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AIRCRAFT ELECTRICAL RESEARCH DIVISION
ELECTRICAL POWER SECTION

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Declassification authority: NAVY DECLASS MANUAL, 11DEC 2012, 02 SERIES

THE EFFECT OF LOAD ON VOLTAGE AND SERIES COMPENSATING CAPACITANCE FOR AIRBORNE AC GENERATORS

By D.S. Toffolo and E.A. White

- Report E-2669 -

Unclassified
[redacted]

FR-2669

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NRL Problem TED No. 31E39

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ABSTRACT

Studies were conducted in accordance with Project Directive TED No. NRL 31E39 to determine the effect of load types on adjustment and performance of A.C. carbon pile voltage regulators and on the amount of compensating capacitance required by A.C. generators for aircraft. The Eclipse type 1097-3-C, Navy type NEA-5, AC-DC generator was used in conjunction with the Eclipse type 1317-1-A AC carbon pile voltage regulator to determine the effect of different type loads i.e., carbon pile, lamp bank, APX-2 radar, APS-4 radar and simulated radar on the regulator adjustments to obtain the specified voltage. The regulators for these generators were adjusted at 6000 RPM to give minimum voltage droop. Voltage as a function of speed was taken for the various load conditions. Load runs were taken with all but the radar loads. Speed runs were made on five AC-DC generators with constant field current to determine the effect of compensating capacitance on minimum and maximum rated speeds of the generators when supplying various power factor loads at full load rated voltage (115 volts rms.) Optimum regulator adjustment differs for various type loads and power factors, but an adjustment can be made which will work satisfactorily with all the different loads used for this work. The optimum value of capacitance to use will depend upon the power factor of the load supplied by the generator, the generator itself, and the average speed at which the generator is driven. The value of capacitance to use as series compensation should be selected on the basis of the power factor of loads to be supplied by the generator.

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INTRODUCTION

A. Authorization

1. The request for the work contained in this report originated in the Bureau of Aeronautics.

B. References

2. (a) BuAer ltr Aer-E-3121-SHH, F36-1(1), Serial number 97205, dated 9 June 1945.
   (b) BuAer ltr Aer-E-3121-SHH, F36-1(1), Serial number 100510 dated 15 June 1945.

Reference is made in this report to the following Naval Research Laboratory report:

   (c) NRL ltr R-F42-1/21(316-1:EAW), R-310-55/45(mec), dated 21 March 1945.

C. Background

3. The object of the report was to determine the following for AC-DC generators used in aircraft:

A. The pile and core screw settings of the AC carbon pile regulator using:

(a) Lamp bank load
(b) Carbon pile load
(c) APX-2 and APS-4 radar loads
(d) Simulated radar (inductance in parallel)
(e) Simulated radar (inductance in series)

with an Eclipse type 1097-3-C, Navy type NEA-5, AC-DC generator and an Eclipse type 1322 control box (this includes the Eclipse type 1317-1-A AC carbon pile plug-in unit). All tests were to be made with 9 microfarads series compensation and data was to be taken over a load range of 0-10 amperes AC and a speed range of at least 4000-10,000 rpm. Adjustment of the regulator at 6000 rpm was to be for a minimum droop consistent with stability. The same regulator rheostat setting was to be used in all cases.

B. The effect of load power factor on the minimum amount of compensating capacitance required to meet minimum rated generator speed and on the maximum amount allowable to meet maximum rated generator speed. Measurements were to be made at rated full load current with 1.5 ohms in series with the alternator field winding and with 27.5 volts DC fixed excitation on the following generators:

Mfg.	Type	Navy Type	Serial No.	Rated Speed	Full Load Amperes
Eclipse	716-3-A	NEA-3	A-7938	2400/4200	10
Eclipse	1310-1-A	NEA-4	16	4400/8000	10
Eclipse	1097-3-C	NEA-5	2166	4400/8000	10
Eclipse	1406-1-A	NEA-7	14	4000/8000	21
Gen.Elec.	2CM81B2	NEA-5	1954298	4400/8000	10

C. The effect of compensating capacitance on rated minimum and maximum speeds for each of the above generators using 0.965 power factor linear inductive load. All tests were to be made using 1.5 ohms in series with the alternator field winding and with 27.5 volts DC fixed excitation. The speed range was to be from 75% to 125% of both minimum and maximum rated speeds.

D. The no load and full load saturation and synchronous impedance characteristics of the General Electric type 2CM81B2, Navy type NEA-5, generator at 4400 and 8000 rpm. The full load characteristics were to be taken at 0.90 power factor lagging, uncompensated.

E. The full load saturation characteristics of the Eclipse type 1097-3-C, Navy type NEA-5, serial number 2166 generator at 4400 and 8000 rpm. The full load characteristics were to be taken at 0.90 power factor lagging, both uncompensated and with 9 microfarads series compensation.

4. An Eclipse type 1097-3-C, Navy type NEA-5, serial number 2166 generator was used in conjunction with an Eclipse type 1317-1-A AC carbon pile voltage regulator to determine the regulator pile and core screw settings and the voltage regulation of the generator with variable speed and with amounts and types of loads. The generator and regulator were brought to equilibrium temperature at 6000 rpm and full load, 10 amperes AC, 9 microfarads series compensation and 200 amperes DC. The same regulator rheostat setting was used for all type loads; the voltage was established largely by core screw adjustment. The regulator pile screw and core screw adjustments were made to give minimum voltage droop, and, then, the voltage regulation as a function of speed was determined. The load runs were then taken at 4400, 6000 and 8000 rpm to determine the voltage regulation. The results of these runs are shown in Figures 1-15. Refer to Table I for a guide in selecting the particular load condition desired. No runs were made as functions of load with the radar equipment since it was not possible to vary the load. Table II shows the pile screw and core screw settings together with the range over which the voltage of the Eclipse type 1097-3-C, Navy type NEA-5, serial number 2166 generator was within specification limits. The minimum pile screw setting was 10.5 and the maximum was 11. This represents a change of 0.5 division on a scale of 24 divisions per 360 degree turn. The pile screw has 40 threads per inch. This makes the total required difference in pile screw settings 0.00052 inch. The minimum core screw setting was 11.5 and the maximum was 12.5. This represents a change of 1 division on a scale of 24 divisions per 360 degree turn. The core screw has 28 threads per inch. This makes the total required difference in core screw settings 0.00149 inch.

METHOD

5. The five AC-DC generators listed in the introduction were operated to determine the effect of capacitance upon the minimum speed and maximum speed ratings for various power factor loads, including 0.965 power factor lagging. Although in the problem as listed in the introduction, paragraph 3-C specified only 0.965 power factor lagging, other power factor runs were taken to furnish data necessary for the information desired in paragraph 3-B of the introduction. The power factor loads most closely simulating radar loads were those with an inductance in parallel with a carbon pile load. However, neither simulated radar load duplicated the regulator adjustment obtained on the radar load. The deviations are given in Table II. Refer to Table I for the index to the figures showing the results obtained on each generator. Note that the tests were actually run with constant alternator field current, whereas, the problem specified 27.5 volts DC fixed excitation. This change was made because it was difficult to get consistent results with 27.5 volts DC fixed excitation. The difficulty arises from the fact that at different speeds the losses differ making the operating temperature of the generators change. Hence, during any one particular power factor run it was not possible to keep the temperature of the generator constant. This change in temperature will cause a change in alternator field winding resistance and a corresponding change in alternator field current delivered from a constant potential (27.5 volts) source. A new variable would then be introduced as can be seen from enclosure (b) of reference (c), Figures 9, 18, 27 and 36 where it is evident that for small increments of field current at maximum rated speed, there is a large increment in capacitance. The General Electric type 2CM81B2, Navy type NEA-5, generator showed the largest change in field current with change in speed. Figure 13 of this report shows the results obtained on this generator with 27.5 volts DC fixed excitation in comparison to Figure 12 which shows the results obtained with constant field current. Field current values for the run taken with constant 27.5 volts DC excitation are shown in Figure 14 and show the effect upon the field current of temperature changes resulting from changes in speed. Accordingly, for the General Electric type 2CM81B2, Navy type NEA-5, two runs were made, one with 3.95 amperes field current and one with 4.10 amperes field current. Referring to Figure 12, the speed range for 3.95 amperes field current with 15 microfarads series compensation extends from 5060 rpm to 8200 rpm for power factors ranging from 0.90 to unity. The speed range for 4.10 amperes field current with 15 microfarads series compensation extends from 5370 rpm to 9800 rpm for power factors ranging from 0.90 to unity. Thus, at high speeds it is seen that an increment of 0.15 amperes in the field current causes an increment of 1290 rpm in the speed range and a difference of 1600 rpm at unity power factor. For low speeds, the change in speed for the same increment of field current is negligible due to the characteristic for the low speed range of the compensation curves referred to in reference (c).

6. The information desired in paragraph 3-B was obtained from the results discussed above in paragraph 5. This was accomplished by erecting an ordinate at the minimum and maximum speed ratings of each machine on the capacitance versus speed graphs, Figures 12, 15, 16, 17 and 18. The intersection of the various power factor curves with the erected ordinates give the results shown in Figures 19 to 23 inclusive. Again, Figure 19 clearly demonstrates the effect of change in field current. For a field current increment of 0.15 amperes, the capacitive increment varies from 0.5 to 1.5 microfarads depending upon the power factor of the load. For the General Electric type 2CM81B2, Navy type NEA-5, any value of capacitance between 6 and 10 microfarads will work with power factor loads ranging from 0.90 lagging to unity over the rated speed range of the generator. For the Eclipse type 716-3-A, Navy type NEA-3, the value of capacitance is critical in that the maximum capacitance is the same as the minimum capacitance for a particular power factor. For this generator, it is highly desirable that the power factor of the load be ascertained before a value of series compensating capacitance is selected. For the Eclipse type 1310-1-A, Navy type NEA-4, any value of capacitance between 6 and 8 microfarads will work with power factor loads ranging from 0.90 lagging to unity over the rated speed range. For the Eclipse type 1097-3-C, Navy type NEA-5, 6 microfarads series compensating capacitance will most likely prove satisfactory for all power factor loads from 0.90 lagging to unity over the rated speed and 7 microfarads will also work from power factor loads ranging from 0.95 lagging to unity power factor. For the Eclipse type 1406-1-A, Navy type NEA-7, the value of capacitance again will be dependent upon the power factor of the load and the power factor of the load should be ascertained before a value of compensating capacitance is selected.

7. The General Electric type 2CM81B2, Navy type NEA-5 was run as outlined in the problem, paragraph 3-D of the introduction. The results of the minimum rated and maximum rated speeds are shown in Figures 24 and 25, respectively. The open circuit voltage and synchronous impedance curves show a direct relationship to generator speed and, therefore, the short circuit current curves are the same for both minimum rated and maximum rated speeds.

8. The Eclipse type 1097-3-C, Navy type NEA-5, was run as outlined in the problem, paragraph 3-E of the introduction. The results of the minimum rated and maximum rated speeds are shown in Figures 26 and 27 respectively. The open circuit voltages show a direct relationship to the speed but the full load voltages do not because 9 microfarads series compensation has a different reactance and, therefore, different effect upon the voltage at minimum rated speed than at maximum rated speed.

CONCLUSIONS

9. It appears that the difference in core screw settings for different types and different power factor loads, while appreciable, seems to be of such a magnitude that a setting made with a carbon pile, unity power factor load will be satisfactory for other types and power factors of loads, because the adjusting rheostat has sufficient range to compensate for changes in voltage with other type and power factor loads.

10. The optimum value of series compensating capacitance to use with each generator will be dependent upon the average power factor of the load to be supplied by the generator. The General Electric type 2CM81B2, Navy type NEA-5, will give the greatest range of selection.

11. The optimum value of series compensating capacitance to use with each generator will also be dependent upon the average speed of the generator.

12. The General Electric type 2CM81B2, Navy type NEA-5, will not deliver full load (10 amperes) at 0.90 power factor lagging without compensation over the rated speed range, because the demagnetizing effect of armature reaction at this power factor is too high.

13. The Eclipse type 1097-3-C, Navy type NEA-5, will deliver full load (10 amperes) at 0.90 power factor lagging with 9 microfarads series compensation at its minimum rated speed, but not at its maximum rated speed, as the maximum allowable capacitance at maximum rated speed for 0.90 power factor lagging full load (10 amperes) is 6.3 microfarads (refer to Figure 21).

RECOMMENDATIONS

14. The value of series compensating capacitance to be used with each of the five type AC-DC generators tested in this report should be based upon a study of the load power factor requirements to be met by the generator; and the voltage should be checked at the minimum rated and maximum rated speeds of the generators to determine if it is within specification limits.

TABLE I

Regulation Characteristics

Fig. 1	Carbon Pile Load	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Speed " " "
	Lamp Bank Load	D.C.-Open Circuit D.C.-Full Load	" " " " " "
Fig. 2	Carbon Pile Load	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Load " " "
Fig. 3	Lamp Bank Load	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Load " " "
Fig. 4	APX-2 Radar Load	D.C.-Open Circuit	Voltage vs. Speed
Fig. 5	APS-4 Radar Load	D.C.-Open Circuit	Voltage vs. Speed
Fig. 6	APX-2 & APS-4 Radar Load	D.C.-Open Circuit	Voltage vs. Speed
Fig. 7	APX-2 & APS-4 Radar Load	D.C.-Open Circuit	Voltage vs. Speed
	Simulated Radar Load	D.C.-Full Load	" " "
Fig. 8	Simulated Radar Load Inductance in Parallel	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Speed " " "
Fig. 9	Simulated Radar Load Inductance in Parallel	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Load " " "
Fig. 10	Simulated Radar Load Inductance in Series	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Speed " " "
Fig. 11	Simulated Radar Load Inductance in Series	D.C.-Open Circuit D.C.-Full Load	Voltage vs. Load " " "

<u>Capacitance - Speed Characteristics</u>

Fig. 12	Gen.Electric	NEA-5	Type 2CM81B2	Field Current Constant
Fig. 13	Gen.Electric	NEA-5	Type 2CM81B2	Field Excitation Constant
Fig. 14	Gen.Electric	NEA-5	Type 2CM81B2	Field Current Characteristic
Fig. 15	Eclipse	NEA-3	Type 716-3-A	Field Current Constant

TABLE II

Speed Regulation Tabulation

Type Load	Regulator Settings Pile Screw	Core Screw	Speed Range RPM Min.	Max.	DC Load Condition
Lamp Bank	10-1/2	11-1/2	3750	9300	Open
" "	10-1/2	11-1/2	3750	10,000*	Full
Carbon Pile	10-1/2	12	3750	9100	Open
" "	10-1/2	12	3750	10,000*	Full
Radar APX-2	11	12-1/2	4400*	10,000*	Open
Radar APS-4	11	12-1/2	4400*	10,000*	Open
Radar APX-2 & APS-4	11	12-1/2	4400*	10,000*	Open
Radar APX-2 & APS-4 & Simulated Radar	11	12-1/2	4000*	8500	Open
" "	11	12-1/2	4000*	9500	Full
Simulated Radar Inductance in Parallel	11	12	4000*	8400	Open
" "	11	12	4000*	9000	Full
Simulated Radar Inductance in Series	11	12	4000*	8100	Open
" "	11	12	4400	8500	Full

* Indicates minimum or maximum speed reached by choice during run.

TABLE II (continued)

Load Regulation Tabulation

Type Load	Regulator Settings Pile Screw	Core Screw	Load Range Amps. Min.	Speed	Max.	D.C. Load Condition
Lamp Bank	10-1/2	11-1/2	0	4400	10	Open
			0	6000	10	
			0	8000	10	
" "	10-1/2	11-1/2	0	4400	10	Full
			0	6000	10	
			0	8000	10	
Carbon Pile	10-1/2	12	0	4400	10	Open
			0	6000	10	
			0	8000	10	
" "	10-1/2	12	0	4400	10	Full
			0	6000	10	
			2.5	8000	10	
Simulated Radar Inductance in Parallel	11	12	0	4400	10	Open
			0	6000	10	
			0	8000	9.9	
" "	11	12	0	4400	10	Full
			0	6000	10	
			0	8000	9.9	
Simulated Radar Inductance in Series	11	12	0	4400	10	Open
			0	6000	10	
			0	8000	10	
Simulated Radar Inductance in Series	11	12	0	4400	10	Full
			0	6000	10	
			0	8000	10	

The maximum load condition for all tests was 10 amperes.

APPENDIX

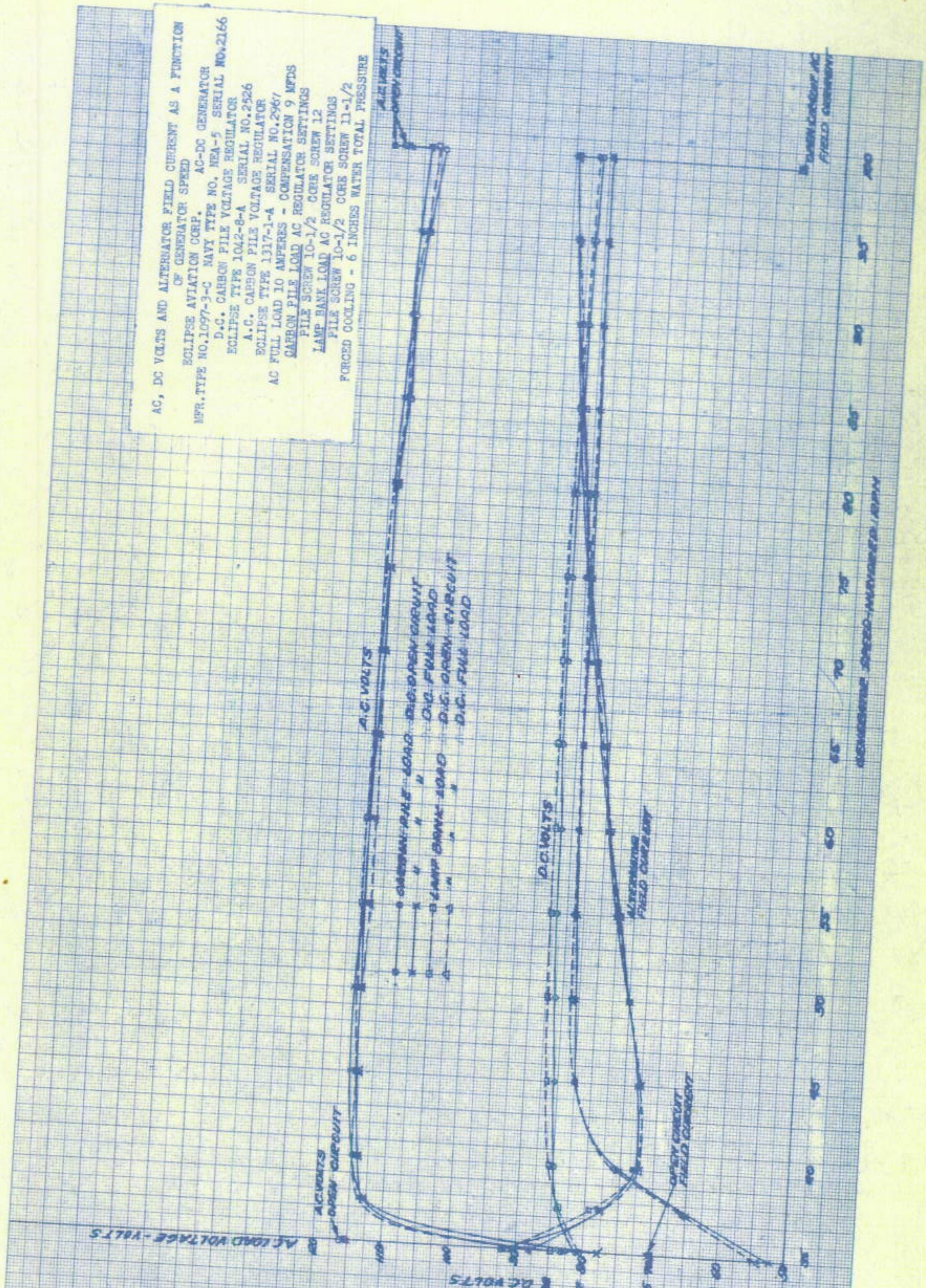
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION
OF GENERATOR SPEED
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
D.C. CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1042-8-A SERIAL NO.2526
A.C. CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
AC FULL LOAD 10 AMPERES - COMPENSATION 9 MFDS
CARBON PILE LOAD AC REGULATOR SETTINGS
PILE SCREW 10-1/2 CORE SCREW 12
LAMP BANK LOAD AC REGULATOR SETTINGS
PILE SCREW 10-1/2 CORE SCREW 11-1/2
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
A.C. VOLTS
A.C. VOLTS OPEN CIRCUIT
D.C. VOLTS
ALTERNATOR FIELD CURRENT
OPEN CIRCUIT FIELD CURRENT
OPEN CIRCUIT AC FIELD CURRENT
CARBON PILE LOAD D.C. OPEN CIRCUIT
" " " D.C. FULL LOAD
LAMP BANK LOAD D.C. OPEN CIRCUIT
" " " D.C. FULL LOAD
AC LOAD VOLTAGE - VOLTS
AC FIELD CURRENT - AMPERES
DC VOLTS
GENERATOR SPEED-HUNDRED RPM
35
40
45
50
55
60
65
70
75
80
85
90
95
100

FIG. 1

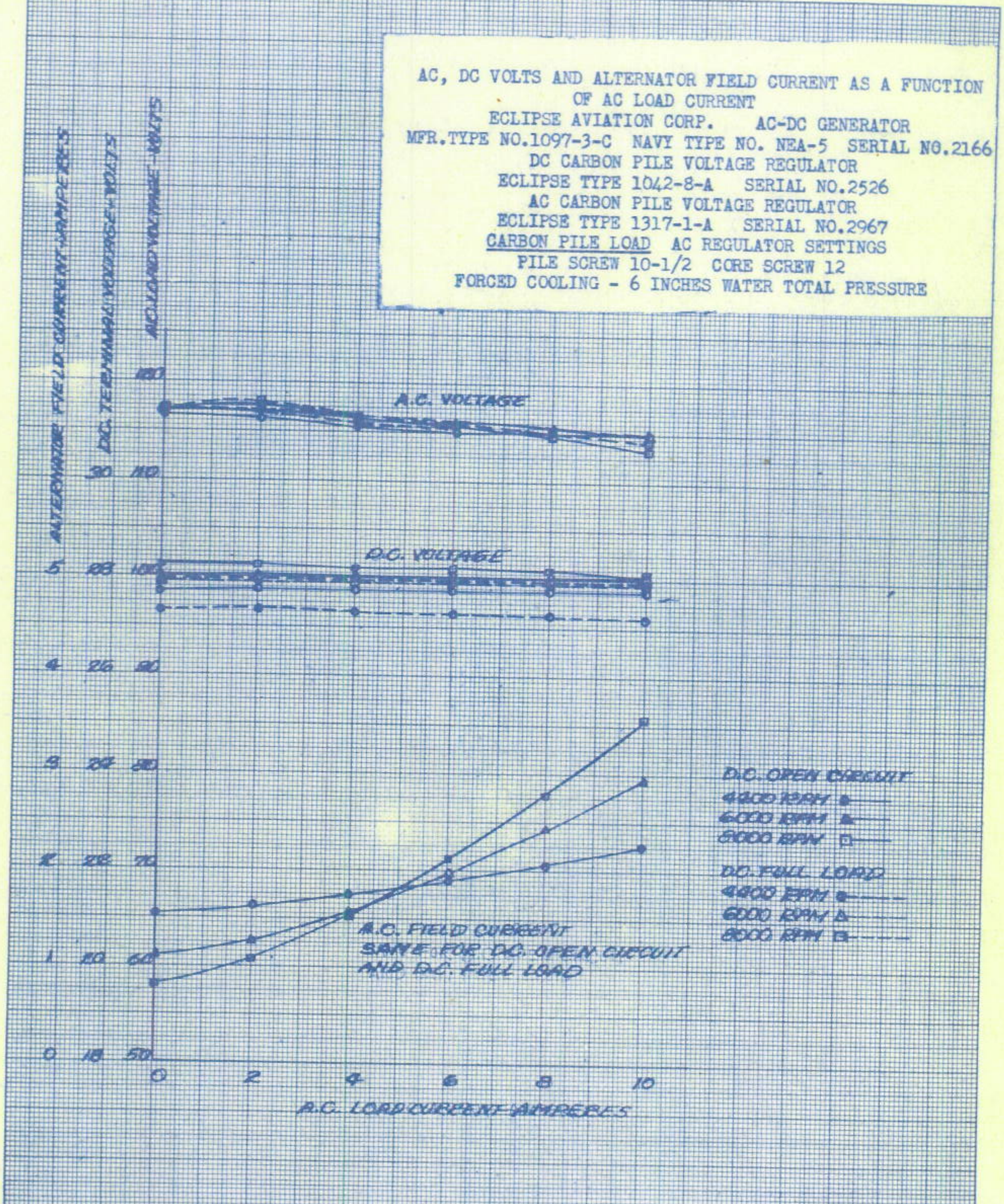
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION OF AC LOAD CURRENT
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
DC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1042-8-A SERIAL NO.2526
AC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
CARBON PILE LOAD AC REGULATOR SETTINGS
PILE SCREW 10-1/2 CORE SCREW 12
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
ALTERNATOR FIELD CURRENT-AMPERES
D.C. TERMINAL VOLTAGE-VOLTS
AC LOAD VOLTAGE-VOLTS
A.C. VOLTAGE
D.C. VOLTAGE
D.C. OPEN CIRCUIT
4800 RPM
6000 RPM
8000 RPM
D.C. FULL LOAD
4800 RPM
6000 RPM
8000 RPM
A.C. FIELD CURRENT
SAME FOR D.C. OPEN CIRCUIT
AND D.C. FULL LOAD
A.C. LOAD CURRENT-AMPERES

FIG. 2

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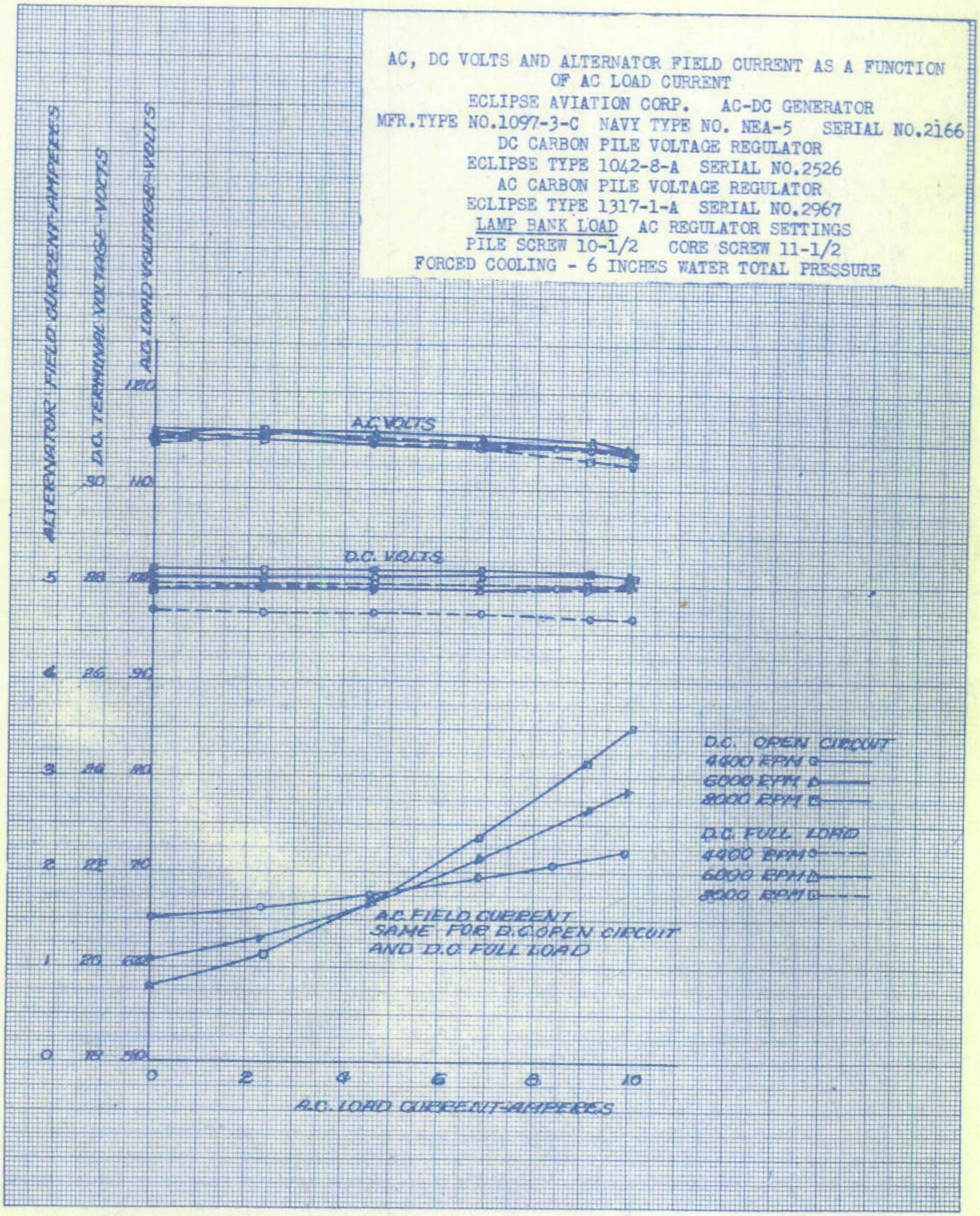

FIG. 3

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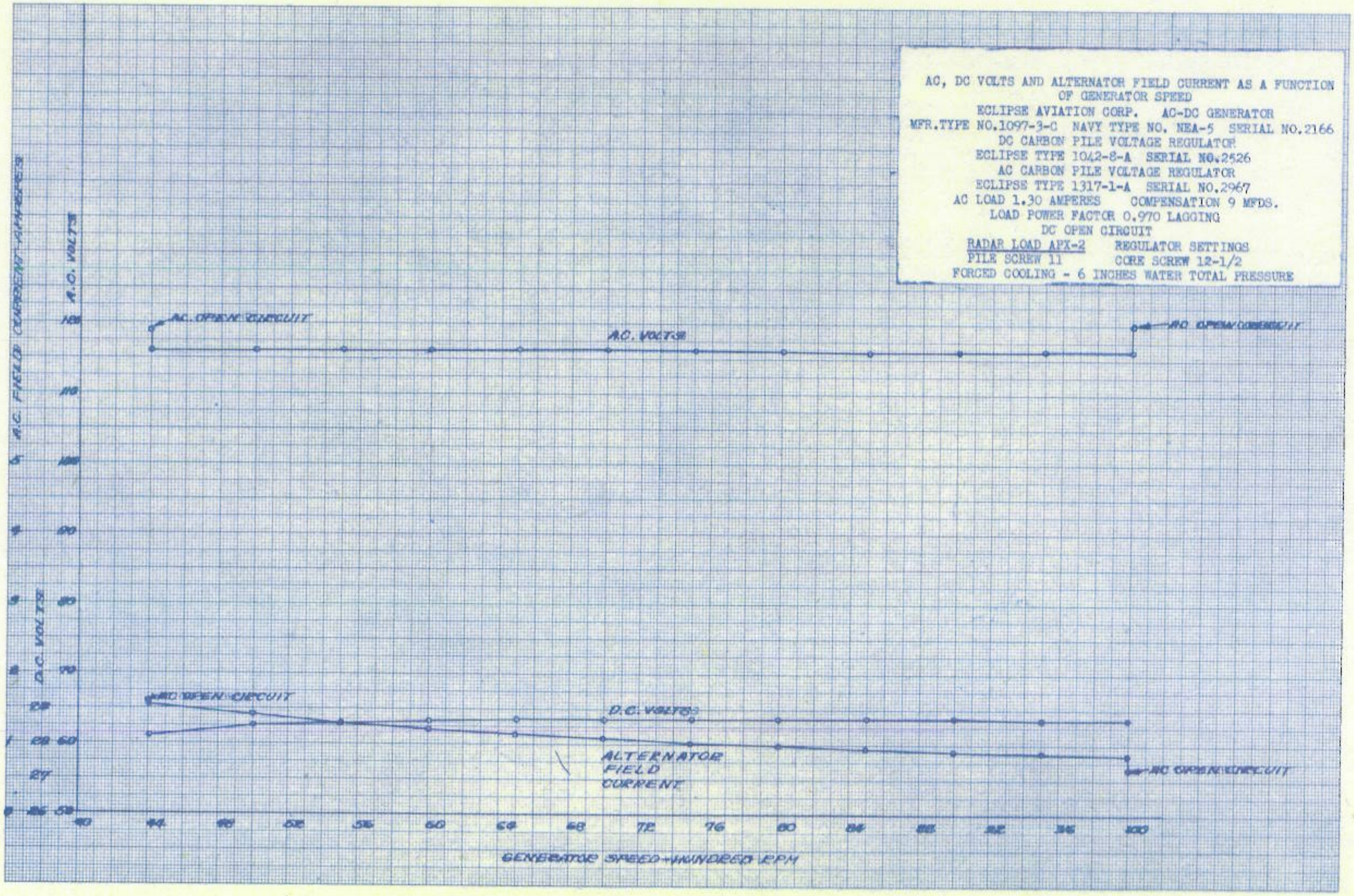
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION
OF GENERATOR SPEED
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
DC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1042-8-A SERIAL NO.2526
AC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
AC LOAD 1.30 AMPERES COMPENSATION 9 MFDS.
LOAD POWER FACTOR 0.970 LAGGING
DC OPEN CIRCUIT
RADAR LOAD APX-2 REGULATOR SETTINGS
PILE SCREW 11 CORE SCREW 12-1/2
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
A.C. FIELD CURRENT-AMPERES
A.C. VOLTS
D.C. VOLTS
A.C. OPEN CIRCUIT
A.C. VOLTS
AC OPEN CIRCUIT
DC OPEN CIRCUIT
D.C. VOLTS
ALTERNATOR
FIELD
CURRENT
AC OPEN CIRCUIT
GENERATOR SPEED-HUNDRED RPM

FIG. 4

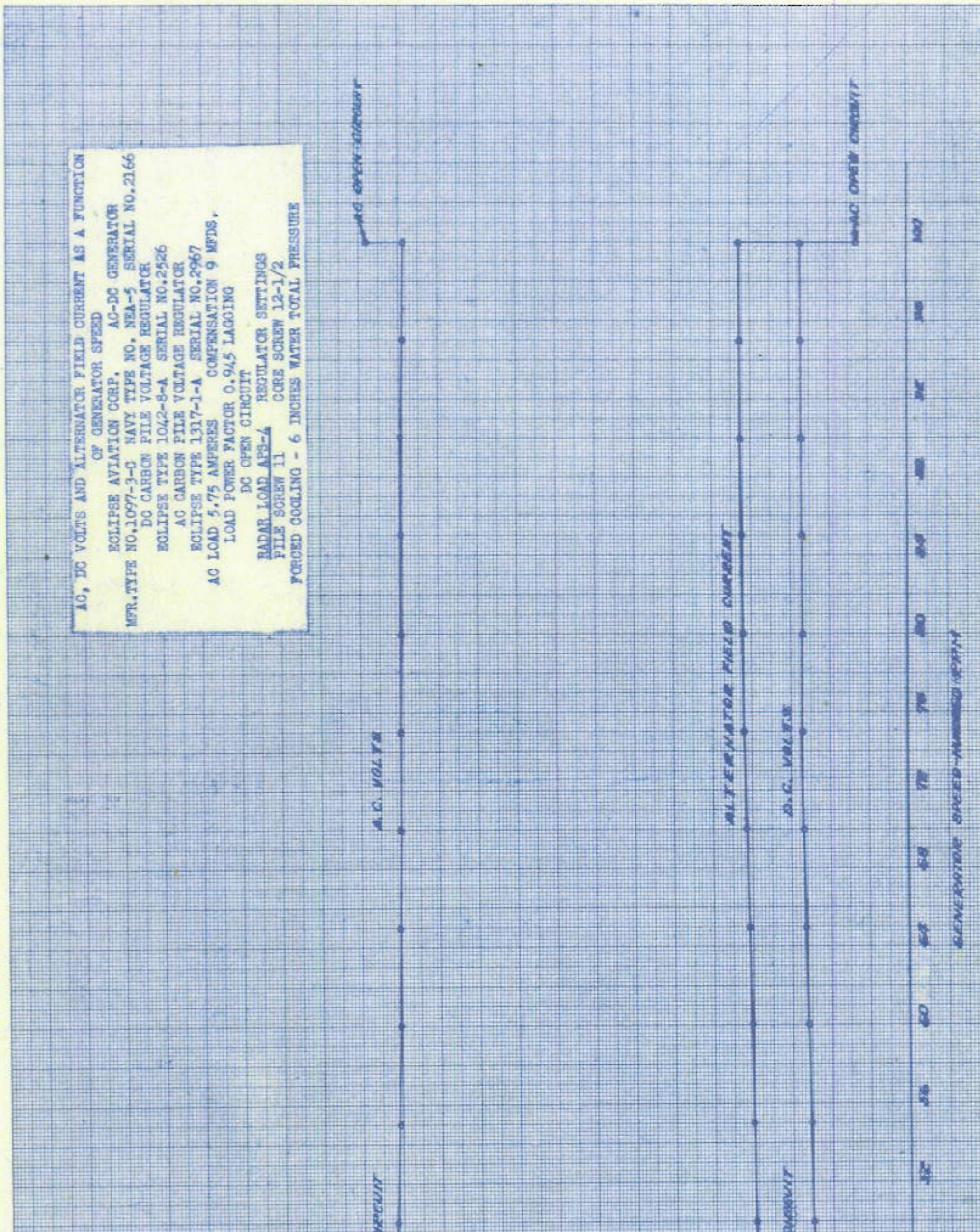
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION
OF GENERATOR SPEED
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
DC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1042-8-A SERIAL NO.2526
AC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
AC LOAD 5.75 AMPERES COMPENSATION 9 MFDS.
LOAD POWER FACTOR 0.945 LAGGING
DC OPEN CIRCUIT
RADAR LOAD APS-4 REGULATOR SETTINGS
PILE SCREW 11 CORE SCREW 12-1/2
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
AC OPEN CIRCUIT
A.C. VOLTS
ALTERNATOR FIELD CURRENT
D.C. VOLTS
A.C. VOLTS
D.C. VOLTS
GENERATOR SPEED

FIG. 5

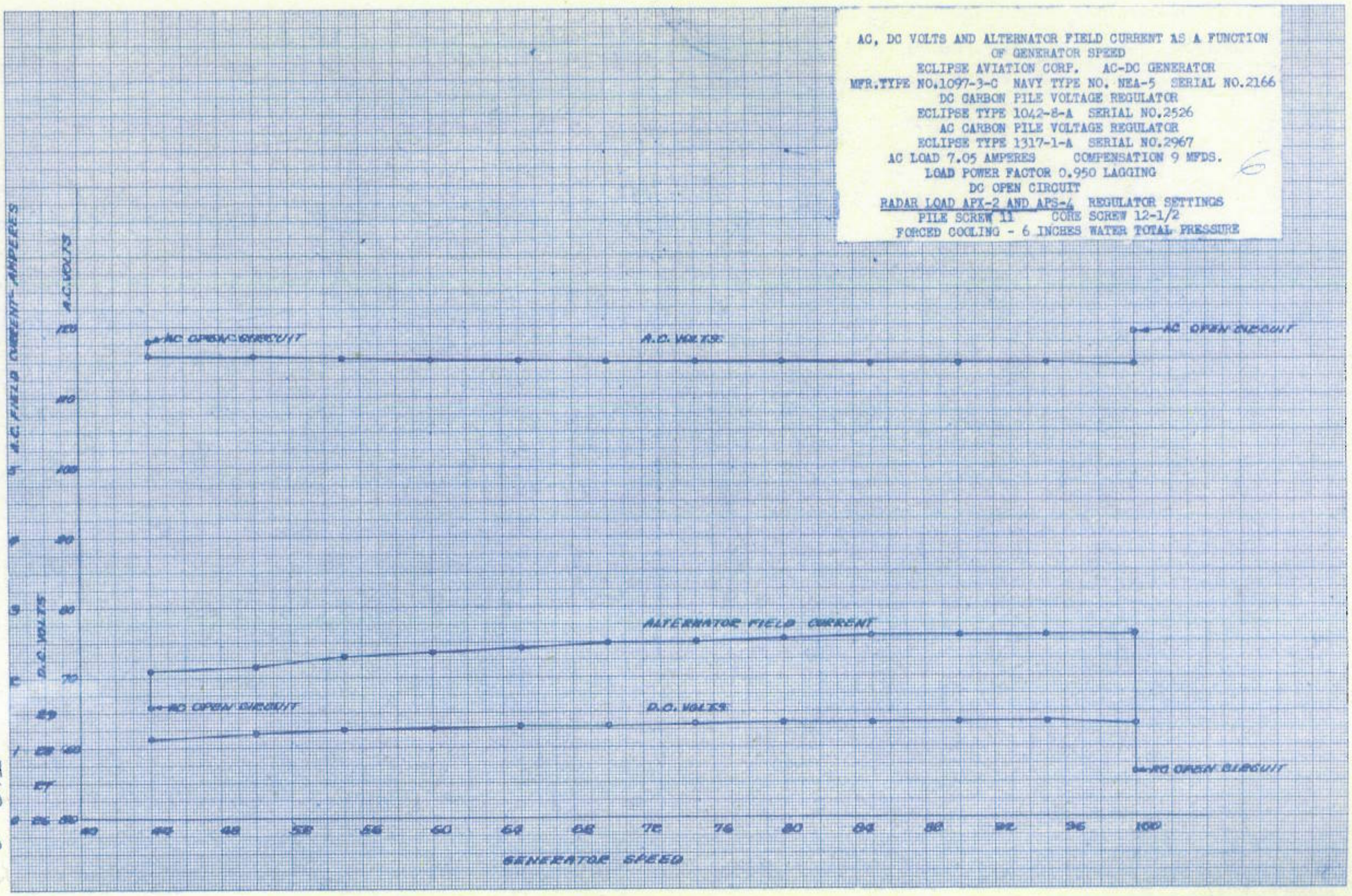

FIG. 6

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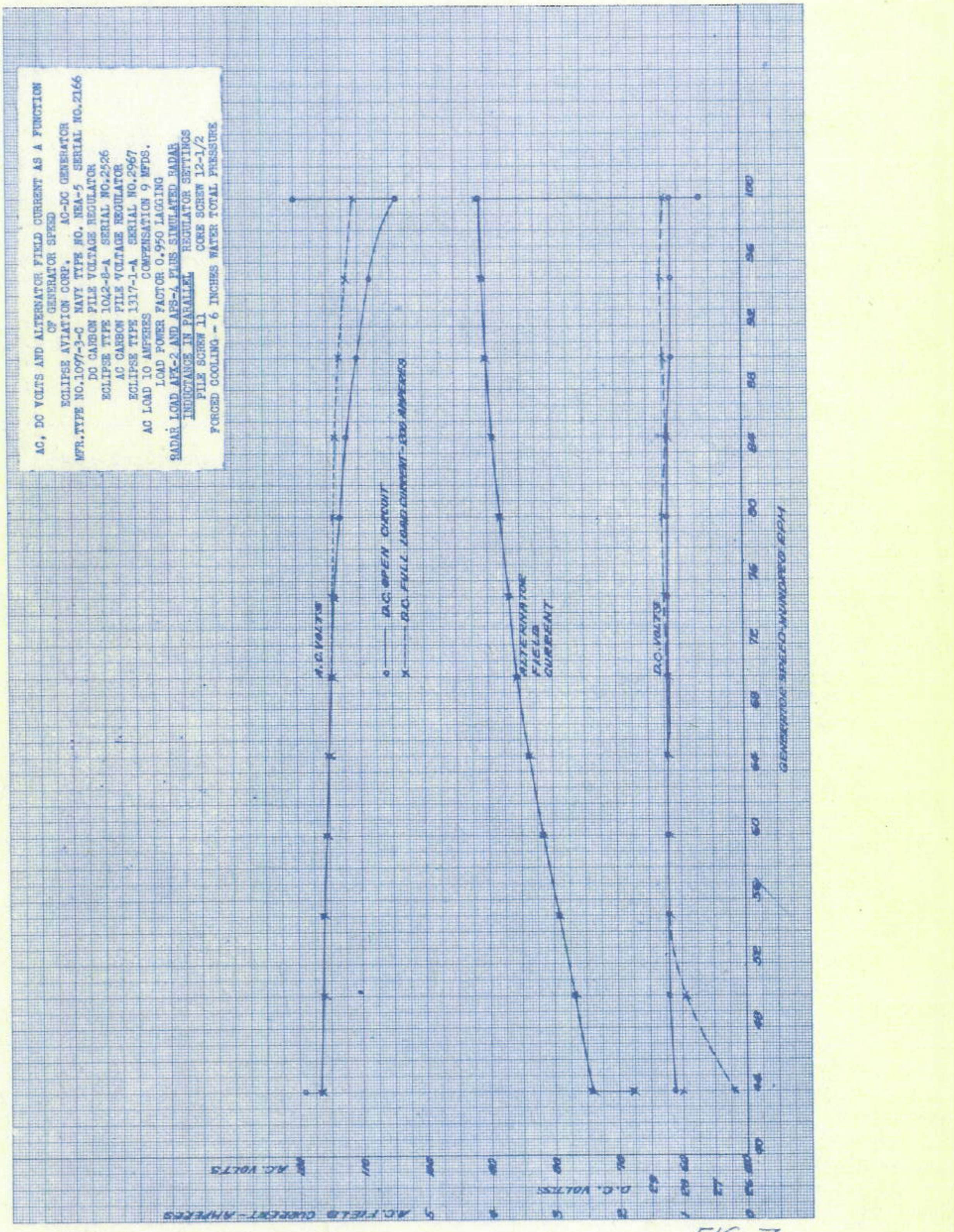

FIG. 7

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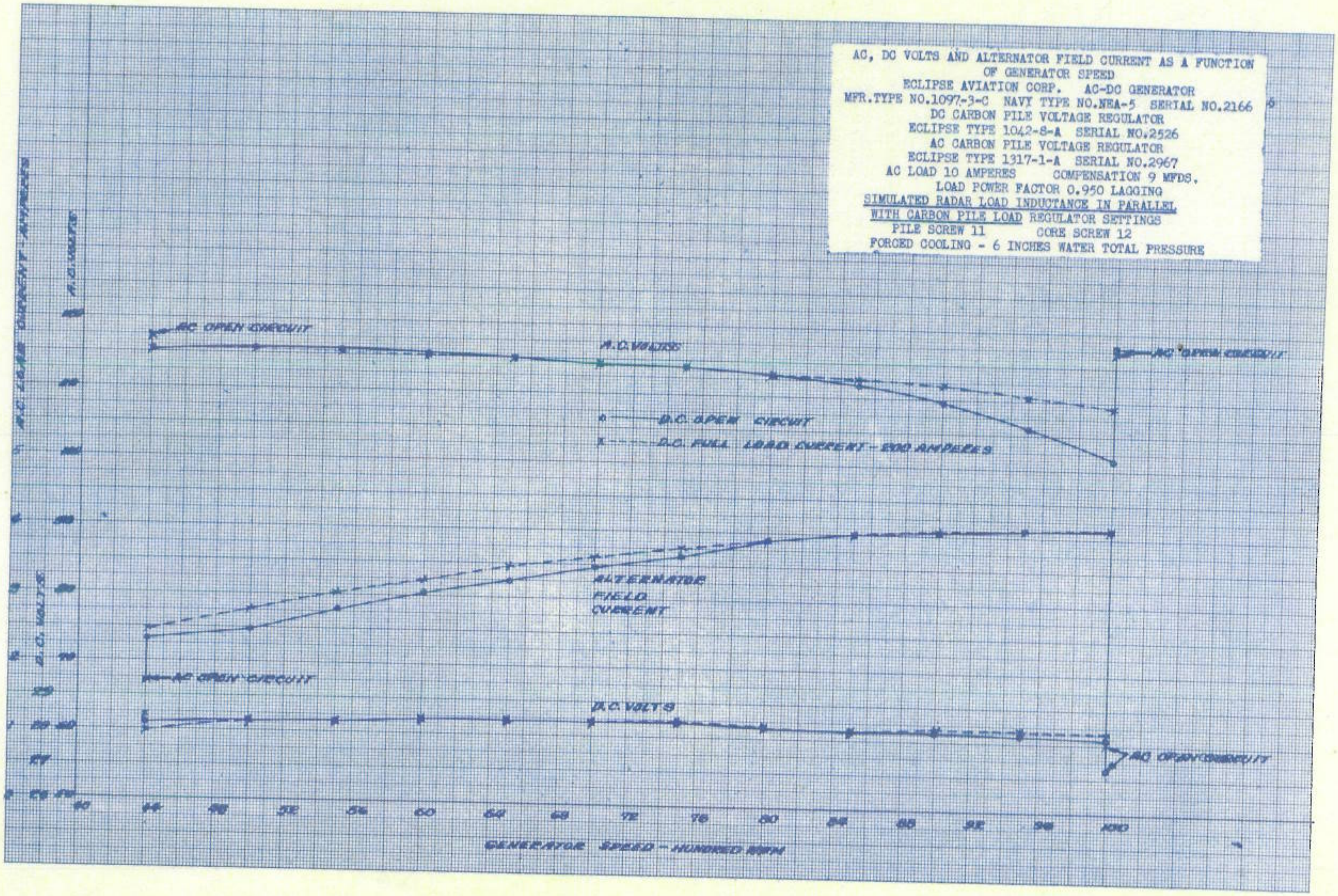

FIG. 8

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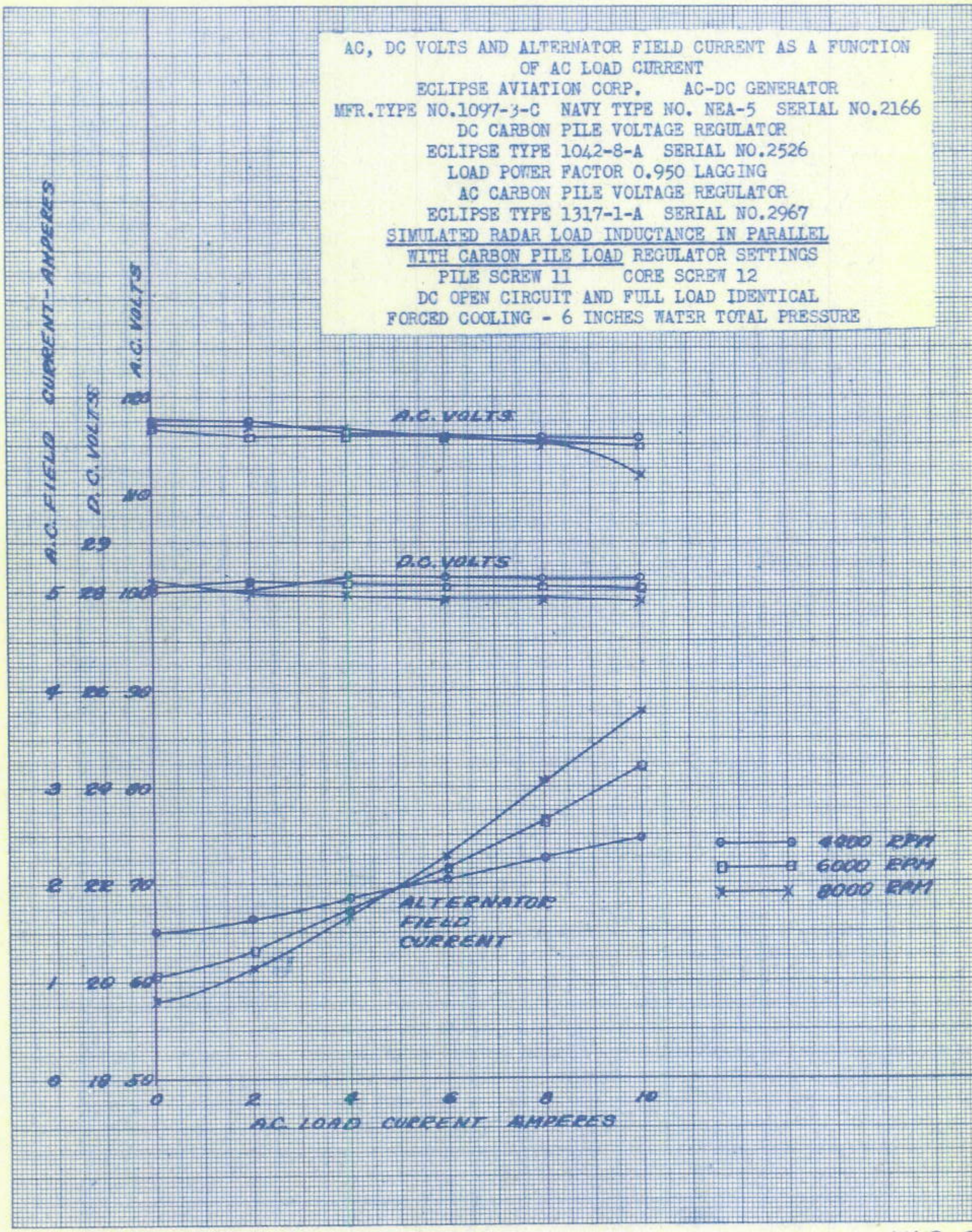
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION
OF AC LOAD CURRENT
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
DC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1042-8-A SERIAL NO.2526
LOAD POWER FACTOR 0.950 LAGGING
AC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
SIMULATED RADAR LOAD INDUCTANCE IN PARALLEL
WITH CARBON PILE LOAD REGULATOR SETTINGS
PILE SCREW 11 CORE SCREW 12
DC OPEN CIRCUIT AND FULL LOAD IDENTICAL
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
A.C. FIELD CURRENT-AMPERES
D.C. VOLTS
A.C. VOLTS
A.C. VOLTS
D.C. VOLTS
ALTERNATOR FIELD CURRENT
4000 RPM
6000 RPM
8000 RPM
A.C. LOAD CURRENT AMPERES

FIG. 9

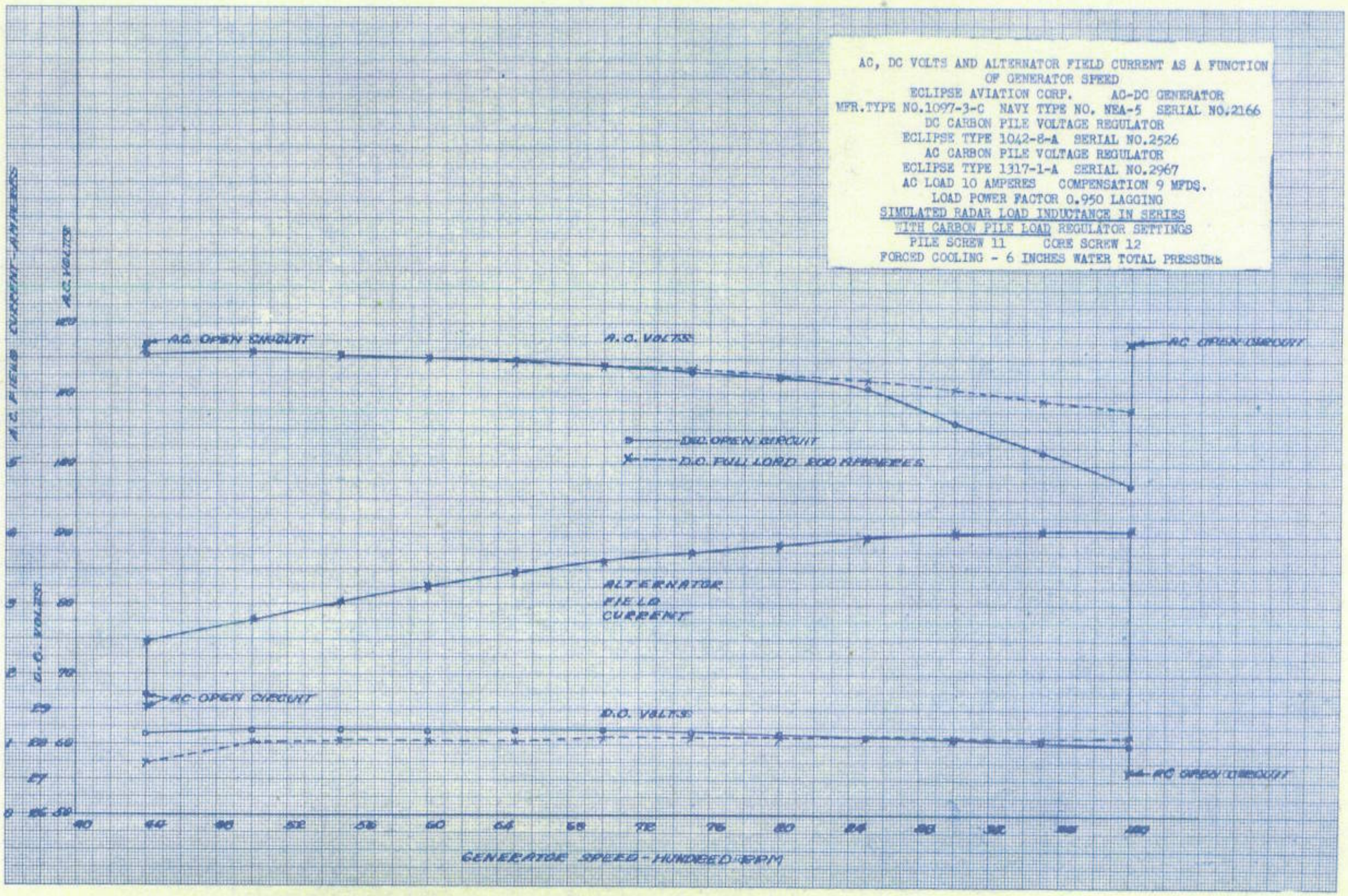

FIG. 10

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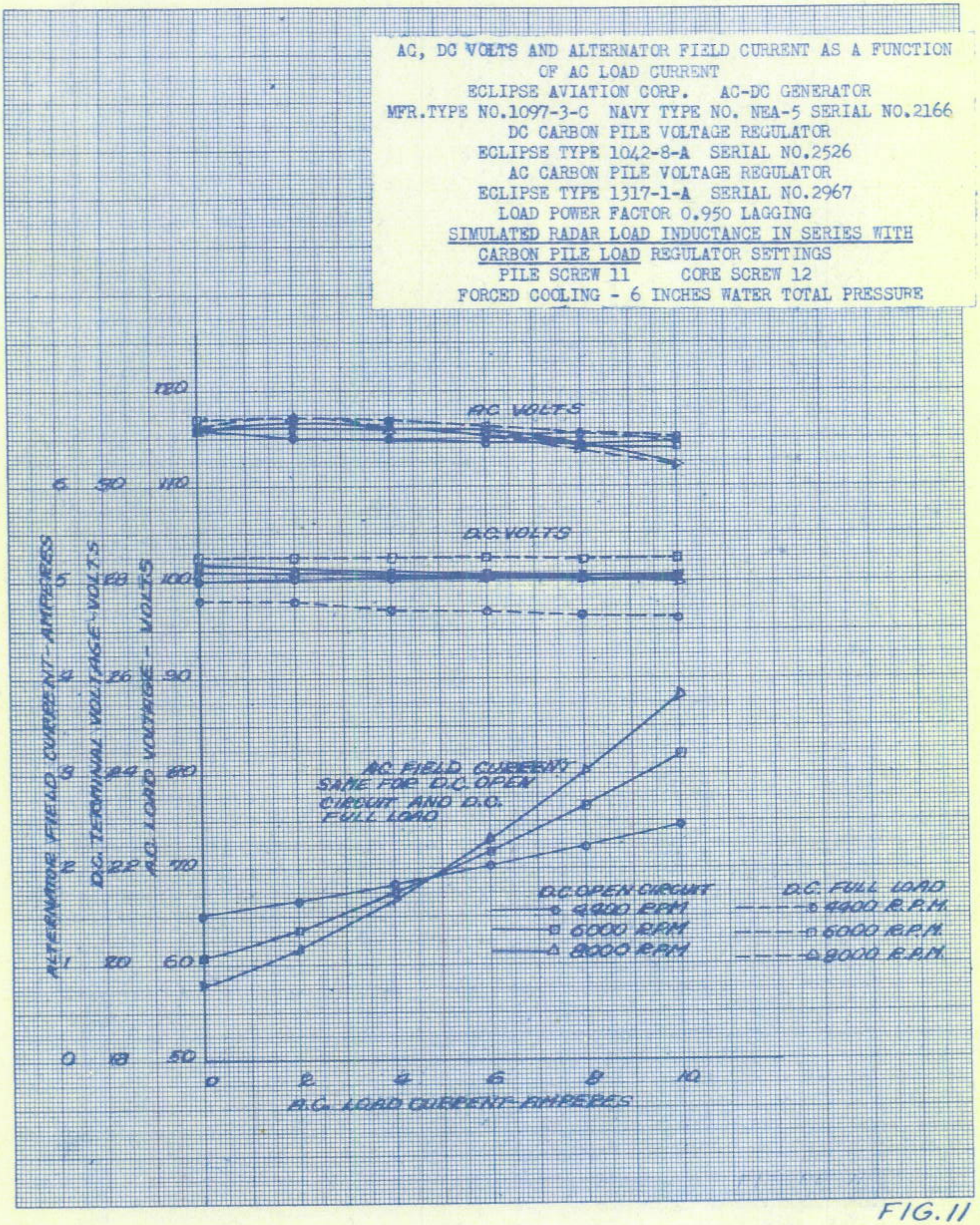
AC, DC VOLTS AND ALTERNATOR FIELD CURRENT AS A FUNCTION
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ECLIPSE TYPE 1042-8-A SERIAL NO.2526
AC CARBON PILE VOLTAGE REGULATOR
ECLIPSE TYPE 1317-1-A SERIAL NO.2967
LOAD POWER FACTOR 0.950 LAGGING
SIMULATED RADAR LOAD INDUCTANCE IN SERIES WITH
CARBON PILE LOAD REGULATOR SETTINGS
PILE SCREW 11 CORE SCREW 12
FORCED COOLING - 6 INCHES WATER TOTAL PRESSURE
A.C. VOLTS
D.C. VOLTS
A.C. FIELD CURRENT
SAME FOR D.C. OPEN
CIRCUIT AND D.C.
FULL LOAD
D.C. OPEN CIRCUIT
4400 R.P.M.
6000 R.P.M.
8000 R.P.M.
D.C. FULL LOAD
4400 R.P.M.
6000 R.P.M.
8000 R.P.M.
ALTERNATOR FIELD CURRENT-AMPERES
D.C. TERMINAL VOLTAGE-VOLTS
A.C. LOAD VOLTAGE-VOLTS
A.C. LOAD CURRENT-AMPERES
0 2 4 6 8 10
0 1 2 3 4 5 6
18 20 22 24 26 28 30
50 60 70 80 90 100 110 120

FIG. 11

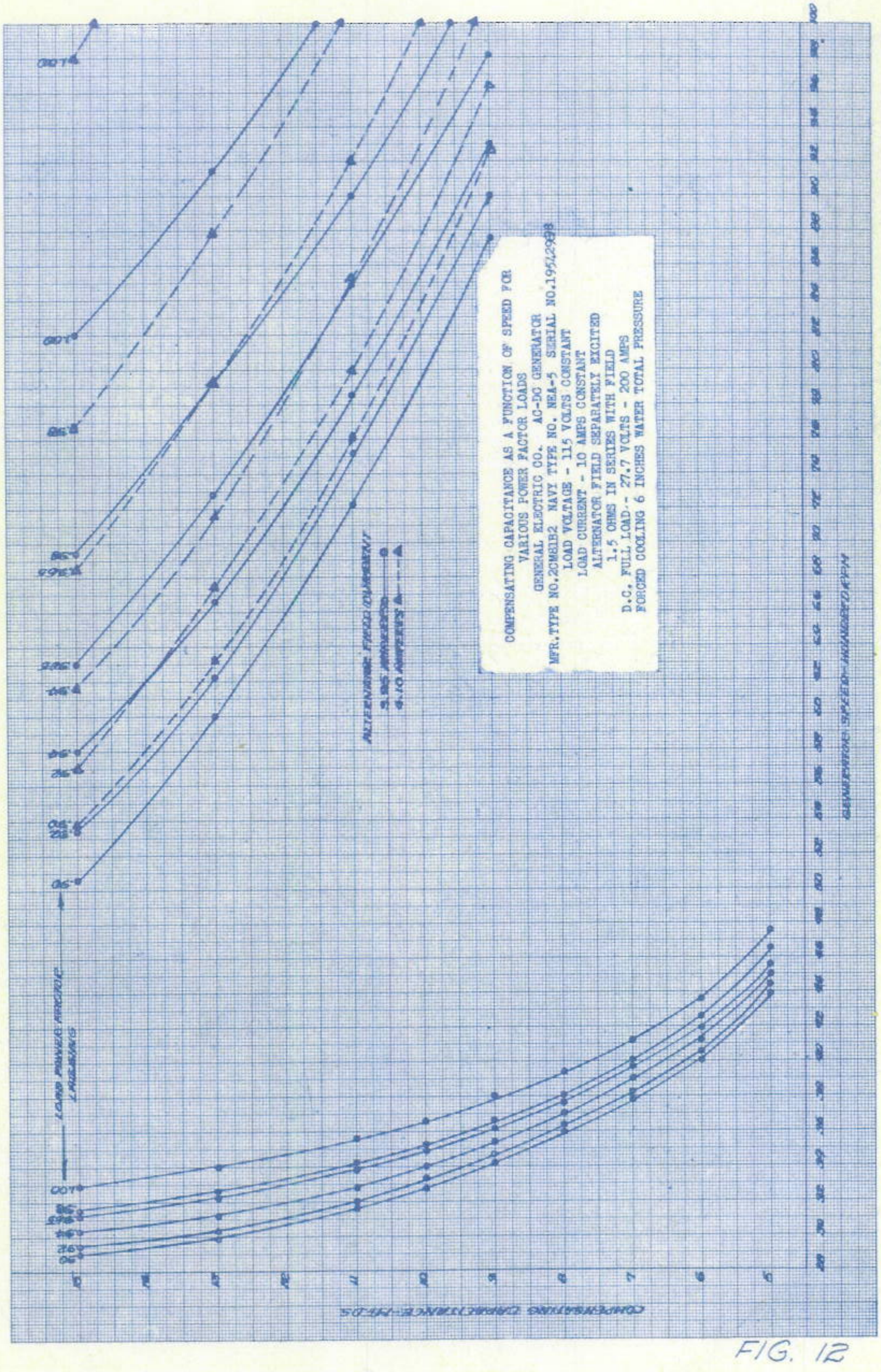

COMPENSATING CAPACITANCE AS A FUNCTION OF SPEED FOR
VARIOUS POWER FACTOR LOADS
GENERAL ELECTRIC CO. AC-DC GENERATOR
MFR. TYPE NO.2CM81B2 NAVY TYPE NO. NEA-5 SERIAL NO.19512998
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE

FIG. 12

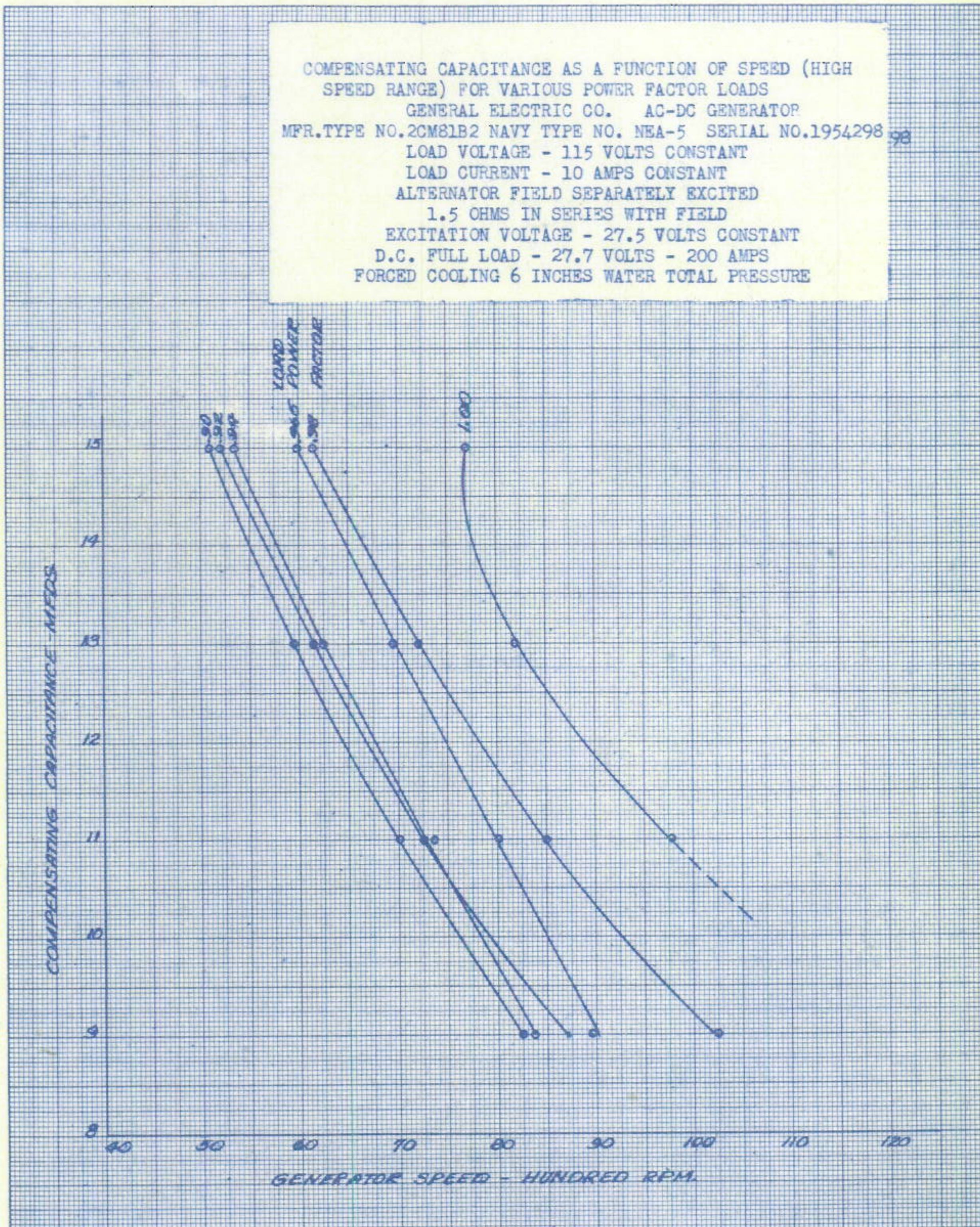

COMPENSATING CAPACITANCE AS A FUNCTION OF SPEED (HIGH SPEED RANGE) FOR VARIOUS POWER FACTOR LOADS
GENERAL ELECTRIC CO. AC-DC GENERATOR
MFR.TYPE NO.2CM81B2 NAVY TYPE NO. NEA-5 SERIAL NO.1954298
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
EXCITATION VOLTAGE - 27.5 VOLTS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
LOAD POWER FACTOR
1.00
COMPENSATING CAPACITANCE MFDS
8
9
10
11
12
13
14
15
40
50
60
70
80
90
100
110
120
GENERATOR SPEED - HUNDRED RPM.

FIG. 13

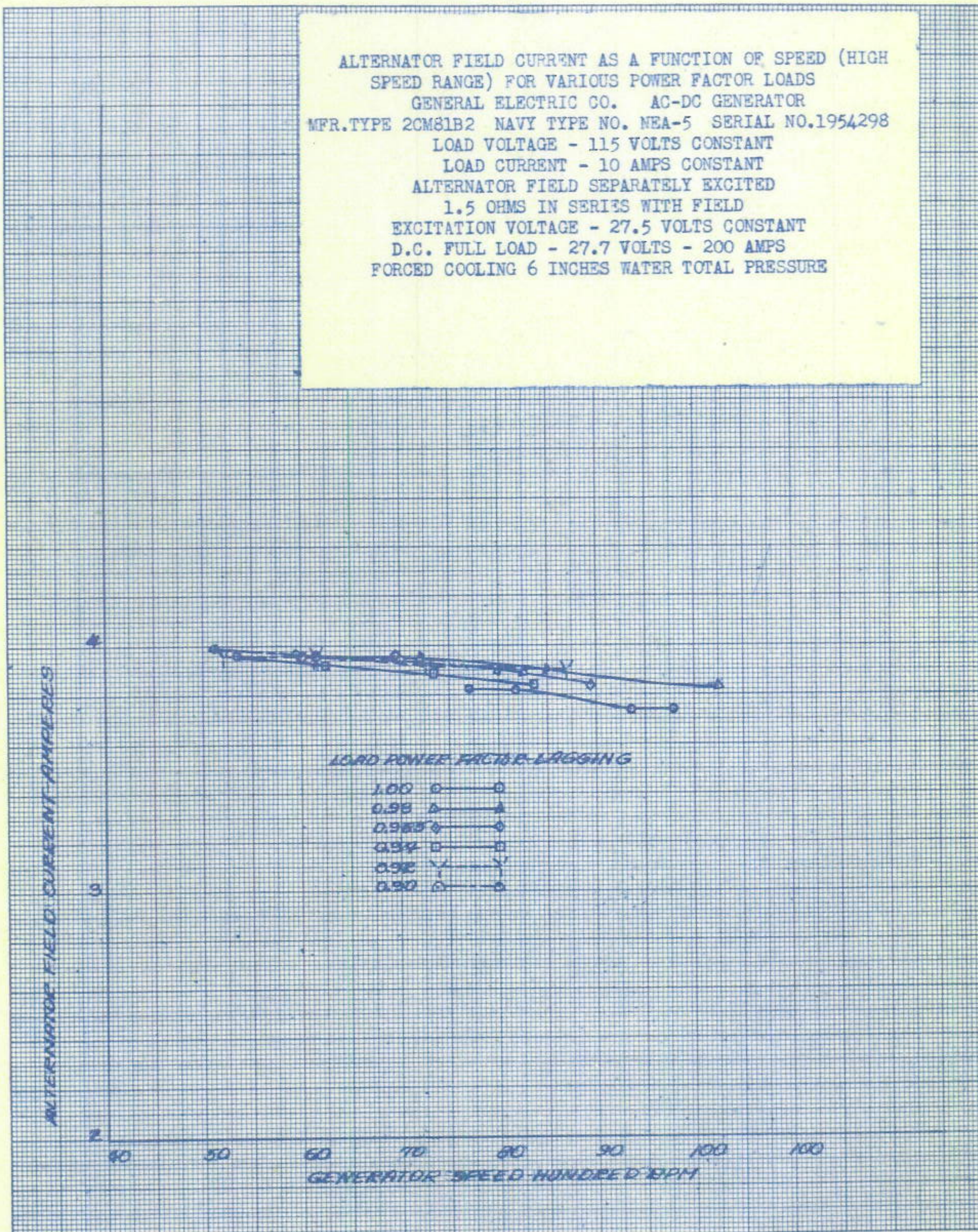

ALTERNATOR FIELD CURRENT AS A FUNCTION OF SPEED (HIGH SPEED RANGE) FOR VARIOUS POWER FACTOR LOADS
GENERAL ELECTRIC CO. AC-DC GENERATOR
MFR.TYPE 2CM81B2 NAVY TYPE NO. NEA-5 SERIAL NO.1954298
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
EXCITATION VOLTAGE - 27.5 VOLTS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
LOAD POWER FACTOR-LAGGING
1.00
0.98
0.965
0.94
0.92
0.90
ALTERNATOR FIELD CURRENT-AMPERES
4
3
2
40
50
60
70
80
90
100
100
GENERATOR SPEED-HUNDRED RPM

FIG. 14

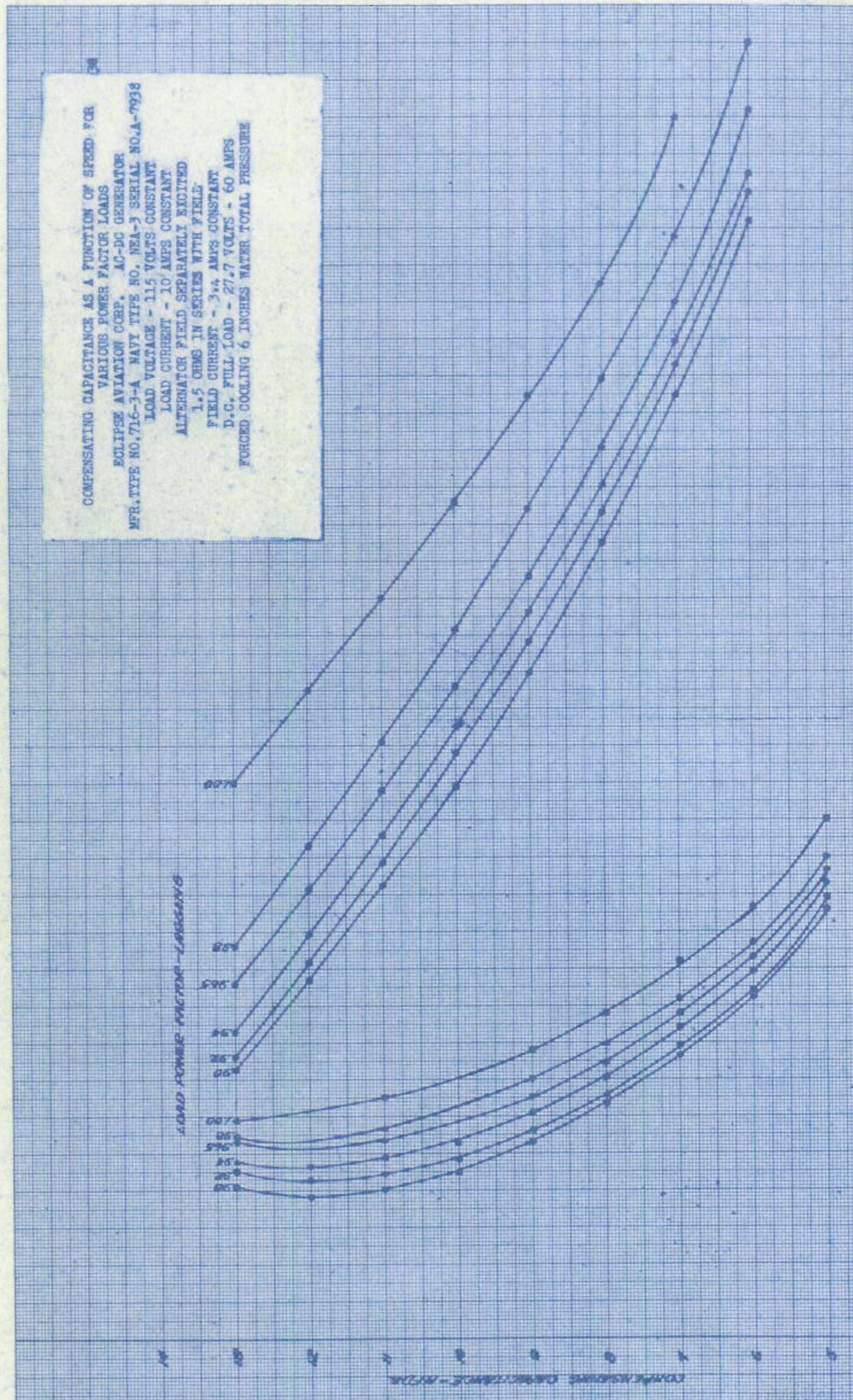


FIG. 15

DECLASSIFIED

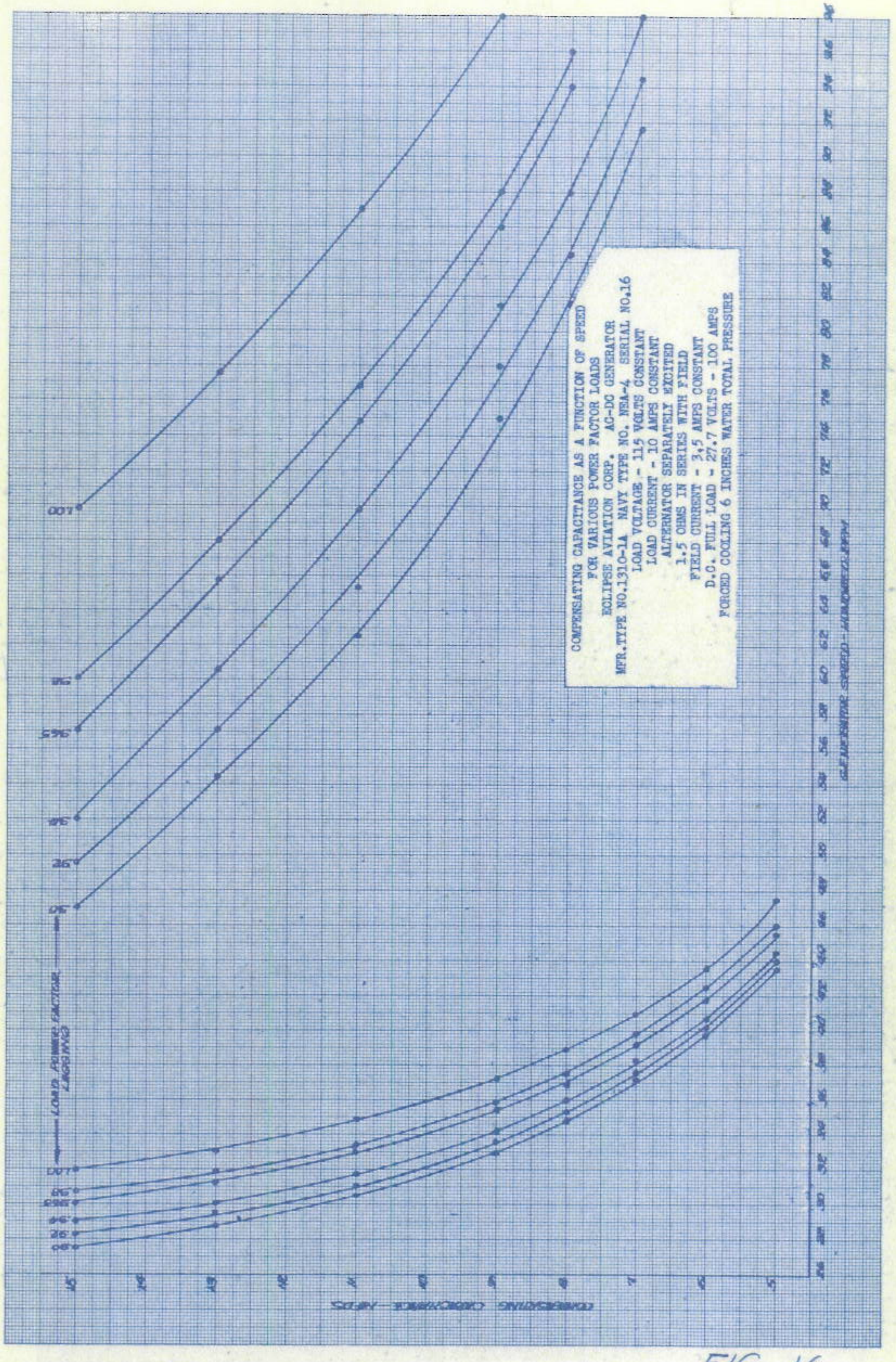

COMPENSATING CAPACITANCE AS A FUNCTION OF SPEED
FOR VARIOUS POWER FACTOR LOADS
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1310-1A NAVY TYPE NO. NEA-4 SERIAL NO.16
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.5 AMPS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 100 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
LOAD POWER FACTOR LAGGING
GENERATOR SPEED - HUNDRED RPM

FIG. 16

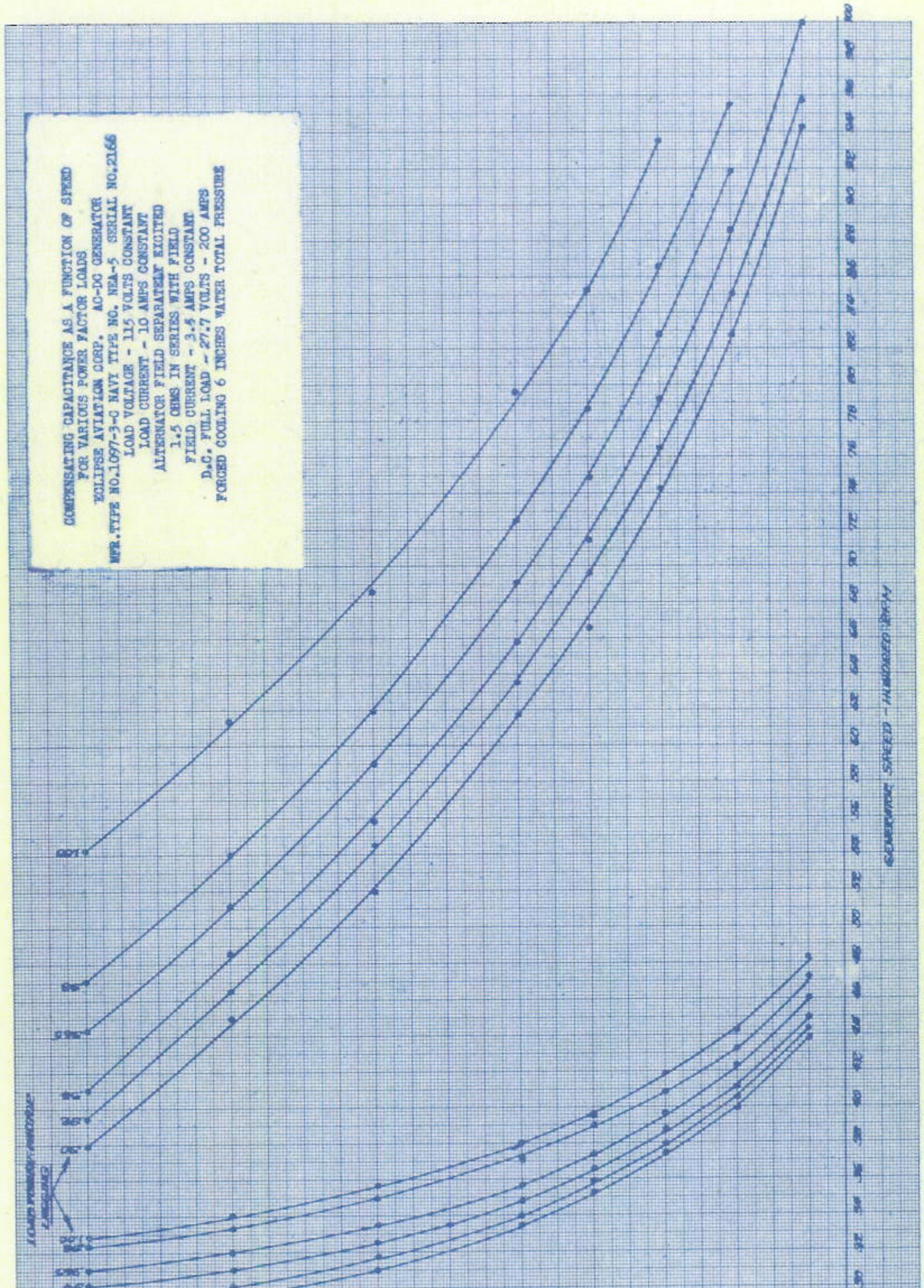

COMPENSATING CAPACITANCE AS A FUNCTION OF SPEED
FOR VARIOUS POWER FACTOR LOADS
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.5 AMPS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
LOAD POWER FACTOR LAGGING
GENERATOR SPEED - HUNDRED RPM
COMPENSATING CAPACITANCE - MFDS

FIG. 17

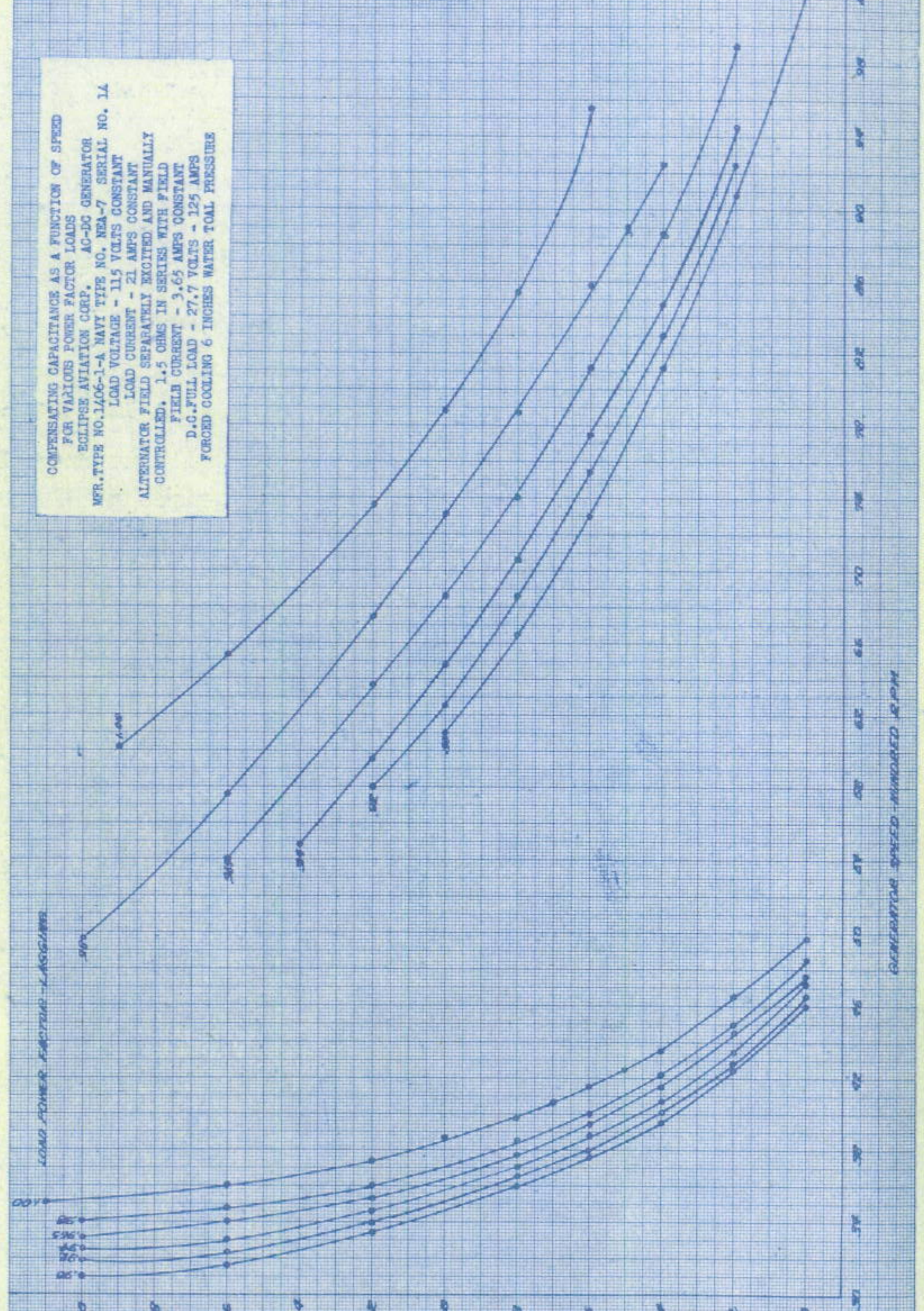
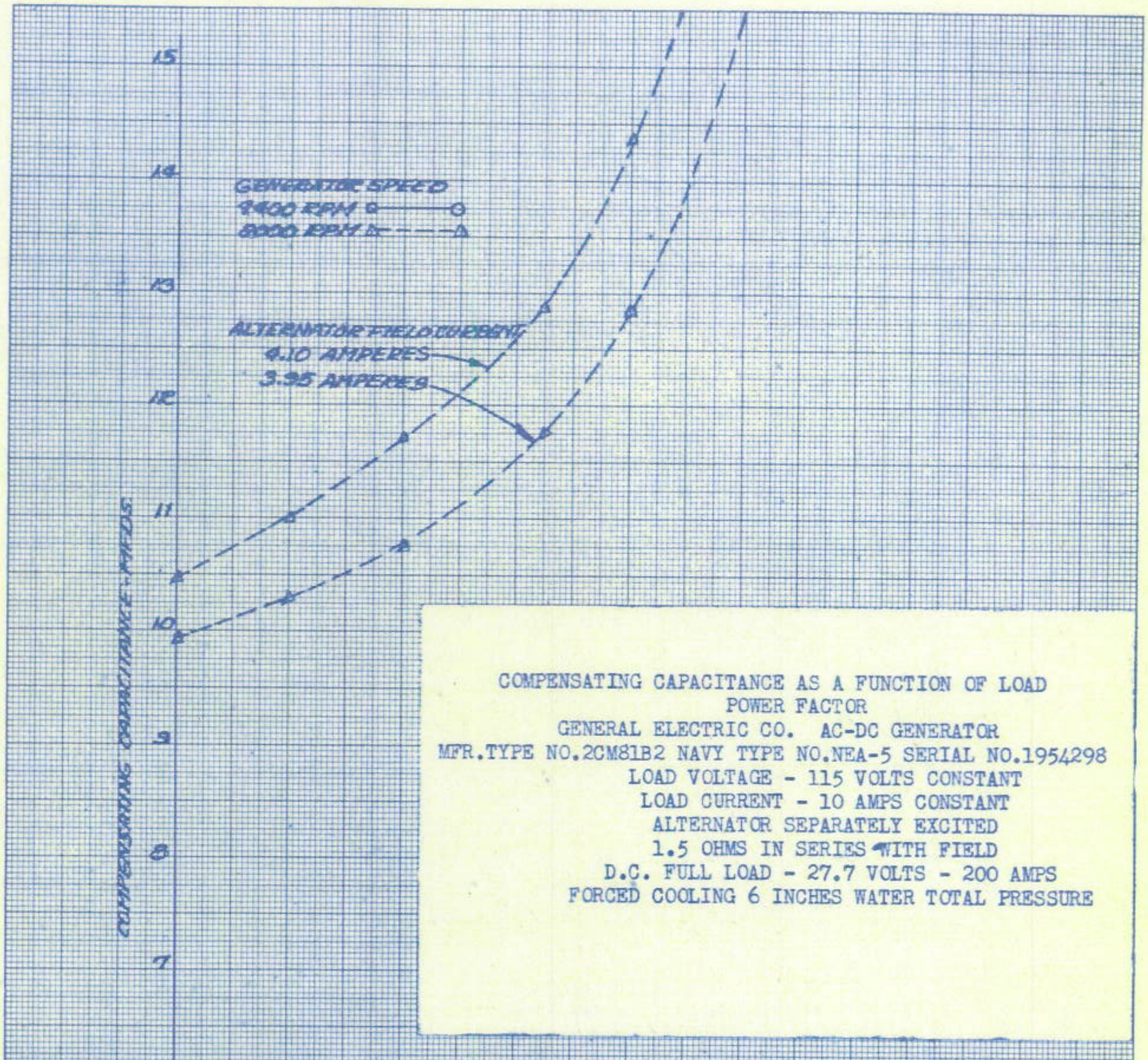

COMPENSATING CAPACITANCE AS A FUNCTION OF SPEED
FOR VARIOUS POWER FACTOR LOADS
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1406-1-A NAVY TYPE NO. NEA-7 SERIAL NO. 14
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 21 AMPS CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED AND MANUALLY
CONTROLLED. 1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.65 AMPS CONSTANT
D.C.FULL LOAD - 27.7 VOLTS - 125 AMPS
FORCED COOLING 6 INCHES WATER TOAL PRESSURE
LOAD POWER FACTOR - LAGGING
GENERATOR SPEED HUNDRED R.P.M.
COMPENSATING CAPACITANCE - MFDS

FIG. 18



COMPENSATING CAPACITANCE AS A FUNCTION OF LOAD POWER FACTOR
GENERAL ELECTRIC CO. AC-DC GENERATOR
MFR.TYPE NO.2CM81B2 NAVY TYPE NO.NEA-5 SERIAL NO.1954298
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE

FIG. 19

COMPENSATING CAPACITANCE AS A FUNCTION OF LOAD
POWER FACTOR
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.716-3-A NAVY TYPE NO.NEA-3 SERIAL NO. A-7938
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR SEPARATELY EXCITED AND MANUALLY CONTROLLED
1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.4 AMPS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 60 AMPS
FORCED COOLING 6 INCHES WATER TOAL PRESSURE

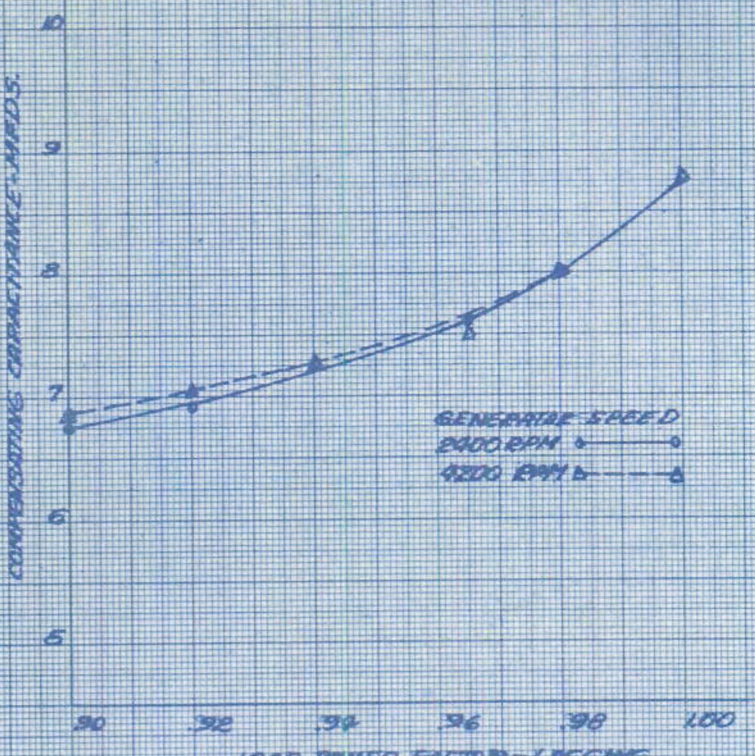


FIG. 20

DECLASSIFIED

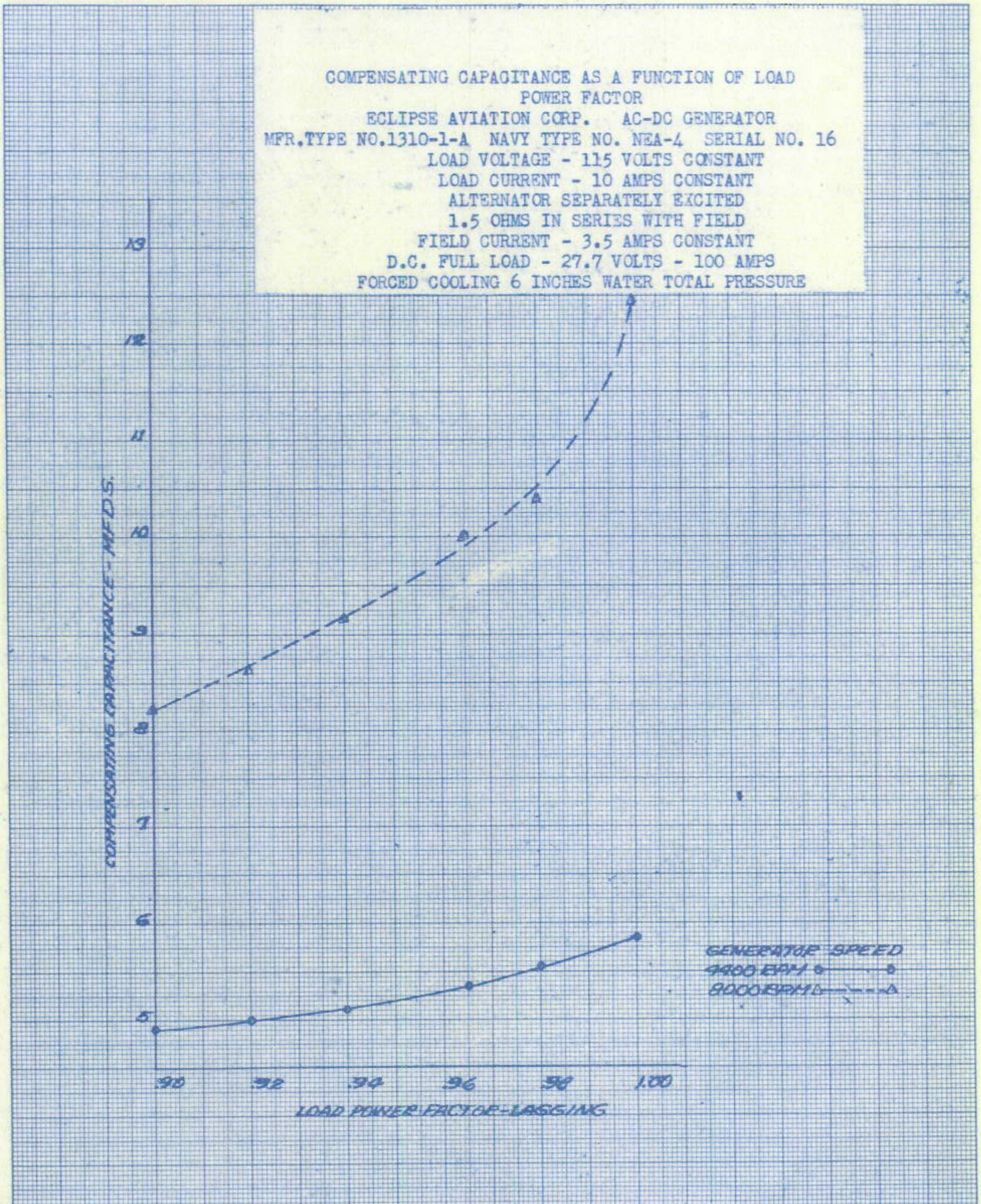

COMPENSATING CAPACITANCE AS A FUNCTION OF LOAD
POWER FACTOR
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1310-1-A NAVY TYPE NO. NEA-4 SERIAL NO. 16
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.5 AMPS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 100 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
COMPENSATING CAPACITANCE - MFDS.
13
12
11
10
9
8
7
6
5
.90
.92
.94
.96
.98
1.00
LOAD POWER FACTOR-LAGGING
GENERATOR SPEED
4400 RPM
8000 RPM

FIG. 21

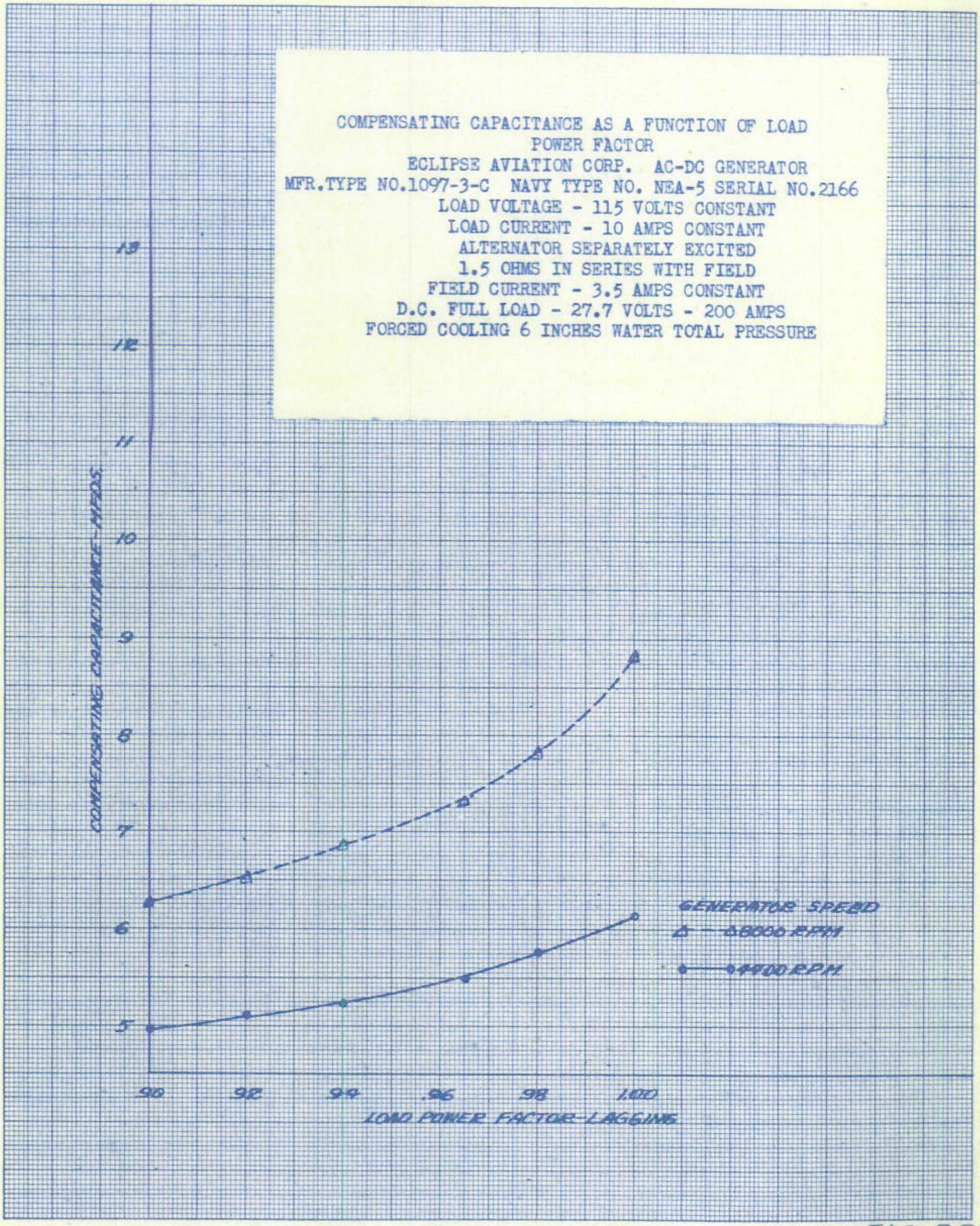

COMPENSATING CAPACITANCE AS A FUNCTION OF LOAD
POWER FACTOR
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
LOAD VOLTAGE - 115 VOLTS CONSTANT
LOAD CURRENT - 10 AMPS CONSTANT
ALTERNATOR SEPARATELY EXCITED
1.5 OHMS IN SERIES WITH FIELD
FIELD CURRENT - 3.5 AMPS CONSTANT
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
COMPENSATING CAPACITANCE - MFDS.
13
12
11
10
9
8
7
6
5
GENERATOR SPEED
6000 RPM
4400 RPM
.90
.92
.94
.96
.98
1.00
LOAD POWER FACTOR-LAGGING

FIG. 22

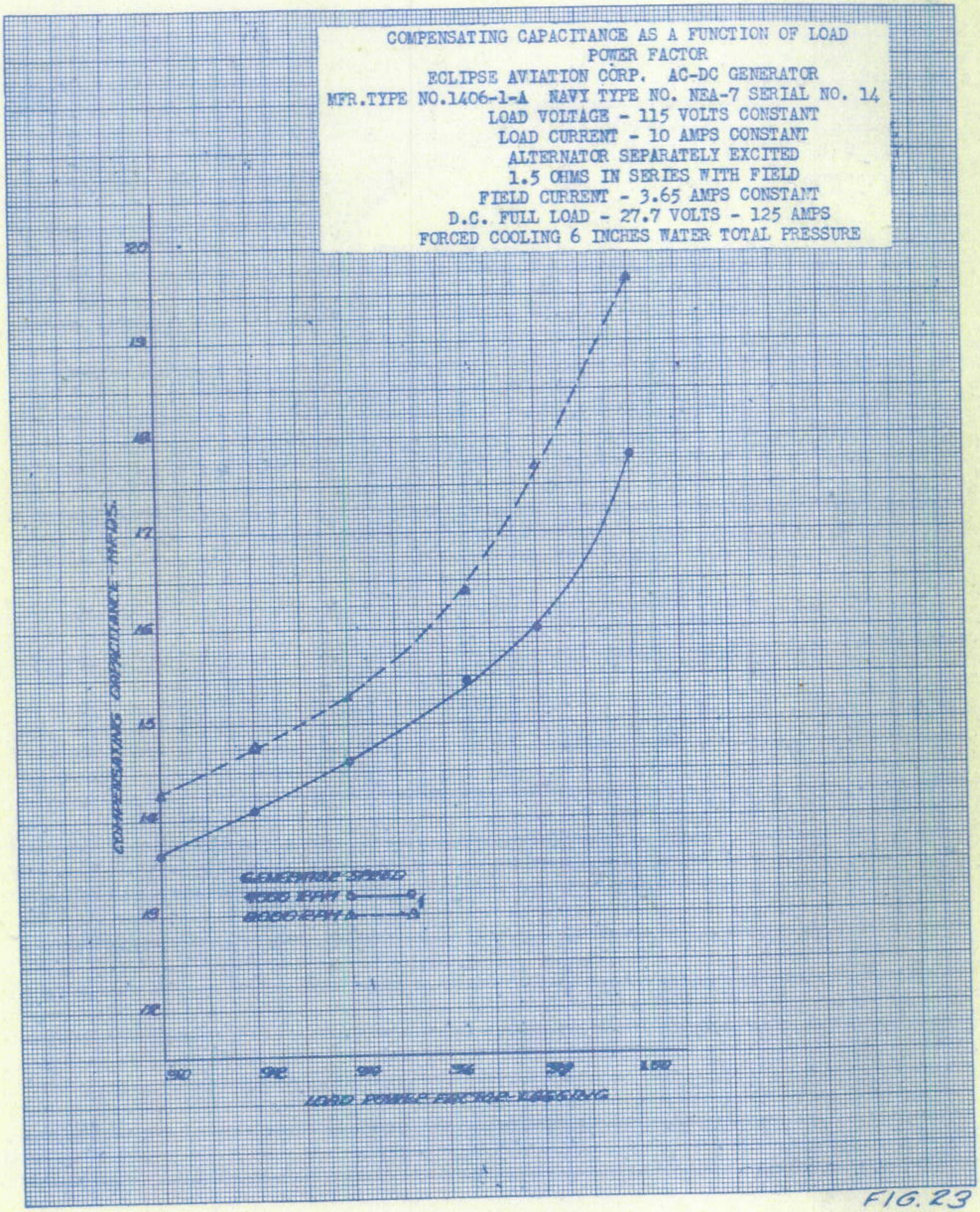


FIG. 23

DECLASSIFIED

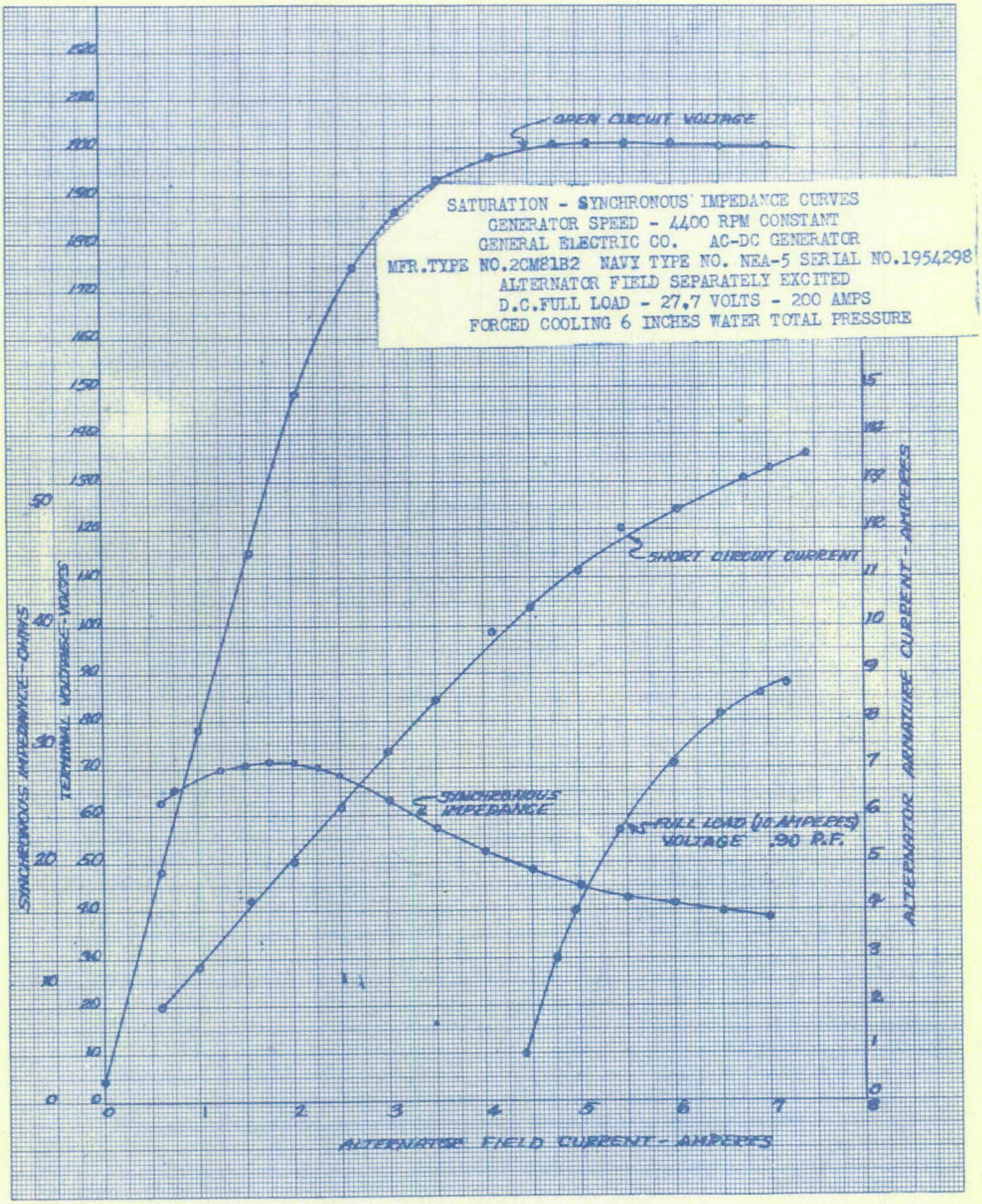


FIG. 24

DECLASSIFIED

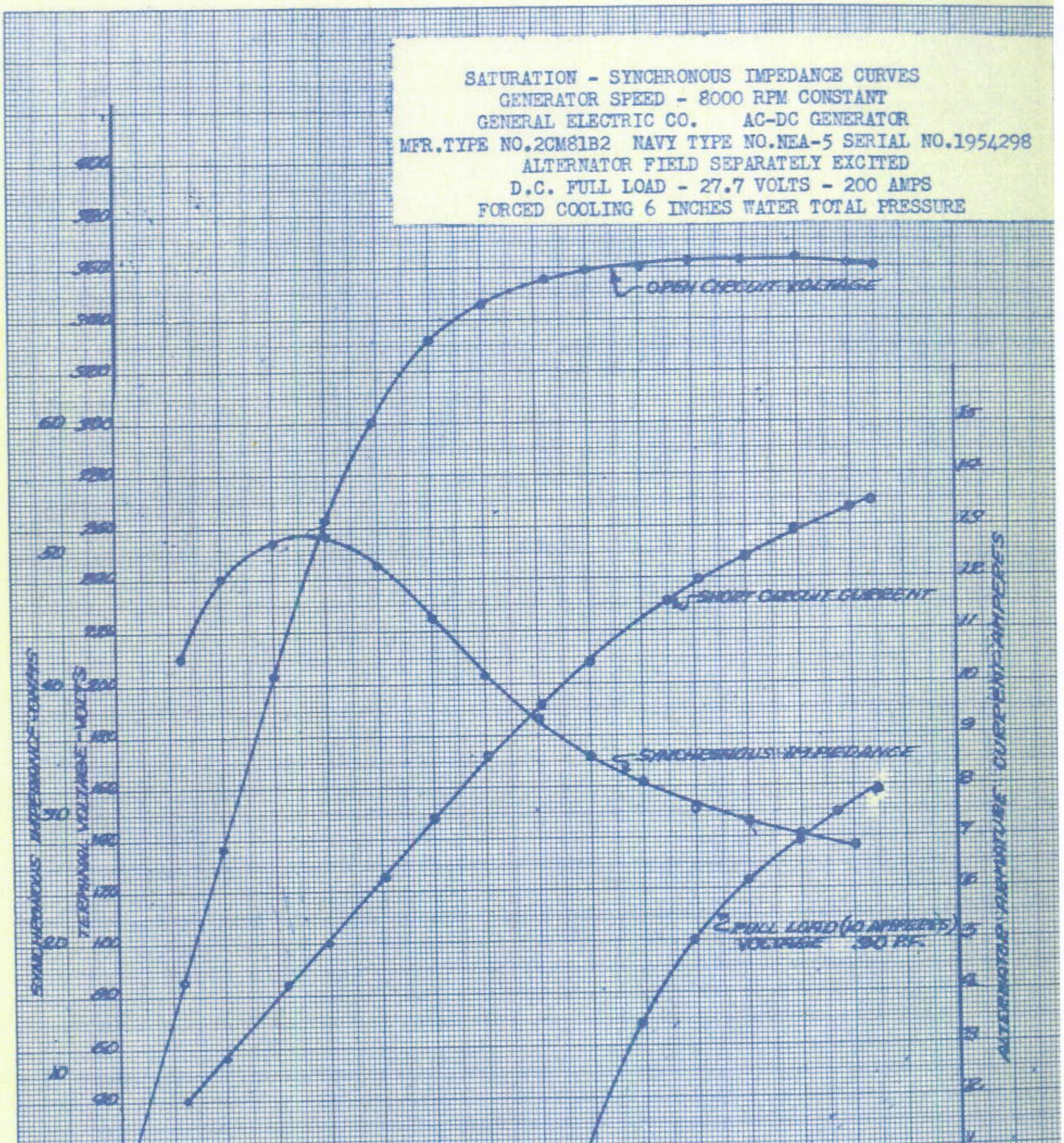

SATURATION - SYNCHRONOUS IMPEDANCE CURVES
GENERATOR SPEED - 8000 RPM CONSTANT
GENERAL ELECTRIC CO. AC-DC GENERATOR
MFR.TYPE NO.2CM81B2 NAVY TYPE NO.NEA-5 SERIAL NO.1954298
ALTERNATOR FIELD SEPARATELY EXCITED
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
OPEN CIRCUIT VOLTAGE
SHORT CIRCUIT CURRENT
SYNCHRONOUS IMPEDANCE
FULL LOAD (10 AMPERES) VOLTAGE .90 P.F.
SYNCHRONOUS IMPEDANCE-OHMS
TERMINAL VOLTAGE-VOLTS
ALTERNATOR ARMATURE CURRENT-AMPERES
ALTERNATOR FIELD CURRENT-AMPERES

FIG. 25

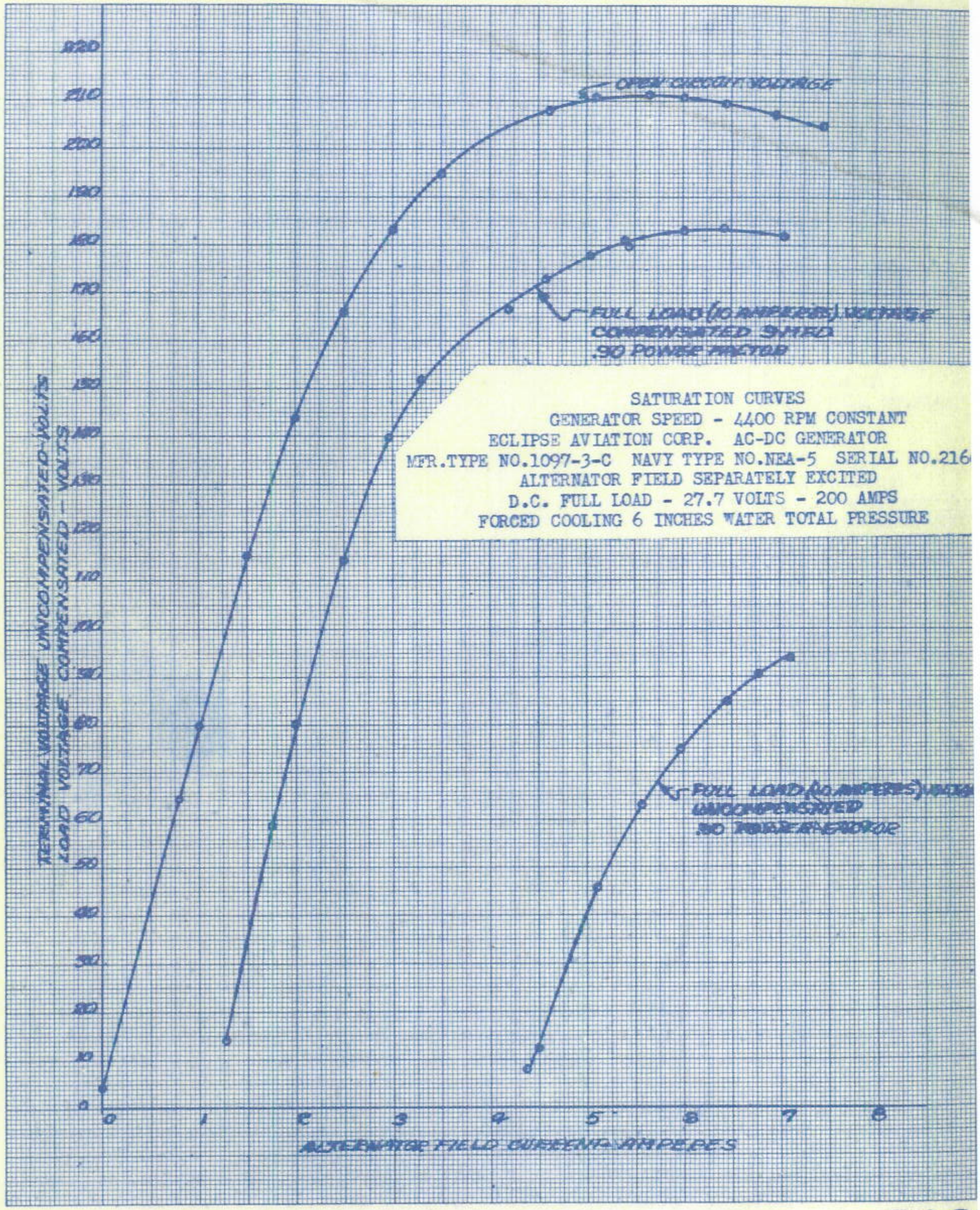

SATURATION CURVES
GENERATOR SPEED - 4400 RPM CONSTANT
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO.NEA-5 SERIAL NO.216
ALTERNATOR FIELD SEPARATELY EXCITED
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
OPEN CIRCUIT VOLTAGE
.90 POWER FACTOR
TERMINAL VOLTAGE UNCOMPENSATED-VOLTS
LOAD VOLTAGE COMPENSATED - VOLTS
ALTERNATOR FIELD CURRENT-AMPERES
0
1
2
3
4
5
6
7
8

FIG. 26

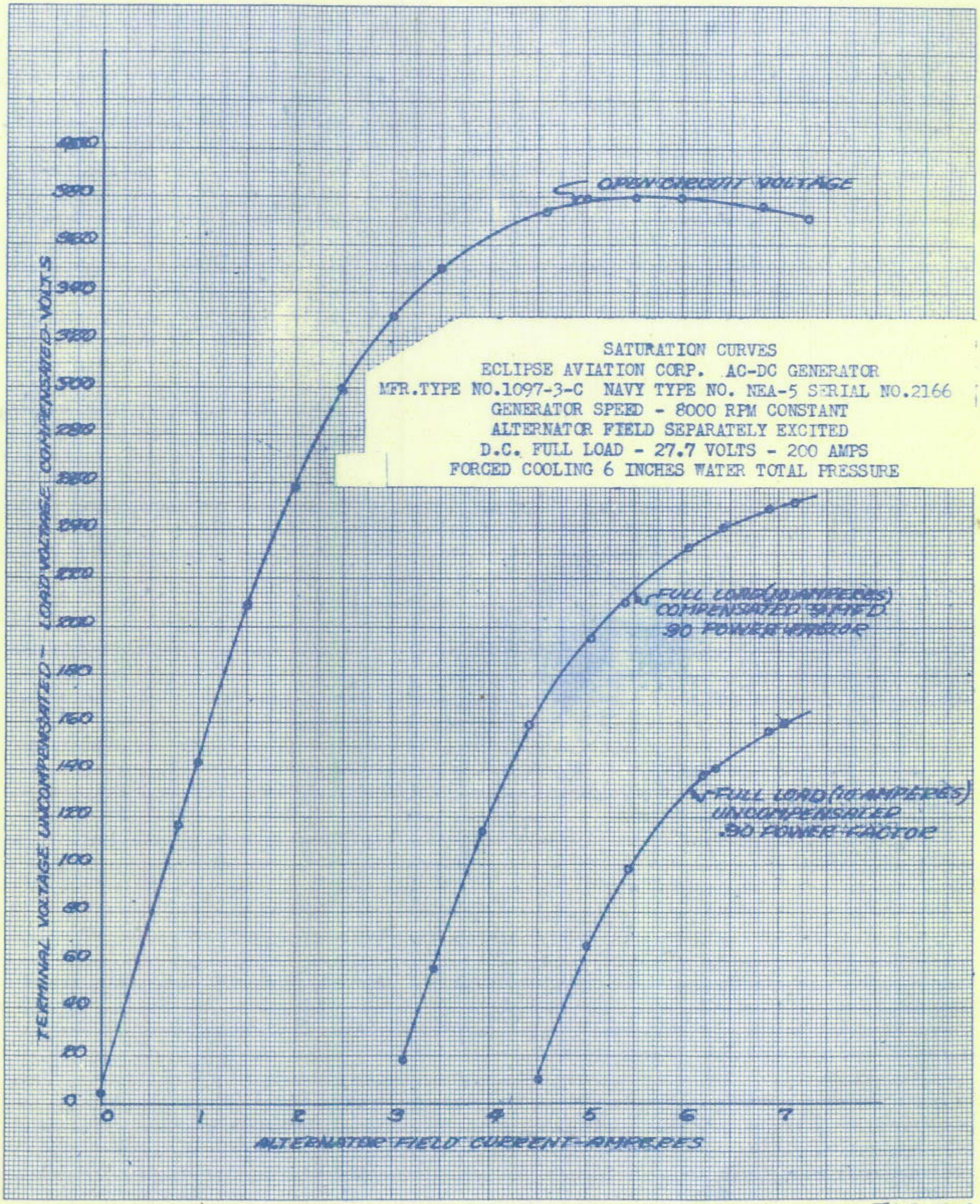

SATURATION CURVES
ECLIPSE AVIATION CORP. AC-DC GENERATOR
MFR.TYPE NO.1097-3-C NAVY TYPE NO. NEA-5 SERIAL NO.2166
GENERATOR SPEED - 8000 RPM CONSTANT
ALTERNATOR FIELD SEPARATELY EXCITED
D.C. FULL LOAD - 27.7 VOLTS - 200 AMPS
FORCED COOLING 6 INCHES WATER TOTAL PRESSURE
OPEN CIRCUIT VOLTAGE
FULL LOAD (10 AMPERES)
COMPENSATED
FULL LOAD (10 AMPERES)
UNCOMPENSATED
.90 POWER FACTOR
TERMINAL VOLTAGE UNCOMPENSATED - LOAD VOLTAGE COMPENSATED - VOLTS
400
380
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
1
2
3
4
5
6
7
ALTERNATOR FIELD CURRENT-AMPERES

FIG.27

DISTRIBUTION:

BuAer	(6)
NACA - Washington	(3)
HAAF - Washington	(1)
BAGR - Wright Field	(2)
ATSC - Washington	(3)
NATC - Patuxent River	(1)

S U B J E C T   I N D E X

A U T H O R   I N D E X