

DG-5
SERVICE MANUAL

SEPTEMBER 1971

Delco

GENERATORS

AC BRUSHLESS TYPE

MAIN FRAME DIAMETER LESS THAN 35 INCHES



Delco Products Division of General Motors Corporation

Post Office Box 1042, Dayton, Ohio 45401

TABLE OF CONTENTS

	PAGE
I. INTRODUCTION	3
A. SCOPE	3
B. SAFETY	3
C. ABBREVIATIONS	3
II. DESCRIPTION	3
A. GENERAL	3
B. ALTERNATOR ARMATURE (STATOR)	6
C. ROTATING FIELD ASSEMBLY	6
D. EXCITER FIELD ASSEMBLY	6
E. EXCITER ARMATURE ASSEMBLY	6
F. ROTATING RECTIFIER ASSEMBLY	6
G. END FRAME ASSEMBLY	6
III. OPERATION	10
A. SAFETY	10
B. BEFORE STARTING	10
C. STARTING	10
D. UNDER-SPEED OPERATION	10
E. RUNNING	10
F. PARALLELING	10
G. STOPPING	10
IV. MAINTENANCE	10
A. INSULATION TEST	10
B. CLEANING	11
C. DRYING	11
D. LUBRICATION	11
E. ROTATING RECTIFIER ASSEMBLY	12
V. TROUBLE-SHOOTING IN FIELD	12
A. PRELIMINARY TESTS	12
B. MANUAL CONTROL TEST	12
C. STATOR TEST	12
D. RESISTANCE CHECKS	12
E. 12-VOLT TEST	13
F. DIODE TEST	13
VI. DISASSEMBLY AND REASSEMBLY	14
A. SAFETY	14
B. PRELIMINARY NOTES	14
C. SEPARATION OF GENERATOR AND ENGINE	14
D. DISASSEMBLY OF GENERATOR	15
VII. CHECK OUT FOR ROTATING RECTIFIER ASSEMBLY	18



GSI GENERATOR
SERVICE
INFORMATION

MODEL

E6921M1

DATE 10-28-74



SERVICEABLE PARTS LIST

Item	Part No.	Description	No. Req.
1.	5547208	Fan and Driving Disc Assembly	1
2.	9411385	Bolt - Fan Assembly Mounting	12
3.	4988356	Rotating Field and Exciter Armature Assembly	1
4.	4988355	Rotating Field and Shaft Assembly	1
5.	4980134	Rotating Coil	6
6.	5384913	Bolt - Rotating Coil Mounting	18
7.	4988354	Armature Assembly - Exciter	1
8.	4988252	Rotating Rectifier Service Kit	1
	3179357	Rectifier	6
	3195233	Locknut - Rectifier	6
	4943587	Silicon Controlled Rectifier (SCR)	2
	4946953	Locknut - SCR	2
9.	5379887	Lockwasher - Exciter Retaining	1
10.	4986993	Exciter Field Assembly	1
11.	4988352	Frame, Stator and Coil Assembly	1
12.	4988351	Stator and Coil Assembly	1
13.	5388489	Gasket - Bearing Cap	1
14.	5364650	Ball Bearing	1
15.	5514417	Sight Gage - Oil Level	1

Reference Generator Service Manual DG-5.

For service information, contact: Generator Sales Department
Delco Products Division, GMC
Phone: 513-445-7981
P. O. Box 1042
TWX: 810-459-1788
Dayton, Ohio 45401

Be sure to include complete generator nameplate data.



GSI GENERATOR SERVICE INFORMATION

MODEL

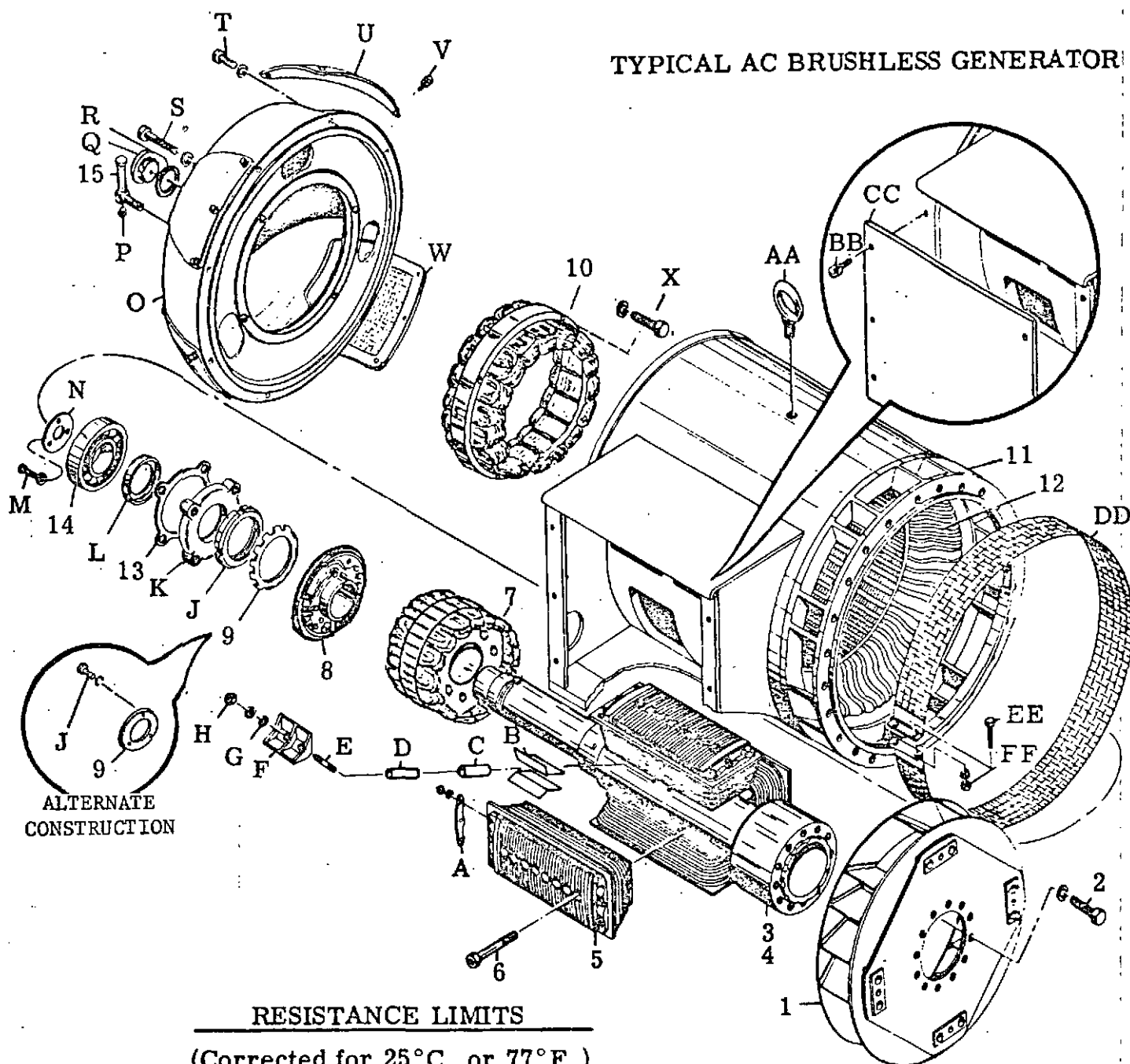
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TYPICAL AC BRUSHLESS GENERATOR



RESISTANCE LIMITS

(Corrected for 25°C. or 77°F.)

*Alternator Armature (Stator)	.065	-	.072	Ohms
Alternator Field (Rotor)	3.7	-	4.1	Ohms
Exciter Armature	.41	-	.46	Ohms
Exciter Field CF	54.0	-	60.0	Ohms
Exciter Field F	1.18	-	1.31	Ohms

* High Voltage Connection

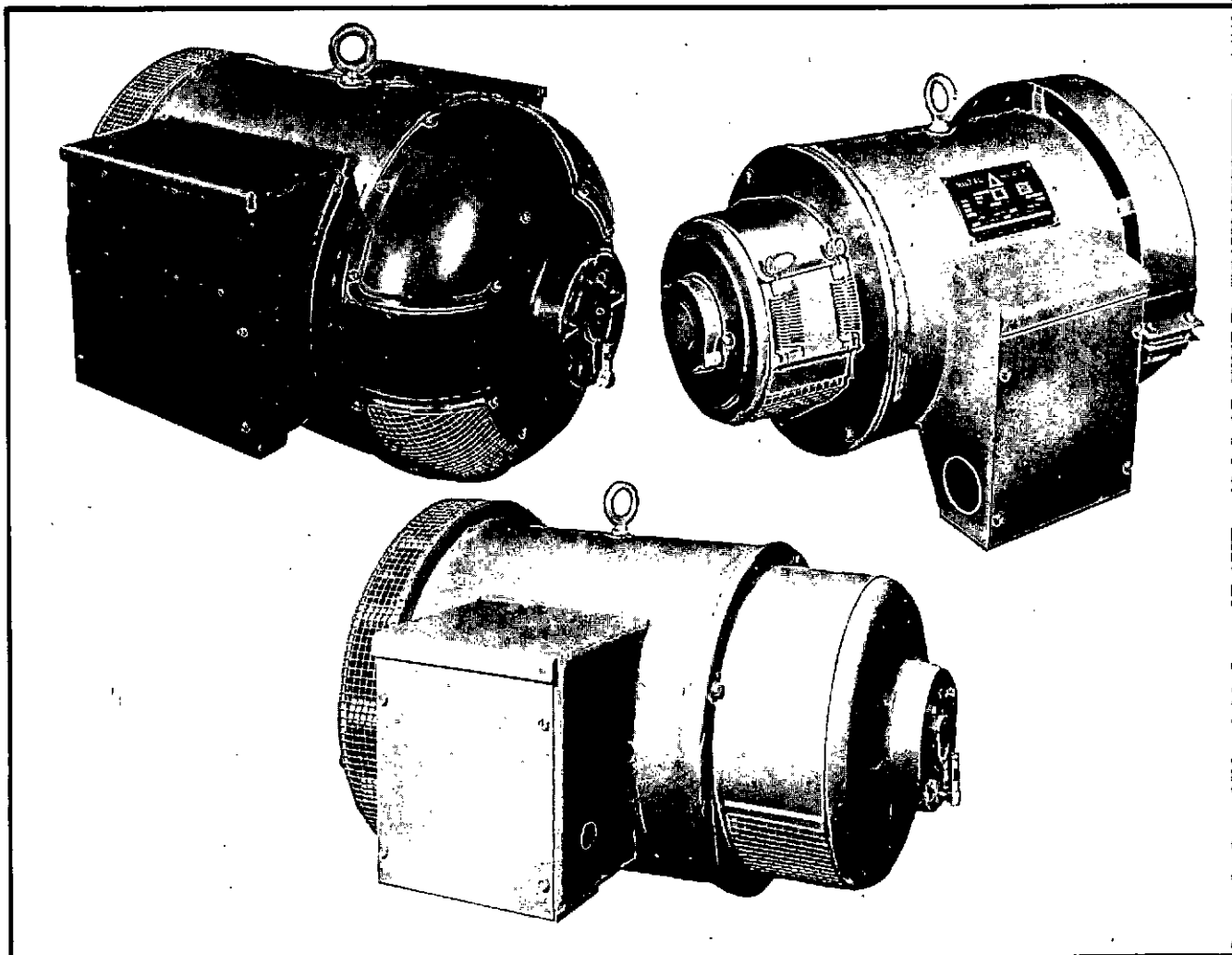


FIGURE 1
EXTERNAL VIEW – TYPICAL DELCO ALTERNATING CURRENT BRUSHLESS GENERATORS

I. INTRODUCTION

A. Scope

This manual covers typical Delco Products ac brushless generators whose main frames are less than 35 inches in diameter.

This manual includes instructions for operation, maintenance and service. A number of design variations occur in this series of generators, such as, single- or dual-bearings, oil or grease lubrication, single- or dual-exciter shunt fields, and several end frame configurations.

B. Safety

All standard safety procedures must be followed during operation, maintenance, and servicing of the Engine-Generator-Regulator set. Some special safety rules are listed under Section III and Section V.

C. Abbreviations

CF – Compensator Field
F – Exciter Shunt Field
GSI – Generator Service Information
PCB – Printed Circuit Board

II. DESCRIPTION

Numbers in () refer to Figures 2 through 7.

A. General

The generators illustrated in Figures 2 through 7 consist of two principal components: the alternator and the integral direct-connected exciter. The alternator may be subdivided into the rotating field, or rotor (7), and the stationary armature, or stator (4). The exciter consists of a rotating armature (25), and a stationary exciter field coil assembly (26). (Continued on P. 6)

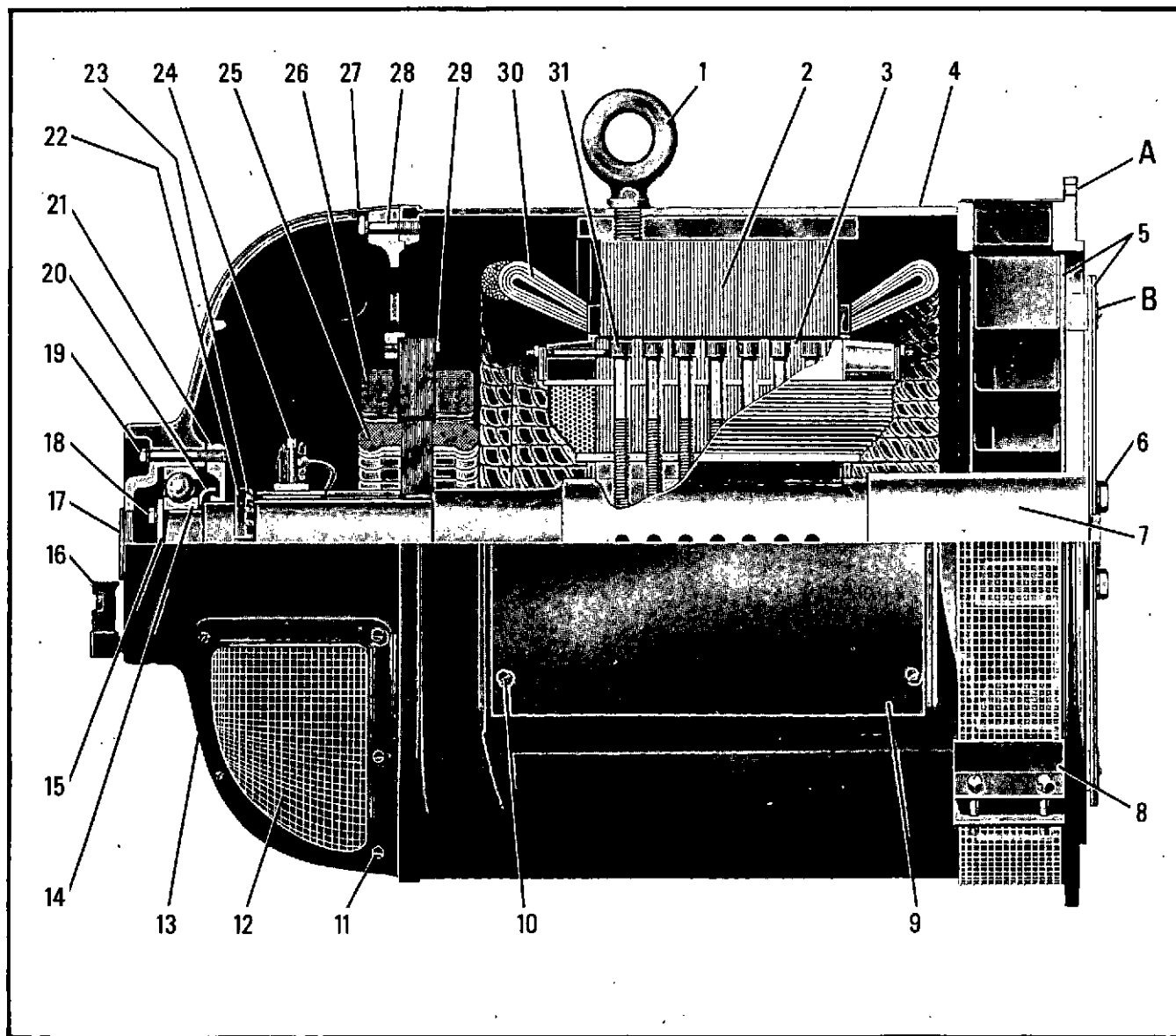


FIGURE 2
TYPICAL KEYED CUTAWAY VIEW
(12-POLE EXCITER, 1-PLATE ROTATING RECTIFIER ASSEMBLY)

- | | |
|---|---|
| 1. Eye bolt (Some models have lifting ears) | 17. Plug — End Frame — Center |
| 2. Stator and Coil Assembly (Alternator Armature) | 18. Bolt — Bearing Washer Retaining |
| 3. Rotating Coil Assembly | 19. Bolt (Screw) — Bearing Cap (Plate) Mounting |
| 4. Frame, Stator and Coil Assembly | 20. Bearing Collar |
| 5. Fan and Driving Disc Assembly | 21. Bearing Cap or Plate |
| 6. Bolt — Fan Mounting | 22. Locknut — Rotating Rectifier Assembly Retaining |
| 7. Rotating Field and Exciter Armature Assembly | 23. Lockwasher — Rotating Rectifier Assembly Retaining |
| 8. Band — Fan Cover | 24. Rotating Rectifier Assembly |
| 9. Plate — Cover Terminal Box | 25. Exciter Armature |
| 10. Bolt — Cover Plate Mounting | 26. Exciter Field Coil Assembly (12-Pole) |
| 11. Bolt — End Frame Cover Mounting | 27. Cover — End Frame — Top |
| 12. Cover — End Frame — Bottom | 28. Bolt — End Frame Mounting |
| 13. End Frame Assembly | 29. Bolt — Exciter Field Coil Assembly Mounting |
| 14. Ball Bearing | 30. Stator Coil |
| 15. Washer — Bearing Retaining | 31. Bolt — Rotating Coil Mounting (Not used on Unit-Lamination Designs) |
| 16. Sight Gage — Oil Level | |

- 32. Shunt Coil
- 33. Bolt — Shunt Coil Mounting
- 34. Snap Ring — Bearing Mounting
- 35. Plug — Bearing Retaining
- 36. Fan Assembly
- 37. Bolt — Fan to Flange Mounting
- 38. Bolt — End Frame Mounting
- 39. End Frame
- 40. Fan Flange
- 41. Bolt — Fan Hub Mounting
- 42. Bearing Cap
- 43. Gasket — Bearing Cap Mounting
- 44. Bolt or Screw — Bearing Cap Mounting
- 45. Ball Bearing
- 46. Lockwasher — Ball Bearing Retaining
- 47. Locknut — Ball Bearing Retaining
- 48. Shaft Key
- 49. Shaft
- 50. Bolt — Fan Cover Band Mounting
- 51. Grease Plug or Oil Gage
- 52. Cover Band — Fan Drive End

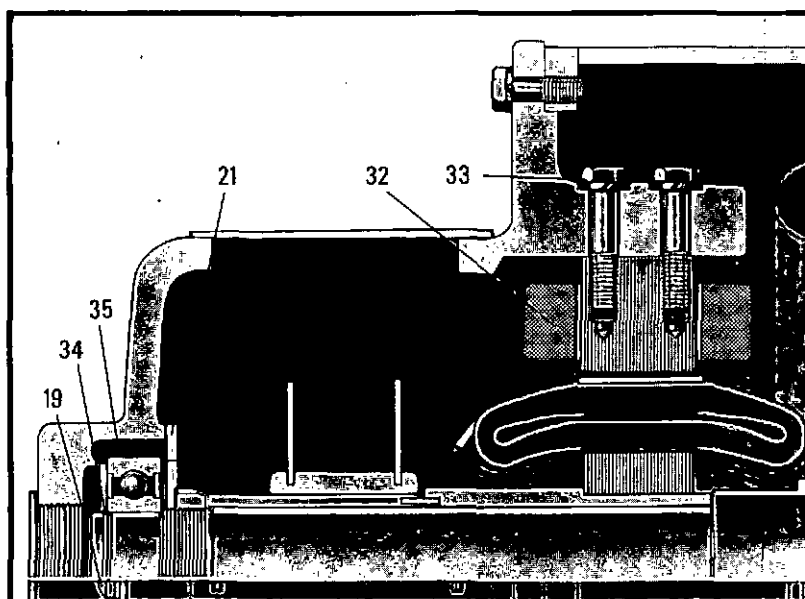


FIGURE 4 TYPICAL KEYED CUTAWAY VIEW
(GREASE LUBRICATION, NEOPRENE BEARING PLUG,
EXCITER FRAME INTEGRAL WITH END FRAME)

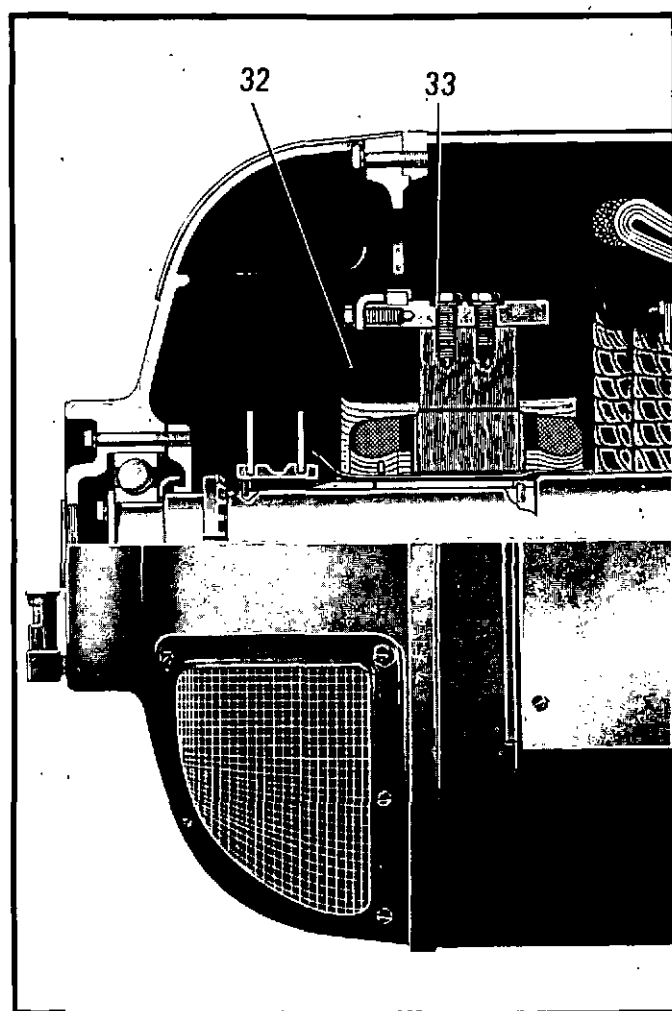


FIGURE 3
TYPICAL KEYED CUTAWAY VIEW
(4-POLE EXCITER, OIL LUBRICATION,
2-PLATE ROTATING RECTIFIER ASSEMBLY)

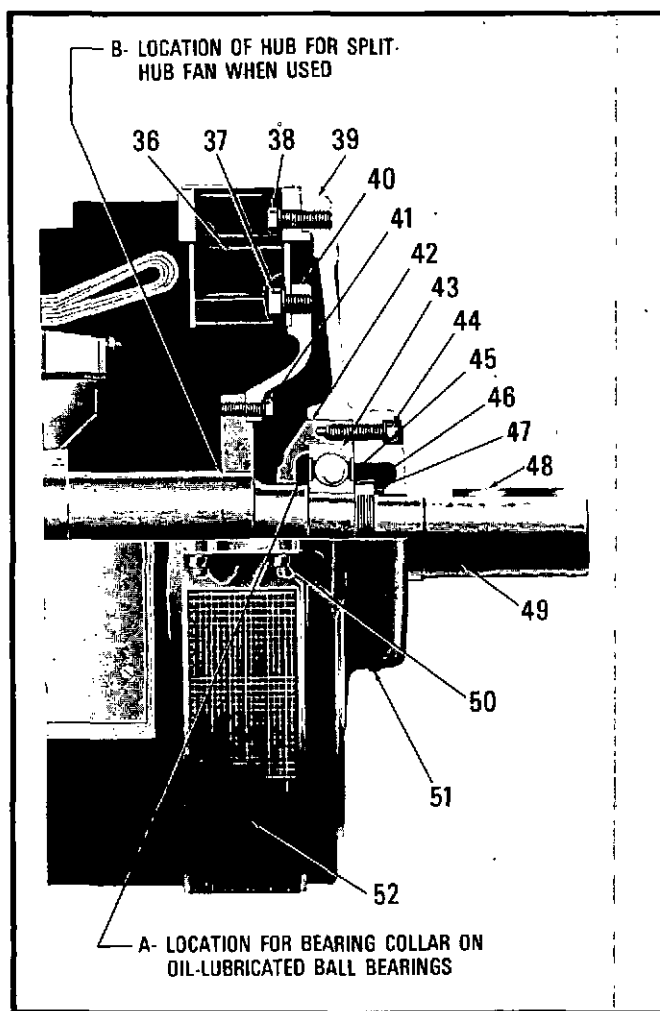


FIGURE 5
TYPICAL KEYED CUTAWAY VIEW DRIVE END
(2-BEARING GENERATOR)

The rotating rectifier assembly (24), the exciter armature (25), and the alternator rotating field (3) are mounted adjacent to each other on the shaft which is supported at the exciter end by a ball bearing (14), and at the drive end by the fan and driving disc assembly (5) which in turn is rigidly mounted to the engine flywheel.

Figures 6 and 7 show typical exploded and "break-away" views.

On applications requiring a belt drive, a gear drive, or special coupling between engine and generator, two-bearing generators are used. Figure 5 shows a typical construction of the drive end of such generators.

B. Alternator Armature (Stator)

The alternator armature (2) consists of coil groups embedded in the semi-enclosed slots of a laminated steel core. This stator and coil assembly is pressed into the main frame, and pegged. The complete assembly is identified as the frame, stator and coil assembly (4).

C. Rotating Field (Rotor) Assembly

The rotating field of the alternator consists of four or six individual coil and pole piece assemblies (3) bolted to the shaft. These coils are connected in series, or series-parallel, and leads are brought out to the rotating rectifier assembly (24).

In the "unit-lamination" design, each lamination is punched with four poles, and the laminations are then stacked, riveted, die cast, and wound with the four poles as an integral unit.

In both designs the rotating coils are energized by the exciter armature output which has been converted to dc in a rotating rectifier assembly. Embedded in the face of the pole piece are copper or cast aluminum conductors forming the "Amortisseur" or damper windings which help to prevent hunting during parallel operation with other engine-driven generators.

D. Exciter Field Assembly

Brushless generators use one of three types of exciter frame and coil assemblies.

1. In one design (see Figures 3 and 8), four or six shunt coils are mounted on a circular steel frame which is bolted to the end frame.

2. Item 26 on Figure 2, is a lamination assembly with twelve coils connected in series. The assembly is bolted to the end frame. See Figure 9.

3. In some generators (see Figure 4) — usually rated at less than 30 kw — the exciter frame is cast as part of the end frame. The individual coils are serviceable.

All three types of exciter systems can use single- or dual-wound shunt coils. The single-wound coil has one coil per pole piece, and the coil terminals are marked F+ and F-. In the dual-wound coils, two electrically separate windings share the same pole piece. The terminals for the second, or compensating, winding are marked CF+ and CF-.

E. Exciter Armature

Brushless generators use two types of exciter armatures. Figure 10 shows the four or six-pole type and Figure 11 illustrates the twelve-pole type. Both types are connected three-phase, three wire, wye, and are constructed of conventional coil groups on a stack-up of steel laminations which are keyed or pinned to the generator shaft. In both designs, the output of the armature is rectified by the adjacent rotating rectifier bridge assembly (24).

F. Rotating Rectifier Assembly

Rectifiers and surge protection resistors are mounted on one or two probe plates which may be used to measure exciter output voltage with the generator operating. See Figures 12 and 13.

Some designs incorporate additional control components which function to put the surge resistors in the circuit only when needed. Figure 14 is the connection diagram for a typical assembly.

G. End Frame Assembly

The end frame (13), in addition to furnishing support for the exciter field coils assembly (26), also incorporates the housing and oil or grease reservoir for the bearing (14). See Figure 2.

In an alternate design, the end frame acts as the exciter frame for mounting the exciter field coils. See Figure 4.

In two-bearing designs, the end frame on the fan end incorporates the second bearing, its housing and its lubrication system, which may include seals. See Figure 5.

(Continued on P. 10)

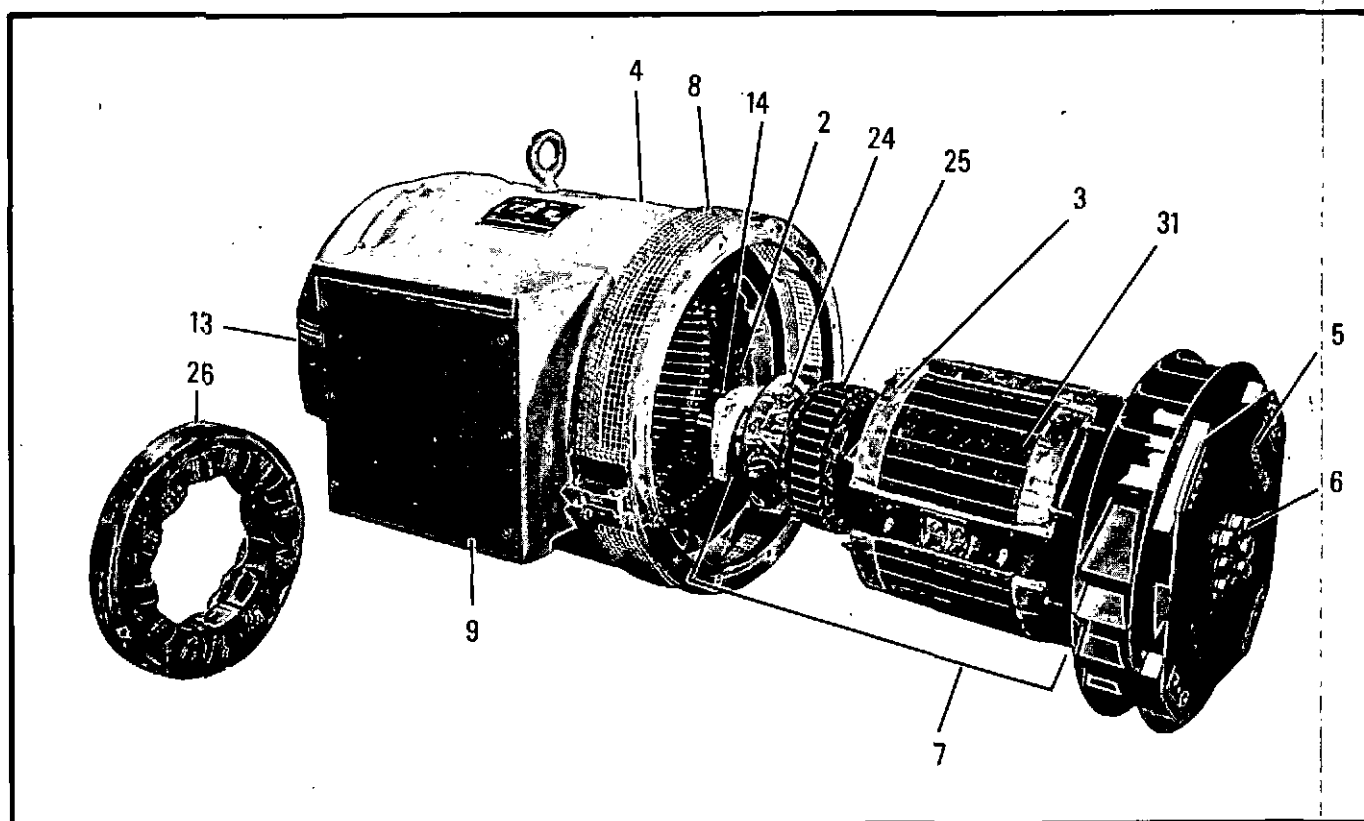


FIGURE 6
TYPICAL EXPLODED VIEW (KEY NUMBERS REFER TO FIGURE 2)

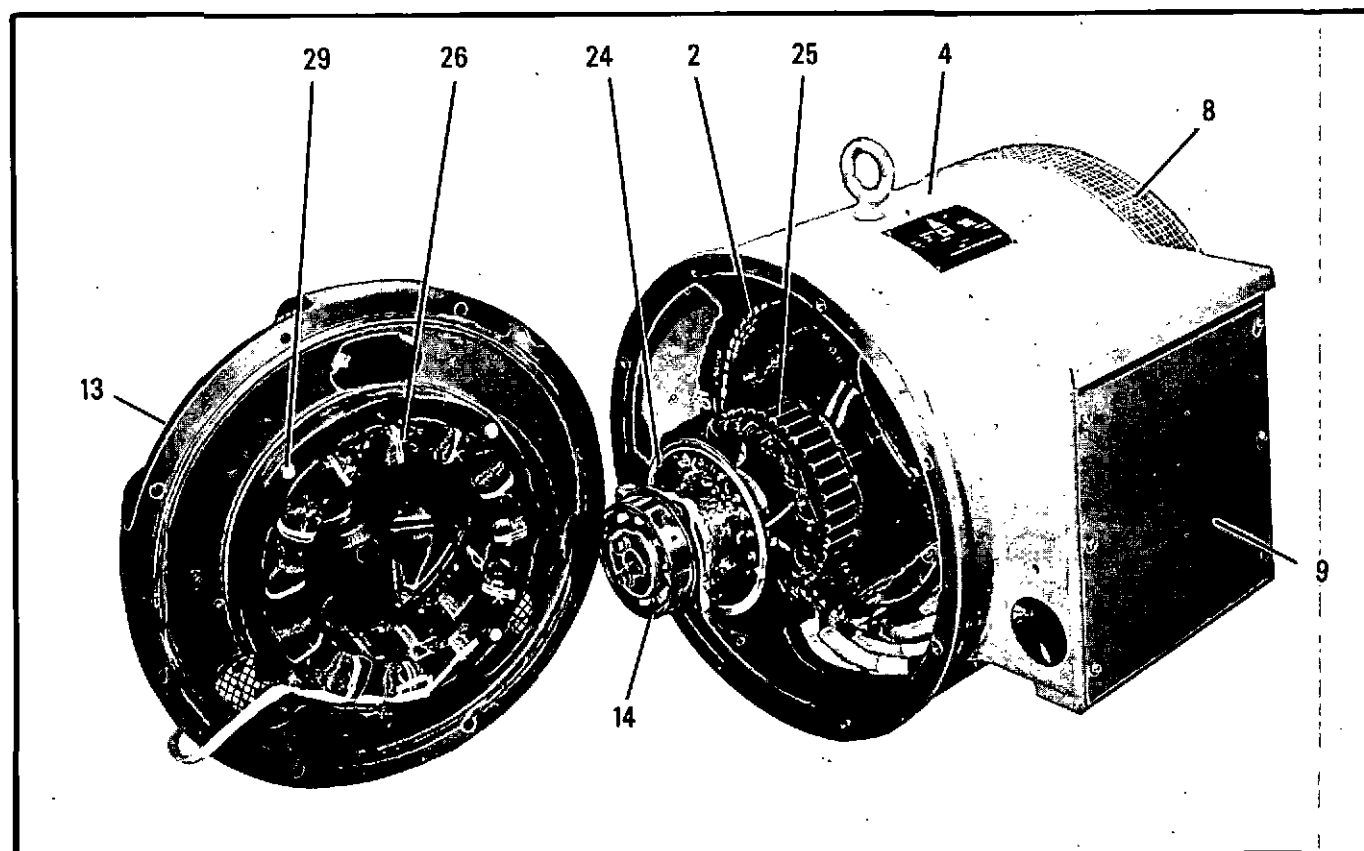


FIGURE 7
TYPICAL "BREAKAWAY" VIEW (KEY NUMBERS REFER TO FIGURE 2)

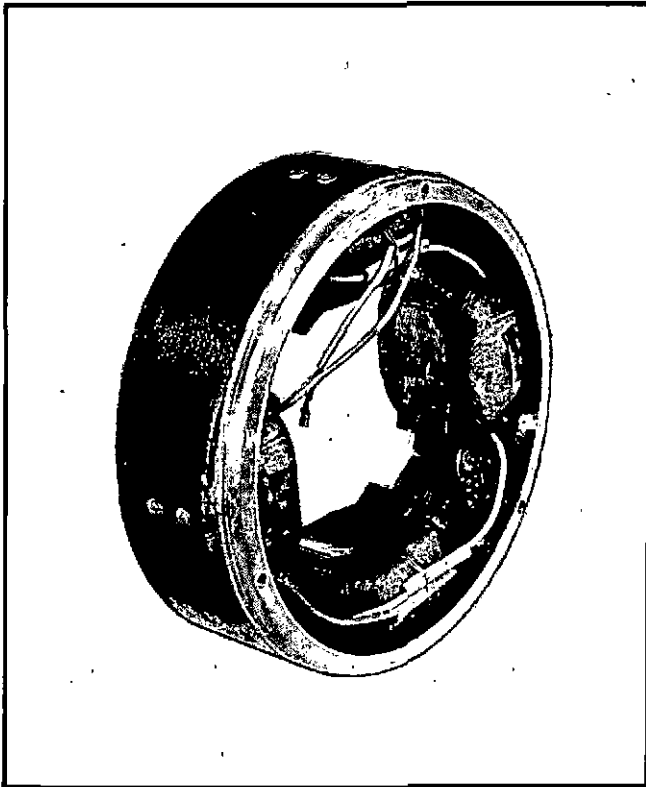


FIGURE 8
TYPICAL 4-POLE EXCITER FRAME
AND COILS ASSEMBLY

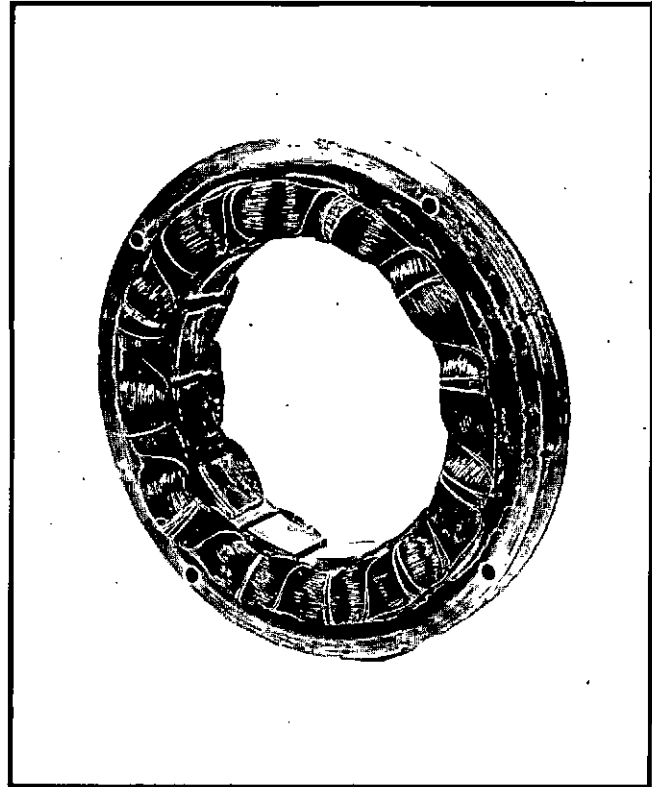


FIGURE 9
TYPICAL 12-POLE EXCITER FIELD COIL ASSEMBLY

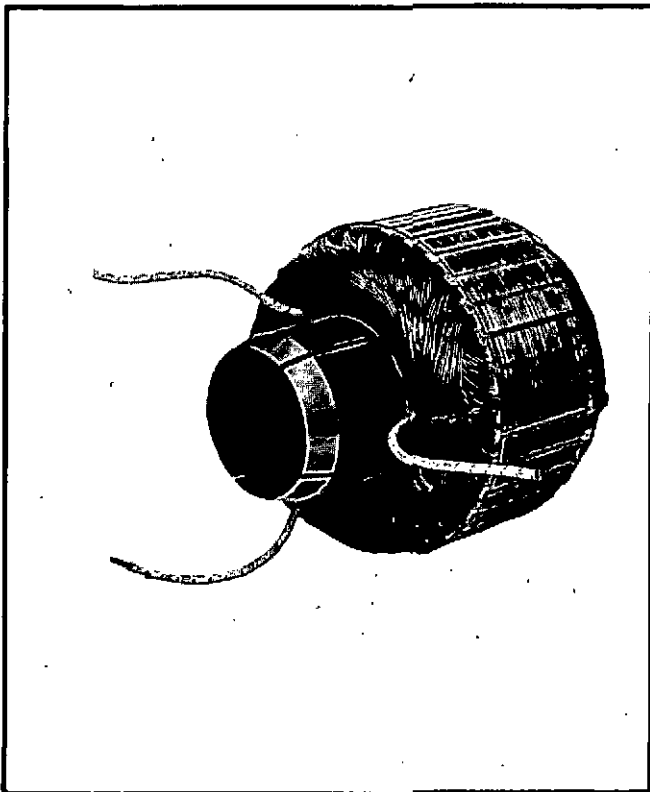


FIGURE 10
TYPICAL EXCITER ARMATURE
FOR 4- OR 6- POLE EXCITER

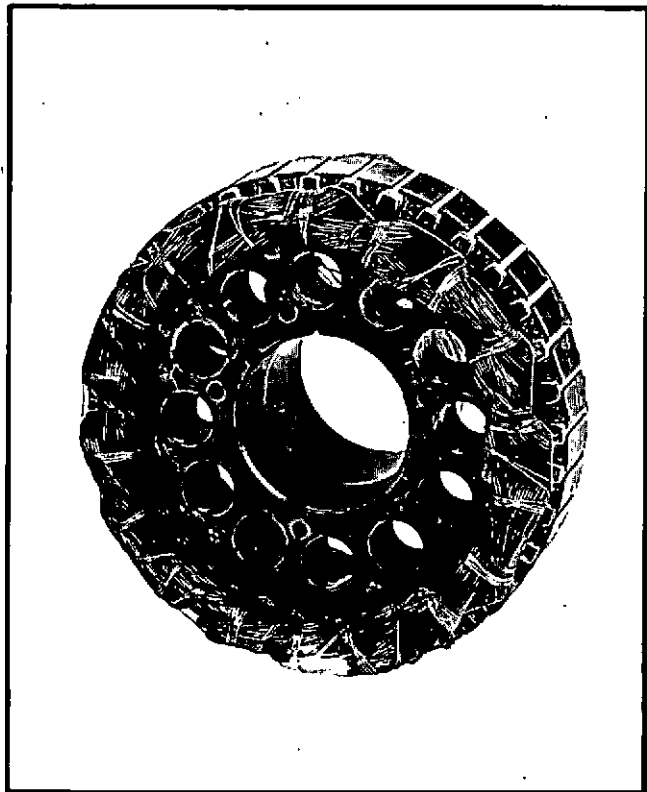


FIGURE 11
TYPICAL EXCITER ARMATURE
FOR 12-POLE EXCITER

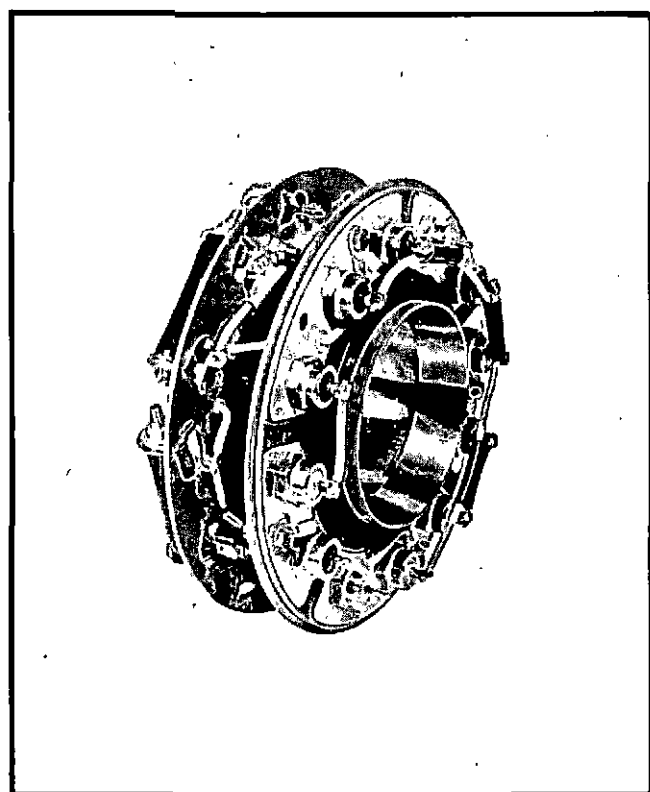


FIGURE 12
TYPICAL TWO-PLATE ROTATING
RECTIFIER ASSEMBLY

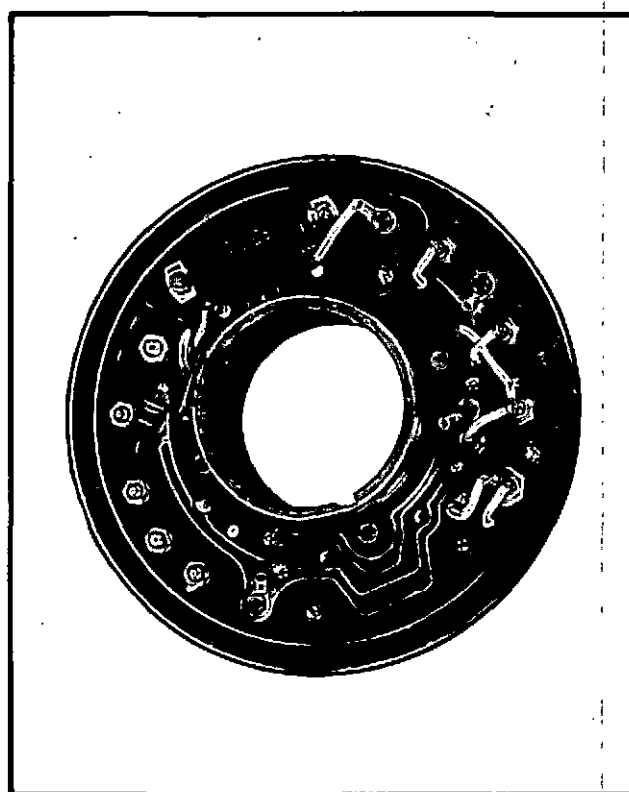


FIGURE 13
TYPICAL SINGLE-PLATE ROTATING
RECTIFIER ASSEMBLY
(WITH ADDITIONAL CONTROL COMPONENTS)

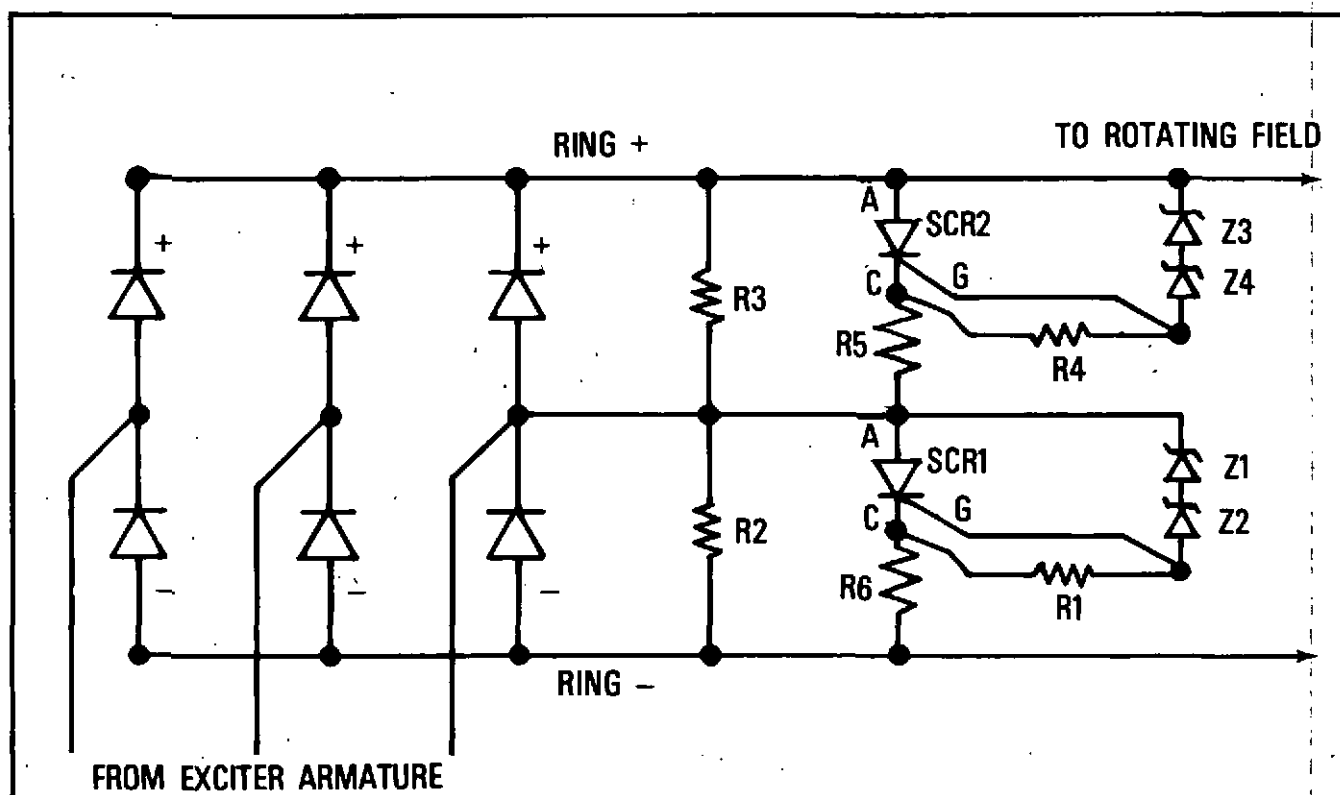


FIGURE 14
TYPICAL ROTATING RECTIFIER ASSEMBLY
CONNECTION DIAGRAM

III. OPERATION

A. Safety

All precautions must be followed and only qualified personnel should be assigned to the operation of the engine-generator-regulator set. For example, before starting be sure that:

1. Circuit breaker or line switch is open.
2. Any external power source is disconnected.
3. Lines are clear of personnel.
4. The driving engine can start only when authorized by the operator.

B. Before Starting

If the generator is new, or has been inactive, perform the following steps:

1. If interior of generator is dusty, blow out with dry air at low pressure (25 lbs max).
2. Check all electrical connections; make certain they are correct and tight.
3. On oil-lubricated generators, check that oil level is on line of sight gage.

CAUTION: Oil-lubricated generators are shipped without oil. Be sure to add oil before running generator. See Section IV,D Lubrication.

C. Starting

After the above steps have been observed, the generator is ready to be started.

1. Set the Auto-Manual switch, if used, in "Auto" position.
2. Put Unit-Parallel switch, if installed, in "Unit" position.
3. Start the driving engine and adjust speed as directed in the Engine Manual.
4. Adjust the generator voltage to nameplate rating with automatic voltage control rheostat.
5. Close line switch or circuit breaker.
6. Recheck amperes, volts, and frequency to be certain values are within nameplate rating.

D. Underspeed Operation

CAUTION: Generators operating with automatic voltage regulators should not be run at less than nameplate speed, unless underspeed protection is in the circuit. Prolonged low speed operation to warm engine may damage generators not having underspeed protection.

E. Running

1. From time to time check line voltages, line amperes, frequency and kilowatts to be sure values are within nameplate ratings.
2. If generators are in parallel, check load division.
3. If single-phase loads are used, the loads must be equally divided among the three phases, and the current through any one phase should not exceed the rated current of the machine.

F. Paralleling

Delco brushless generators can be paralleled with other engine-generator sets having compatible voltage droop, and engine droop characteristics. The control panel circuit must also have provisions for parallel operation. To determine if paralleling is possible, the operator should consult the engine-generator set builder for his specific instructions.

G. Stopping

1. Single generator on line.
 - a. Open circuit-breaker or line switch on generator going off the line, and stop the driving engine as instructed in the proper Engine Manual. See D, above.
2. Two generators running in parallel.
 - a. Be certain load is within nameplate rating of generator remaining on the line.
 - b. Shift load to generator to remain on line.
 - c. Open circuit-breaker or line switch on generator going off the line, and stop the driving engine as instructed in the proper Engine Manual.

IV. MAINTENANCE

The Delco generator is so designed and constructed that it requires a minimum of maintenance. A few simple routine practices will greatly contribute to the useful life of the machine.

A. Insulation Test

1. Periodically check the insulation resistance with a

500 volt megohmmeter according to the procedure below.

CAUTION: To prevent possible damage to the regulator and rotating rectifiers during this test, they should be isolated as follows:

- a. Rotating rectifier assemblies with two plates.
 - aa. Place jumper across mounting plates of rotating rectifier assembly.
 - bb. Place additional jumpers from joined plates to all three exciter armature leads at their termination on the rotating rectifier assembly.
- b. Rotating rectifier assemblies with one plate.
 - aa. Place jumper across PCB's of rotating rectifier assembly.

NOTE: Place jumper near outer edge which is free of coating.

- bb. Place additional jumpers from joined PCB's to all three exciter armature leads at their termination on the rotating rectifier assembly.
- c. Identify, detach, and insulate lugs on all leads from generator to regulator. Disconnect any grounded neutral connection.
- d. Short-circuit secondary of current transformer.
- e. Attach one lead of a 500 volt megohmmeter to frame, and the other (a) to ac power leads, and then (b) to F field. In both tests the minimum insulation resistance should be 1.3 megohms; if it is lower, the generator requires attention. If it is dirty, it should be cleaned (see Cleaning, Section IV,B); if it is wet it should be dried out (see Drying, Section IV,C); if it is grounded, the ground should be located and repaired. Repeat test on CF field, if used. See V D2, D4 for insulation test on rotating field and exciter armature.

NOTE: The insulation resistance should be measured periodically and the results recorded. Any large drop in the resistance indicates that immediate attention is necessary if costly repairs are to be avoided.

- f. Restore the circuit, and remove jumpers if insulation checks are in limits.

B. Cleaning

Keep the generator clean inside and out. A **CLEAN MACHINE RUNS COOLER**. Blow all loose dirt and dust from windings occasionally with dry, low pressure air (25 lbs max). Remove greasy dirt with a cloth.

C. Drying

Always use caution to prevent the presence of moisture inside the generator, either directly or by condensation. If the windings become wet, they must be dried carefully as follows:

1. Open line switch or circuit breaker.
2. Provide an external source to blow warm, dry air through the windings.
3. Check generator system as "Before Starting" under Operation.
4. Switch to "Manual" position, if switch supplied.
5. Disconnect and insulate terminal lug on F+ lead, and CF+ lead (if exciter has dual windings)
6. Start engine as described in "Starting" under Operation and run for several hours.
7. Shut down engine and check insulation resistance with 500 volt megohmmeter. See step IV, A.
8. Restore circuit after satisfactory insulation test.

D. Lubrication

The generator requires lubrication at only one point, the bearing (14).

1. Oil-lubricated bearings.

CAUTION: New generators are shipped without oil.

Maintain oil level to the line on the sight gage. **DO NOT OVERFILL**. After adding oil, run engine for several minutes. Then shut down engine and re-check oil level. Check oil level every 300 hours; change oil every six months. Use the same weight and quality oil in the bearing reservoir as is specified by the engine manual for the engine crankcase.

2. Grease-lubricated bearings.

Use "Chevron" SRI No. 2, or equivalent, or its approved successors.

To grease the generator, remove center plug (17) and add grease until it is up to bottom of shaft or bottom of plug opening.

As a general rule, a new grease lubricated generator will not need relubrication for 2 years or 9000 hours after initial installation. After that, bearing should be lubricated annually or 4500 hours. Unusually severe operating conditions require more frequent additions of grease. If grease in reservoir is hardened, or dirt laden, remove old grease before adding new grease. During an overhaul, the grease reservoir should be cleaned and new grease added.

E. Rotating Rectifier Assembly (24).

Under normal conditions, this assembly rarely requires attention. Keep assembly clean and free from dirt and oil. Periodically check tightness of mounting nuts, bolts, and connections.

Protect plate(s) from damage especially during disassembly and assembly operations.

V. TROUBLE SHOOTING

A. Preliminary Tests

1. Follow safety rules.
 - a. Shut down system according to authorized instructions — such as, the engine manual.
 - b. To protect personnel, take all necessary steps to be sure engine can not be started unless authorized. For example, disconnect remote-starting circuits, starting battery, and mechanical starting equipment. Place red tags, or other warning markers on switches, leads, etc.
 - c. To protect personnel, take all necessary steps to be sure all lines are electrically "dead." For example, disconnect generator load, and external power lines feeding into system. Place red tags, or other warning markers on switches, leads, etc.
 - d. Be sure engine is not running during testing of components, since circuits can be "hot."
2. Find out exact nature of trouble.
3. Check circuit against connection diagrams.
4. Visually inspect circuits and components of generator.

- a. Remove covers from fan intake end, and from feet.
- b. Look for broken wires or connections.
- c. With light pressure, gently move wires and lugs. Check for loose wires and connections.
- d. Look for burned spots on coils, and for bare wires which may be touching ground, or other bare parts.
- e. Look for loose nuts and bolts, loose coils or laminations.

B. Manual Control Test

For generators with manual control option. If generator problems happen when set is in AUTO (automatic) mode, run generator in MAN (manual) mode. If the operator can obtain nameplate voltage by adjusting manual control rheostat at no load and at full load, the generator is operating normally, and the problem is in the regulator. Consult the generator or regulator manual as required.

C. Stator Test

Measure all three line-to-line voltages at nameplate speed at no load. If all three voltages are almost identical, and within nameplate rating, stator is operational. Otherwise, see D, 3.

D. Resistance Checks

Check resistances and compare with resistance limits table on GSI sheets. For procedures, see below.

1. Exciter Field Coil Assembly (26 or 32).

If the exciter field coil assembly is suspected of being open or shorted, check resistance and compare with resistance limits table in GSI sheets. Detach one lead, such as F+, and measure resistance between detached line and corresponding lead, such as F-. Repeat test on CF field, if used. Examine the insulation carefully. Tape and varnish any breaks.

2. Rotating Field Coils (3)

A short or open circuit in the rotating field coils may be detected by measuring the total resistance of the field. Detach both alternator field leads as they terminate on the rotating rectifier assembly. See GSI sheets for resistance value. While leads are detached, check insulation resistance between shaft and one of the detached leads.

NOTE: If new field coil assemblies are installed, the rotating field and exciter armature assembly must be dynamically balanced before reassembling.

3. Alternator Armature (4)

Blow out accumulated dirt, inspect insulation of coils and leads for breaks or worn spots. Minor repairs may be made with air-dry varnish and tape. All coils and insulators should be tight in slots. Check insulation resistance. (See IV, A.) Check GSI sheet for resistance limits.

4. Exciter Armature (25)

An open or shorted armature may be detected by measuring the phase-to-phase resistance at the armature terminals. Detach all three leads at the rotating rectifier assembly. Each phase should be within limits. (See Resistance Limits Table.)

NOTE: An open armature may indicate an overload condition, or a defective rotating control plate assembly, which should be investigated.

Check insulation resistance from winding to armature sleeve or laminations. If a ground is indicated and is not located and repaired, the armature must be replaced.

CAUTION: The insulation test must be done with three exciter armature leads disconnected from rotating rectifier assembly, otherwise the rectifiers could be damaged.

E. 12-Volt Test

The best field test to check generator performance is as follows:

1. Shut down system.
2. Check in foot for exciter leads labeled F+ and F-, or for F+, F-, and CF+, CF- on dual-field units. Otherwise, discontinue test and contact factory.
3. Determine if generator is connected for high or low voltage. See connection diagrams and nameplate.
4. Disconnect, insulate, and identify external leads to regulator terminal board.
5. Check for shorts and grounds in exciter (shunt) field. See D, 1.

Typical shunt field resistances are 30-70 ohms for

"F" field in single-field units or for "CF" field in dual-field units. For exact values see Resistance Limits Table on GSI sheets that cover the model being tested. Repair any shorts or grounds before continuing test.

NOTE: If a 500 volt megohmmeter is available, use it for ground check.

6. Start engine and bring up to rated speed, at no load.
7. Using a fully charged 12-volt battery (or 12-volt section from a 24-volt battery), energize exciter (shunt) field. On dual-field exciters (four leads), place the (+) battery lead on CF+ and the (-) battery lead on CF-. On single-field exciters (two leads), use F+ and F-.
8. Measure and record all three line-to-line voltages at no load. They should balance within 1%. The actual value depends on the connection (high or low voltage), and on several design factors.

If the correct ac voltage for this test is not in the GSI Sheets for the model under test, consult factory.

If the generator passes the 12-volt test, the generator is probably operational. Check Regulator Manual for further tests.

F. Rotating Rectifier Assembly (24)

(See Section VII for additional tests)

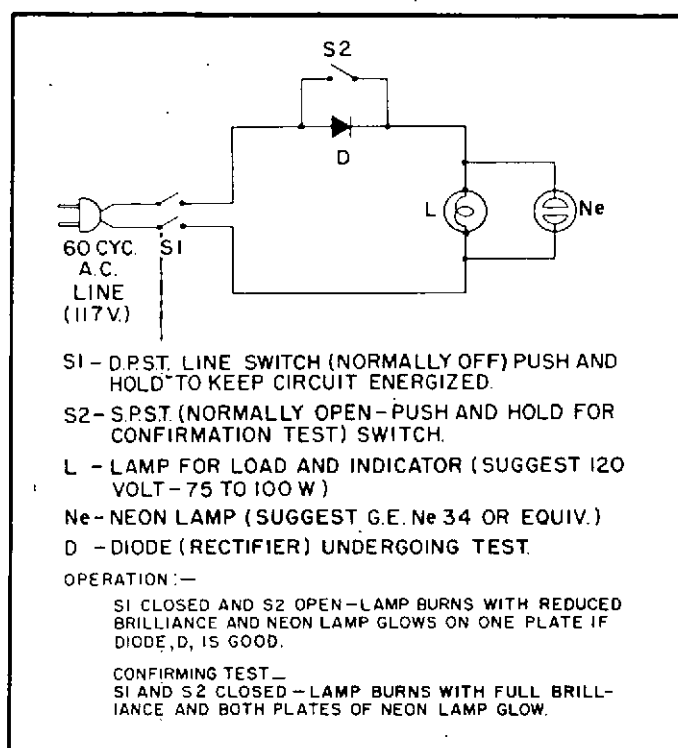
Diodes may be checked as follows:

1. Disconnect all leads from one side of the diode to be tested.
2. With ohmmeter in lowest scale, measure across diode.
3. Reverse ohmmeter leads and measure again.

One reading should be very high, and the other should be approximately mid-scale.

If both readings are very high, diode is open. If both readings are approximately mid-scale, diode is shorted.

A good field test, requiring the rectifier to operate at a higher voltage and under load, is described in circuit on the following page.



Replace any rectifier that gives doubtful results on either test.

VI. DISASSEMBLY AND REASSEMBLY

Study all the following procedures before starting any repair operation.

A. Safety

Some special safety rules are:

1. Take all necessary steps to be sure engine cannot be started unless authorized. For example, disconnect remote-starting circuits, starting battery, and mechanical starting equipment. Place red tags, or other warning markers on switches, leads, etc.
2. Take all necessary steps to be sure all lines are electrically "dead." For example, disconnect generator load, and external power lines feeding into system. Place red tags, or other warning markers on switches, leads, etc.
3. Be sure engine is shut down during testing of components, checking of wiring, or replacing of components, since circuits can be "hot" with engine running.
4. In most cases, generators with single bearings support one end of the engine. Before separating generator and engine, provide for adequate support for the engine.

B. Preliminary Notes

Generators may be disassembled horizontally or vertically. In most cases, the operator or repairman can better protect the generator components from damage by using the vertical method. With either method, the operator or repairman must use good judgment and safe techniques. Both methods require two hoists. Each hoist must have adequate capacity to handle whole load.

The small air gap between the stator assembly and rotating coils allows the operator little margin for error during horizontal disassembly. In vertical disassembly, the shifting of the power generator from a horizontal to vertical position, as well as vertical to horizontal, requires great care.

Reassembly is the reverse of the disassembly procedure unless otherwise noted.

Operations marked with an asterisk (*) may be performed with generator mounted to driving engine.

The disassembly section is divided into four procedures as follows:

1. Separation of single-bearing generator from engine. See Section C, 1.
2. Separation of two-bearing generator from engine. See Section C, 2.
3. Complete disassembly of two-bearing generator. See Section D, 1.
4. Complete disassembly of single-bearing generator. See Section D, 2.

C. Separation of Generator from Engine:

1. Single-bearing generators.
 - a. If generator has oil lubrication system, drain oil.
 - b. Remove terminal box cover plate (9) and disconnect all external leads.
 - c. Remove fan cover band (8).
 - d. Remove the generator driving disc-to-engine flywheel mounting bolts (Location B).
 - e. Attach adequate chain hoist to eyebolt (1) or lifting ears of generator.

WARNING: Support engine according to Engine Manual.

- f. With chain hoist taut, remove the generator frame flange-to-engine flywheel housing mounting bolts (Location A).
- g. Remove generator foot-to-rail mounting bolts.
- h. Using a pry at opposite sides of the generator, loosen the generator frame from engine flywheel housing.

NOTE: Tenon on generator frame flange pilots inside engine flywheel housing; therefore, generator must be withdrawn in a straight line.

- i. To remount generator to engine, proceed as follows if engine manufacturer's instructions are not available.
 - aa. Align bolt holes of generator driving disc with those of engine flywheel. Install bolts and turn until fingertight.
 - bb. Install and tighten generator frame flange to flywheel housing mounting bolts.
 - cc. Install and tighten generator foot-to-chassis mounting bolts.
 - dd. Add oil, if bearing is oil lubricated.
 - ee. Rotate engine-generator system a few revolutions to center fan. Tighten generator driving disc to engine flywheel bolts.
 - ff. Restore electrical circuits.

2. Two-bearing generators

- a. *Disassemble coupling between engine and generator.*
- b. Remove terminal box cover plate (9). Remove and identify all external leads.
- c. Attach chain hoist of adequate capacity to generator eyebolt(s) (1) or lifting ears, and remove generator foot-to-chassis mounting bolts.

D. Disassembly of Generator:

After removal from the engine, the generator should be disassembled in the order set forth below:

1. Two-bearing generators. See Figure 5.

- *a. If generator has an oil-lubrication system, drain oil.
- b. On fan end, remove bearing cap bolts (44) or screws.

NOTE: Some models may have a number of bolts in the center of the end frame. The bearing cap bolts or screws are nearest the shaft, and form an inner circle.

- *c. Remove fan cover band (52).
- d. On fan end, remove one top end frame mounting bolt (38).
- e. Insert eyebolt into threaded hole.

WARNING: In Step f, lift end frame only!

- f. Attach hoist to eyebolt, pull hoist taut, and remove remaining end frame mounting bolts (38), and remove end frame.

CAUTION: Be careful not to damage shaft surface as end frame moves away from generator.

- g. Bend tang on bearing lockwasher (46) out of slot on bearing lock nut (47). Remove (46) and (47).
- h. Remove bearing (45) with standard bearing puller (pull on bearing cap if necessary), and discard bearing.

NOTE: Bearing collar, if used, will come out with bearing cap. On reassembly, be sure bearing collar is in place.

CAUTION: On reassembly, apply pressure to inner race of new bearing until bearing seats against shoulder of shaft (or against bearing collar which seats against shaft).

- i. Remove bearing cap (42).

CAUTION: On reassembly, apply pressure to inner race of new bearing until bearing seats against shoulder of shaft (or against bearing collar which seats against shaft). Do not apply pressure to outer race.

- j. Remove fan hub bolts (41), or disassemble split fan hub, and remove fan.

The above procedures, D,1,a through D,1,j, disassemble the parts required for two-bearing construction. The two-bearing generator is, at this point, a single-bearing type with fan removed. Proceed to D,2,c to complete disassembly.

2. Single Bearing Generators. See Figure 2.

- *a. If generator has an oil lubrication system, drain oil.

NOTE: Oil may have been drained in V,C,1.

- *b. Remove fan and driving disc assembly (5) by removing the mounting bolts (6).

CAUTION: Check for fan spacer. See Figure 15. Be sure to include spacer during reassembly if used on original installation.

- *c. Remove end frame covers (12 and 27).
- *d. Identify and disconnect internal leads at terminal box and see that they are free to be withdrawn through frame.

For vertical method, continue with step e. For horizontal method, go to step k.

- e. Attach one hoist to eyebolt, or lifting ears.
- f. Insert steel cable through windows in end frame, and connect cable to second hoist.
- g. Carefully put generator in vertical position.

WARNING: The generator can "whip" or snap sideways as it shifts to a vertical position.

Keep personnel away from generator. Maintain same precautions during shift from vertical back to horizontal position later in procedure.

- h. Lower generator so that main frame rests on wooden blocks if shaft extends beyond main frame.
- i. Realign cable for vertical removal and remove end frame mounting bolts (28) and lift out end frame and rotating assembly.

NOTE: End frame, exciter field assembly, rotating rectifier assembly, bearing, bearing cap, exciter armature, rotating coil assembly and shaft will come out together.

- j. Carefully lower removed assembly into horizontal position so it will lay into blocks, and end frame will extend beyond edge of support.

NOTE: Beginning with step k, the instructions apply to both horizontal and vertical methods.

- k. Attach or realign hoist cable in end frame windows to support end frame during removal and remove bearing cap mounting bolts (19).

NOTE: For horizontal method, also remove end frame mounting bolts (28).

- *l. Remove end frame.

NOTE: For horizontal method, pry straight out from end frame tenon.

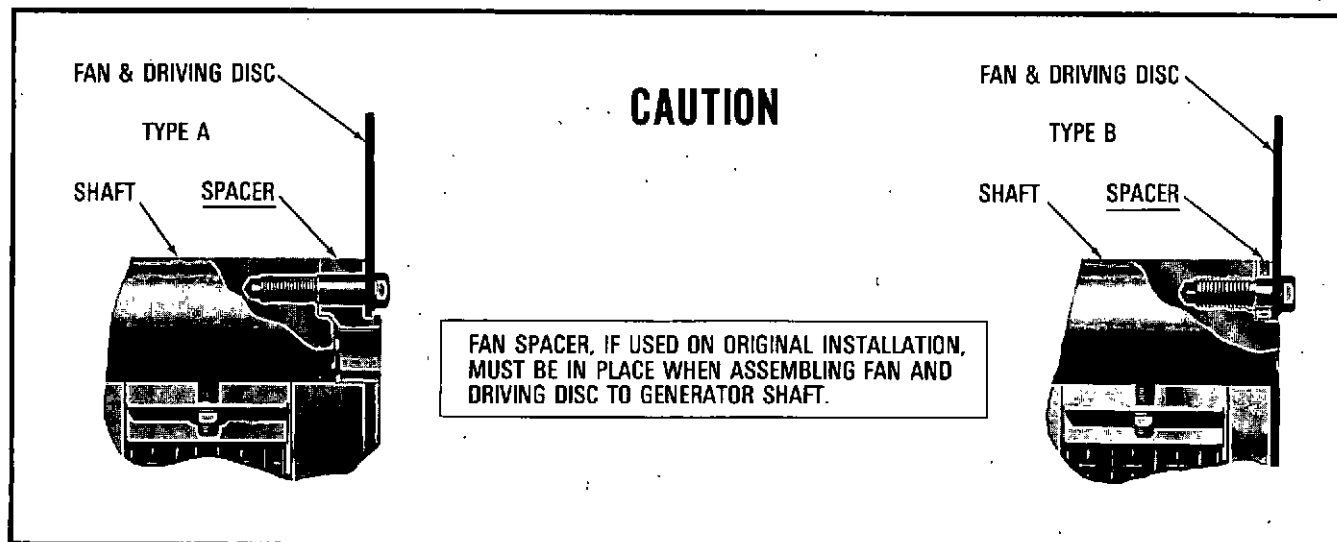


FIGURE 15
TYPICAL FAN SPACERS

CAUTION: Exciter field assembly is attached to end frame. Be careful to protect rotating rectifier assembly (24).

- *m. Detach exciter field coil assembly (26) by removing retaining bolts and washer (29).

NOTE: On reassembly, attach exciter field coil to end frame before mounting end frame on generator.

NOTE: On 4- and 6-pole designs (Figures 3 and 4), the individual shunt coils (32) are serviceable by removing coil mounting bolts (33).

- *n. Remove bearing (14) as follows:

NOTE: If bearing does not have to be removed, then check bearing by turning the outer race with the fingers. If the bearing feels rough, turns hard, or sticks in spots, replace the bearing.

- aa. Remove the bolts (18), or locknut and washer, or snap ring that retains the bearing.
- bb. Using a standard gear or bearing puller, pull bearing from shaft.
- cc. Discard old bearing and use new bearing for reassembly.
- o. During reassembly, apply pressure to inner race until bearing seats against bearing collar (if used) which seats against shoulder on shaft. Do not apply pressure to outer race.
- p. Remove bearing collar (20) (if used) and cap or plate (21).
- q. Remove rotating rectifier assembly (24) and exciter armature (25) as follows:
 - aa. Lift tang on lockwasher (23) and remove locknut (22).
 - bb. Disconnect leads from control plate assembly. Pull assembly straight off shaft.
 - cc. Remove exciter armature by pulling straight off shaft.

NOTE: When replacing the exciter armature, coat generator shaft with a light

application of rust inhibiting grease.

- r. Remove rotating field and shaft assembly from stator as follows: (Horizontal method only.) See VI, B.

aa. (1) Single-Bearing Generators.

Obtain a pipe about 6 feet in length whose outside diameter will just fit inside the circle of fan mounting bolts (6).

To one end of the pipe, weld a flange and drill to mate with the holes in the end of shaft. Use fan mounting bolts (8) to secure in place.

(2) Two-Bearing Generators.

Select a 6 foot section of pipe of suitable inside diameter to fit over drive end of shaft.

CAUTION: Protect ground or threaded section of shaft, such as bearing and coupling surfaces.

- bb. Support the exciter end of the shaft with a suitable leather or canvas sling attached to a hoist.
- cc. Use second hoist to lift pipe just enough to support the weight of the rotating field, and slide out of the stator, using care not to damage the windings.
- dd. Use this same method to replace the rotating field.
- s. To remove the rotating field coils (3), remove coil supports, connected dampers, end rings if used, and then clean the insulating varnish from the wrench sockets of the mounting bolts (31). "Unstake" before attempting to remove the bolts.

(Continued on next page)

When remounting coils, torque the mounting bolts according to Table below and stake bolt heads to laminations.

Bolt Diameter (inches)	*Torque (Ft./Lbs.)
3/8	35
7/16	80
1/2	110
5/8	250
3/4	350
1	Not Used
1-1/4 (Threads Lubricated)	1400

*These values are for coarse thread series

NOTE: If there are no coil mounting bolts, the coils are not serviceable.

CAUTION: Damper connectors are welded, and are not readily serviceable. Consult factory if coil replacement is required.

CAUTION: If new rotating coil assemblies are installed, rebalance the rotating field and exciter armature assembly to less than 1 ounce-inch.

VII. CHECK OUT FOR ROTATING RECTIFIER ASSEMBLY

This section applies only to those single and two-plate designs that incorporate control components in addition to the rectifiers and surge resistors.

NOTE: The following checks may be made with a Simpson 260 VOM, or with equivalent ohmmeter. Complete the entire series of checks before performing any repair. Replace any components which do not have the resistance readings indicated in the instructions. Refer to Figures 16, 17, 18, 19 and 20 for component identification.

- Disconnect and identify armature leads (item 9) and field leads (item 8). Identification should insure that the leads can be reconnected to the same point from which they were removed.
- Remove the nuts from diodes D5 and D6. Pull diodes away from printed circuit board, leaving soldered connection intact.
- Make careful visual inspection of assembly. Look for discoloration or visible damage to large power resistors (item 7). Observe any discoloration or burning on printed circuit board rings.

(Continued)

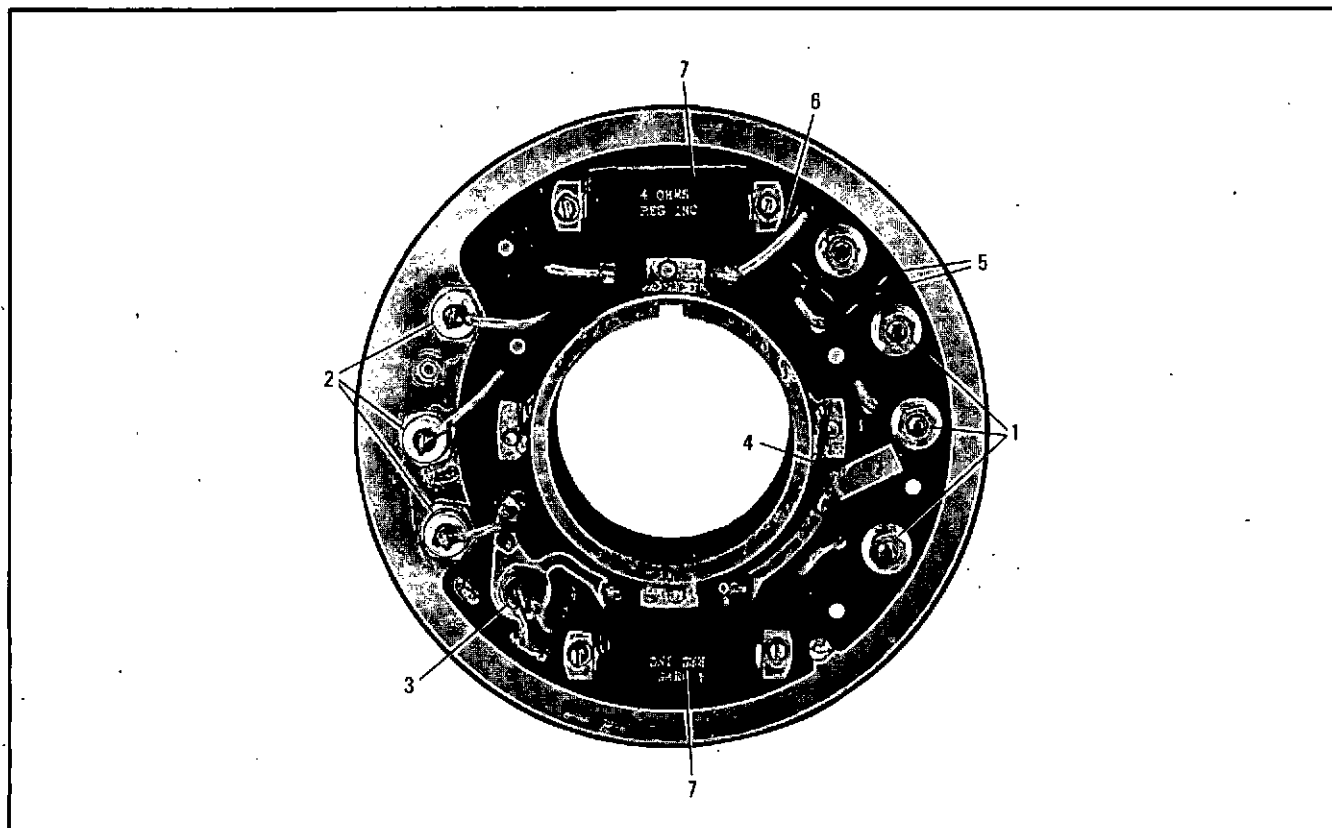


FIGURE 16-
TYPICAL SINGLE-PLATE ROTATING RECTIFIER ASSEMBLY

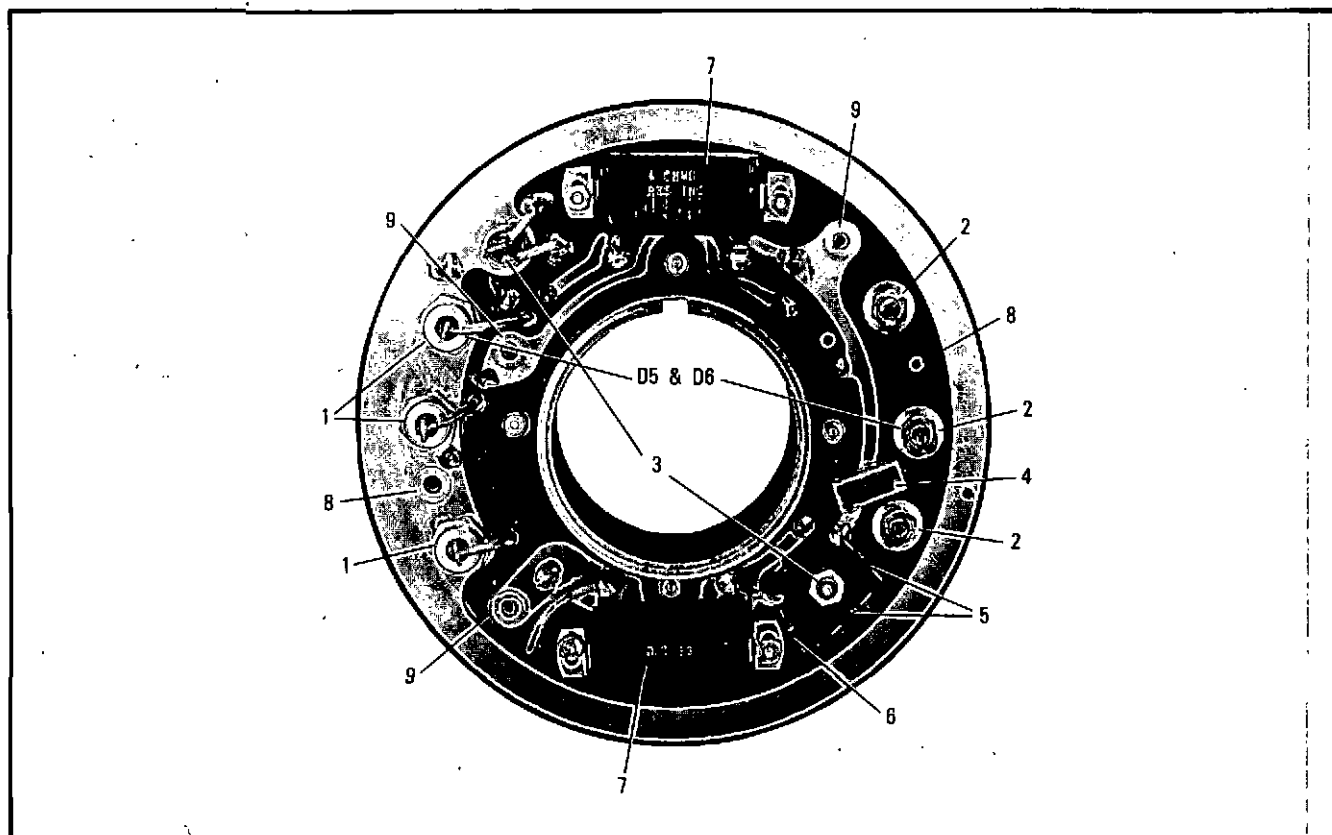


FIGURE 17
TYPICAL SINGLE-PLATE ROTATING RECTIFIER ASSEMBLY

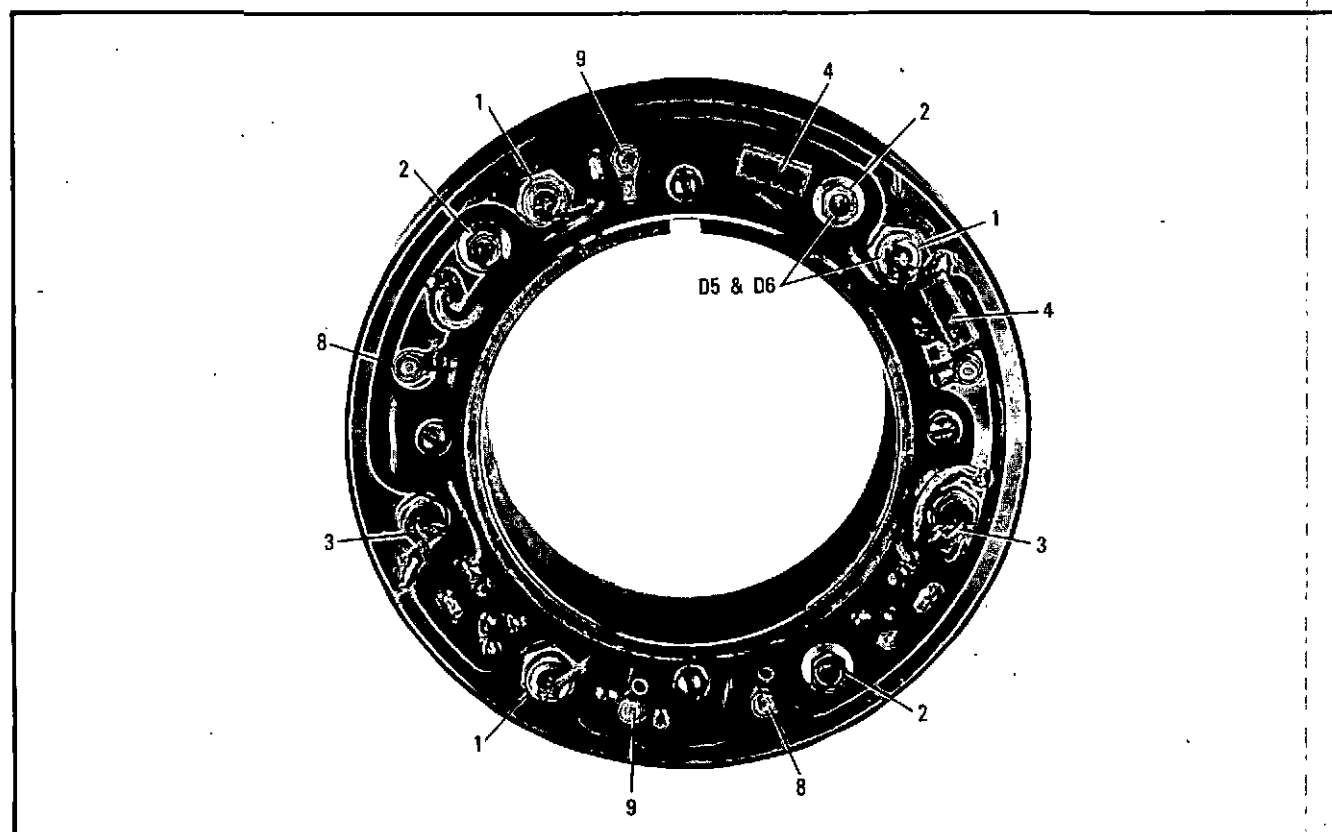


FIGURE 18
TYPICAL TWO-PLATE ROTATING RECTIFIER ASSEMBLY

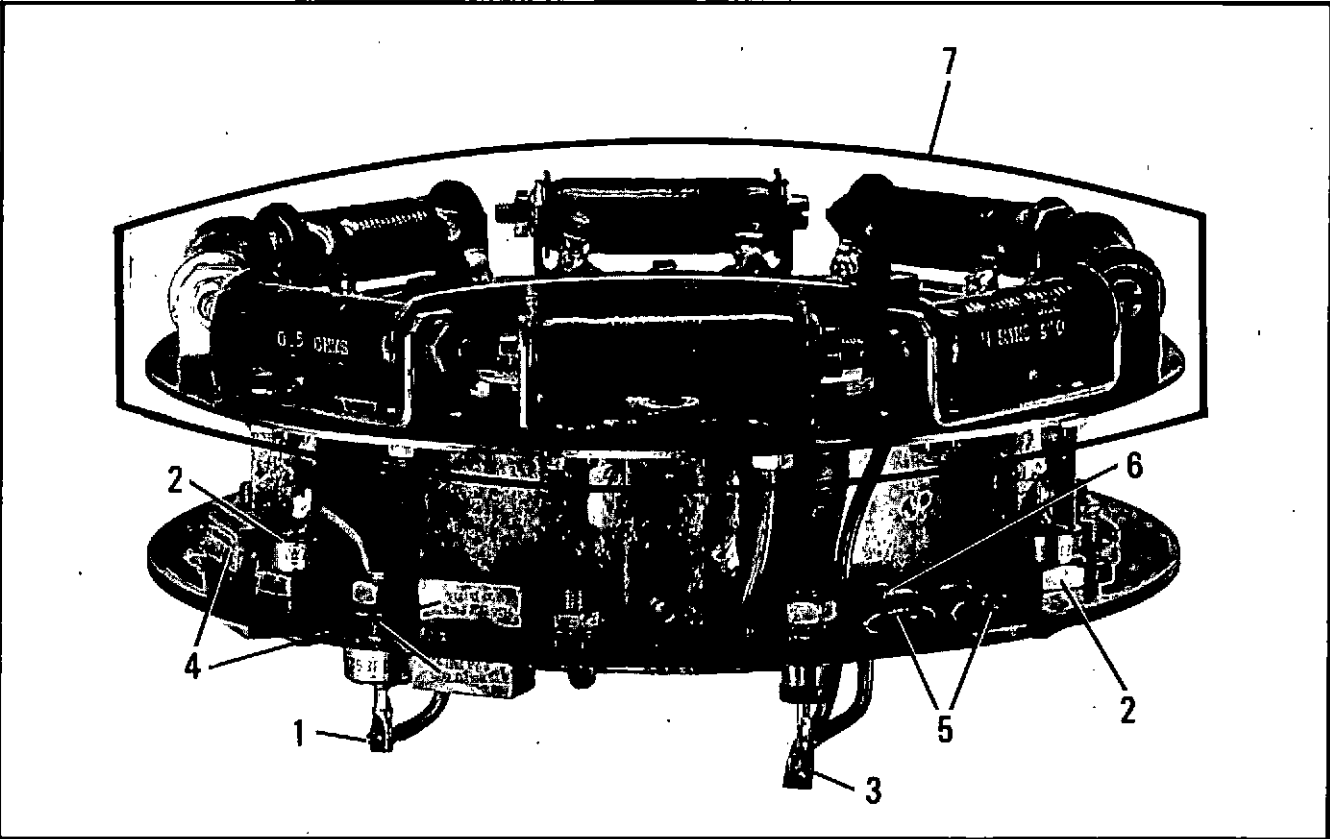


FIGURE 19
TYPICAL TWO-PLATE ROTATING RECTIFIER ASSEMBLY

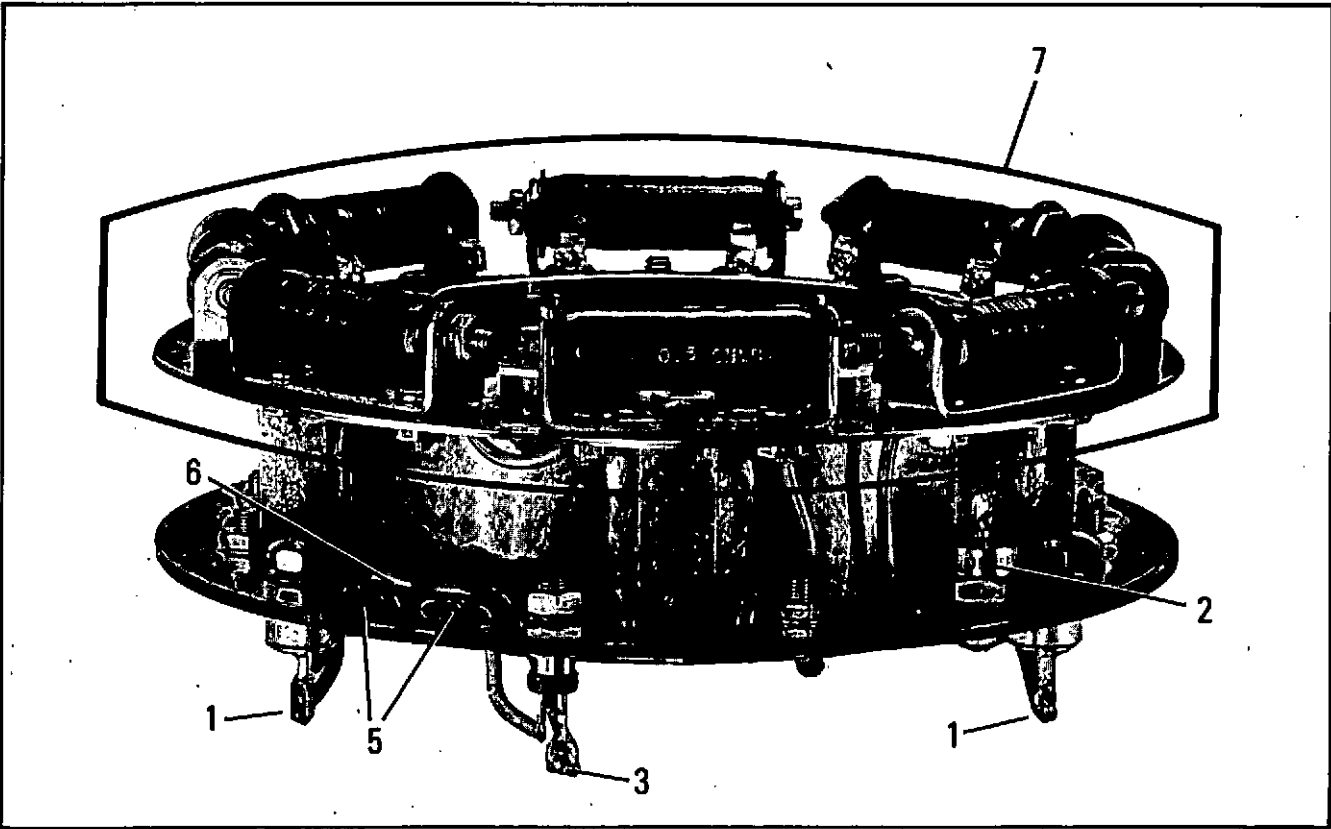


FIGURE 20
TYPICAL TWO-PLATE ROTATING RECTIFIER ASSEMBLY

- D. With ohmmeter in R times 1 scale, check resistances across diodes (items 1 and 2). Meter should read very high resistance in one direction, and approximately mid-scale in the other direction. (Polarities will be reversed going from one side of the printed circuit board to the other.)
- E. With ohmmeter in R times 1000 scale, check resistance across rectangular white resistors (item 4). Meter should show a reading other than open.
- F. With ohmmeter in R times 1 scale, check resistance across large power resistors (item 7). Meter should show a reading other than open.

NOTE: Make sure to measure across soldered leads of resistors, and not on mounting bracket.

- G. With ohmmeter in R times 1 scale, measure resistance

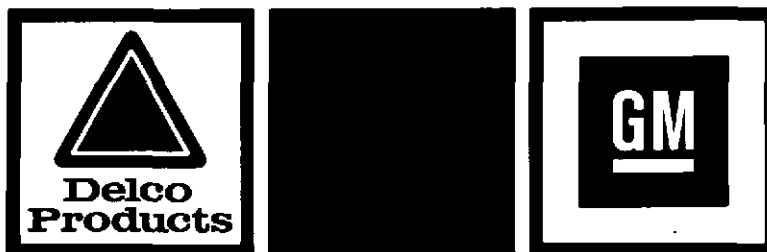
across small resistors with colored bands (item 6). Meter should show a reading other than open (according to color code of resistor).

- H. With ohmmeter in R times 1 scale, resistances across the zener diodes (item 5) should read approximately mid-scale in one direction and very high resistance in the other direction.
- I. With ohmmeter in R times 1 scale, place meter leads on the large soldered lead of the SCR (items 3 and 4), and the other lead on the threaded section of the SCR on the other side of the board. Meter should read very high in one direction, and slightly lower resistance in the other direction. While meter is connected to read the higher resistance, connect a jumper from the positive meter lead to the small soldered SCR lead on the other side of the board. The meter should now read mid-scale.

SERVICE RECORD

1

For further information please contact Delco Products Division of General Motors Corporation, Dayton, Ohio, Attention: Service Department



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