in framehead 17, two-thirds full of grease.

h. Assemble framehead with outer bearing race in position on the shaft.

i. Clamp framehead to bearing cap with cap screws 22 and lock washer 23.

ASSEMBLY-ROLLER BEARINGS (DRIVE-END)

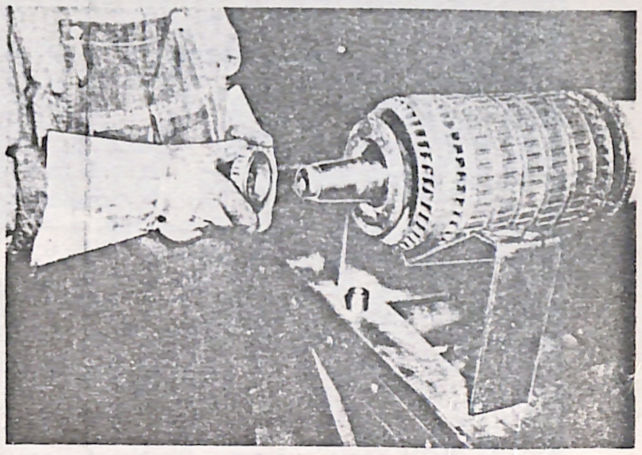


Plate A-118651 Heat bearing and flinger to 100 C and assemble in place on shaft.

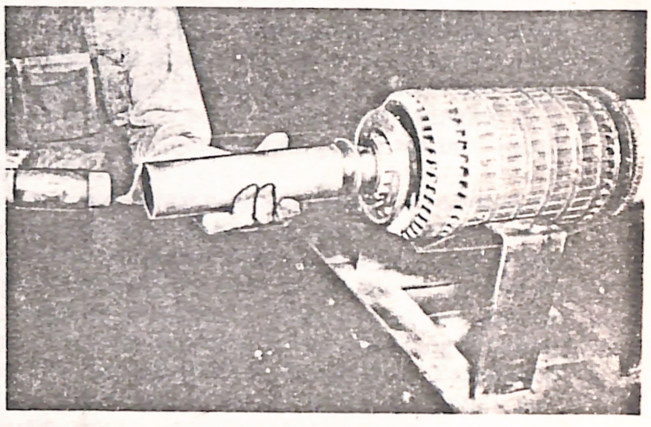


Plate A-118652 Drive the bearing home with a mollet against pipe fitted over the shaft.

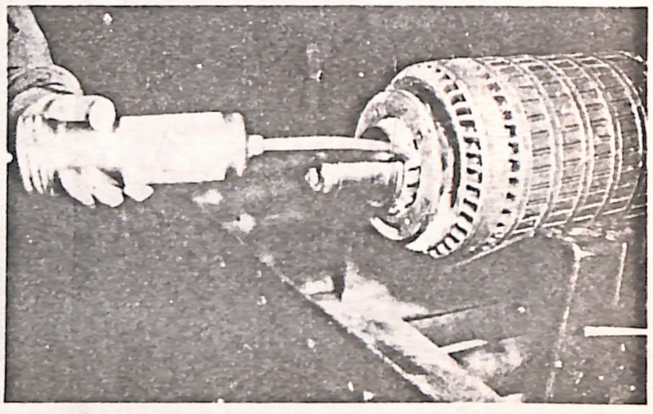


Plate A-118653 Grease bearing with grease gun, assemble retaining ring (heated to 100 C) on shaft.

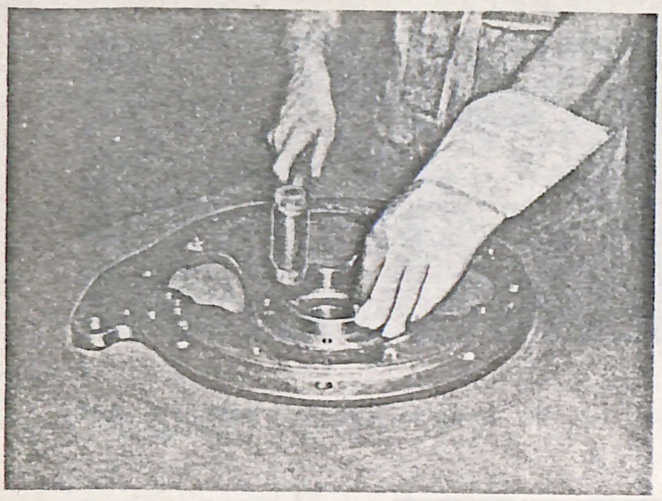


Plate A-118654 Heat framehead to 60 C and drop outer bearing race in place. If necessary, tap with rawhide mallet. Add grease.

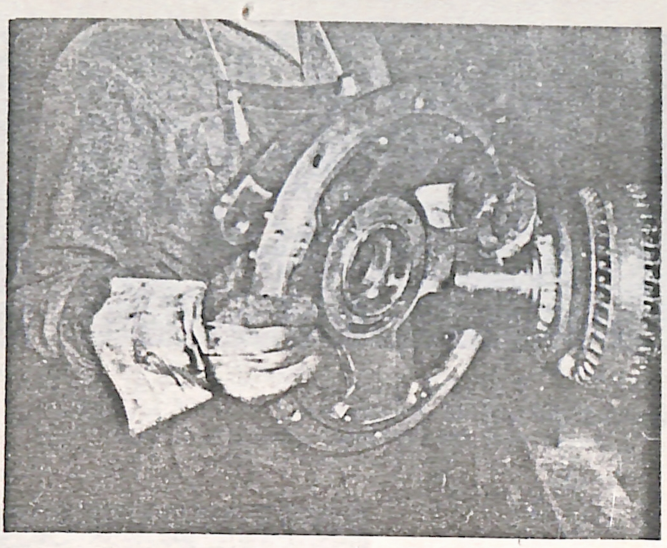


Plate A-118655 Place framehead with outer bearing race on shaft and bolt in place.

Commutator-End Bearing

a. Assemble inner cap 13 and inner flinger 12.

b. Heat ball bearing 4 in oil bath to approximately 125 C (257 F) and assemble on shaft. Note that the bearing must be assembled with the grease seal plate to the inside or toward the armature.

c. Assemble lock washer 7 and nut 6. Bend one side of lock washer over on nut to prevent it from backing off.

d. Allow bearing to cool, then pack with grease (fill approximately 60 per cent of space with grease).

e. Assemble bearing housing 5 (with 60 per cent of available space filled with grease) with gasket 11 by tapping lightly around the edge until it is far enough on to start screws 8.

f. Draw bearing housing into place against inner cap 13.

With the motor frame in a horizontal position on a bench, assemble armature in place. The commutator should be protected with a piece of heavy paper held in place by friction tape while the armature is being assembled in frame. The armature can be drawn into its final position by the bearing housing bolts 3 at the commutator end and the framehead bolts at the drive end. Be sure that armature rotates freely.

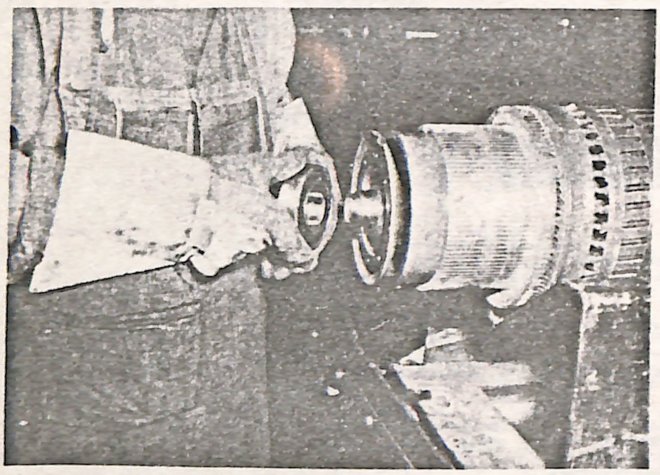


Plate 118656 Assemble inner bearing cap and flinger on shaft. Heat bearing to 100 C and place in position on shaft.

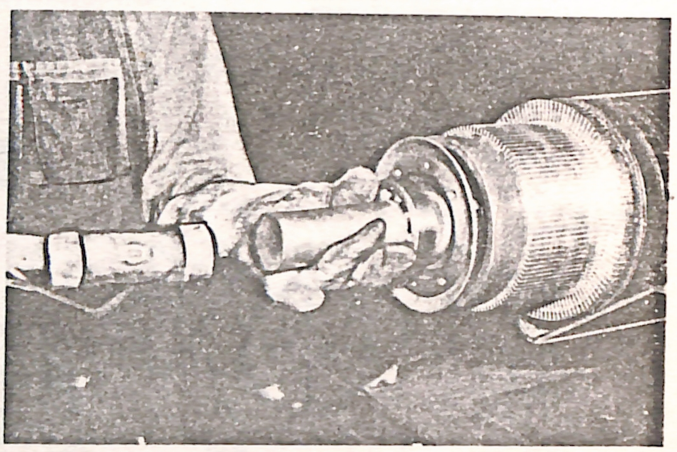


Plate A-118657 Hammer the bearing home with a mallet against a pipe fitted around the shaft and up against the inner bearing race. assemble the lockwasher and nut.

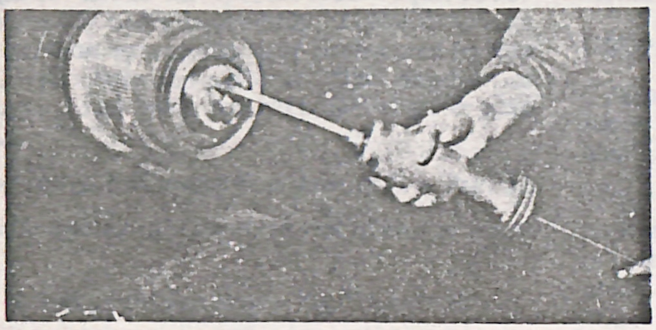


Plate A-118658 Grease bearings. Do not force or overgrease.

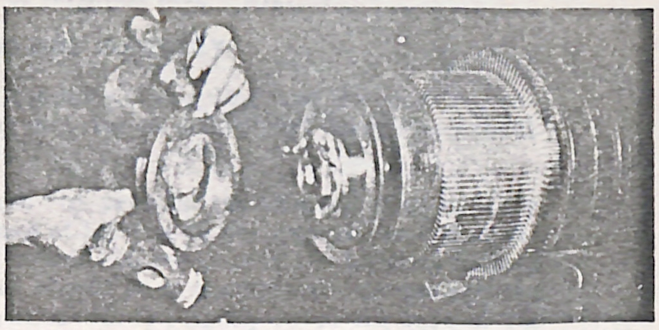


Plate A-118659 Put grease in bearing housing and bolt the housing with gasket into place.

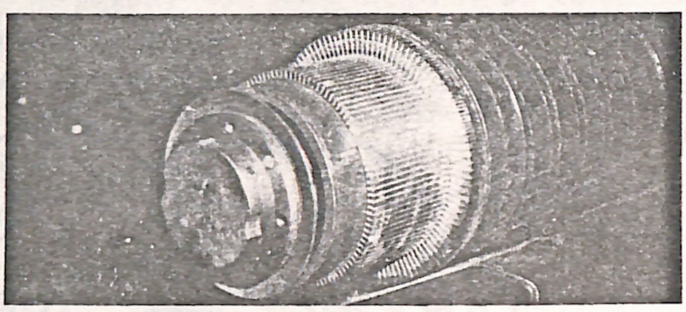


Plate A-118669 Armature with bearing housing cap assembled.

SPECIAL TOOLS

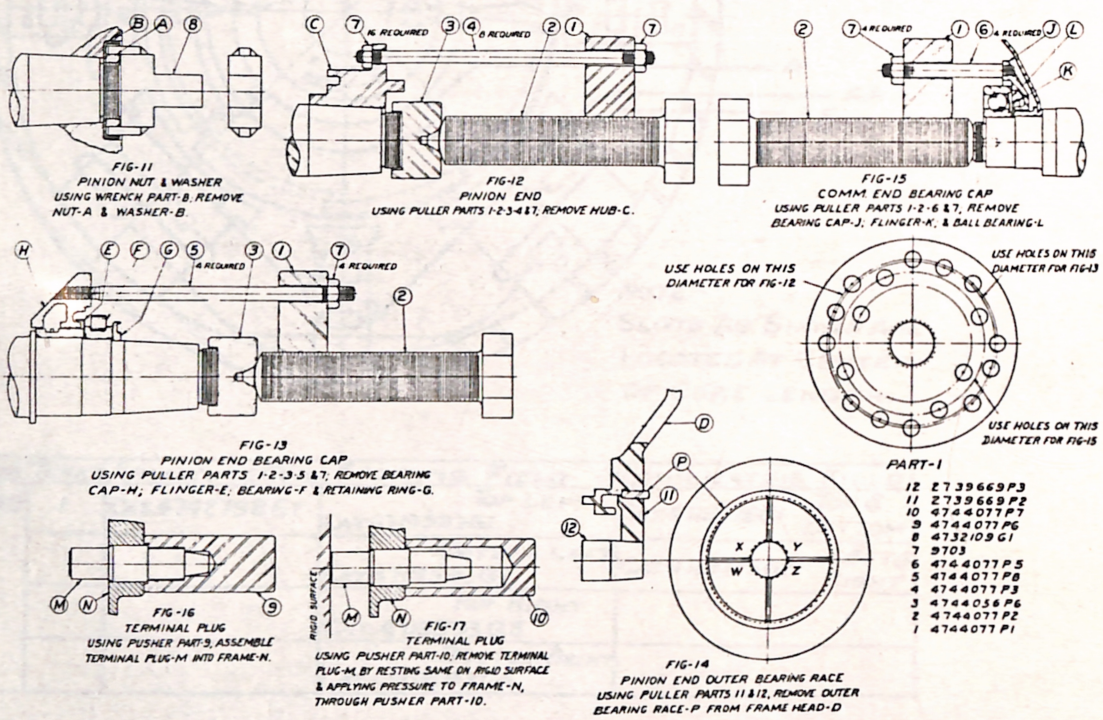


Plate A-118660 Method of disassembling GE-1220 Motor.

This plate shows the special tools required for proper assembly and disassembly. These drawings show the various operations to be performed by use of special wrenches and pullers. The number of puller studs to be used for each operation is also indicated.

Removal of nut on drive end of motor shaft - Fig. 11

Removal of coupling hub on drive end of motor shaft Fig. 12

Removal of drive-end bearing - Fig. 13 and 14

Removal of commutator-end bearing - Fig. 15

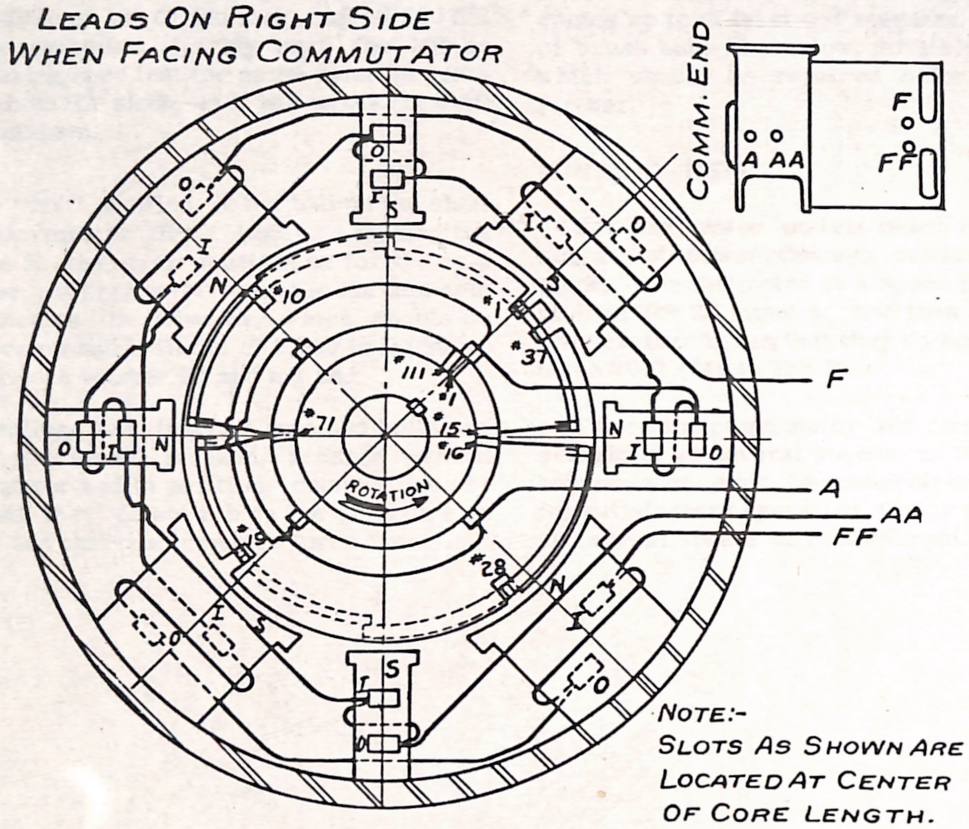
Assembly of terminal plug - Fig. 16

Removal of terminal plug - Fig. 17

COUPLING-HUB ASSEMBLY

Clean the bore of coupling and the shaft fit; remove any scoring on either part using fine crocus cloth.

In order to prevent the slipping of hubs, they should have at least a 75 per cent fit on the shaft. In other words, 75 per cent of the tapered surface of the shaft should be in contact with the bore of the hub. To check for fit, lightly cover the bore of the hub with blueing compound. The cold hub is then snapped on the shaft by hand and the relative position on the shaft is marked with chalk. The hub is



MOTOR	TURNS	ARMATURE COIL	EXCITING FIELD	COMMUTATING FIELD
GE-1198	1	CAT. 4742798 G1	TOP LEFT CAT. 4719593G1	CAT. 4719776G1 TOP & BOTTOM
			BOTTOM LEFT CAT. 4719593G2	CAT. 4719776G2 LEFT & RIGHT
			TOP RIGHT CAT. 4719593 G3	
			BOTTOM RIGHT CAT. 4719593G4	

MADE FROM K-4768796

Plate A-118666 Connection diagram for GE-1220 Motor.

then removed and the blueing from the hub bore should show on the shaft. If 75 per cent of the shaft surface shows traces of blueing, the fit is satisfactory; if, however, only a few spots of blueing show, then the fit is unsatisfactory. In that case, dress up the blue spots on the shaft lightly with fine emery paper. Blue the pinion bore and repeat the process, being careful to apply the hub to the same relative position on the shaft. After a good fit is obtained, remove the blueing from shaft and hub and mount as follows:

Mount the hub cold on the shaft in same relative position as used in above process. Using a micrometer depth gage, measure the "cold" position of the hub on the shaft.

Remove the hub and heat in a suitable oven to a total temperature of 180 C (do not exceed 190 C). When up to temperature, quickly snap the hub on the shaft, making sure that the same relative position of the hub on the shaft as it had in the "cold" check is maintained.

Check the "hot" position. of the hub on the shaft using the micrometer depth gage and making the measurement at the same location as for the cold reading. The difference between the hot and cold readings indicates the advance, which should be within the recommended limits of 0.040 to 0.050 in. Assemble the lock washer 25 and nut 26.

On assembling, see that all nuts and bolts are tight, bearings properly greased, brushes sanded to the commutator and in position, connections secured so that they do not rub on the armature or commutator, and that the armature turns freely.

TESTS AFTER REPAIRS

After being repaired and reassembled, the motor should be given several tests before being placed back in service to be sure that it is operating satisfactorily.

INSULATION TESTS

Using a megohmmeter, measure the insulation resistance between the windings and the frame. If and only when the insulation resistance measures not less than one megohm, apply a high-potential test of 1500 volts, a-c, for one minute between the windings and the frame. If insulation resistance is low, lift the brushes and check individually the armature and field coils. If the armature alone is low, this may be due to a moisture condition or "green" varnish after dippings. In this case, rebake the armature until the megohmmeter reading comes up to at least one megohm. If the field coils or brush holders are low, possibly a ground exists, which should be repaired before proceeding any further.

RUNNING TESTS

Set the motor on test bench and connect it to a source of power through suitable control equipment. Run the motor at a speed of 2000 rpm under no load for 30 minutes, and then check the bearing temperature to see that they do not rise higher than 60 to 70 C (140 to 158 F).

Check the commutator for smoothness and concentricity at several speeds up to 4000 rpm. The commutator must be concentric within 0.001 inch for satisfactory operation. Check machine vibration at several speeds up to 4000 rpm.

APPARATUS DEPARTMENT
LOCOMOTIVE & CAR EQUIPMENT DIVISIONS
GENERAL ELECTRIC
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