C.M.I. 3954-6

CLYDE MAINTENANCE INSTRUCTION

TRACTION MOTOR OVERHAUL

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SECTION 6
ARMATURE OVERHAUL

NOTE

This D43 Traction Motor overhaul instruction is presented in seven sections, each under separate cover, and contains detailed instructions to completely disassemble, inspect, overhaul, assemble, and test the traction motor.

Refer to Maintenance Instruction, CMI3901, for general or "running" maintenance of the traction motor and also for procedures to remove the traction motor from the locomotive bogie.

Section 6	Title
1	Disassembly
2	Bearing Component Inspection
3	Stator Inspection And Reconditioning - Mechanical
4	Stator Inspection And Reconditioning - Electrical
5	Armature Inspection And Reconditioning
6	**Armature Overhaul**
7	Motor Assembly

ARMATURE OVERHAUL

INTRODUCTION

When inspection of the armature indicates the armature must be rewound, the coils must be removed and the commutator and core prepared prior to rewinding.

The purpose of this section of the Maintenance Instruction is to guide personnel engaged in performing these operations to ensure satisfactory performance in operation.

ARMATURE COIL REMOVAL

1. Apply armature shaft (lathe) "driving dog" to the threads at the pinion end of the armature. Refer to Service Data for driving dog part number.

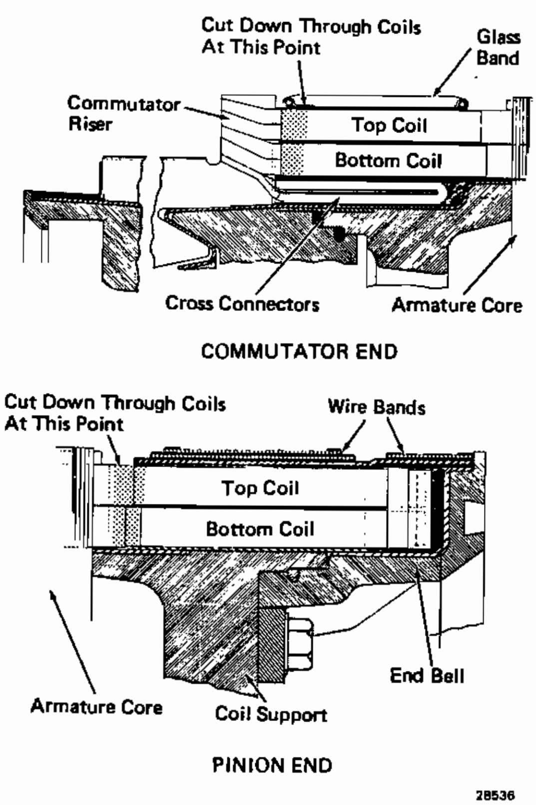

Fig. 1. - Cutting Armature Coils

2. Place armature assembly (with driving dog attached) in a lathe. The lathe must be equipped with a face plate which will attach to the driving dog. The lathe must also have a "live centre" in the tail stock to prevent possible damage to the armature shaft centre.

3. Install armature coil cutting tool in the lathe tool holder and rotate the armature at approximately 76 RPM. Refer to Service Data for armature coil cutting tool.

4. Cut the coils at two points as shown in Fig. 1

   a. At commutator end, behind the commutator, between the riser and the fibreglass band. Do not damage commutator.

   b. At pinion end, between the armature core and the wire band. Do not damage core.

NOTE: Cut the top layer of coils so that the cut area will be wider than the cut area for the lower coils. The top clearance will prevent tool jamming when cutting the bottom coils.

5. Remove armature from lathe. Remove armature shaft driving dog and place armature in a suitable stand. The stand should hold the armature securely and permit the armature to be rotated.

WARNING:
In Step 6, use care when cutting the armature bands. The bands are applied under tension and injury could result to the operator as the bands are released during cutting.

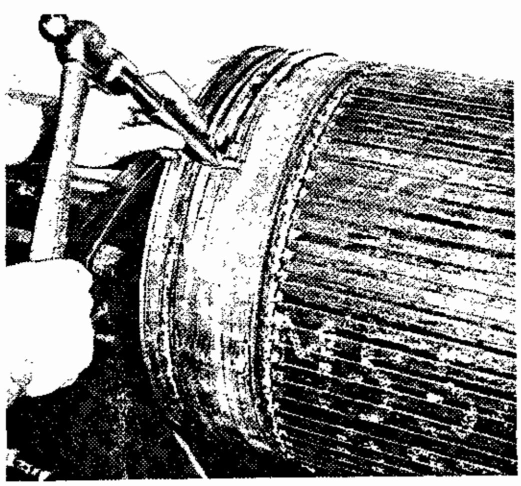

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Fig. 2 - Removing Wire Bands

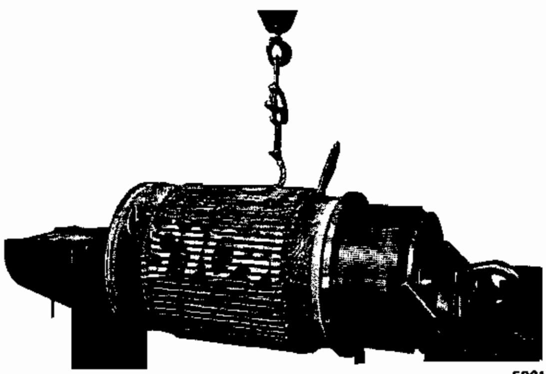

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Fig. 3 - Removing Armature Coils

6. Remove the bands from the armature by using a sharp chisel and hammer. Cut through one layer of bands at a time as shown in Fig. 2. Newer assemblies will be equipped with glass bands at the commutator end instead of wire.

7. Separate and remove the section of coils at the pinion end which had been under the wire band.

8. Raise the coil ends between the core and commutator. Raise one layer at a time. Fig. 3 shows a method of removing the coils without first removing the armature slot wedges. Ensure the coil being removed is a top coil and that the coil is being pulled up straight to prevent binding or damaging the end plates of the armature core.

9. At the pinion end, remove bolts holding the end bell to the coil support, Fig. 1. Remove end bell, being careful not to damage bell.

10. Clean core and coil supports thoroughly. Remove all pieces of insulation, dirt, cement, carbon dust, and any other foreign material. Do not use heating torches or sand blasting for this operation which could damage the armature core. Smooth cut files and scrapers can be used carefully so as not to damage the laminations

ARMATURE INSPECTION AND CLEANING BEFORE REWIND

1. Remove all burrs and nicks from armature core slots, end plates, and coil supports. Any nick or burr could damage coil insulation.

2. Check all slots to ensure that core laminations in slots are aligned and not bumped out-of-line. Check slots for alignment with slot gauge, Fig. 4. The gauge is to fit slot with a slight "feel" and should be neither loose nor tight. If laminations have been bent, they may be realigned by inserting a wedge, the, same size as the gauge, and tapping lightly with a mallet. Use care so as not to roughen or burr laminations. If core slots are tight, file the core slots with a slot file as shown in Fig. 4. Do not file the core slots excessively to cause shiny spots. Excessive filing will cause dragover of laminations which will result in shorting between the laminations causing core heating (hot spots) during operation. Refer to Service Data for gauge and file part numbers.

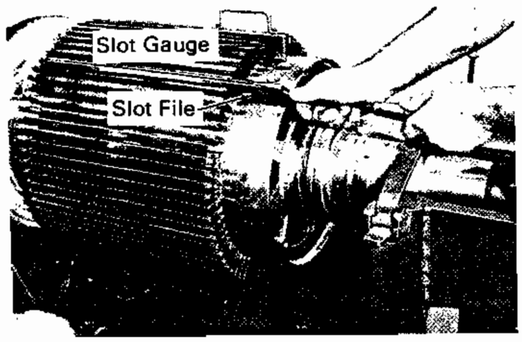


Fig. 4 - Filing Armature Core Slots

3. Check all slot wedge grooves with wedge slot gauge, Fig. 5. The gauge is to fit-slot wedge groove with a slight "feel" and should be neither loose nor tight. If gauge will not fit properly, use wedge slot file to clean out slot as shown in Fig. 5. Refer to Service Data for gauge and file part numbers.

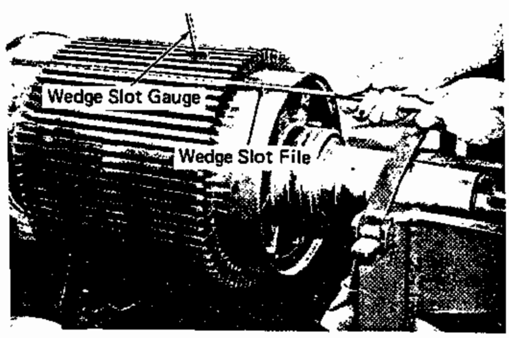


Fig. 5 - Filing Slot Wedges

NOTE: Preserve the upper portion of the slot wedge groove which is the slot wedge contact surface. Excessive filing will distort the wedge slot.

4. Check the core end plates at both ends of the slots with a gauge, Fig. 6. Ensure there is clearance at both sides of the end plate for the "U " piece insulation which will be applied when winding the armature.

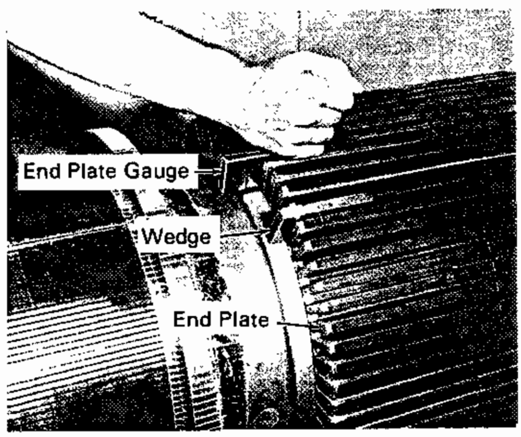


Fig. 6 - Checking End Plates

NOTE: Do not use the gauge to line up the end plates. Use a wedge, Fig. 6, made to the size of the gauge, which can be tapped. Aligning end plates with the gauge can damage the gauge.

5. Inspect the end plates for breaks or separations. If they are separated, push back in place and file a small "V" notch in the top of the end plate. Weld the end plate in place and file to shape.

6. Clean ventilation holes in armature core thoroughly or to a minimum diameter of 24 mm

7. Clean commutator end and pinion end coil supports thoroughly of all insulation, varnish, and shellac.

8. Inspect commutator end and pinion end coil supports for cracks. Replace coil support with a new coil support if cracked. No welding should be performed on coil supports. Refer to following paragraphs for coil support replacement.

REMOVING COMMUTATOR RISER COIL LEAD ENDS

1. Split both sides of the coil lead ends at the riser with a chisel by carefully driving the chisel down between the commutator riser and the lead ends. Do not damage the riser.

2. Knock the coil lead ends out of the riser with a chisel as shown in Fig. 7. Use care to prevent damage or distortion of the riser.

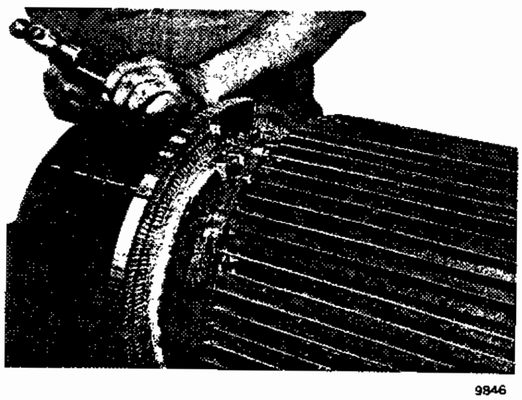


Fig. 7 - Lead Removal from Riser

COMMUTATOR RISER CLEANING AND INSPECTION

1. When all the coil lead ends have been removed from the commutator riser slots, the bottom and sides of the slots should be scraped. cobblasted, or glass bead blasted to remove all varnish, carbon, enamel, or dirt that may be on the back of the riser. Do not damage the mica that extends out from between the riser bars. Protect the commutator end band and insulation.

2. Check the riser of each bar closely for cracks. Check mica segments between riser bars to ensure the segments have not been damaged during stripping operation. Ensure all copper, chips, and carbon dust have been removed. Clean out slots between the commutator bars at the brush surface using a scraper. Refer to Service Data for scraper part number.

3. Perform commutator bar-to-bar resistance check to ensure no bar-to-bar shorts exist.

4. Ground test commutator at 5000 volts for 10 seconds prior to rewinding.

ARMATURE SHAFT REMOVAL

When it is required to remove coil supports, core laminations, or armature spider, removal of the armature shaft is required. Perform the following procedure to remove the armature shaft.

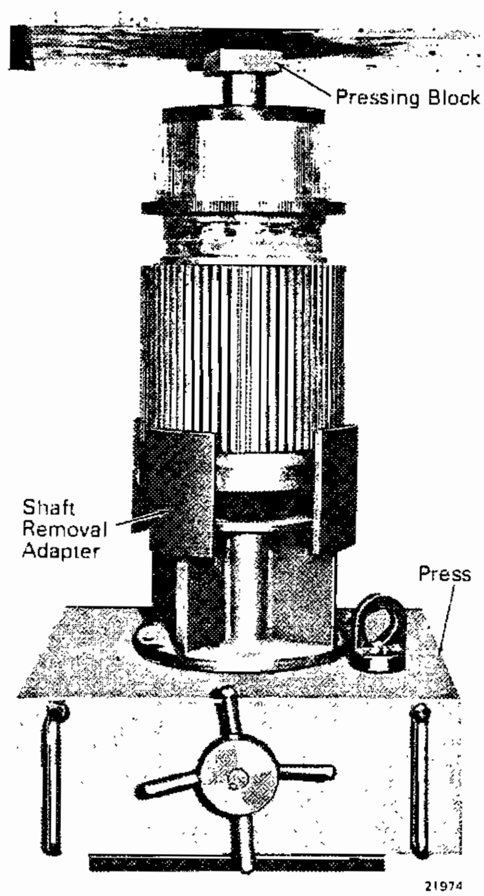


Fig. 8 - Shaft and Commutator Removal

- Position assembly under press, Fig. 8. Apply pressing block to commutator end of shaft and press shaft out. Do not allow pressure to be applied to the steel "V " ring of the commutator.

- Commutator and core will now be free of shaft. Remove commutator and shaft from armature core.

COMMUTATOR REMOVAL

If the commutator must be removed for repair or if the commutator end coil support must be removed, perform the following procedure.

NOTE: A fixture made of 51 mm steel plate is required to remove the commutator. The plate must be drilled to receive four 25.4 mm bolts and positioned to go into the four bolt holes of the bolts removed in Step 1.

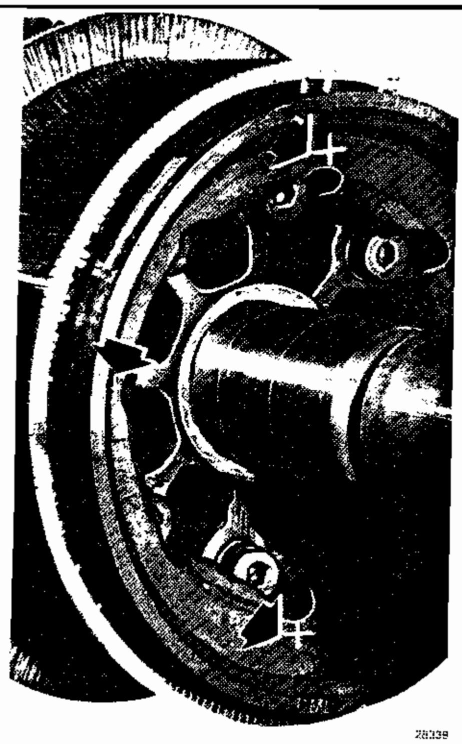


Fig. 9 - Location of Commutator Threads

1. Remove the four commutator bolts located on the front of the commutator spider that are indicated with an "X" on Fig. 9.

2. Apply commutator removal fixture to front of commutator with four 25.4 mm bolts into the threaded portion of the holes of the studs removed in Step 1.

3. Place pinion puller between the commutator removal fixture and the armature shaft. Check alignment to ensure the pull will be equal on all four studs.

4. Support commutator to prevent commutator from falling as it is pulled from shaft.

5. Apply pressure with the pinion puller to remove the commutator. Approximately 40-55 tonne force will be required to remove the commutator. If the ram travel is not sufficient to remove the commutator in one operation, it will be necessary to release pressure of pinion puller to allow the ram to retract and then add a steel block between the shaft and the ram. Repeat operation until the commutator is removed.

PINION END COIL SUPPORT REMOVAL AND REPLACEMENT

1. Place armature in a lathe and machine off weld and portion of coil support hub as shown in Fig. 10.

2. Press out armature shaft as directed in Armature Shaft Removal procedure.

3. Apply puller studs to the 5/8"-11 tapped holes in the coil support. Apply a puller plate to the studs and pull coil support off the quill. It may be necessary to cut through the remaining part of the coil support hub to relieve the hold on the quill.

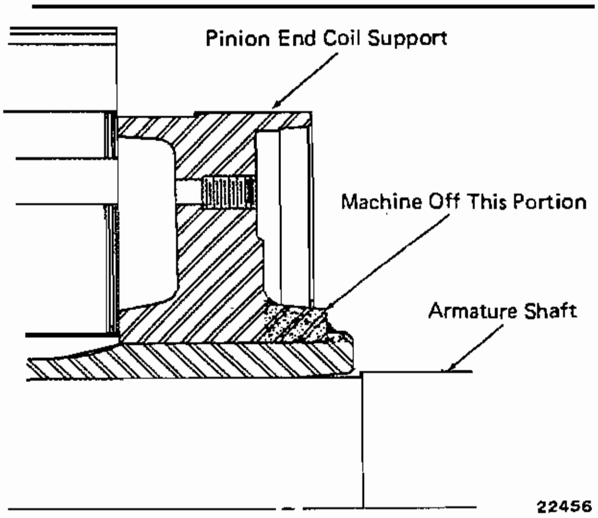


Fig. 10 - Pinion End Coil Support Removal

4. Place core assembly under hydraulic press. Heat a new coil support to 160^{0} C (320^{0} F). Press heated coil support onto quill and hold under 54 tonnes pressure. Tack weld coil support to quill while under pressure.

5. Remove core assembly from press and weld coil support onto quill with a half inch fillet weld all around coil support.

6. Apply a mandrel to the core assembly. Place core assembly in a lathe and machine coil support diameters to dimensions shown in Fig. 11.

COMMUTATOR END COIL SUPPORT REMOVAL AND REPLACEMENT

1. Press out armature shaft and remove commutator as directed in Armature Shaft Removal and Commutator Removal procedures.

2. Remove 1/4"-20 set screws in quill, Fig. 12.

3. Place core assembly in a stacking fixture, pinion end down.

4. Place a plate on top of the commutator end coil support.

5. Place assembly under hydraulic press and apply 54 tonnes pressure. Hold pressure and remove armature nut. Release pressure and remove assembly from press.

6. Remove commutator end coil support by driving wedge shape pry bars between the coil support and armature core end plate.

NOTE: If core laminations are damaged and must be replaced, replace laminations before applying coil support. Refer to Replacing Armature Core Laminations procedure which follows.

7. Apply a new coil support and top pressing plate.

8. Place Assembly under press and apply 27 tonnes pressure.

9. Replace and tighten armature nut while assembly is under pressure.

10. Remove assembly from press, and replace 1/4"-20 quill setscrew.

REPLACING ARMATURE CORE LAMINATIONS

When laminations are damaged or overheated, or lamination fingers are beyond repair, perform the following procedure to replace damaged area.

NOTE: If armature core is rubbed or scuffed on the outside diameter, the damage is acceptable over any portion of the core outer diameter if the damaged area, after cleanup (edges of the laminations must be clearly visible), has not been reduced more than 0.46 mm

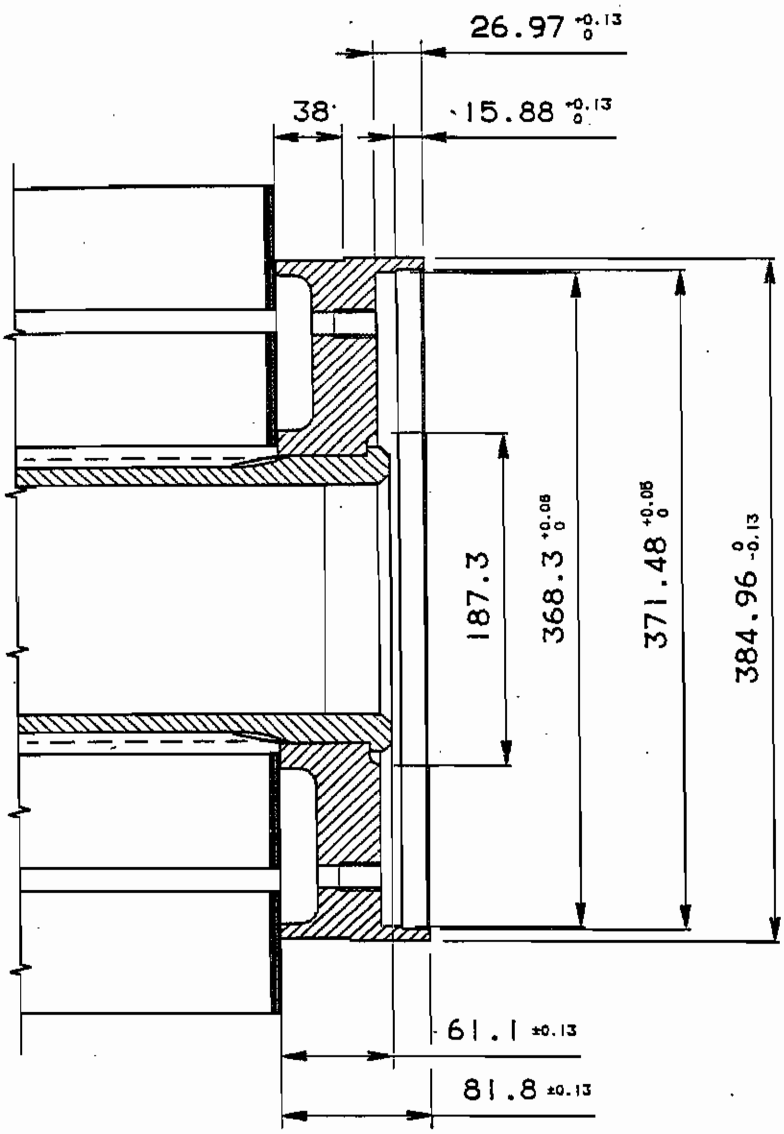


Fig. 11 - Pinion End Coil Support Dimensions

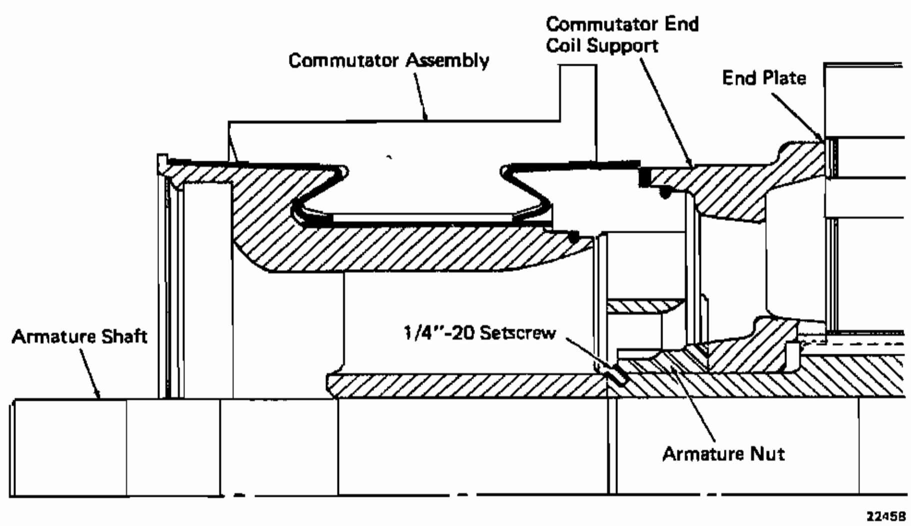


Fig. 12 - Commutator End Coil Support Removal

1. Perform Steps 1 through 6 of Commutator End Coil Support Removal And Replacement to remove armature shaft, commutator, and commutator end coil support.

2. Place core assembly in a stacking fixture, pinion end down. Remove end plate and all damaged laminations by driving wedge shaped pry bars into damaged area. Remove only 15 or 20 laminations at a time.

NOTE: If the damaged laminations are at the pinion end, the armature spider may be pressed out of the core and the damaged laminations removed from the core. Press the remaining laminations back onto the spider. Restack the core to proper size. Core will have to be taped or somehow held together during handling once it is removed from the quill.

3. When all damaged laminations have been removed, restack the core with new laminations of the proper bore to obtain a press fit from 0.05 mm to 0.064 mm between laminations, spider, and new end plate. Apply only 10 to 15 laminations at a time to avoid bending laminations. Use stacking bars 90^{o} apart in coil slots to line up the slots. Use end plate gauge to line up end plate slots with lamination slots.

4. Apply coil support and a top pressing plate.

5. Place assembly under press and apply 27 tonnes pressure. Measure the height of the stack while under pressure. The core stack should be 304.00 mm to 305.59 mm at bottom of core slots and over the end plates.

6. Replace and tighten armature nut while assembly is under pressure.

7. Remove assembly from press and replace 1/4"-20 quill setscrew.

ARMATURE SPIDER REMOVAL AND REPLACEMENT

If the armature spider is damaged in the shaft bore, the spider should be replaced with a new spider. Perform the following procedure to remove and replace armature spider.

1. Press out armature shaft and remove commutator as directed in Armature Shaft Removal and Commutator Removal procedures.

2. Remove 1/4"-20 setscrew in quill, Fig. 12.

3. Place core assembly under press, pinion end down.

4. Place a plate on top of the commutator end coil support.

5. Place assembly under press and apply 54 tonnes pressure. Hold pressure and remove armature nut. Release pressure and remove assembly from press.

6. Remove commutator end coil support by driving wedge shape pry bars between the coil support and armature core end plate.

7. Place core assembly on pinion end laminations under press. Place four guide bars in the core slots, 90^{o} apart around the core.

8. Place a pressing plate on the commutator end of the spider. Apply pressure and press out spider from the core lamination stack.

9. Place the applicable new spider, commutator end down in the lamination

stack. Line up the key and press spider into the stack.

10. Remove the assembly from the press and turn stack over (commutator end up).

11. Apply commutator end coil support and a pressing plate.

12. Place assembly under press and apply 27 tonnes pressure.

13. Replace and tighten armature nut while assembly is under pressure.

14. Remove assembly from press and replace 1/4"-20 quill setscrew.

COMMUTATOR INSPECTION AFTER REMOVAL

NOTE: Ensure commutator has been inspected per procedure of Armature Inspection And Reconditioning, Section 5 of this Maintenance Instruction.

1. Check commutator riser slots for burrs and remove any that are present. These burrs may cause the commutator necks to tighten up when winding in the coils.

2. Clean commutator riser slots to remove all dirt, corrosion, carbonized materials. A clean bare copper surface is required.

   The scraping can be done using a scraper. Do not scrape off an excessive amount of copper as this will enlarge the slot. Remove only foreign material. It is absolutely necessary that the commutator necks are thoroughly cleaned.

5. Check riser of each commutator bar for cracks. Check mica segments between bar risers. If mica has been overheated and is flaking out, segments should be replaced. If only the protruding section of the mica segment, behind the riser, has been damaged, it may be repaired with RTV compound. This repair is permissible providing all loose mica and carbon is removed from the damaged area prior to applying RTV compound.

6. Commutator spider should be thoroughly checked and magnafluxed for cracks, especially in the spokes or ribs around the bore. If any cracks are found, the spider must be replaced with a new spider.

7. Check back of commutator necks for metal and organic particles and thoroughly clean. Remove all old cement. Scrape copper and edge of extending mica clean. Carbon dust collects in this area and can cause bar-to-bar shorts. If scraping is required, scrape with a small, sharp, square-edged tool. Scraping motion should be toward the outside diameter of the commutator risers. Use care not be damage mica segments or cause burrs on commutator risers. Ensure all foreign material is removed.

8. Clean insulation "V" ring in back of commutator neck. Thoroughly clean the small "V" formed where insulation "V" ring and copper join. When clean, pack a small amount of silastic compound in this "V". Ensure compound does not get into commutator bar slots.

NOTE: Renewal of string band will be done after armature has been rewound, during permanent banding.

PRESSING IN SHAFT

1. Wrap fish paper around armature core and connect two-piece lift ring to armature core as shown in Fig. 13. Place assembly in a vertical position, pinion end up.

2. Ensure the bores of the armature spider and diameters of the armature shaft are free of burrs and protrusions.

3. Ensure all score marks and burrs have been removed from the armature spider bores and the armature shaft.

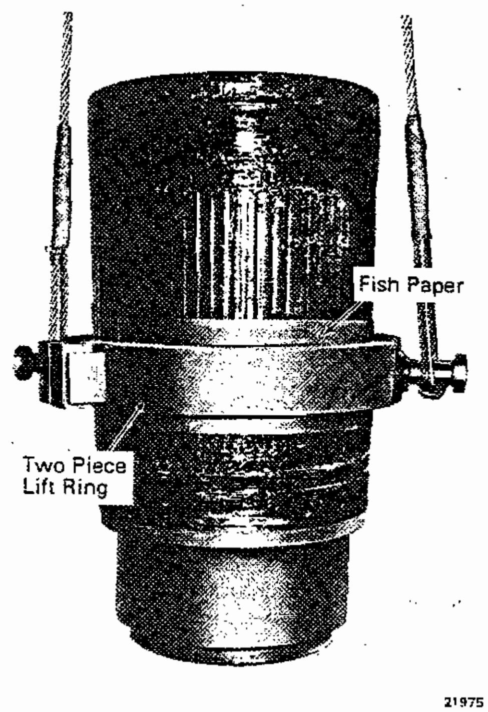


Fig. 13 - Armature Lift Ring Application

4. Check armature spider bores for taper and size. If bores are tapered, bores may be corrected by using an engine cylinder liner hone. Refer to Service Data for hone kit part number. If after honing, the bores are oversize, an oversize shaft must be used. Refer to Fig. 14 for interference required between the shaft diameters and the bores to maintain the proper tonnage when pressing in the shaft. Refer to Service data for part numbers and sizes of oversize that is available.

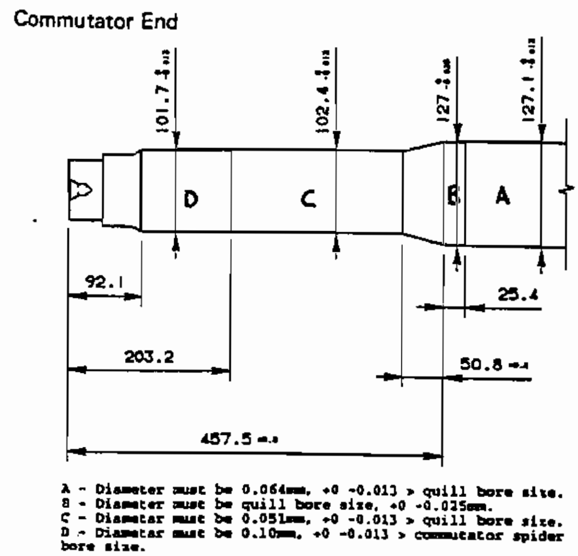


Fig. 14 - Interference Fit Between Shaft and Armature Core Bores

5. Place armature core assembly, commutator end down, on the shaft replacement adapter on a pressing cart. Refer to Service Data for adapter and pressing cart part number.

6. Apply lubricant to the shaft, Fig. 15. Ensure shaft bore is properly lined up with base adapter. Guide armature shaft, commutator end down, into armature core assembly. Place shaft replacement sleeve on pinion end of shaft, Fig. 16. Position assembly under press.

7. Press shaft in slowly and observe tonnage on press pressure gauge. Pressure gauge should register between 36 and 82 tonnes for proper shaft-to-core fit. If the pressure required is less than 27 tonnes or exceeds 81 tonnes, remove the shaft and recheck the shaft-to-core-fits.

8. After the shaft has been pressed into position, remove core assembly from the press and complete the following checks.

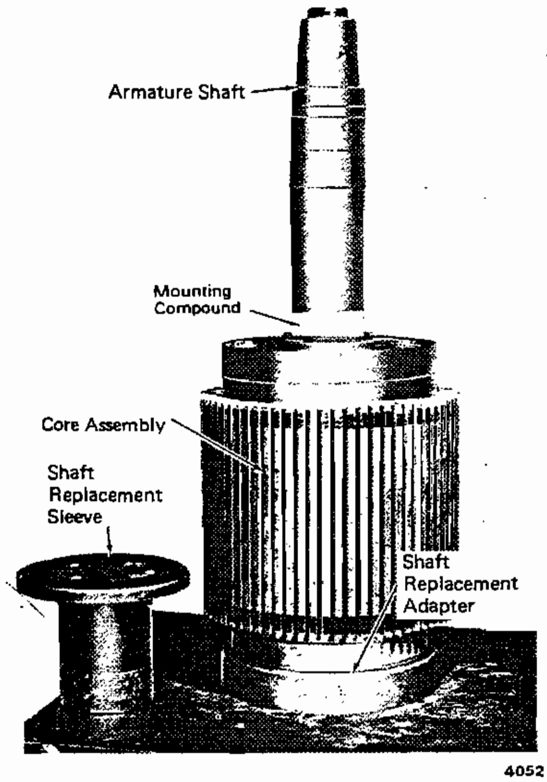


Fig. 15 - Armature Shaft in Core Assembly

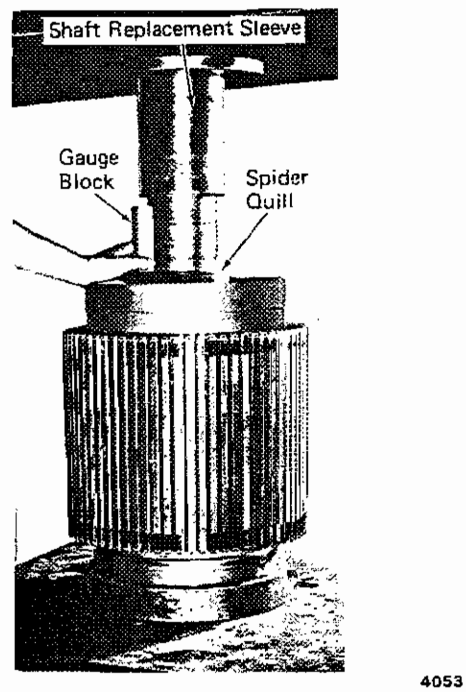


Fig. 16 - Pressing Shaft

a. Check the 209.55 ± 0.25 mm dimension from the step on the commutator end of the shaft to the inner machined surface of the coil support, as shown in Fig. 17.

b. Check the 156.35 ± 0.15 mm dimension from the step on the commutator end of the shaft to the commutator end of the hub, as shown in Fig. 17.

If this dimension is outside the above tolerance, either add shims or machine the end of the hub as required to achieve specification.

The relative position of this dimension with respect to that in a. above must be maintained in order to have the correct dimension between the laminations and the back of the commutator riser for ease of winding.

c. Check the 632.6 ± 0.15 mm dimension from the step on the commutator end of the shaft to the pinion end of the hub, as shown in Fig. 17.

If this dimension is outside the above tolerance, either add shims or machine the end of the hub as required to achieve specification.

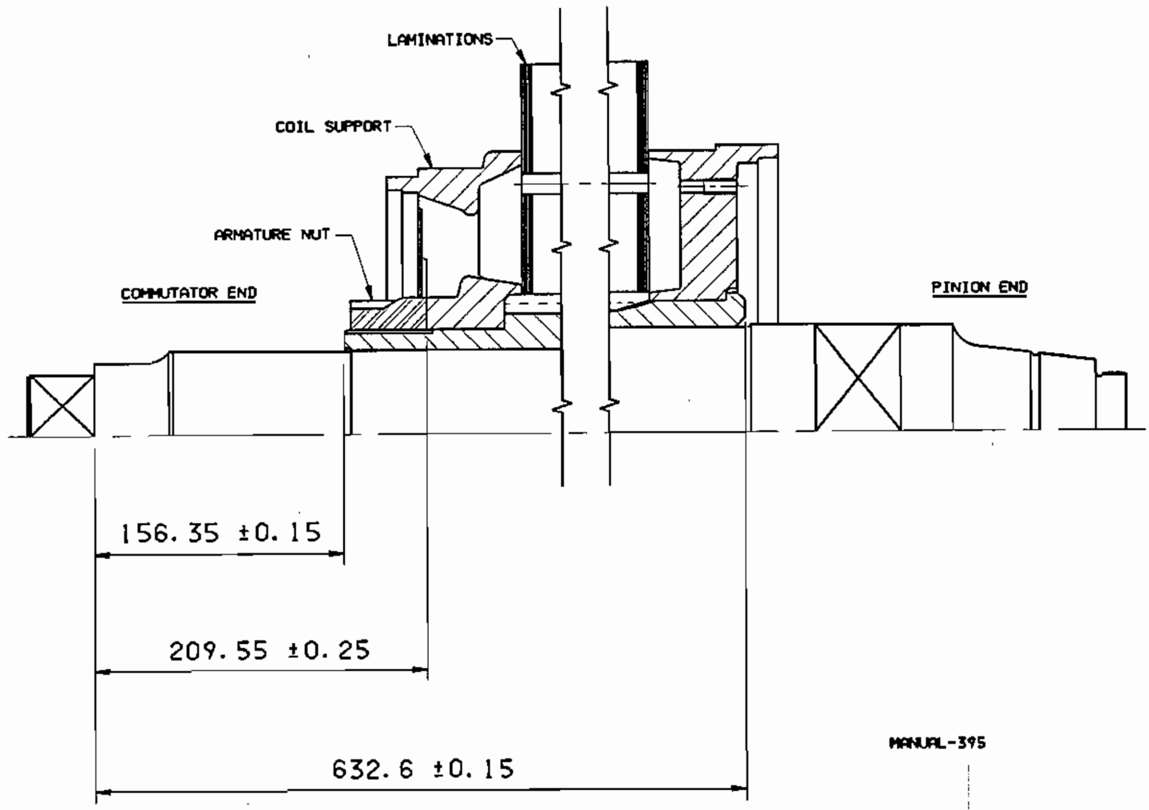


Fig. 17 - Armature Core Position on Shaft

PRESSING ON COMMUTATOR

1. Clean up commutator-to-core mating surfaces. Check the corresponding mating fits as shown in Fig. 18.

2. Clean commutator-to-shaft mating surfaces. Ensure surfaces are free of all nicks and burrs.

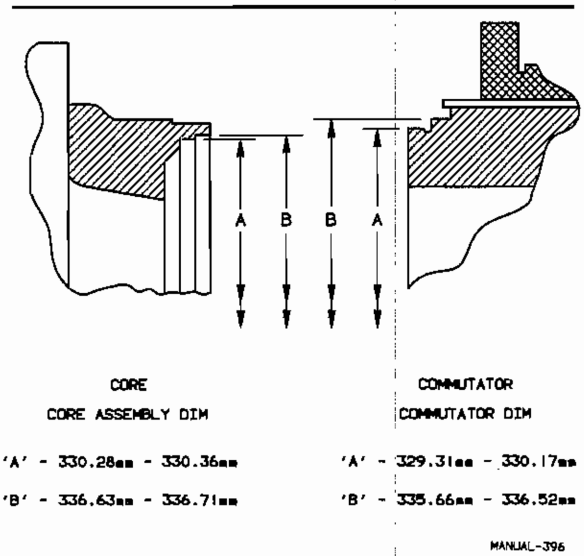


Fig. 18 - Commutator-to-Core Fits

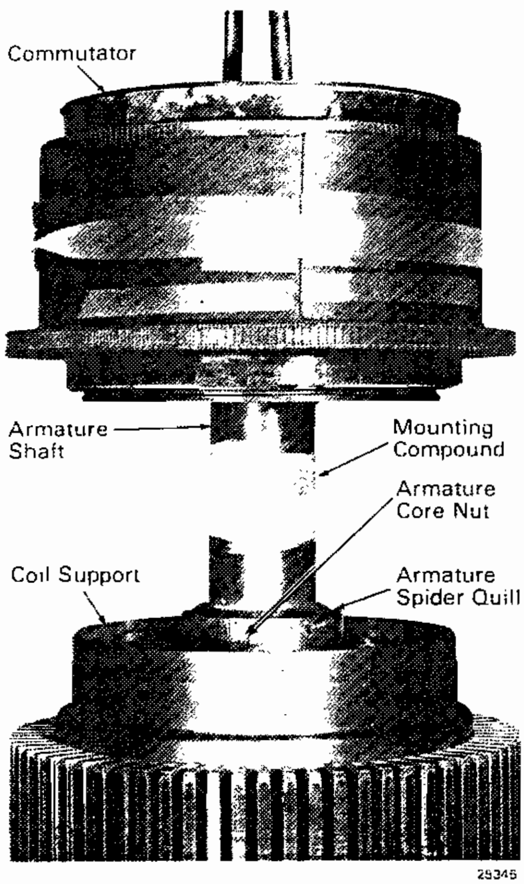


Fig. 19 - Application of Lubrication to Shaft

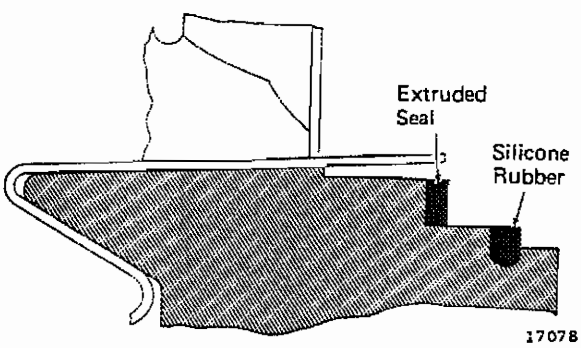


Fig. 20 - Silicone Rubber Applied to Groove in Commutator Steel "V" Ring

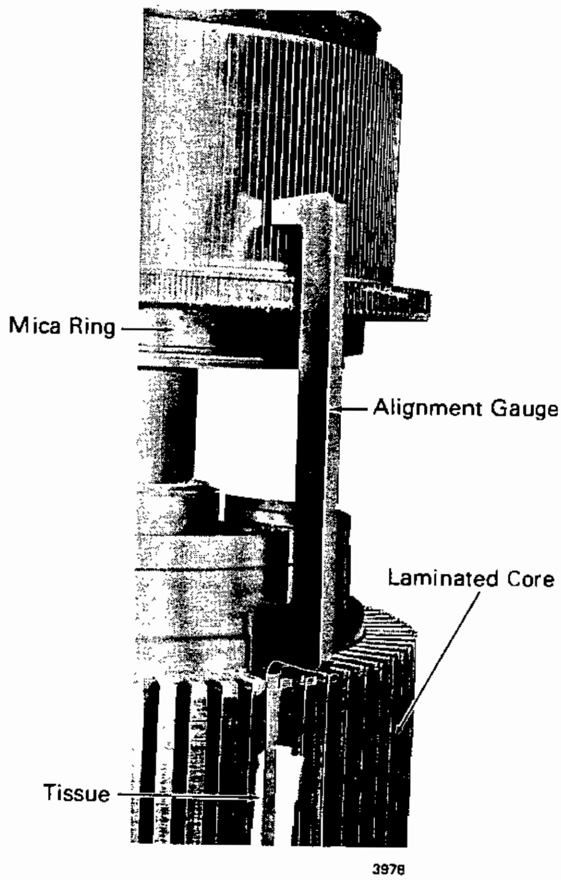


Fig. 21 - Alignment of Commutator with Core Before Pressing

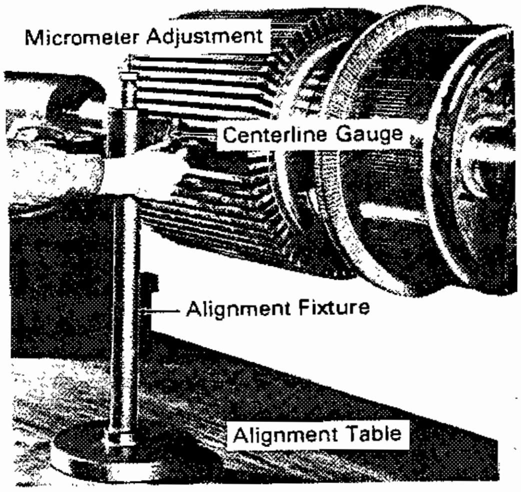


Fig. 22 - Setting of Gauge Alignment

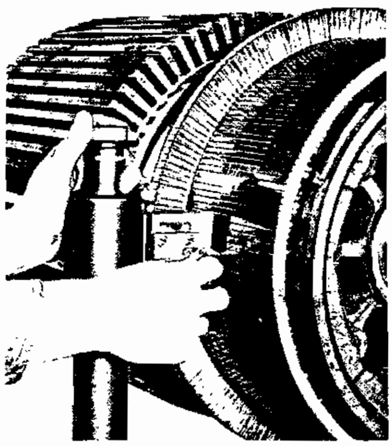


Fig. 23 - Alignment of Commutator

3. Place core and shaft assembly on shaft removal adapter. Refer to Service Data for shaft removal adapter part number. Apply small quantity of lubricant compound to the shaft surface where commutator mates with shaft, Fig. 19.

4. Apply silicone rubber compound to the groove in the commutator "V" ring with a putty knife. Fill groove with a sufficient amount to ensure a good seal at assembly. Apply extruded seal to "V" ring, Fig. 20.

5. Place commutator on the shaft. Line up the commutator to the core with an alignment gauge, Fig. 21, so that the mica between the commutator bars will line up with the centreline of the coil slot in the core. Refer to Service Data for alignment gauge part number. Ensure air passage holes in the commutator spider line up between the spokes in the coil support.

6. Lower the commutator as far as it will go on the shaft and remove lifting hook and the alignment gauge.

7. Move the assembly under press and press commutator down on the shaft until there is a distance of approximately 38 mm between the commutator and the coil support. Do not press the steel "V" ring of the commutator. Use the shaft replacement adapter. Refer to Service Data for shaft replacement adapter part number.

8. Remove assembly from press and place the core and commutator in a horizontal position on an alignment table as shown in Fig. 22. Check the alignment of the commutator to the core with an alignment fixture and centreline gauge. Refer to Service Data for alignment fixture and centreline gauge part number. Place the centreline gauge in one of the core slots approximately in the centre of the core. Adjust alignment fixture to the centreline gauge by making adjustment with micrometer adjusting screw on the top of the fixture, Fig. 22.

9. Move the alignment fixture over to the commutator and check the setting on the alignment fixture to the centreline of the mica between the commutator bars as shown in Fig. 23. The centreline of the mica between the core and commutator at six equally spaced locations around the assembly and record the readings.

The algebraic sum of the six readings should not be more than 0.08 mm

10. If the alignment is satisfactory, reposition the assembly under the press and press commutator into position. A normal commutator application will require approximately 18-28 tonnes to press the commutator into position.

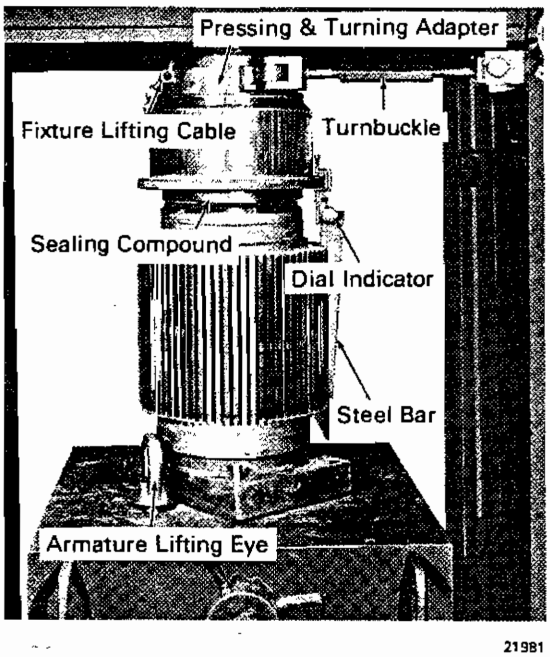


Fig. 24 - Final Pressing of Commutator to Core

11. If the commutator alignment is not within the 0.08 mm limit, a pressing and turning adapter must be placed on the core assembly while the assembly is still positioned on the press, Fig. 24.

    Secure a dial indicator to the riser of the commutator as shown in Fig. 24. Place a steel bar in a slot of the core and adjust the indicator to make contact with the bar. Depress the indicator slightly and set the indicator pointer at zero. Place turnbuckle in position to rotate the commutator in the direction necessary to make the correction.

    Operate the press to apply pressure to the commutator and at the same time adjust the turnbuckle to properly position the commutator. Press the commutator slowly and adjust the turnbuckle until proper adjustment is shown on the dial indicator.

12. Remove the assembly and adaptors from press and place assembly on a lineup table. Recheck commutator position. If commutator lineup is not satisfactory, it will be necessary to pull the commutator back approximately 38 mm and repeat Step 11.

13. If commutator is properly assembled, dynamically balance the core and commutator assembly within 1 440 mg.m (2 in.-oz.) before rewind operation. Refer to Service Data for balance weights and set screw part numbers.

WINDING ARMATURE

PREPARATION BEFORE WINDING ARMATURE

1. Inspect armature core for dirt, burrs, slot size, end plate clearance, and slot wedge size as instructed in previous sections of this Maintenance Instruction.

2. Ensure commutator riser slots are clean and free of burrs.

3. Remove the excess silicone rubber compound from under the mica "V" ring with a scraper as shown in Fig. 25. Refer to Service Data for scraper part number.

4. Perform a commutator bar-to-bar resistance

5. Place the core and commutator assembly in a suitable stand. The stand should be constructed so that it is possible to rotate the assembly during the winding operation.

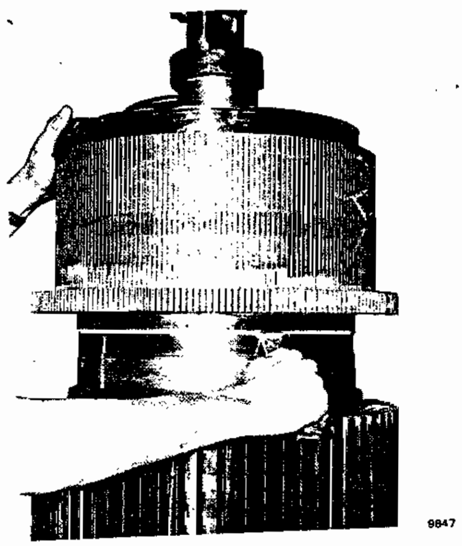


Fig. 25 - Removing Excess Silicone Rubber Compound from Under "V" Ring

6. Mark the edge of the commutator for the winding layout as shown in Fig. 26. Mark the core for location of first coil position.

7. Fill the gap between the front insulation "V" ring and the outer edge of the commutator "V" ring, Fig. 27, with insulating cement 8124636 to provide an unbroken surface for the "V" ring string band.

8. Seal in the back of the commutator neck at the rear insulation "V" ring, Fig. 27, with silicone rubber compound. Keep the compound out of commutator slots.

COIL SUPPORT INSULATION

Prior to installing the armature coils to the core, the coil support area at each end of the core must be insulated. The insulation buildup is also required to properly position the armature coils in the core. Refer to Figs. 27 and 31 for cross-section of insulation.

COMMUTATOR END INSULATION

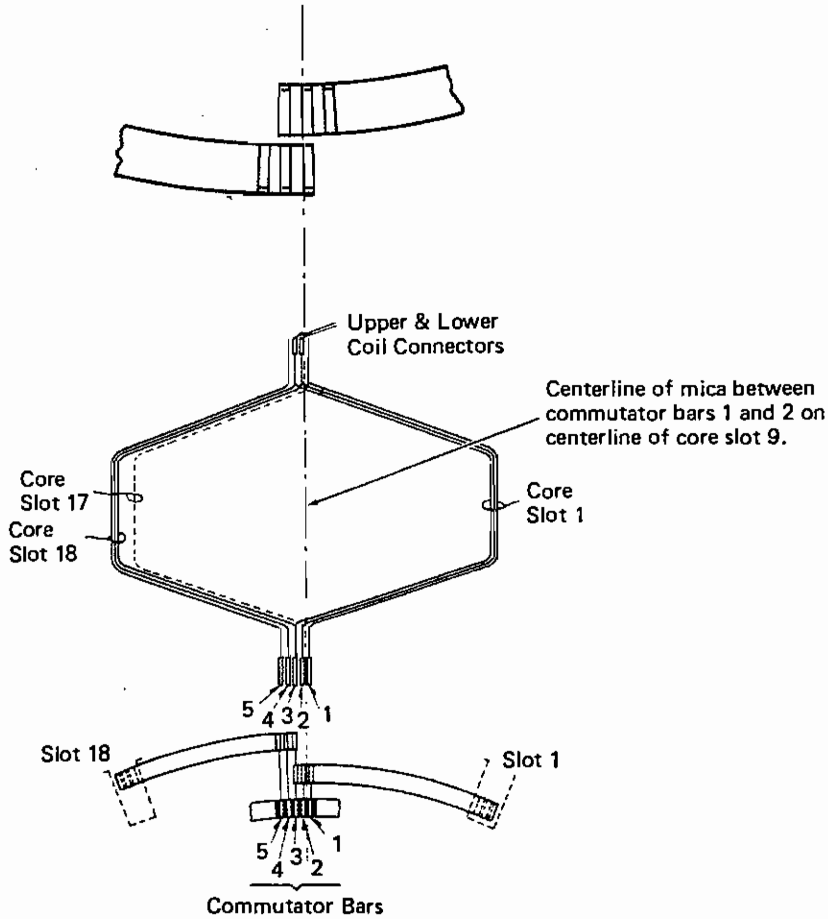
1. Ensure the coil support area is free of nicks and sharp edges.

2. Brush shellac in the recessed section and under the rear insulation "V" ring, Fig. 27. While shellac is still wet, install mica ring, consisting of three sections, in the recess as shown in Fig. 28. Slip the mica sections under the projecting portion of the rear insulation "V" ring. Tap insulation gently in place with a rawhide mallet. Do not brush shellac in silicone rubber compound area.

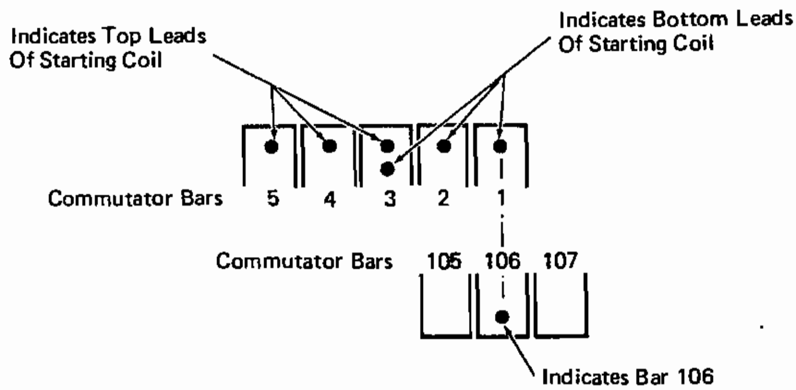
3. Brush shellac sparingly over the commutator end coil support. While shellac is still wet, install mica ring, consisting of three sections. Position the sections against the core and space them equally around the coil support. Hold the sections in place with a turn of twine placed around the insulation next to the core slots.

4. If a gap of 1.6 mm or more exists between the rear insulation "V" ring and the mica ring just installed, fill the gap with turns of fibreglass cord as shown in Fig. 29.

5. Apply shellac sparingly over mica and "V" ring. Keep shellac away from back of commutator riser. While shellac is still wet, wind in one layer of insulation (3 pieces) with ends butted together and sides butting the commutator riser. Apply one layer of 0.25 mm x 25 mm fibreglass tape. Start tape at commutator side by securing tape through slot in riser, Fig. 30, and proceed toward the core, butting edges of the tape. Secure fibreglass tape with adhesive coated mylar film tape. Remove the starting end of the fibreglass tape from the riser slot and cut flush with the first turn of the fibreglass tape. Refer to Service Data for fibreglass and adhesive tape part numbers.



ARMATURE COIL LAYOUT



NOTE: Commutator bar cross connectors connect bars 180° apart, bar 1 is connected to bar 106, etc.

COMMUTATOR BAR PRICK PUNCH MARKS

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Fig. 26 - Armature Coil Winding Layout

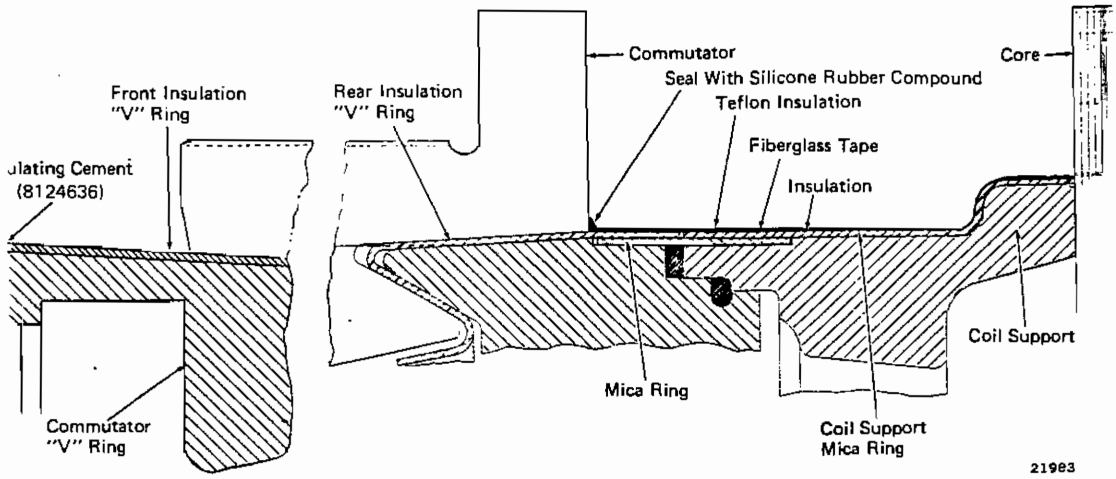

Fig. 27 - Commutator End Coil Support Insulation

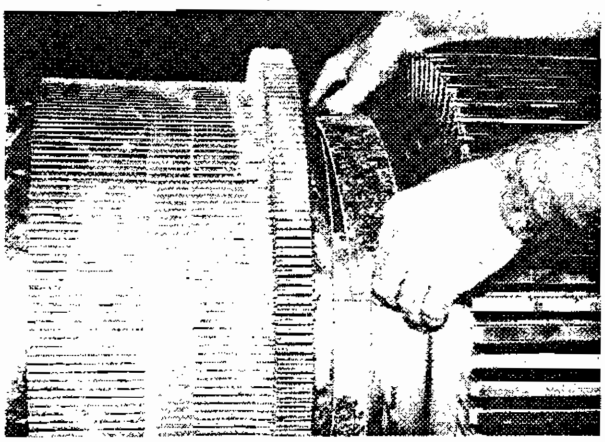

Fig. 28 - Installing Mica Ring

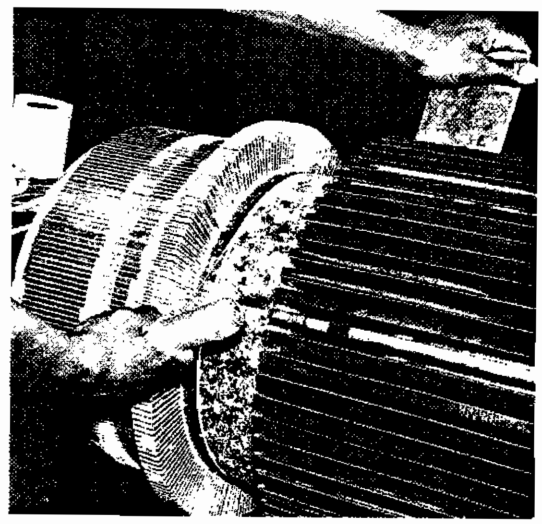

Fig. 29 - Filling In Gap between Insulation

6. Remove the temporary hold-down twine and apply shellac sparingly over the entire area, being careful to keep shellac out of the commutator riser slots.

Fig. 30 - Applying Fibreglass Tape over Insulation

7. While shellac is still wet, apply one layer of teflon tape. Butt edge of tape to the commutator riser. Apply teflon tape from roll and cut to allow 13 mm to 25 mm overlap at the ends. Secure ends of teflon tape with adhesive coated mylar film tape. Refer to Service Data for teflon and adhesive tape part numbers.

PINION END INSULATION

1. Install temporary winding fixture to armature pinion end by securing fixture to bolt holes in coil support, Fig. 31.

2. Apply shellac to the recessed area of the coil support. While shellac is still wet, install mica ring 8104089, consisting of three sections, butting each section against end plate. Position the three sections so the space between the ends will be equalised. Temporarily tie down insulation with twine, keeping twine next to the core. Shellac over the mica ring.

3. While shellac is still wet, apply mica ring 8331017, consisting of three sections, and hold down with twine. When applying this insulation, keep the sections 16-17 mm away from the end plate. Apply one layer of 0.13 mm x 19 mm fibreglass tape over this insulation. Start tape at outer edge of mica ring and make two turns, butting each turn and securing ends with adhesive coated mylar film tape. On other models hold mica ring in place with three turns of 0.25 mm x 25 mm fibreglass tape. Start tape at outer edge of second mica ring.

4. Remove all temporary twine and apply shellac over the entire area.

WINDING CROSS CONNECTORS

The cross connectors are formed in a manner which requires that a complete bottom layer be installed before applying insulation between the top and bottom layers of the cross connectors.

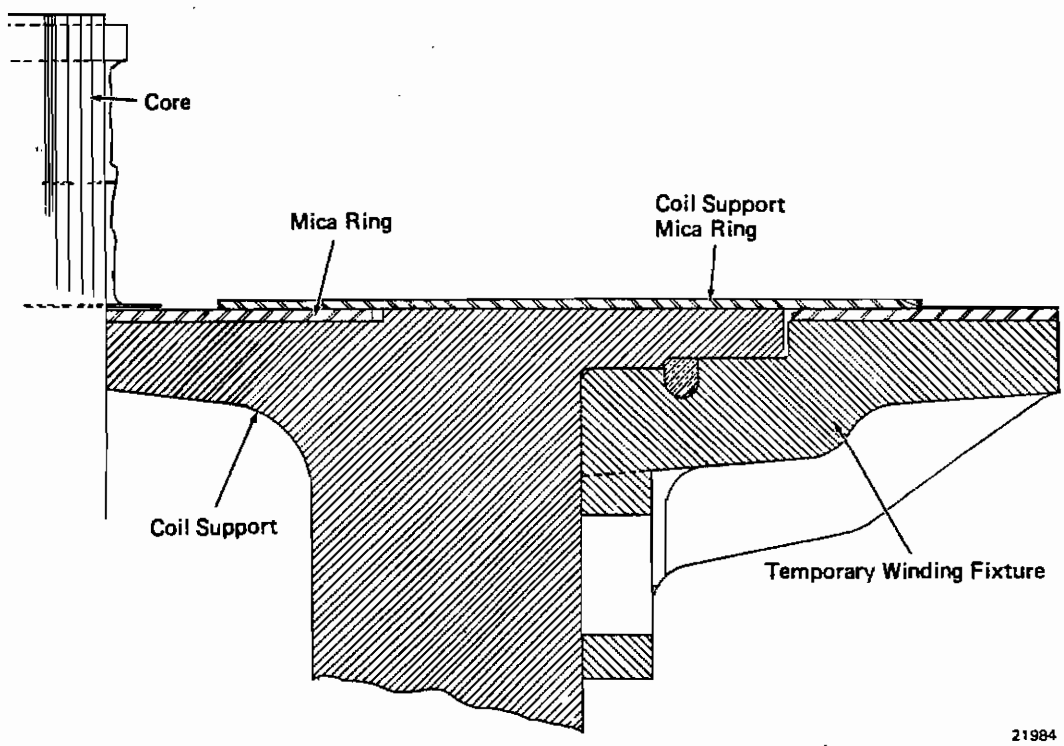

Fig. 31 - Pinion End Coil Support Insulation

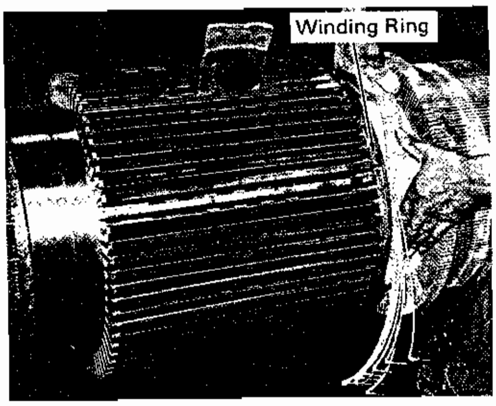

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Fig. 32 - Connectors in Starting Position

It will be necessary to have a piece of fish paper 80 mm x 80 mm x 2 mm ready to hold the first few cross connectors in position.

To wind the cross connectors proceed as follows.

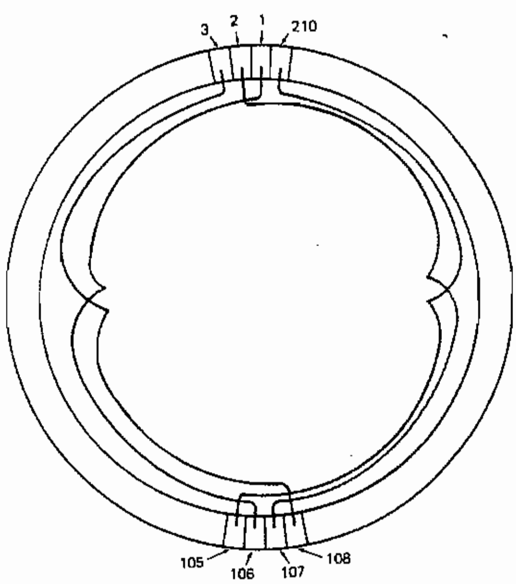

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Fig. 33 - Bar Cross Connector Winding Layout

1. Assemble a winding ring over the commutator end coil support, butting the rear face of the ring against the core. The winding ring is necessary to hold the knuckle of the "gull wing" cross connectors in place, Fig. 32. Refer to Service Data for winding ring part number.

The commutator has only one width slot 2.29 mm for coil leads and cross connectors. The winding of the two types of cross connectors will be the same.

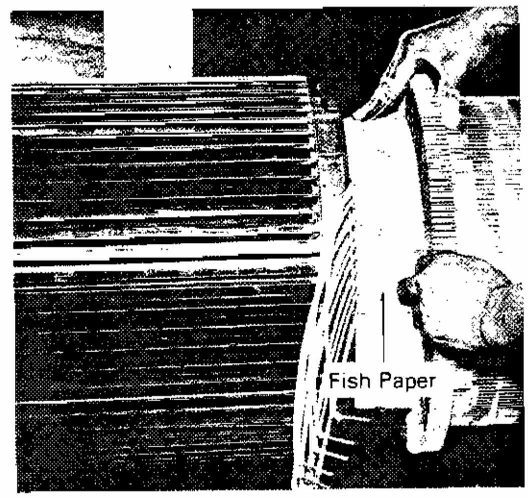

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Fig. 34 - Holding Connectors in Position

2. Refer to Fig. 26 Commutator Bar Prick Punch Marks to establish riser slots and slot 106 and refer to Fig. 33 to determine starting point of winding cross connectors.

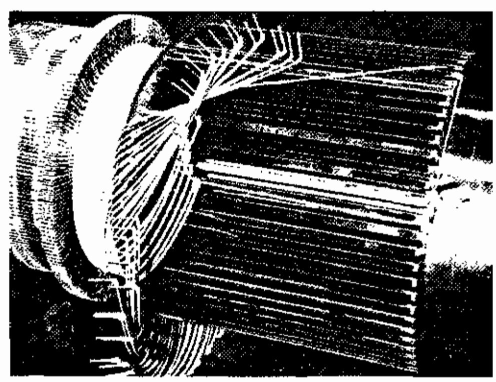

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Fig. 35 - Holding Connectors Back Out of the way

3. On double width commutator riser slots, insert commutator neck filler 8095058 at the bottom of slots 2, 4, 6, 8, etc.

4. Take approximately ten cross connectors at a time and arrange in position for assembly into riser slots as shown in Fig. 34. Slip knuckles under radius of winding ring and insert bottom leads into the top of the commutator riser slots 1. 3, 5, 7, etc.

5. When the first few cross connectors are installed, place an 80 mm square fish paper between the knuckle and the commutator riser, Fig. 34, to hold the knuckles under the winding ring. Do not remove the piece of fish paper until fish paper interferes with laying in of the final cross connectors.

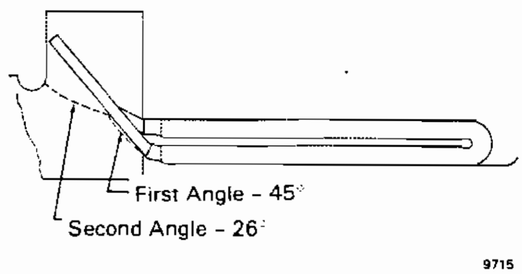

Fig. 36 - Angle Base in Riser Slot

6. Tie back the starting group of cross connectors with a loop of twine as shown in Fig. 35.

7. Press leads down into the bottom of the riser slot so the radius of the cross connector where connector enters the slot is approximately 3 mm from the rear of the commutator riser. Do not bend the lead end over to the second angle base in the slot at this time, just push down lead to the second angle, Fig. 36.

   As the first cross connector is inserted in the No. 1 riser slot, identify and mark the top end of the cross connector so connector can be installed later in the proper position in the No. 106 riser slot.

8. Wind cross connectors straight and tight in order to have enough space for all connectors. This is best accomplished by using a rawhide or nylon mallet and drift to position cross connectors as winding progresses as shown in Fig. 37. Use care not to damage insulation or distort the cross connectors when drifting them in place. Refer to Service Data for drift part number.

Fig. 37 - Drifting Connectors Into Position

9. Complete winding of lower cross connectors, putting in the last few cross connectors in one at a time, working connectors into position, between the other connectors. When bottom layer of cross connectors is completely installed, gently tap over the layer to position the cross connectors and to prevent connectors from rising up.

INSULATING BETWEEN BOTTOM AND TOP CROSS CONNECTORS

1. Fill the gap between the radius of the lower layer of the cross connectors and the commutator riser with insulating cement as shown in Fig. 38. Fill this area flush with the top of the lower cross connectors. Use care when applying insulating cement to prevent cement

working into the riser slots of the commutator. Refer to Service Data for insulating cement part number.

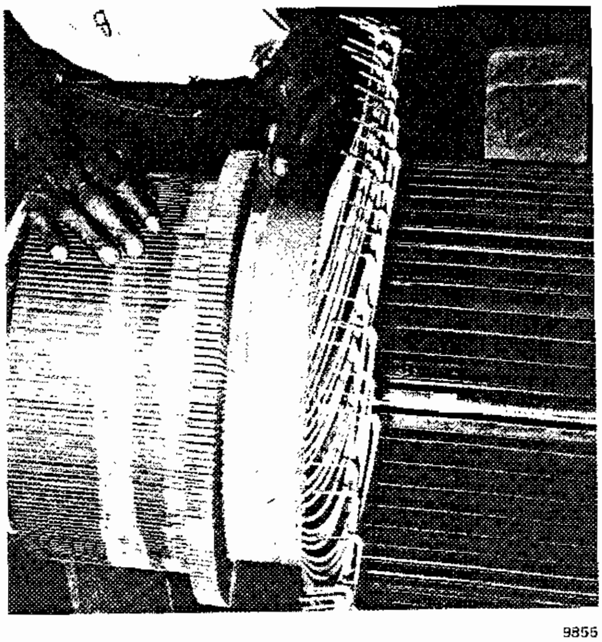

Fig. 38 - Applying Cement Behind Riser

2. Apply one coat of varnish to the bottom layer of cross connectors. Keep the varnish approximately 12 mm away from the back of the commutator riser to prevent varnish getting into the riser slots. Refer to Service Data for varnish part number.

3. The insulation between the bottom and top cross connectors is made of three layers consisting of four butted pieces of glass and mica insulation and two butted pieces of treated cloth insulation applied in the following manner:

   First Layer

   Apply two pieces of 8124776 insulation with the mica side up. Slip the pieces of insulation under the knuckles of the cross connectors and press down flat between the commutator riser and the knuckles of the cross connectors. Position the two pieces so there will be approximately 5 mm between their ends, starting approximately 76 mm (3") back from the No. 106 slot of the commutator riser.

   Second Layer

   Apply two pieces of 8124776 ,7G insulation with the mica side down (mica to mica), staggering the end 19-25 mm from the joints of the first layer.

   Third Layer

   Apply two pieces of 9538950 to the area, placing the first piece so the end is past the No. 106 slot of the commutator riser, approximately even with the No. 104 bar. Space the pieces of insulation so there is approximately 5 mm between the pieces to allow movement of the insulation during the winding of the top layer of cross connectors.

4. On double width commutator riser slots, insert commutator neck filler at bottom of slots 1, 3, 5, 7, etc.

5. Locate the top end of cross connector No. 1, which was identified and marked earlier. Move the twine holding the cross connectors out of the way, and insert No. 1 lead into riser slot No. 106. Continue to place cross connectors in slots 108, 110, etc., taking them one at a time and pulling them gently down over the insulation toward the commutator riser slot into which the connector will be inserted, bending each connector at the knuckle, Fig. 39. Insert the tip of the cross connector lead into the top of its proper commutator riser slot and press down using setting tool. Refer to Service Data for setting tool part number. Do not attempt to set the leads at this time, just push down to the second angle.

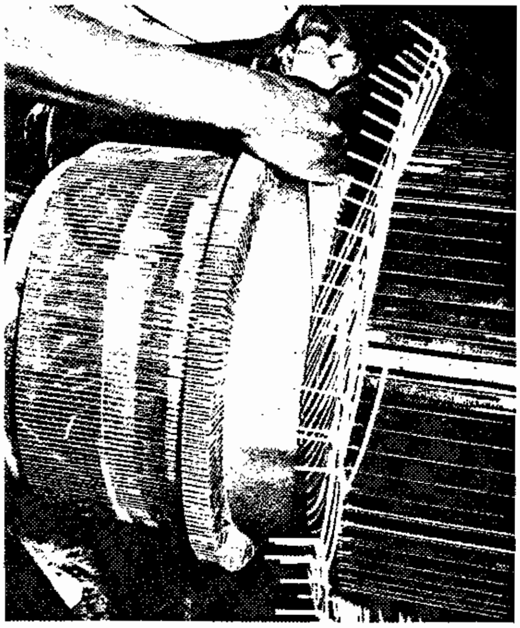

Fig. 39 - Installing Top Connectors

NOTE: When inserting the top layer of cross connector leads into the commutator riser slots, it may appear that the connectors are too short. This is because the distance to the top of the slot is greater than to the bottom. As the lead is pressed into position, it will fit properly.

6. Continue to wind in all cross connectors, drifting where necessary and using the same precautions as used on the bottom layer of connectors. Install the cross connectors so that connectors have a neat appearance. The radius of the connectors behind the commutator should be approximately 3 mm the knuckle at the winding ring should be evenly around the coil support and equally spaced, and the cross connectors should fall into a straight even position as shown in Fig. 40.

NOTE: While placing the top layer of cross connectors in position, the insulation between layers will close down tight and creep slightly in the direction of winding. During winding it may be necessary to lightly tap the insulation down to keep insulation in proper position.

PERMANENT POSITIONING OF CROSS CONNECTORS

1. Stake the bottom cross connectors using a rawhide mallet and staking tool, Fig. 41. Stake the leads all the way around the commutator. Refer to Service Data for staking tool part number.

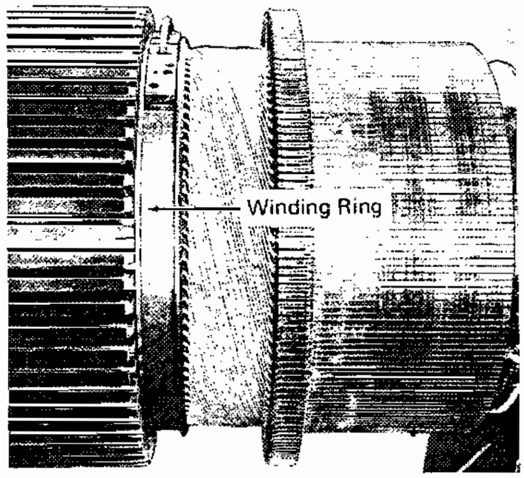

Fig. 40 - Properly Installed Connectors

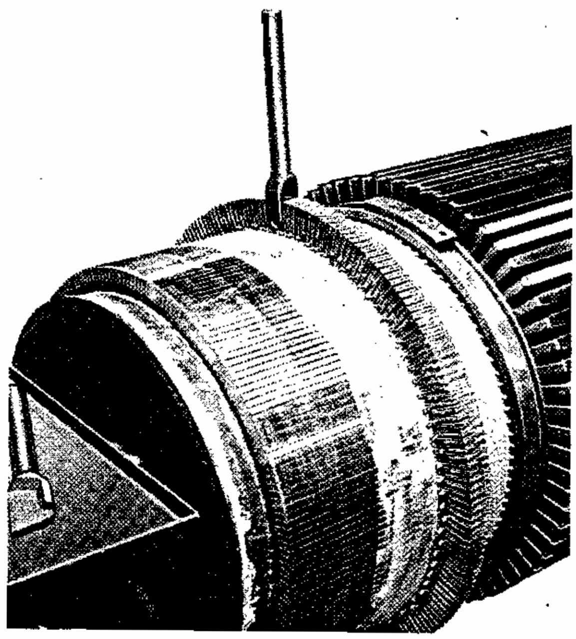

Fig. 41 - Staking Connector Leads

2. Stake the top cross connectors with the mallet and staking tool.

3. Apply four layers of surgical tape, one-half lapped over the cross connectors. Secure the end of the surgical tape with adhesive coated mylar film tape. Refer to Service Data for surgical and adhesive tape part numbers.

4. Place the assembly in a convection oven and heat for 4 hours at a temperature of 115^{0} C

5. Remove assembly from convection oven and place in a banding lathe. Apply metal banding strap around cross connectors at 91 kg (200 lbs) tension to pull cross connectors down.

6. Allow assembly to cool to room temperature. Remove cross connector winding ring.

7. Perform commutator bar-to-bar resistance check. Refer to Section 5 of this Maintenance Instruction for procedure.

8. Ground test commutator cross connectors at 5000 volts for 10 seconds.

9. Remove banding strap and surgical tape.

10. Apply insulating compound between the knuckles and coil pockets in back of the commutator riser, using a scraper. Refer to Service Data for insulating cement and scraper part number. Apply insulating cement flush with the top of the cross connectors and apply insulating cement between the steel "V" ring and the mica "V" ring, keeping cement flush with the top of the mica so it will not interfere when applying the string band. Use care to keep insulating cement out of the riser slots.

11. Apply a liberal amount of varnish over the cross connectors. Refer to Service Data for varnish part number. Use care to keep varnish out of the riser slots.

INSULATION OVER CROSS CONNECTORS

The insulation over the cross connectors consists of eight layers of insulation wound in with continuous 0.13 mm x 19 mm fibreglass tape. If it is necessary to splice the fibreglass tape during the operation, use adhesive tape to make splice. Butted ends of layers 2, 5, and 6 may "gap" approximately 3 mm. The gaps of the various layers should be staggered so that no two gaps fall in the same line. Insulate the cross connectors (from bottom to top) as follows.

First Layer

Apply one turn of fibreglass tape around centre area of cross connectors. Overlap tape on start of second turn approximately 200 mm to keep tape from slipping. Pull tape as tightly as possible over insulation to prevent insulation from creeping when main coils are wound in. Refer to Service Data for fibreglass part number.

Continue with fibreglass tape; shift tape to approximately 25 mm behind the commutator riser and wind in one layer of teflon film insulation. Butt one side of the teflon insulation against the riser and overlap the ends 13-25 mm. Hold in place with one turn of fibreglass tape approximately 25 mm from commutator riser.

Second Layer

Continue with fibreglass tape; shift over toward the core so as not to overlap the last turn of the tape. Wind in one layer of varnished insulation 8460431 consisting of three sections. Butt one side of each section against the riser and butt the ends.

Third Layer

Continue with fibreglass tape; shift over towards the core so as not to overlap the last turn of the tape. Wind in two layers of glass teflon insulation 8197244 consisting of six sections. Apply two sections at a time, stagger the layer 51 mm and butt one side against the riser. When starting the double layer, stagger 51 mm in relation to the joints in layer No. 2. Stagger the gap of each layer so that no gap will overlap a previous gap.

Fourth Layer

Continue with fibreglass tape; shift tape back toward the riser and lay in three turns of tape, butting sides. Start first turn next to the riser.

Fifth Layer

Continue with fibreglass tape; shift tape back toward the riser and wind in three sections of insulation 8460429 butting the riser with one side and butting the ends.

Sixth Layer

Continue with fibreglass tape; shift slightly toward the core and wind in three sections varnished tape butting riser with one side and butting the ends. Stagger the joints 51 mm in relation to joints of layer No. 5.

Seventh Layer

Continue with fibreglass tape; shift tape back toward the riser and starting with the first turn next to the riser, wind in three turns of fibreglass tape, butting each side of a turn. Secure the end of the fibreglass tape with adhesive coated mylar film tape.

Eighth Layer

Continue with fibreglass tape; shifting tape to centre of the area, wind in one layer of teflon film 8166935 butting riser and overlapping teflon ends film 13 to 25 mm. Cut and secure end of fibreglass tape and teflon film with pieces of adhesive coated mylar film tape.

INSULATION OF BOTTOM MAIN COILS

Before the application of the bottom coils it is necessary to install a "U" piece in the end plates and filler strip in the bottom of each coil slot. First place the "U" piece in the end plates at each end of each slot extending 13 mm out from the end of the slot. Then place the filler strips in the bottom of each slot overlapping the "U" pieces at both ends.

NOTE: The "U" piece should not extend into the coil slot far enough to cover any of the core laminations. If the end plates were properly gauged during core cleaning, there should be clearance between the end plates and "U" piece when the coils are installed.

The coils are designed to lay in without difficulty providing the core has been properly cleaned and gauged during preparation for rewind. The coil should be inserted by hand only, using a nylon mallet to drive coil leads into the commutator riser slots, Fig. 42. When it is necessary to set the coils in the slot use a fibre block and a 0.5 kg rawhide mallet. Do not hit the coil excessively with the mallet.

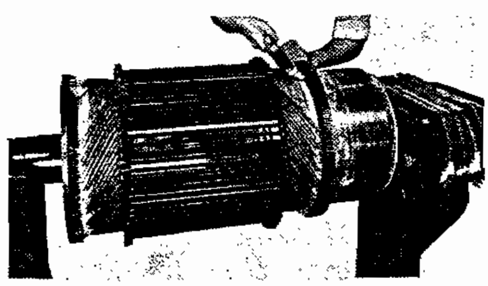

Fig. 42 - Winding Bottom Armature Coils

Each bottom coil has a "U" shaped clip brazed to the leads at the pinion end. The clip is to connect the top and bottom coil leads.

Use care in winding coils so as not to damage coil leads or clips.

The insulation on the coils is a semi-rigid material and will stand no bending at the straight sections. Therefore, it is important that the coil be placed in the slot as horizontally as possible without bending or cracking the insulation.

The straight section of the coil should be centred in the slot, having equal space on each end of the core where the coil bends over the coil support. To accomplish this and make certain they are equally spaced at the start, it is suggested that a coil centreing gauge be used. Failure to properly space the first coils will result in difficulty as the winding progresses causing unnecessary stress on the coil insulation and eventual coil failure in operation. When difficulty is experienced in laying in the coils, the winding operation should be stopped and cause of trouble corrected. Do not bend or twist the coils in an attempt to get them in their proper position. Coils should lay in evenly and uniformly.

Ensure "U" pieces and bottom filler strips are in proper position and proceed to wind in bottom coils as follows.

1. Refer to Fig. 26 Armature Coil Layout to determine core slot No. 9. Count clockwise from core slot No. 9 to determine core slot No. 1.

2. Place first coil in core slot No. 1.

3. Install coil centering gauge at pinion end between core and angle of coil; Press coil horizontally into slot. Position straight section of coil at bottom of core slot before inserting coil leads into commutator riser slots. Position coil leads in proper location in the riser and tap in place with nylon mallet.

4. Place second coil in core slot No. 2. Mark the clip end (pinion end) of coils No. 1 and 2, marking clips 2 and 3 of No. 1 coil and marking clip 1 of the No. 2 coil. These marks will be used later when winding top coils.

5. Wind in balance of bottom coils. Ensure "U" pieces and bottom filler strips are in position before installing the coils.

NOTE: When installing coil leads in the commutator riser, the riser may start drifting or bending. The riser can be straightened by using a drift tool and mallet. Refer to Service Data for drift tool part number.

6. After all bottom coils are installed, remove coil centreing gauge and install clamping ring over the pinion end clips of the lower coils. This ring is required to prevent coil ends from raising as coils are set in the slot and riser.

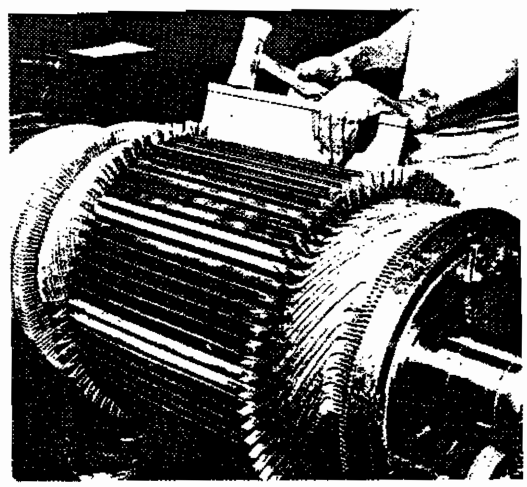

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Fig. 43 - Setting Coils in Slots

7. Set the coils in the core slots by using a 0.5 kg mallet and a fiber block, Fig. 43. Refer to Service Data for fibre setting block part number.

8. Apply a 25 mm strip of masking tape over the leads just behind the riser. The tape is required to prevent copper chips or slivers from falling into the openings

between the coils and riser when placing the leads and filler in the riser.

9. Using mallet and setting tool, set bottom filler and coils. Do not allow fillers to shift back into the coils as shorts may develop later between coils. If leads are loose in commutator riser slots, add 0.25 mm plate mica pieces to mica section in riser. Use care when inserting mica pieces to prevent damaging mica between risers.

10. Remove the masking tape from behind the riser. Ensure there are no loose metalic particles in the opening. Pack insulating cement between the bottom coil leads in back of the commutator riser, flush with the top of the coils. Keep cement out of the commutator riser slots.

INSULATION OVER BOTTOM COILS

The insulation over the bottom coils at the commutator end diamond section (area over the coil supports) consists of eight layers of insulation wound in with continous 0.13 mm x 19 mm fibreglass tape. The insulation over the bottom coils at the pinion end diamond section consists of seven layers wound in. If it is necessary to splice the fibreglass tape during the operation, use adhesive tape to make the splice. Insulate over the bottom coils as follows.

COMMUTATOR END DIAMOND SECTION

First Layer

Apply one turn of fibreglass tape approximately 25 mm from the riser at the commutator end diamond section. Overlap the fibreglass tape on start of second turn approximately 200 mm to keep tape from slipping. Pull tape as tightly as possible over insulation to prevent insulation from creeping when top layer of coils is installed.

Continue with fibreglass tape; shift to approximately 25 mm behind the commutator riser and wind in one layer of teflon film insulation. Butt one side of teflon insulation against the riser and overlap the ends 13 to 25 mm.

Hold in place with one turn of fibreglass tape.

Second Layer

Continue with fibreglass tape; shift over toward the core so as not to overlap the last turn of the tape. Wind in one layer of glass teflon insulation 8260276 consisting of three sections. Butt one side of each section against the riser and butt the ends.

Third Layer

Continue with fibreglass tape; wind in one layer of glass teflon insulation 8077328, consisting of three sections, butting riser and overlapping ends approximately 13 mm Stagger the joints of this layer 51 mm with the joints of No. 2 layer.

Fourth Layer

Continue with fibreglass tape; apply three turns of fibreglass tape starting the first turn next to the riser and butting the sides of the tape.

Fifth Layer

Continue with fibreglass tape; shift tape back towards the riser. Wind in one layer of insulation 8166934 consisting of three sections. Butt the back of riser and ends of insulation.

Sixth Layer

Continue with fibreglass tape; shift tape toward the core slightly and wind in one layer of glass teflon 9324914 consisting of three sections. Butt back of riser and ends of insulators. Stagger the joints 51 mm in relation to the joints of layer No. 5.

Seventh Layer

Continue with fibreglass tape; shift tape back toward the riser and starting with the first turn behind the riser, wind in three turns of fibreglass tape, butting each side of a turn. Secure the end of the fibreglass tape with adhesive coated mylar film tape.

Eighth Layer

Continue with fibreglass tape, shifting tape to centre of the area; wind in one layer teflon film 8166934. Apply teflon tape from roll, butting the riser and overlapping the teflon film ends 13 to 25 mm. Cut and secure end of fibreglass tape and teflon film with pieces of adhesive coated mylar film tape.

PINION END DIAMOND SECTION

First Layer

Apply one turn of 0.13 mm x 19 mm fibreglass tape around pinion end diamond section, starting approximately 25 mm from the pinion end. Overlap the fibreglass tape on start of second turn approximately 200 mm to keep tape from slipping. Pull tape as tightly as possible over insulation to prevent insulation from creeping when top layer of coils is installed.

Continue with fibreglass tape; wind in one layer of glass teflon 9324914 consisting of three sections. Butt ends of insulation and locate within 19 mm from end of strap.

Second Layer

Continue with fibreglass tape; wind in four turns 5 of tape butted toward the core.

Third Layer

Continue with fibreglass tape; wind in one layer of glass teflon 8260276 consisting of three sections. Stagger joints of glass teflon approximately 51 mm in relation to the joints of glass teflon 9324914. Overlap teflon approximately 13 mm.

Fourth Layer

Continue with fibreglass tape; wind in four turns of tape butted toward the pinion end.

Fifth Layer

Continue with fibreglass tape; wind in one layer of insulation 8197246. Butt the ends of insulation and locate within 19 mm from end of strap. Stagger the end of this layer of insulation approximately 51 mm in relation to the joints of glass teflon.

Sixth Layer

Continue with fibreglass tape; wind in three sections of glass teflon insulation 9324914. Butt the ends of the insulation and locate within 19 mm from end of strap. The butted ends may "gap" approximately 3 mm. Stagger the ends of the glass teflon insulation approximately 51 mm in relation to the joints of sixth layer.

Seventh Layer

Continue with fibreglass tape; wind in four turns of tape butted toward the pinion end. Secure fibreglass tape with adhesive coated mylar film tape. Remove clamping ring from pinion end clips.

INSULATION OVER BOTTOM COILS

The insulation over the bottom coils, Fig. 44, at the commutator end diamond section (area over the coil supports) consists of eight layers of insulation wound in with continous 0.13 mm x 19 mm fibreglass tape.

The insulation over the bottom coils at the pinion end diamond section consists of five layers wound in. If it is necessary to splice the fibreglass tape during winding, use adhesive tape to make the splice. Insulate over bottom coils as follows.

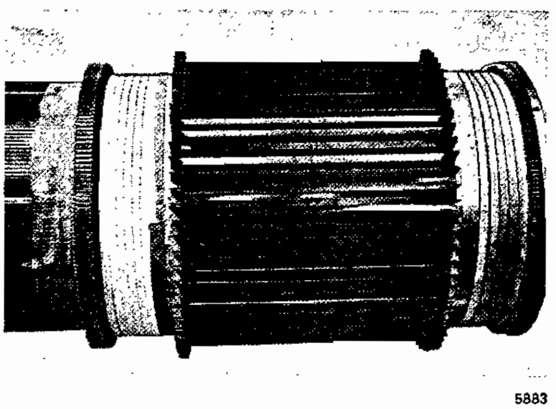

Fig. 44 - Insulation Over Bottom Coils

COMMUTATOR END DIAMOND SECTION

First Layer

Apply one turn of fibreglass tape approximately 25 mm from the riser at the commutator end diamond section. Overlap the fibreglass tape on start of second turn approximately 200 mm to keep tape from slipping. Pull tape as tightly as possible over insulation to prevent insulation from creeping when one layer of coils is installed.

Continue with fibreglass tape; shift to approximately 25 mm behind the commutator riser and wind in one layer of teflon film insulation 8166934. Apply teflon from roll, butt one side of teflon insulation against riser and overlap the ends 13 to 25 mm. Hold in place with one turn of fibreglass tape.

Second Layer

Continue with fibreglass tape; shift over toward the core so as not to overlap the last turn of the tape. Wind in one layer of glass teflon insulation 8260276 consisting of three sections. Butt one side of each section against the riser and butt the ends.

Third Layer

Continue with fibreglass tape; wind in one layer of glass teflon insulation 8197244, consisting of three sections, butting riser and stagger end approximately 51 mm to form double layer. Stagger the joints of this double layer 51 mm with the joints of No. 2 layer.

Fourth Layer

Continue with fibreglass tape. Start first turn next to riser. Wind in three butted turns.

Fifth Layer

Continue with fibreglass tape; wind in one layer of insulation 8197245, consisting of three pieces, butting riser and butting ends.

Sixth Layer

Continue with fibreglass tape; wind in one layer of insulation 8460429 consisting of three pieces. Stagger this layer 51 mm with the No. 5 layer.

Seventh Layer

Continue with fibreglass tape. Start first turn next to riser. Wind in three butted turns. Secure end of tape with adhesive coated mylar film tape.

Eighth Layer

Continue with fibreglass tape; wind in one layer of teflon film insulation 8166935. Apply teflon from roll. Butt riser and cut to allow 13 to 25 overlap at the ends. Secure teflon film insulation with adhesive coated mylar film tape.

PINION END DIAMOND SECTION

First Layer

Apply one turn of 0.13 mm x 19 mm fibreglass tape around pinion end diamond section, starting approximately 25 mm from pinion end. Overlap the fibreglass tape on start of second turn approximately 200 mm to keep tape from slipping. Pull tape as tightly as possible over insulation to prevent insulation from creeping when top layer of coils is installed.

Continue with fibreglass tape; wind in one layer of teflon film insulation 8166934. Apply teflon from roll. Locate insulation 19 mm from end of strap. Overlap teflon film insulation with fibreglass tape by 19 mm

Second Layer

Continue with fibreglass tape; shift tape approximately 25 mm from pinion end and wind in one layer of insulation 8372919. Locate insulation 19 mm from end of strap.

Third Layer

Continue with fibreglass tape; shift tape approximately 25 mm and wind in one layer of glass teflon 8060276 consisting of three sections. Stagger joints of glass teflon approximately 51 mm (2") in relation to the joints of No. 2 layer. Overlap glass teflon approximately 13 mm

Fourth Layer

Continue with fibreglass tape; shift tape approximately 25 mm and wind in one layer of insulation 8372919 consisting of three sections. Locate insulation 19 mm from the end of the strap and stagger the joints 51 mm in relation to the joints of No. 3 layer. Butt wind second turn of fibreglass tape and fasten with adhesive coated mylar film tape.

Fifth Layer

Continue with fibreglass tape; and wind in one layer of teflon film 8166934. Apply teflon from roll. Locate teflon film 19 mm from end of the strap. Fasten teflon film with adhesive coated mylar film tape.

INSTALLING UPPER COILS

1. Place one filler strip in each coil slot over bottom coils.

2. Refer to Fig. 26, Armature Coil Layout, to determine the start of upper coils.

3. Place coil in core slot, centrally locate coil in slot using coil centreing gauge. Press coil horizontally into slot. Position straight section of coil against filler strips at bottom of slot before inserting coil leads into commutator riser slots, Fig. 45.

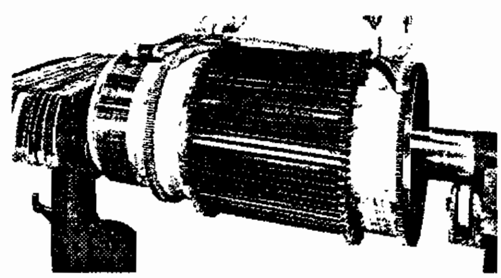

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Fig. 45 - Installing Top Coils

4. Position the three straps of the first top coil into the clips of the first two bottom coils identified and marked earlier.

   Commutator end insulation must butt the rear of the riser. If insulation tends to creep away from the riser during winding, correct before proceeding with winding.

5. Wind in balance of upper coils. Ensure filler strips are in position. Tap pinion end coil leads of top coils into pinion end clip of bottom coil and place leads into commutator riser slots.

NOTE: When installing leads in the commutator riser, the riser may start drifting or bending. The riser can be straightened by using a drift tool and mallet.

6. After all the upper coils are installed, remove coil centreing gauge and install clamping ring over the pinion end clips of the coils. This ring is required to prevent coil ends from rising as coils are set in the slot and riser.

7. Set the coils in the core slots by using a 0.5 kg mallet and a fibre block. If the leads are loose in the commutator riser, add 0.25 mm plate mica pieces to mica section in riser. Use care when inserting mica pieces to prevent damaging mica between risers.

8. Check the openings between the coils and the commutator riser for copper chips or slivers. Apply a 25 mm strip of masking tape over the leads just behind the riser.

9. Trim the "U" pieces even with the bottom of the wedge slot, using a cutting tool to start the cutting, and manually tear off the rest of the way.

10. Remove masking tape from behind the riser and check for any loose metalic particles.

11. Remove clamping ring from pinion end clips.

COMMUTATOR END STRING BAND

All varnished or painted polyester string bands or epoxy coated string bands which require replacement should be replaced with fibreglass cord string band and teflon string band covering.

If the string band is being replaced with a fibreglass cord string band or if a new fibreglass cord string is required, refer to Fig. 46 and perform the following procedure:

1. Remove any loose cement from commutator "V" ring.

2. Mix epoxy resin kit per instructions furnished with the kit. Refer to Service Data for kit part number.

NOTE: Epoxy resin and catalyst also available in bulk quantities and can be mixed in the proportion of 950 cc of polyester resin to 10 cc of catalyst. These recommended proportions result in a mixture "pot life" of approximately nine days. Refer to Service Data for part numbers of polyester resin and catalyst.

3. Apply a liberal coating of epoxy resin with a 25 mm brush to the commutator "V" ring. Do not allow the epoxy resin to work into the slots of the commutator.

4. Wind in one layer of glass cord over epoxy resin coating. Starting next to the commutator, secure one end of cord by overlapping one turn as shown in Fig. 47. Keep glass cord pulled tightly and keep turns as close together as possible. When there are approximately four turns left to make, form a loop of a short piece of the cord and wind under the remaining turns, leaving the loop and loose ends exposed as shown in Fig. 48.

5. When all turns are completed, cut cord from spool and insert loose end through formed loop and carefully pull loose end under, but not out of, the turns. Cut all loose ends flush with the layer of glass cord. Apply a liberal coat of epoxy resin over the glass cord.

Ensure the vertical edge of the commutator bars are clean and in good condition, refer to Fig. 46 and perform the following procedure to install the string band covering:

1. Apply epoxy primer to vertical edge of commutator. Refer to Service Data for epoxy primer part number.

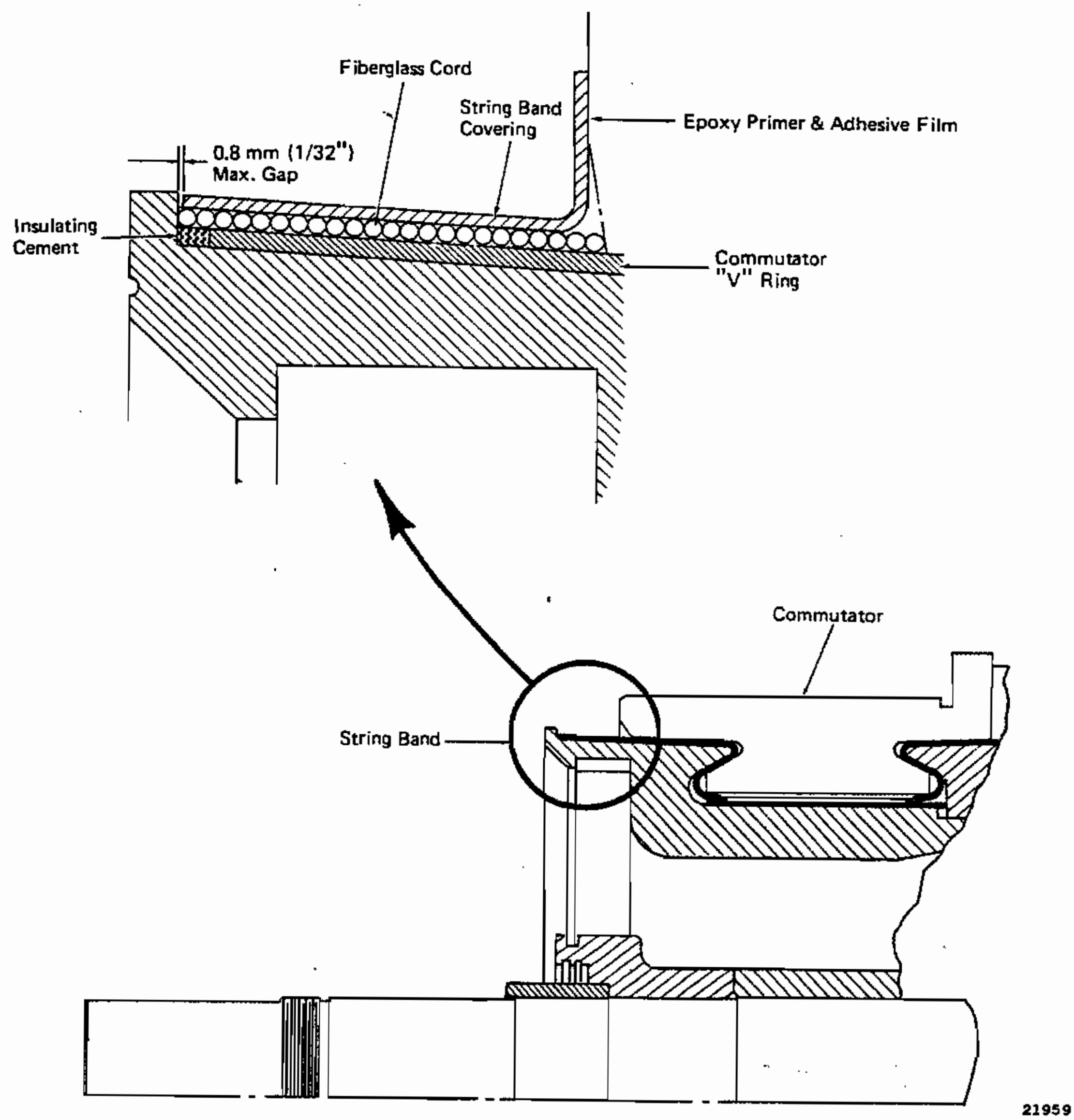

Fig. 46 - Commutator End String Band Application

2. Apply adhesive film to string band and commutator wall where string band covering will seat. Refer to Service Data for adhesive film part number.

3. Install the string band covering and apply pressure with a steel band or similar device. Ensure there is no more than an 0.8 mm gap between the string band covering outer edge and inner edge of the commutator spider assembly.

4. Place armature in an oven and bake at 149° C for one hour.

5. Remove armature from oven and remove steel pressure band.

TEMPORARY BAND APPLICATION

A temporary banding operation is required to properly set the coils and insulation prior to wedging and final banding. The armature must be heated and while hot, temporary bands applied over the core and coil area as shown in Fig. 49. The heating operation is required to soften the bonding agents in the insulation to assure an even pull down or setting of the coils and insulation. Apply temporary band to armature as follows.

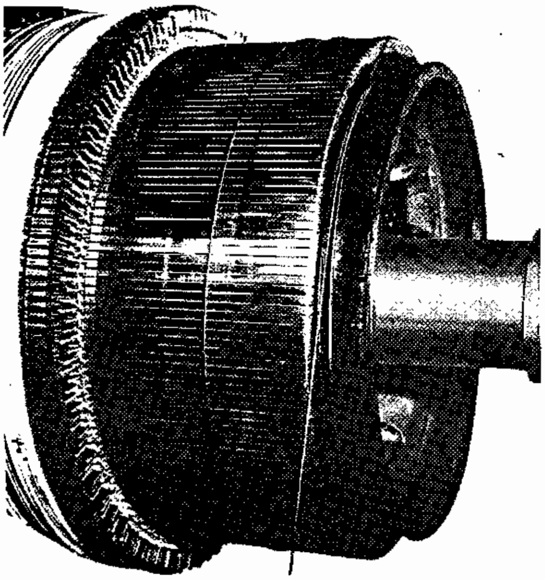

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Fig. 47 - Securing Start of String Band

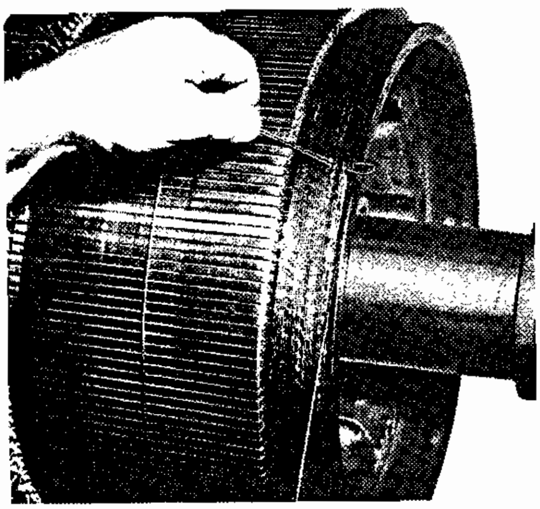

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Fig. 48 - Securing Finish of String Band

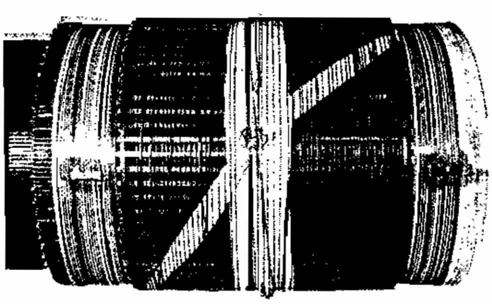

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Fig. 49 - Armature with Temporary Band Applied

NOTE: Metal banding straps may be used in place of the wire bands. If used, perform Steps 1, 4, 5, and 6, then apply protective pads over the pinion end and commutator end diamond sections. Apply the steel straps at 137 kg tension over the pads, placing two each over the diamond sections and three evenly spaced over the banding sticks.

1. Apply one turn of 0.51 mm x 25 mm white cotton tape around the centre of the core. Insert one armature banding stick into each coil slot under the tape (70 banding sticks are required).

2. Starting next to the pinion end banding sticks, apply one turn of white cotton tape folded to one-half its width over the diamond area (area over the coil supports). Insert a piece of 50 mm x 100 mm fish paper under the white cotton tape and at a right angle to the tape at the area the banding wire will be soldered.

3. Guide the white cotton tape unfolded toward the commutator riser and apply a folded turn of white cotton 13 mm from the pinion end coil clips to hold down the fish paper. Fill the space between and over the folded turns with two layers of approximately one-half lapped white cotton tape.

4. Continue white cotton tape in wide open turns to the commutator end diamond section. Apply tape and fish paper as for the pinion end, starting the first turn 6 mm behind the commutator riser. Place the fish paper in line with the piece inserted in the pinion end.

5. Place the armature in an over preheated at 155° C + 22°. Allow armature to heat for five hours. Remove armature.

NOTE: Banding operation must start within fifteen minutes after removal from oven. Ensure tension bars are properly positioned before starting temporary banding.

6. Place armature in a banding lathe.

7. Secure the end of temporary banding wire to a loop in the surgical tape. Apply a few turns crisscrossed over the surgical tape in the middle of core while regulating tension to 137 kg.

8. Move the carriage on the banding lathe, applying wide spiral turns toward the commutator end of the banding sticks, then apply wide spiral turns toward the pinion end of the banding sticks. Return wire in wide spiral turns to the centre area of the core.

9. Continue turns of wire band, spaced approximately 9.5 mm to within 25 mm of commutator end of banding sticks. At this point, apply five turns of band wire side-by-side as shown in Fig. 50. Cross wire over this band to hold the tension, then drop down commutator end diamond sections and apply a minimum of seven turns within 38 mm ± 3 mm of the core. Insert a temporary banding clip over the fish paper and under the next turn of wire. Make a 51 mm band of nineteen to twenty-one turns over the clip, as shown in Fig. 50. When inserting the banding clip, position clip so there will be a portion extending on either side of the band.

10. Bend up end of banding clip and insert a second banding clip for approximately a 19 mm band of at least ten turns. When necessary, tap coils lightly with a 0.5 kg mallet.

11. Holding the 137 kg tension on the banding wire, trim the clip as necessary to have a 9.5 mm end to solder down. Bend clip over wire and solder each end of clip using flux and high temperature solder. Do not cut the wire at this time.

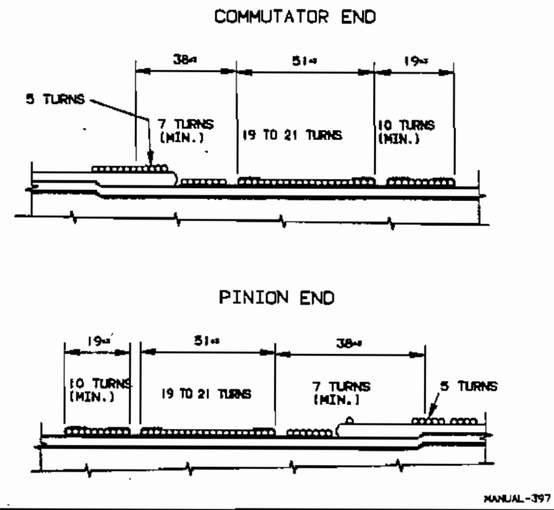

Fig. 50 - Armature Temporary Band Application

12. After completing the commutator end, return the wire band in wide spiral turns to the centre of the core maintaining 137 kg tension. Continue turns spaced approximately 9.5 mm apart to within 25 mm of the pinion end of the banding sticks. At this point apply bands side by side for at least five turns as shown in Fig.50. Cross wire over this band to hold the tension, then drop down to pinion end diamond section. Apply a minimum of seven turns approximately 38 mm of the pinion end of the core. Insert a banding clip over the piece of fish paper inserted in the surgical tape and under the next turn of wire. Make a band approximately 51 mm wide of nineteen to twenty-one turns over the clip. Bend up one end of the clip and insert a second clip for a band approximately 19 mm wide of at least ten turns. When necessary tap down coils lightly using a 0.454 kg rawhide mallet.

13. Holding the 137 kg tension on the banding wire, trim the clip as necessary to have a 9.5 mm end to solder down. Bend clip over wire and solder each end of the clip using flux and high temperature solder.

14. After solder is hard, relieve tension on the wire and bend wire sharply over the clip. Cut wire 6 mm from the clip.

NOTE: The temporary band is applied in the manner described so the wire can be removed from the core section and still remain on the diamond sections.

15. Remove the armature from the banding lathe and allow to cool to room temperature. After cooling, place the armature in a winding stand. Remove the temporary banding wire from over the core and remove banding sticks. Leave the bands over the diamond sections.

16. Remove the pinion end clamping ring and ground test the armature at 5000 volts for ten seconds. If ground test is satisfactory, proceed to install coil slot wedges.

WEDGING COILS

The armature coils are wedged to prevent the coils from shifting during operation. Various thicknesses of wedge strips are used because of the variation of coil slots and coils. Each individual wedge must be gauged by the "feel" of the wedge when the wedge is being driven into the slot.

After the wedge is in place, a light tap can determine if the wedge is tight. If the wedge sounds solid, the wedge is tight. If not tight, there will be vibration in the wedge when tapped.

Care must also be taken not to get the wedges too tight. When the armature is heated, the coils will expand and cause overly tight wedges to buckle. This will result in loose wedges when the armature cools.

The objective during wedging is to distribute all the forces equally over the entire core surface. Uneven forces can bend the laminations to cause the wedges in one slot to be tighter than wedges in other slots.

There are several methods which can be used to distribute these forces. One acceptable method is to drive a wedge in every other slot to the centre of the core over the full circumference, making several rotations of the armature to complete the job. Another method is to fill a given accessible area of a few slots, working the commutator end half of the core by sections until completely wedged, then doing the pinion end half in the same manner. Regardless of the method used, wedges should be driven into every other slot one at a time so that without exception, no two adjacent wedges will be driven into adjacent slots.

Prior to driving the wedges, mark a line around the centre of the core. This mark is used to locate the wedges in even rows around the core.

Apply filler strips to the top of the coil and drive three or four wedges into the commutator end area of the core to determine general filler strip thickness to give a proper tightness of the wedges. Wedges may be driven into the slots by using an air hammer, driving head, and spindle bushing as shown in Fig. 51, or they may be driven in by hand using a rawhide mallet and drive key to start the wedges and a drive bar to position the wedges. Refer to Service Data for tool part numbers.

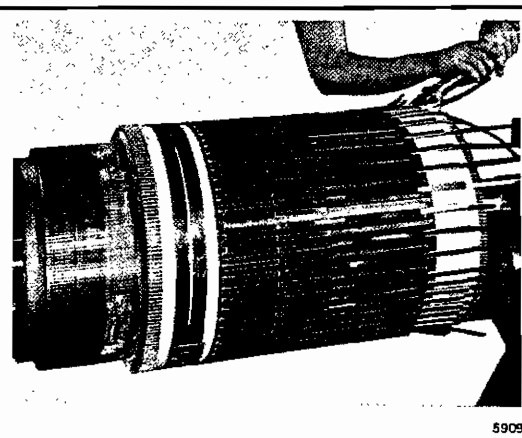

Fig. 51 - Wedging of Armature

NOTE: During wedging operation, filler strips may jam up between the ends of the wedges as they are driven into position. This will not interfere with the wedging so long as the next wedge fits tight in the slot. Cut build up between wedge ends flush with the top of the wedge and beyond ends of the outer wedge, being careful not to damage the coils.

Insulate the pinion end of the armature by placing pieces of insulation between adjacent coils and insert a "U" shaped piece of insulation between the top and bottom coils as shown in Fig. 52. Apply a ground test of 4600 volts for 10 seconds to the armature.

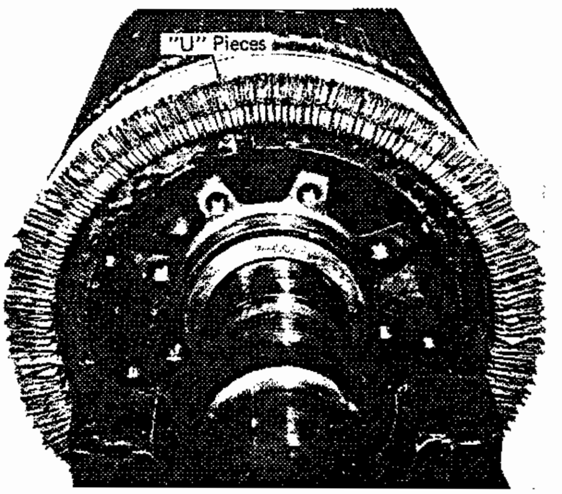

Fig. 52 - Temporary Test Insulation

Ensure all commutator plugs are in place and properly positioned. Refer to Section 5, CommutatorBar-To-Bar Resistance Test and perform a 300 volt bar-to-bar resistance test to commutator.

T.I.G. WELDING

T.I.G. (Tungsten-Inert-Gas) welding is a process by which the welding of metal is accomplished by creating an electric arc between a 2% thoriated tungsten electrode, and the metal to be welded in an inert atmosphere of argon gas.

NOTE: For best results, those armatures that were not T.I.G. welded during original installation should not be T.I.G. welded during rebuild.

BRAZING PINION END COILS

Place armature in a suitable brazing machine and prepare to braze top coil leads to the bottom coil leads and clips at the pinion end of the armature. Braze the coil leads and clips as follows.

1. Straighten coil leads and clips carefully. Ensure the coil clips are seated evenly, Fig. 53.

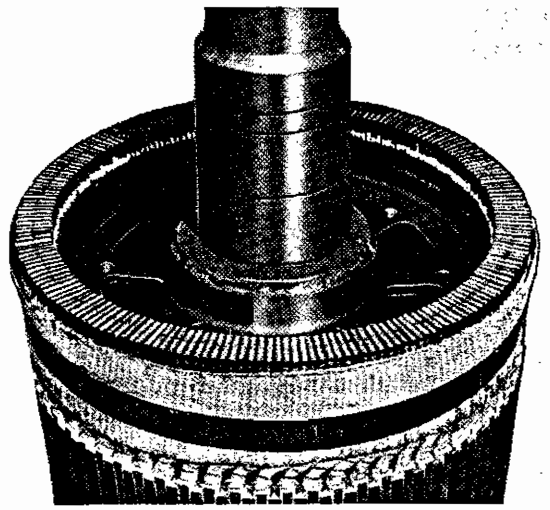

Fig. 53 - Pinion End Coil Connectors

2. Place heat resistant material between the brazing equipment and the adjacent coil leads. This material is to prevent heat from the brazing equipment damaging the coil insulation.

CAUTION:
Use care when applying heat to the coil leads and clips being brazed as excessive heat could burn coil ends and damage insulation on the coils.

3. Braze coil leads using "U" piece solder strips. Finish with Sil-Fos solder. When a good bond is obtained, remove heat

resistant material and repeat operation on the next leads until all leads are brazed.

NOTE: "U" piece solder strips part of Armature Rewind Kit. Refer to Service Data for Sil-Fos solder part number.

4. Remove brazing equipment. It will be necessary to place armature in an oven set at 115° C for six to eight hours to remove any moisture in the windings.

INSULATING PINION END COIL LEADS AND CLIPS

After the pinion end coil leads and clips are brazed and the armature thoroughly dried, insulate the coil leads and clips as follows.

1. Assemble the pinion end temporary winding fixture. Refer to Service Data for part number.

2. Straighten the pinion end brazed leads.

3. Insulate between the coil clips with mica spacers as shown in Fig. 54. Use mica filler as required to make spacer fit snug. Mica filler when used is to be flush with the top of the mica spacer.

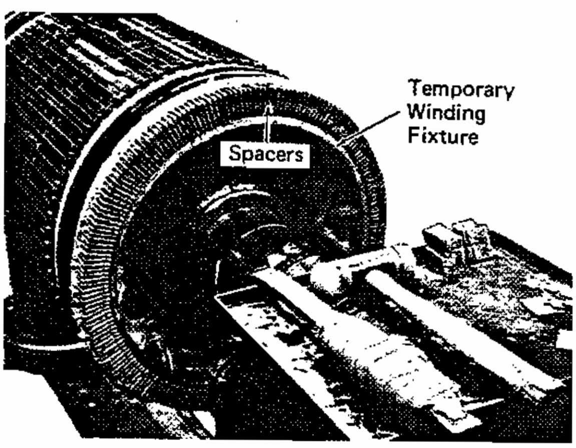

Fig. 54 - Mica Spacers in Position

4. When all spacers are in place and fit tight, remove temporary winding fixture. File the ends of the spacers to fit end bell insulation gauge. The gauge must move freely around the ends of the mica spacers, Figs. 55 and 56. There must be a clearance of 1.5 mm from the top of the mica spacer to the coil clips and a clearance of 1.5 mm between the bottom end of the mica spacer to the bottom of the clip connecting the top and bottom coil. There should also be 3 mm clearance from the outer edge coil clips as shown in Fig. 57. The distance between the armature shaft and the inside radius of the mica spacers should be 127 mm. At no time should the coil leads or clips be flush with the ends of the mica spacer.

5. After filing the ends of the spacers, remove all mica filings and dust with clean, dry, low pressure compressed air.

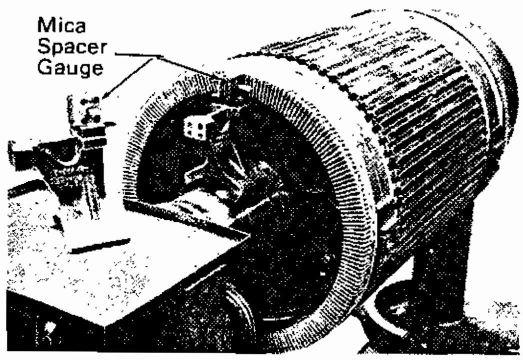

Fig. 55 - Gauging Inside and Outside Diameters of Mica Spacers

6. Fill the spaces under and over connections and between mica spacers with silicone rubber compound. The space between mica spacers at the end of the connections may be filled flush with silicone rubber compound.

7. When pinion end coil connectors are insulated, refer to Section 5, Commutator Bar-To-Bar Resistance Test and

perform a 300 volt bar-to-bar resistance test to commutator.

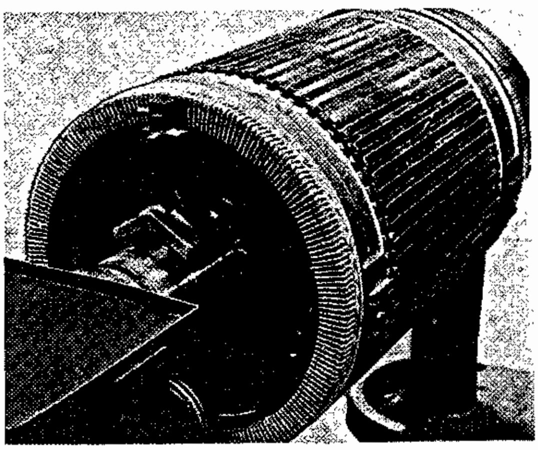

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Fig. 56 - Checking the Extensions of Spacers

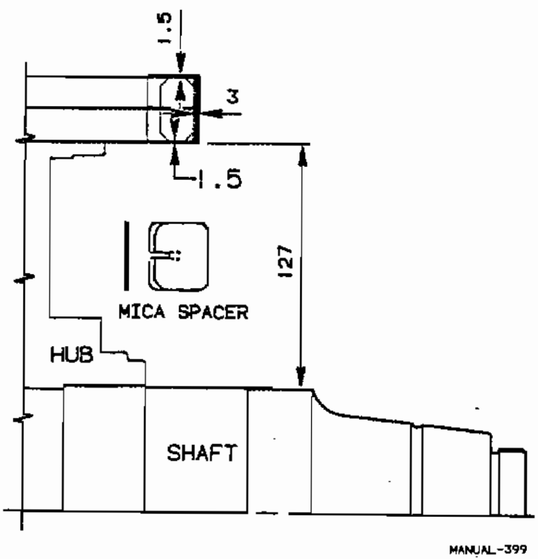


Fig. 57 - Pinion End Mica Spacing

INSTALLATION OF END BELL AND INSULATION

1. Place armature in a vertical position, pinion end up.

2. Ensure end bell is clean and free of nicks and burrs. Ensure mounting location on armature is free of all varnish and nicks.

3. Apply silicone rubber compound to the groove in the end bell, Fig. 58. Fill groove with a sufficient quantity to ensure a good seal at assembly.

4. Place mica ring in position on the pinion end of the armature.

5. Fit the end bell over the mica ring and fasten loosely to the armature coil support with bolts and washers. Do not tighten bolts at this time.

6. Insert one layer (50 pieces) of glass and mica insulation between the mica ring and the pinion end coil connectors. With the joints half lapped, place pieces between mica ring and pinion end coil connections so glass side is up, Fig. 59.

7. Tighten end bell bolts. Check tightness of the glass and mica insulation by gently pulling on free end of the insulation. If any pieces of glass and mica insulation are found to be loose, the end bell will have to be loosened and additional pieces of glass and mica insulation will have to be inserted. Insert glass and mica insulation where necessary between the first layer of the insulation and the mica ring (mica side toward the end bell) until a tight fit is secured around the end bell when the end bell is tightened with the bolts. Any added insulation must be cut flush with the top of the main coils.

8. Remove tension bands on the commutator end and the pinion end diamond sections.

9. Place the armature in a horizontal position in a winding stand. Rotate the armature and apply one temporary layer of 0.18 mm x 38 mm fibreglass tape, half lapped over the pinion end diamond section. Start the fibreglass tape next to the core and run tape towards the centre of the diamond area, folding the end bell

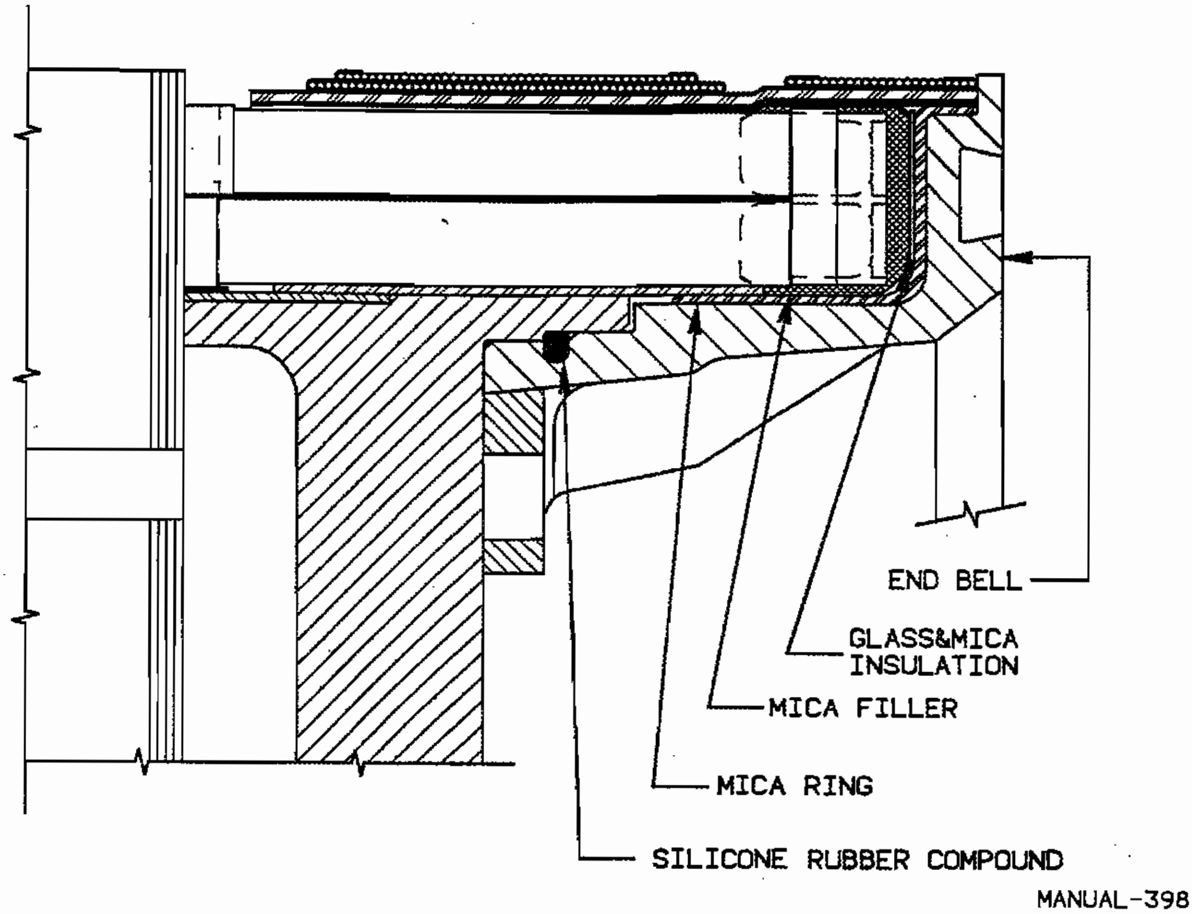


Fig. 58 - End Bell Insulation

insulation down and hold in place with the tape. Continue to run the tape towards the end bell, pulling tight to position the insulation. When the tape reaches the inside edge of the end bell, use a light mallet to tap over the area just covered, to set the end bell insulation. Continue to run two turns of the fibreglass tape over the area butting the end bell. Then run the fibreglass tape half lapped across the diamond section back to the core. Cut the fibreglass tape and secure end with adhesive tape. Run a few turns of cord over the glass area to prevent the tape from coming loose during heating operation.

10. Repeat similar operation at the commutator end diamond section, applying one layer of the 38 mm fibreglass tape butting the commutator riser. Secure the end of the fibreglass tape and hold in place with a few turns of cord.

NOTE: The fibreglass tape will be removed after varnish treatment operations. The tape is applied to provide a smooth surface for final band applications.

VARNISH TREATMENT

Upon completion of the coil winding operations, the armature should be vacuum impregnated with varnish and baked before applying the final bands. Varnish should be thinned to maintain Ford Cup No. 4 orifice viscosity at 250-325 seconds at 21.1^{o} C and a minimum specific gravity of 0.900.

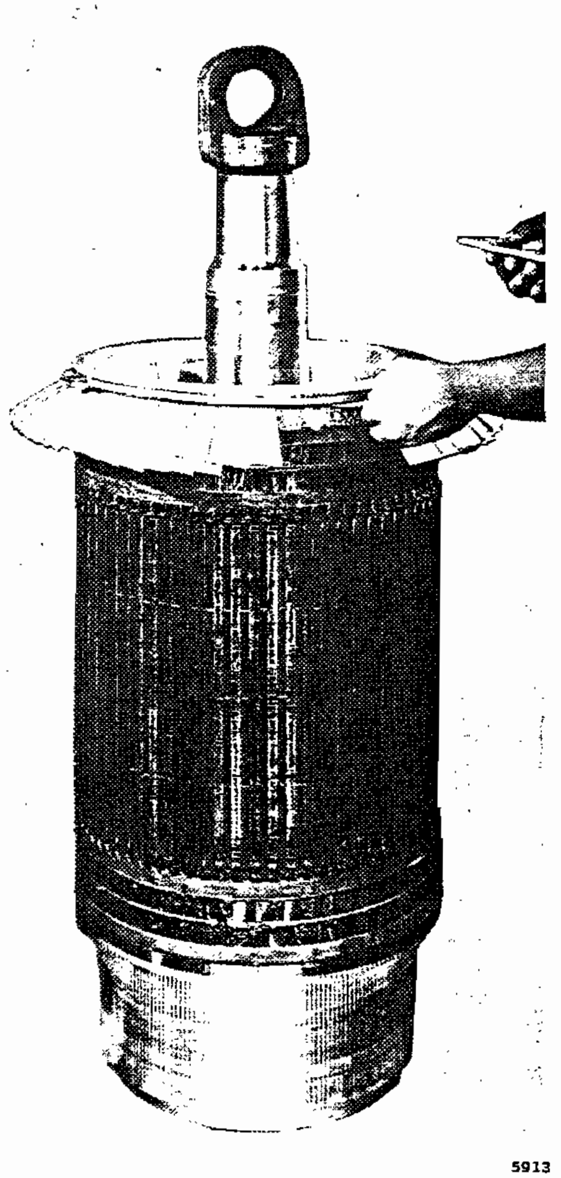


Fig. 59 - Installing End Bell Glass and Mica Insulation

Refer to Fig. 60 for a typical varnish treatment installation and perform vacuum impregnation and baking of armature as follows:

1. Clean armature core section thoroughly with Xylol or petroleum solvent and wipe dry with clean dry cloths. On armatures with hydraulic pinion removal feature, remove 1/2"-20 set screw in the shaft centre prior to varnish impregnation .

2. Brush-coat armature core tooth and wedge area with baking varnish. Do not thin varnish.

3. Preheat armature in a convection oven so that the average armature core temperature stabilizes at 120° C + 5°, -10° C. Ensure core temperature does not exceed 125° C or oven temperature does not exceed 175° C

4. Remove armature from oven and place in vacuum impregnation tank. Average core temperature of armature should be between 100° C to 120° C when placed in tank. Do not allow armature core to cool below 100° C before placing in tank.

5. Apply 710-760 mm Hg vacuum to tank for 15 minutes. Bolt down tank lid while vacuum is building up.

6. With vacuum still on tank, run varnish into tank to minimum level of 8 mm over rear side of the commutator riser outside diameter to a maximum of up to, but not over, the riser face. Break down foam by occasionally injecting small amounts of CO_2 into impregnating tank as varnish rises around armature. If vacuum is not sufficient to draw varnish up to the required level, CO_2 may be injected into the tank to force the varnish up to the desire level. Do not open release valve to admit atmospheric air into impregnating tank.

7. Reduce vacuum to zero with CO_2 additions. Check that varnish is at the proper level, then increase CO_2 pressure to 200-275 kPa. Allow armature to remain under pressure for a minimum of 15 minutes to a maximum of 20 minutes.

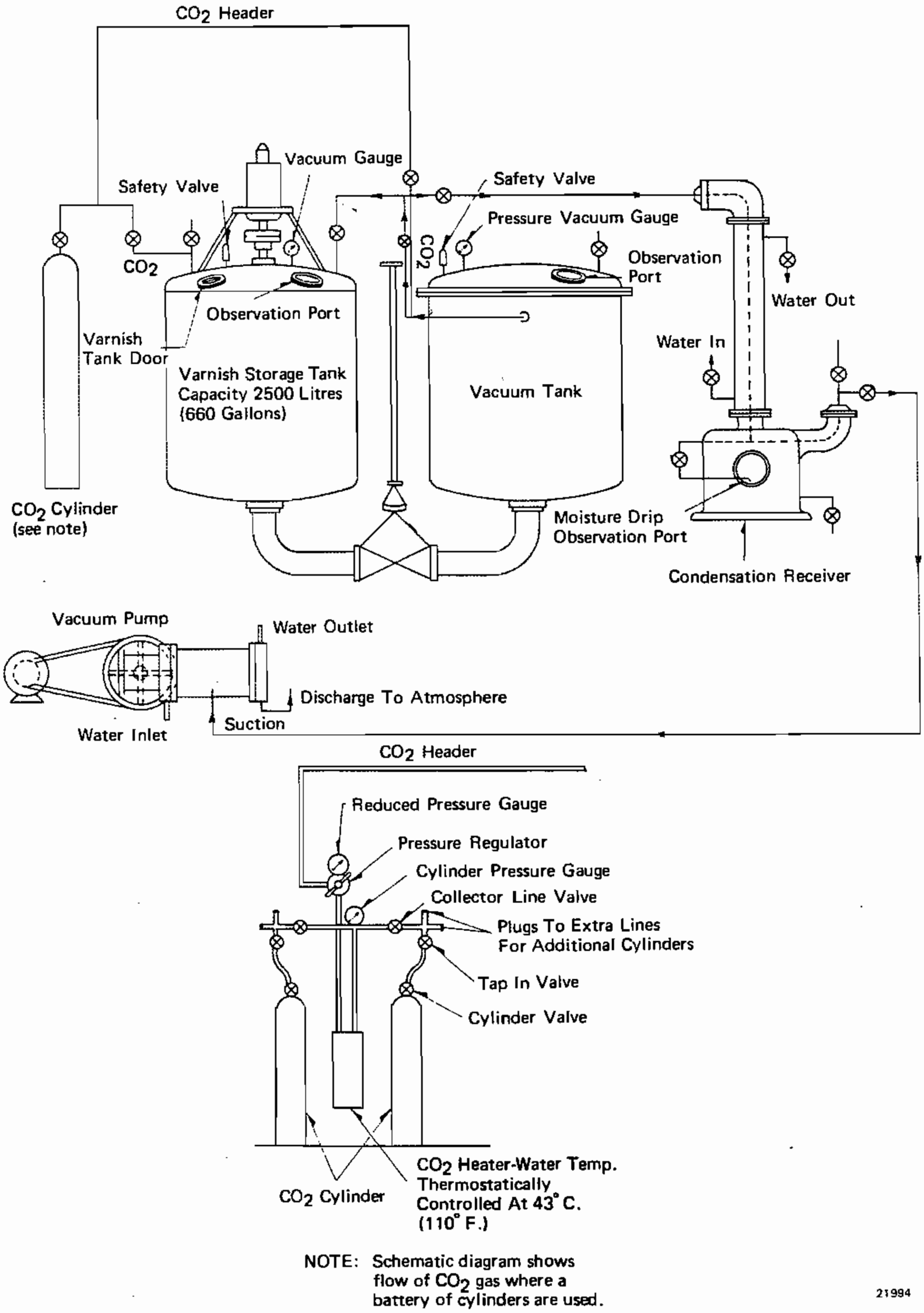


Fig. 60 - Typical Varnish Treatment Equipment Installation

8. Reduce CO2 pressure to 70-100 kPa by opening vacuum valve. Do not open release valve to atmospheric air. Empty varnish from impregnating tank using the 70-100 kPa CO2 pressure.

9. Open release valve to atmospheric air. Allow armature to drain for 25 minutes. Upon completion of drain period, close release valve and apply 710-760 mm Hg vacuum for a minimum of 5 minutes.

10. Remove armature from impregnation tank and wash varnish from shaft, end bell, and commutator face and risers with a rag saturated with Xylol or petroleum solvent. On armatures with hydraulic pinion removal feature, thoroughly clean hydraulic hole passages with solvent, then re-apply 1/2"-20 set screw finger tight.

11. Remove excess varnish from pinion end diamond pockets under the band.

12. Place armature in a convection oven.

NOTE: Bake cycle should start within 15 minutes after completion of impregnation cycle.

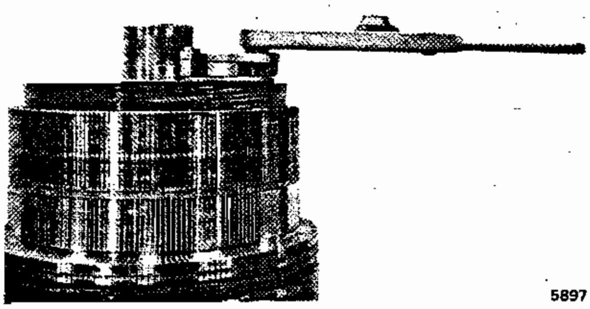


Fig. 61 - Checking Commutator Bolts

13. Attach thermocouple to armature commutator. Bake armature 6 hours after average core temperature reaches 155°C. Ensure commutator temperature does not exceed 155° C or oven temperature does not exceed 175°

14. Remove armature from oven and while armature is still between 40°-60°C, perform a ground test at 3200 volts for 1 minute.

15. Compress armature diamond areas while armature is at a minimum temperature of 125° C to the diameter listed in Service Data. The diameters must be held constant by metal tension bands until the armature is ready for banding.

16. If armature bolts have been loosened for any reason during repair, torque commutator bolts after armature has cooled using a torque wrench and 4:1 reduction gear as shown in Fig. 61. Torque armature commutator as follows:

    Commutator with Nomex V' rings
    373 N m
    Commutator with mica "V" rings
    434 Nm
    Arch bound commutator 190 Nm

NOTE: Arch bound commutator may be identified by groove machined into chamfer of spider flange.

17. When bolts are determined to be torqued to the correct value, tack weld Nomex and mica "V" ring commutators bolts in place. DO NOT tack weld bolts on arch bound commutators.

PERMANENT BANDING OF COILS

Current model traction motor armatures are banded with non-magnetic wire at the pinion end and banded with fibreglass tape at the commutator end. Those units manufactured with wire bands at both the commutator end and pinion end should have the commutator end band replaced with a fibreglass band when the band requires replacement.

NOTE: If a unit has a satisfactory wire band at the commutator end, the wire must have a covering of fibreglass tape and epoxy. Refer to Section 5, Tension Bands for procedure.

APPLICATION OF PINION END BANDS

Before applying wire bands a smooth and level insulation base must be applied as follows:

1. Apply one layer of teflon glass insulation with edge located 17 mm from core and one layer butting pinion end bell. Hold ends with adhesive coated mylar film tape.

2. Apply one layer of half lapped 0.18 mm x 38 mm fibreglass tape from a point 22 mm from core to end bell. Fill voids to provide an even base for banding. Hold fibreglass tape down with adhesive coated mylar film tape.

3. Apply one layer of glass mica (mica side down) with edges butting end bell and ends overlapped 10 mm. Wind in with fibreglass tape.

4. Wind in with 0.13 mm x 19 mm fibreglass tape one layer of varnished insulation with edges butting end bell and ends over lapped 10 mm. Cover varnished insulation with one layer of 0.18 mm x 38 mm fibreglass tape. Centre the tape over the gap area between bands, wind one turn, then shift tape sharply 25 mm towards core and continue winding. Hold end of tape with adhesive coated mylar film tape.

To prevent solder from entering the pockets located between the band insulation and the core, during banding operations, cover the openings with white cotton tape. Apply three turns so that the first turn is bunched to cover the pocket. Catch the first turn with second and third turns partially overlapping the core to provide maximum recess protection. Secure loose end by inserting under previous turns.

PINION END LOWER BAND

1. Place armature in a banding lathe.

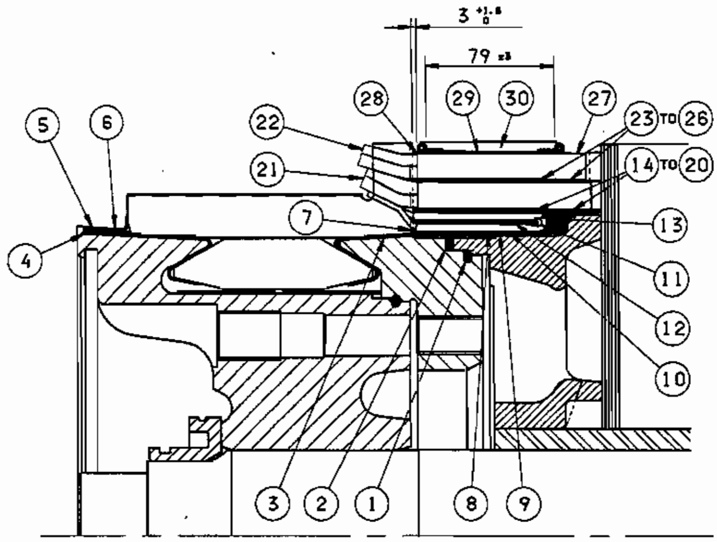
2. Position banding wire in groove of guide roll and lock wire in cam locks. Adjust banding tension to 181 kg + 11 and locate first band so that the band is 22 mm from the core.

3. Insert one banding clip under the first turn of wire opposite of every fifth wedge. Insert two extra clips at the starting point between the first and second regular clips. Clips should extend approximately 13 mm beyond the first wire. There are a total of 16 clips.

4. Guide wire so that all turns, or strands, are tight against each other. Continue banding remainder of diamond section until band is at the width shown on Fig. 62. Bend up the four starting clips and trim clips to approximately 6 mm. Tap clips down over wire.

5. Apply soldering flux to area of band between the four clips. Solder bands in this area. Cut wire and bend wire back around the first starting clip at as near to band level as possible and trim close.

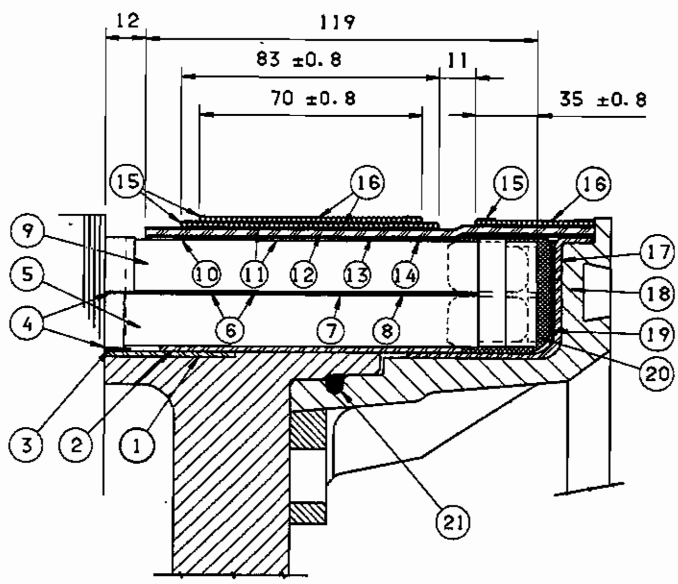
6. Flux and solder several strands at both edges of band over starting clips. Bend up, trim, and tap back onto the band the ends of all remaining clips. Close up any gaps in the band and set clips against the band. Do not nick the wire.



COMMUTATOR END

1. SILICONE RUBBER COMPOUND
2. SEAL
3. MICA RING
4. INSULATING CEMENT
5. FIBREGLASS STRING BAND
6. STRING BAND COVERING
7. INSULATING CEMENT
8. INSULATION
9. FIBREGLASS TAPE
10. INSULATION
11. MICA INSULATION
12. CEMENT
13. CONNECTOR
14. INSULATION
15. INSULATION
16. TEFLON INSULATION
17. GLASS TAPE
18. INSULATION
19. INSULATION
20. TEFLON FILM
21. LOWER COIL
22. UPPER COIL
23. TEFLON FILM
24. INSULATION
25. GLASS TEFLON
26. INSULATION
27. INSULATION
28. POLYESTER TAPE
29. BAND EDGE RESTRAINT
30. FIBREGLASS BAND

MANUAL-400



PINION END

1. MICA RING
2. MICA RING
3. "U"PIECE
4. FILTER STRIP
5. LOWER COIL
6. TEFLON FILM
7. INSULATION
8. INSULATION
9. UPPER COIL
10. INSULATION
11. FIBREGLASS TAPE
12. MICA INSULATION
13. GLASS TAPE
14. VARNISHED INSULATION
15. BANDING CLIP
16. BANDING WIRE
17. END BELL RING
18. END BELL
19. END BELL INSULATION
20. MICA FILTER
21. SILICONE RUBBER COMPOUND

MANUAL-401

Fig. 62 - Permanent Wire Band Locations

PINION END NARROW OUTER BAND

1. Set up banding lathe in proper position for the pinion end outer narrow band as previously done for lower band. While setting the proper band tension, guide wire across pinion end lower band andapply two to four turns over the insulation adjacent to the lower band to prevent it from bulging during application of narrow band.

2. Insert one banding clip 54 mm long under the first turn of wire, opposite of every fifth wedge. Space clips alternately to clips previously applied for lower band. Two extra clips should be inserted between the first and second regular clips as previously done for the lower bands. There are a total of 16 clips. Clips should extend approximately 13 mm beyond first turn of wire band.

3. Apply banding wire to proper width, Fig. 62, being sure to maintain tight contact between turns. Finish with the four starting clips at top, then bend the starting clips up, trim clips to 6 mm and tap them down over wire. Do not nick wire. Tap wire tightly against end bell at the four starting clips.

4. Flux and solder the four starting clips. When solder is hard, release tension, cut off excess wire, and bend both ends sharply around starting clips as near to band level as possible. Trim and set all remaining clips.

SOLDERING BANDS

Flux and solder the entire surface of the two permanent bands. Solder the bands all the way around and across the full width. A gas heated soldering iron, is recommended for this operation.

After soldering, rotate the armature and remove any loose solder with a wire brush. Do not use a file or sharp tool for removing excess solder. Be careful not to nick the bands at any time during lathe banding or cleaning operation.

UPPER BANDS

1. On top of 83 mm band, wind one layer of 0.18 mm x 38 mm fibereglass tape overlapping as needed to secure insulation. Hold down fibreglass tape with adhesive coated mylar film tape.

2. Set banding machine tension to 160 kg ± 11 and position for pinion end upper band.

3. Locate band edges 6 mm from outer edges of the 83 mm band. Under the first turn of the band wire, insert one banding clip opposite every fifth wedge, at alternate positions relative to the position of the clips on the lower band. Insert two extra clips between the first and second regular clips. There are 16 total clips. Clips should extend approximately 13 mm beyond first turn of wire band.

4. Apply banding wire to proper width, Fig. 62, being sure to maintain tight contact between turns. Finish with the four starting clips at the top of the arrnature. Bend up the four starting clips and trim them to 6 mm. Tap clips down against the wire. Do not nick wire.

5. Flux and solder the four starting clips. When solder is hard, release tension, cut off excess wire, and band both ends sharply around starting clips as near to band level as possible. Trim and set all remaining clips.

6. Flux and solder the complete band as instructed in Soldering Bands paragraph.

7. Apply varnish to pinion end bands and to fibreglass tape in the space between the bands.

APPLICATION OF COMMUTATOR END BANDS

1. Place armature in banding lathe and remove commutator end steel tension band and protective blanket. Remove layer of protective tape applied before varnish impregnation operation.

2. Apply one layer of teflon insulation 8279203 around diamond section with edge located 13 mm from core. Hold in place with adhesive coated mylar film tape.

3. Apply one layer of polyester glass tape 8339111 butting commutator riser.

4. Apply one turn of acrylic banding tape 8279297 at 90 kg tension over the fibreglass tape, starting in the centre of the diamond section.

5. Locate band edge restraint 8340746 as shown in Fig. 66. Feed in place under first turn of banding tape.

6. Apply a 140 mm length of tape 8340741 centred longitudinally under butted joint ends of edge restraint. Pull ends of tape over rounded edges of edge restraint. Hold down with first layer of banding tape.

7. Apply 85 + 2 turns of acrylic banding tape at 181 kg + 11 tension between the rolled edges of the banding restraint.

8. Place a tape tie-off tool with the handle toward the core under the tape at the point where it is being fed onto the band. Rotate the armature until the tool is held down by three layers of tape lapped one on top of the other. Apply two more turns of tape while moving the carriage toward the commutator so that those layers butt against the two which hold down the tool. Apply one more turn of tape moving the carriage so that the last turn covers the tape about 305 mm beyond the tool and pass it under the tape where it bridges the tool. Pull the loose end to remove slack and remove the tool. Pull the loose end as tightly as possible and trim it where it emerges from the band. A total of 90 + 5 - 0 turns including turns used for tie-off should have been made.

9. After the fibreglass bands are applied, place 90 mm wide plastic film over band with edge of film flush with the outer edge of the band edge restraint on the core side.

10. Cover the film with a layer of pressure sensitive tape. Ensure the tape only comes in contact with the plastic film and not the fibreglass bands.

11. Thread 19 mm rayon tape through tension device and secure end of tape to commutator riser and adhesive coated mylar film tape. Wind in a silicone rubber pad 101 mm x 2 mm, approximately 1.5 m (5 ft) long under one layer of 19 mm rayon tape at 113-136 kg tension. Tie-off tape at centre of winding.

12. Cure the bands by placing armature in a recirculating hot air oven for 6-1/2 hours at 175 ± 5^{o} C.

13. After removing armature from oven, allow it to cool to below 32^{o}C before removing rayon tape, silicone pad, adhesive tape, and plastic film.

STRING BAND COVERING

If the string band was replaced with a fibreglass cord string band, it should be protected with teflon covering 8442224. Be sure the string band and vertical edge of the commutator bars are clean and in good condition. Apply epoxy primer to the vertical edge of the commutar bars. Then apply an adhesive

Apply epoxy primer to the vertical edge of the commutar bars. Then apply an adhesive film to the string band and commutator wall where the teflon covering will seat. Install the teflon covering and apply pressure with a steel band or similar device. Put the armature in an oven at 150° C, for one hour. Remove from oven and take off steel pressure band.

FINAL ASSEMBLY

If the pinion end inner oil ring and the commutator collar and spacer were removed, they should be reapplied at this time. Refer to Section 5, Final Assembly Of Armature for procedure. Also refer to Commutator Undercutting, Dynamic Balance, and De-Burring Commutator sections of Final Assembly Of Armature if required.

SERVICE DATA

SPECIFICATIONS

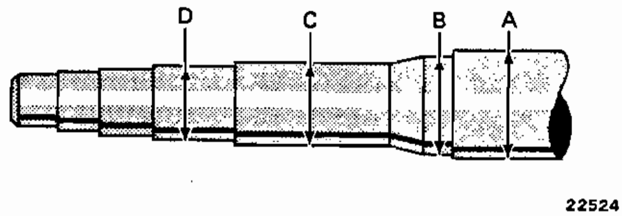
Armature Resistance at 75° C .... 0.0105 ohms ± 2%

Commutator
- Mica Groove Width .... 1.27 mm (.050")
- Mica Groove Depth .... Min 1.2 mm (3/64")
  Max. 2 mm (5/64")

Band Tension
- Pinion End, Lower Bands .... 181 kg (400 lbs)
- Pinion End, Upper Bands .... 159 kg (350 lbs)
- Pinion End, Narrow Band .... 181 kg (400 lbs)
- Commutator End, Fibreglass Band .... 181 kg (400 lbs)

Armature Diameter
- Commutator End .... 456.44 mm (17.970)
- Pinion End .... 454.66 mm (17.900")

ARMATURE SHAFT DIMENSIONS (Standard)



Part No.	'A' Dim.	'B' Dim.	'C' Dim.	'D' Dim.
9323978 Standard	101.70	102.45	127.00	127.06

EQUIPMENT LIST

Adapter, Pressing And Turning 82858 1 5
Adapter, Shaft Removal 82872 1 6
Adapter, Shaft Replacement 8285811
Air Hammer, Slot Wedge 8147511
    Driving Head 8142055
    Spindle Bushing 81475 12
Block, Fiber 8133105
Block, Shaft Pressing 8285810
Bolt, Lifting, Commutator End 8174221
Bolt, Lifting, Pinion End 8067122
Cart, Shaft Pressing 8285820
Chisel, Lead End Removal 8133100-D2
Chisel, Lead Splitting 8269134
Drift, Cross Connector Straightening 8133098
Drift, Riser Straightening 8133097
Drive Bar, Slot Wedge (manual) 8133116
Drive Key, Slot Wedge (manual) 8133115
Driving Dog (lathe), Armature Shaft 8164610
File, Core Slot 8133205
File, Slot Wedge 8133177
Fixture, Armature Turning 8287215
Fixture, Commutator Alignment 8285834
Fixture, Temporary Winding 8188334
Fixture, Wire Locking 8304245
Gauge, Coil Centering 8285841
Gauge, Commutator Alignment 8285814
Gauge, End Bell Insulation 8133117
Gauge, End Plate 8133273
Gauge, Shaft Replacement 8285813
Gauge, Slot Alignment 8133164
Gauge, Slot Wedge 8133176
Gear, Reduction, Commutator Tightening 8064963
Hone Kit (less motor) 8431585
Ohmmeter, Low Resistance (commutator bar-to-bar) 8068118
    Leads 8107968
Puller, Pinion 8239217
Ring, Clamping 8133107
Ring, Winding 8172434
Sticks, Armature Banding (70 required) 8064960
Soldering Iron Kit, Gas Heated 8164609
Sleeve, Shaft Replacement 8285812
Shim, (core hub) Commutator End 8082782
Shim, Laminated (spider quill) Pinion End 8135277
Scraper, Commutator Slots 8238105
Scraper, Insulating Compound 8133099
Scraper, Silicone Rubber Compound Remover 8285836

Tool, Staking, 1 " riser width (upper leads) 8285816
Tool, Staking, 1 " riser width (lower leads) 8173254

Tool, Staking 7/8" riser width (upper leads) 8285837
Tool, Staking 7/8" riser width (lower leads) 8285838
Tool, Staking, 3/4" riser width (upper leads) 8285839
Tool, Staking 3/4" riser width (lower leads) 8285817
Tool, Setting Connectors 8133100
Tool, Cutting (coil slot "U" piece) 8133109