Master Service Manual

Our energy working for you.™

Power Generation

Generator Set

English 8-1988 922-0502 (Issue 1)

CONTENTS
GENERATOR MANUAL

NOTE: THE FOLLOWING SECTION 1 CONTAINS A COMPLETE INDEX OF CURRENT GENERATOR SET SERIES AND WHICH SECTION TO LOOK FOR INFORMATION.

922-0502
8-88
(Replaces 10-87)

SECTION 1. MODEL INDEX

Basic generator information for each series shown below (alphabetically) is included in one of the sections, 3 through 13.

GENERATOR SET SERIES	SPEC LETTERS	BASIC INFO. IN SECTION
AJ, AK	ALL	3
BF Welder	ALL	4
BF, BFA	ALL	11
BFAB	ALL	6
BG, BGA	ALL	11
CCK	A-P	3
CCK	Begin R	11
CCKB	ALL	3
DDA, DDB	ALL	8
DEF	A-C	4
DEF	Begin D	8
DEG	A-B	4
DEG	Begin C	8
DEH	A	4
DEH	Begin B	8
DFE	H-L	8
DFE	Begin M	8,13
DFM	H-M	9
DFM	Begin N	9,13
DFN 350	A-C	9
DFN 350	Begin D	9,13
DFN 400	A-C	10
DFN 400	Begin D	10,13
DFP	H-L	9
DFP	Spec M	9,13
DFS	ALL	9
DFT	A-D	10
DFT	Begin E	9
DFU	A-D	10
DFU	Begin E	9
DFV	ALL	10
DFW	A-G	10
DFW	Begin H	10,13
DFX	ALL	10
DFY	A-D	10
DFY	Begin E	10,13
DFZ	A-D	10
DFZ	Begin E	10,13
DGCA	ALL	8, 13
DGCB	ALL	8,13
DGDA	ALL	8,13
DGDB	ALL	8,13
DGEA	ALL	8,13
DGFA	ALL	8,13
DHA, DHB	ALL	9
DJA	ALL	3
DJB	A-Z	4
DJB	Begin AA	7
DJC	A-Z	4
DJC	Begin AA	7
DJE	Begin AA	7
DKC,DKD	ALL	7
DL3	ALL	7
DL4,DL6,DL6T	A-D	7

GENERATOR SET SERIES	SPEC LETTERS	BASIC INFO. IN SECTION
DL4,DL6,DL6T	Begin E	7,13
DL4B,DL6B, DL6TB	ALL	12
DTA	ALL	7
DWV	ALL	10
DYA	A	4
DYA	Begin B	8
DYB	A-C	4
DYB	Begin D	9
DYC,DYD	ALL	8
DYG,150,175	ALL	8
DYG 200	Begin F	9
DYH	A-B	4
DYH	Begin C	9
DYJ	ALL	8
EK,EM	A-B	4
EK,EM	C-N	8
EK,EM	Begin Spec P	8,13
EN	A-D	8
EN	Begin E	8,13
ENT	ALL	8
ENTX	ALL	8,13
ES	ALL	7
FT	A-C	4
FT	Begin D	9
GTU 560	ALL	10
JB	A-Z	4
JB	Begin AA	7
JC	A-Z	4
JC	Begin AA	7
KB,KR	A-M	4
KB,KR	Begin N	8
LK	A-L	3
LK (RV)	Begin M	11
LKB	ALL	3
MAJ	ALL	3
MCCK	A-C	3
MCCK	Begin D	11
MDEG	A-D	4
MDEG	Begin E	8
MDEH	A	4
MDEH	Begin B	8
MDJA	ALL	3
MDJB	A-Z	4
MDJB	Begin AA	7
MDJC	A-Z	4
MDJC	Begin AA	7
MDJE	A-Z	4
MDJE	Begin AA	7

GENERATOR SET SERIES	SPEC LETTERS	BASIC INFO. IN SECTION
MDJF	A-Z	4
MDJF	Begin AA	7
MDKC,MDKD	ALL	7
MDL3,MDL4 MDL6	ALL	7
MDTA	ALL	7
MJA	ALL	3
MJB	ALL	4
MJC	A-Z	4
MJC	Begin AA	7
NB	ALL	11
NB-Welder	ALL	4
NH	ALL	11
PC	A-C	3
PC	Begin D	6
P Ser.,Other	ALL	6
RDJC	A-Z	4
RDJC	Begin AA	7
RDJF	A-Z	4
RDJF	Begin AA	7
RJC	A-Z	4
RJC	Begin AA	7
SJB	ALL	12,13
SK	ALL	7
SKB	ALL	12,13
TA,TB	ALL	3
TC,TD	ALL	3
TE,TF	ALL	3
TJ Welder	ALL	4
TM,TN	ALL	6
TP,TR	ALL	6
TS,TT	ALL	6
WA	A-E	4
WA	Begin F	8
WB	A-F	4
WB	Begin H	8
WE	A	4
WE	Begin B	8
WF,WK	A-B	10
WF	Begin C	9

SEPARATE 2-BEARING GENERATORS		
UD	ALL	3
UF (AC)	ALL	3
UF (DC)	ALL	5
UT	ALL	4
UR	ALL	8
YCB	ALL	6
YD	ALL	7

REFERENCE

SECTION 3. REVOLVING ARMATURE
SECTION 4. REVOLVING FIELD
SECTION 5. DC GENERATORS

SECTION 6. YCB GENERATORS
SECTION 7. YD GENERATORS
SECTION 8. UR GENERATORS
SECTION 9. YB GENERATORS

SECTION 10. UV GENERATORS
SECTION 11. UN GENERATORS
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SECTION 2.
GENERATOR TABLES

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TABLE 2-1. SPRING PRESSURE AND BRUSH THICKNESS

MINIMUM AND MAXIMUM SPRING PRESSURES

BRUSH SPRING	NORMAL SPRING PRESSURE IN OZ. AT WORKING POSITION MIN.	MAX.
212A1003	12-1/2	18-1/2
212B1004	12-1/2	18-1/2
212B1011	25	37
* 212B1105	16	20
212B1106	30	34
212A1123	20	26
212B1195	5	7
212B1210	33	40

BRUSHES USED WITH BRUSH SPRING NO. 212A1003

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A1	1/4	Comm.
214A4	Use 214A41	Comm.
214A5	1/4	Comm.
214A6	1/4	Comm.
214A9	9/32	Comm.
214A12	9/32	Comm.
214A13	Use 214A30	Comm.
214A14	9/32	Comm.
214A22	9/32	Comm.
214A24	1/4	Comm.
214A25	1/4	Comm.
214A28	Use 214A10	S.R.
214A30	9/32	Comm.
214A33	7/16	Comm.
214A34	7/16	Comm.
214A38	9/32	Comm.
214A39	9/32	Comm.
214A40	3/8	Comm.
214A41	1/4	Comm.
214A43	1/4	Comm.
214A55	9/32	Comm.
214A73	9/32	Comm.
214A81	Use 214A30	Comm.
214A91	9/32	Comm.

BRUSHES USED WITH BRUSH SPRING NO. 212A1004

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A2	1/4	S.R.
214A3	1/4	Comm.
214A7	9/32	S.R.
214A8	9/32	S.R.
214A10	9/32	S.R.
214A11	9/32	S.R.
214A19	1/4	S.R.
214A27	1/4	S.R.
214A31	9/32	S.R.
214A32	9/32	S.R.
214A62	9/32	S.R.
214A69	9/32	S.R.
214A71	9/32	S.R.
214A79	9/32	S.R.

BRUSHES USED WITH BRUSH SPRING NO. 212B1011

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A15	Use 214A23	Comm.
214A16	1/2	Comm.
214A17	1/2	Comm.
214A18	1/2	Comm.
214A20	1/2	Comm.
214A23	1/2	Comm.
214A26	1/2	Comm.
214A29	1/2	Comm.
214A36	**	Comm.
214A37	3/4	Comm.
214A42	***	Comm.
214A48	1/2	Comm.
214A70	1/2	Comm.
214A75	3/4	Comm.
214A82	1/2	Comm.

BRUSHES USED WITH BRUSH SPRING NO. 212A1105

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A44	9/32	Comm.
214A46	9/32	S.R.
214A47	1/2	Comm.
214A50	9/32	S.R.
214A56	9/32	S.R.
214A61	9/32	Comm.
214A65	9/32	Comm.
214A66	9/32	Comm.
214A72	9/32	S.R.
214A76	Use 214A72	S.R.
214A77	9/32	Comm.
214A78	9/32	S.R.
214A80	Use 214A61	Comm.
214A83	9/32	Comm.
214A85	9/32	S.R.
214A86	9/32	S.R.
214A87	9/32	S.R.
214A88	9/32	Comm.

BRUSHES USED WITH BRUSH SPRING NO. 212A1106

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A45	1/2	Comm.
214A49	1/2	Comm.
214A51	1/2	Comm.
214A53	1/2	Comm.
214A57	1/2	Comm.
214A58	1/2	Comm.
214A60	Use 214A67	Comm.
214A64	1/2	Comm.
214A67	1/2	Comm.
214A68	1/2	Comm.

BRUSHES USED WITH BRUSH SPRING NO. 212A1123

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A46	9/32	S.R.
214A52	9/32	S.R.
214A54	9/32	S.R.

BRUSH USED WITH BRUSH SPRING NO. 212B1195

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214A84	3/8	S.R.

BRUSH USED WITH BRUSH SPRING NO. 212B1210

BRUSH PART NO.	BRUSH THICKNESS IN INCHES	BRUSH TYPE
214B90	3/8	S.R.

BRUSHES WITH SPRING ATTACHED

214A21	(For IC-AC)
214A35	Use 214A59 (For AAE-AC)
214A59	(For AJ-AK-AC) †
214A63	(For AJ-AK-AC)
214A74	Use 214A59
214B89	(For IUD/173 AC)
214A92	(For 2.5AJ-IEV/6820 AC)
214A93	(For 2.5AJ-IEV/6820 DC)
214A94	(For 2.0UGIN/5A AC/DC)
214A97	(For 2.5AJ-IE/8533 DC)

COMM - COMMUTATOR S.R. - SLIP RING (COLLECTOR RING)

*212B1106 Replaces 212B1105 in certain applications where more spring tension is required. Check spring number being replaced.

**Special Taper - For energizer and welder.

***Tapered Brush - For starter-generator with radial type commutator.

†Also used on J series revolving field - DC application on slip rings.

TABLE 2-2. SHUNT FIELD RESISTANCE CHART

The resistances (ohms) listed are based on the present models and at 76°F. Customer options, or a factory production change may affect the suitability of the chart in relation to a particular generator. If in doubt, contact the factory giving complete model and serial number.

AJ MODELS (DC)	OHMS
105AJ-115, 1.5AJ-115	175.0
105AJ-224, 1.5AJ-224	4.6
105AJ-232, 1.5AJ-232	15.4

AK MODELS (DC)	OHMS
06AK-212, 0.6AK-212	4.4
07AK-224, 0.7AK-224	4.4
07AK-232, 0.7AK-232	25.6

AJ MODELS (AC)	OHMS
08AJ-52M	1.70
08AJ-51M	13.20
1AJ-2M	1.70
1AJ-1M, 1.0AJ-1M	13.20
1.0AJ-1R	1.70
1AJ-1RV/1330	1.07
2AJ-1R, 2R, 3R	4.70
2AJ-51M	16.02
2AJ-52M, 2.0AJ-52P	64.00
2.0AJ-52R, 53R	4.67
205AJ-1M, 2.5AJ-1P	16.02
205AJ-2M	64.00
205AJ-1R, 2R, 3R, 2.5AJ-1R, 3R	4.70

AK MODELS (AC)	OHMS
102AK-51M, 1.2AK-51P	21.00
102AK-52M, 1.2AK-52P	90.00
105AK-1M, 1.5AK-1P	21.00
105AK-2M	90.00

CCK MODELS	OHMS
3CCK-1R4	3.80
305CCK, 3.5CCK	0.80
305MCCK, 3.5MCCK	3.81
4CCK, 4.0CCK	0.73
4MCCK, 4.0MCCK	2.10
5CCK, 5.0CCK	0.73
5CCK, 115 (DC)	131.00
5CCK, 150 (DC); 5.0CCK, 150 (DC)	269.00
5MCCK	2.10
5.5MCCK	2.12
6CCK, 331 & 332	4.70
6.5MCCK	2.12
7CCK, 381 (DC)	4.70
7CCK, 381 (AC)	21.00

CCKB MODEL	OHMS
10CCKB, 10.0CCKB	10.30

DLA MODEL	OHMS
205DLA-232, 2.5DLA-232	9.30

LK MODELS	OHMS
107LK (50 cycle), 1.7LK (50 cycle)	1.00
205LK (60 cycle), 2.5LK (60 cycle)	1.00
305LKB-52M	30.80
305LKB-51M	11.80
4LKB-1M	11.80
4LKB-2M	30.00

PC, TC MODELS	OHMS
104PC-51P, 1.4PC-51P	21.00
104PC-52P, 1.4PC-52P	90.00
107PC-1P, 1.7PC-1P	21.00
107PC-2P	90.00
2TC-51P	16.00
2TC-52P	64.00
2.0TE-1P	21.00
2.3TF-51P, 53P	16.02
205TC-1P	16.00
205TC-2P	64.00
2.8TF-1P, 3P	16.02
3.2TD-51P, 53P	12.20
4.0TD-1P, 3P	12.20

UD MODELS (AC)	OHMS
105UD-1N	21.00
2UD-51N, 2.0UD-51N	16.00
205UD-1N, 2.5UD-1N	16.00
305UD-1N, 3.5UD-1N	12.00

UF MODELS (AC)	OHMS
205UF (60 cycle), 2.5UF (60 cycle)	1.26
3UF (50 cycle)	.95
4UF (60 cycle), 4.0UF (60 cycle)	.95
5UF (50 cycle), 5.0UF (60 cycle)	.73
7UF (60 cycle), 7.0UF (60 cycle)	.73

UF MODELS (DC)	OHMS
105UF-232, 1.5UF-232	13.10
2UF-125, 2.0UF-125	134.00
2UF-232N1A	10.40
2UF-232N32, 2.0UF-232N32	14.30
3UF-210	78.00
3UF-232, 3.0UF-232	9.30
5UF-125	112.00
5.0UF-210	62.00
10UF-150, 10.0UF-150	200.00

JA MODELS	OHMS
205JA	1.50
205JA-51R4	3.80
205JA-53R3	2.10
205DJA-224	5.14
3JA Spec C	1.50
3JA-1R4	3.80
3JA Spec D	0.80
3JA-1R3	2.10
3DJA-232	8.80

UB MODEL	OHMS
15UB-150, 15.0UB-150	142.00

UF TRACTOR DRIVE (AC)		OHMS
15UF	SHUNT	5.60
	AUX SHUNT	8.90

TABLE 2-2. SHUNT FIELD RESISTANCE CHART
(Continued)

UT TRACTOR DRIVE (AC)	OHMS
25.0UT-3N106, 5N106	2.40
NB, NH MODELS	**OHMS**
3.0NB, IR LK Generator	.72
6.5NH	1.03

CCK, MCCK, NB, NH MODELS	OHMS
4.0CCK, After & including Spec R UN Generator	0.79
4.0MCCK, After & including Spec D UN Generator	0.79
5.5MCCK, UN Generator, Spec O	0.83
6.5MCCK, After & including Spec O UN Generator	0.82
5.0CCK, After & including Spec R UN Generator	0.82
6.5NH, After & including Spec B UN Generator	0.82
3.0NB, 3CR UN Generator	0.59

TABLE 2-3. RESISTANCE VALUES FOR ROTORS

All resistances should be ±10% of the values specified at 25°C (77°F). This includes readings between slip rings on static excited rotors and between field leads (with rectifiers disconnected) on brushless rotors. Use an ohmmeter for testing.

KW RATING AND SERIES		RESISTANCE (OHMS)
50 HERTZ	60 HERTZ	
5.0JB		4.8
6.0JB		3.5
	6.0JB	4.8
	7.5JB	3.5
8.0JC		3.3
10.0JC		2.7
	10.0JC	3.3
12.5JC		2.33
	12.5JC	2.7
	15.0JC	2.33
	10.0RJC	3.3
12.5RJC		2.33
	12.5RJC	3.3
25.0EK	30.0EK	3.76
25.0DEH	30.0DEH	3.76
	40.0UR	2.83
37.0EM	45.0EM	2.83
37.0DEF	45.0DEF	2.83
40.0DEG	50.0DEG	2.83
	55.0UR	3.13
45.0KB	55.0KB	3.13
50.0DYA	60.0DYA	3.43
55.0KB	65.0KB	3.43
60.0DYC	75.0DYC	3.58
70.0KR	85.0KR	3.14
75.0DYC	90.0DYC	3.14
80.0DYD	100.0DYD	3.62
95.0WA	115.0WA	3.70
100.0DYD	125.0DYD	4.08
115.0WE	140.0WE	4.08
125.0DYG	150.0DYG	3.51
	150.0WE	3.51
140.0WB	170.0WB	3.88
145.0DYG	175.0DYG	3.88
165.0DFP	200.0DFP	3.07
190.0DFM	230.0DFM	3.07
200.0DYB	250.0DYB	3.07
210.0FT	250.0FT	3.07
250.0DFT	300.0DFT	1.87
290.0DFU	350.0DFU	1.87
290.0WF	350.0WF	1.87
330.0DFV	400.0DFV	2.00
330.0WK	400.0WK	2.00
400.0DFW	450.0DFW	2.16
400.0DFY	500.0DFY	2.37

FIELD RECONNECTING ONAN MAGNECITER AC GENERATORS

GENERAL

Onan builds and ships a variety of *revolving field* (magneciter) sets equipped with 12 lead generators. These generators are built on *special order* for sets up to 100KW, but are *standard* on the larger 3 phase models from 100-250KW (except 600 volt).

All of the generators can be reconnected in the field to change output phase and voltage by changing the generator winding connections.

When shipped, the generators are connected to deliver the voltage specified on the order. The unit nameplate shows *only* the single specified voltage for which the generator is connected. The output instruments on the set (such as voltmeters, ammeters, transformers, frequency meters, and running time meters) are intended for use with the specific nameplate voltage.

Some units may include an optional reconnection terminal block which allows safe and simple voltage changes. The generator leadwires terminate at the optional reconnection block or in the junction box on the generator side. The junction box also contains the ammeter current transformers (some sets have the current transformers in the control box) which may require replacement when changing to different output voltages. Instruments, which may require changes per new output voltages, are accessible by tipping out the control box front panel.

The generator is a basic *coded type (either 2X, 5X, 6X)* as identified by the generator data number on the unit nameplate. Example - 150UK*2X*N1A, 150UK*5X*N1A, 150UK*6X*N1A. Each type can be connected for output voltages shown in Tables 2-4 and 2-5. Use Table 2-4 for 10 to 85 KW and Table 2-5 for 100 to 250 KW generators.

All generator wires have wire tags for identification. The output leads to load are T_0, T_1, T_2, T_3. The generator winding leads, which are joined to form the output leads, are marked 1 through 12. See Figure 2-1 wiring diagrams for 10 to 85 KW and Figure 2-2 for 100 to 250 KW generators. All numbered leads are joined in various combinations to the output leads for the different voltages.

Instruments and their related parts may require changes because of different voltages and current. New instruments are selected by the new voltage and current ratings of the set. Refer to Table 2-6 for voltage rated instruments and select according to the new voltage output. Always size the instrument so the set output will not exceed instrument rating.

For changing current rated instruments (ammeters and current transformers) refer to Table 2-8 and find the correct ampere rating of the set after reconnection. After determining current rating, refer to Table 2-7 for the proper size ammeter and current transformers.

Instrument wiring is essentially the same for all sets. Connect new instruments in the same manner as the old ones were connected. Wiring diagrams, supplied by ONAN after the reconnection registration, provide additional instructions and part numbers required to complete the unit wiring.

CAUTION *SEVERE DAMAGE WILL RESULT IF LEADS ARE INCORRECTLY CONNECTED OR IMPROPERLY INSULATED. USE EXTREME CARE IN CHECKING LEADS TO ASSURE PROPER CONNECTIONS.*

IMPORTANT: *BEFORE ATTEMPTING TO RECONNECT A GENERATOR, CONTACT THE ONAN FACTORY FOR REQUIRED INSTRUMENT CHANGES, NEW WIRING DIAGRAMS, NEW SET NAMEPLATE WITH PROPER SPECIFICATION NUMBER AND VOLTAGE.*

TABLE 2-4 (10-85 KW ONLY)

CODE	VOLTAGE	OUTPUT
"2X" GENERATOR		
4R	120/208	3 ph Wye
7XR	240/416	3 ph Wye
5DR	120/240	3 ph Delta (Note 2)
	240/480	1 ph "Zig-Zag" (Note 1)
7R	220/380	3 ph Wye "Dog-Leg"
"5X" GENERATOR		
7XR	240/416	3 ph Wye
5R	240	3 ph Delta
6DR	240/480	3 ph Delta (Note 2)
	240	1 ph Delta (Note 1)
"6X" GENERATOR		
4XR	277/480	3 ph Wye
	138/240	3 ph Wye
7XR	240/416	3 ph Wye "Dog-Leg"

TABLE 2-5 (100-250 KW ONLY)

CODE	VOLTAGE	OUTPUT
"2X" GENERATOR		
4R	120/208	3 ph Wye
7XR	240/416	3 ph Wye
5DR	120/240	3 ph Delta (Note 2)
	240/480	1 ph "Zig-Zag" (Note 1)
7R	220/380	3 ph Wye "Dog-Leg"
"5X" GENERATOR		
7XR	240/416	3 ph Wye
5DR	240	3 ph Delta
6DR	240/480	3 ph Delta (Note 2)
	240	1 ph Delta (Note 1)
"6X" GENERATOR		
4XR	277/480	3 ph Wye
	138/240	3 ph Wye
7XR	240/416	3 ph Wye "Dog-Leg"

NOTE 1: Usable output is 2/3 of normal 3 ph rating.
NOTE 2: Delta-one phase center tapped. If no 3 ph output is being used, usable 1 ph output is up to 2/3 of normal 3 ph rating but, 1 ph output must be balanced between the two output legs.

TABLE 2-6. VOLTAGE RATED INSTRUMENTS

AC VOLTMETER VOLTAGE	RESISTOR	METER PART NO.
150	None	302P420
300	None	302P421
600	None	302P422
750	None	302P423
RUNNING-TIME METER		
120-240 (1 ph)	None	302P465
120-208 (3 ph)	None	302P465
220-380 (3 ph)	None	302P466
277-480 (3 ph)	None	302P467
FREQUENCY METER		
120	None	302P213
208	None	302P221
240	None	302P221
240 (5R Connection)	304A125	302P213
220-380 (3 ph)	304A125	302P213
277-480 (3 ph)	304A305	302P213
480	304A305	302P213

TABLE 2-7. CURRENT RATED INSTRUMENTS

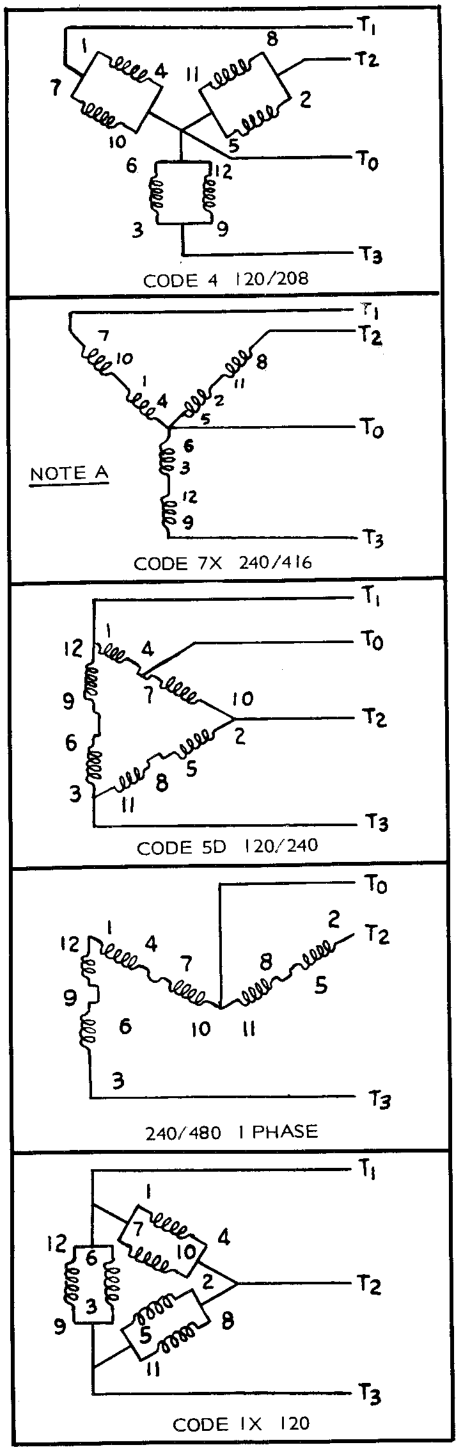
AC AMMETER CURRENT (AMPS)	CURRENT TRANS.	METER PART NO.
30	None	302P418
50	None	302P419
80	None	302P458
100	302P78	302P408
150	302B79	302P410
200	302B106	302P411
300	302B107	302P413
500	302B372	302P414
750	302B385	302P415

TABLE 2-8. NOMINAL AMPERE RATINGS OF DIFFERENT SIZE ALTERNATORS

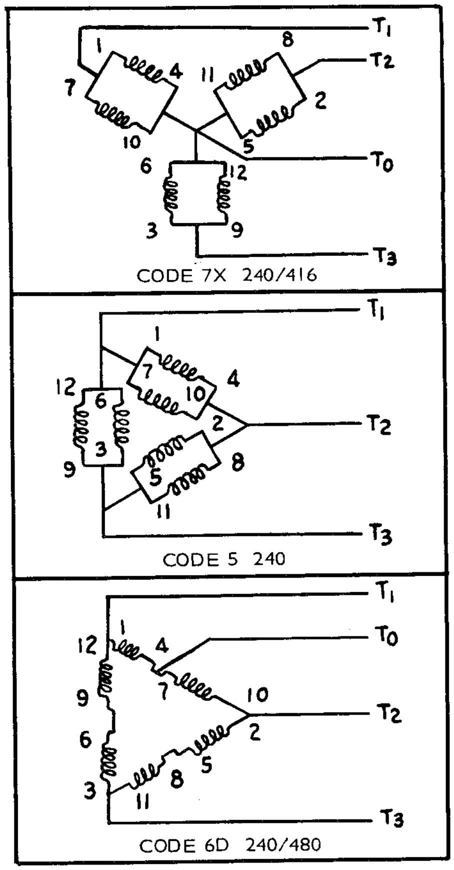
ALWAYS USE KVA RATINGS WHEN SHOWN OR KNOWN		ONAN CODE	SINGLE PHASE		THREE PHASE				
			-1	-3	-4	-5 -5D	-7	-4X -6	-9
POWER FACTOR 80%		UNITY							
KW	KVA	KW/KVA	120-V AMP	120/240-V AMP	120/208-V AMP	240-V 120/240-V AMP	220/380-V AMP	480-V 277/480-V AMP	600-V AMP
		.5	4.2	2.1					
		.75	6.25	3.2					
		1.0	8.3	4.2					
		1.25	10.4	5.2					
		1.5	12.5	6.2					
		2.0	16.7	8.3					
		2.5	20.8	10.4					
		3.0	25.0	12.5	8.3	7.2	4.6		
		3.5	29.2	14.6	9.7	8.4	5.3		
		4.0	34	17	11.0	9.6	6.0		
		4.5	38	19	13	11	7.2	5.4	4.3
4.0	5.0	5.0	42.0	21.0	14	12	8	6	5
		6.0	50	25	16	14	9	7	6
6.0	7.5	7.5	63	32	21	18	11	9	7
		9.0	75	38	25	22	14	11	9
		10.0	83	42	28	24	15	12	10
10.0	12.5	12.5	104	52	35	30	19	15	12
12.5	15.6	15.6	130	65	43	38	23	19	15
		15.0	125	63	42	36	23	18	14
15.0	18.75	18.75	155	78	53	45	29	23	18
		17.5	146	73	49	42	27	21	17
17.5	21.87	21.87	182	91	61	53	33	26	21
		20.0	167	84	56	48	30	24	19
20.0	25.0	25.0	208	104	70	60	38	30	24
25.0	31.25	31.25	260	130	87	75	48	38	30
		30.0	250	125	83	72	46	36	29
30.0	37.5	37.5	312	156	104	90	57	45	36
35.0	43.75	43.75	364	182	122	105	67	53	42
40.0	50.0	50.0	416	208	139	120	76	60	48
45.0	56.25	56.25	468	234	156	135	86	68	54
50.0	62.5	62.5	521	260	174	151	95	75	60
55.0	68.75	68.75	574	286	191	166	105	83	66
60.0	75.0	75.0	625	313	209	181	114	90	72
65.0	81.25	81.25	677	339	226	196	124	98	78
70.0	87.5	87.5	730	365	244	210	133	105	84
75.0	93.75	93.75	782	390	261	226	143	113	90
80.0	100.0	100.0	834	417	278	240	152	120	96
85.0	106.25	106.25	885	443	295	256	162	128	103
90.0	112.5	112.5	936	468	312	271	171	135	108
100.0	125.0	125.0	1042	520	348	300	190	150	120
110.0	137.50	137.5	1145	573	382	332	210	166	132
115.0	143.75	143.75	1190	595	400	346	218	173	138
125.0	156.25	156.25	1302	651	435	376	238	188	150
140.0	175.0	175.0	1458	720	486	421	266	211	169
150.0	187.5	187.5			521	452	285	226	181
155.0	193.75	193.75			538	468	295	234	187
165.0	206.25	206.25			575	498	314	248	199
170.0	212.5	212.5			591	513	324	256	204
175.0	218.75	218.75			609	527	333	263	211
190.0	237.5	237.5			660	573	361	286	229
200.0	250.0	250.0			696	602	380	300	241
230	287.5				799	693	438	346	277
250	312.5				867	751	475	376	301

RECONNECTIBLE ONLY AS SHOWN

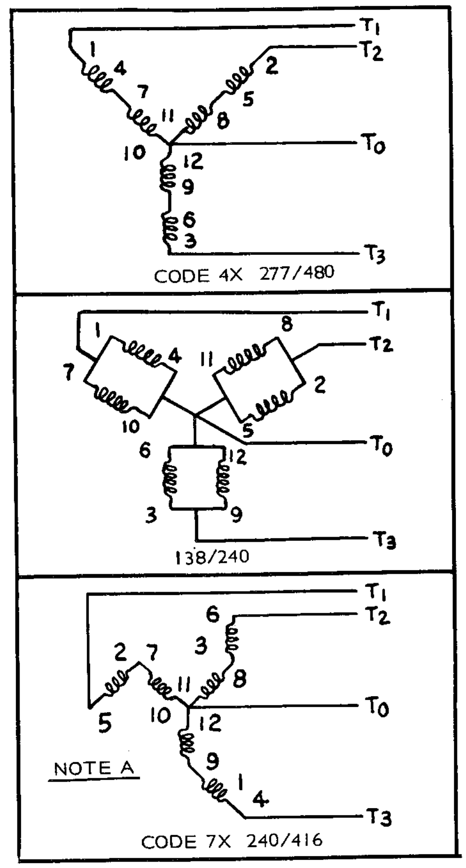
'2X' ALTERNATOR



'5X' ALTERNATOR



'6X' ALTERNATOR



10KW to 85KW (12 Lead Generator Only)

"2X" - Basic 120 Volt Reconnectible Windings
"5X" - Basic 240 Volt Reconnectible Windings
"6X" - Basic 138 Volt Reconnectible Windings

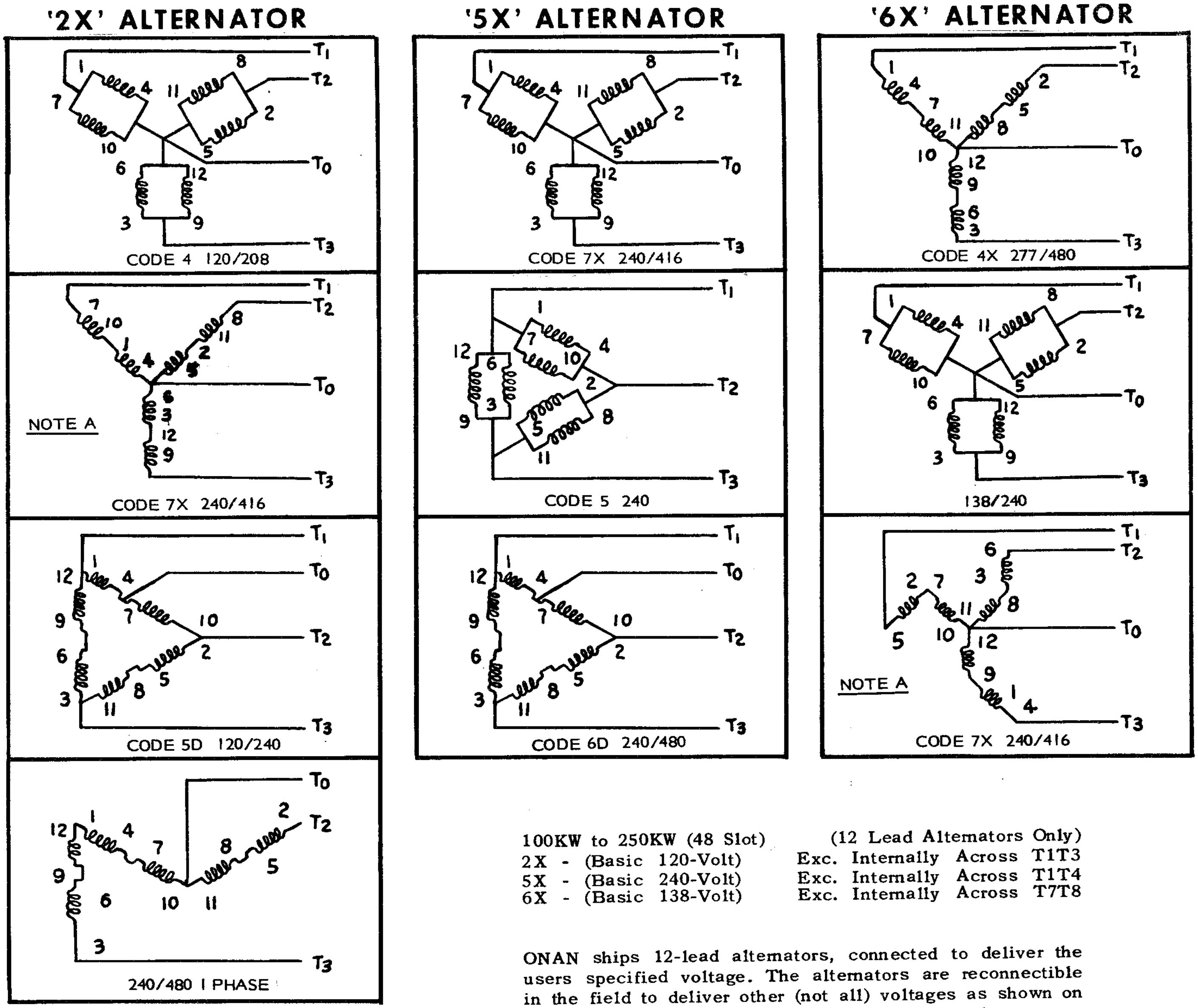
Static Exciter Connection permanently internally connected for 120 Volt Input.

"Under no circumstance shall 12 lead generators be connected in any other manner than as recommended above."

Note A: Connections shown are correct, but not in accordance with NEMA designations. (This is necessary to provide proper input voltage to static exciter.)

TABLE 2-9. RECONNECTION DIAGRAMS

RECONNECTIBLE ONLY AS SHOWN



100KW to 250KW (48 Slot)	(12 Lead Alternators Only)
2X - (Basic 120-Volt)	Exc. Internally Across T1T3
5X - (Basic 240-Volt)	Exc. Internally Across T1T4
6X - (Basic 138-Volt)	Exc. Internally Across T7T8

ONAN ships 12-lead alternators, connected to deliver the users specified voltage. The alternators are reconnectible in the field to deliver other (not all) voltages as shown on this page. Control components also change when reconnected. 120/240-volt single-phase, 3-wire and 347/600-volt, 3-phase are 4-lead alternators. 1R and 1X are not offered as Magneciter Alternators.

Note A: Connections shown are correct, but not in accordance with NEMA designations. (This is necessary to provide proper input voltage to static exciter.)

TABLE 2-9. RECONNECTION DIAGRAMS (CONTINUED)

TABLE 2-10. UV GENERATOR RESISTANCE VALUES FOR GENERATOR FIELD AND EXCITER FIELD

(Use an accurate ohmmeter-check between disconnected F1 and F2 leads)

MODEL NUMBER	HERTZ	GENERATOR FIELD (ROTOR) RESISTANCE*	EXCITER FIELD RESISTANCE*
300.0 DFT	60	1.87 Ohms	16.8 Ohms
350.0 DFU	60	1.87 Ohms	16.8 Ohms
350.0 WF	60	1.87 Ohms	16.8 Ohms
400.0 DFV	60	2.00 Ohms	16.8 Ohms
400.0 WK	60	2.00 Ohms	16.8 Ohms
450.0 DFW	60	2.16 Ohms	16.8 Ohms
250.0 DFT	50	1.87 Ohms	16.8 Ohms
290.0 DFU	50	1.87 Ohms	16.8 Ohms
290.0 WF	50	1.87 Ohms	16.8 Ohms
330.0 DFV	50	2.00 Ohms	16.8 Ohms
330.0 WK	50	2.00 Ohms	16.8 Ohms
400.0 DFW	50	2.16 Ohms	16.8 Ohms

* - Resistance of connected windings at 25C (77F) shall be ±10% of values specified above.

ONAN SERVICE TRAINING

DC - EXCITATION VOLTAGES - CLASS "A" UNITS

MODEL	DC VOLTAGE
PC (1P and 3P)	56 - 57
PC (2P)	106
YCB (Short Stack)	60 - 90
YCB (Long Stack)	100 - 150
1AJ	21
2.5AJ (STD)	31
3.0AJ (RV)	37
LK (Round)	18
LK (Square)	17
CCK (Round)	17
CCKB (50 Hertz)	46
CCKB (60 Hertz)	56
4CCK (Square)	27
5CCK (Square)	33
JB	31.5
DJA	17
3.5MCCK (Round)	33
4MCCK (Round)	31.5
6.5MCCK (Round)	33
4.5MCCK (Square)	27
6.5MCCK (Square)	33
4.0MCCK (Spec H)	120
6.5MCCK (Spec H)	120
6.5NH (Square)	33
J Series/AA	7 - 11
BFA	25
BGA	30

JH/jr
3/28/80

Onan Corporation
A Subsidiary of
McGraw-Edison Company

1400 73rd Avenue N.E.
Minneapolis, MN 55432
612 574-5000

SECTION 3.
REVOLVING ARMATURE GENERATORS

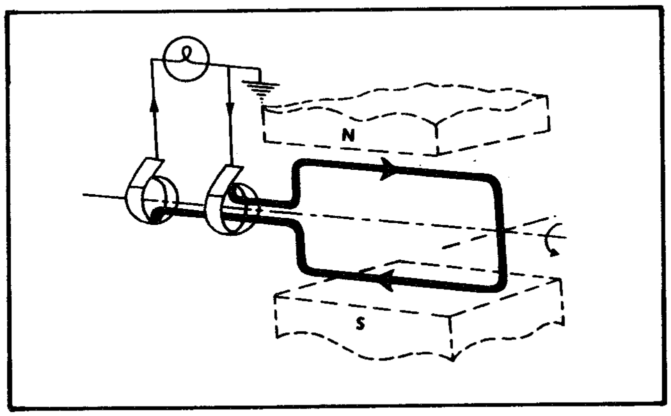
INDEX

GENERAL

Generating Electricity

Revolving armature generators can be either two or four pole units, are self-excited and inherently regulated.

A simple generator (Figure 3-1) consists of a coil rotated in a magnetic field. This coil produces a voltage (Figure 3-2) when rotated and the slip rings remove this voltage to an external circuit. Each segment of the voltage curve corresponds to a position of the coil in the magnetic field. The highest voltage occurs when the sides of the coil move at right angles to the magnetic flux. The zero voltage occurs when moving parallel to the flux. The voltage reverses direction four times for a four pole generator (twice for a two pole) for each revolution. This is alternating current (AC) and it has a frequency equal to the number of complete cycles it makes each second.



ALTERNATING CURRENT GENERATOR

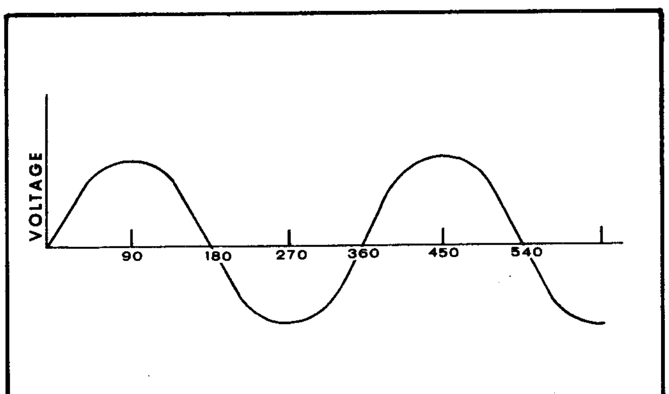


FIGURE 3-2. WAVE FORM OF ALTERNATING CURRENT

The frequency of the AC produced depends directly on the rotating speed of the coil or armature (faster rotation, higher frequency – slower rotation, lower frequency). The voltage produced depends on the speed of rotation, the number of windings in the coil, and the strength of the magnetic field. Changing any one of these changes the output voltage.

In a two pole revolving armature generator the rotating coil is the armature, the magnet is the field. If another magnet were added (Figure 3-3) the generator would become a four pole generator. The AC output frequency doubles that of a two pole unit operating at the same speed, therefore a two pole AC generator must operate at 3600 rpm and a four pole AC generator at 1800 rpm to produce the same frequency.

Converting the simple AC generator to a direct current generator requires the addition of a commutator which performs as a switch. The commutator (Figure 3-4) inverts half of the output voltage by reversing the relationship of the armature and output wires each time the voltage is zero.

Producing The Generator Field

Using permanent magnets to produce the magnetic field is unsuitable. The magnet required is usually large, hard to produce, and often hard to control. If a method were available for varying the field strength it could be used to control the generator's output voltage. This is accomplished with electromagnets. Electromagnets are field windings with an iron core (Figure 3-3). The magnet field strength is then proportional to the current in the field. The more current in the field, the more magnetic flux and the higher the output voltage. Current for the field can be supplied either from an external source, such as batteries or from the generator's output, known as self-excitation.

There are several configurations (Figure 3-5) for a self-excited generator; shunt windings, where the field is in series with the armature and all load current passes through the field; and a combination of shunt and series winding.

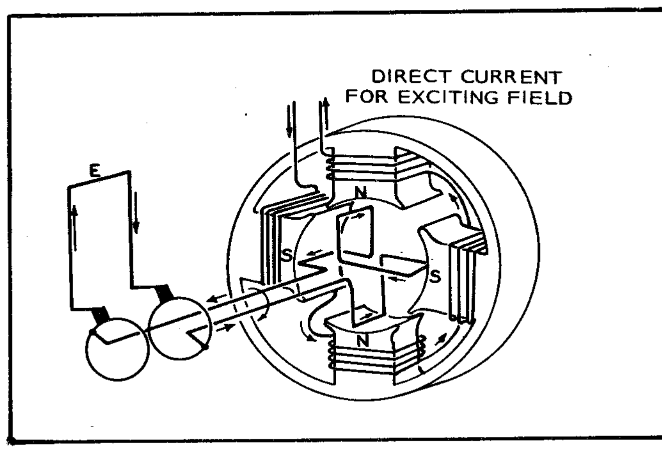


FIGURE 3-3. FOUR POLE AC GENERATOR

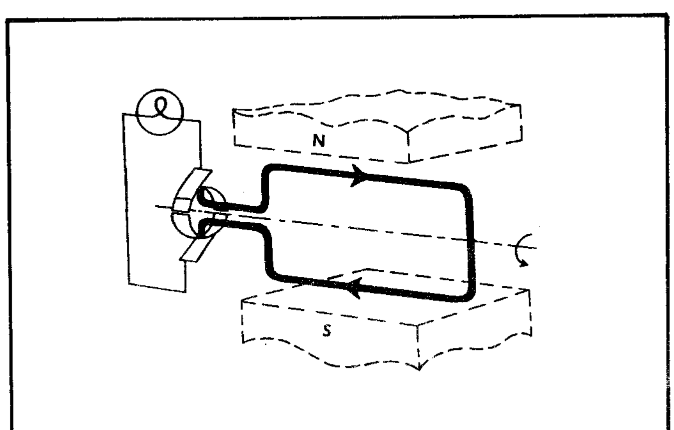


FIGURE 3-4. SIMPLE DIRECT CURRENT GENERATOR

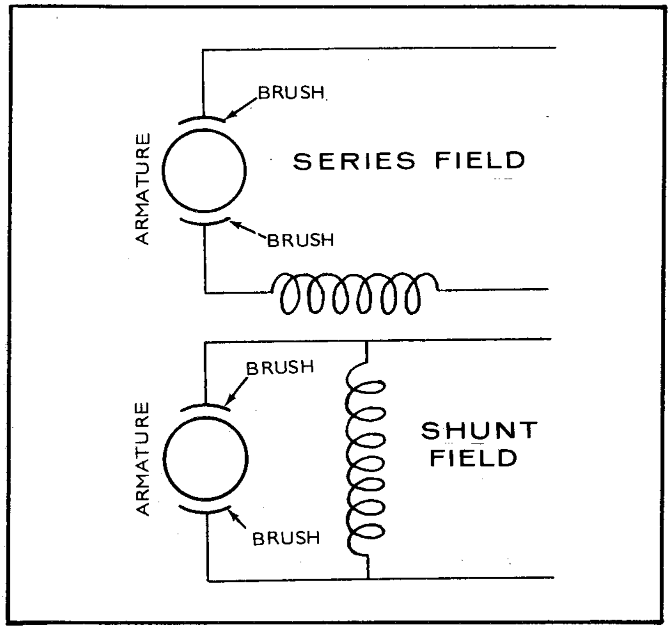


FIGURE 3-5. GENERATOR FIELD CONFIGURATIONS

The difference between each of these methods is the voltage control available. In the shunt wound generator, the field current depends on the armature output voltage. If a heavy load reduces voltage slightly, the shunt field current drops and the resulting output drops further. This results in a voltage drop with increased load (Figure 3-6). The series winding, however, passes all load current through the field. So on a series wound generator, the output voltage is almost zero with no load and increases as the load increases (Figure 3-6). By combining both series and shunt fields, the generator designer can produce a voltage characteristic that rises, decreases or remains almost constant with load. A combined series and shunt field is known as a compound wound field. The type of field used will depend on the generator's application.

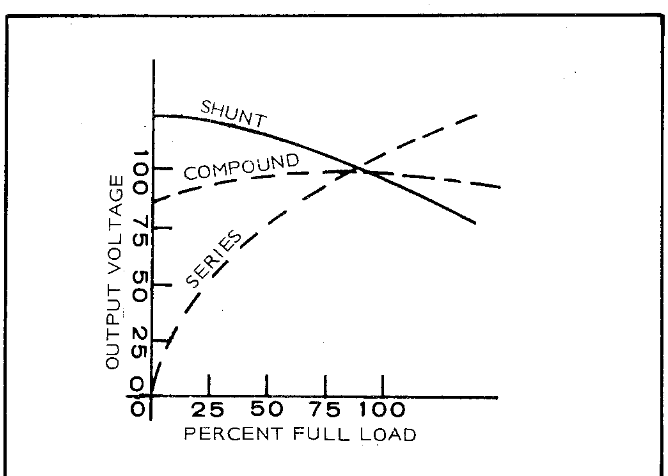


FIGURE 3-6. VOLTAGE REGULATION OF SHUNT, SERIES AND COMPOUNT FIELD WINDINGS

Since the field current determines output voltage, the output voltage can be changed by changing field current.

AC Generators

The AC generator has different requirements than DC generators. In order to develop direct current for its field, an additional winding and commutator, known as the exciter, are required on the armature. The voltage regulation method also differs. All AC revolving armature generators are inherently regulated. Late model small generators use heavy duty silicon rectifiers for AC to DC conversion to produce field winding excitation which eliminates the commutator and its brushes.

Generator Starting And Inherent Regulation

Further understanding of the generator requires knowledge of phenomena of iron when magnetized. First, iron is saturable – increasing the current in a coil around a piece of iron will increase the magnetic flux in the iron only to a point. Above that point, increased current has a reduced effect until finally further increases don't change the field strength. At this point, the magnet is said to be saturated. Secondly, when current is stopped, the magnet retains some of its strength or has residual magnetism (Figure 3-7). As the current in the coil is increased, the magnetic strength finally reaches saturation point A. When the current is reduced to zero, the strength stays at point B.

When the generator supplies its own field, an initial jolt is required to start voltage build. The residual magnetism supplies this by maintaining a small field when the generator is stopped. Once the generator is turning, this residual field induces a small voltage in the armature which is fed back through the field windings to reinforce the field. The reinforced field induces a larger voltage which further reinforces the field. Build continues until limited by the generator characteristics.

The maximum voltage a generator will produce is determined by the field saturation. At this point, further increases in field current won't change the field strength and so won't affect the generator's voltage. This affect is utilized in Onan AC revolving armature generators and is called inherent regulation. By allowing the generator to operate with the field saturated,

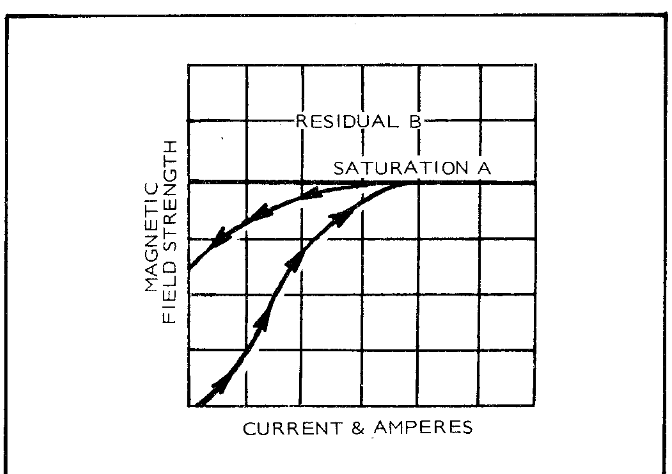


FIGURE 3-7. SATURATION AND RESIDUAL MAGNETISM

small changes in the output voltage which change the field current will have little effect on the field strength. This provides voltage regulation (Figure 3-8). It is important to note with this system, a rheostat in the field can be used only to reduce voltage.

Inherent regulation through saturation isn't utilized in the operating range of Onan DC generators, so the operator can maintain complete control over output voltage.

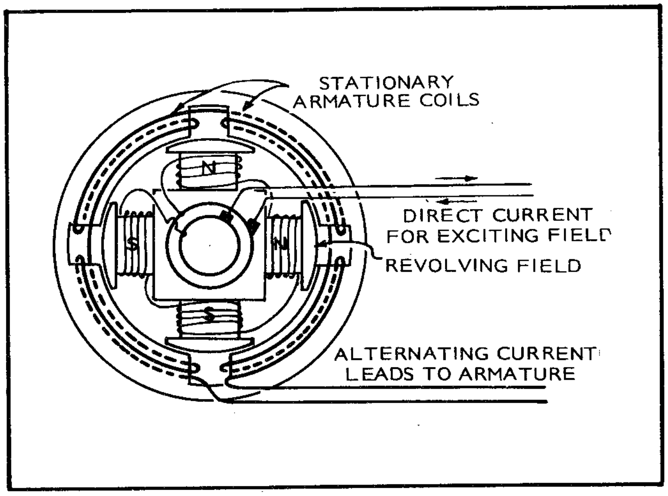


FIGURE 3-8. REVOLVING FIELD GENERATOR

Generator Speed And Speed Regulation

The generator speed is important because it determines the frequency of AC generators and the output voltage of all generators.

AC generator output frequency is directly proportional to the generator's speed. This formula shows how frequency can be calculated from speed.

$$\text{FREQUENCY} = \frac{\text{Generator rpm x number of poles}}{120}$$

As shown, any change in generator speed changes the output frequency. The speed of a 4 pole 60 hertz generator should be 1800 rpm. If speed drops to 1710 rpm, the output frequency drops to 57 hertz.

In this light, it is important that the engine be speed regulated by some type of governor to maintain a reasonable speed drop when load is added and removed. The maximum allowable frequency difference will depend on the load equipment. Typically, Onan generating sets are regulated to a drop of 5% (3 hertz) throughout operation. This magnitude of speed regulation is recommended for most AC applications.

FREQUENCY VS. GENERATOR SPEED

OUTPUT FREQUENCY	GENERATOR SPEED 2 POLE	GENERATOR SPEED 4 POLE
60	3600	1800
50	3000	1500

TROUBLESHOOTING REVOLVING ARMATURE GENERATORS

Table 3-1 contains the troubleshooting information for the revolving armature generators. All the test and repair procedures referenced in these tables are explained in either the *Maintenance and Adjustments* or *Generator Repair* portions of this section.

MAINTENANCE AND ADJUSTMENTS

After approximately 500 hours of operation check the generator brushes, slip rings, and commutator for wear and scoring. In addition the generator should be blown clean with compressed air every 100 hours (more often if generator is operated under extremely dusty conditions.

Brush Maintenance AK, AJ, MAJ, LK Sets

Install new commutator brushes and other rectangular brushes when the old ones are worn to 5/8" or less (AK units prior to Spec J). The cylindrical or nearly square (1/4" x 3/8") collector ring brush with spring attached may be worn to 5/16". It is not necessary to remove the brush rig to install the brushes (Figure 3-9). Remove the end cover to expose the brush rig. Brushes are then easily accessible.

New brushes are shaped to fit and seldom need sanding to fit properly. Always use the correct brush as listed in the Onan parts manual. Never substitute a brush. They may appear to be the same but have different electrical characteristics.

After brush installation be sure to tighten brush lead terminal nuts. If some brush sparking occurs after brush replacement run the set at a light load until brushes wear into a good seat.

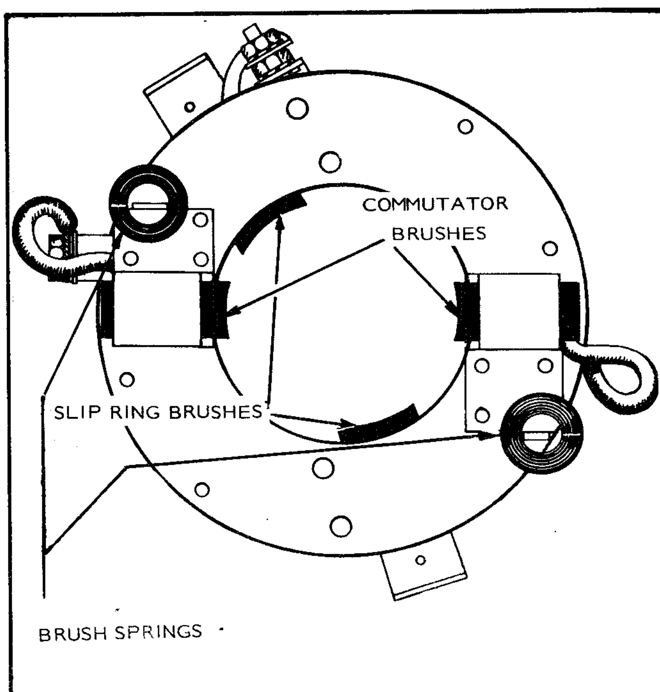


FIGURE 3-9. AK, AJ, MAJ BRUSH REPLACEMENT

TABLE 3-1. TROUBLESHOOTING AC REVOLVING ARMATURE GENERATORS

NATURE OF TROUBLE	CAUSE	REMEDY
1. Exciter troubles: See DC Generator Troubles.		
2. AC slip rings shorting.	2. Conducting dirt, dust, grease, or oil shorting out the slip rings.	2. Clean slip rings with approved solvent.
3. AC armature short circuit.	3. Insulation or coils broken down.	3. Rewind or replace.
4. AC armature open circuit.	4. Rough usage or original short circuit which may have burned a coil or connection.	4. Test with an ohmmeter and if open replace or rewind the armature.
5. Incomplete circuit from AC armature to load.	5. Insulating film on slip rings.	5. Clean slip rings with stone or fine sandpaper and blow out dust. DO NOT USE EMERY CLOTH.
	5. Slip ring brushes not contacting the slip rings.	5. Replace brush spring which may have broken or come off; or replace brushes which may have become worn down too far to contact the slip rings. Make brushes free to move in holders.
	5. Brush shunt broken.	5. Check brush shunts with an ohm-meter and replace open brushes and shunts.
	5. Loose connections at the slip ring brush terminals.	5. Check and tighten all slip ring brush terminal connections.
6. Faulty load connections.	6. Open circuit or short circuit on the line.	6. Check line and load connections and load.
7. Residual magnetism lost; or residual magnetism weak.	7. Residual magnetism lost through non-use or disassembly of generator.	7. Charge the shunt fields with another DC generator or a battery, making sure the fields are connected for proper polarity.
8. Residual magnetism reversed.	8. Reversed-current through field coils from some outside voltage source.	8. Connect fields for proper polarity and charge the shunt field with another DC generator or a battery, using correct polarity from the gener-ator or battery.
9. Armature short circuit.	9. (a) Carbon dust or other con-ducting dust between adjacent bars.	9. (a) Clean the commutator. The presence of this trouble will be shown by flashing of brushes or heating of one or more coils.
	(b) Insulation or coils broken down.	(b) Replace or rewind if insulation is beyond repair.
10. Armature open circuit.	10. Rough usage, or original short circuit which may have burned a coil or connection.	10. Test adjacent commutator bars; replace or rewind the armature.
11. Incomplete circuit from DC armature to shunt field	11. (a) Insulating film on commutator.	11. (a) Clean commutator with fine sandpaper or a commutator stone and blow out dust. DO NOT USE EMERY CLOTH.
	(b) DC commutator brushes not contacting the commutator.	(b) Replace brush spring which may have broken or come off; Replace brushes which may have become worn down too far to make contact. Make brushes free to move in holder.

TABLE 3-1. TROUBLESHOOTING AC REVOLVING ARMATURE GENERATORS (continued)

NATURE OF TROUBLE	CAUSE	REMEDY
11. Incomplete circuit from DC armature to shunt field.	(c) Brush leads broken due to vibration.	(c) Check brush shunts with an ohmmeter and replace defective brushes and leads.
	(d) Loose connections at the brush terminals.	(d) Check and tighten all brush terminal connections.
	(e) Open circuit in shunt field coil leads.	(e) Check leads with an ohmmeter and repair as needed.
	(f) Open circuit in rheostat or voltage regulator resistances.	(f) Check rheostat or regulator with ohmmeter and repair or replace.
12. Short circuit in field.	12. Dampness or deteriorated insulation.	12. Bake if damp, repair or rewind if insulation is deteriorated.
13. Open circuit in field.	13. Rough usage or original short circuit which may have burned a coil or connection.	13. Examine field connections and test with an ohmmeter; If a coil is open, replace it.
14. Short circuit in exterior	14. Device connected to line short-circuited or line itself short-circuited.	14. Check all load connections.
15. Fields opposed to each other.	15. (a) Field coils of either a shunt or a series generator connected for the same polarity.	15. (a) Change connections between field coils, and test with a compass for opposite polarity of adjacent coils. When adjacent coils show opposite polarity, the generator should build up voltage.
	(b) Shunt and series field of compound wound generator connected for proper polarity individually but connections of generator made so that they oppose or buck each other.	(b) Change polarity of either field, but do not change connections of both, as the same trouble will occur again.
16. Generator running backward. (Separate generator)	16. Prime mover running in wrong direction.	16. Reverse direction of rotation of prime mover or change the polarity of the generator by changing the connections of the field of a shunt and series machine.

TABLE 3-2. VOLTAGE AND FREQUENCY RANGES

Nominal Output	Maximum Voltage At No Load	Minimum Voltage At Full Load	Preferred Drop No Load To Full Load	Maximum Frequency At No Load	Minimum Frequency At Full Load	Preferred Frequency No Load To Full Load
120	126	110	122-114	64 Cycles	57 Cycles	61-59
240	252	228	246-236	64 Cycles	57 Cycles	61-59
120/240	252	228	246-236	64 Cycles	57 Cycles	61-59
120/208	218	198	216-200	64 Cycles	57 Cycles	61-59

Brush Rig Position: Brush rig position is important. Correct setting results in the least sparking at the commutator brushes during average load operation. On AK models beginning with Spec J and most AJ models the brush rig position is permanently fixed at the factory. The brush rig cannot shift from the neutral position.

Some special AK and AJ models have a brush rig of adjustable design where the neutral position is identified by a "witness" mark at the point of mounting.

As long as the original brush rig and armature are used these reference marks must be observed. If a new brush rig or armature is installed the original alignment marks may have to be disregarded in order to find the proper neutral position.

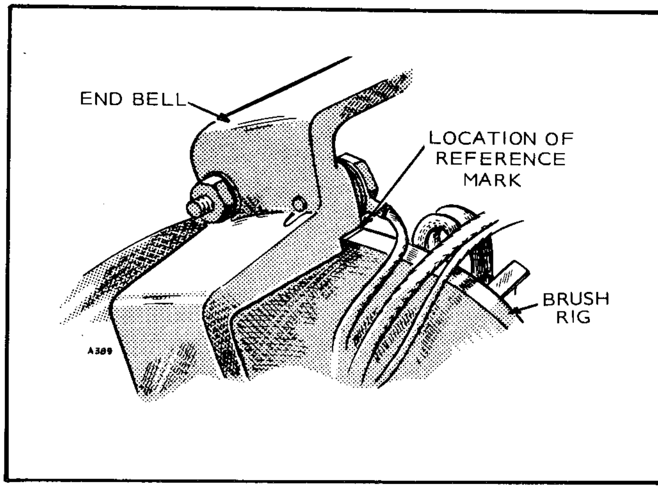


FIGURE 3-11. BRUSH RIG ALIGNMENT

CCK, CCK Sets (Prior to Spec R)

Inspect brushes periodically. Brushes worn to 5/8″ should be replaced. Replace springs if damaged or if proper tension is questionable. Rapid brush wear may be caused from high mica between commutator bars, rough commutator or collector rings, or from a deviation from neutral position in the adjustment of the brush rig. Never bend the constant-pressure-type spring over the edge of its support. See Figure 3-10.

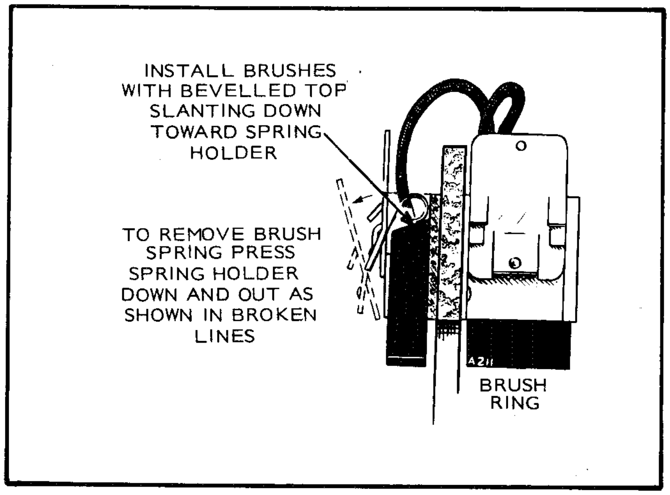


FIGURE 3-10. CCK, CCKB BRUSH SPRINGS

Brush Rig Position: Check the witness mark on the brush rig and if necessary align it with the boss in the end bell. If the brush rig is adjusted so that there is arcing of the brushes, brush wear will be rapid, voltage and current will not hold steady, and the generator may overheat.

Whenever a new brush rig or armature is installed, the brush rig must be rotated to the point of highest voltage (point of least arcing of the brushes) regardless of where the witness mark falls. After the brushes are seated and the generator is hot, readjust the brush rig. This is commonly known as the neutral brush position (see Figure 3-11).

NB, NH, CCK (Beginning Spec R)

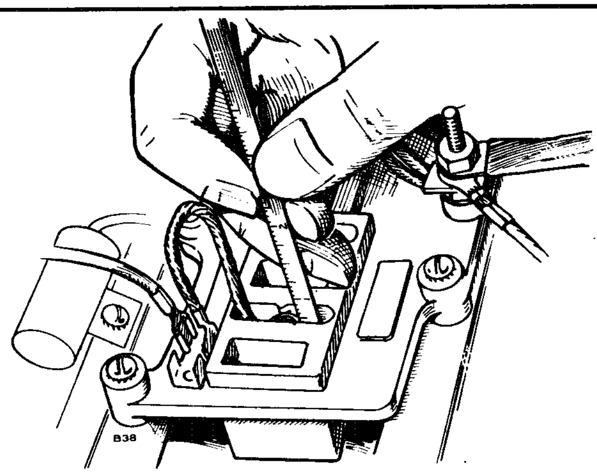
To gain access to the brushes, remove the machine screws at the bottom of the end bell wrap, or unsnap the catches (depending on model) and slide the wrapper off the generator end bell. Take brush wear measurements as shown in Figure 3-12. If a narrow metal scale is not available a match-stick or similar object may be used as a gauge. If the trademark "ONAN" is visable below the brass brush guide, replacement is in order without further measurement.

To replace the brushes, pull the AC brush lead clips from their fastening posts and disconnect the DC brush lead from the binding post.

NOTE: *Since there are four brush holders, each containing three brushes, it is suggested that each brush holder be removed and serviced individually rather than removing all brushes and holders at one time. This will prevent errors in reinstallation of holders and brush leads.*

Remove the three attaching screws and carefully lift the assembly away from the commutator and slip rings. Since the brushes are spring loaded in the holders, hold the brush leads firmly with alligator clips to prevent the brushes from falling out and being damaged. Examine the brushes for damage such as chips, deep grooves, wear, etc. The brush faces should have a smooth copper cast with no deep grooves present. If deep grooves or indications of burning are noted, the commutator and slip rings should be inspected to determine the cause, for corrective purposes.

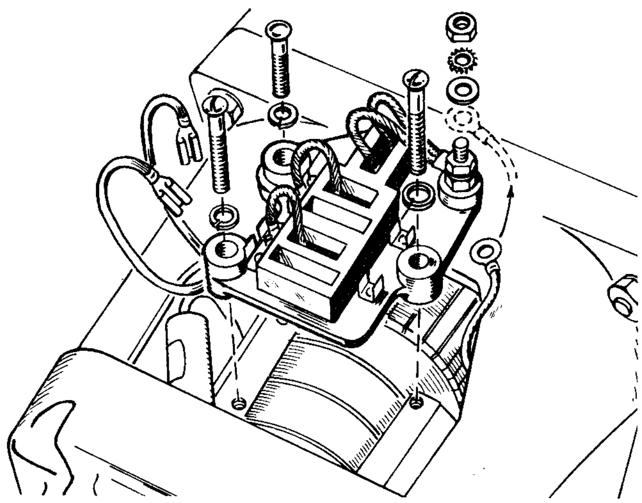
Check the brush holders for dirt and oily deposits which could cause the brush to stick. If necessary wash the brush holder in Chlorothene or similar oil free solvent. DO NOT wash the brushes. Wipe with a clean, dry cloth. If the brushes appear to be oil soaked, replace them. Blow out any carbon dust, lint, or other foreign matter from around the slip rings and commutator with compressed air.



MEASURE FROM TOP FACE OF BRUSH BLOCK TO TOP OF BRUSH

	DC	AC
NEW	5/8"	11/16"
½ WEAR	13/16"	7/8"
REPLACE	1"	1 1/16"

GENERATOR BRUSH WEAR LIMITS



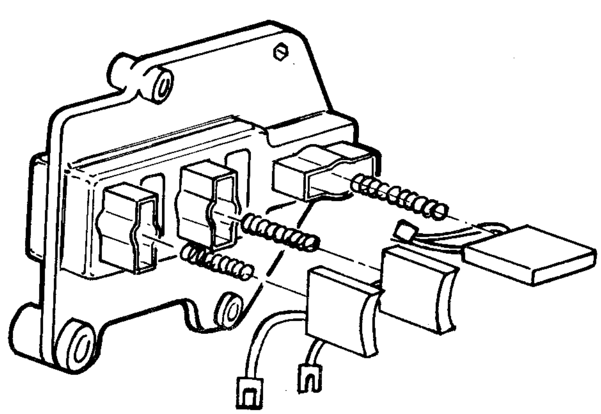


FIGURE 3-12. NB, NH, CCK (Begin Spec R) BRUSHES

If the brushes appear to be in satisfactory condition and are not worn to the Tolerances as shown in Figure 3-12, insert the springs and brushes in the holder and reinstall the assembly. If the brushes are worn to the trademark, they must be replaced. Use only original equipment type brushes. Do not use a substitute that may look identical. It may have entirely different electrical characteristics.

DJA, and MDJA Brushes: To examine the brushes, remove the end bell band and cover. Replace the brushes when they wear to the Onan name and part number. At this point there is about 5/8 inch of brush remaining. If the brush is not replaced, the slip rings or commutator will be damaged. All brushes must have at least a 50 percent seat. If they don't, sand as illustrated in Figure 3-14.

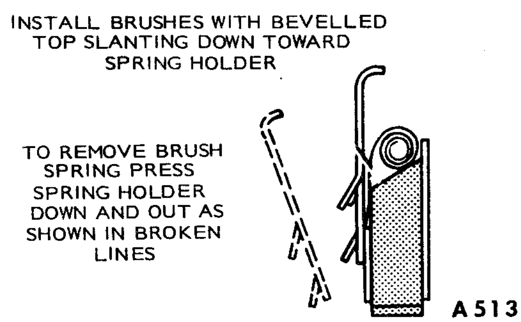


FIGURE 3-13. BRUSH INSTALLATION

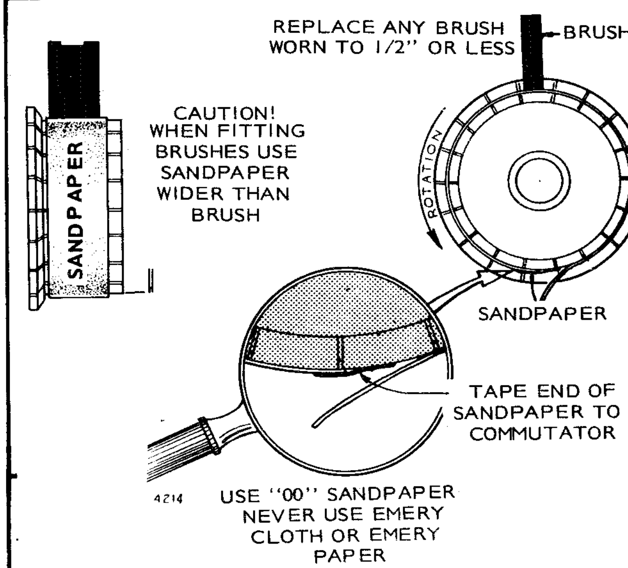


FIGURE 3-14. SEATING BRUSHES

Brush Rig Alignment: The brush rig must be aligned in the neutral position. If it isn't, sparking will occur. Normally the brush neutral position is identified by a yellow mark extending from the brush rig to the end bell. If the mark is lost or a new brush rig installed, follow these instructions to find the neutral position.

1. Remove the end cover and band to allow access to the rig.
2. Start the unit.
3. Apply full rated load.
4. Allow unit to reach full operating temperature.
5. Inspect brushes; they must be seated across the brush face for an accurate setting.
6. Connect a voltmeter across the DC terminals.
7. Loosen the brush rig mounting screws and rotate the rig to get the highest voltage with full load.
8. Rotate the rig in one direction until the voltmeter reading starts to decrease. Mark this point Figure 3-11.
9. Repeat step 8 in the other direction.
10. Half the distance between the two marked points is the neutral position.

NOTE: *If a voltmeter is not available, use the above procedure, but mark the point where arcing begins in each direction and set it at one half the distance. (This procedure is not as accurate as the procedure above.)*

Collector Rings

If the collector rings become grooved or out-of-round, or the brush surface becomes pitted or rough so that good brush film cannot be maintained, remove the armature and refinish the collector rings in a lathe. If the commutator appears to be rough or scored, refinish it at the same time. Remove or adequately shield the ball bearing during refinishing. There should be a maximum of .002″ run-out of the collector ring when compared to the generator bearing.

Commutator

The commutator bars wear down with usage so that the mica between them must be undercut. This should be done as soon as the mica on any part of the commutator touches the brushes. A suitable undercutting tool can be made from a hacksaw blade (Figure 3-16). Avoid injury to the surfaces of the copper bars. Leave no burrs along the edges of the bars. The mica must also be undercut whenever the commutator is refinished.

Frequency And Voltage Adjustment

The engine governor controls generator output frequency. Engine speed determines generator output voltage. The voltage drop from no load to full load operation is determined by the engine governor sensitivity.

To change output voltage slightly within the range shown in Table 3-2 adjust the governor. This will also change the unit output frequency. Be sure the frequency stays within the maximum and minimum limits shown in Table 3-2 for Revolving Armature generators.

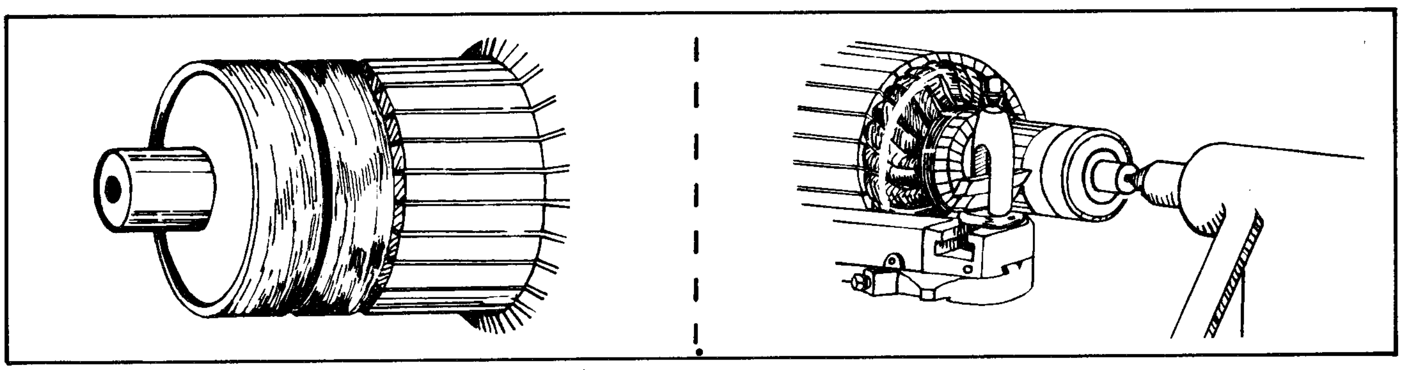


FIGURE 3-15. COLLECTOR RINGS

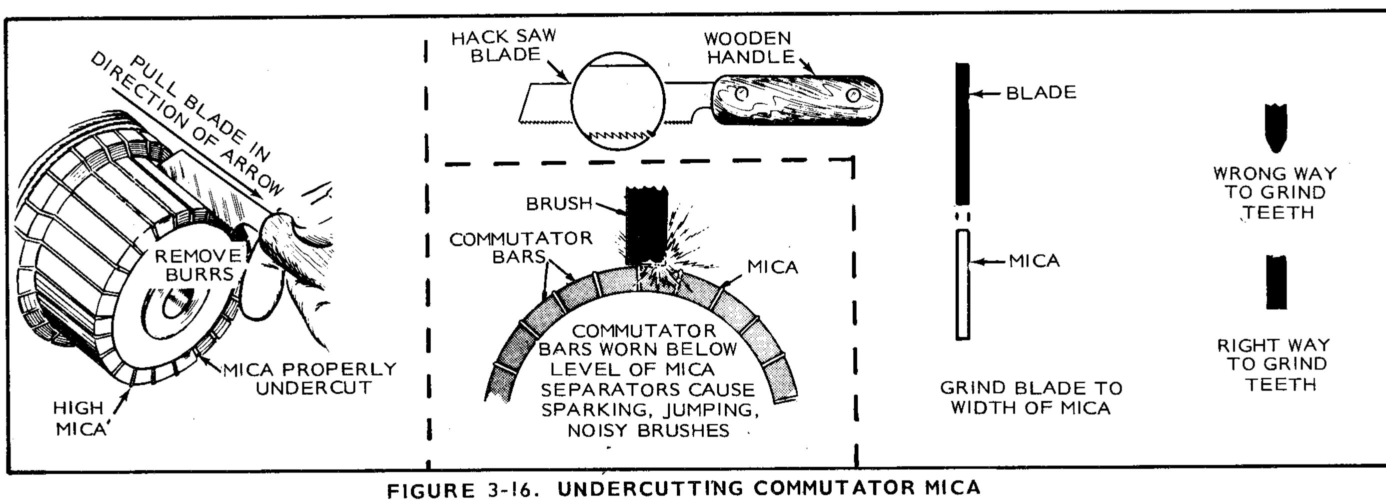


FIGURE 3-16. UNDERCUTTING COMMUTATOR MICA

GENERATOR REPAIR

Figures 3-17 through 3-21 show generator assembly drawings of various revolving armature two and four pole generators.

Generator Disassembly

1. Disconnect the battery to prevent accidental starting of the set.
2. Remove the end bell cover and band.
3. Remove brush springs and brushes.
4. Loosen the through-armature stud nut located in the center of the rear bearing.
5. Remove the through-generator stud nuts on the end bell.
6. Slide the end bell, brush rig, and frame off as one assembly.

   Be careful not to drag the frame on the armature.
7. Remove the screws holding the blower baffle to the engine-to-generator adapter and remove the baffle.
8. Slide the armature and blower assembly off the stud. To loosen the assembly from the crankshaft, tap the threaded end of the stud several times with a soft hammer to avoid damaging the threads. **NOTE:** *If the above procedure does not loosen the armature assembly, tap downwards on the outboard end of the armature shaft, rotate it 1/2 turn and repeat.*

   CAUTION *Be careful not to hit the commutator, collector rings, or bearings.*
9. If it is necessary to remove the field coils remove the pole shoes by removing the capscrews holding each to the frame.

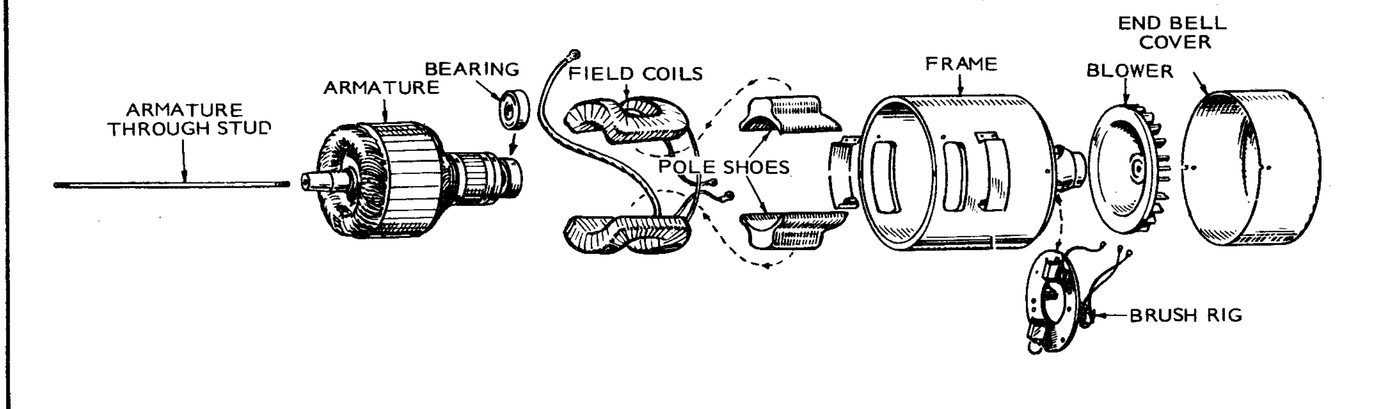


FIGURE 3-17. AK-AJ, 2 POLE GENERATOR ASSEMBLY

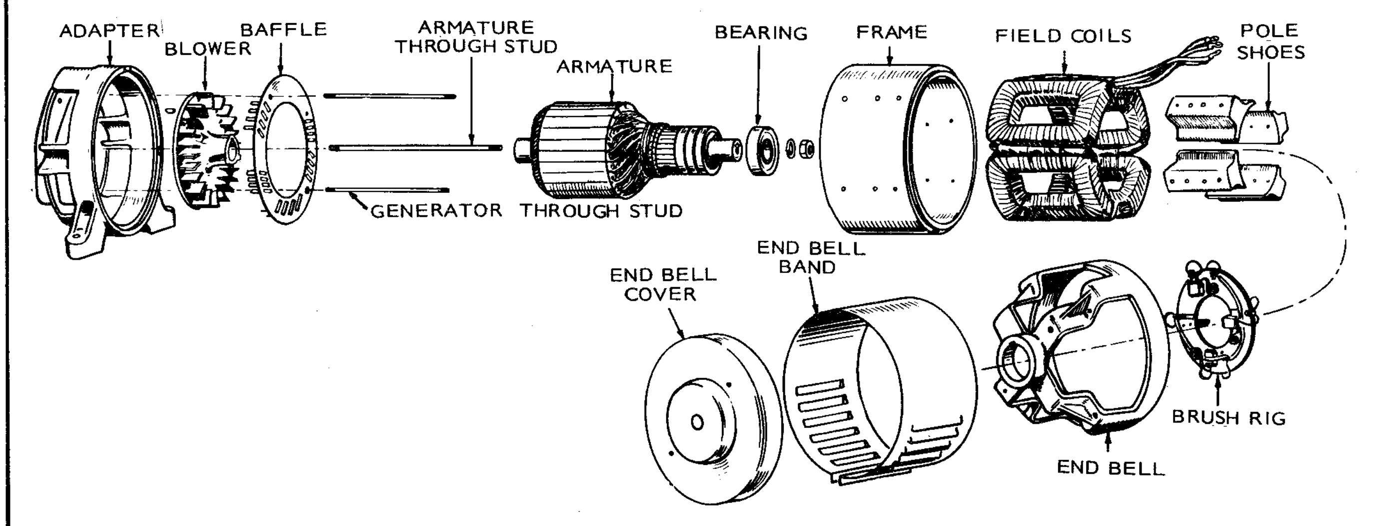


FIGURE 3-18. AJ, CCK, CCKB 4 POLE GENERATOR ASSEMBLY

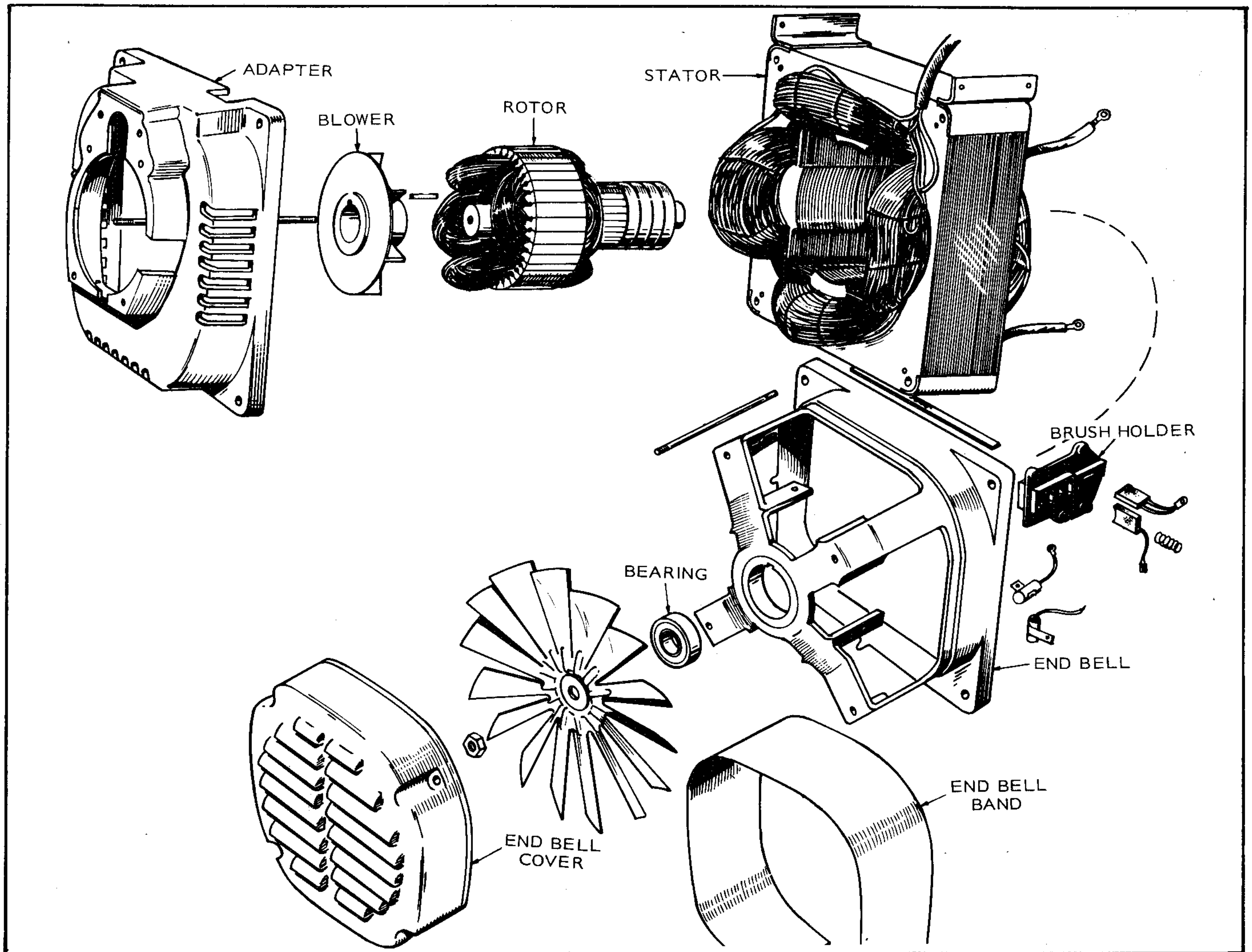


FIGURE 3-19. NB, NH, CCK (BEGIN SPEC R) GENERATOR ASSEMBLY

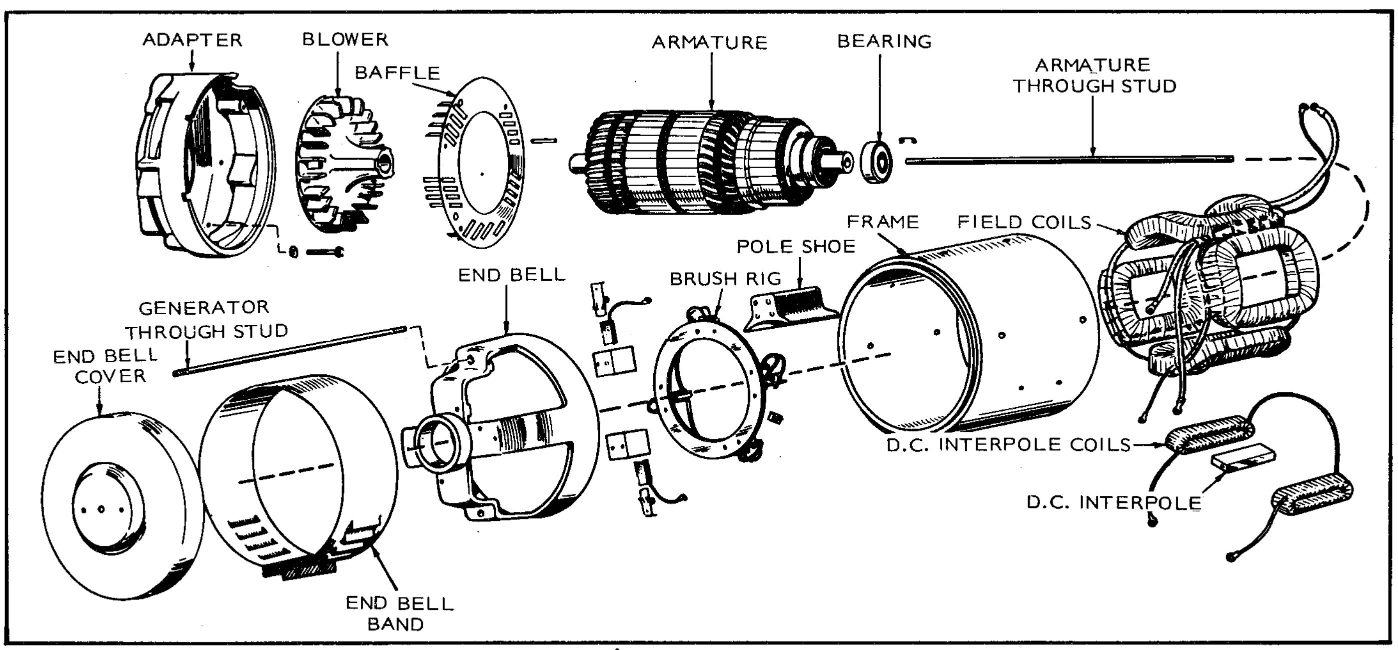


FIGURE 3-20. DJA, MDJA GENERATOR ASSEMBLY

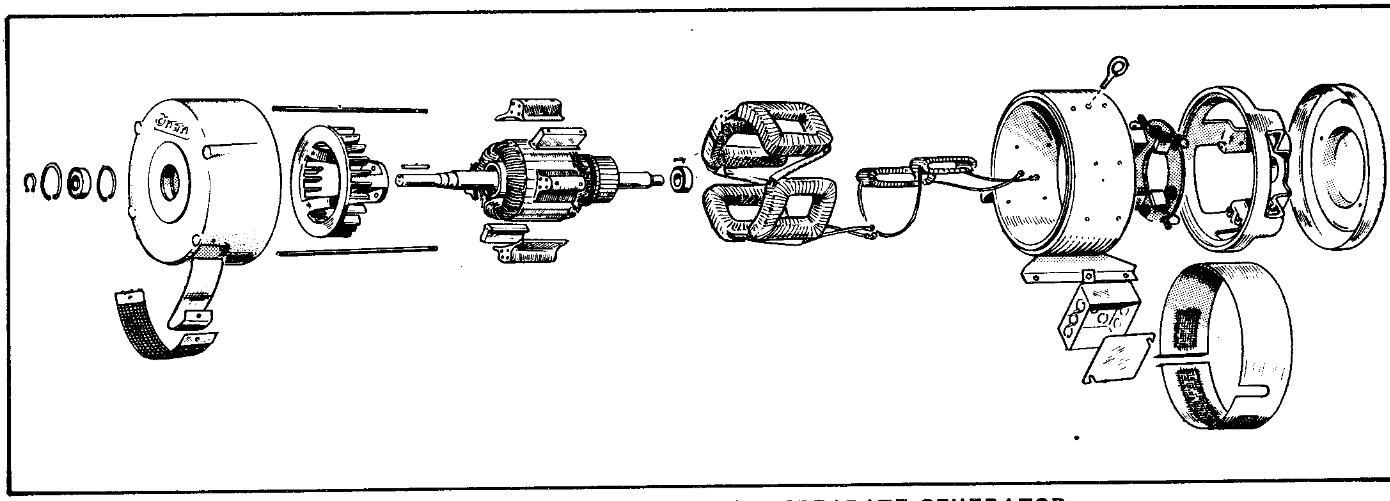


FIGURE 3-21. 4 POLE, TWO BEARING SEPARATE GENERATOR

Testing and Repair
Most of the following tests can be performed without disassembling the generator.

Armature Testing
Before testing remove all brushes from their holders.

1. Using a test lamp or ohmmeter, check the AC winding for an open circuit between the slip rings. If an open circuit if found, replace the armature (Figure 3-22A).
2. Test both the slip rings and commutator for grounding to the shaft (Figure 3-22B).

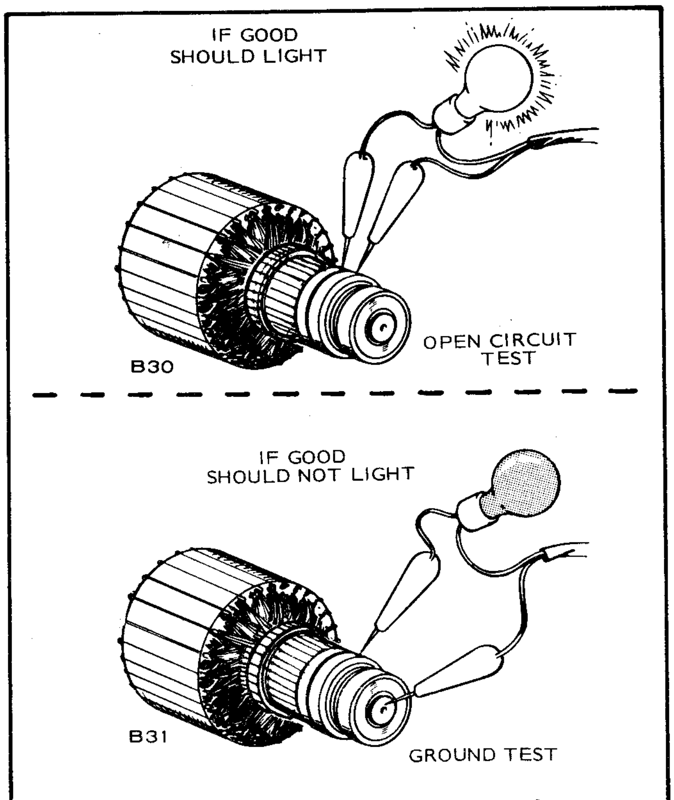


FIGURE 3-22. ARMATURE TESTING

3. Test the armature for an open circuit in the DC windings by checking continuity between all adjacent bars of the commutator.

   Touch the probes to two adjacent bars and check for continuity. Move each probe over one bar and again check. Continue around the commutator. Any adjacent bars that don't show continuity indicate an open armature winding. Test for shorts in the DC armature winding.
4. This test can only be performed with the generator disassembled and requires a growler. Place the armature in the growler, operate the growler and pass a steel strip back and forth above the armature windings (Figure 3-23). If the strip is magnetically attracted to the armature at any point, a short is indicated. After testing in one position, rotate the armature slightly and repeat the test. Do this for one complete revolution.

   If the test indicates a short circuit in the DC windings be sure the commutator is clean. Carbon dust, dirt and grease between the bars or slip rings could cause a short.

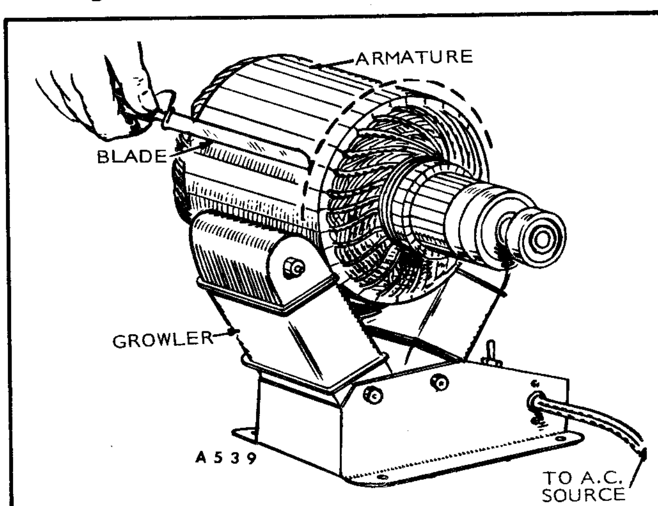


FIGURE 3-23. CHECKING FOR SHORTS

If any of the tests above show that the armature is defective, replace it.

If the commutator is grooved, out-of-round, or otherwise damaged, refinish it. Turn it in a lathe and then undercut the mica as described above. Shield the ball bearing during refinishing.

Commutator

Be sure the run-out at the commutator end is not more than .012″ (Figure 3-24). Excessive run-out may be due to a nick or dirt on the taper of either the armature or crankshaft. Remove any foreign material, install the armature, then correct excessive run-out by striking the high side of the shaft near the ball bearing. Never strike the commutator.

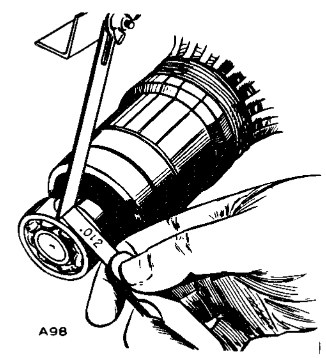


FIGURE 3-24. CHECKING COMMUTATOR RUNOUT

Collector Rings: If the collector rings are grooved, out-of-round or rough so that good brush seating can't be maintained, remove the armature and refinish the rings in a lathe. Shield the ball bearing during refinishing (Figure 3-25).

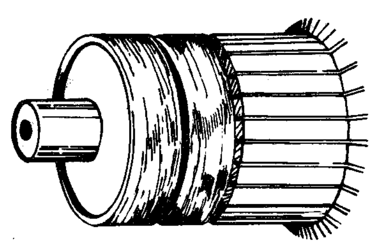


FIGURE 3-25. COLLECTOR RINGS

EXCEPTION – GENERATORS WITH 4-SLIP RINGS

1. If the generator is a single phase model, test between the two slip rings nearest the commutator, and repeat the test between the two rings nearest the ball bearing. In each case the test lamp should glow. If the test is made between the two center rings the test lamp should not glow. If the test lamp does glow, a short circuit between the separate windings is indicated.
2. If the generator is a 3 phase, 3 wire model, the ring nearest the bearing is not connected and should be disregarded.

To test the DC winding, place the armature in a growler. With the growler current on, pass a smooth steel strip across the commutator segments. Repeat all around the commutator. At some point around the commutator, a spark should occur as the strip contacts two adjacent segments. Rotate the armature slightly and repeat the test. Continue until a spark is obtained between all adjacent segments. If no spark is obtained at some point, an open circuit is indicated.

NOTE: *A short circuit in the winding might prevent sparking. This condition may be indicated by the short circuit test described in the next paragraph.*

Replace an open circuited armature with a new one.

Ball Bearing

If the ball bearing becomes noisy, worn or otherwise defective, replace it. Remove the old ball bearing with a gear puller and install a new one as shown (Figure 3-26).

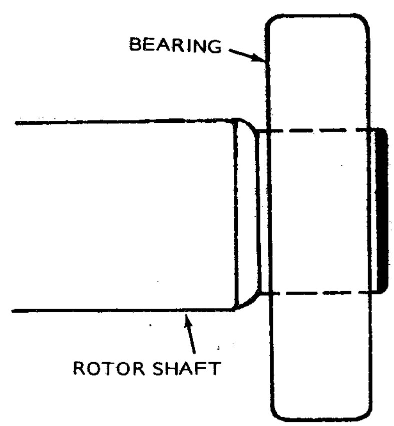


FIGURE 3-26. BEARING REPLACEMENT

The generator bearing is prelubricated and double sealed. It should be replaced every 5 years because oxidation causes deterioration of the bearing grease.

Field Winding Testing

Field Winding Tests: Perform the following tests without disassembling the generator. The field coil leads must all be disconnected from their terminal points; brush rig, control box, and external connections. If a defective coil is found, disassemble the generator and replace the defective coil.

1. With an ohmmeter or continuity lamp, check for grounding to the generator frame. Touch one prod to each coil terminal in turn and the other to a clean, paint-free part of the frame. If the test indicates grounding, separate the windings and check each.
2. Check the field winding resistance from the negative commutator brushes (from F2 when used) to the F+ connection on the generator (F+ is connected to the positive brushes)with all commutators lifted off their seats. See Resistance Table in the *Specifications Section* of the book for correct values. If the windings are warm from running, the resistance will be slightly higher than specified. If the resistance is high, check for an open circuit in one of the parallel windings, step 3, otherwise go directly to step 4.
3. Separate the parallel field windings (at F+) and check each for open circuit.
4. Check for open circuit in the series winding with ohmmeter. Touch probes to lead S1 and connection F+. If there is an open circuit, isolate each coil and check it.
5. Test for short circuit between the starter windings and the shunt windings. Before doing this, separate all windings at F+.

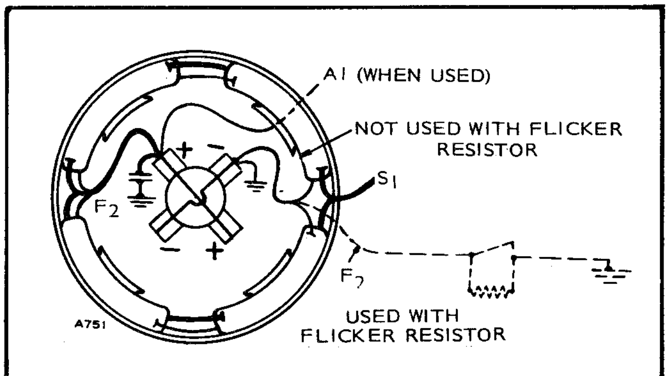


FIGURE 3-27. FIELD LEADS

Anti-Flicker Points

Anti-Flicker Points And Resistor: The anti-flicker breaker points are located on the left rear corner of the engine crankcase. The camshaft opens these points on every power stroke to add a resistor in series with the generator field windings. To adjust the points, crank the engine until the points are at full separation. Adjust the stationary contact to .025 in. gap. Retighten and check the gap. When breaker plunger guide and "O" ring are removed, dip "O" ring in oil before reinstalling. Tighten guide to 25 to 28 foot pounds. Figure 3-28 shows breaker point adjustment.

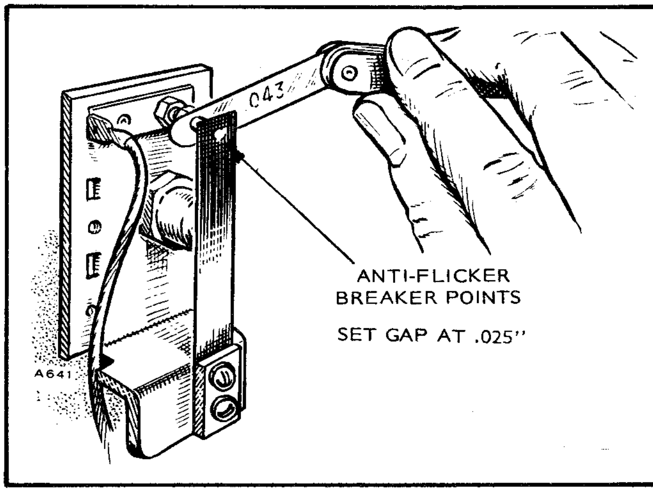


FIGURE 3-28. SETTING ANTI-FLICKER BREAKER POINTS

The adjustable flicker resistor is located on the right side of the control box. If flicker becomes excessive, adjust the resistor by moving its slider. Adjust resistor for minimum flicker with the average load on the set.

Generator Assembly

1. Reinstall any pole shoes to field coils removed.
2. Install the armature and blower assembly and install the stud nut.
3. Check for armature runout (Figure 3-29). The runout should be less than .002".

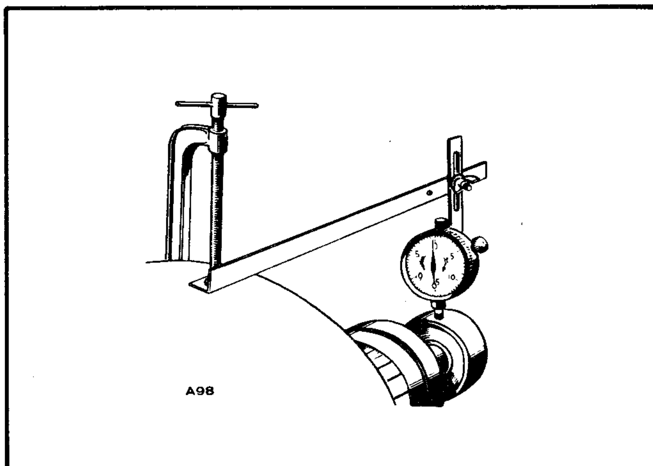


FIGURE 29. MEASURING ARMATURE RUNOUT

CAUTION *Excessive runout may be caused by dirt or a nick on the taper of either the rotor or crankshaft. If not, correct by tapping the high side of the shaft near the ball bearing. Don't hit the ball bearing commutator or collector rings.*

4. Install the blower baffle and secure with screws.
5. Install the bearing stop on the ball bearing.

6. Install and secure the field frame and end bell assembly. Be sure the generator output wires feed through the slot in the front of the frame.
7. Tighten the through armature stud nut to 30 to 40 lb. ft.
8. Connect the leads to the engine and install the battery cables.
9. Align the brush rig.

SECTION 4.
REVOLVING FIELD GENERATORS

INDEX

REVOLVING FIELD GENERATORS

GENERAL

Keeping in mind the material on revolving armature power generation in the preceding section we can now discuss revolving field generators.

Suppose instead of turning a coil of wire in the magnetic field rotated inside the coil. The result is a revolving field generator (Figure 4-1). The revolving field is the rotor and permanently fixed winding is the stator. With this type of generator there is no need for slip rings to transfer power from the stationary armature coils.

Slip rings are used to supply direct current to the electromagnetic field of the alternator. Onan generators use a static exciter, a non rotating device that converts AC output to DC and regulates current to the field. This static exciter is called a Magneciter (Figure 4-2).

The output frequency of the revolving field generator depends directly on its rotating speed. The voltage output of this generator is determined by rotating speed, number of turns in the stator, and the field strength by controlling the field current. The magneciter allows the adjusting of output voltage over a limited range – 3% at a steady speed – and has rapid recovery capabilities from a sudden load application or removal.

MAGNECITER DESCRIPTION, TROUBLESHOOTING, AND REPAIR.

The static exciter (Magneciter) supplies direct current to the alternator field coils and regulates the voltage produced by the alternator. Voltage stabilization occurs within two seconds after a change in load. Voltage regulation should be within ±3 percent.

The Onan static exciter has no moving parts and consequently demands minimum maintenance. By periodically performing preventive maintenance (blowing dust from the unit using filtered, low pressure air), corrective maintenance will be virtually eliminated.

Corrective maintenance can be handled by anyone with a knowledge of basic electricity and with the proper equipment for applying that knowledge. Most troubleshooting can be accomplished with a multimeter or a battery operated volt-ohmmeter, and a 120-volt, 25-watt AC test lamp.

Troubleshooting

Troubles are listed in advancing order, from no output voltage to a rated but fluctuating output voltage. The relationship between trouble and cause is not always consistent from model to model, so the following information must be used as a guide, *not an absolute rule!* The column entitled "Method" indicates the method for testing a standard component. When the word "None" appears in that column, all the information needed to complete the check is given in the column headed "Corrective Action". When more than one letter appears in that column for a single action,

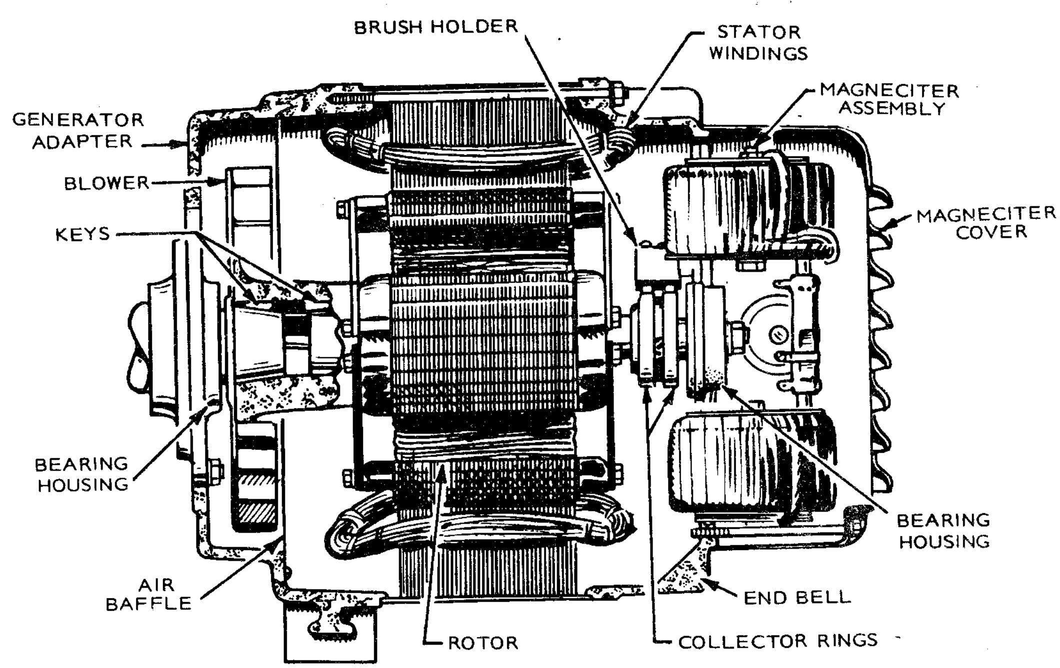


FIGURE 4-1. REVOLVING FIELD GENERATOR

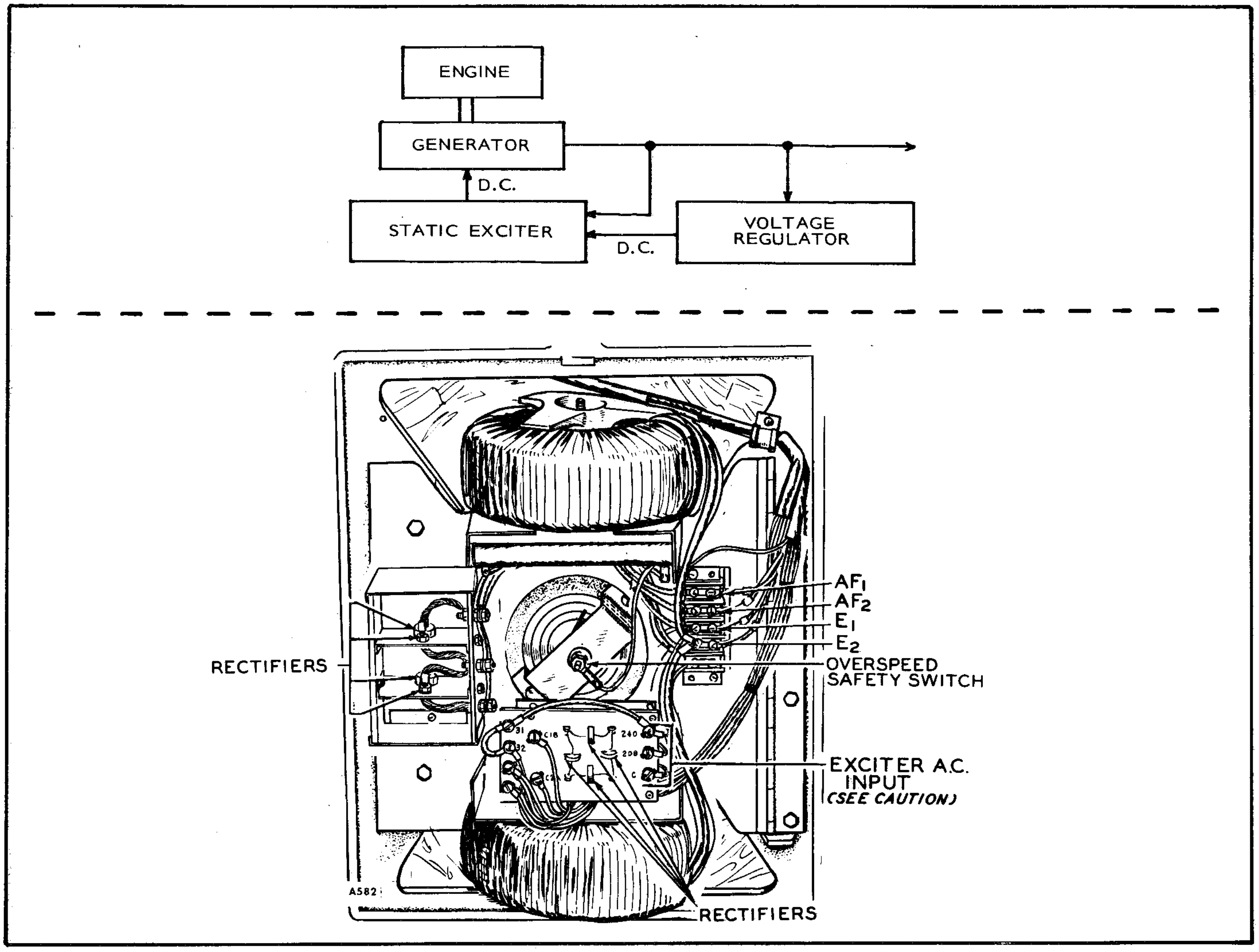


FIGURE 4-2. ONAN MAGNECITER

more than one method of checking a component or situation is given in the section on testing.

NOTE: *It is imperative that the testing procedures are completely understood by the service technician before attempting to perform corrective procedures.*

TESTING

CAUTION *Avoid grounding the hot lead of a tester (Figure 4-3) when checking a Magneciter component installed on a generator. A tester with an isolation transformer circuit (Figure 4-4) is not subject to such a problem. This is the preferred type to use with a Magneciter.*

Because more than one method of testing Magneciter components can be used, test procedures for both multimeters and continuity testers are outlined here.

METHOD A

Rectifier: Using an ohmmeter (multimeter)

1. Select the middle resistance range (RX10 or RX100) for measurements.
2. Isolate the rectifier by disconnecting one end from its point of connection.
3. Connect the test leads to the rectifier ends and observe the meter reading.
4. Reverse the leads and again observe the meter reading.

Results:

a. RECTIFIER IS GOOD if one reading is much higher than the other.
b. RECTIFIER IS DEFECTIVE if both readings are low, indicating the presence of a short, or if both readings are high, indicating the presence of an open circuit. In either case, the rectifier should be replaced.

Rectifier: Using 6-volt buzzer tester

1. Connect tester leads to rectifier ends.
2. Reverse the leads and connect again.

Results:

a. RECTIFIER IS GOOD if there is a buzz for one connection and *no* buzz for the other.

TABLE 1. MAGNECITER TROUBLESHOOTING

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	METHOD
Generator will not build up voltage	Circuit breaker in "off" or "tripped" position	Reset and close breaker	None
	Open in circuit breaker	Stop plant and check breaker continuity	None
	No AC power to Magneciter	Check AC voltage at E1-E2 with the plant operating*. Voltage should be 5 percent of the rated voltage. If not, check continuity from E1-E2 back to the generator	None
	Shorted or Grounded Rotor	Replace Rotor	Ohmmeter or Series Test Light
	Contacts dirty in Build-up Relay of 02SX1N1A	Stop plant. Clean by drawing hard surfaced paper between contacts	None
	Partial loss of residual in Rotor	With plant operating*, short out reactor(s)	J or K
	Field Rectifiers W & Z or X & Y open	Test rectifiers and replace if defective	A or B
	Field Rectifiers X & Y shorted	Test rectifiers and replace if defective	A or B
Output voltage slow to build up. Circuit breaker opens in about five seconds	Either Field Rectifier X or Y shorted	Test rectifiers and replace if defective	A or B
Output voltage slow to build up. 5 percent below rated voltage. Poor voltage regulation	Either Field Rectifier W or Z shorted	Test rectifier and replace if defective	A or B
Output voltage slow to build up and higher than rated voltage after build up	Open circuit in one or more Control Rectifier	Test rectifier and replace if defective. Check soldered connections to rectifiers	A or B
Output voltage slow to build up and 10 to 20 percent above rated voltage after build up	Open in one Field Rectifier	Test rectifiers and replace if defective	D or E
	Open circuit in Gate winding G1-G2 of Reactor A or B	If Field Rectifiers Y and Z check okay, check continuities of Gate windings G1-G2	D or E

* **WARNING** *USE CAUTION WHEN TROUBLESHOOTING A UNIT IN OPERATION! ELECTRICAL SHOCK HAZARD IS PRESENT.*

TABLE 1. MAGNECITER TROUBLESHOOTING
(Continued)

NATURE OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION	METHOD
Output voltage builds up normally but less than rated voltage after build up	Shorted winding in Control Reactor	Test Control Reactor and replace if defective	F
Output voltage builds up normally with slightly less than rated voltage at no load and low voltage at full load	Compound winding S1-S2 installed backward or has open circuit	Check wiring diagram for polarity of Compound windings thru Reactors A and B and test for continuity	None
Output voltage builds up normally but 20 percent above rated voltage after build up. Voltage regulation poor.	Compound winding S1-S2 installed backward thru one Reactor (A or B)	Check wiring diagram for polarity of Compound winding thru Reactor A or B	None
Output voltage builds up normally but is 25 percent above rated voltage after build up	Open circuit in Control Rectifier bridge	Check continuity from the junction of Control Rectifiers Y and Z to the junction of Control Rectifiers W and X	C
Output voltage builds up normally but 125 to 150 percent above rated voltage after build up	Shorted turn in gate winding G1-G2 of Reactor A or B	Test Reactors A and B for shorted turns and replace if defective	D or E
Output voltage builds up normally but 150 to 200 percent above rated voltage after build up. No regulation possible	Control winding C1-C2 of Reactor A or B polarized incorrectly	Check circuit connections of both Reactors A and B	None
	Shorted turn in Control winding C1-C2 of Reactor A or B	Test Reactors A and B for shorted turn and replace if defective	D or E
	Relay inoperative	Check coil continuity; replace if defective	H
	Open in Control Circuit	Check continuity from E1 to E2 thru Control Circuit	None
Generator voltage fluctuating while engine running at constant speed	Incorrect setting on the Stabilizing Resistor	Check resistance and compare with resistance value in Table	G
Output Voltage High	Shorted Control Diode	Replace Diode	C

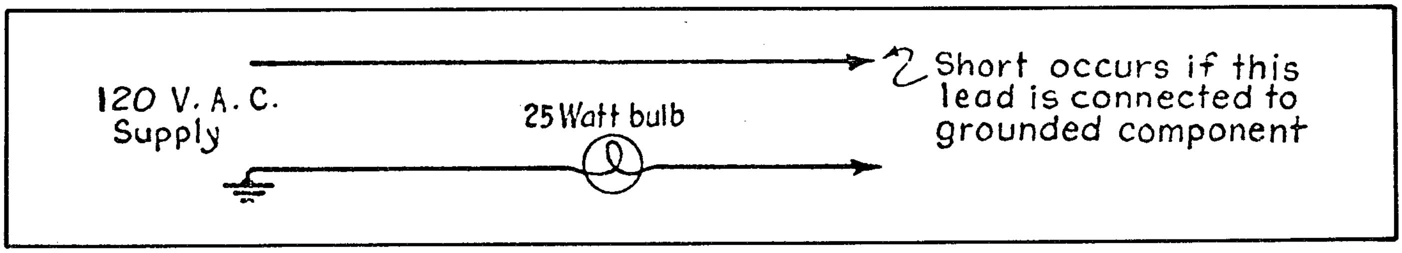


FIGURE 4-3. TEST LAMP SET

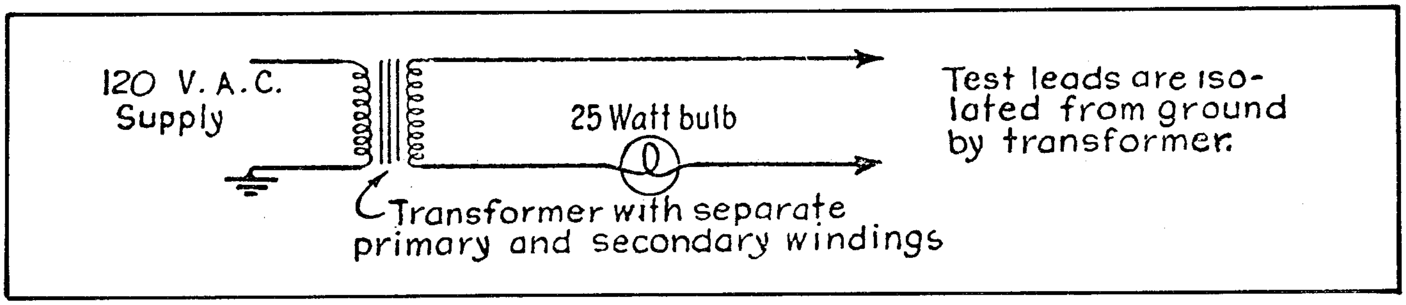


FIGURE 4-4. RECOMMENDED TEST LAMP SET

b. RECTIFIER IS DEFECTIVE if (1) there is no buzz for either connection or (2) a buzz in both connections. In either case, replace the rectifier.

METHOD B

Rectifier: Using 120-volt AC tester

1. Make certain that no component part of the Magneciter is electrically grounded.
2. Isolate the rectifier by disconnecting one end from its point of connection.
3. Connect the two test leads together and observe the brilliance of the bulb. (Only the lead resistance is present in the test circuit.)
4. Connect the test leads to the rectifier and observe the brilliance of the bulb.

Results:

a. RECTIFIER IS GOOD if the bulb lights with a low intensity.
b. RECTIFIER IS DEFECTIVE if the bulb lights with high intensity, indicating the presence of a short, or if the bulb fails to light at all, indicating the presence of an open circuit. In either case, the rectifier should be replaced. *BE SURE TO INSTALL THE RECTIFIER IN THE PROPER DIRECTION. (SEE WIRING DIAGRAM FOR CORRECT POLARITY.)*

NOTE: *Results which are questionable can be affirmed by testing a good rectifier.*

METHOD C

Control Rectifier Bridge Circuit

1. Follow the above procedures for troubleshooting rectifiers. The multimeter will indicate no continuity in one direction or the other if an open circuit exists in the bridge circuit.

METHOD D

Reactors: Using an ohmmeter (multimeter)

These reactors are basically transformers having isolated primary and secondary windings. The reactors can be tested as transformers.

1. Select the resistance range on the meter to the resistance specified in Table 3 for a given rectifier model.
2. Isolate one gate winding by disconnecting either end of gate winding G1-G2 from its point of connection; for example, disconnect G1 at E2.
3. Measure the resistance in the gate winding across G1-G2.
4. Isolate the control winding by disconnecting either lead C1 or C2 from the terminal strip. Measure the resistance in the control winding across C1-C2.
5. Connect one meter lead to the disconnected gate winding lead and the other meter lead to the disconnected control winding lead and check for continuity.

Results:

a. REACTOR IS GOOD if resistance is within ± 20 percent of the value listed in Table 3 and if there is also no continuity between the control and gate windings.
b. REACTOR IS DEFECTIVE if there is an open circuit in either the gate or the control windings. Continuity between the gate and the control windings is also an indication of a defective reactor. In either case, the reactor should be replaced.

METHOD E

Reactors A and B: Using 120-volt AC tester

1. Remove exciter from generator.
2. Make certain that no part of the Magneciter is

grounded.

3. Isolate the gate winding by disconnecting one lead from its point of connection.
4. Isolate the control winding by disconnecting both leads C1 and C2 from their points of connection.
5. Connect one test lead to G1 and the other test lead to G2 and observe the light bulb.
6. With the test leads still connected to the gate winding leads, short across leads C1 and C2 and again observe the bulb.
7. Connect one test lead to the control winding lead and the other test lead to one of the gate winding leads and observe the bulb.

Results:

a. REACTOR IS GOOD if bulb is dark for steps 5 and 7 but bright for step 6.
b. REACTOR IS DEFECTIVE if bulb lights with low intensity for step 5, indicating the presence of a short in either the gate winding or the control winding. If the bulb lights for step 7, the gate winding and the control are shorted together. If the bulb fails to light in step 6, there is very likely an open circuit in either the gate winding or the control winding. Replacement is required.

METHOD F

Control Reactor: Using an ohmmeter only

This method of testing the control reactor is not always positive, but the meter reading will indicate a trouble if one exists.

1. Isolate the control reactor by disconnecting common lead "C" from its point of connection and carefully measure the resistance from this lead to the numbered lead on the control reactor.

Results:

a. CONTROL REACTOR IS GOOD if resistance is within 10 percent of the value specified in Table 1.
b. CONTROL REACTOR IS DEFECTIVE if no resistance is indicated between the common lead "C" and the numbered lead. (Open circuit is indicated.)

METHOD G

Resistor: Using an ohmmeter only

1. The resistance should be measured with an ohmmeter. See Table 3 for selecting the resistance range (RX10, RX100, etc.) so readings are near center of meter scale.
2. Isolate the resistor by disconnecting one end from its point of connection before measuring the resistance.

Results:

a. RESISTOR IS GOOD if the measured resistance falls within ± 20 percent either way of the value given in Table 3.
b. RESISTOR IS DEFECTIVE if there is no indication of continuity through the resistor or if the measured resistance exceeds the allowable tolerance.

NOTE: *The stabilizing resistor can be adjusted to bring the specified resistance within the required limits.*

METHOD H

Build-up Relay Coil: Using an ohmmeter

This test will determine whether the resistance through the coil winding is within tolerance.

1. Isolate the coil by disconnecting one of its leads. With the meter adjusted to indicate center scale resistance reading, connect the meter leads to the coil.

Results:

a. COIL IS GOOD if 525 ohms ± 10 percent resistance is measured.
b. COIL IS DEFECTIVE if no resistance or low resistance is indicated; replace the relay.

METHOD J

Producing Voltage Build-up:

The first method used is shorting out the gate reactor(s) (temporarily removing their resistance) and thus applying full residual voltage to alternator field. Refer to diagrams to locate *terminal points* for the jumper connections. *Have set running but be cautious!*

1. For 04SX and 06SX press residual reset switch in Magneciter.

   EXCEPTION: For Spec A, which has no switch, place a jumper joining G1 - G2 - E2. Remove jumper wires when AC voltage starts to build up.
2. For 07SX, 102SX, and 2SX, jumper E2 to heat sink of rectifier No. 1. Remove jumper wires when AC voltage starts to build up.

METHOD K

Restoring Residual Magnetism: Flashing the field (Figure 4-5)

If output voltage won't build up after trying Method J, then it may be necessary to restore residual magnetism by flashing the field with a *separate* battery. Connect a voltmeter across terminals E1 and E2. After starting the set touch the positive leads of a 6-volt dry cell lantern battery to F1 positive (+) and the negative (–) lead to F2. When voltage starts to build-up, remove the battery leads. If voltage does not build up to normal and then drops to zero when you remove the battery leads, the trouble is a faulty component(s) in the exciter.

NOTE: *You may substitute a 12-volt automotive battery for the 6-volt lantern battery if a 10-ohm resistance is connected in series with the battery to limit current to the exciter circuit.*

AUTOMATIC FIELD FLASHING (Figure 4-5)

Some new units have an automatic field flashing circuit which uses the set battery to "flash the field" when the engine cranks. This helps insure voltage buildup. All generators use this circuit except the 5DR and 4XR models. The circuit is identified by the additional field rectifier ("V") shown on the set exciter wiring diagram.

Two things are necessary for this circuit to work properly:

1. The plant battery must be negative ground.
2. Alternator lead T2 must be grounded (T2 must be grounded on a 3-phase, 4 wire.)

CAUTION *If these conditions are not followed, the field flashing circuit will be ineffective or it may damage the exciter.*

INSTALLING NEW RECTIFIERS (Figure 4-6).

Observe caution when installing a new field rectifier. Applying too much torque on the holding nut will strain the internal connection and cause premature failure. Small rectifiers used on the J series should not be torqued over 20-inch lbs. If no torque wrench is available this is finger-tight plus one-quarter turn.

Larger rectifiers require 35 to 40-inch lbs. of torque.

EXCITER VOLTAGE TEST (Figure 4-7).

A. *Bench Test (Auxiliary Power)*

1. Connect Variac to exciter terminals E1 and E2 as shown in Figure 5.
2. Connect an AC voltmeter to these same terminals E1 and E2.
3. Connect DC voltmeter to field leads F1 and F2.
4. Connect a 100 watt light bulb across these same terminals F1 and F2.
5. Adjust Variac until voltage reaches value shown in column 2 (according to exciter model shown on Onan nameplate). DC voltage should now be within limits shown in column 3. (TABLE 4-2).

B. *Generator Running at No Load*

1. Connect an AC voltmeter to exciter terminals E1 and E2 as shown in Figure 4-8.
2. Connect DC voltmeter to exciter terminals F1 and F2.
3. With generator running at recommended rpm and no load connected, AC voltage values should be the same as those given in column 1; DC voltage values should be the same as those shown in column 2 (according to exciter model). SEE TABLE 4-3.

MAINTENANCE AND ADJUSTMENTS

J-Series

Revolving field generators normally need little care other than periodic inspection of the exciter, ball-bearing, collector rings, and brushes. These items must be inspected at least every 1000 hours.

NOTE: *J-series generator sets using 02SX exciters require voltage build-up relay cleaning every 500 hours.*

Brushes (J-Series)

To examine the brushes, brush springs, and slip rings the exciter cover at the rear of the generator must be removed. The exciter mounts on a hinged plate. Remove the screw from the right side of the plate and swing the assembly outward. To remove the brush holders unscrew the four machine screws on the end-bell near the ballbearing (Figure 4-9).

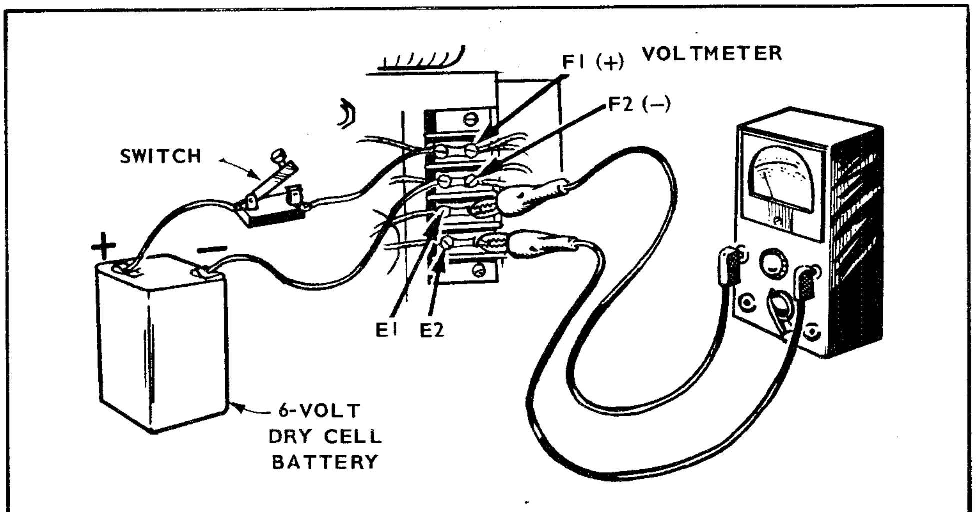


FIGURE 4-5. FLASHING THE FIELD

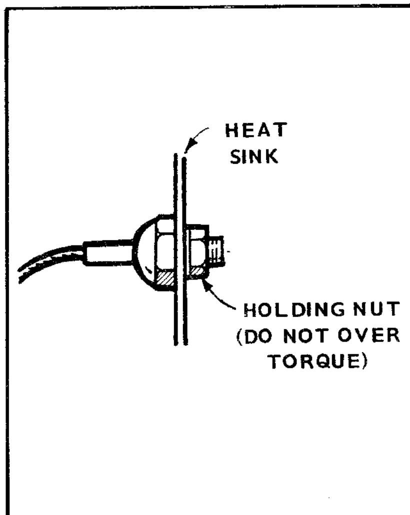


FIGURE 4-6. INSTALLING NEW RECTIFIERS

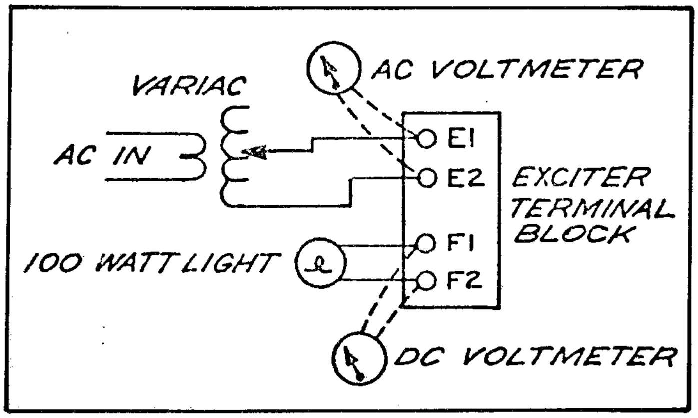


FIGURE 4-7. BENCH TEST SCHEMATIC

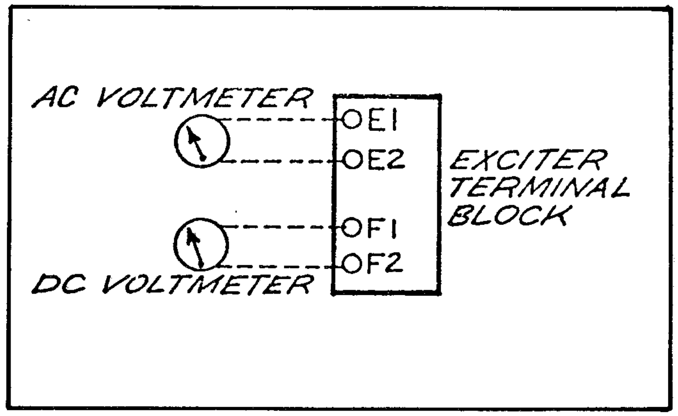


FIGURE 4-8. TEST SCHEMATIC (GENERATOR RUNNING AT NO LOAD)

TABLE 4-2. VOLTAGE VALUES FOR BENCH TEST

EXCITER MODEL	1 NOMINAL EXCITER VOLTAGE	2 AC VOLTS AT FIRE DOWN *	3 DC VOLTS AT FIRE DOWN *
04SX1N	120	138-140	60-80
06SX1N			
06SX1N	120	122-129	60-80
06SX51N	120	146-150	70-90
07SX1N	120	116-119	60-80
07SX51N	120	136-140	70-90
102SX1N	120	118-119	70-90
102SX51N	120	133-140	80-100
2SX1N	240	236-240	150-170
	208	208-210	130-150
2SX51N	240	258-262	150-170
	208	222-228	130-150

NOTE: All bench test values are the same for 50 cycle and 60 cycle models.
* - Value will vary with rheostat setting.

TABLE 4-3. VOLTAGE VALUES FOR EXCITER (GENERATOR RUNNING AT NO LOAD)

EXCITER MODEL	NOMINAL EXCITER VOLTAGE	1 AC VOLTAGE AT E1, E2	2 DC VOLTAGE AT F1, F2	3 ENGINE SPEED
04SX1N	120	124	21	1860
06SX1N	120	126	22	1860
07SX1N	120	123	21	1860
102SX1N	120	122	19	1860
2SX1N	240	253	39	1875
	208	215	36	1860

NOTE: Values will vary with engine speed and rheostat setting. All values at no load.

TABLE 4-4. RESISTANCE VALUES

CAUTION *Always use an accurate ohmmeter for checking resistance values. Resistance readings in the range of values found between G1 and G2 cannot be read with accuracy on the multimeter.*

MODEL OF MAGNECITER	CONTROL REACTOR				LARGE REACTOR		STABILIZING RESISTOR SETTINGS
	from C to 25	from C to 31	from C to 4	from C to 1	from C1 to C2	from G1 to G2	
02SX1N1A				14.0	5.0	1.0	Fixed
07SX1N1A	23.0				9.0	.75	113.0
07SX1N1B	23.0				9.0	.75	113.0
07SX1N1C		18.0			9.0	.75	150.0
102SX1N1A	23.0				8.5	.30	80.0
102SX1N1B		18.0			8.5	.30	80.0
2SX2N1A			155.0		17.5	.37	Fixed
2SX2N1B				150.0	17.5	.37	Fixed
07SX51N1A	28.0				9.0	.90	113.0
07SX51N1B	28.0				9.0	.90	113.0
07SX51N1C		22.0			9.0	.90	150.0
102SX51N1A	28.0				8.5	.35	80.0
102SX51N1B		22.0			8.5	.35	80.0
2SX52N1A			192.0		17.5	.45	Fixed
2SX52N1B			180.0		17.5	.45	Fixed
04SX1N1A		12.5			11.0	1.77	Fixed
04SX1N1B, 2B, 3B, 4B		12.5			11.0	1.77	Fixed
06SX1N1A		12.5			5.5	.66	Fixed
06SX1N1B, 2B, 3B, 4B		12.5			5.5	.66	Fixed
06SX51N1A		15.0			6.6	.79	Fixed
06SX51N1B, 2B, 3B, 4B		15.0			6.6	.79	Fixed

TABLE 4—5. MAGNECITER DIAGRAMS

2SX MAGNECITER

07SX AND 102SX MAGNECITER

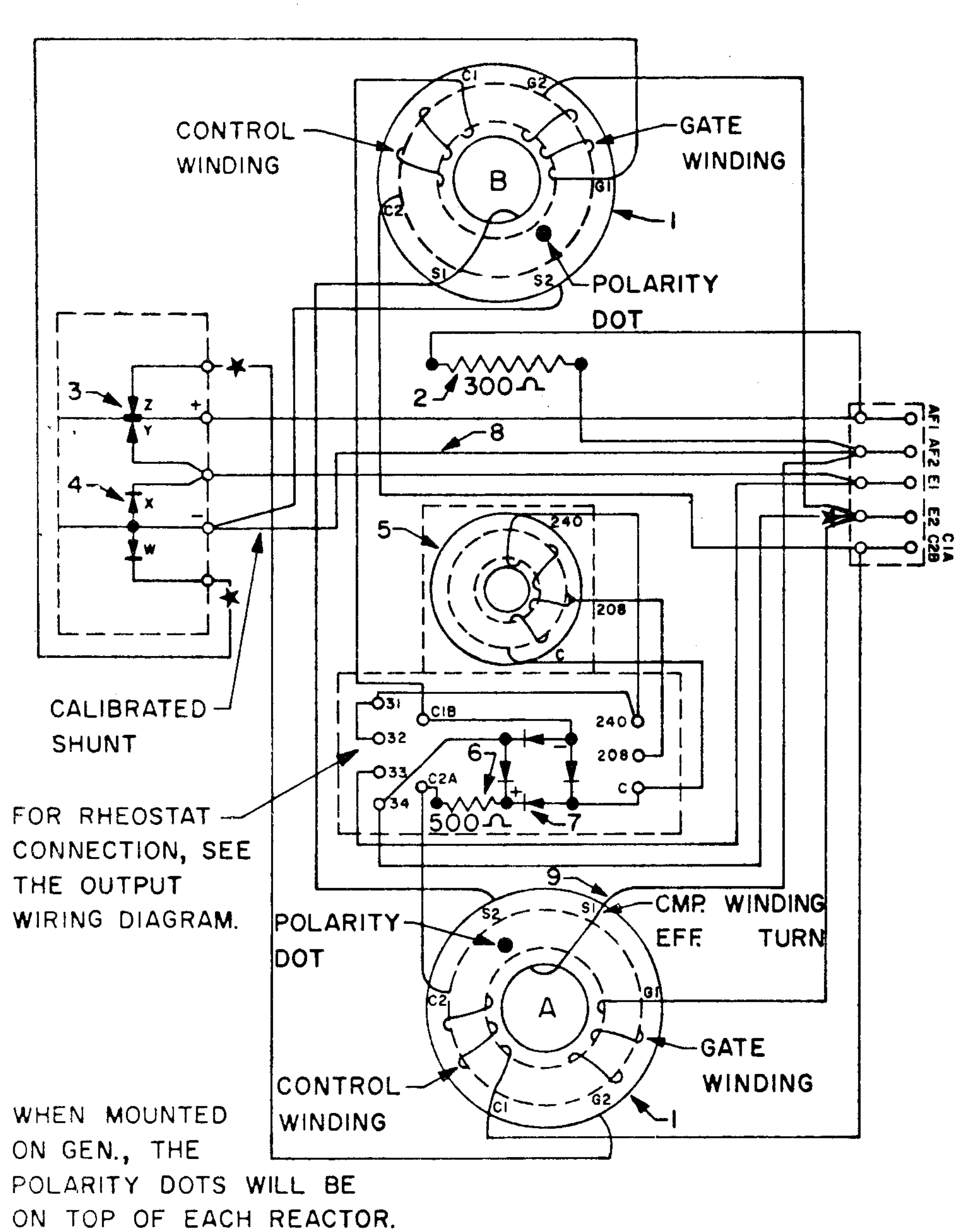
04SX AND 06SX MAGNECITER

WITH AND WITHOUT AUTOMATIC FIELD FLASHING

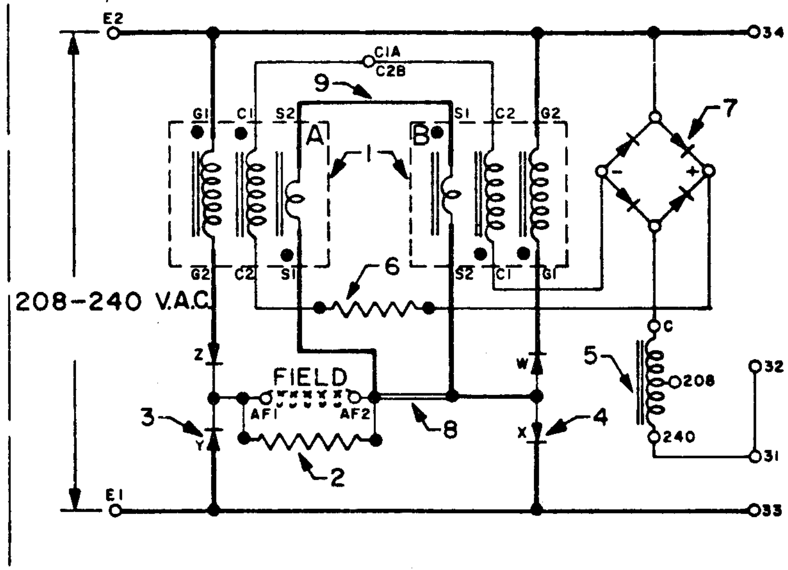
02SX1N1A MAGNECITER

TYPICAL DIAGRAM OF 2SX MAGNECITERS

PICTORIAL



SCHEMATIC



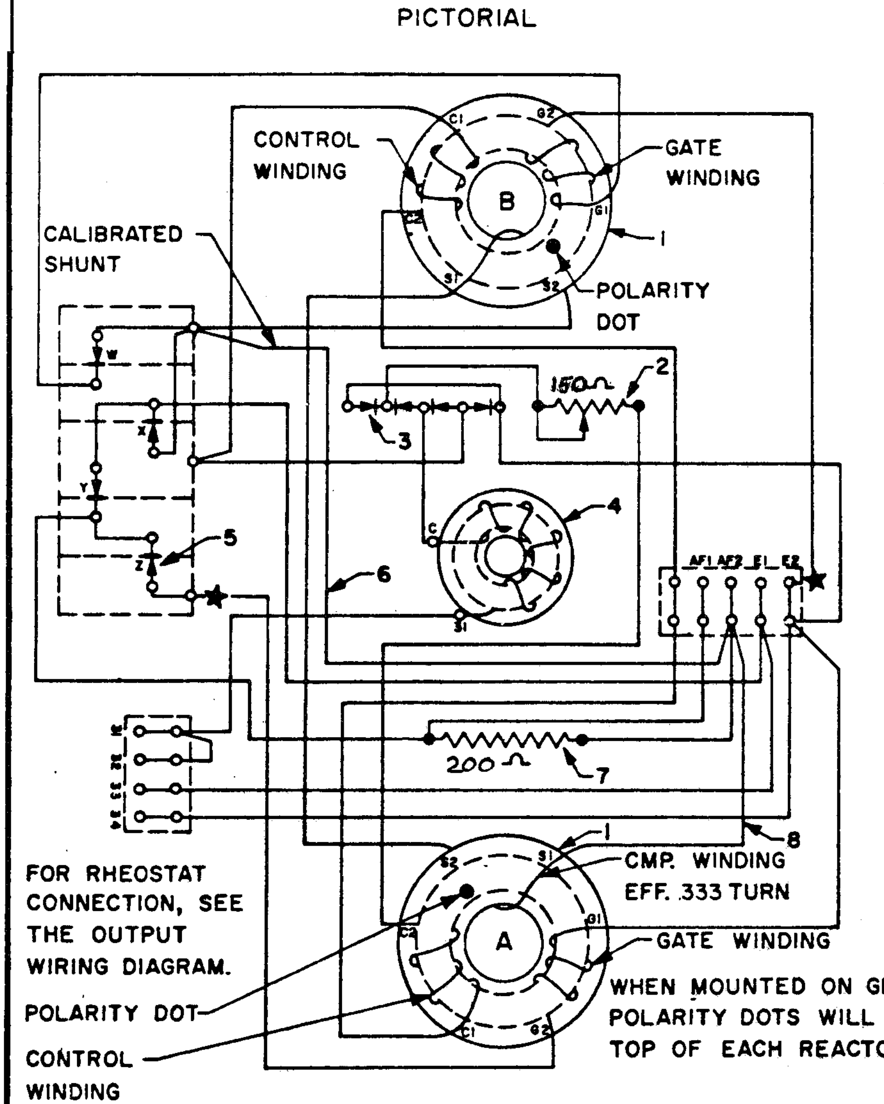
ITEM	QTY	DESCRIPTION
9	1	NO. 12 WIRE, 40" LG.
8	1	NO. 12 WIRE, 20" LG.
7	4	RECTIFIER-CONTROL
6	1	RESISTOR-STABILIZING
5	1	REACTOR-CONTROL
4	2	RECTIFIER-FIELD, NEG.
3	2	RECTIFIER-FIELD, POS.
2	1	RESISTOR-DAMPING
1	2	REACTOR-GATE

PARTS LIST

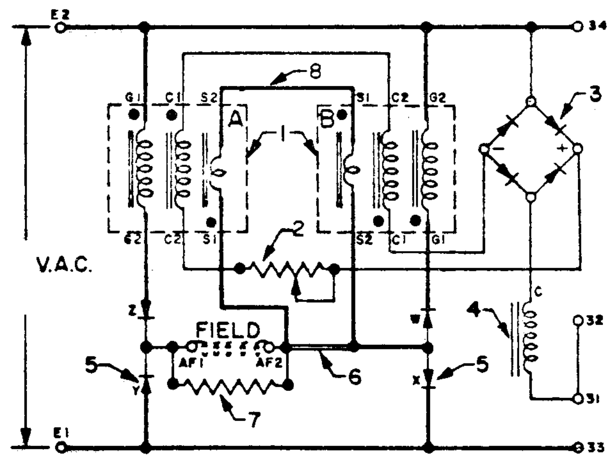
★ JUMPER CONNECTION POINTS FOR METHOD J. TESTING

TYPICAL DIAGRAM OF 07SX AND 102SX MAGNECITERS

PICTORIAL



SCHEMATIC



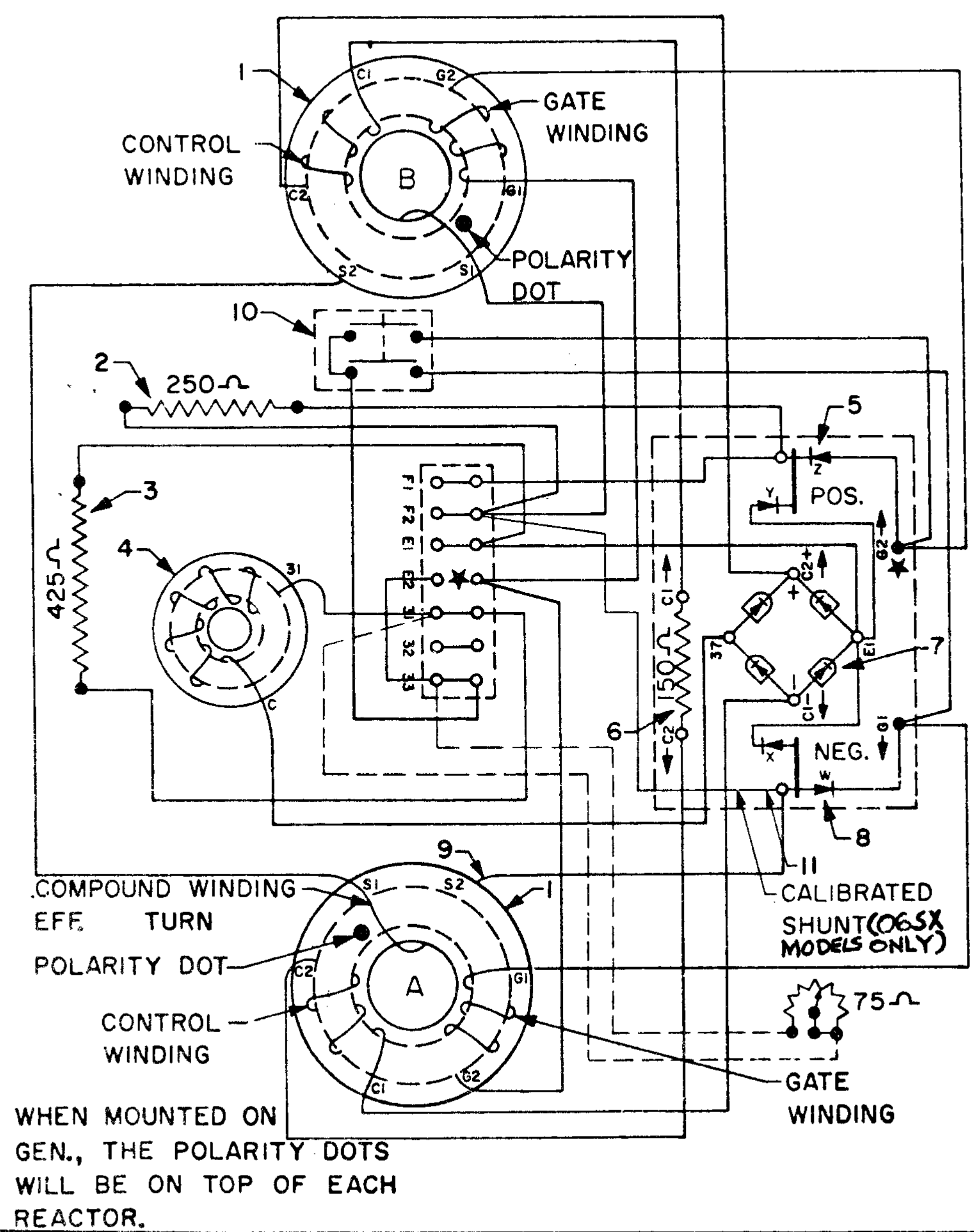
ITEM	QTY	DESCRIPTION
8	1	NO. 14 WIRE, 27" LG.
7	1	RESISTOR-DAMPING
6	1	NO. 14 WIRE, 13½" LG.
5	4	RECTIFIER-FIELD
4	1	REACTOR-CONTROL
3	4	RECTIFIER-CONTROL
2	1	RESISTOR-STABILIZING
1	2	REACTOR-GATE

PARTS LIST

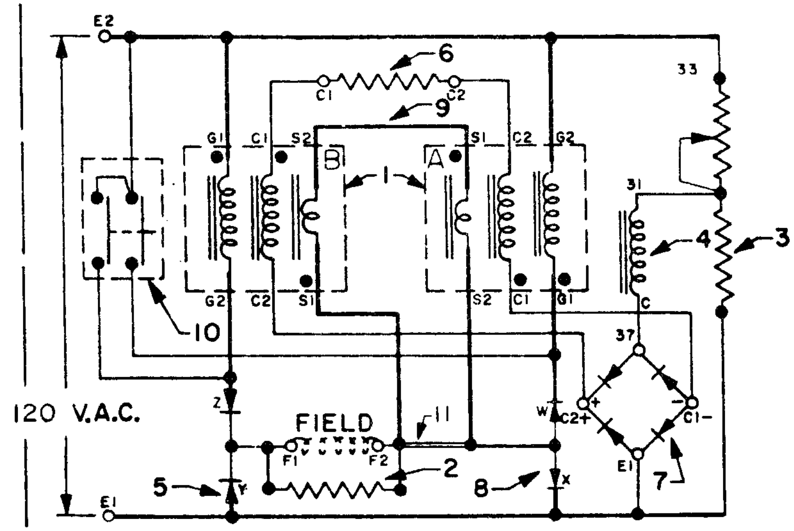
★ JUMPER CONNECTION POINTS FOR METHOD J. TESTING

TYPICAL DIAGRAM OF 04SX AND 06SX MAGNECITERS

PICTORIAL



SCHEMATIC



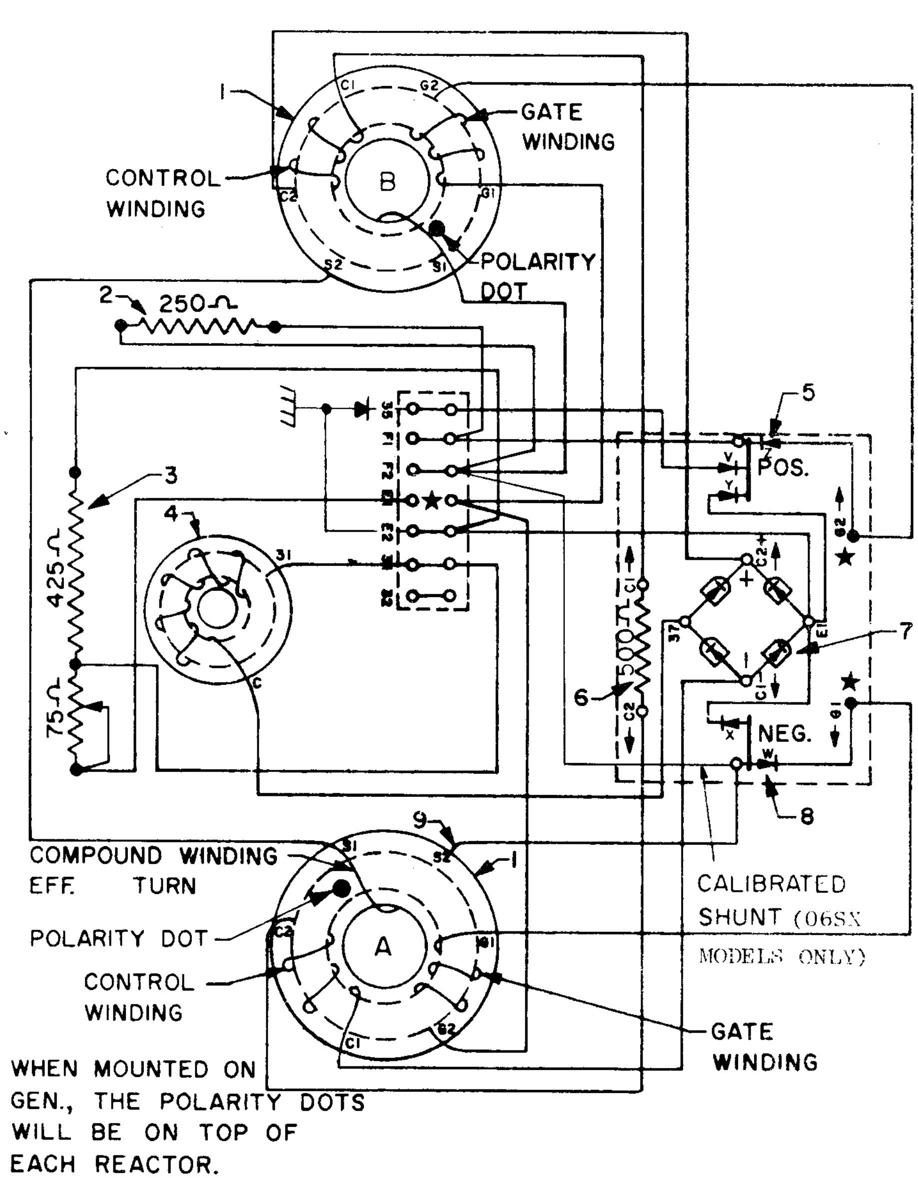
ITEM	QTY	DESCRIPTION
11	1	NO. 16 WIRE, 27½" LG.
10	1	SWITCH-RESIDUAL RESET
9	1	NO. 14 WIRE, 27½" LG.
8	2	RECTIFIER-FIELD NEG.
7	4	RECTIFIER-CONTROL
6	1	RESISTOR-STABILIZING
5	2	RECTIFIER-FIELD POS.
4	1	REACTOR-CONTROL
3	1	RESISTOR-VOLT. CONTROL
2	1	RESISTOR-DAMPING
1	2	REACTOR-GATE

PARTS LIST

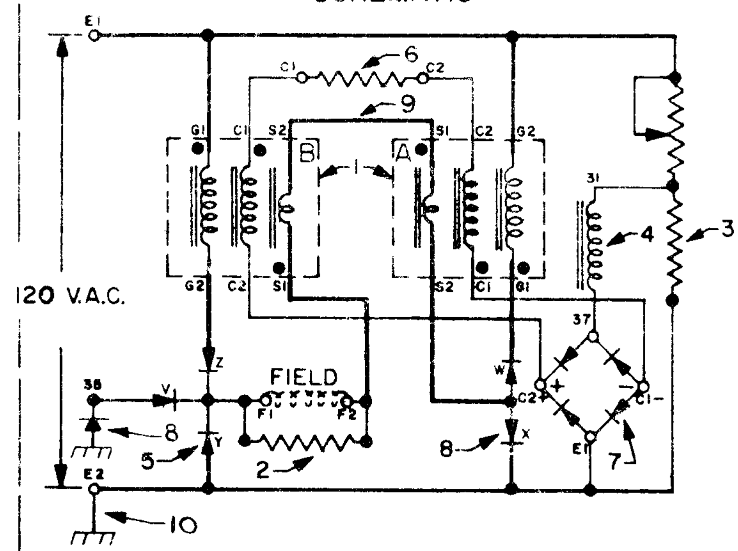
★JUMPER CONNECTION POINTS FOR METHOD J. TESTING

TYPICAL DIAGRAM OF 04SX AND 06SX MAGNECITERS WITH AUTOMATIC FIELD FLASHING

PICTORIAL



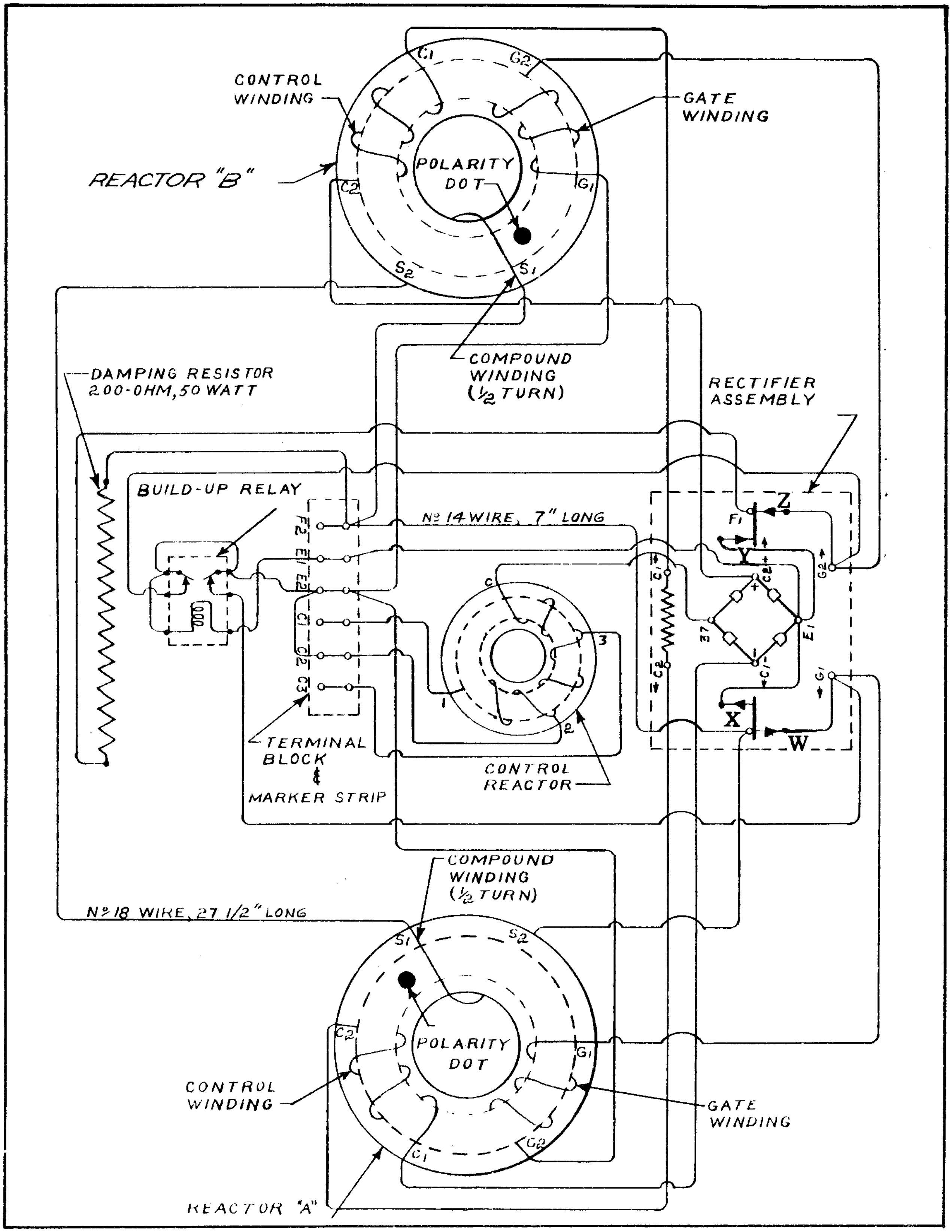
SCHEMATIC



ITEM	QTY	DESCRIPTION
10	1	LEAD ASSY
9	1	NO. 14 WIRE, 27 1/2" LG.
8	3	RECTIFIER-FIELD NEG.
7	4	RECTIFIER-CONTROL
6	1	RESISTOR-STABILIZING
5	3	RECTIFIER-FIELD POS.
4	1	REACTOR-CONTROL
3	1	RESISTOR-VOLT. CONTROL
2	1	RESISTOR-DAMPING
1	2	REACTOR-GATE

PARTS LIST

★ JUMPER CONNECTION POINTS FOR METHOD J. TESTING



02SX1N1A MAGNECITER

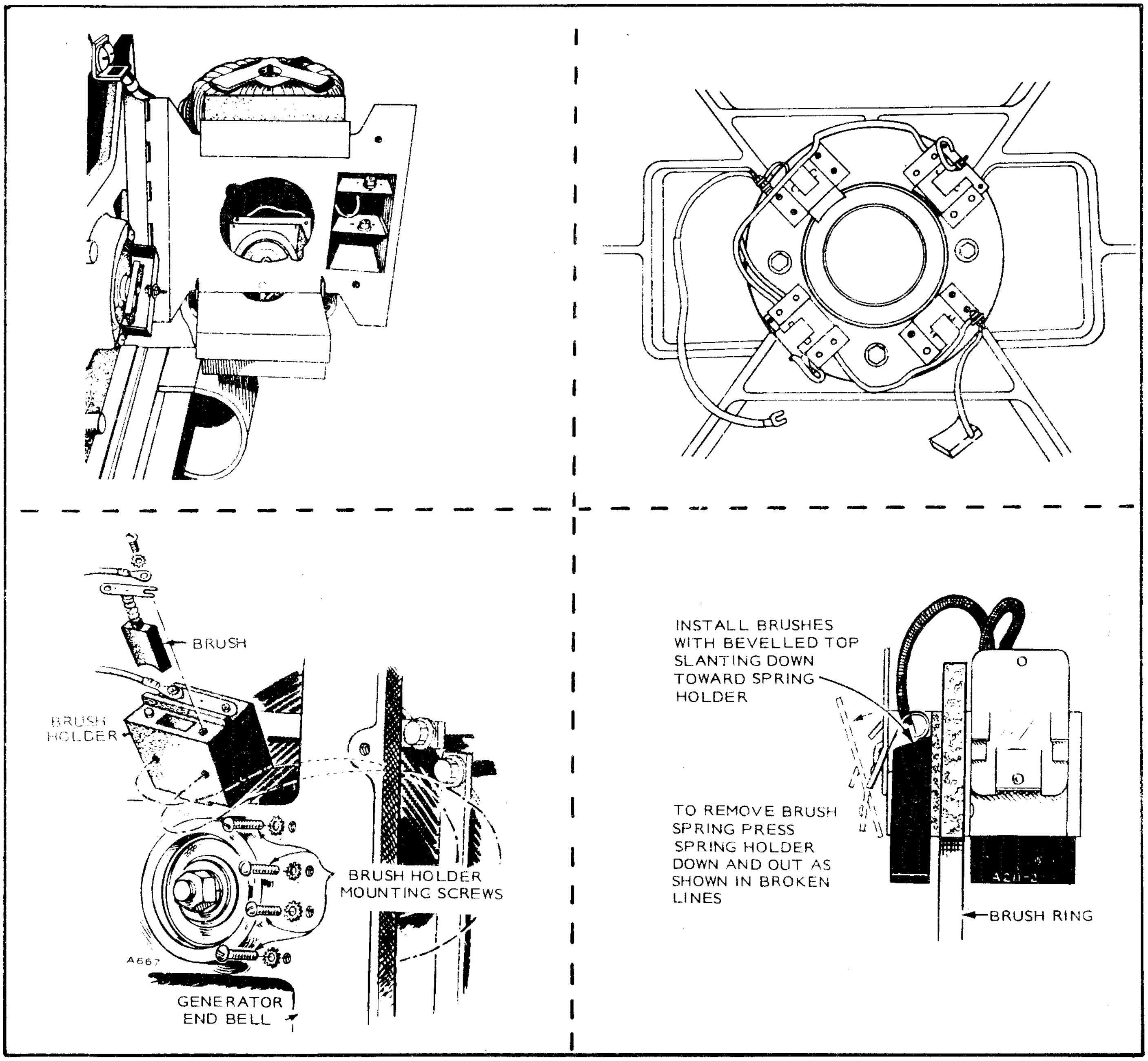


FIGURE 4-9. BRUSH LOCATION AND REPLACEMENT

Brushes should be replaced when they wear to about 5/16 inch.

CAUTION *Use only Onan parts when replacing brushes. Other replacement brushes may look identical but they may have entirely different electrical characteristics.*

TESTING AND REPAIR

If repair work is necessary on the generator, it should be performed by a competent electrician who is familiar with operation of electric generating equipment.

TROUBLESHOOTING

In the event of abnormal generator output voltage, observe the following procedures.

No Voltage Buildup: Remove the exciter cover and with the set running, operate the residual reset button on the Magneciter.

NOTE: *Early 04SX and 06SX models had no reset button. On these models place jumpers momentarily from G1 to G2 of each reactor simultaneously with the unit running. On the 02SX exciter, the buildup relay automatically performs this function. Units beginning Spec P have a voltage tap at terminal 35 which allows automatic field flashing during unit cranking to assure voltage buildup.*

If output voltage won't buildup after pushing the reset button, flash the field (Figure 4-11). Connect a voltmeter across the AC output. Then run the unit and momentarily touch the leads of a 6-volt lantern battery to the exciter to brush leads . . . positive (+) to F1 and negative (–) to F2.

While viewing the voltmeter:

1. If voltage builds up to normal, trouble was due to lost residual in the field.
2. If voltage is low, the Magneciter is probably defective. (See *Magneciter Troubleshooting Chart.)*
3. If there is no voltage output with battery connected to F1 and F2, trouble is in alternator.

Over-Voltage or Fluctuating Voltage: If the engine is operating at the correct speed, see *Magneciter Troubleshooting Chart.*

GENERATOR BEARING

The generator ballbearing is prelubricated and double-sealed. Inspect every 1000 hours with the unit running.

If the set is used for "standby power", replace bearing every five years. If used as "prime power", replace bearing every 10,000 hours or two years. Deterioration of the bearing grease due to oxidation makes this replacement necessary.

If the bearing becomes noisy, worn or otherwise defective, replace it. Remove the old ballbearing with a gear puller and press a new one into place (Figure 4-10).

COLLECTOR RINGS

The collector rings must be clean and free of burrs, scratches and marks. If necessary, use No. 00 sandpaper to clean the surface. Never use emery cloth or other conducting abrasives.

Collector rings may have a dark brown or black appearance. This is a thin lubricating film and aids the life of the brushes and slip rings. (Do not remove film.)

If the collector rings are grooved, out-of-round, pitted or rough so that good brush seating can't be maintained, remove the rotor and refinish the rings in a lathe. Remove or shield the ballbearing during refinishing. The collector rings should have a Total Indicated Reading (T.I.R.) of .002″.

MAGNECITER

The magneciter contains no moving parts except for the 02SX. Periodically blow out any dust and make certain that all components and connections are secure.

For detailed magneciter description see the *Magneciter Description, Troubleshooting,* and *Repair* portion of this section.

ALTERNATOR TESTING

Most alternator testing can be performed without disassembling the generator.

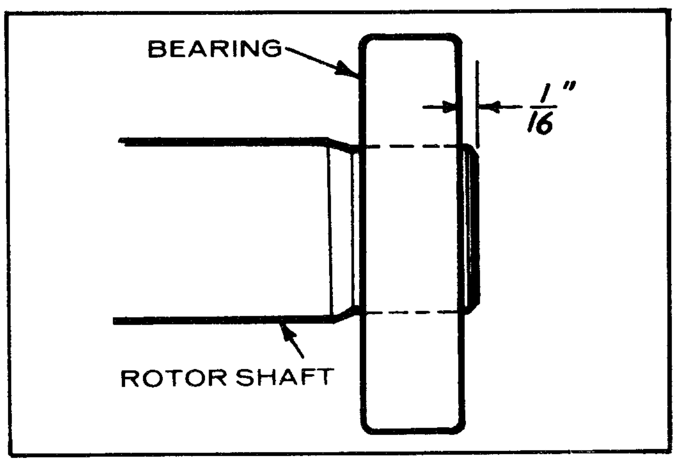


FIGURE 4-10. BEARING INSTALLATION.

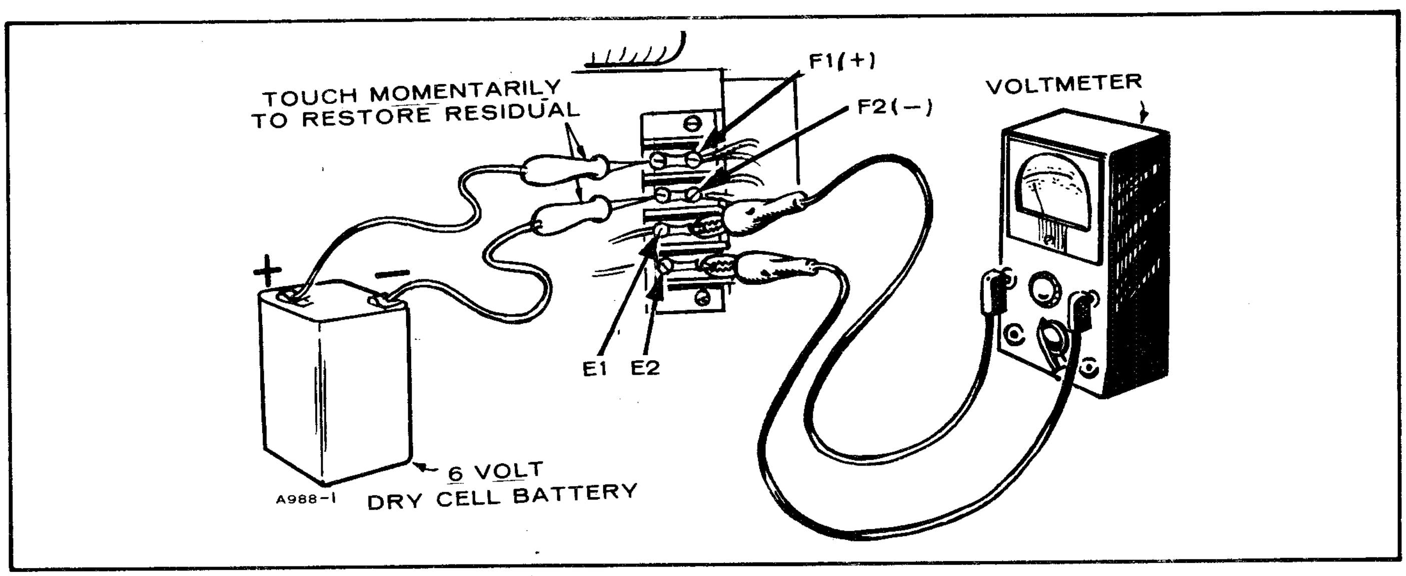


FIGURE 4-11. FLASHING THE FIELD.

Test Rotor Continuity As Follows:

Remove the brushes so none touch the collector rings.

1. Using an ohmmeter, test for grounding between each slip ring and the rotor shaft.
2. Test for a short or open circuit in rotor winding by measuring resistance of winding. It should measure between 3.5 and 4.8 ohms for the JB and between 2 and 3 ohms for the JC (at 70°F). If an accurate ohmmeter isn't available, check the rotor for open circuit or grounding with an AC test lamp (Figure 4-12). Replace the rotor if it is grounded, or has an open circuit or short.

Test Stator Continuity As Follows:

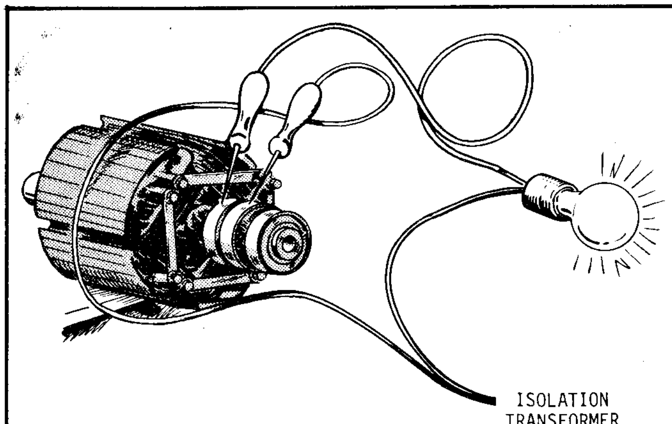
1. Disconnect the generator output leads in the control box. Use the wiring diagrams to determine the output leads in the control box. Use the wiring diagrams to determine the output lead coding. Using either the test lamp or an ohmmeter, check each winding of the stator for grounding to the laminations or frame.

   NOTE: *Some generators have ground connections to the frame. Check the wiring diagrams.*
2. Using an accurate ohmmeter, test the resistance of each stator winding. Compare the resistances obtained. All windings of equal output voltage should indicate about the same resistance. An unusually low reading indicates a short; a high reading an open circuit. If the ohmmeter required for this test isn't available, check for open circuits with the test lamp.
3. If any windings are shorted, open-circuited or grounded, replace the stator assembly. Before replacing the assembly, check the leads for broken wires or insulation and replace any defective lead. If this does not correct the fault, replace the assembly.

Battery Charging Winding Tests: Remove the lead from the battery polarity reconnection block to ammeter at the ammeter. Install a DC voltmeter between the lead and ground. At governed engine speed, the average DC output should be 19 to 21 volts. If the output is defective, test for open circuit or grounding in the leads and windings. If leads are defective, replace them. If the winding is defective, replace the stator.

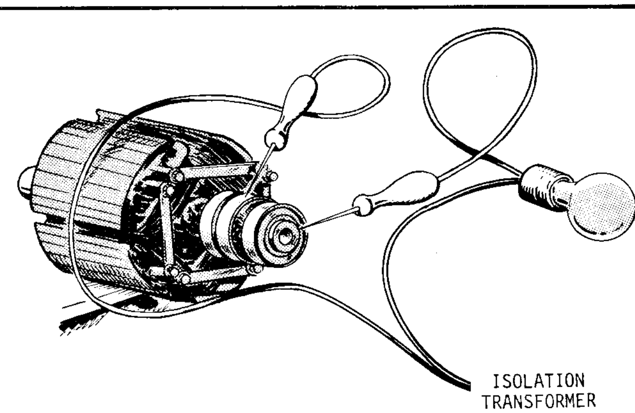
GENERATOR DISASSEMBLY (Figure 4-14)

1. Disconnect the battery to prevent accidental starting of the set.
2. Remove the exciter cover and open the exciter. This will reveal the rotor-thru-stud nut.
3. Remove the four machine screws on the end bell near the bearing and lift out the brush holders.
4. Remove the lead from the tapped adjustable resistor in the generator air outlet opening.
5. Remove the leads from the control box to the ignition system choke, start disconnect switch, etc. on the engine.
6. Remove generator-through-stud nuts, remove the end bell and stator assembly. Screwdriver slots in the adapter provide a means for prying the stator loose. Be careful not to let the stator touch or drag on the rotor.
7. Remove baffle ring from adapter. Turn rotor-through-stud nut to the end of the through stud. While pulling the rotor outward with one hand, strike a sharp blow to the nut (in the direction of the through stud, *not vertically*) with a heavy, soft faced hammer to loosen the rotor from its tapered shaft fit. If the rotor does not come loose, strike it with a sharp downward blow in the center of the lamination stack with a lead or plastic hammer. Rotate the rotor and repeat until it comes loose. Be careful not to hit the collector rings, bearings or windings.
8. After disassembly, all parts should be wiped clean and visually inspected.



TESTING FOR OPEN CIRCUIT

CONTACT ONE TEST PROD TO ONE SLIP RING AND THE OTHER PROD TO THE SECOND SLIP RING.
IF GOOD BULB SHOULD LIGHT.



TESTING FOR GROUNDS

CONTACT ONE PROD TO EACH OF THE SLIP RINGS AND THE OTHER PROD TO THE ROTOR SHAFT.
IF GOOD BULB SHOULD NOT LIGHT.

FIGURE 4-12. TESTING FOR OPEN CIRCUIT AND GROUNDS.

GENERATOR ASSEMBLY

1. Clean and inspect all mating surfaces.
2. Coat the mating area between the generator shaft and the engine crankshaft with a thin film of lubricating oil, "Molykote" or equal.
3. Install the rotor-through-stud in the engine crankshaft.
4. Install the key in the crankshaft.
5. Slide the rotor over the through-stud and onto the crankshaft. Be careful not to let the weight of the rotor rest on the through-stud.
6. Install the baffle ring.
7. Install generator through studs in the adapter.
8. Install the stator and bearing support (end bell). Tighten the nuts on through-studs.

   NOTE: *Make certain the B1 lead is placed through the grommet in the baffle ring and out the air discharge opening in the adapter.*

9. Now torque down the rotor-through-stud nut (55-60 ft. lb.). Because the stator and bearing support were tightened before tightening the rotor, the rotor and stator are automatically aligned.
10. Tap the bearing support to the horizontal and vertical plane with a lead hammer to relieve stresses on the components (recheck torque).
11. Reconnect the leads to the preheater, centrifugal switch and governor solenoid.
12. Install lead B1 on the adjustable resistor.

    CAUTION *Check this lead to see that it is short and is kept away from the blower. If necessary when installing a new stator or leads, cut it shorter and reinstall the connector.*

13. Install the brushes and brush holders.
14. Close the Magneciter, secure with four capscrews and install the end cover.

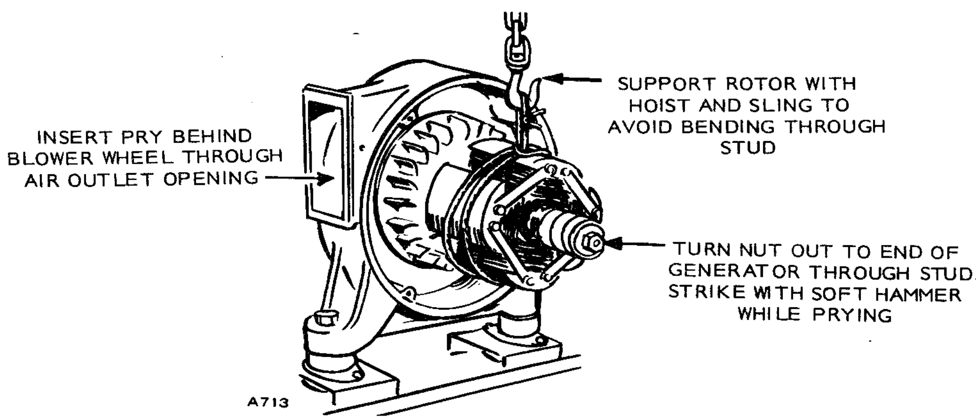


FIGURE 4-13. SUPPORTING THE ROTOR

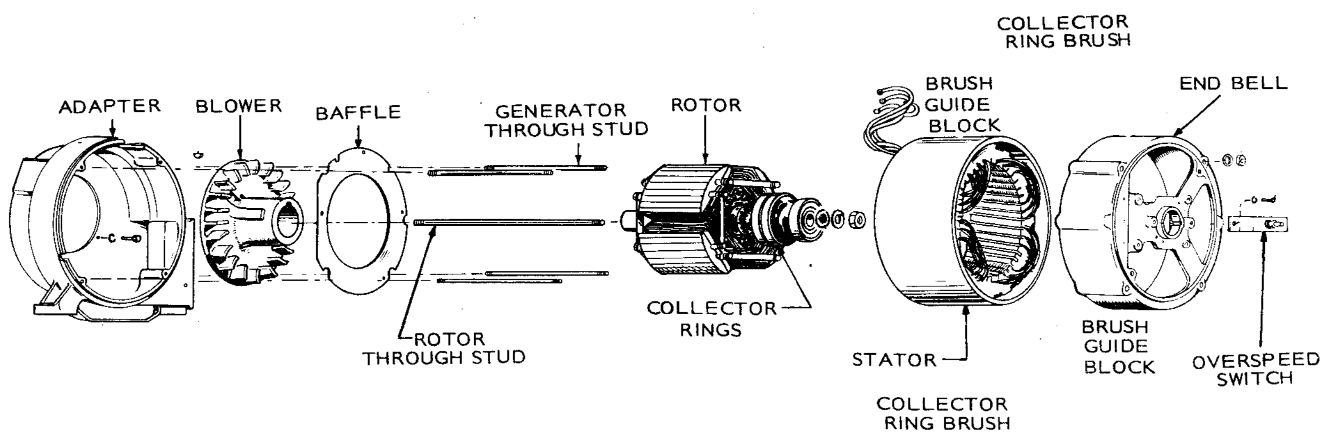


FIGURE 4-14. REVOLVING FIELD GENERATOR ASSEMBLY.

SECTION 5.
DIRECT CURRENT GENERATORS

INDEX

DIRECT CURRENT GENERATORS

GENERAL

Onan manufactures several types of direct current generators.

Welders: Onan DC welders are engine-driven, direct current, arc welding machines. See Table 5-1 for a listing of welder voltages and currents.

Generators used on the welders are conventional revolving armature units. Some have separate AC and DC armatures. Figures 5-1 and 5-2 illustrate typical welder generators.

TABLE 5-1. WELDER SIZES

MODEL	AMPS	VOLTS	AUXILIARY AC
6.0DJB	200	28 DC	YES *
7.0CCK	225	28 DC	YES
6.0CCK	200	30 DC	YES *
5.0NB	180	25 AC	YES

* On these models auxiliary AC is available by switch control and only when no welding is being done.

Direct Service Generators: These DC generators supply direct DC loads for lighting, microwave power, etc. Direct Service generators are available with nominal output voltages of 125 or 250 volts. They are similar in design and appearance to the generators in figures 5-1 and 5-2. Direct Service generators have no HC capabilities.

Magnet Service Generators: These DC generators are used in cranes to provide power for the lifting magnet. They have a 250 volt nominal output.

DC application generators such as Direct Service generators, magnet service generators, and battery chargers differ from conventional revolving armature generators primarily in the type of field winding used (Figure 5-3).

A battery charging generator uses a shunt field to obtain the greatest charging rate throughout its load range. This allows a high rate of charge into partially discharged batteries without an excessive discharge rate into completely discharged batteries. The charge rate tapers off as the batteries come up to full charge.

Direct service generators require a flat voltage curve.

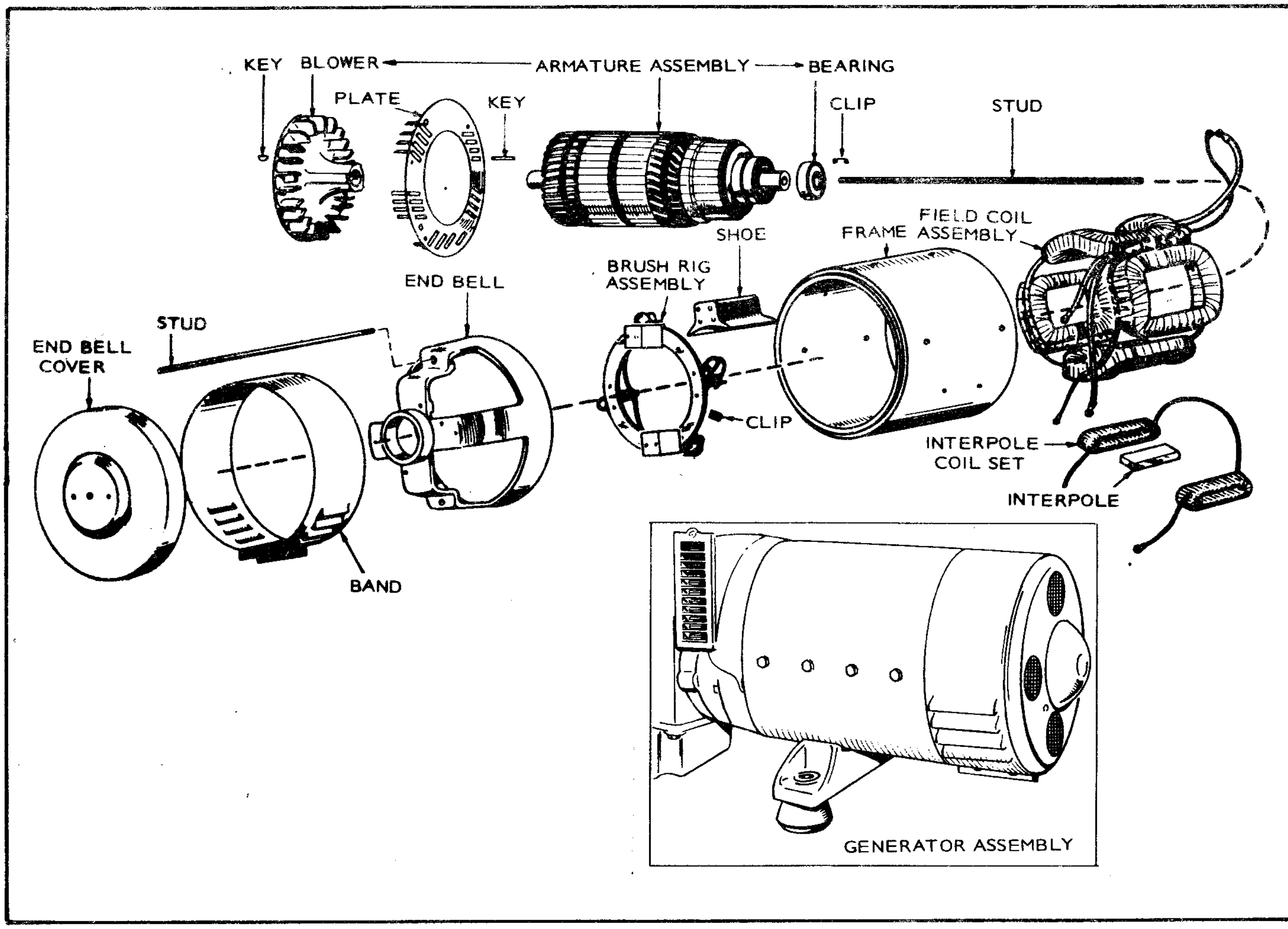


FIGURE 5-1, 5-2. TYPICAL WELDER GENERATOR ASSEMBLY

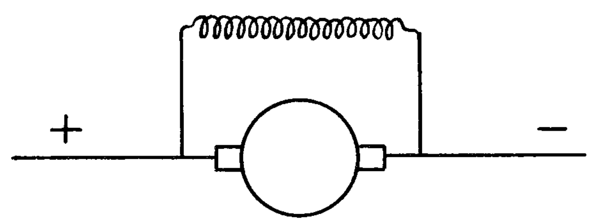


FIGURE 5-3. DC GENERATOR FIELD WINDING

The load receives the same voltage whether the generator is lightly or heavily loaded. This type of generator uses a compound wound field (Figure 5-4).

Magnet service generators must fulfill special requirements. For most applications the shunt field is best (Figure 5-3) because it offers high initial voltage when the magnet is switched on and lower voltage during magnet operation. This reduces the amount of power that must be dissipated when the magnet is switched off.

Most DC generators use a rheostat or some other type of resistance in the shunt field circuit to determine and adjust the output voltage.

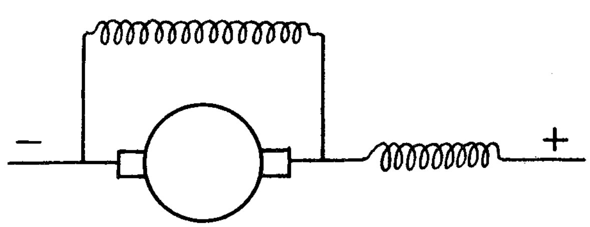


FIGURE 5-4. COMPOUND WOUND FIELD

TROUBLESHOOTING

Table 5-2 contains troubleshooting information concerning DC generators. Table 5-3 provides troubleshooting information for DC welders.

ADJUSTMENTS

BRUSH RIG NEUTRAL POSITION

Each unit is shipped from the factory with the brush rig correctly set in the neutral position. This position is identified by a paint mark or similar mark extending from the brush rig to one of three parts: the generator end plate, end bell, or bearing support. This neutral position, as evidenced by the paint marks, should never have to be changed unless you have replaced the armature, brush rig, or if the generator's direction of rotation has been changed. See Figure 5-5.

The neutral position of the brush rig is where the generator, running at its rated rpm, produces the highest voltage (with no load connected) with no sparking (or arcing) at the brushes. The neutral position can be set as follows:

1. Start the unit and run at rated rpm.
2. Connect a DC voltmeter (0-30 range) across the positive (+) and the negative (–) commutator brushes.
3. Loosen the brush rig mounting screws and rotate the rig to obtain the highest voltage. Rotate the brush rig in the direction of rotation until the voltage decreases or dips.
4. Then rotate the brush rig against rotation to the highest voltage point. Observe this position. Rotate farther against rotation until voltage dips. Mark rig with a pencil using the generator reference mark.
5. Now rotate in the direction of rotation to the highest voltage point. Note this position. Rotate approximately 1/8″ farther in direction of rotation and lock the brush rig in position.
6. When brush rig is secure, apply the full rated load to the generator to make sure there is no sparking (or arcing) at the brushes. If no sparking occurs, mark the ring of the brush rig to the reference point with a notch or with paint.

TABLE 5-2. WELDER GENERATOR TROUBLESHOOTING

POSSIBLE CAUSE	REMEDY
ENGINE CRANKS TOO SLOWLY	
Brushes worn excessively or making poor contact.	Replace brushes or clean commutator.
Short circuit in generator or load circuit.	Repair or replace parts necessary. Disconnect load.
EXCESSIVE ARCING OF BRUSHES	
Rough commutator or rings.	Turn down.
Dirty commutator or rings.	Clean.
Brushes not seating properly.	Sand to a good seat or reduce load until worn in.
Open circuit in armature.	Install a new armature.
Brush rig out of position.	Line up properly.
GENERATOR OVERHEATING	
Operation of welder for long periods without welding.	Do not run engine for long periods of time unless welding, or using AC output.
Improper brush rig position.	See "Brushes" in "Generator" section.
UNSATISFACTORY WELDING AT HIGH AMPERAGE POSITION	
Engine lacks power.	See remedies under "Engine Misfires at Heavy Load".
Poor compression.	Tighten cylinder heads and spark plugs. If still not corrected, grind valves and replace piston rings if necessary.
Faulty carburetion.	Check fuel system. Clean, adjust or repair as needed.
Micro switch DC contacts stuck closed.	Replace micro switch.
Choke partially closed.	Choke plate must be wide open after warm up.
Carbon in cylinders or in carburetor venturi.	Remove carbon.
Restricted exhaust lines.	Clean or increase the size.

POSSIBLE CAUSE	REMEDY
ENGINE RUNS BUT VOLTAGE DOES NOT BUILD UP	
Poor brush contact.	See that brushes seat well on commutator, collector rings, are free in holders and not worn shorter than 5/8″ and have good spring tension.
Open circuit, short circuit, or ground in armature.	See "Generator Maintenance and Repair" section.
VOLTAGE UNSTEADY BUT ENGINE NOT MISFIRING	
Speed too low.	Adjust governor to correct speed.
Poor commutator or brush contact.	Refinish commutator or undercut mica if necessary. See that brushes seat well on commutator, are free in holders, are *not worn* shorter than 5/8″, and have good spring tension.
Loose connections.	Tighten connections.
Improper brush rig position.	See "Generator Maintenance and Repair" section.
NO AC OUTPUT AVAILABLE	
Micro switch AC contacts stuck open.	Replace micro switch.
AC OUTPUT WHEN WELDING	
Micro switch AC contacts stuck closed.	Replace micro switch.
AC OUTPUT VOLTAGE LOW	
Micro switch DC contacts stuck open.	Replace micro switch.
NOISY BRUSHES	
High mica between turn of commutator.	Undercut mica.

TABLE 5-3. TROUBLESHOOTING DC GENERATORS

NATURE OF TROUBLE	CAUSE	REMEDY
1. Residual magnetism lost; or residual magnetism weak.	1. Residual magnetism lost through non-use or disassembly of generator.	1. Charge the shunt fields with another DC generator or a battery, making sure the fields are connected for proper polarity.
2. Residual magnetism reversed.	2. Reversed-current through field coils from some outside voltage source.	2. Connect fields for proper polarity and charge the shunt field with another DC generator or a battery, using correct polarity from the generator or battery.
3. Armature short circuit.	3. (a) Carbon dust or other conducting dust between adjacent bars.	3. (a) Clean the commutator. The presence of this trouble will be shown by flashing of brushes or heating of one or more coils.
	3. (b) Insulation or coils broken down.	3. (b) Replace or rewind if insulation is beyond repair.
4. Armature open circuit.	4. Rough usage, or original short circuit which may have burned a coil or connection.	4. Test adjacent commutator bars; replace or rewind the armature.
5. Incomplete circuit from DC armature to shunt field	5. (a) Insulating film on commutator.	5. (a) Clean commutator with fine sandpaper or a commutator stone and blow out dust. DO NOT USE EMERY CLOTH.
	5. (b) DC commutator brushes not contacting the commutator.	5. (b) Replace brush spring which may have broken or come off; replace brushes which may have become worn down too far to make contact. Make brushes free to move in holder.
	5. (c) Brush leads broken due to vibration.	5. (c) Check brush shunts with an ohmmeter and replace defective brushes and leads.
	5. (d) Loose connections at the brush terminals.	5. (d) Check and tighten all brush terminal connections.
	5. (e) Open circuit in shunt field coil leads.	5. (e) Check leads with an ohmmeter and repair as needed.
	5. (f) Open circuit in rheostat or voltage regulator resistances.	5. (f) Check rheostat or regulator with ohmmeter and repair or replace.
6. Short circuit in field.	6. Dampness or deteriorated insulation.	6. Bake if damp, repair or rewind if insulation is deteriorated.
7. Open circuit in field.	7. Rough usage or original short circuit which may have burned a coil or connection.	7. Examine field connections and test with an ohmmeter; if a coil is open, replace it.
8. Short circuit in exterior	8. Device connected to line short-circuited or line itself short-circuited.	8. Check all load connections.
9. Fields opposed to each other.	9. (a) Field coils of either a shunt or a series generator connected for the same polarity.	9. (a) Change connections between field coils, and test with a compass for opposite polarity of adjacent coils. When adjacent coils show opposite polarity, the generator should build up voltage.
	9. (b) Shunt and series field of compound wound generator connected for proper polarity individually but connections of generator made so that they oppose or buck each other.	9. (b) Change polarity of either field, but do not change connections of both, as the same trouble will occur again.
10. Generator running backward. (Separate generator)	10. Prime mover running in wrong direction.	10. Reverse direction of rotation of prime mover or change the polarity of the generator by changing the connections of the field of a shunt and series machine.

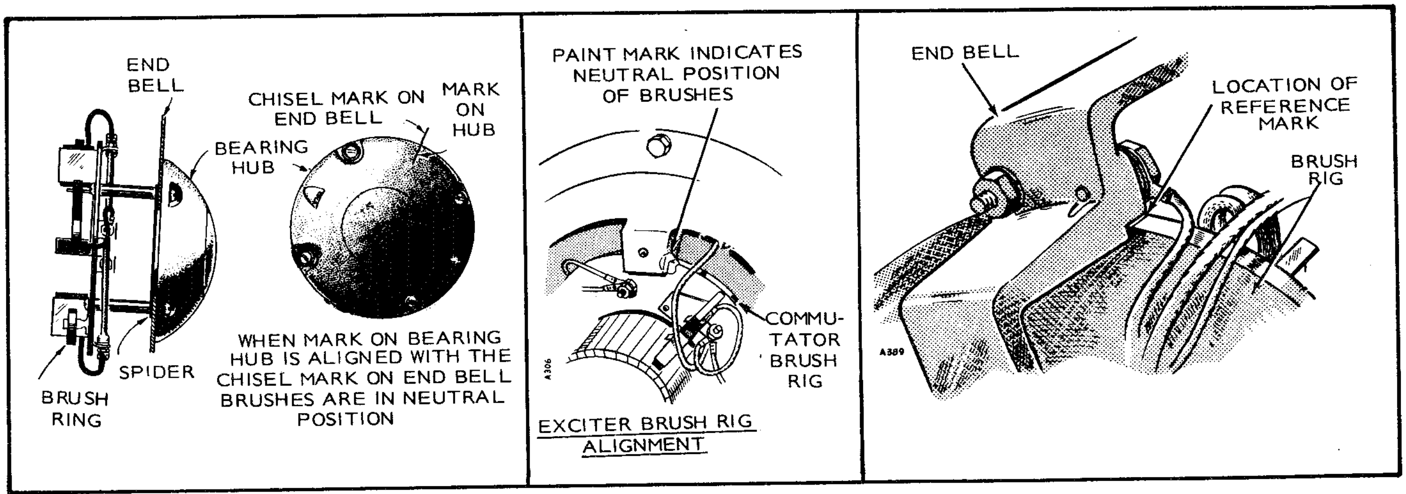


FIGURE 5-5. BRUSH RIG ALIGNMENT

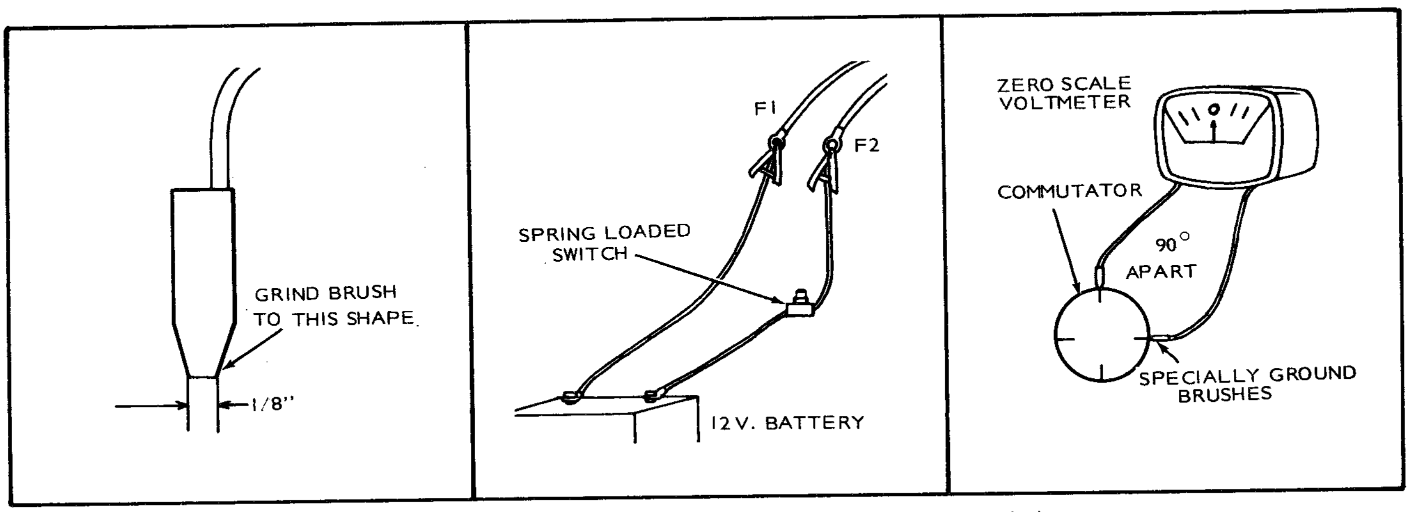


FIGURE 5-6. BRUSH RIG ALIGNMENT (INDUCTIVE METHOD)

If a voltmeter is not available, set the brush rig as follows: Shift the brush rig in each direction until arcing occurs between the commutator and brushes and mark each position. Lock the brush rig at a point approximately halfway between the two marks, where no arcing occurs. This will be the neutral position.

On DC generators it is especially important to determine the brush rig neutral position at both no load and full load. Should any variation exist between the two settings, the brush rig neutral position may be assumed to be between the two settings, and should be locked in this position and marked.

On DC generators with a higher capacity the *INDUCTIVE* method is the most accurate way to set the brush rig. Proceed as follows using the illustrations in Figure 5-6.

1. Grind the contact of a pair of brushes to a wedge shape leaving a 1/8" flat surface. This reduces the contact area to obtain setting of the neutral position.
2. Isolate the F1 and F2 generator field leads and connect at least a 12 volt battery to these leads. Use a spring loaded switch in one of the wires to make and break the circuit.

CAUTION *BE SURE A1 AND A2 ARE NOT TOUCHING EACH OTHER DURING THE TEST.*

3. Remove all brushes from brush rig and insert specially ground brushes in brush holders, 90° apart. Connect a zero center voltmeter (1 volt scale) or galvanometer across these brushes "+" and "–".
4. Make and break the circuit with the switch, keeping the armature *stationary,* and moving the brush rig until needle on meter centers on zero (no deflection).
5. Turn the armature to a new position and repeat step 4. Continue turn and test method until you are sure needle stays on zero.
6. Lock the brush rig and make a reference mark.
7. Remove test brushes and switch, then reconnect generator.

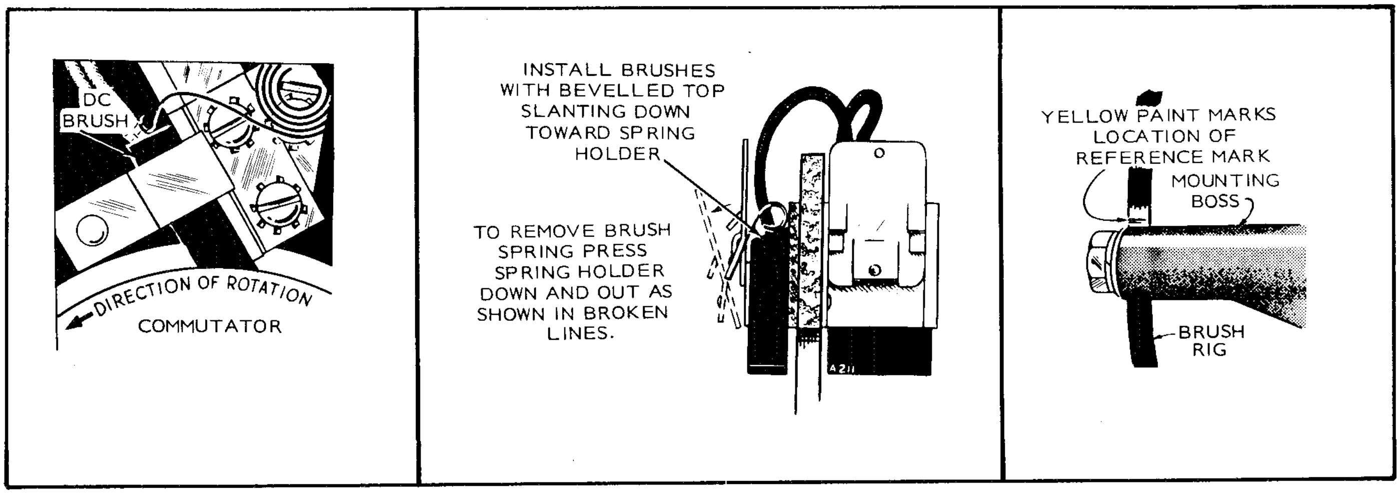


FIGURE 5-7. WELDER BRUSH RIG ADJUSTMENT

ADJUSTING BRUSH RIG POSITION ON 180 AND 200 AMP WELDERS

There are two points to consider when adjusting brush rig position for 180 ampere and 200 ampere DC welder.

1. Adjusting for proper commutation.
2. Adjusting for proper welding characteristics.

When adjusted for proper commutation brush position will usually be correct for welding. Final brush setting should be the best compromise between welding characteristics and sparking at the brushes (commutation). Use Figure 5-7 with the following description.

Make adjustments as follows:

180 amp Welder: Check the brushes periodically. Be sure they are not worn shorter than 5/8 ″ and that spring tension is not less than 26 ounces for a worn brush nor more than 32 ounces for a new brush. Where brushes of the type shown in Figure A are used be sure they are installed as shown, the tapered end against armature rotation.

200 amp Welder: Inspect the brushes periodically. Brushes worn to 1/2 ″ should be replaced. The constant pressure spring should be replaced only if it is bent, twisted or broken. Brushes should be installed as shown.

Brush Rig Adjustment:

Step One: Attach a voltmeter (0-75) across the output terminals of the welder and start the unit. With no load on the unit, loosen the brush rig ring mounting screws and adjust the position of the brush rig until the highest voltage is obtained as indicated on the voltmeter. Tighten one brush rig screw and mark brush rig ring with pencil at a mounting screw boss.

Step Two: Weld and note if sparking occurs at the brushes during welding. To correct, move the brush rig slightly in either direction (preferably with armature rotation) until sparking is no longer noticeable while welding. After final setting is reached, make a permanent mark on the brush rig ring as shown.

NOTE: *Sparking will occur as the welding arc is struck. This is a normal condition and cannot be eliminated.*

CAUTION *Brushes not properly set may result in:*

a. *engine speed dropping considerably when attempting to weld at about 180 to 200 amp – to correct, move brush rig slightly with armature rotation until condition is corrected. A simple test for this condition is to disconnect the generator field lead from the control terminal block terminal marked "F1" and short circuit the welding cables. If a heavy current appears to be flowing, this correction should be made. This test should be made with the main current control at maximum position.*

b. *a weak welding arc – to correct, move brush rig slightly against rotation until condition is corrected.*

Conditions as described will be more apparent when the generator is producing highest current but will be noticeable at all currents. Remember: *the final adjustment will be a compromise between welding characteristics and sparking at the brushes (commutation).* Stop the welder and remove the voltmeter. Be sure to tighten all brush rig mounting screws after final adjustment.

GENERATOR DISASSEMBLY

DC generator disassembly is self-evident and follows a natural sequence. Use figures 5-1, 5-2, or 5-8 for disassembly procedure depending on type of generator to be worked on. The following disassembly procedure applies to both one and two bearing DC generators.

Disassembly is as follows:

1. Remove unit from carrying frame or mountings.
2. Remove end bell cover and cover band.
3. Remove all brush springs and lift all brushes out of their guides.
4. Remove bolts holding brush rig holder on the end bell.
5. Remove bolts located inside the end bell which hold the DC frame in position.
6. Remove nuts from generator frame through studs.
7. Tap end bell back until it is free from the armature bearing.
8. Lift off the end bell (and AC frame on welders).

   CAUTION *Do not pry against slip rings.*
9. Remove armature thru-stud-nut (then the AC armature, on Welders, by tapping gently on the shaft, rotating the armature as you tap).
10. Provide blocking under the rear of the engine for support. Slots in the engine-to-generator adapter provide for prying the DC generator frame loose.
11. Pull the generator frame straight back over the armature, using care not to let it catch or drag on the armature.
12. Remove the generator scroll, then replace the armature thru stud nut on the end of the armature thru stud.
13. While pulling outward, with one hand under the armature, strike a sharp endwise blow on the nut to loosen the armature.
14. Remove armature and blower as an assembly. The blower is keyed and press fit on the armature shaft, and is keyed and tapered fit to the engine crankshaft. If the armature does not come loose, place a heavy brass rod on the armature shaft near the ball bearing and strike a sharp downward blow on the rod with a hammer. Rotate the armature 1/2 turn before repeating this process.

CAUTION *Do not strike the commutator, collector rings, bearings, or laminations.*

BRUSHES AND SPRINGS

Inspect brushes periodically. Brushes worn to 5/8 inch should be replaced. Use replacement brushes specified in the parts list for this welder. Other brushes may look identical but have entirely different electrical characteristics. Replace springs if damaged or if proper tension is questionable. To remove the brush, press down on the spring holder and out (Figure 5-9). Then lift the brush from the guide. Spring tension for the DC brushes is 30 to 34 ounces and for the AC brushes is 16 to 20 ounces. Always replace a brush spring if it is twisted, bent or broken.

BRUSH RIG ADJUSTMENT

For brush rig adjustment of DC generators see the *ADJUSTMENTS* portion of this section.

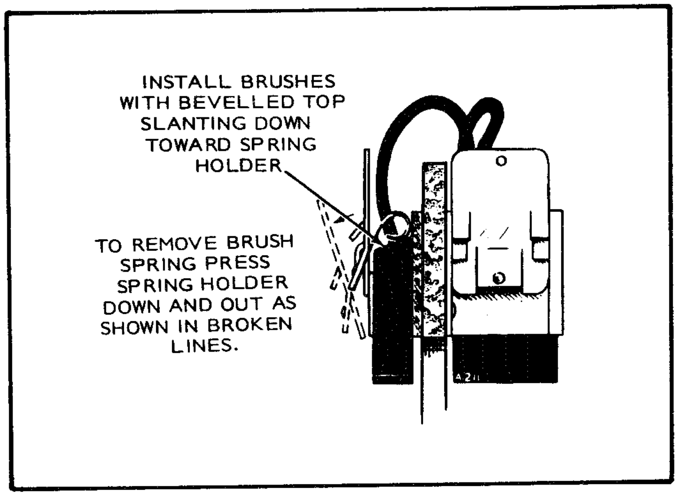


FIGURE 5-9. BRUSH REPLACEMENT

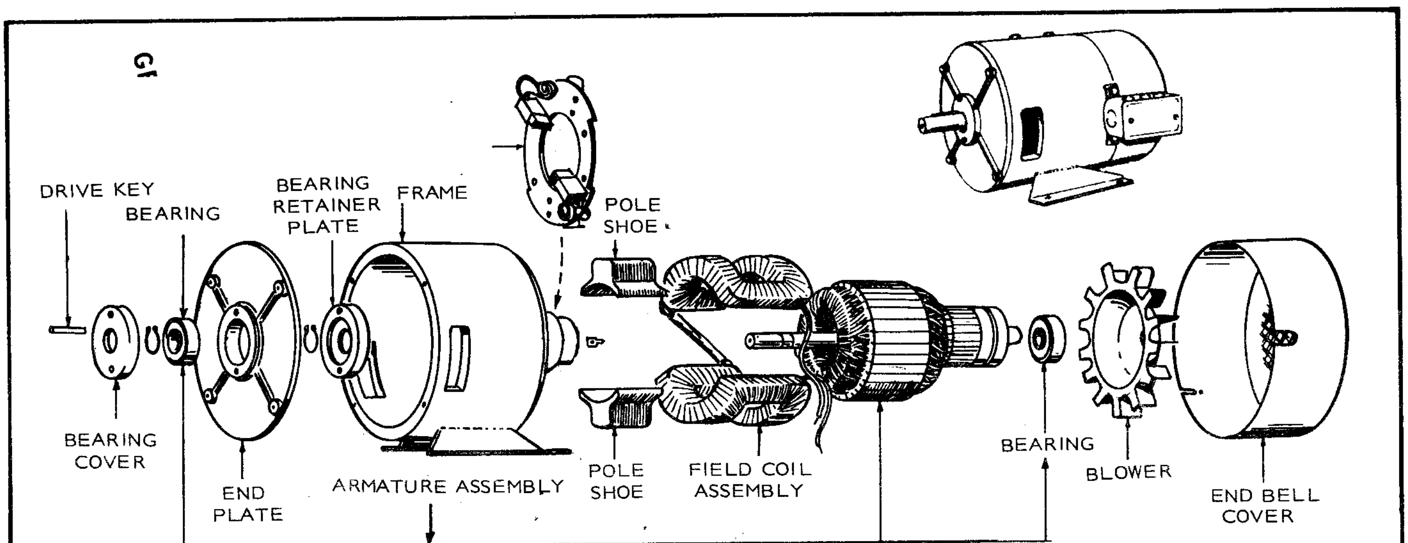


FIGURE 5-8. TWO BEARING DC GENERATOR

COLLECTOR RINGS

If collector rings become grooved or out-of-round, or the brush contact surface becomes pitted or rough so that good brush seating cannot be maintained, remove the armature and refinish the collector rings in a lathe. If the commutator appears to be rough or scored, refinish it at the same time. Remove or adequately shield the ball bearing during refinishing.

COMMUTATOR

The commutator gradually wears with use. If the proper brushes have been used, and they have been replaced at the proper intervals, this wear will be slow and even. Under dusty conditions or if improper brushes have been used, the wear may be accelerated. Improper or excessive cleaning with sandpaper may cause the commutator to become grooved or out-of-round. Refinish in a lathe.

CAUTION *Never bend the constant-pressure spring over the edge of its support.*

Rapid brush wear may be caused from high mica between commutator bars, rough commutator or collector rings or from a deviation from "neutral" position in the adjustment of the brush rig.

TURNING COLLECTOR RINGS OR COMMUTATOR (Using a Lathe)

When a collector ring or commutator becomes grooved, worn out of round or pitted, it should be turned true on a lathe. This operation is easily performed by any qualified lathe operator. Remove the armature and center accurately on the lathe. Turn the commutator or collector ring enough to provide a perfectly true surface. Tool marks can be removed by using number 00 sandpaper.

After turning the slip rings, cut a slight chamfer on them to remove burrs and sharp edges. This reduces the possibility of a "flash over" between the rings. After turning the commutator, the mica insulation between the commutator bars must be undercut as described in the paragraph *"UNDERCUTTING THE MICA INSULATION."*

NOTE: *Always install new brushes after servicing slip rings and commutator.*

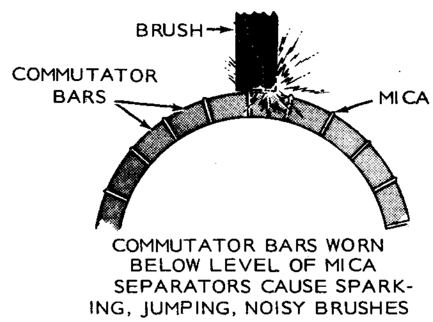


FIGURE 5-10. HIGH MICA ON COMMUTATOR

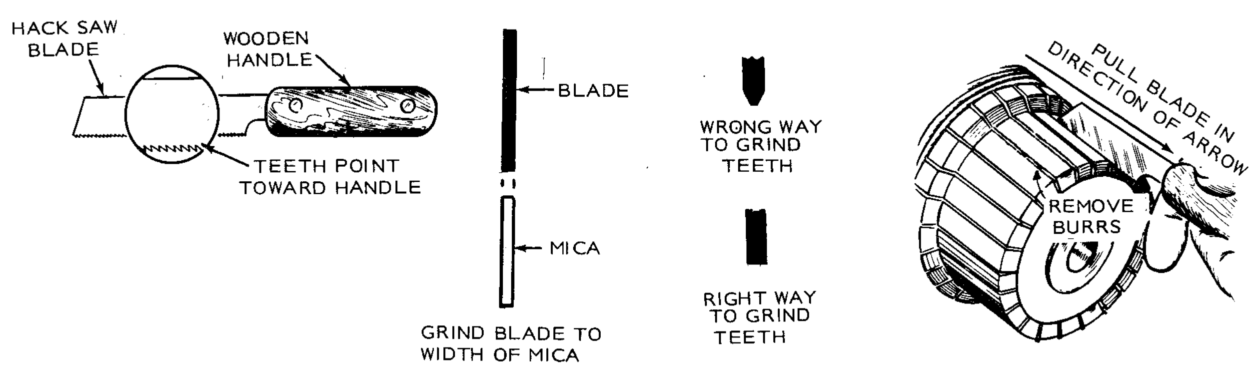


FIGURE 5-11. UNDERCUTTING COMMUTATOR MICA

UNDERCUTTING THE MICA INSULATION

When the commutator wears down so that the mica insulation between any bars comes in contact with the brushes, it will cause the brushes to "jump", spark, be noisy in operation and wear rapidly. Sparking brushes lower the efficiency of the generator and burn the commutator (Figure 5-10). When a "high mica" condition exists or after commutator has been turned on a lathe, mica insulation requires undercutting. A typical tool for this is shown in Figure 5-11.

To undercut the mica, center the cutting tool over the mica and with a firm, steady pull draw the tool the length of the commutator.

CAUTION *Be careful not to draw the undercutting tool into the slip rings.*

Repeat the cutting operation until the mica has been cut down to approximately 1/32 inch below the surface of the commutator. As each section of mica is cut to the proper depth, proceed to the next one until all are equally undercut. If any burrs are present along the edges of the bars after the mica is undercut, carefully remove them. This is done by holding a piece of number 00 sandpaper against the commutator with a perfectly flat piece of wood while the commutator is turning rapidly. Before putting the armature back into service, be sure to blow or brush all mica dust, metallic particles, etc. from the commutator grooves and surface. The edges of the bars on the larger commutators should be beveled to assure a good edge.

TESTING WINDINGS

A test lamp set and an armature growler are required for the various tests. Before making any tests, lift all brushes in their holders and disconnect the load circuit wires from the welder. If the armature tests defective, the practical repair is to replace it. If a field coil tests defective, replace the entire coil assembly unless the trouble is in one of the external leads. Then it can be repaired as required.

ARMATURE GROUND TEST

To test the armature for a grounded condition, lift or remove the brushes so that none contact the commutator or collector rings. Use a continuity test lamp set. Place one test prod on the commutator, and the other test prod on a bare, clean part of the armature shaft (Figure 5-12). The test prods must make good electrical contact. If the test lamp glows, the DC winding or commutator is grounded. Replace the armature.

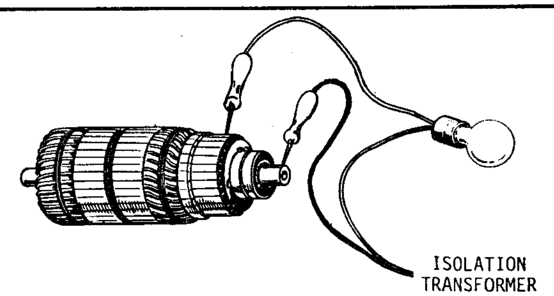
To test the AC winding, place one prod on one of the collector rings and the other prod on the armature shaft (Figure 5-13). The lamp shouldn't glow. Continuity, lamp glowing, indicates the AC winding or a collector ring is grounded. Replace armature.

ARMATURE OPEN CIRCUIT TEST

If the armature has AC windings they may be tested for an open circuit without armature removal. Testing DC windings requires armature removal and the use of an armature growler.

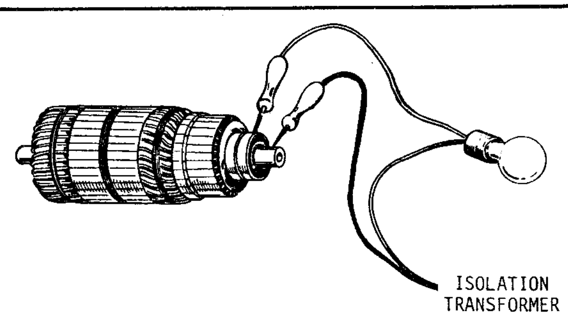
To test the AC windings, be sure all brushes are lifted or removed. Place one prod on each of the collector rings (Figure 5-14). If the test lamp glows (continuity), the AC winding is okay. If it doesn't glow, the AC winding is open and the armature should be replaced.

To test the DC winding, place the armature in a growler. With the growler current on, pass a smooth steel strip across the commutator segments (Figure 5-15). Repeat all around the commutator. At some point around the commutator, a spark should occur as the strip contacts two adjacent segments. Rotate the armature slightly and repeat the test. Continue until a spark is obtained between all adjacent segments. If no spark is obtained at some point, an open circuit is indicated. Replace an open circuited armature with a new one.



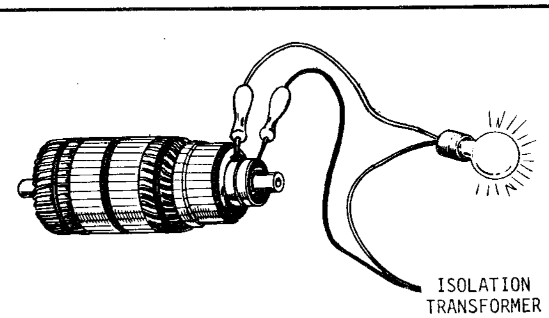
ONE PROD ON COMMUTATOR, ONE PROD ON ARMATURE SHAFT. -SHOULD NOT LIGHT.

FIGURE 5-12. ARMATURE DC GROUND TEST



ONE PROD ON SLIP RING, ONE PROD ON ARMATURE SHAFT. -SHOULD NOT LIGHT.

FIGURE 5-13. ARMATURE AC GROUND TEST



ONE PROD ON EACH SLIP RING. -SHOULD LIGHT.

FIGURE 5-14. ARMATURE AC OPEN TEST

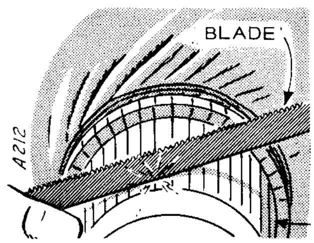


FIGURE 5-15. ARMATURE DC OPEN TEST

NOTE: *A short circuit in the winding might prevent sparking. This condition may be indicated by the short circuit test described in the next paragraph.*

ARMATURE SHORT CIRCUIT TEST

To test for a short circuit, place the armature in a growler. With the growler current on, hold a steel strip about 1/2 inch above the armature laminations (Figure 5-16). Pass the strip back and forth over the laminations. Cover as much of the lamination area as possible. If the strip is magnetically attracted to the armature at any point, a short circuit is indicated. After testing in one position, rotate the armature slightly in the growler and repeat the test. Continue until a complete revolution of the armature in the growler has been made. Replace a short circuited armature with a new one.

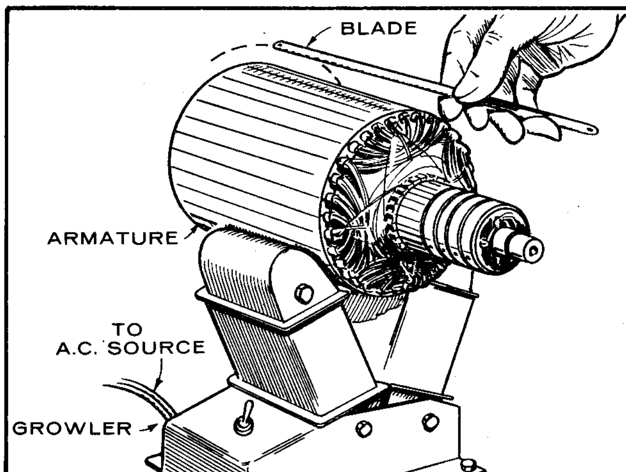
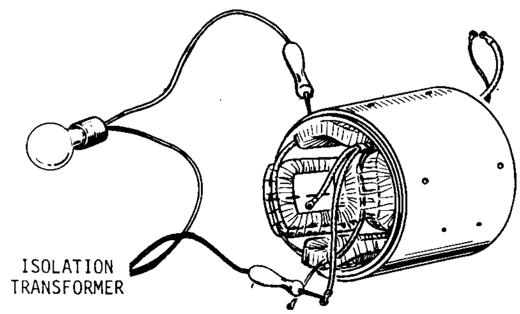


FIGURE 5-16. ARMATURE SHORT CIRCUIT TEST

TESTING FIELD WINDINGS FOR GROUNDS

To test a coil assembly for a ground, disconnect its external leads and touch one test prod to the terminal of one of its leads and the other test prod to the generator frame. Continuity (lamp glows) indicates the coil assembly is grounded (Figure 5-17). The ground may be in a coil, coil connection or coil lead. Repair or replace as required. Repeat procedure for each coil assembly.

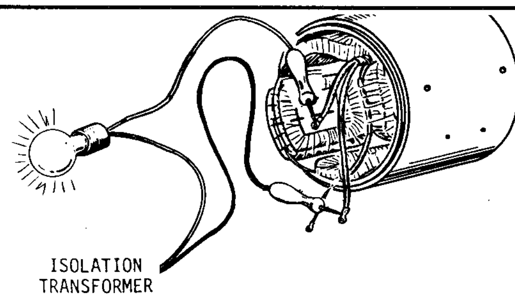


ONE TEST PROD TO GENERATOR FRAME. OTHER TEST PROD TO COIL ASSEMBLY. -SHOULD NOT LIGHT.

FIGURE 5-17. GROUND TEST FOR FIELD WINDINGS

TESTING FIELD WINDINGS FOR OPEN CIRCUIT

To test a coil assembly for an open circuit, disconnect its external leads and touch one test prod to the terminal of one coil winding lead and the other test prod to each of the other leads of the coil winding in turn (Figure 5-18). If the test lamp doesn't glow, the field coil circuit is open. If the open circuit is caused by a connection between coils or in a coil lead, the trouble can be repaired. If it is inside the coil itself, the entire coil assembly must be replaced. Repeat the procedure for each coil assembly.



ONE TEST PROD ON EACH FIELD COIL LEAD -SHOULD LIGHT.

FIGURE 5-18. OPEN TEST FOR FIELD WINDINGS

RECTIFIERS

Test each rectifier believed to be defective by isolating it and measuring the resistance first in one direction, then in the other. If the rectifier is operating properly, one reading will be at least 10 times higher than the other. If a test lamp is used, first touch the tester probes together and observe the brightness of the bulb. Then touch them across the rectifier. If the bulb lights brightly or not at all, the rectifier is defective. If it lights dimly, this indicates that the rectifier is passing current in only one direction and is functioning properly. Replace any rectifier found defective. Figure 5-19 illustrates the rectifier checking procedure.

VOLTAGE REGULATOR TEST PROCEDURE

Use the following instructions and refer to Figure 5-20 for checking voltage regulators on CCK welders.

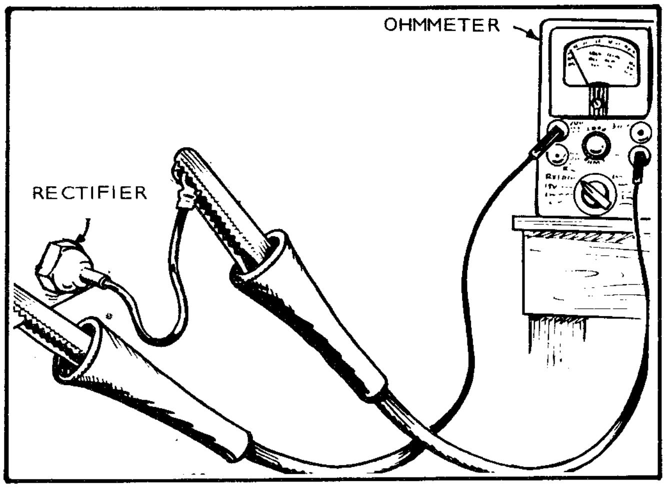


FIGURE 5-19. RECTIFIER TESTING

1. Move switch (S) to constant current position.
2. Connect ohmmeter to sockets 1 (J1-1) and 4 (J1-4) of jack J1. The ohmmeter must show a continuous circuit.
3. Energize relay K by applying 120volts, 60 CPS to J2. The ohmmeter must show an open circuit.
4. De-energize relay K and switch S to constant potential position. Ohmmeter must show an open circuit.
5. Disconnect ohmmeter.
6. Install RMS reading ammeter in series with 120 volts, 60 CPS applied to J1-7 and J1-8. Energize relay K by applying 120volts, 60 CPS to J2.
   a. Ammeter reading must be less than 0.13amps.
   b. Voltage between J1-6 and J1-5 must be 17±1 volt DC.
   c. Voltage between J1-1 and J1-2 must be 26±1 volt DC.
7. Connect a 10-ohm, 50watt resistor to J1-1 and J1-2. Apply and maintain 120volts, 60 CPS at J1-7, J1-8. Voltage across 10-ohm resistor must be 7±05 volts DC with rheostat R in minimum voltage position, and 22±1.5 volts DC with rheostat in maximum voltage position.
8. Ambient at 77°F. (20°C.).

BALL BEARING

If armature bearing replacement becomes necessary, pull the bearing or bearings from the shaft with a suitable bearing puller. Be careful not to damage the armature shaft because it must remain true to serve as a turning center when refinishing the commutator or collector rings. Drive the bearing on to the shoulder of the shaft.

NOTE: *The bearing is prelubricated, double sealed and normally requires no service. However, when rebuilding the engine or generator, or if the bearing ever becomes noisy, replace it.*

GENERATOR ASSEMBLY

1. Clean and inspect all mating surfaces. Surfaces should be free of nicks and dirt.
2. Coat mating area between the generator shaft and the engine crankshaft with a thin film of lubricating oil, Molykote or equal.
3. Assemble the armature through stud to the engine crankshaft with required torque.
4. Check to see that the key is in the crankshaft.
5. Slide armature over the through stud and onto the crankshaft being careful not to let the weight of the armature rest on the through stud.
6. Install baffle ring, when used.
7. Assemble generator through studs to the adapter with required torque.

CAUTION *Do not tighten the armature or rotor through stud before mounting the frame and bearing support. If this procedure is not followed, misalignment may occur shortening the life of the rear main and outboard bearings. Also, cranking torque requirements could be doubled, resulting in damage to the commutator and DC brushes of the starter.*

8. Install the frame and bearing support. Tighten frame to required torque.

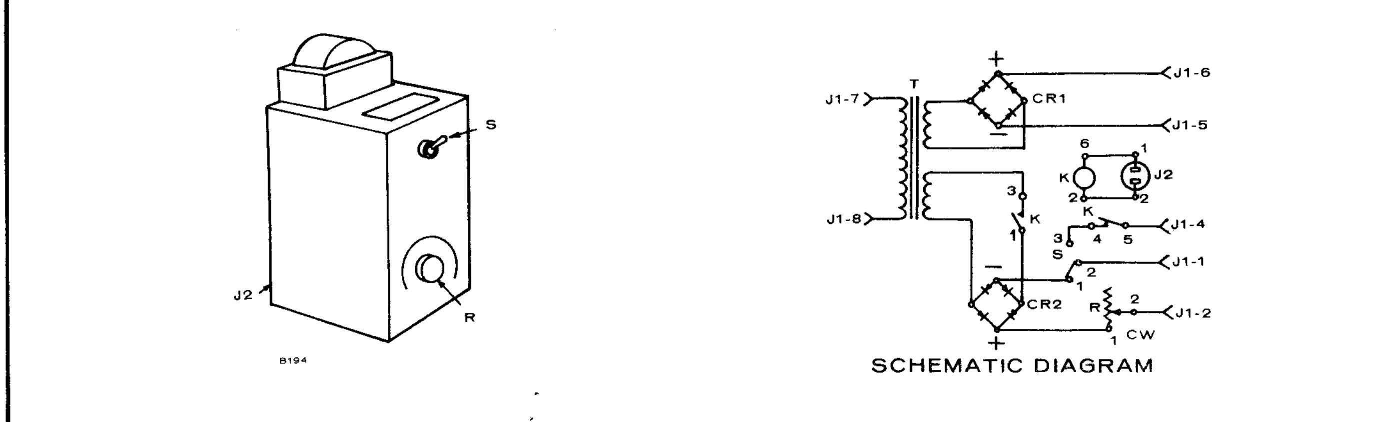


FIGURE 5-20. VOLTAGE REGULATOR ADJUSTMENT

9. Now torque down the armature through-stud nut. Because the frame and bearing support were tightened before tightening the armature, the armature and frame are aligned.
10. Tap the bearing support in the horizontal and vertical plane with a lead hammer to relieve stresses on the components and then recheck the torque.
11. Reconnect the wire leads to the engine.
12. Reinstall the battery cables.
13. Align the brush rig.

DC SEPARATE GENERATORS

The preceding information pertains to all DC generators. The following data refers to DC separate generators only.

WIRING CONNECTIONS

The generator external leads are not connected, and their manner of connection will depend upon the *DIRECTION OF ROTATION*. Refer to the *Wiring Diagram*.

The leads are marked as shown on the wiring diagram. The rheostat must be connected as shown, depending upon direction of rotation of the generator. Examine the rheostat carefully before connecting it into the generator circuit. The rheostat resistance wire may be composed of two different size wires, spliced near the center of the entire winding. If the rheostat is of this type, one generator lead must be connected to the center rheostat post, and the remaining generator lead to the post on the heavier size of the rheostat. Never connect to the lighter side of the rheostat.

Observe specifications of local and national electrical codes for connecting to the electrical load. Use wire sufficiently large to avoid excessive voltage drop between the generator and the load.

DRIVING UNIT

The proper size and type of driving unit for the generator is important for satisfactory operation of the generator. When a gasoline or diesel engine is used the following factors should be considered:

1. **Engine Power:** The engine must have a minimum of 2 horsepower for each 1000 watts of generator output. For example, if a 5,000 watt generator is to be operated, the engine must deliver at least 10 horsepower at the drive shaft. If the engine has a considerable reserve of power the speed regulation and voltage regulation will be much better.

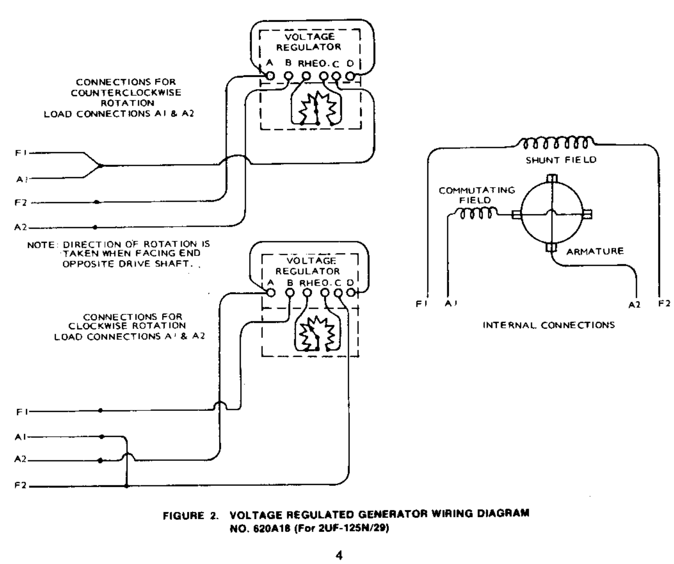


FIGURE 5-21. VOLTAGE REGULATED GENERATOR DIAGRAM

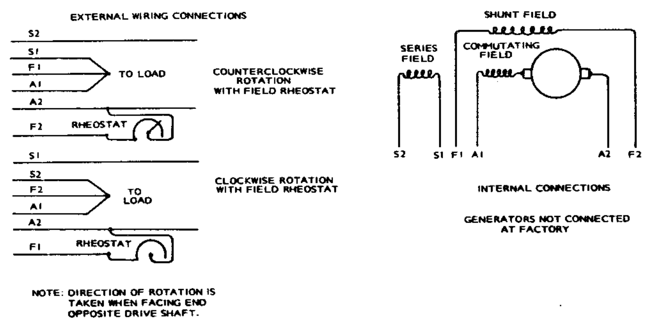


FIGURE 5-22. COMPOUND WOUND DC GENERATOR WIRING DIAGRAM

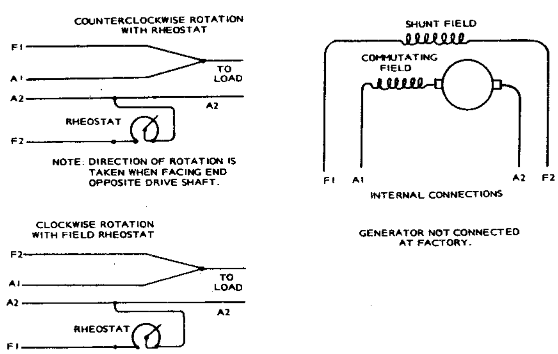


FIGURE 5-23. SHUNT WOUND DC GENERATOR WIRING DIAGRAM

2. **Engine Pulley Speed:** The engine may have a variable speed governor which regulates engine speed at about 8-1/2 to 12 percent. If so, governor operation is best at the maximum rated speed of the engine. When the generator is operating at or near its capacity, the tendency of the engine is to increase speed when the load is suddenly removed. The engine governor does not react fast enough at low speed to prevent momentary acceleration and high voltage. This may possibly cause serious damage to any electrical equipment left connected. Governor action is much better when the engine is operating at its rated speed, and the engine cannot increase its speed too much when the load is removed. If the engine has a constant speed governor, the speed regulation is 5 percent or less and the above effects are not present. Low generator speed causes low voltage.

3. **Pulley Selection:** The rated speed of the engine (or electric motor) driving the generator will determine the size of pulley to use on the generator. Drive the generator as near as practicable to the rated generator speed, then adjust the rheostat to attain the desired voltage. To determine the correct generator pulley size to use, proceed as follows:

   a. Multiply the *diameter* of the driving unit pulley by its *speed* in rpm (revolutions per minute).

   b. Divide the above result by the nameplate speed on the generator.

   EXAMPLE: A driving pulley 15 inches in diameter operates at 1200 rpm. Multiply 15 x 1200 getting a result of 18,000. Divide the 18,000 by 1750 rpm (generator pulley speed desired) and the final result is 10 (nominal), which expresses the size of the pulley (in inches) required.

REVERSING THE SCROLL

The generator is shipped from the factory with the blower scroll mounted for counterclockwise rotation. The direction of rotation is determined while looking at the end opposite the drive end. If a clockwise direction of rotation is desired, the blower scroll position must be reversed. The arrow which is printed on the scroll must be pointing in the direction of the rotation of the generator shaft. See illustration, *BLOWER SCROLL.*

To reverse the scroll, remove only the scroll with screen attached, turn it end for end and reinstall it so that the scroll will be at the opposite end of the air outlet hole, as illustrated.

POLARIZING THE GENERATOR FIELD

When the generator is received the generator field is correctly polarized for counterclockwise direction. After the generator field is once polarized it does not have to be polarized again unless the direction of rotation of the generator is changed. The procedure for polarizing the generator field is different for each direction of rotation of the generator. Follow the instructions for polarizing the generator field for whatever direction of rotation of the generator is to be used. The use of a good battery in fully charged condition (or a higher DC voltage source) is required. Have the generator field leads (F1, F2) disconnected from the control (rheostat or regulator where used).

1. **Polarizing the Generator Field for Clockwise Rotation** (use a 24 volt battery when polarizing the generator, check battery for *full 24 volt output):*

   a. Connect the generator F2 lead to the battery positive (B+) terminal.

   b. Connect the generator F1 lead to the battery

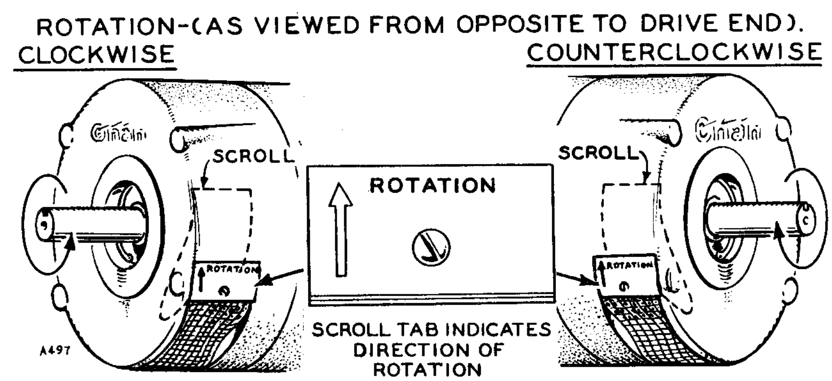


FIGURE 5-24. BLOWER SCROLL

negative (B–) terminal. Be sure good contact is made. A definite spark should be observed where this is done. If no spark is seen, check for bad battery or open circuit between F1 and F2.

c. Connect the generator as shown in the *Generator Wiring Diagram* and check the polarity of the A1 lead with a DC voltmeter. The polarity of the A1 lead must always be positive. With the generator running the meter should read in the right direction when the positive terminal of the meter is connected to A1 and the negative terminal of the meter is connected to A2. If the voltmeter does not read in the right direction, check all connections and repeat the polarizing procedure until it does. A weak spark or a reverse reading indicates a higher DC voltage source is needed to kill the existing residual magnetism. (**NOTE**: *If an ONAN Switchboard Control is being used with model* 5UF-125N, *connect the generator as shown on the Wiring Diagram for that control.)*

2. **Polarizing the Generator Field for Counterclockwise Rotation:**

a. (**NOTE**: *This procedure is required only if a return to counterclockwise rotation is desired.)* Connect the generator F1 lead to the battery positive (B+) terminal.

b. Connect the generator F2 lead to the battery negative (B–) terminal. Be sure good contact is made. A definite spark should be observed where this is done. If no spark is seen check for bad battery or open circuit between F1 and F2.

c. Connect the generator as shown in the *Generator Wiring Diagram* for counterclockwise rotation and check the polarity of the A1 lead with a DC voltmeter. The polarity of the A1 lead must always be positive. With the generator running the meter should read in the right direction when the positive terminal of the meter is connected to A1 and the negative terminal of the meter is connected to A2. If the voltmeter does not read in the right direction, check all connections and repeat the polarizing procedure until it does. A weak spark or a reverse reading indicates a higher DC voltage source is needed to kill the existing residual magnetism. (**NOTE**: *If an ONAN Switchboard Control is being used with model* 5UF-125N, *connect the generator as shown on the Wiring Diagram for that control).*

ONAN SWITCHBOARD CONTROLS
(For Model 5UF-125N)

Specially designed ONAN Switchboard Control Model No. 5S-125/A is available for generator Model 5UF-125N. This control includes voltmeter, ammeter, outlet receptacle, circuit breaker, and output terminals. See the illustration, *Switchboard Control Wiring Diagram,* for making connections.

GENERAL

Separate operating instructions are given for each model listed in the *TABLE OF RATINGS*. Select the following instructions which apply to the model in question.

See that the generator is always kept in alignment with the driving mechanism. If a belt drive is used, see that belt tension is correct. A belt which is too tight will wear rapidly and cause excessive bearing wear on both generator and driving machine. A belt which is too loose will slip, wear rapidly, and cause low generator output.

Check the generator cooling air circulation. When the blower scroll is installed properly, a strong current of air comes out of the drive shaft end of the generator. See the paragraph on *REVERSING THE SCROLL* for proper installation of the blower scroll.

The generator must be driven in the direction for which it was connected and polarized, as previously explained.

INITIAL START
(Model 2UF-125N/29)

Be sure the generator is connected for the direction of rotation being used. On the initial start, run the generator with no load connected and adjust the regulator rheostat to obtain the desired rated voltage. Check the voltage under load operation.

GENERATOR OPERATION
(Model 2UF-125N/29)

As explained in the *TABLE OF RATINGS,* the automatic voltage regulator keeps the output voltage within 1-1/2 percent of the voltage selected by the adjustment of the rheostat, regardless of speed variation between driven speeds of 1200 and 2500 rpm.

The adjustable resistor on the voltage regulator base is set at the factory so that the rated voltage is obtained when the regulator rheostat is set in approximately the middle of its range or travel. Check abnormal speed or load conditions before attempting to readjust the resistor.

INITIAL START
(Model 5UF-125N)

Be sure the generator is connected for the direction of rotation being used. On the initial start, reduce the generator voltage by turning the manual field rheostat to the maximum counterclockwise position. Then, run the generator at no load and rated speed (see name-

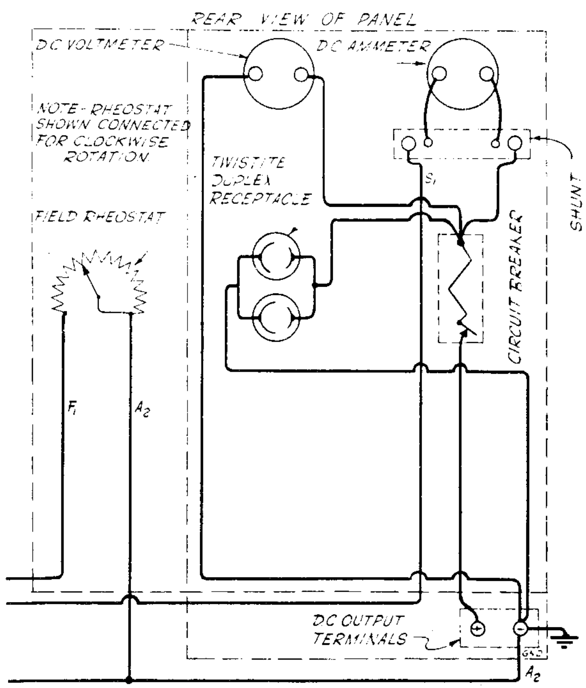


FIGURE 5-25. SWITCHBOARD CONTROL WIRING DIAGRAM

plate). Adjust the manual field rheostat to obtain a generator output of approximately 132 volts for a 125 volt rated generator with no load connected. This results in a desirable voltage under full load operation.

GENERATOR OPERATION
(Model 5UF-125N)

Connect the various electrical loads after the generator voltage is adjusted to the proper value at no load. The voltage can be controlled by the manual field rheostat or by changing the generator speed slightly. This may be necessary when large changes in the electrical load are made. The rheostat is used to compensate for slight variations from the nameplate speed. If the speed of the generator is held to within 100 rpm of that shown on the nameplate, the output differential between no load and full load conditions will be satisfactory.

Keep the electrical load on the generator within its nameplate rating. Overloading the generator will cause the voltage to be low.

SWITCHBOARD OPERATION
(Model 5UF-125N)

When the generator installation includes a Switchboard Control, generator operation can be checked by means of the voltmeter and ammeter. See the illustration, *Switchboard Control Wiring Diagram.* The circuit breaker is designed to automatically disconnect the load when the generator becomes excessively overloaded.

The Duplex receptacle is included so that small loads (not to exceed 15 amperes per receptacle) can be conveniently connected at the Switchboard. Loads connected at the receptacle do not pass through the circuit breaker but they are recorded on the ammeter. The generator current as read on the ammeter must not exceed the generator nameplate rating.

INITIAL START
(Model 10.0UF-150N & 10UF-150N)

Be sure the generator is connected for the direction of rotation being used. Set the rheostat at maximum resistance (minimum voltage) position. Start up the generator and drive it at nameplate rated speed. Connect a full load to the generator and adjust the rheostat to obtain 250 volts generator output as shown on the DC voltmeter.

GENERATOR OPERATION
(Model 10.0UF-150N & 10UF-150N)

Use these operating instructions only in the absence of any instructions furnished with the special control system used with the generator.

If it is known that a higher voltage when starting will not damage the load to be connected, the rheostat will not require adjusting between successive operations.

To assure protection of the load, begin each start with the manual field rheostat in the maximum resistance (minimum voltage) position. Start the generator and adjust the generator voltage by means of the manual field rheostat to 250 volts or to the rated voltage of the magnet. Connect the magnet to the generator by operating the magnet controller. After the magnet is connected to the generator, the voltage should again be adjusted to 250 volts or to the rated voltage of the magnet. As the magnet warms up its resistance increases until it reaches normal operating temperature. The voltage of the generator should be readjusted to the proper value when the magnet reaches normal operating temperature.

Keep the electrical load on the generator within its nameplate rating. Overloading the generator will cause the voltage to be low and overheat the generator. The generator is rated for "50% DUTY CYCLE – not over 30 minutes per full load run". Fifty percent duty cycle means that if for example, the lifting magnet is "turned on" for approximately five minutes, then it should be "turned off" for approximately five minutes (or as conditions require to prevent overheating of the generator).

BELT ADJUSTMENT, BELT DRIVE UNITS

Proper belt tension must be maintained at all times. Too much belt tension will cause an extra load on the driving unit and rapid wear of the belts and generator bearings. Belts which are too loose will slip, wear out rapidly, and cause the generator to run at a lower speed. Reduced generator speed causes lower output voltage.

To test the V type belt tension, press down on the belt at a point midway between the driving unit and generator pulleys, with the unit not in operation. It should be possible to press the belt down a certain amount depending upon the distance between the belts. When more than one belt is used, each belt should show the same tension. When necessary to replace a worn belt, all belts should be replaced at the same time. A new belt will stretch slightly when first put into operation. Tension should be frequently checked during the first week or two of operation. After this period, little further adjustment should be required.

Driving unit and generator pulleys must be in alignment. To test alignment, place a straight edge tool against the side of the outer driving unit pulley. As a straight edge contacts both sides of the driving unit pulley, it should also contact both sides of the generator pulley. Complete contact of both pulleys should be made at the same time. It may be necessary to loosen the mounting bolts of either the driving unit or generator and slightly turn the loosened unit for proper alignment. Be sure to retighten the mounting bolts.

ALIGNMENT, COUPLING DRIVE UNITS

Coupling (direct) drive units have the driving unit and generator shafts in line with each other. If either the driving unit or generator is loosened from the base, the loosened unit must be properly realigned when installed. Misalignment will cause vibration and excessive strain on the coupling and bearings. Generator shaft maximum run-out is .002 inch.

CONTROL TROUBLESHOOTING
(For Model 2UF-125N/29)

No maintenance is required on the Regohm voltage regulator. The cover should always be kept on the regulator. The component parts of the regulator base assembly should be kept free of dust, grease and moisture.

If a hunting condition (alternate increase and decrease in voltage) exists when using an engine as prime mover, first check for too sensitive adjustment of the engine governor (not enough speed drop from no load to full load condition). Also check for too lean fuel mixture due to incorrect carburetor adjustment. If the hunting condition cannot be eliminated by adjusting the governor and carburetor, then the voltage regulator dashpot screw must be adjusted slightly (see illustration). *NEVER ATTEMPT TO ADJUST ANY OTHER PART OF THE REGULATOR PLUG-IN UNIT.*

Be sure the generator brush rig is in neutral position (witness marks aligned for least arcing and highest voltage) before moving the adjustable resistor sliding clip in order to attain the desired voltage when the rheostat is set at approximately the middle of its travel. Check the voltage output when operating the rheostat to see that the range of adjustment is satisfactory.

If faulty operation occurs, the circuit of the generator and load should be checked first. If the cause of the faulty operation can be definitely traced to the voltage regulator, return it for inspection to the factory or to an ONAN Authorized Service Station. Return the entire base assembly, consisting of the resistors, plus the regulator plug-in-unit; remove wires connected to the terminals marked A, B, RHEO, C and D.

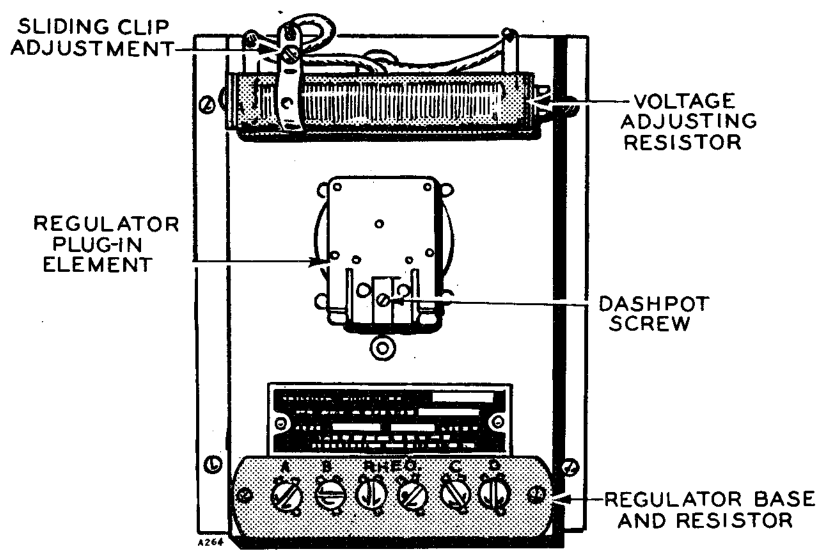


FIGURE 5-26. REGOHM VOLTAGE REGULATOR ADJUSTMENT

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