REPORT No. 141

EXPERIMENTAL RESEARCH ON AIR PROPELLERS, V

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(1) SCOPE OF INVESTIGATION COVERED BY PRESENT REPORT.

National Advisory Committee reports Nos. 14, 30, 64 comprise the results of a series of wind-tunnel tests on model forms of air propellers, extending over a three-year program of experimental work. These reports were made progressively and each without reference to the results given in preceding reports and relating to forms perhaps adjacent in geometrical form and proportion. These reports thus represent a survey, made in three parts, of a somewhat extended area covering a considerable number of model forms and proportions and varying in various characteristics in a systematic and regular manner.

At the conclusion of the work thus carried on in parts, it has seemed desirable to review the entire series of results, to examine through graphical and other appropriate means the nature of the history of the characteristics of operation as related to the systematic variation in characteristics of form, proportions, etc., through the entire series of such variations, to check doubtful points by repetition of test, to remove inconsistencies where found, and generally to develop, for the series of models represented by these tests, a consistent set of results as judged by the relation of those for any one model to those for all models adjacent in geometrical form and proportion.

It is the purpose of the present report to give the results of this general analysis and review of these series of experimental observations.

NUMBER AND CHARACTERISTICS OF MODEL FORMS.

The number of model forms included in the analysis which is the subject of the present report is 88. The three reports on which this analysis is primarily based covered a certain number of additional forms, the results for which are not here included. These omitted forms represent unusual or special forms or slight variations from normal types and were intended to indicate the results to be anticipated by such departures from the more normal range of form and proportion. The results derived from these models are generally without valuable or hopeful indications.

There remains the aggregate of 88 models distributed over the range of variations in form and proportion as follows:

	Variations.
Pitch ratio	6
Area of blade	2
Form of blade	2
Form of cross section of blade	4
Mode of pitch distribution	4

In designating these models, the following notation has been employed:

Form of blade contour No. 1	F_1 (see fig. 1).
Form of blade contour No. 2	F_2 (see fig. 2).
Area of blade No. 1	A_1 (see figs. 1, 2).
Area of blade No. 2	A_2 (see figs. 1, 2).
Pitch distribution uniform	P_1.
Pitch distribution according to constant angle of attack 3°	P_2.
Pitch distribution according to constant angle of attack 6°	P_3.
Pitch distribution according to constant angle of attack 9°	P_4.
Driving face of blade plane or without camber	S_1 (see figs. 3, 4, 5, 6).
Driving face of blade cambered (full)	S_2 (see figs. 7, 8, 9, 10).
Driving face of blade cambered (half)	S_3 (see figs, 11, 12).
Driving face of blade convex	S_4 (see fig. 13).

These various models cover the following combinations of characteristics of form and proportion:

No.	
6 constant $F_1A_1S_1P_1$ with 6 variations in nominal pitch ratio	0.3, 0.5, 0.7, 0.9, 1.1, 1.3
6 constant $F_1A_2S_1P_1$ with 6 variations in nominal pitch ratio	0.3, 0.5, 0.7, 0.9, 1.1, 1.3
6 constant $F_2A_1S_1P_1$ with 6 variations in nominal pitch ratio	0.3, 0.5, 0.7, 0.9, 1.1, 1.3
6 constant $F_2A_2S_1P_1$ with 6 variations in nominal pitch ratio	0.3, 0.5, 0.7, 0.9, 1.1, 1.3
3 constant $F_1A_1S_1P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_1A_2S_1P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
5 constant $F_2A_1S_1P_2$ with 5 variations in nominal pitch ratio	0.5, 0.7, 0.9, 1.1, 1.3
3 constant $F_2A_2S_1P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_1A_1S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_1A_2S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_1S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_2S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_1A_1S_2P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_1A_2S_2P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_1S_2P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_2S_2P_2$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_1S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
3 constant $F_2A_2S_2P_1$ with 3 variations in nominal pitch ratio	0.5, 0.7, 0.9
5 constant $F_2A_1S_4P_1$ with 5 variations in nominal pitch ratio	0.5, 0.7, 0.9, 1.1, 1.3
5 constant $F_2A_1S_1P_3$ with 5 variations in nominal pitch ratio	0.5, 0.7, 0.9, 1.1, 1.3
5 constant $F_2A_1S_1P_4$ with 5 variations in nominal pitch ratio	0.5, 0.7, 0.9, 1.1, 1.3

In addition to the above 83 models the report includes results for:

Four models of constant F_2A_1 and nominal pitch ratio 0.7, but with maximum thickness of cross-section at 0.17, 0.25, 0.41, and 0.49 of the width from the leading edge. See figures 14, 15, 16, and 17.

One model of constant $F_1A_1S_1$ with blades made adjustable for change of pitch, the pitch being uniform at 0.7 pitch ratio.

The characteristics of these various models in detail will be found in Table I.

TABLE I.—*Model characteristics.*

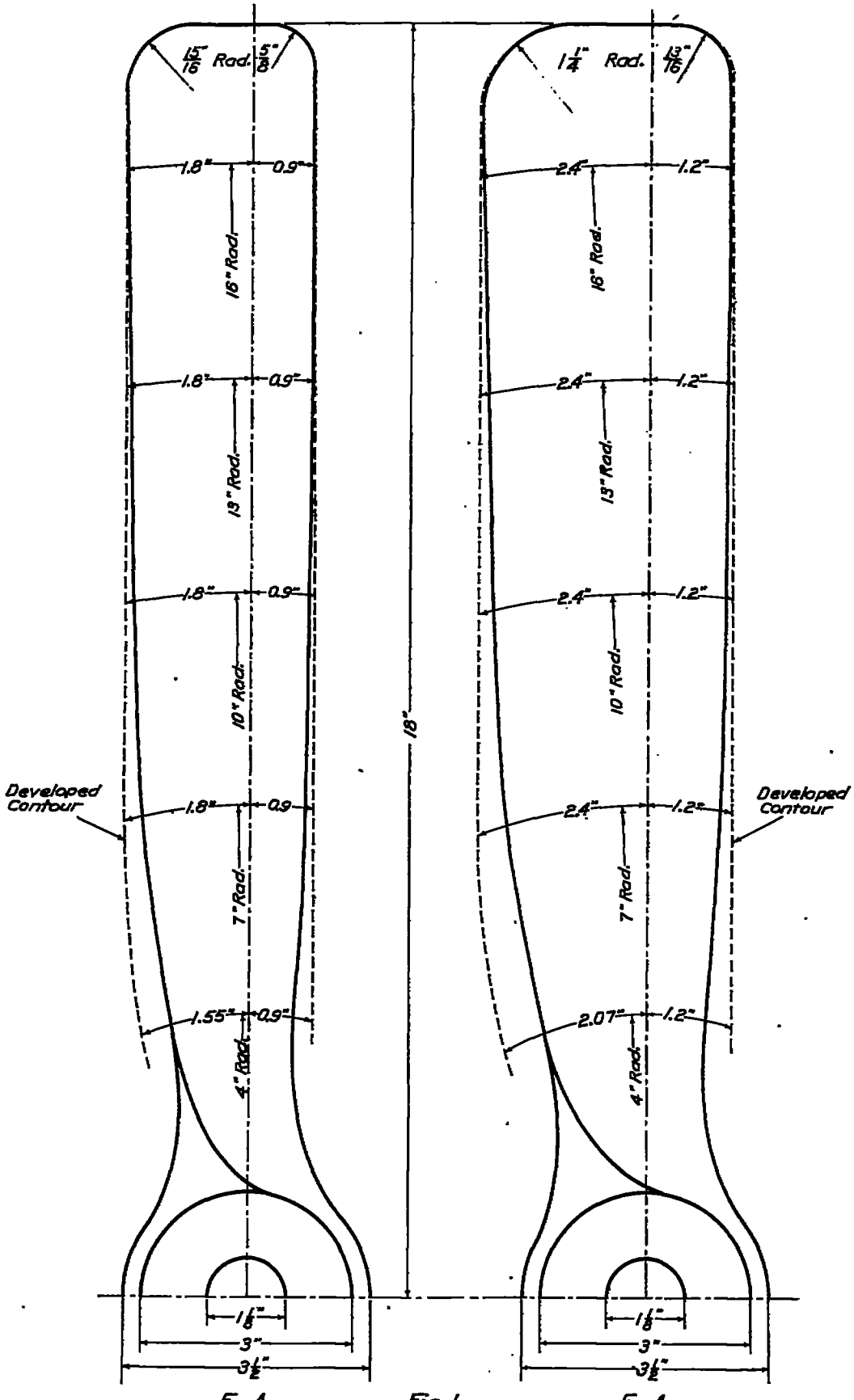
Number.	Section symbol.	Form symbol.	Area symbol.	Pitch symbol.	Pitch ratio.	Mean blade width.	Number.	Section symbol.	Form symbol.	Area symbol.	Pitch symbol.	Pitch ratio.	Mean blade width.
1	S_1	F_1	A_1	P_1	0.9	0.15r	45	S_2	F_1	A_1	P_2	0.5	0.15r
2	S_1	F_1	A_2	P_1	.9	.20r	46	S_2	F_1	A_2	P_2	.5	.20r
3	S_1	F_2	A_1	P_1	.9	.15r	47	S_2	F_2	A_1	P_2	.5	.15r
4	S_1	F_2	A_2	P_1	.9	.20r	48	S_2	F_2	A_2	P_2	.5	.20r
5	S_1	F_1	A_1	P_1	.7	.15r	80	S_1	F_1	A_1	P_1	1.1	.15r
6	S_1	F_1	A_2	P_1	.7	.20r	81	S_1	F_1	A_2	P_1	1.1	.20r
7	S_1	F_2	A_1	P_1	.7	.15r	82	S_1	F_2	A_1	P_1	1.1	.15r
8	S_1	F_2	A_2	P_1	.7	.20r	83	S_1	F_2	A_2	P_1	1.1	.20r
9	S_1	F_1	A_1	P_1	.5	.15r	90	S_2	F_2	A_1	P_1	.5	.15r
10	S_1	F_1	A_2	P_1	.5	.20r	91	S_2	F_2	A_2	P_1	.5	.20r
11	S_1	F_2	A_1	P_1	.5	.15r	92	S_2	F_2	A_1	P_1	.7	.15r
12	S_1	F_2	A_2	P_1	.5	.20r	93	S_2	F_2	A_2	P_1	.7	.20r
13	S_1	F_1	A_1	P_2	.9	.15r	94	S_2	F_2	A_1	P_1	.9	.15r
14	S_1	F_1	A_2	P_2	.9	.20r	95	S_2	F_2	A_2	P_1	.9	.20r
15	S_1	F_2	A_1	P_2	.9	.15r	96[1]	S_1	F_1	A_1	P_1	.7	.15r
16	S_1	F_2	A_2	P_2	.9	.20r	111	S_1	F_1	A_1	P_1	1.3	.15r
17	S_1	F_1	A_1	P_2	.7	.15r	112	S_1	F_1	A_2	P_1	1.3	.20r
18	S_1	F_1	A_2	P_2	.7	.20r	113	S_1	F_2	A_1	P_1	1.3	.15r
19	S_1	F_2	A_1	P_2	.7	.15r	114	S_1	F_2	A_2	P_1	1.3	.20r
20	S_1	F_2	A_2	P_2	.7	.20r	115	S_4	F_2	A_1	P_1	.5	.15r
21	S_1	F_1	A_1	P_2	.5	.15r	116	S_4	F_2	A_1	P_1	.7	.15r
22	S_1	F_1	A_2	P_2	.5	.20r	117	S_4	F_2	A_1	P_1	.9	.15r
23	S_1	F_2	A_1	P_2	.5	.15r	118	S_4	F_2	A_1	P_1	1.1	.15r
24	S_1	F_2	A_2	P_2	.5	.20r	119	S_4	F_2	A_1	P_1	1.3	.15r
25	S_2	F_1	A_1	P_1	.9	.15r	120	S_4	F_2	A_1	P_1	.7	.15r
26	S_2	F_1	A_2	P_1	.9	.20r	121	S_4	F_2	A_1	P_1	.7	.15r
27	S_2	F_2	A_1	P_1	.9	.15r	122	S_7	F_2	A_1	P_1	.7	.15r
28	S_2	F_2	A_2	P_1	.9	.20r	123	S_3	F_2	A_1	P_1	.7	.15r
29	S_2	F_1	A_1	P_1	.7	.15r	127	S_1	F_2	A_1	P_2	.5	.15r
30	S_2	F_1	A_2	P_1	.7	.20r	128	S_1	F_2	A_1	P_4	.5	.15r
31	S_2	F_2	A_1	P_1	.7	.15r	129	S_1	F_2	A_1	P_2	.7	.15r
32	S_2	F_2	A_2	P_1	.7	.20r	130	S_1	F_2	A_1	P_4	.7	.15r
33	S_2	F_1	A_1	P_1	.5	.15r	131	S_1	F_2	A_1	P_2	.9	.15r
34	S_2	F_1	A_2	P_1	.5	.20r	132	S_1	F_2	A_1	P_4	.9	.15r
35	S_2	F_2	A_1	P_1	.5	.15r	133	S_1	F_2	A_1	P_2	1.1	15r
36	S_2	F_2	A_2	P_1	.5	.20r	134	S_1	F_2	A_1	P_2	1.1	.15r
37	S_2	F_1	A_1	P_2	.9	.15r	135	S_1	F_2	A_1	P_4	1.1	.15r
38	S_2	F_1	A_2	P_2	.9	.20r	136	S_1	F_2	A_1	P_2	1.3	.15r
39	S_2	F_2	A_1	P_2	.9	.15r	137	S_1	F_2	A_1	P_2	1.3	.15r
40	S_2	F_2	A_2	P_2	.9	.20r	138	S_1	F_2	A_1	P_4	1.3	.15r
41	S_2	F_1	A_1	P_2	.7	.15r	139	S_1	F_2	A_1	P_1	.3	.15r
42	S_2	F_1	A_2	P_2	.7	.20r	144	S_1	F_2	A_2	P_1	.3	.20r
43	S_2	F_2	A_1	P_2	.7	.15r	145	S_1	F_1	A_1	P_1	.3	.15r
44	S_2	F_2	A_2	P_2	.7	.20r	146	S_1	F_1	A_2	P_1	.3	.20r

[1] Adjustable pitch.

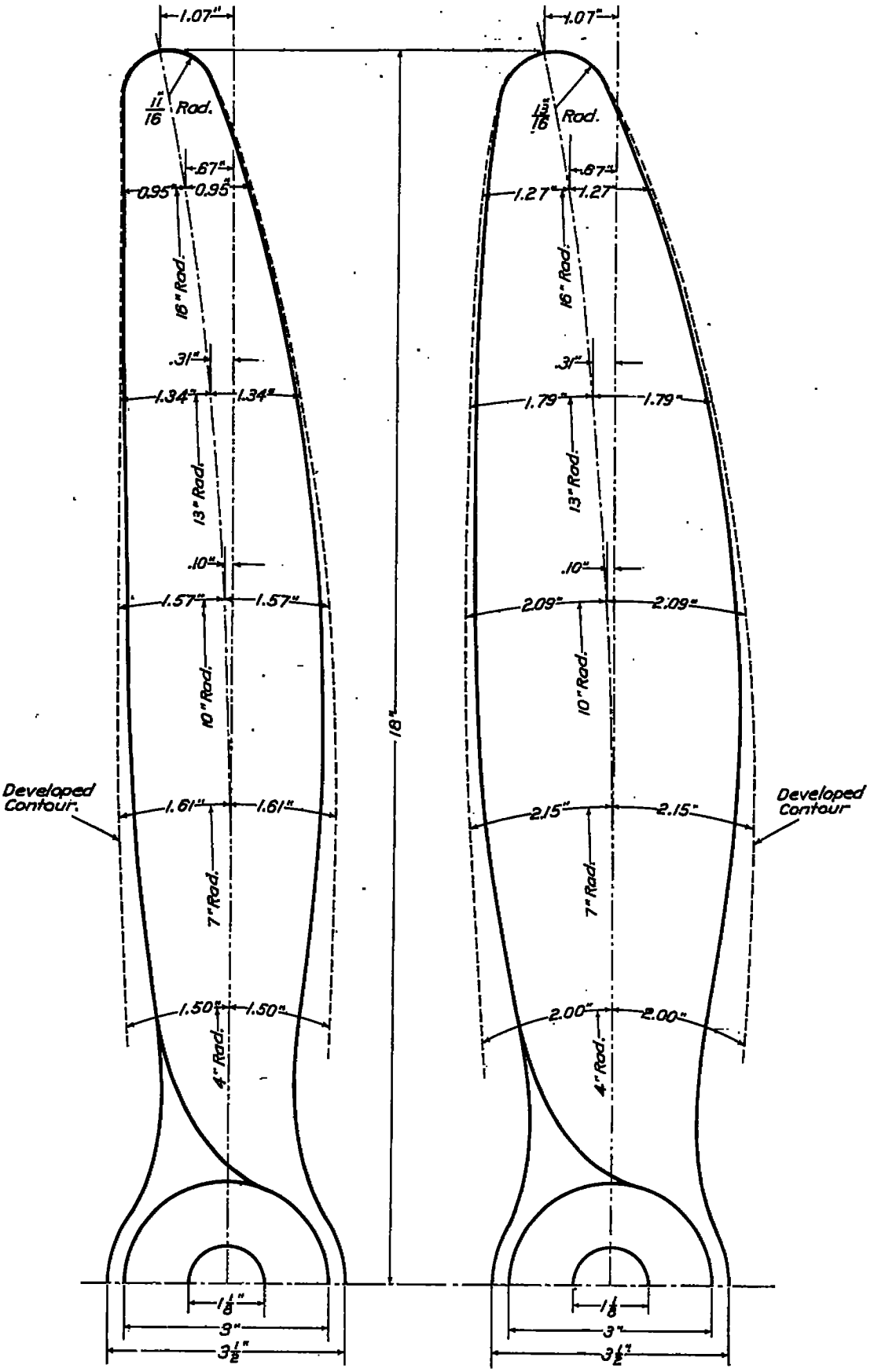
TABLE II.—*Dimensions of sections (see Fig. 18).*

Fig. No.	Section form and area.	Radius of section.	AB.	AE.	AC and BD.	EG.	EH.	EM.	RS.	O.
	Symbols.	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*	*Degrees.*
3	$S_1 F_1 A_1$	4	2.45	0.90	0.05	0.70	1.19	.....	0.15	78
		7	2.70	.90	.05	.60	1.01	.....	.....	69
		10	2.70	.90	.05	.50	.84	.....	.....	60
		13	2.70	.90	.05	.40	.66	.....	.....	51
		16	2.70	.90	.05	.30	.49	.....	.....	42
4	$S_1 F_1 A_2$	4	3.27	1.20	.05	.70	1.19	.....	.20	78
		7	3.60	1.20	.05	.60	1.01	.....	.....	69
		10	3.60	1.20	.05	.50	.84	.....	.....	60
		13	3.60	1.20	.05	.40	.66	.....	.....	51
		16	3.60	1.20	.05	.30	.49	.....	.....	42
5	$S_1 F_2 A_1$	4	3.00	1.00	.05	.70	1.19	.....	.18	78
		7	3.22	1.07	.05	.60	1.01	.....	.....	69
		10	3.14	1.05	.05	.50	.84	.....	.....	60
		13	2.68	.89	.05	.40	.66	.....	.....	51
		16	1.90	.63	.05	.30	.49	.....	.....	42
6	$S_1 F_2 A_2$	4	4.00	1.33	.05	.70	1.19	.....	.25	78
		7	4.30	1.43	.05	.60	1.01	.....	.....	69
		10	4.18	1.39	.05	.50	.84	.....	.....	60
		13	3.58	1.19	.05	.40	.66	.....	.....	51
		16	2.54	.85	.05	.30	.49	.....	.....	42
7	$S_2 F_1 A_1$	4	2.45	.90	.05	.70	1.19	.....	.....	78
		7	2.70	.90	.05	.60	1.01	0.17	.....	69
		10	2.70	.90	.05	.50	.84	.17	.....	60
		13	2.70	.90	.05	.40	.66	.13	.....	51
		16	2.70	.90	.05	.30	.49	.10	.....	42
8	$S_2 F_1 A_2$	4	3.27	1.20	.05	.70	1.19	.....	.....	78
		7	3.60	1.20	.05	.60	1.01	.17	.....	69
		10	3.60	1.20	.05	.50	.84	.17	.....	60
		13	3.60	1.20	.05	.40	.66	.13	.....	51
		16	3.60	1.20	.05	.30	.49	.10	.....	42
9	$S_2 F_2 A_1$	4	3.00	1.00	.05	.70	1.19	.....	.....	78
		7	3.22	1.07	.05	.60	1.01	.17	.....	69
		10	3.14	1.05	.05	.50	.84	.17	.....	60
		13	2.68	.89	.05	.40	.66	.13	.....	51
		16	1.90	.63	.05	.30	.49	.10	.....	42
10	$S_2 F_2 A_2$	4	4.00	1.33	.05	.70	1.19	.....	.....	78
		7	4.30	1.43	.05	.60	1.01	.17	.....	69
		10	4.18	1.39	.05	.50	.84	.17	.....	60
		13	3.58	1.19	.05	.40	.66	.13	.....	51
		16	2.54	.85	.05	.30	.49	.10	.....	42
11	$S_3 F_1 A_1$	4	3.00	1.00	.05	.70	1.19	.....	.....	78
		7	3.22	1.07	.05	.60	1.01	.08	.....	69
		10	3.14	1.05	.05	.50	.84	.08	.....	60
		13	2.68	.89	.05	.40	.66	.07	.....	51
		16	1.90	.63	.05	.30	.49	.05	.....	42
12	$S_3 F_1 A_2$	4	4.00	1.33	.05	.70	1.19	.....	.....	78
		7	4.30	1.43	.05	.60	1.01	.08	.....	69
		10	4.18	1.39	.05	.50	.84	.08	.....	60
		13	3.58	1.19	.05	.40	.66	.07	.....	51
		16	2.54	.85	.05	.30	.49	.05	.....	42
13	$S_3 F_2 A_1$	4	3.00	1.00	.05	.70	1.19	.....	.18	78
		7	3.22	1.07	.05	.60	1.01	.....	.08	69
		10	3.14	1.05	.05	.50	.84	.....	.08	60
		13	2.68	.89	.05	.40	.66	.....	.07	51
		16	1.90	.63	.05	.30	.49	.....	.05	42
14	$S_3 F_2 A_1$	4	3.00	.51	.05	.70	1.19	.....	.18	78
		7	3.22	.55	.05	.60	1.01	.....	.....	69
		10	3.14	.53	.05	.50	.84	.....	.....	60
		13	2.68	.45	.05	.40	.66	.....	.....	51
		16	1.90	.32	.05	.30	.49	.....	.....	42
15	$S_3 F_2 A_1$	4	3.00	.75	.05	.70	1.19	.....	.18	78
		7	3.22	.81	.05	.60	1.01	.....	.....	69
		10	3.14	.78	.05	.50	.84	.....	.....	60
		13	2.68	.67	.05	.40	.66	.....	.....	51
		16	1.90	.47	.05	.30	.49	.....	.....	42
16	$S_7 F_2 A_1$	4	3.00	1.23	.05	.70	1.19	.....	.18	78
		7	3.22	1.32	.05	.60	1.01	.....	.....	69
		10	3.14	1.29	.05	.50	.84	.....	.....	60
		13	2.68	1.10	.05	.40	.66	.....	.....	51
		16	1.90	.78	.05	.30	.49	.....	.....	42
17	$S_8 F_2 A_1$	4	3.00	1.47	.05	.70	1.19	.....	.18	78
		7	3.22	1.58	.05	.60	1.01	.....	.....	69
		10	3.14	1.54	.05	.50	.84	.....	.....	60
		13	2.68	1.31	.05	.40	.66	.....	.....	51
		16	1.90	.93	.05	.30	.49	.....	.....	42

The dimensions of the sections shown in figures 3 to 17 are given in Table II, reference being made to figure 18.



$F_1 A_1$ Fig. 1 $F_1 A_2$



$F_2 A_1$ Fig. 2 $F_2 A_2$

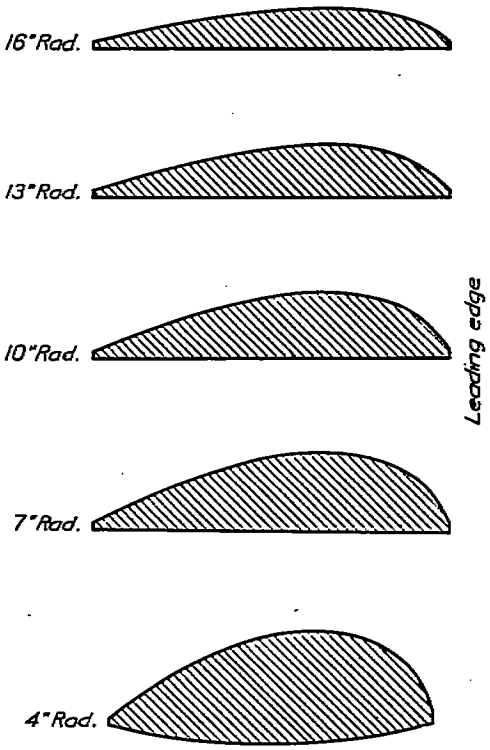


Fig. 3 $S_1 F_1 A_1$

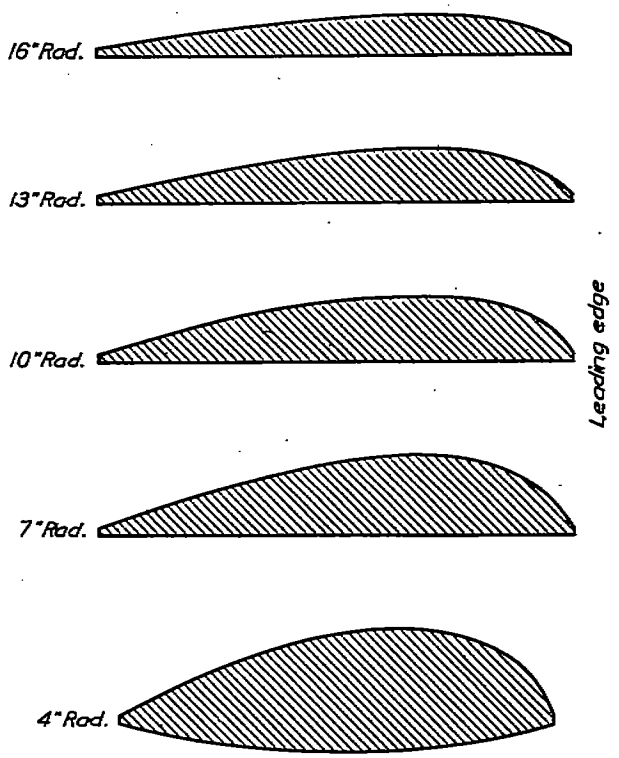


Fig. 4 $S_1 F_1 A_2$

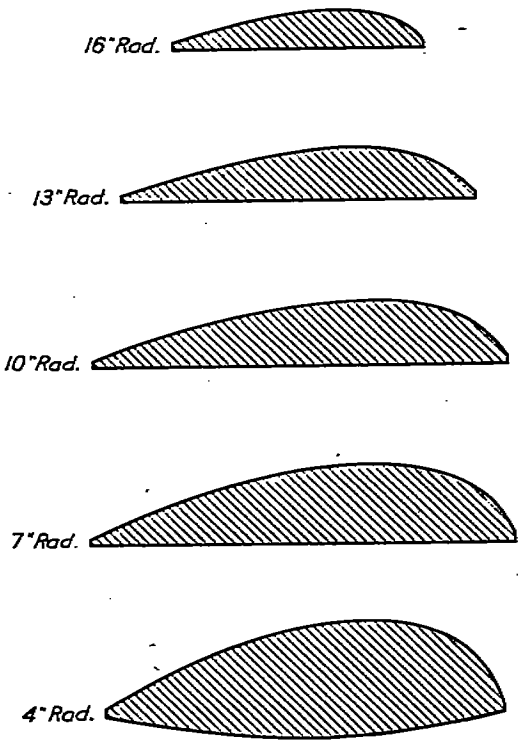


Fig. 5 $S_1 F_2 A_1$

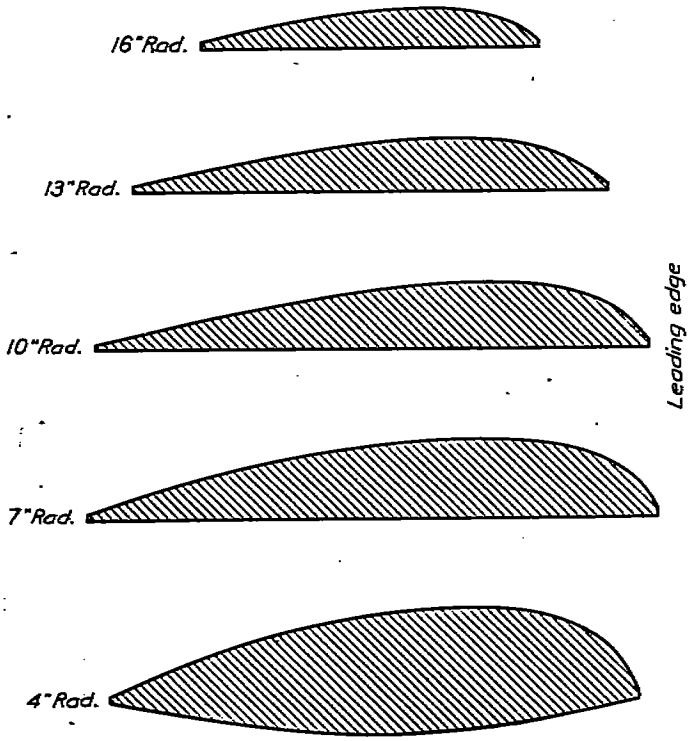


Fig. 6 $S_1 F_2 A_2$

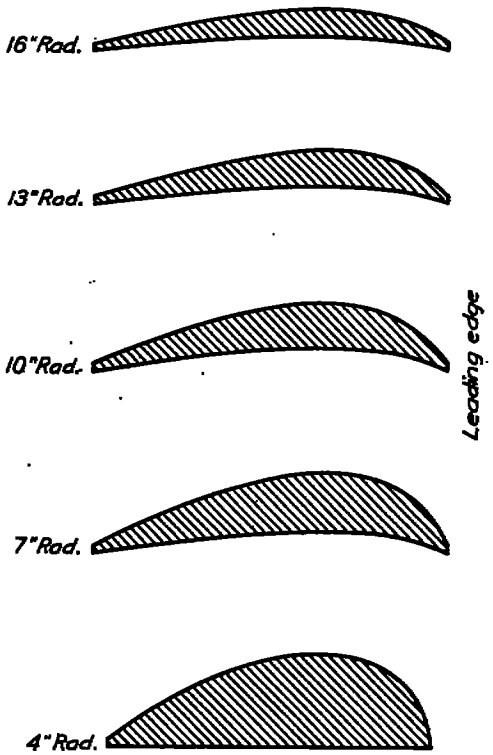


Fig. 7 $S_2 F_1 A_1$

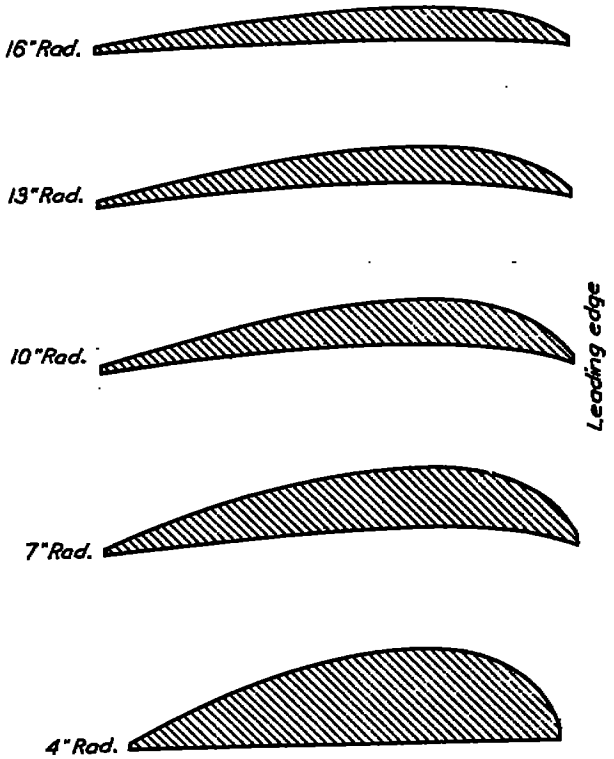


Fig. 8 $S_2 F_1 A_2$

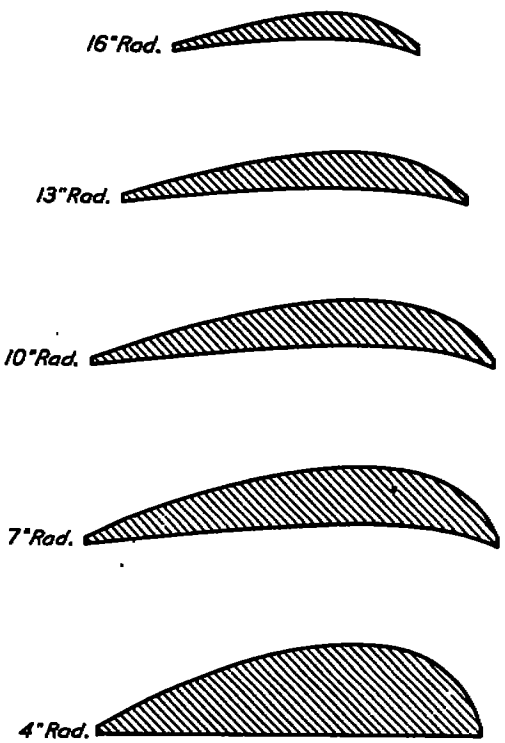


Fig. 9 $S_2 F_2 A_1$

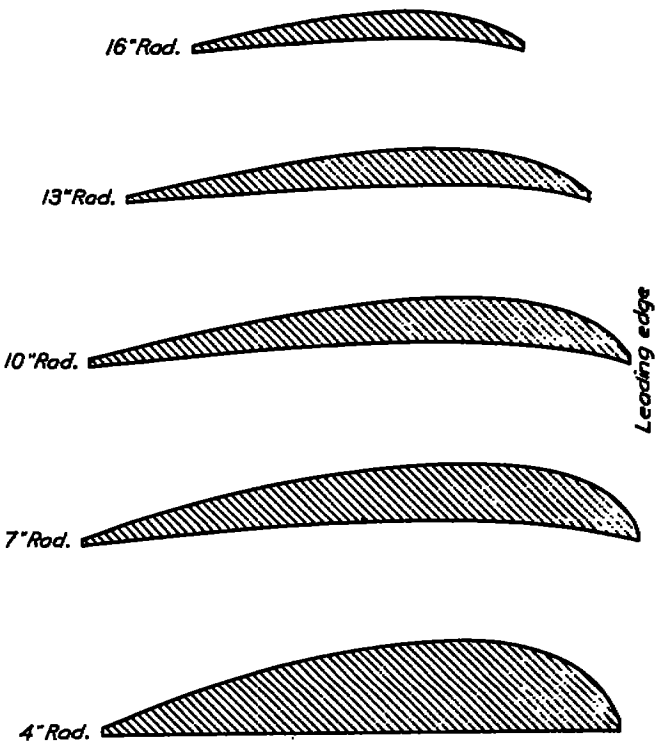


Fig. 10 $S_2 F_2 A_2$

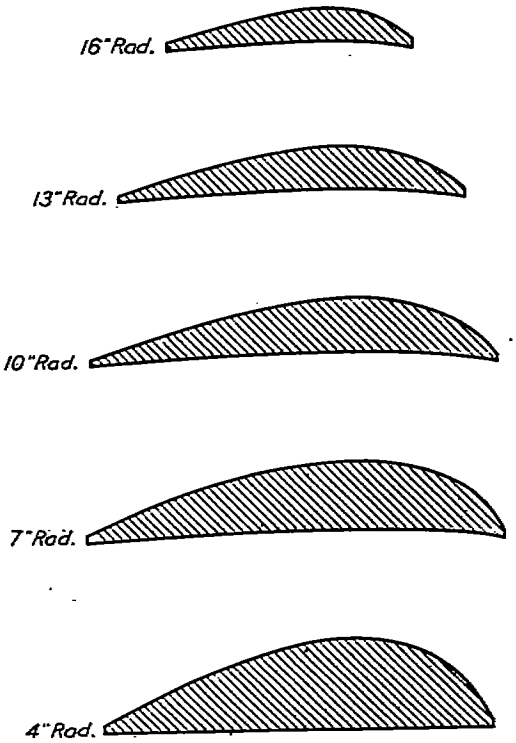


Fig.11 $S_3 F_2 A_1$

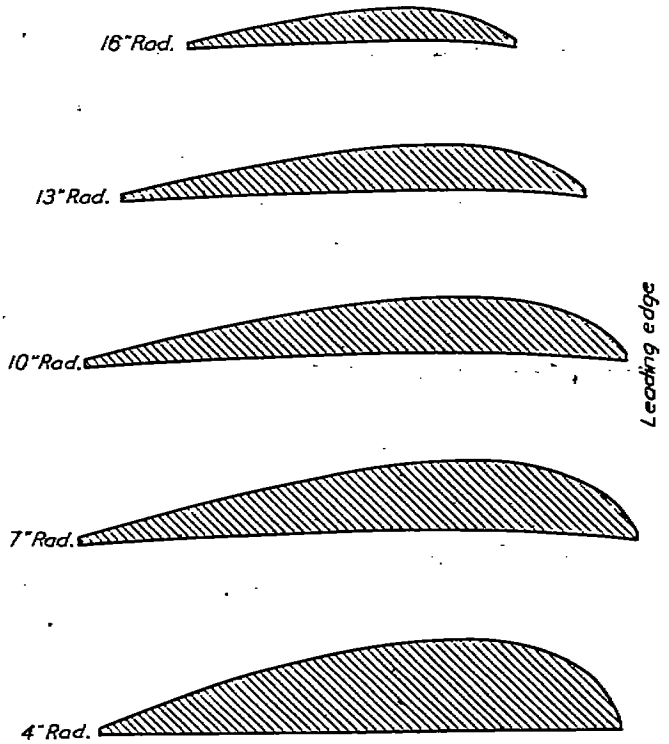


Fig.12 $S_3 F_2 A_2$

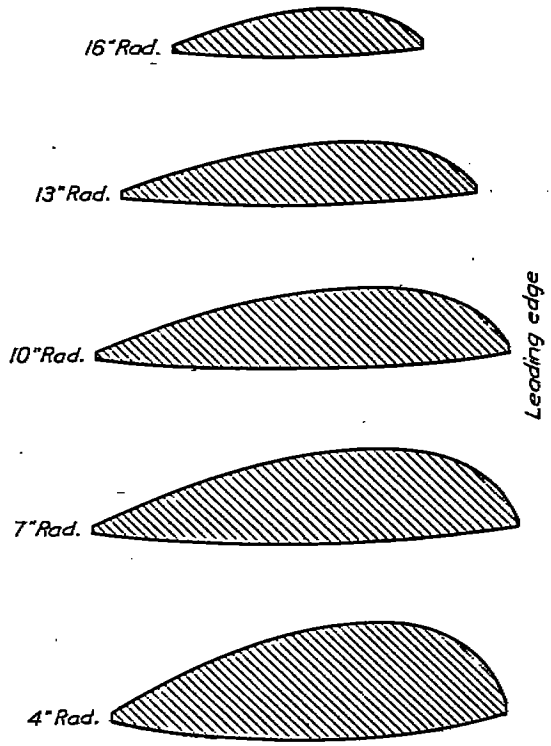


Fig.13 $S_4 F_2 A_1$

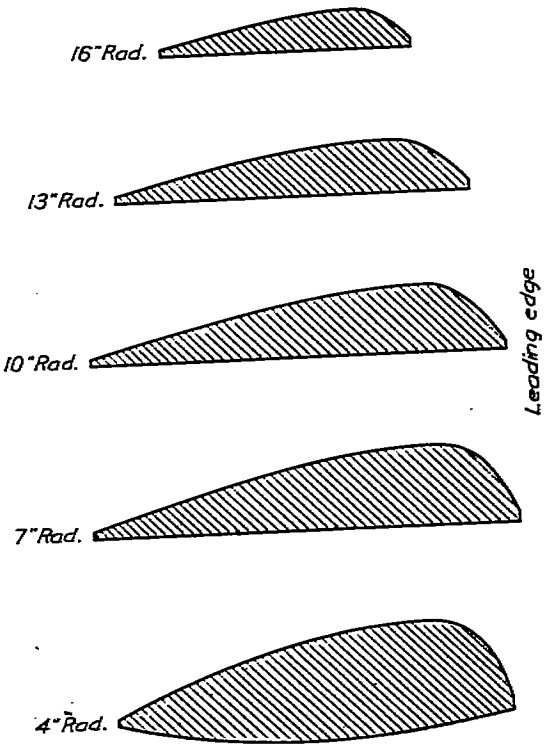


Fig.14 $S_5 F_2 A_1$

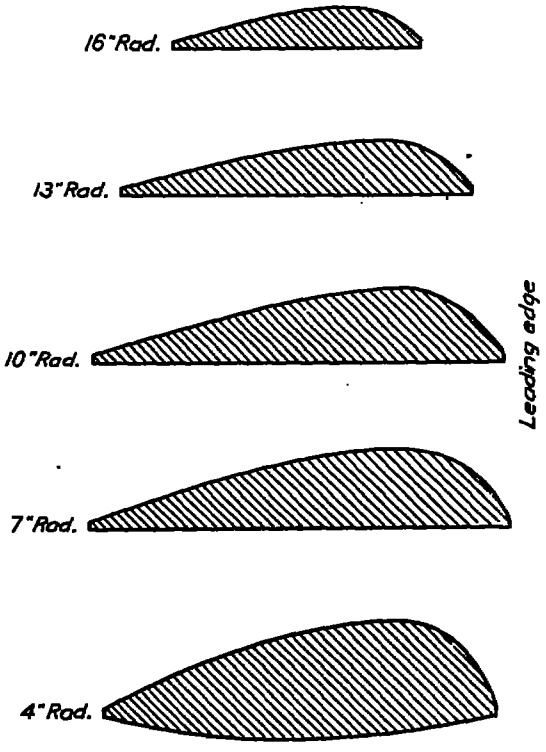


Fig 15 $S_8 F_2 A_1$

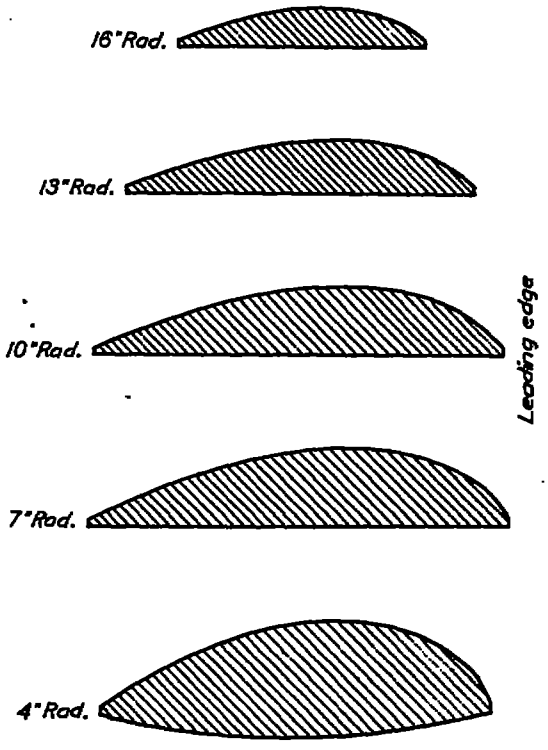


Fig.16 $S_7 F_2 A_1$

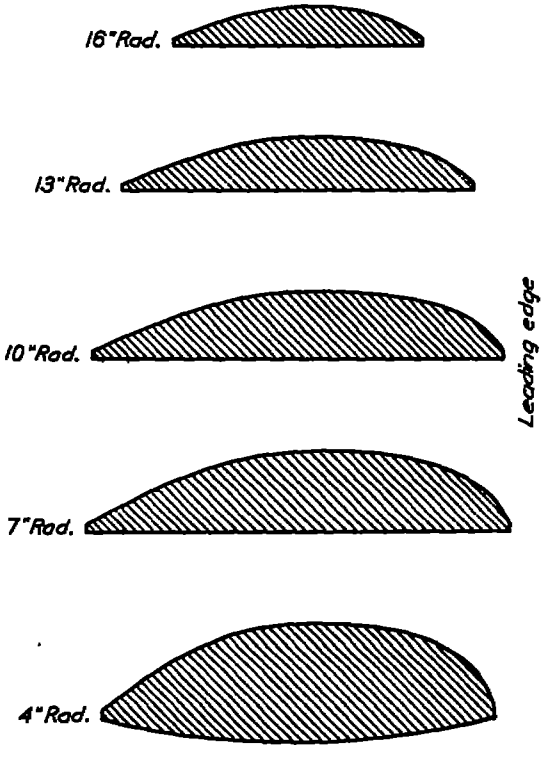


Fig.17 $S_8 F_2 A_1$

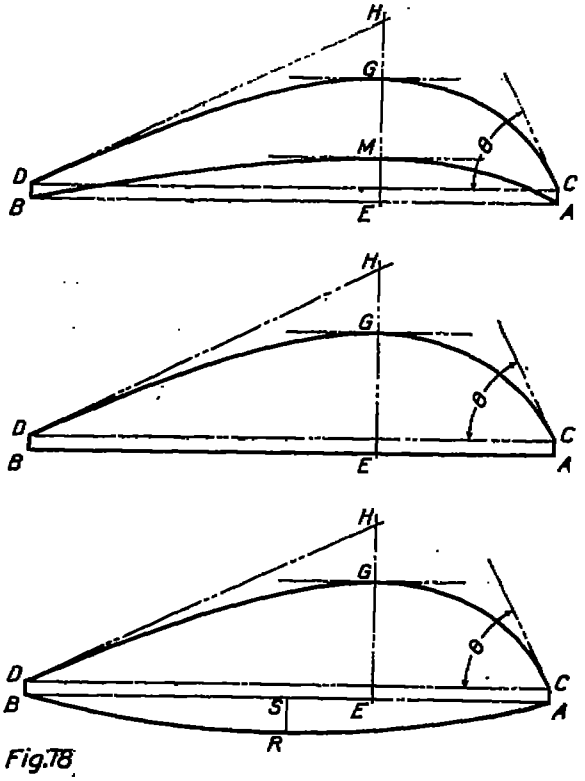


Fig.18

These models furthermore permit of grouping in such manner as to give results for the following series of graded variations:

6 variations of pitch ratio with 4 combinations of.....*F A S P.*
5 variations of pitch ratio with 4 other combinations of.....*F A S P.*
3 variations of pitch ratio with 18 other combinations of.....*F A S P.*
2 variations of contour with 30 combinations of.....*A S P* with pitch ratio.
2 variations of blade area with 33 combinations of.....*F S P* with pitch ratio.
2 variations of blade section with 24 combinations of.....*F A P* with pitch ratio.
3 variations of blade section with 6 other combinations of.....*F A P* with pitch ratio.
4 variations of blade section with 5 other combinations of.....*F A P* with pitch ratio.
2 variations of pitch distribution with 26 combinations of.....*F A S* with pitch ratio.
4 variations of pitch distribution with 5 other combinations of.....*F A S* with pitch ratio.

METHOD OF TEST.

The general method of test has already been described in preceding reports (Nos. 14, 30) and need not be more especially referred to at this point.

(2) REDUCTION OF EXPERIMENTAL RESULTS.

For the reduction of experimental model results to forms suited to use in practical problems, the following notation is employed.

D = diameter.
N = revolutions.
V = velocity.
Δ = density of air.
H = altitude.
T = thrust.
Q = torque.
P = effective power (power delivered by engine to propeller).
P_1 = useful power (utilized by propeller for propulsion of plane).
η = efficiency $= P_1 \div P$.
B, C = coefficients variously specified by subscript, and serving to relate T, Q, P, or P_1 to some function of V, D, N.
$x = V/ND$.

COEFFICIENTS OF THRUST, TORQUE, AND POWER.

The law of comparison which is accepted for the discussion of experimental results on model air propellers and for the purpose of making use of such results in connection with practical problems relating to full size propellers, may be stated thus:

For propellers of similar geometrical form and at equal values of the function V/ND the following relations hold

$$T \sim V^2D^2 \tag{1}$$

$$Q \sim V^2D^3 \tag{2}$$

These relations may be expressed in the form of equations by the introduction of coefficients B_1, B_2. In order furthermore to make these cofficients non-dimensional while at the same time measuring T and Q themselves in gravitational units, we may introduce the factor g, thus giving equations as follows:

$$gT = B_1 \Delta V^2 D^2 \tag{3}$$

$$gQ = B_2 \Delta V^2 D^3 \tag{4}$$

This gives for the coefficients B_1 and B_2 the values:

$$B_1 = \frac{gT}{\Delta V^2 D^2} \tag{5}$$

$$B_2 = \frac{gQ}{\Delta V^2 D^3} \tag{6}$$

We may now restate the assumed law of comparison as follows:

For propellers of similar geometrical form and at equal values of the function V/ND, values of B_1 in (5) will be the same independent of absolute size; and likewise for values of B_2 in (6).

If then we multiply equation (5) by the equation $x^n = (V/ND)^n$ it is evident that we shall have, on the left, a new coefficient, likewise independent of absolute size, and expressed in form as determined by the right hand member of the resulting equation.

This will be clear by holding in mind two propellers of similar geometrical form and operating at the same value of V/ND. For these particular conditions, the values of the coefficient B_1, for each propeller, will be the same. If then this single value of B_1 be multiplied by the value of V/ND we shall have a new single value, likewise applicable to these two propellers operating at this value of V/ND. We may similarly multiply or divide by any power of V/ND or by $(V/ND)^n$ where n may have any value positive or negative.

We may thus derive an indefinite series of coefficients, all relating to thrust, and in each case fulfilling the condition of equal values of coefficient for equal values of V/ND for two propellers of similar geometrical form; and if for some two propellers, then for any two and hence for any number, so long as they belong to the same family as regards geometrical type or form.

Thus by way of example, by suitably selecting the index of V/ND, we derive coefficients for T related as follows to the variables V, D, N, Δ:

$$\frac{gT}{\Delta V^2 D^2},\quad \frac{gT}{\Delta N^2 D^4},\quad \frac{gT}{\Delta V^4 N^{-2}},\quad \frac{gT}{\Delta VND^3} \tag{7}$$

It will be noted that of these four examples, the first involves V and D, the second N and D, the third V and N and the fourth V, N, D.

We may derive similarly coefficients for Q as follows:

$$\frac{gQ}{\Delta V^2 D^3},\quad \frac{gQ}{\Delta N^2 D^5},\quad \frac{gQ}{\Delta V^4 N^{-3}},\quad \frac{gQ}{\Delta VND^4} \tag{8}$$

Turning now to power we have immediately from (3) and (4)

$$gP_1 = gTV = B_1 \Delta V^3 D^2 \tag{9}$$

$$gP = 2\pi gQN = 2\pi_1 B_2 \Delta N V^3 D^3 \tag{10}$$

Hence

$$\frac{P_1}{P} = \eta = \frac{B_1}{2\pi B_2} \cdot \frac{V}{ND} \tag{11}$$

But for any two propellers geometrically similar in form and at the same value of V/ND, the two values of B_1 are the same, and likewise for B_2, while by specification V/ND is the same. Hence from (11) the efficiency will be the same.

This means specifically that for any pair of propellers geometrically similar in form and operating at equal values of V/ND, the efficiencies will be the same; or more broadly, that throughout all the members of a given family of propellers of the same geometrical form, a given value of V/ND will fix the efficiency; or otherwise, that for a given family of the same geometrical form, efficiency is a function of V/ND only.

From (9) we have the coefficient,

$$B_1 = \frac{gP_1}{\Delta V^3 D^2} \tag{12}$$

In the same manner as for T and Q we may now derive a series of coefficients from that defined as in (12), by multiplication or division by powers of V/ND. We may thus derive in particular three coefficents as follows:

$$\frac{gP_1}{\Delta N^3 D^4},\quad \frac{gP_1}{\Delta V^3 D^2},\quad \frac{gP_1}{\Delta V^6 N^{-3}} \tag{13}$$

There will obviously be three similar coefficients for the effective power P which may be derived from (10) in the same manner in which those expressed in (13) are derived from (9). It is clear, however, that if for two similar propellers at the same value of V/ND there is a numerical coefficient relating P_1 to some function of V, N, D, and which numerical coefficient is the same for both propellers, then since the efficiency is also the same, there will be another numerical coefficient relating P to the same function of V, N, D, and which numerical coefficient will likewise be the same for both propellers.

We may therefore use coefficients having the forms given in (13) and derived either from P_1 or from P.

For present purposes we shall use the effective power P as the primary power quantity and we shall denote the three coefficients derived from effective power and having forms as above, respectively by C_1, C_2, C_3.

We shall have then for these coefficients:

$$C_1 = \frac{gP}{\Delta N^3 D^5} \tag{14a}$$

$$C_2 = \frac{gP}{\Delta V^3 D^2} \tag{14b}$$

$$C_3 = \frac{gP}{\Delta V^5 N^{-2}} \tag{14c}$$

The following relations will be noted:

$$\begin{aligned} C_1 &= (V/ND)^3 C_2 \\ C_2 &= (V/ND)^2 C_3 \end{aligned} \tag{15}$$

With any consistent set of units, we shall then have a set of coefficients C_1, C_2, C_3 independent of the system of units as such, and hence the same for either metric or English measures.

It results furthermore that in these basic formulæ, power is measured in kilogram-meters per second or foot-pounds per second and not horsepower. Likewise speed is measured in meters per second or feet per second and not kilometers per hour or miles per hour.

Collecting these various equations we have as follows:

$$gP = C_1 \Delta N^3 D^5 \tag{16}$$

$$gP = C_2 \Delta V^3 D^2 \tag{17}$$

$$gP = C_3 \Delta V^5 N^{-2} \tag{18}$$

$$X = V/ND \tag{19}$$

$$P_1 = \eta P \tag{20}$$

η = function of V/ND as in tables or diagrams

$$T = P_1 \div V \tag{21}$$

$$Q = P \div 2\pi N \tag{22}$$

In the use of these equations it must be remembered that the units are:

Metric: meter, kilogram, second.

English: foot, pound, second.

Hence D is measured in meters or feet.

N is measured in revolutions per second.

V is measured in meters per second, or feet per second.

Δ is measured in kilos. per cubic meter, or pounds per cubic foot.

P is measured in kilogram meters per second, or foot-pounds per second.

T is measured in kilograms, or pounds.

Q is measured in kilogram-meters, or pound-feet.

With these units, as previously noted, the values of C_1, C_2, C_3 will be nondimensional, and hence the same with either metric or English units.

If any of these various quantities are expressed in terms of other units such as horsepower (metric or English), kilometers per hour, or miles per hour, they must be reduced to values in terms of the above units before direct use is made of the formulæ with the numerical values of C_1, C_2, C_3 as in Table VIII or figures 19 to 52.

The actual test results are then put in the form of the following series of items.

TABULAR.

Values of coefficient C_1 on V/ND as argument.
Values of coefficient C_2 on V/ND as argument.
Values of coefficient C_3 on V/ND as argument.
Values of efficiency η on V/ND as argument.
See Table VIII.

GRAPHIC.

Values of coefficient C_1 plotted on V/ND as independent variable.
Values of efficiency η spotted on curves of C_1 as above.
(See figs. 19 to 52.)

APPLICATION OF EQUATIONS (16), (17), (18) TO PRACTICAL PROBLEMS.

Of the nine quantities P_1, P, V, N, D, $\triangle$, H, η, x, with the three coefficients C_1, C_2, C_3, some combination of which will enter into such problems, we may note first that:

P_1, is dependent on η and P, being related as in (20).

η is dependent on x, being determined and expressed both in tabular form and graphically as a function of x alone.
(See also (11).)

The three coefficients C_1, C_2, C_3, are dependent on x and are so determined and given in tabular and graphic form.
(See Table VIII and figs. 19 to 52.)

H is dependent on $\triangle$ being connected by the relation between altitude and the density of the air.

There remain then six variables, P, V, N, D, $\triangle$, x, any four of which (with one exception to be noted later) may be taken as the necessary and sufficient specification of a problem.

The number of type problems which may thus arise involving combinations of these six quantities would be then the number of combinations of six things taken four at a time. This number is 15 and the combinations are as shown in column 1 of Table III.

TABLE III.

No.	(1) Knowns.	(2) Unknowns.	(3) C_1	(4)	(5)	(6)
1	$\triangle$ V D N	P x	✓	✓	✓	*
2	x V D N	P $\triangle$				
3	x $\triangle$ D N	P V	✓	✓	✓	*
4	x $\triangle$ V N	P D	✓	✓	✓	*
5	x $\triangle$ V D	P N	✓	✓	✓	*
6	P V D N	x $\triangle$	✓	✓	✓	*
7	P $\triangle$ D N	x V	✓			
8	P $\triangle$ V N	x D			✓	
9	P $\triangle$ V D	x N		✓		
10	P x D N	$\triangle$ V	✓	✓	✓	*
11	P x V N	$\triangle$ D	✓	✓	✓	*
12	P x V D	$\triangle$ N	✓	✓	✓	*
13	P x $\triangle$ N	V D	✓		✓	
14	P x $\triangle$ D	V N	✓	✓		
15	P x $\triangle$ V	D N		✓	✓	

Of these 15 combinations, all represent possible physical problems except the second, involving x, V, D, N. Since $x = V/ND$ it is clear that we can not arbitrarily take values of more than three of these particular four quantities. This is the exception referred to above.

In column (2) are given the unkowns for the several cases as noted. If the value of x is among the knowns, the value of the efficiency will follow immediately from Table VIII or figures 19 to 52. Otherwise, if x is among the unknowns, its value will result immediately from equation (19) as soon as V, D, and N are known. Once η is known, the useful power P, together with the thrust T and torque Q, may be readily found from equations (20), (21), (22), if desired.

In column (3) a check mark indicates the cases which may be solved by equation (14a) or through the coefficient C_1 as defined by this equation. Similarly, in columns (4) and (5), check marks denote the cases which may be solved respectively by equations (14b) and (14c) or through the coefficients C_2, C_3 as defined by these equations.

The cases checked in column (3) are in effect those in which the four knowns of column (1) are found in equation (1) and similarly for those of columns (4) and (5).

The stars in column (6) denote the cases which are checked in all three columns—that is, the cases which may be solved by any or all of the three equations.

In addition to these eight cases, it will be noted that cases (13), (14), and (15) may be solved by either or both of two equations, while numbers (7), (8), (9) permit each of solution through one equation only as indicated.

By the use of these equations, as choice or necessity may dictate, any of the 14 combinations of quantities as noted in Table III and representing possible problems involving these variables may be solved by suitable methods of computation.

RELATION OF TYPE FORM OF PROPELLER TO THE PROBLEM OF DESIGN.

In most problems in design or of like practical character, the geometrical type form of the propeller is first assumed. Such assumption is, of course, only tentative, but it is usually convenient to carry on the program of search for a suitable design through trial of a series of selected type forms. In such case, with a type form chosen, the relation between the coefficients C_1, C_2, C_3, and V/ND is immediately fixed, and, assuming it to be one of the 88 type forms covered by the present report, reference may be made directly to the corresponding diagram or table for values of the efficiency and of the coefficients C_1, C_2, C_3, as functions of V/ND. In any such case, then, an assumed value of the efficiency η or of the function V/ND will immediately determine the values of these coefficients and the solution will proceed along lines as indicated.

In certain cases, however (cases 7, 8, 9, Table III), the value of the coefficient may be left as an unknown, the various other quantities having been determined independent of any selected type form of propeller. The solution will then give the value of the coefficient C_1, C_2, C_3. This coefficient value may then be sought in the table or on the diagrams for various type forms. Wherever it is found it will at the same time determine a value of x, and hence of efficiency, and the value of the latter will naturally be a guide in the choice of the type form to be ultimately accepted. If no acceptable results in these respects can be found, it means naturally that suitable changes must be made in the basic data—as, for example, an increase or decrease in the diameter or in the revolutions or speed or some combination change in these basic data which will give a different value of the coefficient and thence perhaps a more acceptable efficiency.

In a similar manner, with other types of problems, as in Table III, the selected type form with the resultant value of C may be such as to give an unacceptable result, especially in terms of D, N, or V. In such case, likewise, the basic assumptions must be modified in such manner as to give finally an acceptable combination of values.

(3) NOMOGRAPHIC DIAGRAMS.

For the rapid graphical solution of problems such as those considered in the preceding section, nomographic diagrams have been prepared as in Plates I–VIII, the first four being in metric and the second four in English units. In the earlier reports, covering progressively the

series of tests forming the subject of the present report, this feature was represented by the Eiffel logarithmic diagram, with curves showing values of C_1 for useful and effective power drawn thereon. This form of diagram, while furnishing a solution for all combinations of data involved in design problems, is, however, subject to two disadvantages:

(1) The operative program with reference to the sequence and direction of the vectors is not easy to carry in mind with only occasional use, and this fact has undoubtedly discouraged, in some measure, the use of this exceedingly ingenious form of graphical solution for design problems.

(2) Values are not infrequently determined by intersections of lines at rather acute angles, thus tending to magnify the probable error of construction.

For these reasons the nomographic form of diagram has been chosen in the present report. In diagrams of this type the operative program is simpler than in the Eiffel diagram, and the intersections may be made less acute. To cover all combinations of the data which may enter into such problems, however, four diagrams are required rather than one.

Thus, referring to the diagrams intended for metric units, Plates I, II, III are laid out for the use of equations (16), (17), (18), respectively, while Plate IV is provided for the solution of equation (19) or generally for connecting together the four quantities x, V, N, D.

Any discussion of the theory of nomographic diagrams or of the details of construction of such diagrams is beyond the scope of the present report. It will be desirable, however, to give some description of the diagrams as they are, together with suggestions regarding their use, and with such data as may be required should it be desired to reconstruct such diagrams on a larger scale or to extend the scale on any of the axes of the diagrams as given.

Referring to Plate I, the diagram is intended for the solution of the equation

$$gP = C_1 \triangle N^3 D^5$$

Attention may first be directed to the following points:

(1) The factor g does not appear in the construction. It is "absorbed" in the program of development of the diagram. This remark applies equally to the diagrams of Plates II, III.

(2) The quantity $\triangle$ does not appear directly in the construction. Its place is taken by altitude H. This is simply a matter of the numbering of the graduations on this axis. The actual distance which is involved in the graphical construction is really $\triangle$ to a suitable unit, but the numbering on the scale represents the corresponding value of the altitude H. Thus the scales may be read directly in terms of altitude, while the density $\triangle$ is the quantity really employed in the computation. This remark applies equally to the diagrams of Plates II, III.

(3) The diagram contains axes, one each for the five quantities P, C_1, $H(\triangle)$, N, D, as noted, together with two auxiliary axes Y_1, Y_2.

(4) Let these be arranged in order as follows

$$D \quad H(\triangle) \quad N \quad Y_2 \quad Y_1 \quad C_1 \quad P$$

(5) These may then be taken in three successive groups of three each as follows (see also small key diagrams on plates):

$$\begin{array}{ccc} H & Y_1 & C_1 \\ N & Y_2 & Y_1 \\ D & Y_2 & P \end{array}$$

(6) The solution consists, in effect, then, of drawing three straight lines across these three groups of axes, as in (5), in such manner as to contain the known data and to have common points on the auxiliary axes Y_1 and Y_2. One of these lines will then cut the axis of the unknown at the value required for the solution. (See also small key diagrams as above.)

(7) It should be especially noted that the seven axes are associated in three groups of three as above and in this way only.

(8) The following points regarding the units of Plates I, II, III, IV should be noted.

(*a*) The unit of P is the metric horsepower direct and not the kilogram meter per second, as in the case of numerical computation.

(*b*) The unit of N is one revolution per minute instead of per second, as in the case of numerical computation.

(*c*) The unit of V is one kilometer per hour instead of one meter per second, as in the case of numerical computation.

These changes are made possible by suitable changes in the units used for the various scales of the axes of P, V, N, and thus permit the direct use of these quantities in terms of the common engineering units of measurement.

The scales on these diagrams, therefore, indicate as follows:

V in kilometers per hour.
N in r. p. m.
D in meters.
P in horsepower (metric).
H in meters.
C_1, C_2, C_3, nondimensional.

ILLUSTRATIVE PROGRAMS.

Before noting a few illustrative programs, attention may be called to the following points:

The solution in each case will call for the determination of the unknowns as noted in the several cases of Table III, and this will require the use of two diagrams—viz, Plate IV and either Plates I, II, or III. The former will determine one of the four quantities V, N, D, or x and the latter the remaining unknown.

The coefficients C_1, C_2, C_3 are dependent on $x = V/ND$ and may be determined from figures 19 to 52 or Table VIII as soon as x is known.

In cases where x is one of the knowns, the values of C_1, C_2, C_3 become known from figures 19 to 52 and Table VIII. In such cases the nomographic diagrams are to be used in such order as may be required by the details of the case—that is, Plate IV first and then Plate I, II, or III, or vice versa. (See cases 3, 4, 5, 10, 11, 12, 13, 14, 15, Table III.)

In cases where x is one of the unknowns, its determination may fall under either of two programs:

(1) If the knowns include V, N, D, then x is found immediately from the diagram of Plate IV. (See cases 1, 6, Table III.)

(2) If the knowns do not include V, N, D, they will include four quantities permitting the direct use of either Plate I, Plate II, or Plate III. This will give the value of C_1, C_2, or C_3, and this through figures 19 to 52 or Table VIII will give $x = V/ND$, and this through Plate IV will give the remaining unknown. (See cases 7, 8, 9, Table III.)

By way of illustration assume first case 1, Table III. The values V, D, N serve immediately to determine x or V/ND by the diagram of Plate IV. A line is drawn through the values of V and D, cutting Y. A second line is then drawn through N and the point on Y. This line extended to the axis of x or V/ND will then give the value desired.

With x known, we find from the suitable diagram of figures 19 to 52 or from Table VIII the value of C_1.

We have now as knowns all values involved in the diagram of Plate 1 except P. The triad groups are then as follows:

$$\begin{array}{ccc} H & Y_1 & C_1 \\ N & Y_2 & Y_1 \\ D & Y_3 & (P) \end{array}$$

The line for the first triad being drawn, the point on Y_1 is determined. This point with N serves to determine Y_2 in the second triad, and this point with D serves to determine P in the third triad, and thus the solution is completed.

Suppose with the same data it were chosen to use Plate 2. The program will proceed in entirely similar fashion. The value of x is first found and then C_1. Then in Plate II the triad develop as follows:

$$\begin{array}{ccc} H & Y_1 & D \\ V & Y_2 & Y_1 \\ C_2 & Y_2 & (P) \end{array}$$

In an entirely similar manner Plate 3 may be used if desired.

Assume next the data of case 10, Table III. The values of x, D, N being given, V is found by Plate IV. The values of C_1, C_2, C_3 result immediately from x through figures 19 to 52 and Table VIII. In case Plate I is employed, the triad groups result as follows:

$$\begin{array}{ccc} (H) & Y_1 & C_1 \\ N & Y_2 & Y_1 \\ D & Y_3 & P \end{array}$$

and H is determined as the remaining unknown.

Assume again the data of case 7, Table III. The knowns P, Δ, D, N indicate Plate I as the only one available for this combination. The triad groups result as follows:

$$\begin{array}{ccc} H & Y_1 & (C_1) \\ N & Y_2 & Y_1 \\ D & Y_3 & P \end{array}$$

The value of C_1 thus results, and this gives, through figures 19 to 52 or Table VIII, the value of x, and thence through Plate IV we find V.

In all of these cases the value of the efficiency η will naturally play an important part in determining the course of treatment of a design problem. This value follows immediately from x, through figs. 19 to 52 and Table VIII. In many cases η will be assumed as a trial figure at some value which it is desired to realize if possible. Or otherwise the value of $x = V/ND$ will be assumed with primary reference to the corresponding value of the efficiency.

Diagrams of the nomographic type are especially well adapted to the purpose of indicating quickly the correlative changes in any two variables of either end triad, all other quantities remaining the same. Thus, a line in either end triad may be revolved about its Y axis point without disturbing the remainder of the diagram. In this manner the correlative changes of either of these two pair of variables are readily examined.

Thus, in case (1), V, N, and D are assumed known. The value of x follows and thence C_1 and the solution proceeds, as previously indicated, to a resultant value of P. In this triad P is associated with D. We may then tilt the line back and forth about the point on Y_3 as center and read off the values of P for a series of diameters, *all other quantities on this diagram remaining the same.*

In order to realize the latter condition, however, it is clear that if C_1 is to remain the same with the same type of propeller, then $x = V/ND$ must remain the same, and hence (N remaining the same) V must be assumed to vary directly with the varying values of D. Thus if the D be taken 10 per cent larger than the first value assumed, then the value of P for a speed also 10 per cent greater at the same r. p. m. will be given by tilting the line about the intersection on Y_3 as indicated above.

Again in Plate IV, suppose that the value of x is one which gives a value of the efficiency undesirably low. In this diagram x is associated with N. We may then tilt the xYN line about the Y point as a center and note the relation between change in the r. p. m. and change in x and hence change in efficiency, the ratio of V to D being supposed to remain the same.

Other similar applications of this convenient feature will occur to the interested reader.

It is apparent that in all of these various cases the solution may be carried on through equations (20), (21), (22), to include, if desired, values of useful power, thrust, and torque.

Nomographic diagrams might, of course, be prepared for the carrying out of the indicated computations, but their relatively lesser importance has not seemed to justify the extension of the present report to include the preparation of such diagrams.

While the preceding discussion of these diagrams has applied especially to those of Plates I–IV adapted to metric measures, the same general remarks apply equally well to those of Plates V–VIII adapted to English measures.

The scales of these indicate as follows:

V in miles per hour.
N in r. p. m.
D in feet.
P in horsepower.
H in feet.
C_1, C_2, C_3 nondimensional as in Plates I–IV.

Proportions and scales.—A nomographic diagram such as that of Plate I for the solution of an equation such as (16) may be infinitely varied in proportion and in the scale units employed, all however, so related as to fulfill the basic conditions required for the solution. The particular proportions and scales employed in Plates I–VIII have been chosen primarily in such manner as to give a fairly equable distribution of axes over the diagram, combined with the ranges of values chosen for the different variables.

In case it should be desired to lay down any of these diagrams larger or smaller than those represented in plates I . . . VIII, or covering different ranges of values, the following method may be followed:

TABLE IV.—*Spacing of axes.*

PLATES.

I, V.		II, VI.		III, VII.		IV, VIII.	
D	0.000	C_2	0.000	C_2	0.000	X	0.000
H	1.977	H	2.594	V	2.740	V	4.453
N	4.440	V	4.539	Y	5.352	Y	8.895
Y	7.870	Y	7.216	H	9.830	D	18.133
V	10.989	V	11.483	P	13.444	N	20.000
C_1	15.299	D	15.927	Y	17.234		
P	20.000	P	20.000	N	20.000		

The spacing of the successive axes is given in Table IV. In the originals from which Plates I . . . VIII were reproduced, the unit was 1 inch. This unit may be similarly taken at any value whatever, thus giving diagrams with spacings always in the same proportions as those of Plates I . . . VIII, but of any actual size as may be desired.

Next we must consider the mid values; that is, the values lying on a single continuous straight line drawn through the center of the field covered by the diagram. These values are given in Table V each in terms of the special unit appropriate to the quantity in question.

TABLE V.—*Mid values.*

PLATES.

I.		V.	II.		VI.	III.		VII.	IV.		VIII.
D	2.8	9	C_2	0.441	0.452	C_2	1.969	2.006	X	0.556	0.552
H	4,600	15,100	H	4,600	15,100	V	124	77	V	130	80
N	1,800	1,800	V	122	82	H	4,600	15,100	D	2.6	8.5
C_1	0.0547	0.0615	D	2.6	8.5	P	160	160	N	1,800	1,800
P	154	154	P	154	154	N	1,800	1,800			

Next, for the scale subdivisions, there is, for each axis, a factor f as defined by the equation

$$a_2 - a_1 = f \log. a_2/a_1$$

where $(a_2 - a_1)$ = distance, in terms of any arbitrary unit, between graduations for values a_2 and a_1 $(a_2 > a_1)$.

These factors f are given under the appropriate heading in Table VI. They are independent of the system of measures employed and are therefore the same for both metric and English measures. It will, of course, be understood that the unit of measure employed must be the same throughout any one diagram.

TABLE VI.—*Values of factors f.*

PLATES.

I, V.	II, VI.	III, VII.	IV, VIII.
D.....18.33	*C*.....3.030	*C*.....1.882	*X*.....9.353
H.....16.00	*H*.....16.000	*V*.....8.603	*V*.....7.601
N.....12.570	*V*.....9.091	*H*.....16.000	*D*.....16.000
C.....7.651	*D*.....16.00	*P*.....5.33	*N*.....11.68
P.....6.285	*P*.....5.333	*N*.....11.43	

To fix the ideas, take Plate I, axis of D. The mid value is 2.8 (metric). The distance to the graduation for 2 (meters) will then be measured by 18.33 log. 1.4 = 2.678. This may then be laid down to any convenient unit, having in view the size of diagram permissible and the range of values desired.

If there should be reason for extending the diagram to include, say, values of 1 and 10, the distance from 2.8 to 1 would be measured by 18.33 log. 2.8 = 8.197, and, again, the distance from 1 to 0 would be measured by 18.33 log. 10 = 18.33.

Instead of using factors as given in Table VI with a unit adapted to the size of diagram desired, a fixed unit such as 1 cm. or 1 inch may be adopted, and we may multiply or divide the series of factors in Table VI by any coefficient at will, thus giving various series of numbers, but always in the proportion of those in the table.

Thus, by way of illustration, in Plate I, axis D, the total range is from about 1.875 to about 4.182. The log. of the ratio of these two numbers is 0.3483, and with a unit of 1 cm. and the factor 18.33 as in Table VI the total length of this axis would equal 6.384 cm. By taking a unit of 5 cm. or otherwise by using a factor $5 \times 18.33 = 91.65$, the over-all length would become 31.92 cm.

In this manner, then, the graduations on any axis may be laid out according to convenience. Obviously the same unit must be used throughout for any one diagram.

If for any reason it should be desired to subdivide the graduations on Plates I . . . VIII as printed, or to extend them to somewhat higher or lower limits, the following steps may be taken:

(1) Measure with scale the linear distance between two convenient numbers such as 1 and 5 or 1 and 10 or any other convenient pair, taking them, however, in such manner as to include a considerable part of the scale length.

(2) Take the log. of the ratio of the two numbers and divide it into the distance.

The quotient will establish the factor f for the particular unit of measure employed and for the plate as actually printed. This factor f may then be used in manner as indicated above to determine the distance between the graduations for any two numbers on the scale as desired.

The scales for altitude require somewhat different treatment.

TABLE VII.—*Relation between altitude and density.*

Altitude (meters).	Kg. per cubic meter.	Altitude (feet).	Pounds per cubic foot.
000	1.214	000	0.0758
500	1.155	1,000	.0726
1,000	1.099	2,000	.0713
1,500	1.045	3,000	.0691
2,000	.995	4,000	.0671
2,500	.945	5,000	.0651
3,000	.901	6,000	.0631
3,500	.857	7,000	.0612
4,000	.815	8,000	.0595
4,500	.776	9,000	.0576
5,000	.738	10,000	.0559
5,500	.702	11,000	.0543
6,000	.669	12,000	.0527
6,500	.637	13,000	.0511
7,000	.608	14,000	.0497
7,500	.580	15,000	.0481
8,000	.553	16,000	.0467
8,500	.529	17,000	.0453
9,000	.506	18,000	.0442
		19,000	.0428
		20,000	.0416
		21,000	.0402
		22,000	.0390
		23,000	.0379
		24,000	.0368
		25,000	.0358
		26,000	.0348
		27,000	.0338
		28,000	.0328
		29,000	.0318
		30,000	.0309

Table VII gives the relations employed between altitude and density in both metric and English measures.

As previously noted, the actual quantity involved in the computation is density Δ, but for convenience this is represented on the diagram by altitude H. The factor f as given in Table VI is for density. Hence, in order to determine the distance between the graduations for any two values of the altitude, we may proceed as follows:

(1) Convert the two values of H into values of Δ through Table VII by interpolation, or graphically by curves plotted from these tables.

(2) Then divide the larger value of Δ by the smaller, find the log. of the ratio, multiply by the factor f, and the product will give the distance desired.

TABLE VIII.

PROPELLER NO. 1.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0919	11.49	257.3	0.343
.25	.0928	5.940	95.02	.414
.30	.0940	3.482	38.70	.479
.35	.0949	2.213	18.06	.537
.40	.0952	1.487	9.295	.585
.45	.0943	1.040	5.128	.629
.50	.0938	.7506	3.002	.667
.55	.0920	.5530	1.828	.701
.60	.0895	.4144	1.151	.729
.65	.0863	.3143	.7440	.753
.70	.0825	.2405	.4909	.770
.75	.0783	.1856	.3300	.782
.80	.0737	.1440	.2260	.788
.85	.0685	.1115	.1548	.788
.90	.0630	.0864	.1067	.780
.95	.0570	.0665	.0737	.760

PROPELLER NO. 2.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.1065	13.31	332.8	0.332
.25	.1067	6.828	109.3	.404
.30	.1068	3.953	43.96	.472
.35	.1065	2.434	20.23	.533
.40	.1057	1.651	10.32	.585
.45	.1045	1.147	5.665	.632
.50	.1024	.8192	3.277	.674
.55	.0991	.5947	1.969	.708
.60	.0950	.4395	1.222	.736
.65	.0901	.3252	.7769	.759
.70	.0847	.2470	.5040	.774
.75	.0788	.1868	.3321	.781
.80	.0725	.1416	.2212	.781
.85	.0660	.1075	.1458	.775
.90	.0593	.0813	.1004	.757
.95	.0525	.0613	.0679	.717

TABLE VIII—Continued.

PROPELLER NO. 3.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0843	10.60	265.0	0.353
.25	.0859	5.50	87.97	.425
.30	.0870	3.222	35.80	.487
.35	.0877	2.046	16.70	.544
.40	.0880	1.375	8.594	.594
.45	.0879	.9648	4.764	.638
.50	.0872	.6976	2.791	.679
.55	.0860	.5168	1.709	.713
.60	.0845	.3912	1.087	.744
.65	.0825	.3004	.7112	.768
.70	.0802	.2338	.4772	.788
.75	.0770	.1835	.3244	.803
.80	.0733	.1433	.2288	.809
.85	.0684	.1114	.1542	.809
.90	.0629	.0863	.1055	.805
.95	.0555	.0659	.0730	.786
1.00	.0498	.0498	.0498	.752

PROPELLER NO. 4.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.25	0.1032	6.605	105.7	0.410
.30	.1035	3.833	42.59	.476
.35	.1035	2.414	19.71	.532
.40	.1030	1.609	10.05	.583
.45	.1015	1.114	5.802	.629
.50	.0994	.7953	3.182	.668
.55	.0963	.5783	1.913	.704
.60	.0927	.4292	1.192	.734
.65	.0886	.3237	.7539	.759
.70	.0841	.2453	.5004	.778
.75	.0790	.1873	.3330	.794
.80	.0733	.1430	.2234	.797
.85	.0665	.1083	.1499	.786
.90	.0590	.0809	.0999	.761

PROPELLER No. 5.

0.20	0.0710	8.575	221.9	0.383
.25	.0713	4.563	73.02	.461
.30	.0712	2.637	29.30	.526
.35	.0706	1.6515	13.48	.583
.40	.0698	1.091	6.819	.630
.45	.0683	.7497	3.702	.670
.50	.0661	.5289	2.116	.702
.55	.0633	.3806	1.288	.726
.60	.0601	.2783	.7728	.745
.65	.0566	.2061	.4879	.753
.70	.0526	.1534	.3131	.743
.75	.0485	.1150	.2045	.712

PROPELLER No. 6.

0.20	0.0771	9.638	241.0	0.382
.25	.0762	4.877	78.05	.461
.30	.0750	2.778	30.87	.530
.35	.0736	1.717	14.02	.586
.40	.0717	1.1205	7.003	.635
.45	.0690	.7874	3.740	.676
.50	.0655	.5541	2.096	.710
.55	.0615	.3996	1.232	.733
.60	.0569	.2834	.7315	.744
.65	.0520	.1894	.4453	.736
.70	.0466	.1359	.2773	.705

PROPELLER No. 7.

0.20	0.0682	8.525	213.1	0.395
.25	.0686	4.391	70.26	.473
.30	.0686	2.541	28.24	.538
.35	.0680	1.586	12.95	.597
.40	.0667	1.042	6.513	.650
.45	.0649	.7123	3.518	.695
.50	.0626	.5009	2.004	.730
.55	.0600	.3605	1.122	.755
.60	.0568	.2630	.7306	.772
.65	.0534	.1945	.4604	.778
.70	.0494	.1440	.2939	.767
.75	.0453	.1074	.1910	.737

PROPELLER No. 8.

0.20	0.0733	9.163	229.1	0.385
.25	.0726	4.647	74.36	.453
.30	.0717	2.655	29.50	.528
.35	.0700	1.633	13.33	.590
.40	.0677	1.068	6.613	.634
.45	.0645	.7060	3.496	.675
.50	.0605	.4840	1.936	.708
.55	.0554	.3300	1.120	.736
.60	.0517	.2393	.6647	.755
.65	.0470	.1712	.4052	.757
.70	.0421	.1228	.2606	.734
.75	.0368	.0867	.1542	.679

PROPELLER No. 9.

0.20	0.0455	5.688	142.2	0.419
.25	.0449	2.874	45.98	.496
.30	.0439	1.696	18.07	.561
.35	.0423	.9866	8.066	.619
.40	.0405	.6328	3.955	.659
.45	.0383	.4204	2.076	.683
.50	.0359	.2872	1.149	.684
.55	.0335	.2013	.6654	.657
.60	.0310	.1435	.3966	.583
.65	.0283	.1030	.2438	.469

PROPELLER No. 10.

0.20	0.0457	6.087	152.2	0.421
.25	.0473	3.027	48.44	.506
.30	.0458	1.696	18.85	.572
.35	.0437	1.019	8.322	.623
.40	.0409	.6390	3.994	.657
.45	.0376	.4127	2.033	.670
.50	.0337	.2696	1.078	.659
.55	.0293	.1761	.583	.614

PROPELLER No. 11.

0.20	0.0451	5.638	141.0	0.424
.25	.0446	2.855	45.67	.522
.30	.0440	1.680	18.11	.590
.35	.0429	1.000	8.164	.644
.40	.0417	.6515	4.073	.683
.45	.0400	.4390	2.168	.704
.50	.0378	.3024	1.210	.707
.55	.0350	.2104	.6954	.693
.60	.0319	.1477	.4103	.644

PROPELLER NO. 12.

0.20	0.0471	5.888	147.2	0.426
.25	.0464	2.970	47.52	.506
.30	.0453	1.678	18.64	.571
.35	.0436	1.017	8.302	.622
.40	.0412	.6437	4.023	.655
.45	.0379	.4160	2.055	.669
.50	.0340	.2720	1.088	.665
.55	.0297	.1785	.590	.628

TABLE VIII—Continued.

PROPELLER NO. 13.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0907	11.34	283.5	0.331
.25	.0920	5.889	94.24	.404
.30	.0928	3.437	38.19	.469
.35	.0933	2.176	17.76	.527
.40	.0934	1.459	9.120	.580
.45	.0930	1.021	5.042	.626
.50	.0916	.7399	2.932	.669
.55	.0895	.5390	1.778	.705
.60	.0867	.4014	1.115	.736
.65	.0835	.3041	.7197	.760
.70	.0795	.2318	.4731	.779
.75	.0754	.1787	.3177	.791
.80	.0708	.1383	.2161	.795
.85	.0660	.1075	.1488	.795
.90	.0610	.0837	.1038	.779
.95	.0557	.0650	.0720	.745

PROPELLER NO. 14.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.25	0.1100	7.041	112.7	0.402
.30	.1100	4.073	45.26	.466
.35	.1097	2.559	20.89	.524
.40	.1085	1.695	10.60	.575
.45	.1065	1.169	5.773	.620
.50	.1041	.8329	3.332	.660
.55	.1007	.6053	2.001	.698
.60	.0968	.4472	1.242	.730
.65	.0916	.3338	.7905	.757
.70	.0860	.2508	.5119	.775
.75	.0797	.1889	.3558	.784
.80	.0731	.1428	.2531	.786
.85	.0662	.1078	.1492	.778
.90	.0586	.0804	.0993	.760
.95	.0507	.0591	.0655	.704

PROPELLER NO. 15.

0.20	0.0857	10.71	267.8	0.341
.25	.0871	5.575	89.21	.412
.30	.0888	3.299	36.55	.475
.35	.0900	2.099	17.14	.531
.40	.0908	1.419	8.570	.586
.45	.0910	.9933	4.933	.638
.50	.0902	.7217	2.857	.684
.55	.0887	.5332	1.763	.720
.60	.0865	.4005	1.112	.749
.65	.0836	.3045	.7206	.771
.70	.0800	.2333	.4761	.787
.75	.0761	.1804	.3207	.799
.80	.0719	.1404	.2194	.804
.85	.0671	.1093	.1512	.802
.90	.0622	.0853	.1063	.790
.95	.0570	.0665	.0737	.761

PROPELLER NO. 16.

0.25	0.1029	6.865	105.4	0.417
.30	.1030	3.814	42.33	.478
.35	.1026	2.393	19.54	.535
.40	.1016	1.587	9.930	.587
.45	.1000	1.097	5.418	.632
.50	.0979	.7833	3.133	.673
.55	.0950	.5710	1.888	.711
.60	.0915	.4286	1.177	.745
.65	.0876	.3190	.7550	.772
.70	.0829	.2417	.4933	.791
.75	.0775	.1837	.3266	.801
.80	.0717	.1400	.2187	.803
.85	.0648	.1065	.1460	.795
.90	.0570	.0782	.0955	.774
.95	.0484	.0565	.0626	.731

PROPELLER NO. 17.

0.20	0.0835	8.553	214.1	0.374
.25	.0837	4.397	70.36	.438
.30	.0835	2.537	28.19	.500
.35	.0830	1.586	12.95	.558
.40	.0864	1.037	6.484	.628
.45	.0842	.7047	3.480	.670
.50	.0813	.4905	1.962	.710
.55	.0781	.3492	1.154	.740
.60	.0745	.2523	.7010	.761
.65	.0706	.1849	.4362	.769
.70	.0665	.1356	.2767	.759
.75	.0622	.1000	.1778	.735

PROPELLER NO. 18.

0.20	0.0742	9.275	231.9	0.370
.25	.0738	4.734	75.58	.443
.30	.0727	2.693	29.92	.515
.35	.0706	1.647	13.45	.576
.40	.0680	1.063	6.644	.630
.45	.0647	.7102	3.507	.677
.50	.0607	.4857	1.943	.717
.55	.0564	.3390	1.121	.743
.60	.0517	.2393	.6647	.762
.65	.0469	.1706	.4042	.758
.70	.0418	.1219	.2488	.728

PROPELLER NO. 19.

0.20	0.0614	7.675	191.9	0.334
.25	.0611	3.911	62.58	.402
.30	.0609	2.255	25.06	.531
.35	.0601	1.402	11.45	.593
.40	.0589	.9203	5.752	.647
.45	.0574	.6300	3.111	.694
.50	.0555	.4440	1.776	.730
.55	.0532	.3198	1.067	.759
.60	.0504	.2333	.6480	.777
.65	.0474	.1726	.4085	.772
.70	.0437	.1274	.2600	.738

PROPELLER NO. 20.

0.20	0.0761	9.514	237.8	0.383
.25	.0754	4.826	77.22	.455
.30	.0742	2.743	30.53	.519
.35	.0724	1.680	13.70	.577
.40	.0701	1.095	6.844	.629
.45	.0674	.7396	3.654	.674
.50	.0639	.5112	2.046	.714
.55	.0600	.3606	1.192	.745
.60	.0556	.2574	.7150	.765
.65	.0508	.1850	.4378	.772
.70	.0454	.1324	.2702	.757
.75	.0391	.0927	.1648	.713

PROPELLER NO. 21.

0.20	0.0486	5.700	142.5	0.413
.25	.0458	2.912	46.59	.495
.30	.0444	1.644	18.27	.563
.35	.0426	.9914	8.094	.620
.40	.0402	.6281	3.926	.664
.45	.0375	.4115	2.033	.697
.50	.0346	.2768	1.107	.704
.55	.0317	.1905	.6297	.678
.60	.0286	.1324	.3675	.613

PROPELLER NO. 22.

0.20	0.0479	5.988	149.7	0.412
.25	.0472	3.021	48.34	.490
.30	.0455	1.685	18.72	.555
.35	.0433	1.010	8.245	.606
.40	.0408	.6297	3.936	.643
.45	.0380	.4050	2.000	.660
.50	.0351	.2643	1.059	.641
.55	.0290	.1743	.5761	.583

TABLE VIII—Continued.

PROPELLER NO. 23.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0413	5.163	129.1	0.425
.25	.0410	2.694	41.99	.507
.30	.0403	1.493	16.59	.577
.35	.0390	.9096	7.426	.633
.40	.0373	.5828	3.643	.673
.45	.0356	.3907	1.930	.695
.50	.0335	.2680	1.072	.696
.55	.0311	.1869	.6178	.671
.60	.0283	.1310	.3639	.610

PROPELLER NO. 24.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0454	5.675	141.9	0.429
.25	.0444	2.842	45.47	.510
.30	.0427	1.581	17.87	.576
.35	.0404	.9424	7.692	.626
.40	.0378	.6005	3.691	.663
.45	.0345	.3787	1.870	.679
.50	.0310	.2480	.9920	.671
.55	.0271	.1629	.5334	.616

PROPELLER NO. 25.

0.25	0.1123	7.187	115.0	0.370
.30	.1140	4.222	46.93	.433
.35	.1157	2.609	23.04	.494
.40	.1168	1.825	11.41	.546
.45	.1169	1.283	6.338	.594
.50	.1162	.9295	3.718	.636
.55	.1148	.6900	2.281	.672
.60	.1126	.5213	1.448	.701
.65	.1099	.4002	.9478	.727
.70	.1066	.3108	.6343	.744
.75	.1026	.2432	.4324	.753
.80	.0981	.1916	.2994	.755
.85	.0930	.1514	.2095	.749
.90	.0872	.1196	.1477	.735
.95	.0806	.0940	.1042	.705

PROPELLER NO. 26.

0.25	0.1182	7.555	121.05	0.390
.30	.1183	4.389	48.69	.455
.35	.1181	2.755	23.49	.514
.40	.1176	1.897	11.48	.564
.45	.1163	1.276	6.304	.610
.50	.1137	.9097	3.639	.651
.55	.1103	.6630	2.192	.685
.60	.1065	.4931	1.370	.715
.65	.1020	.3715	.8792	.740
.70	.0973	.2837	.5790	.758
.75	.0919	.2178	.3872	.763
.80	.0859	.1678	.2622	.759
.85	.0798	.1300	.1799	.742
.90	.0731	.1003	.1238	.705

PROPELLER NO. 27.

0.25	0.0920	6.336	101.4	0.415
.30	.1004	3.718	41.31	.478
.35	.1016	2.370	19.35	.530
.40	.1027	1.605	10.03	.578
.45	.1033	1.134	5.600	.620
.50	.1033	.8255	3.305	.659
.55	.1022	.6143	2.031	.691
.60	.1003	.4644	1.290	.719
.65	.0975	.3551	.8405	.741
.70	.0940	.2741	.5594	.759
.75	.0900	.2133	.3792	.769
.80	.0854	.1668	.2606	.772
.85	.0804	.1309	.1812	.767
.90	.0751	.1030	.1272	.746
.95	.0691	.0806	.0893	.707

PROPELLER NO. 28.

0.25	0.1105	7.072	113.17	0.403
.30	.1121	4.162	46.13	.463
.35	.1134	2.645	22.76	.517
.40	.1140	1.781	11.13	.565
.45	.1137	1.248	6.164	.608
.50	.1129	.8903	3.597	.646
.55	.1103	.6630	2.192	.683
.60	.1075	.4976	1.382	.718
.65	.1037	.3777	.8939	.741
.70	.0988	.2881	.5880	.763
.75	.0929	.2202	.3915	.778
.80	.0863	.1696	.2634	.783
.85	.0796	.1295	.1792	.774
.90	.0724	.0993	.1236	.741

PROPELLER NO. 29.

0.20	0.0873	10.91	272.8	0.348
.25	.0890	5.606	91.14	.424
.30	.0901	3.337	37.06	.492
.35	.0906	2.113	17.25	.551
.40	.0904	1.4125	8.328	.600
.45	.0888	.9747	4.818	.644
.50	.0861	.6889	2.756	.676
.55	.0826	.4965	1.641	.700
.60	.0783	.3625	1.007	.714
.65	.0740	.2696	.6378	.717
.70	.0695	.2027	.4137	.709
.75	.0648	.1536	.2731	.680

PROPELLER NO. 30.

0.20	0.0869	10.86	271.5	0.365
.25	.0884	5.530	88.49	.433
.30	.0887	3.174	35.27	.496
.35	.0845	1.971	16.09	.553
.40	.0826	1.291	8.089	.602
.45	.0797	.8743	4.320	.645
.50	.0759	.6073	2.429	.680
.55	.0713	.4285	1.416	.706
.60	.0665	.3079	.8554	.721
.65	.0614	.2236	.5292	.719
.70	.0560	.1633	.3333	.691

PROPELLER NO. 31.

0.20	0.0783	9.788	244.7	0.371
.25	.0792	5.069	81.11	.448
.30	.0799	2.959	32.88	.509
.35	.0799	1.864	15.22	.561
.40	.0791	1.236	7.725	.607
.45	.0776	.8518	4.207	.649
.50	.0754	.6038	2.419	.684
.55	.0725	.4358	1.441	.715
.60	.0689	.3190	.8861	.734
.65	.0650	.2367	.5602	.738
.70	.0604	.1761	.3594	.727
.75	.0556	.1318	.2343	.695
.80	.0505	.0986	.1541	.641

PROPELLER NO. 32.

0.20	0.0828	10.35	258.8	0.367
.25	.0838	5.364	85.83	.440
.30	.0844	3.126	34.73	.504
.35	.0841	1.962	16.02	.560
.40	.0825	1.289	8.056	.610
.45	.0797	.8743	4.320	.655
.50	.0760	.6081	2.432	.694
.55	.0716	.4303	1.422	.723
.60	.0670	.3102	.8618	.739
.65	.0621	.2261	.5351	.737
.70	.0571	.1665	.3396	.701

TABLE VIII—Continued.

PROPELLER NO. 33.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0579	7.238	180.95	0.397
.25	.0559	3.770	60.32	.473
.30	.0558	2.178	24.20	.536
.35	.0577	1.346	10.99	.585
.40	.0580	.8780	5.469	.620
.45	.0634	.5861	2.895	.634
.50	.0503	.4025	1.610	.631
.55	.0463	.2813	.9298	.605
.60	.0428	.1931	.5504	.544

PROPELLER NO. 34.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0540	6.750	168.8	0.410
.25	.0535	3.424	54.79	.479
.30	.0524	1.941	21.57	.537
.35	.0506	1.180	9.633	.580
.40	.0478	.7463	4.669	.606
.45	.0442	.4951	2.396	.613
.50	.0401	.3209	1.284	.590
.55	.0353	.2152	.7113	.527

PROPELLER No. 35.

0.20	0.0557	6.963	174.1	0.404
.25	.0560	3.584	57.34	.431
.30	.0560	2.074	23.04	.541
.35	.0550	1.283	10.47	.581
.40	.0531	.8297	5.186	.627
.45	.0505	.5542	2.727	.645
.50	.0477	.3817	1.527	.643
.55	.0447	.2687	.8881	.612

PROPELLER No. 36.

0.20	0.0530	7.260	181.2	0.400
.25	.0579	3.706	59.30	.471
.30	.0571	2.115	23.50	.531
.35	.0554	1.292	10.55	.576
.40	.0524	.8188	5.117	.612
.45	.0488	.5356	2.645	.628
.50	.0446	.3569	1.428	.622
.55	.0398	.2392	.7907	.581

PROPELLER No. 37.

0.25	0.1130	7.222	115.7	0.371
.30	.1182	4.267	47.41	.432
.35	.1179	2.750	22.45	.490
.40	.1186	1.853	11.53	.544
.45	.1178	1.293	6.385	.593
.50	.1157	.9257	3.703	.635
.55	.1120	.6792	2.245	.672
.60	.1092	.5056	1.404	.702
.65	.1051	.3837	.9058	.728
.70	.1007	.2936	.6992	.745
.75	.0954	.2262	.4021	.757
.80	.0898	.1754	.2741	.751
.85	.0819	.1366	.1891	.757
.90	.0777	.1066	.1316	.741
.95	.0712	.0831	.0921	.710

PROPELLER No. 38.

0.25	0.1199	7.674	122.8	0.350
.30	.1217	4.507	50.08	.445
.35	.1222	2.853	23.29	.506
.40	.1212	1.894	11.84	.560
.45	.1189	1.305	6.445	.610
.50	.1155	.9240	3.696	.652
.55	.1113	.6690	2.212	.689
.60	.1064	.4926	1.368	.721
.65	.1009	.3675	.8928	.745
.70	.0949	.2767	.5647	.760
.75	.0885	.2093	.3730	.761
.80	.0818	.1598	.2497	.747
.85	.0747	.1217	.1694	.717

PROPELLER No. 39.

0.25	0.0996	6.375	102.0	0.414
.30	.1011	3.745	41.61	.473
.35	.1027	2.395	19.56	.523
.40	.1039	1.623	10.14	.562
.45	.1043	1.145	5.655	.625
.50	.1039	.8312	3.325	.661
.55	.1028	.6179	2.042	.692
.60	.1013	.4590	1.302	.720
.65	.0990	.3606	.8332	.741
.70	.0960	.2799	.5713	.757
.75	.0920	.2181	.3377	.769
.00	.0874	.1707	.2667	.770
.85	.0821	.1287	.1850	.764
.90	.0764	.1043	.1294	.740
.95	.0702	.0819	.0907	.699

PROPELLER No. 40.

0.25	0.1139	7.290	116.6	0.339
.30	.1151	4.263	47.36	.453
.35	.1163	2.713	22.15	.510
.40	.1161	1.814	11.34	.561
.45	.1143	1.250	6.223	.607
.50	.1125	.9000	3.600	.650
.55	.1091	.6558	2.168	.685
.60	.1050	.5061	1.628	.718
.65	.1000	.3642	.8520	.741
.70	.0945	.2755	.5523	.759
.75	.0885	.2093	.3730	.766
.80	.0831	.1604	.2506	.755
.85	.0787	.1233	.1707	.733
.90	.0733	.0944	.1165	.722

PROPELLER No. 41.

0.20	0.0856	10.827	270.6	0.347
.25	.0890	5.632	90.12	.419
.30	.0891	3.300	36.67	.490
.35	.0892	2.081	16.99	.540
.40	.0875	1.367	8.544	.589
.45	.0847	.9297	4.591	.636
.50	.0807	.6457	2.583	.674
.55	.0763	.4556	1.516	.704
.60	.0716	.3315	.9209	.723
.65	.0664	.2418	.5722	.726
.70	.0612	.1788	.3649	.709
.75	.0559	.1325	.2356	.682

PROPELLER No. 42.

0.20	0.0863	10.79	269.5	0.345
.25	.0875	5.600	89.61	.418
.30	.0880	3.269	36.22	.490
.35	.0873	2.036	16.62	.550
.40	.0846	1.322	8.256	.603
.45	.0809	.8880	4.385	.643
.50	.0767	.6126	2.454	.685
.55	.0720	.4328	1.431	.713
.60	.0668	.3093	.8592	.725
.65	.0611	.2225	.5266	.723
.70	.0553	.1612	.3290	.690

TABLE VIII—Continued.

PROPELLER NO. 43.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0770	9.625	240.6	0.371
.25	.0780	4.992	79.88	.448
.30	.0792	2.994	32.60	.510
.35	.0795	1.854	15.14	.565
.40	.0787	1.230	7.687	.614
.45	.0773	.8485	4.190	.656
.50	.0751	.6009	2.404	.690
.55	.0723	.4346	1.426	.717
.60	.0690	.3194	.8874	.731
.65	.0653	.2378	.5628	.731
.70	.0612	.1785	.3643	.711
.75	.0570	.1351	.2402	.666

PROPELLER NO. 44.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0831	10.26	256.5	0.359
.25	.0833	5.331	85.30	.434
.30	.0838	3.103	34.48	.500
.35	.0828	1.931	15.77	.555
.40	.0807	1.261	7.882	.604
.45	.0776	.8517	4.206	.647
.50	.0736	.5889	2.355	.682
.55	.0694	.4171	1.379	.701
.60	.0647	.2995	.8320	.707
.65	.0599	.2181	.5162	.696
.70	.0548	.1598	.3261	.666

PROPELLER NO. 45.

0.20	0.0563	7.088	176.0	0.400
.25	.0564	3.610	57.76	.474
.30	.0561	2.078	23.09	.535
.35	.0551	1.285	10.49	.578
.40	.0535	.8359	5.224	.602
.45	.0516	.5663	2.797	.606
.50	.0492	.3936	1.574	.591
.55	.0465	.2795	.9238	.546

PROPELLER NO. 46.

0.20	0.0607	7.583	189.7	0.399
.25	.0602	3.853	61.65	.472
.30	.0589	2.181	24.24	.534
.35	.0568	1.325	10.82	.581
.40	.0539	.8430	5.263	.609
.45	.0501	.5499	2.716	.615
.50	.0451	.3633	1.476	.590
.55	.0415	.2494	.8244	.530

PROPELLER NO. 47.

0.20	0.0518	6.476	161.9	0.415
.25	.0519	3.332	53.15	.489
.30	.0515	1.907	21.19	.545
.35	.0504	1.175	9.506	.585
.40	.0489	.7640	4.775	.608
.45	.0466	.5115	2.526	.613
.50	.0442	.3537	1.415	.602
.55	.0412	.2476	.8184	.565

PROPELLER NO. 48.

0.20	0.0560	7.000	175.0	0.402
.25	.0557	3.565	57.04	.480
.30	.0544	2.015	22.39	.541
.35	.0522	1.217	9.938	.583
.40	.0496	.7750	4.844	.606
.45	.0466	.5115	2.526	.605
.50	.0434	.3473	1.390	.579
.55	.0400	.2404	.7946	.515

PROPELLER NO. 80.

0.25	0.1101	7.049	112.8	0.355
.30	.1114	4.127	45.85	.414
.35	.1129	2.528	21.50	.470
.40	.1144	1.788	11.18	.520
.45	.1159	1.272	6.281	.567
.50	.1171	.9369	3.748	.610
.55	.1176	.7068	2.337	.648
.60	.1170	.5417	1.505	.680
.65	.1155	.4206	.9954	.711
.70	.1130	.3295	.6726	.737
.75	.1095	.2596	.4615	.760
.80	.1053	.2087	.3214	.779
.85	.1000	.1639	.2255	.795
.90	.0943	.1294	.1598	.806
.95	.0879	.1025	.1136	.813
1.00	.0811	.0811	.0811	.816
1.05	.0740	.0639	.0580	.811
1.10	.0665	.0500	.0412	.796

PROPELLER NO. 81.

0.25	0.1346	8.616	137.9	0.349
.30	.1354	5.016	55.73	.409
.35	.1363	3.179	25.95	.458
.40	.1367	2.136	13.35	.518
.45	.1367	1.501	7.412	.565
.50	.1359	1.087	4.348	.610
.55	.1342	.8066	2.667	.650
.60	.1315	.6039	1.692	.684
.65	.1277	.4550	1.101	.714
.70	.1229	.3584	.7814	.740
.75	.1172	.2779	.4941	.763
.80	.1107	.2162	.3378	.781
.85	.1038	.1690	.2339	.796
.90	.0960	.1317	.1626	.808
.95	.0880	.1027	.1138	.804
1.00	.0797	.0797	.0797	.796
1.05	.0711	.0614	.0557	.780
1.10	.0624	.0469	.0388	.748

PROPELLER NO. 82.

0.25	0.0993	6.356	101.7	0.374
.30	.1006	3.738	41.48	.438
.35	.1029	2.400	19.60	.490
.40	.1055	1.648	10.30	.540
.45	.1077	1.182	5.837	.584
.50	.1094	.8733	3.501	.628
.55	.1104	.6636	2.194	.668
.60	.1106	.5120	1.422	.704
.65	.1098	.3999	.9455	.734
.70	.1080	.3149	.6437	.757
.75	.1053	.2496	.4437	.778
.80	.1016	.1985	.3103	.796
.85	.0974	.1586	.2195	.811
.90	.0924	.1267	.1584	.823
.95	.0869	.1014	.1134	.832
1.00	.0811	.0811	.0811	.834
1.05	.0748	.0646	.0586	.830
1.10	.0678	.0509	.0421	.817
1.15	.0608	.0386	.0300	.794

PROPELLER NO. 83.

0.25	0.1242	7.950	127.2	0.359
.30	.1251	4.633	51.48	.419
.35	.1260	2.940	24.00	.474
.40	.1268	1.931	12.38	.529
.45	.1274	1.328	6.904	.577
.50	.1273	1.018	4.072	.620
.55	.1267	.7616	2.518	.658
.60	.1255	.5810	1.614	.693
.65	.1230	.4479	1.060	.724
.70	.1198	.3493	.7130	.750
.75	.1157	.2743	.4877	.773
.80	.1107	.2162	.3378	.791
.85	.1045	.1702	.2355	.805
.90	.0975	.1338	.1582	.815
.95	.0898	.1047	.1160	.817
1.00	.0814	.0814	.0814	.816
1.05	.0726	.0626	.0558	.807
1.10	.0629	.0473	.0391	.784
1.15	.0530	.0348	.0268	.740
1.20	.0427	.0247	.0172	.663

TABLE VIII—Continued.

PROPELLER NO. 90.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0500	6.260	155.2	0.426
.25	.0497	3.181	50.90	.504
.30	.0489	1.811	20.12	.570
.35	.0474	1.105	9.025	.621
.40	.0453	.7073	4.424	.653
.45	.0428	.4693	2.320	.668
.50	.0398	.3134	1.274	.666
.55	.0366	.2200	.7272	.626

PROPELLER NO. 91.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0513	6.413	160.3	0.430
.25	.0502	3.213	51.41	.508
.30	.0488	1.800	20.00	.571
.35	.0464	1.052	8.932	.620
.40	.0434	.6732	4.229	.661
.45	.0401	.4401	2.174	.658
.50	.0365	.2920	1.168	.632
.55	.0326	.1969	.6475	.570

PROPELLER NO. 92.

0.20	0.0729	9.113	227.8	0.375
.25	.0734	5.098	91.18	.451
.30	.0737	2.730	30.38	.523
.35	.0736	1.717	14.02	.585
.40	.0732	1.144	7.150	.637
.45	.0722	.7924	3.914	.677
.50	.0705	.5540	2.265	.710
.55	.0681	.4093	1.359	.734
.60	.0650	.3009	.8359	.749
.65	.0615	.2240	.5302	.756
.70	.0574	.1674	.3417	.750
.75	.0531	.1259	.2238	.728
.80	.0484	.0945	.1477	.664

PROPELLER NO. 93.

0.20	0.0765	9.563	239.1	0.375
.25	.0760	4.865	77.84	.450
.30	.0750	2.778	30.86	.521
.35	.0737	1.719	14.02	.586
.40	.0719	1.1235	7.022	.640
.45	.0692	.7696	3.751	.684
.50	.0656	.5249	2.100	.715
.55	.0615	.3696	1.222	.734
.60	.0568	.2630	.7306	.739
.65	.0515	.1875	.4437	.726
.70	.0459	.1338	.2731	.694

PROPELLER NO. 94.

0.25	0.0954	6.106	97.70	0.422
.30	.0968	3.585	39.84	.485
.35	.0980	2.286	18.67	.540
.40	.0987	1.542	9.638	.583
.45	.0990	1.067	5.369	.620
.50	.0987	.7597	3.159	.657
.55	.0979	.5585	1.946	.701
.60	.0964	.4463	1.240	.728
.65	.0940	.3423	.8101	.752
.70	.0905	.2639	.5386	.771
.75	.0864	.2043	.3641	.784
.80	.0816	.1594	.2491	.790
.85	.0761	.1239	.1715	.790
.90	.0704	.0966	.1193	.776
.95	.0642	.0749	.0830	.742

PROPELLER NO. 95.

0.25	0.1122	7.181	114.9	0.390
.30	.1127	4.174	46.37	.456
.35	.1127	2.623	21.46	.515
.40	.1120	1.780	10.94	.569
.45	.1106	1.214	5.996	.616
.50	.1083	.8665	3.467	.659
.55	.1063	.6329	2.092	.695
.60	.1016	.4704	1.307	.725
.65	.0970	.3583	.8362	.751
.70	.0916	.2671	.5481	.767
.75	.0855	.2027	.3604	.773
.80	.0789	.1541	.2403	.772
.85	.0719	1171	.1621	.758
.90	.0644	.0883	.1090	.728

PROPELLER NO. 96 (ANGLE DECREASED 6°).

0.25	0.0439	2.810	44.96	0.471
.30	.0433	1.604	17.83	.532
.35	.0421	.9820	8.016	.581
.40	.0405	.6328	3.955	.615
.45	.0387	.4247	2.097	.632
.50	.0366	.2928	1.171	.628
.55	.0343	.2062	.6817	.596
.60	.0318	1472	.4090	.525
.65	.0292	.1063	.2516	.386

PROPELLER NO. 96 (ANGLE DECREASED 4°).

0.25	0.0514	3.290	52.64	0.455
.30	.0508	1.881	20.90	.534
.35	.0494	1.152	9.405	.574
.40	.0474	.7407	4.630	.619
.45	.0450	.4939	2.439	.655
.50	.0421	.3368	1.347	.677
.55	.0389	.2338	.7728	.673
.60	.0357	.1653	.4592	.630
.65	.0322	.1173	.2776	.549

PROPELLER NO. 96 (STANDARD SETTING).

0.25	0.0746	4.774	76.40	0.419
.30	.0740	2.741	30.45	.489
.35	.0727	1.696	12.85	.551
.40	.0707	1.105	6.906	.608
.45	.0681	7474	2.601	.655
.50	.0651	.5209	2.084	.694
.55	.0615	.3696	1.222	.722
.60	.0575	.2675	.7434	.740
.65	.0537	.1935	.4920	.748
.70	.0495	.1443	.3045	.744
.75	.0451	.1069	.1901	.716

PROPELLER NO. 96 (ANGLE INCREASED 4°).

0.35	0.0979	2.253	18.64	0.519
.40	.0970	1.516	9.475	.570
.45	.0953	1.046	5.166	.615
.50	.0931	.7449	2.980	.657
.55	.0899	.5404	1.787	.691
.60	.0862	.3991	1.109	.721
.65	.0820	.2986	.7067	.746
.70	.0775	.2260	.4512	.762
.75	.0728	.1721	.3060	.772
.80	.0675	.1318	.2060	.771
.85	.0621	.1011	.1390	.756
.90	.0565	.0775	.0937	.722
.95	.0507	.0591	.0635	.669

TABLE VIII—Continued.

PROPELLER NO. 96 (ANGLE INCREASED 8°).

$\frac{V}{ND}$	C_1	C_3	C_2	Efficiency.
0.40	0.1183	1.848	11.55	0.518
.45	.1189	1.305	8.445	.565
.50	.1186	.9489	3.796	.606
.55	.1177	.7074	2.389	.643
.60	.1159	.5366	1.491	.677
.65	.1134	.4130	.9776	.707
.70	.1104	.3219	.6570	.733
.75	.1063	.2520	.4480	.752
.80	.1018	.1968	.3107	.767
.85	.0965	.1572	.2176	.774
.90	.0911	.1250	.1543	.775
.95	.0853	.0995	.1103	.765
1.00	.0791	.0791	.0791	.745

PROPELLER NO. 96 (ANGLE INCREASED 12°).

$\frac{V}{ND}$	C_1	C_3	C_2	Efficiency.
0.50	0.1444	1.155	4.620	0.534
.55	.1457	.8767	2.805	.577
.60	.1465	.6782	1.884	.614
.65	.1464	.5331	1.262	.648
.70	.1454	.4210	.8654	.679
.75	.1436	.3404	.6059	.704
.80	.1410	.2754	.4304	.725
.85	.1375	.2239	.3099	.742
.90	.1331	.1826	.2255	.756
.95	.1278	.1491	.1652	.765
1.00	.1215	.1215	.1215	.770
1.05	.1147	.0991	.0889	.771
1.10	.1073	.0808	.0666	.767
1.15	.0996	.0658	.0196	.756
1.20	.0913	.0526	.0367	.733
1.25	.0826	.0423	.0271	.702

PROPELLER NO. 96 (ANGLE INCREASE 16°).

0.55	0.1600	0.9617	3.179	0.533
.60	.1627	.7582	2.093	.574
.65	.1657	.6034	1.428	.610
.70	.1682	.4904	1.001	.644
.75	.1702	.4034	.7172	.670
.80	.1713	.3346	.5226	.694
.85	.1704	.2775	.3841	.713
.90	.1682	.2307	.2848	.728
.95	.1646	.1920	.2128	.741
1.00	.1596	.1596	.1596	.750
1.05	.1539	.1329	.1206	.758
1.10	.1478	.1111	.0918	.763
1.15	.1412	.0928	.0702	.764
1.20	.1344	.0778	.0540	.762
1.25	.1271	.0651	.0417	.754
1.30	.1198	.0545	.0323	.742
1.35	.1121	.0456	.0250	.721

PROPELLER NO. 96 (ANGLE INCREASED 20°).

0.65	0.1839	0.6880	1.629	0.539
.70	.1912	.5575	1.138	.574
.75	.1962	.4603	.8184	.606
.80	.1999	.3846	.6010	.635
.85	.1990	.3241	.4486	.661
.90	.2003	.2748	.3393	.684
.95	.2006	.2339	.2592	.701
1.00	.1995	.1995	.1995	.720
1.05	.1972	.1704	.1546	.732
1.10	.1940	.1458	.1205	.742
1.15	.1897	.1247	.0943	.748
1.20	.1847	.1069	.0742	.753
1.25	.1790	.0917	.0587	.756
1.30	.1730	.0787	.0466	.756
1.35	.1668	.0678	.0372	.753
1.40	.1605	.0585	.0298	.745
1.45	.1542	.0506	.0241	.734
1.50	.1477	.0433	.0196	.719

PROPELLER NO. 111.

0.25	0.1234	7.898	126.4	0.285
.30	.1236	4.578	50.37	.310
.35	.1241	2.895	23.63	.394
.40	.1252	1.956	12.22	.445
.45	.1266	1.390	6.955	.496
.50	.1284	1.027	4.108	.541
.55	.1303	.7831	2.589	.583
.60	.1318	.6103	1.695	.623
.65	.1329	.4840	1.146	.659
.70	.1336	.3896	.7951	.689
.75	.1334	.3162	.5622	.718
.80	.1322	.2582	.4085	.742
.85	.1303	.2122	.2937	.764
.90	.1276	.1750	.2161	.782
.95	.1237	.1443	.1599	.797
1.00	.1189	.1189	.1189	.810
1.05	.1133	.0979	.0888	.820
1.10	.1070	.0804	.0665	.827
1.15	.1000	.0658	.0497	.829
1.20	.0927	.0536	.0372	.829
1.25	.0850	.0435	.0278	.825
1.30	.0766	.0349	.0206	.814
1.35	.0686	.0279	.0153	.790

PROPELLER NO. 112.

0.25	0.1647	10.54	168.7	0.291
.30	.1659	6.145	68.28	.345
.35	.1671	3.898	31.89	.397
.40	.1685	2.633	18.46	.446
.45	.1698	1.864	9.205	.491
.50	.1703	1.362	5.448	.536
.55	.1702	1.023	3.382	.577
.60	.1691	.7830	2.175	.617
.65	.1672	.6089	1.441	.651
.70	.1646	.4799	.9795	.682
.75	.1611	.3819	.6790	.710
.80	.1570	.3067	.4793	.735
.85	.1520	.2475	.3426	.756
.90	.1462	.2005	.2475	.775
.95	.1395	.1637	.1808	.790
1.00	.1319	.1319	.1319	.802
1.05	.1234	.1066	.0967	.810
1.10	.1141	.0857	.0709	.815
1.15	.1049	.0690	.0522	.816
1.20	.0951	.0550	.0382	.813
1.25	.0853	.0437	.0280	.801
1.30	.0753	.0343	.0203	.777

PROPELLER NO. 113.

0.25	0.1209	7.738	123.8	0.311
.30	.1221	4.523	50.25	.369
.35	.1237	2.885	23.55	.425
.40	.1260	1.969	12.31	.473
.45	.1289	1.415	6.987	.529
.50	.1320	1.056	4.234	.577
.55	.1354	.8138	2.690	.619
.60	.1380	.6390	1.775	.655
.65	.1395	.5080	1.202	.685
.70	.1400	.4082	.8331	.711
.75	.1394	.3304	.5874	.735
.80	.1380	.2696	.4213	.756
.85	.1357	.2210	.3059	.775
.90	.1327	.1820	.2247	.791
.95	.1288	.1502	.1664	.806
1.00	.1240	.1240	.1240	.819
1.05	.1185	.1024	.0929	.831
1.10	.1124	.0844	.0698	.838
1.15	.1059	.0696	.0536	.840
1.20	.0990	.0573	.0398	.837
1.25	.0915	.0469	.0300	.826
1.30	.0837	.0381	.0225	.803

PROPELLER NO. 114.

0.25	0.1453	9.332	149.3	0.311
.30	.1476	5.457	60.75	.369
.35	.1497	3.492	28.51	.422
.40	.1519	2.373	14.83	.473
.45	.1538	1.688	8.336	.518
.50	.1557	1.246	4.984	.561
.55	.1574	.9461	3.128	.599
.60	.1588	.7352	2.042	.634
.65	.1595	.5808	1.375	.665
.70	.1596	.4658	.9406	.694
.75	.1582	.3750	.6566	.719
.80	.1566	.3040	.4750	.742
.85	.1514	.2466	.3413	.761
.90	.1458	.2000	.2470	.780
.95	.1386	.1617	.1792	.795
1.00	.1308	.1308	.1308	.807
1.05	.1224	.1057	.0959	.817
1.10	.1137	.0854	.0706	.823
1.15	.1049	.0692	.0532	.826
1.20	.0957	.0554	.0385	.823
1.25	.0865	.0443	.0284	.811
1.30	.0770	.0350	.0207	.790

TABLE VIII—Continued.

PROPELLER NO. 115.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0404	5.080	126.2	0.422
.25	.0400	2.580	40.96	.508
.30	.0394	1.459	16.22	.579
.35	.0380	.8863	7.236	.632
.40	.0358	.5694	3.496	.674
.45	.0334	.3666	1.811	.700
.50	.0304	.2432	.9728	.705
.55	.0271	.1629	.5384	.681
.60	.0236	.1092	.3035	.624

PROPELLER NO. 116.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0556	6.960	173.8	0.384
.25	.0552	3.533	55.53	.459
.30	.0547	2.026	22.51	.521
.35	.0538	1.255	10.25	.580
.40	.0527	.8235	5.147	.632
.45	.0513	.5831	2.781	.680
.50	.0496	.3968	1.557	.718
.55	.0478	.2843	.9308	.751
.60	.0441	.2042	.5673	.769
.65	.0404	.1471	.3431	.775
.70	.0364	.1061	.2165	.760
.75	.0320	.0758	.1248	.720

PROPELLER NO. 117.

0.20	0.0746	9.325	233.1	0.360
.25	.0752	4.813	77.02	.431
.30	.0760	2.815	31.23	.492
.35	.0766	1.787	14.59	.547
.40	.0771	1.205	7.531	.594
.45	.0776	.8513	4.207	.636
.50	.0777	.6317	2.457	.673
.55	.0771	.4634	1.552	.705
.60	.0757	.3505	.9756	.727
.65	.0727	.2643	.6267	.754
.70	.0688	.2006	.4094	.752
.75	.0639	.1515	.2693	.795
.80	.0578	.1120	.1764	.793
.85	.0512	.0834	.1154	.790
.90	.0443	.0608	.0751	.770
.95	.0370	.0432	.0479	.724

PROPELLER No. 118.

0.25	0.0937	5.997	95.96	0.387
.30	.0945	3.500	38.89	.421
.35	.0950	2.237	18.26	.453
.40	.0972	1.519	9.493	.540
.45	.0984	1.080	5.333	.590
.50	.0999	.7993	3.197	.631
.55	.1009	.6065	2.005	.665
.60	.1011	.4681	1.300	.699
.65	.1010	.3678	.8705	.727
.70	.1000	.2918	.6963	.753
.75	.0980	.2328	.4130	.773
.80	.0946	.1848	.2887	.789
.85	.0902	.1469	.2033	.801
.90	.0852	.1169	.1443	.810
.95	.0792	.0924	.1024	.816
1.00	.0729	.0729	.0729	.819
1.05	.0660	.0570	.0517	.817
1.10	.0586	.0440	.0364	.804
1.15	.0509	.0335	.0258	.774

PROPELLER No. 119.

0.25	0.1128	7.220	115.5	0.301
.30	.1130	4.185	45.50	.359
.35	.1131	2.633	21.54	.411
.40	.1137	1.777	11.11	.464
.45	.1144	1.255	6.198	.513
.50	.1153	.9223	3.690	.561
.55	.1164	.6993	2.313	.606
.60	.1177	.5449	1.514	.646
.65	.1195	.4351	1.030	.680
.70	.1210	.3528	.7200	.710
.75	.1230	.2902	.5141	.738
.80	.1221	.2385	.3727	.760
.85	.1250	.2036	.2818	.779
.90	.1196	.1641	.2026	.790
.95	.1167	.1361	.1508	.806
1.00	.1126	.1126	.1126	.812
1.05	.1073	.0927	.0841	.817
1.10	.1011	.0760	.0628	.818
1.15	.0935	.0615	.0455	.812
1.20	.0851	.0492	.0342	.802
1.25	.0762	.0390	.0250	.785
1.30	.0670	.0306	.0181	.756

PROPELLER No. 120.

0.20	0.0625	7.814	195.4	0.362
.25	.0617	3.949	63.19	.440
.30	.0605	2.241	24.90	.506
.35	.0592	1.331	11.27	.570
.40	.0576	.9000	5.625	.628
.45	.0554	.6081	3.003	.667
.50	.0525	.4200	1.680	.701
.55	.0489	.2939	.9714	.728
.60	.0447	.2069	.5749	.731
.65	.0400	.1457	.3443	.716
.70	.0351	.1028	.2058	.677

PROPELLER No. 121.

0.20	0.0620	7.760	193.8	0.371
.25	.0617	3.949	63.19	.443
.30	.0612	2.267	25.19	.518
.35	.0603	1.406	11.43	.572
.40	.0592	.9250	5.782	.619
.45	.0575	.6311	3.117	.661
.50	.0553	.4434	1.770	.695
.55	.0531	.3131	1.035	.720
.60	.0497	.2255	.6365	.737
.65	.0448	.1631	.3860	.739
.70	.0407	.1187	.2123	.714
.75	.0354	.0853	.1534	.641

PROPELLER No. 122.

0.20	0.0659	8.238	206.0	0.367
.25	.0656	4.199	67.20	.440
.30	.0651	2.411	26.79	.504
.35	.0645	1.504	12.25	.555
.40	.0635	.9922	6.201	.608
.45	.0623	.6828	3.377	.649
.50	.0604	.4833	1.933	.687
.55	.0582	.3498	1.155	.721
.60	.0556	.2575	.7153	.745
.65	.0526	.1915	.4553	.759
.70	.0492	.1435	.2929	.755
.75	.0453	.1074	.1909	.728

TABLE VIII—Continued.

PROPELLER NO. 123.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0625	7.814	195.4	0.357
.25	.0627	4.013	64.22	.431
.30	.0628	2.326	25.84	.499
.35	.0628	1.465	11.96	.554
.40	.0625	.9766	6.104	.606
.45	.0622	.6837	3.372	.652
.50	.0615	.4921	1.968	.693
.55	.0604	.3630	1.200	.725
.60	.0585	.2708	.7524	.744
.65	.0554	.2017	.4774	.756
.70	.0514	.1496	.3067	.755
.75	.0469	.1112	.1977	.736
.80	.0417	.0815	.1273	.696

PROPELLER NO. 127.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.20	0.0401	5.013	125.3	0.430
.25	.0395	2.528	40.45	.494
.30	.0385	1.426	15.84	.543
.35	.0368	.8584	7.008	.592
.40	.0346	.5406	3.379	.627
.45	.0320	.3512	1.735	.644
.50	.0291	.2328	.9312	.624
.55	.0261	.1589	.5186	.560

PROPELLER NO. 128.

0.20	0.0369	4.613	115.3	0.440
.25	.0353	2.291	36.66	.508
.30	.0345	1.321	14.24	.562
.35	.0329	.7674	6.265	.598
.40	.0308	.4812	3.007	.615
.45	.0287	.3150	1.556	.606
.50	.0264	.2112	.8443	.563

PROPELLER NO. 129.

0.20	0.0332	7.900	197.5	0.403
.25	.0330	4.032	64.52	.473
.30	.0329	2.330	25.90	.533
.35	.0321	1.448	11.53	.585
.40	.0311	.9548	5.968	.622
.45	.0295	.6530	3.225	.671
.50	.0273	.4585	1.834	.705
.55	.0245	.3276	1.082	.721
.60	.0211	.2366	.6978	.745
.65	.0173	.1722	.4075	.747
.70	.0129	.1261	.2553	.733
.75	.0079	.0923	.1597	.690

PROPELLER NO. 130.

0.20	0.0600	7.500	187.5	0.402
.25	.0596	3.815	61.04	.474
.30	.0590	2.185	24.28	.532
.35	.0582	1.358	11.09	.583
.40	.0573	.8953	5.596	.629
.45	.0559	.6135	3.030	.667
.50	.0539	.4312	1.725	.698
.55	.0515	.3095	1.023	.718
.60	.0481	.2327	.6136	.724
.65	.0441	.1806	.3801	.710
.70	.0392	.1443	.2333	.669

PROPELLER NO. 131.

0.20	0.0826	10.35	258.8	0.355
.25	.0840	5.377	86.04	.421
.30	.0855	3.166	35.18	.480
.35	.0873	2.036	16.63	.532
.40	.0890	1.375	8.595	.581
.45	.0873	.9537	4.760	.626
.50	.0866	.6929	2.772	.668
.55	.0845	.5079	1.679	.705
.60	.0817	.3783	1.050	.740
.65	.0783	.2851	.6748	.768
.70	.0741	.2161	.4410	.789
.75	.0692	.1640	.2915	.798
.80	.0639	.1248	.1950	.800
.85	.0582	.0948	.1312	.791
.90	.0523	.0717	.0885	.772
.95	.0462	.0539	.0597	.730

PROPELLER NO. 132.

0.20	0.0822	10.27	256.9	0.364
.25	.0838	5.364	85.85	.431
.30	.0859	3.181	35.34	.493
.35	.0874	2.039	16.65	.547
.40	.0881	1.376	8.600	.595
.45	.0881	.9670	4.776	.637
.50	.0870	.6961	2.784	.672
.55	.0848	.5097	1.685	.705
.60	.0818	.3787	1.052	.734
.65	.0780	.2841	.6723	.759
.70	.0737	.2149	.4386	.776
.75	.0687	.1628	.2894	.786
.80	.0633	.1237	.1933	.788
.85	.0575	.0936	.1296	.780
.90	.0513	.0704	.0859	.756
.95	.0449	.0534	.0581	.706

PROPELLER NO. 133.

0.25	0.1088	6.642	106.3	0.349
.30	.1047	3.877	43.08	.410
.35	.1060	2.472	20.18	.467
.40	.1075	1.680	10.50	.521
.45	.1093	1.200	5.926	.573
.50	.1107	.8856	3.543	.619
.55	.1117	.6713	2.219	.660
.60	.1119	.5181	1.439	.695
.65	.1110	.4043	.9570	.724
.70	.1093	.3187	.6505	.750
.75	.1067	.2539	.4496	.773
.80	.1037	.2026	.3166	.789
.85	.1000	.1628	.2253	.804
.90	.0955	.1310	.1617	.810
.95	.0902	.1052	.1166	.810
1.00	.0841	.0841	.0841	.808
1.05	.0774	.0669	.0607	.801
1.10	.0702	.0537	.0436	.783
1.15	.0626	.0412	.0311	.747

TABLE VIII—Continued.

PROPELLER NO. 134.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.25	0.1030	6.802	105.5	0.370
.30	.1043	3.863	42.32	.423
.35	.1062	2.477	20.22	.453
.40	.1085	1.695	10.60	.539
.45	.1105	1.218	5.990	.583
.50	.1121	.8959	3.683	.625
.55	.1130	.6792	2.345	.661
.60	.1132	.5341	1.456	.695
.65	.1127	.4104	.9712	.721
.70	.1114	.3248	.6529	.746
.75	.1091	.2586	.4597	.767
.80	.1060	.2070	.3335	.784
.85	.1021	.1663	.2502	.797
.90	.0974	.1336	.1950	.805
.95	.0921	.1074	.1190	.810
1.00	.0865	.0865	.0865	.810
1.05	.0806	.0696	.0622	.805
1.10	.0745	.0560	.0463	.796
1.15	.0681	.0443	.0339	.772

PROPELLER NO. 135.

$\frac{V}{ND}$	C_1	C_2	C_3	Efficiency.
0.25	0.1019	6.821	104.3	0.380
.30	.1032	3.828	42.43	.439
.35	.1050	2.450	20.00	.493
.40	.1074	1.678	10.49	.542
.45	.1101	1.206	5.966	.587
.50	.1122	.8977	3.691	.624
.55	.1130	.6792	2.345	.660
.60	.1129	.5227	1.452	.691
.65	.1118	.4072	.9633	.720
.70	.1098	.3202	.6535	.744
.75	.1070	.2536	.4509	.767
.80	.1031	.2014	.3147	.784
.85	.0987	.1607	.2224	.799
.90	.0936	.1284	.1585	.810
.95	.0877	.1023	.1134	.815
1.00	.0811	.0811	.0811	.815
1.05	.0742	.0641	.0581	.807
1.10	.0669	.0503	.0416	.785
1.15	.0590	.0388	.0293	.741

PROPELLER NO. 136.

0.25	0.1266	8.108	120.7	0.289
.30	.1268	4.697	52.18	.345
.35	.1272	2.957	24.22	.400
.40	.1278	1.997	12.48	.454
.45	.1287	1.413	6.978	.506
.50	.1299	1.039	4.156	.553
.55	.1316	.7910	2.615	.597
.60	.1341	.6209	1.735	.640
.65	.1367	.4978	1.178	.677
.70	.1394	.4065	.8395	.710
.75	.1412	.3348	.5952	.737
.80	.1416	.2766	.4322	.759
.85	.1403	.2285	.3153	.778
.90	.1380	.1888	.2387	.794
.95	.1346	.1570	.1740	.805
1.00	.1308	.1308	.1308	.815
1.05	.1250	.1090	.0980	.820
1.10	.1191	.0895	.0740	.824
1.15	.1128	.0738	.0558	.825
1.20	.1048	.0605	.0420	.821
1.25	.0965	.0495	.0317	.810
1.30	.0881	.0401	.0237	.790
1.35	.0797	.0324	.0178	.752

PROPELLER NO. 137.

0.25	0.1210	7.744	123.9	0.301
.30	.1214	4.497	49.97	.360
.35	.1221	2.843	23.25	.417
.40	.1234	1.928	12.05	.474
.45	.1251	1.373	6.780	.527
.50	.1274	1.019	4.076	.575
.55	.1302	.7836	2.587	.616
.60	.1334	.6176	1.715	.654
.65	.1360	.4962	1.172	.687
.70	.1378	.4018	.8200	.715
.75	.1390	.3295	.5958	.739
.80	.1390	.2715	.4242	.760
.85	.1380	.2247	.3110	.780
.90	.1360	.1885	.2308	.795
.95	.1327	.1543	.1715	.807
1.00	.1284	.1284	.1284	.815
1.05	.1230	.1063	.0964	.822
1.10	.1168	.0877	.0726	.824
1.15	.1100	.0723	.0547	.821
1.20	.1029	.0595	.0413	.814
1.25	.0950	.0495	.0311	.801
1.30	.0870	.0396	.0234	.785
1.35	.0785	.0319	.0175	.752

PROPELLER NO. 138.

0.25	0.1266	8.103	129.6	0.317
.30	.1280	4.740	52.57	.372
.35	.1296	3.023	24.63	.426
.40	.1320	2.063	12.90	.478
.45	.1345	1.476	7.290	.525
.50	.1375	1.100	4.400	.569
.55	.1407	.8457	2.796	.607
.60	.1430	.6630	1.839	.645
.65	.1447	.5269	1.247	.679
.70	.1453	.4237	.8643	.707
.75	.1445	.3433	.6103	.733
.80	.1431	.2795	.4367	.757
.85	.1407	.2291	.3171	.776
.90	.1373	.1883	.2325	.791
.95	.1330	.1561	.1715	.803
1.00	.1282	.1282	.1282	.813
1.05	.1229	.1062	.0968	.821
1.10	.1170	.0879	.0727	.826
1.15	.1105	.0727	.0550	.827
1.20	.1037	.0600	.0417	.824
1.25	.0961	.0492	.0315	.817
1.30	.0883	.0402	.0238	.804
1.35	.0800	.0325	.0178	.784

PROPELLER NO. 139.

0.15	0.0249	7.38	328.0	0.385
.20	.0247	3.088	77.20	.469
.25	.0241	1.543	24.68	.517
.30	.0234	.8667	9.630	.523
.35	.0225	.5943	4.285	.490
.40	.0214	.3843	2.090	.415

PROPELLER NO. 144.

0.15	0.0234	6.982	308.0	0.395
.20	.0226	2.835	70.62	.461
.25	.0216	1.382	22.12	.488
.30	.0201	.7446	8.271	.470
.35	.0183	.4260	3.488	.399
.40	.0161	.2515	1.578	.244

PROPELLER NO. 145.

0.15	0.0262	7.763	345.0	0.37
.20	.0261	3.263	81.58	.448
.25	.0258	1.651	26.42	.491
.30	.0253	.9372	10.41	.501
.35	.0243	.5668	4.637	.47
.40	.0231	.3610	2.255	.40
.45	.0218	.2392	1.182	.276

PROPELLER NO. 146.

0.15	0.0258	7.645	339.8	0.382
.20	.0245	3.063	76.58	.461
.25	.0230	1.472	23.55	.492
.30	.0211	.7816	8.685	.491
.35	.0193	.4503	3.675	.439
.40	.0170	.2655	1.660	.284

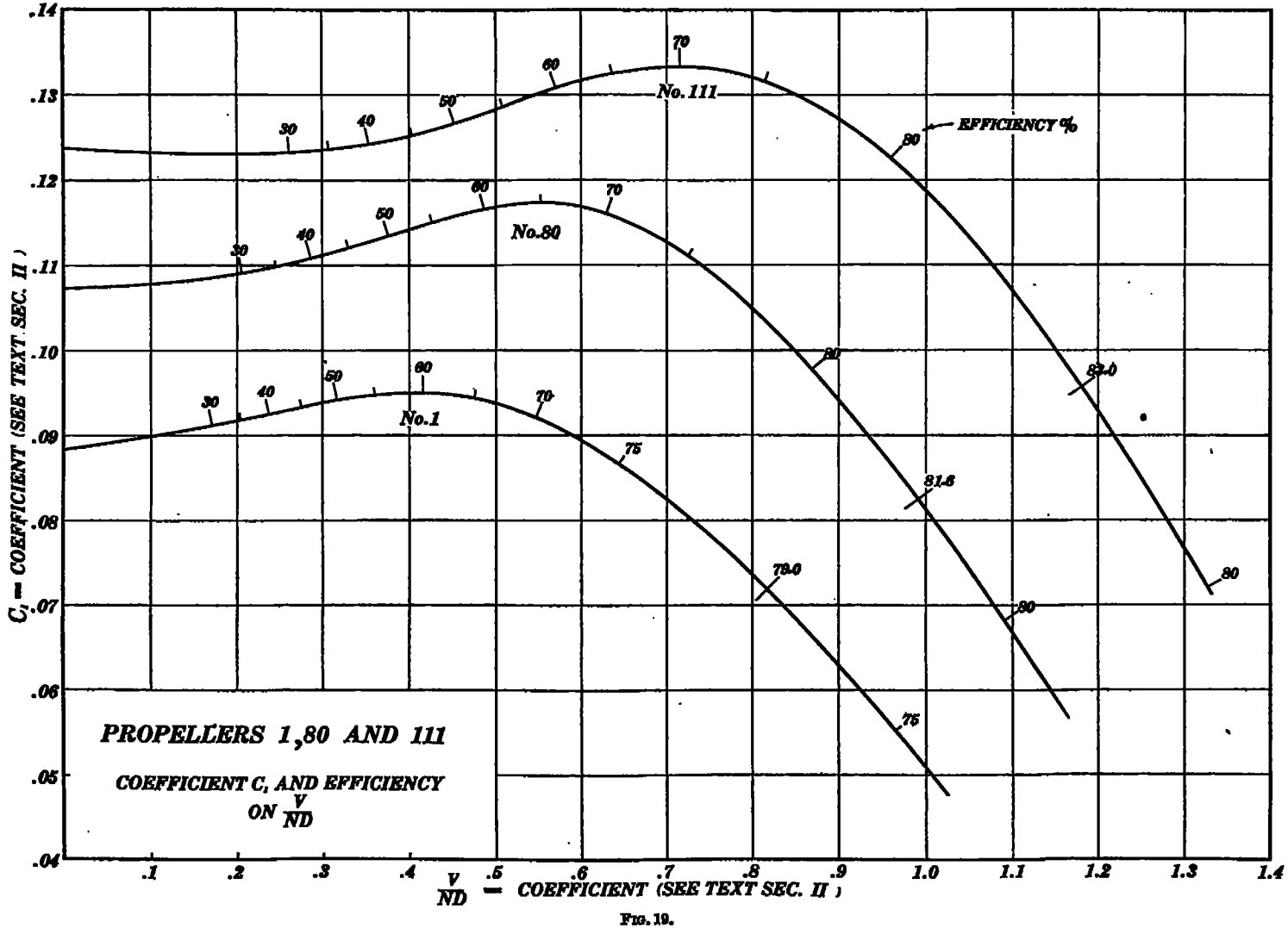

PROPELLERS 1,80 AND 111
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)
EFFICIENCY %
No. 111
No. 80
No. 1
.04
.05
.06
.07
.08
.09
.10
.11
.12
.13
.14
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
30
40
50
60
70
75
80
81.6
83.0
79.0

FIG. 19.

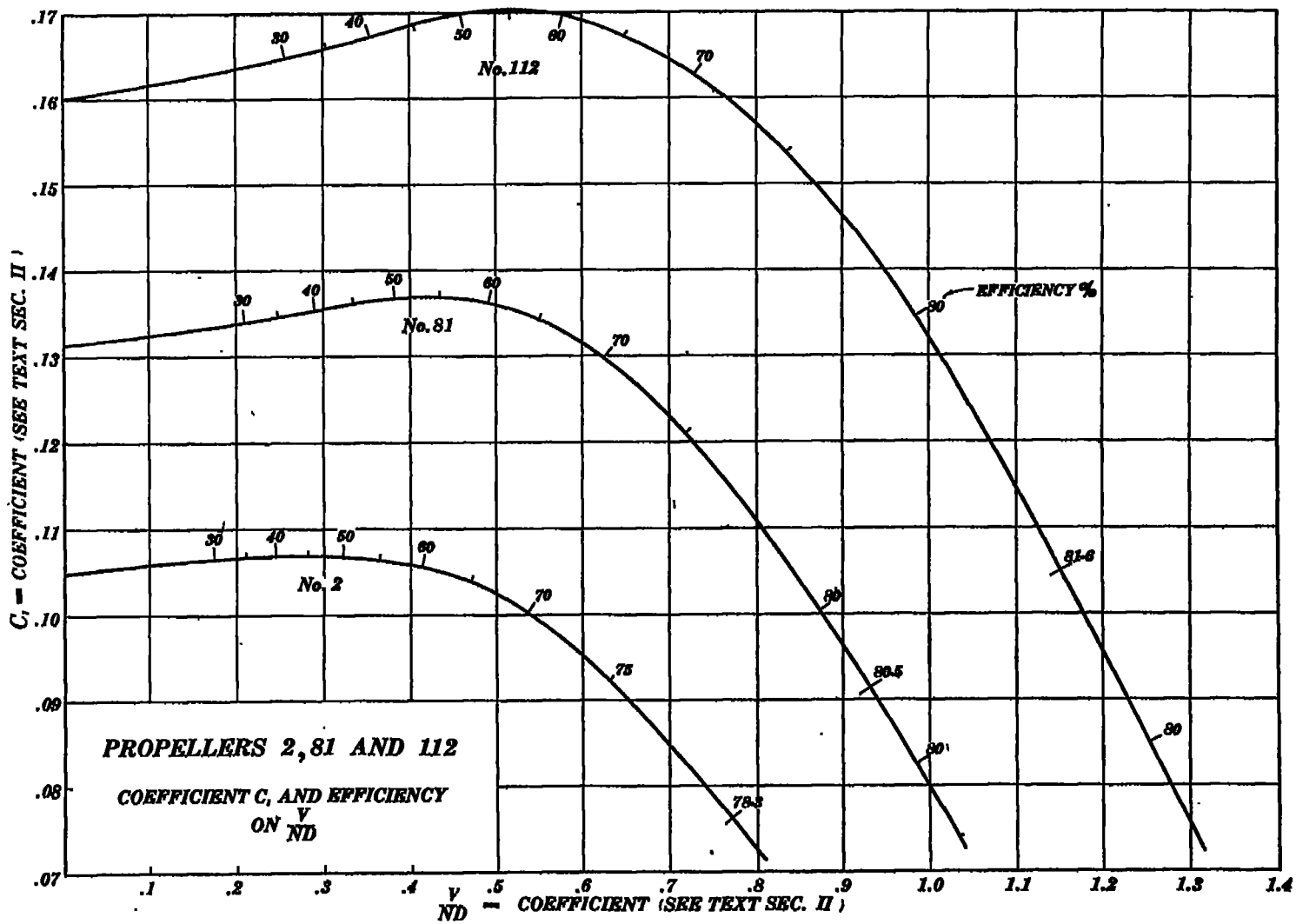

PROPELLERS 2, 81 AND 112
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 112
No. 81
No. 2
EFFICIENCY %
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.17
.16
.15
.14
.13
.12
.11
.10
.09
.08
.07
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
30
40
50
60
70
75
78.2
80.5
81.6
80

FIG. 20.

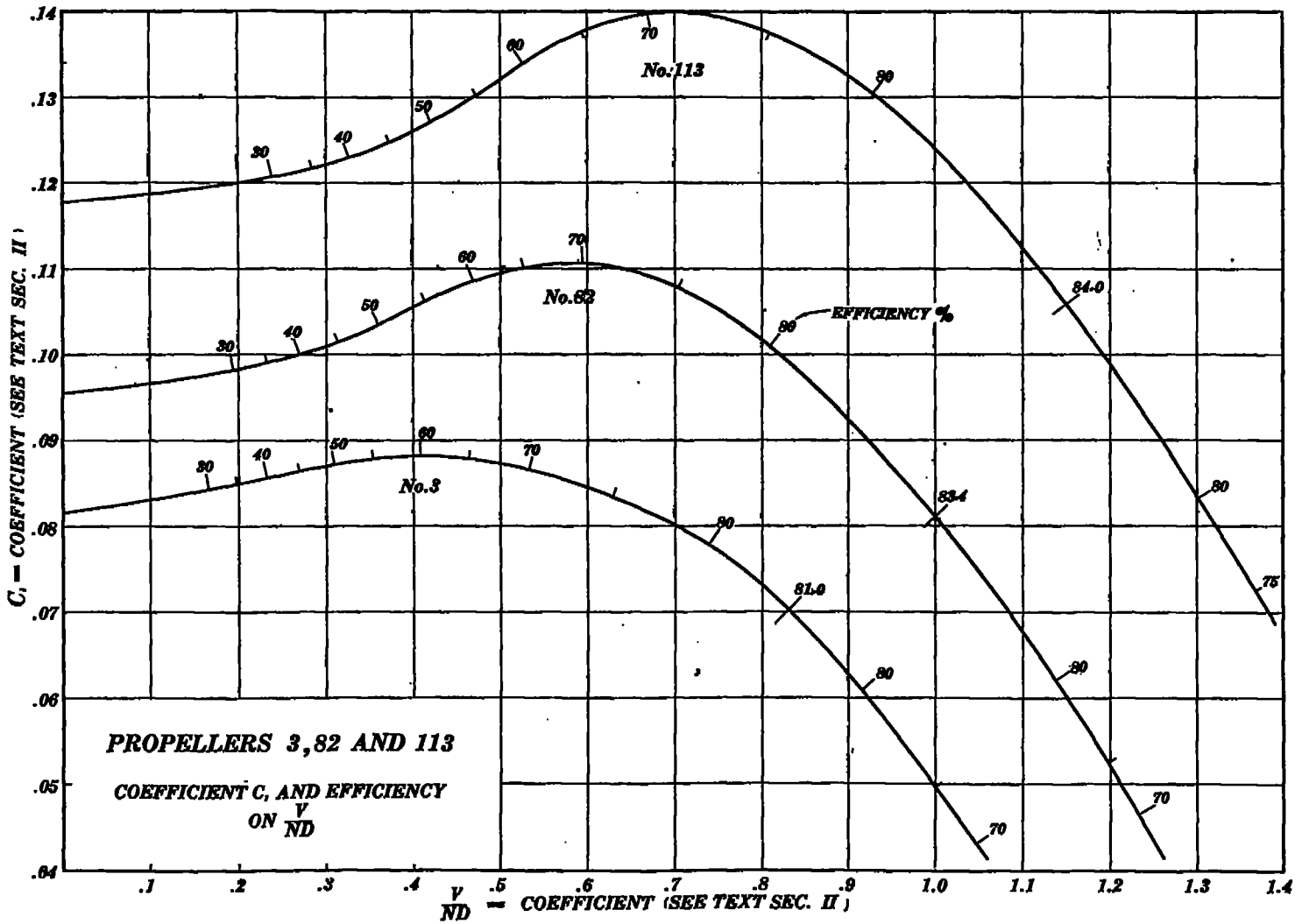

PROPELLERS 3, 82 AND 113
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 113
No. 82
No. 3
EFFICIENCY %
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.14
.13
.12
.11
.10
.09
.08
.07
.06
.05
.04
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
30
40
50
60
70
80
84.0
83.4
81.0
75

Fig. 21.

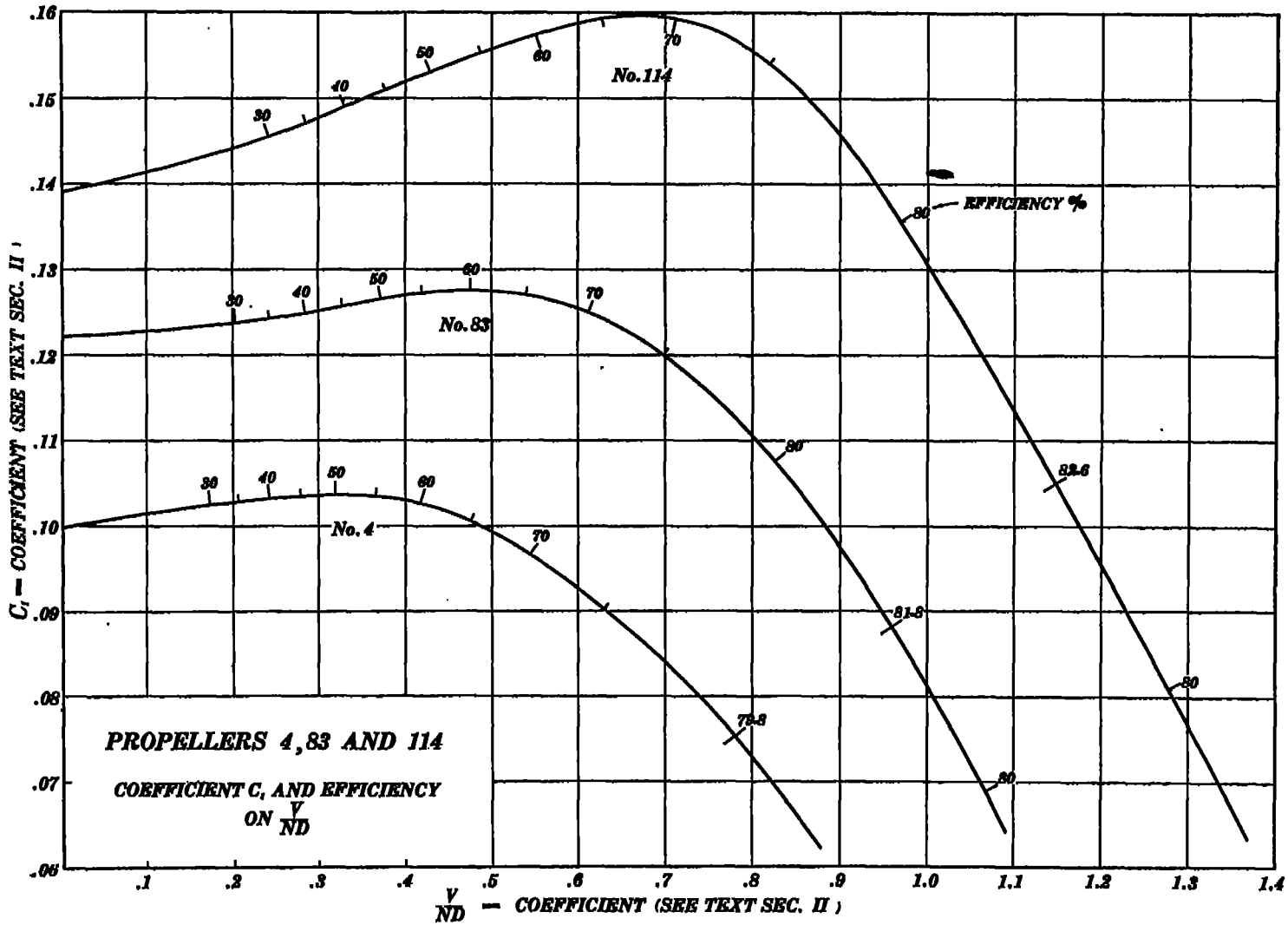

PROPELLERS 4, 83 AND 114
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
No. 114
No. 83
No. 4
EFFICIENCY %
82.6
81.8
79.8
80
C_t — COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ — COEFFICIENT (SEE TEXT SEC. II)

FIG. 22.

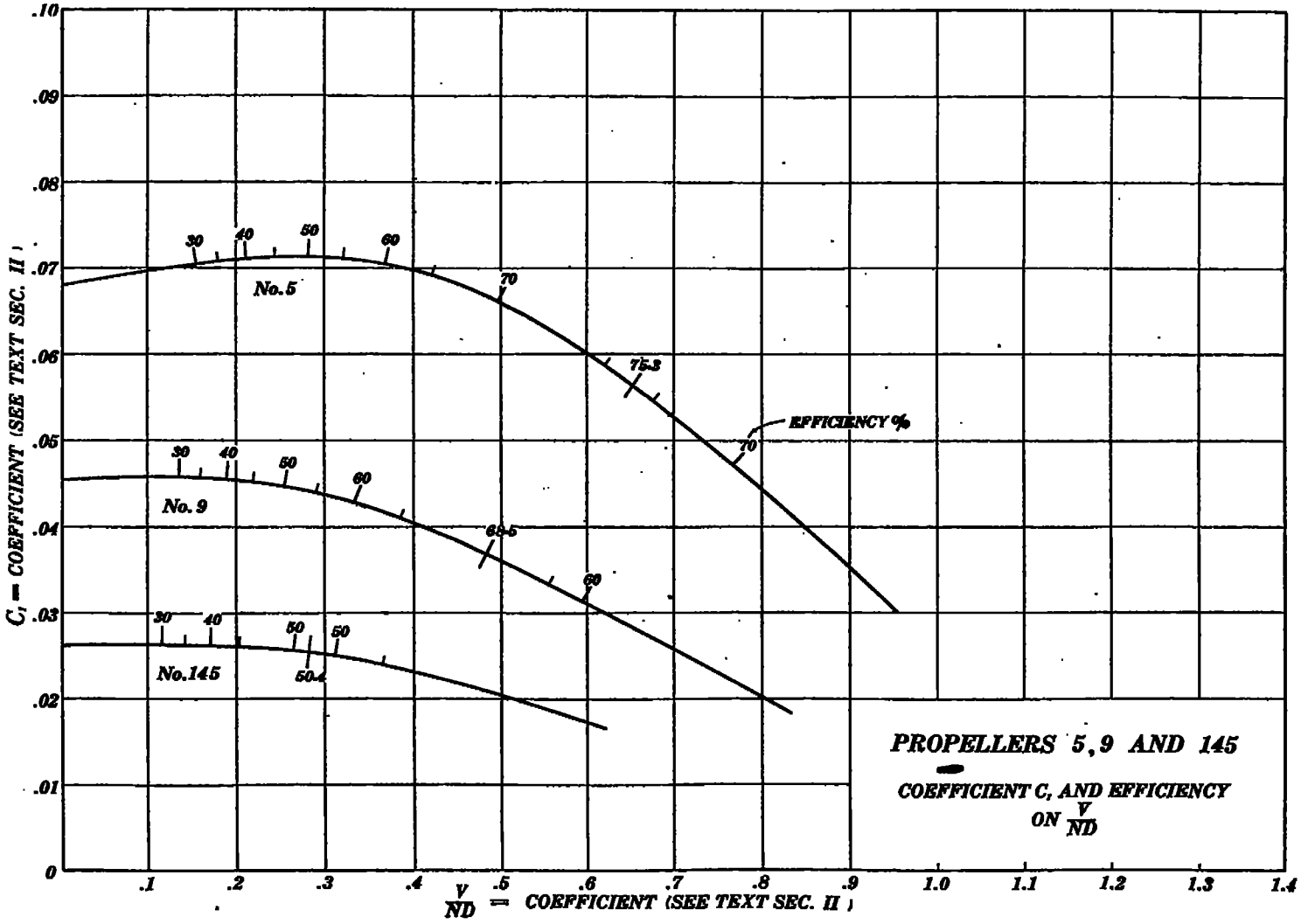

PROPELLERS 5, 9 AND 145
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 5
No. 9
No. 145
30
40
50
60
70
75.3
68.5
50.4
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 23.

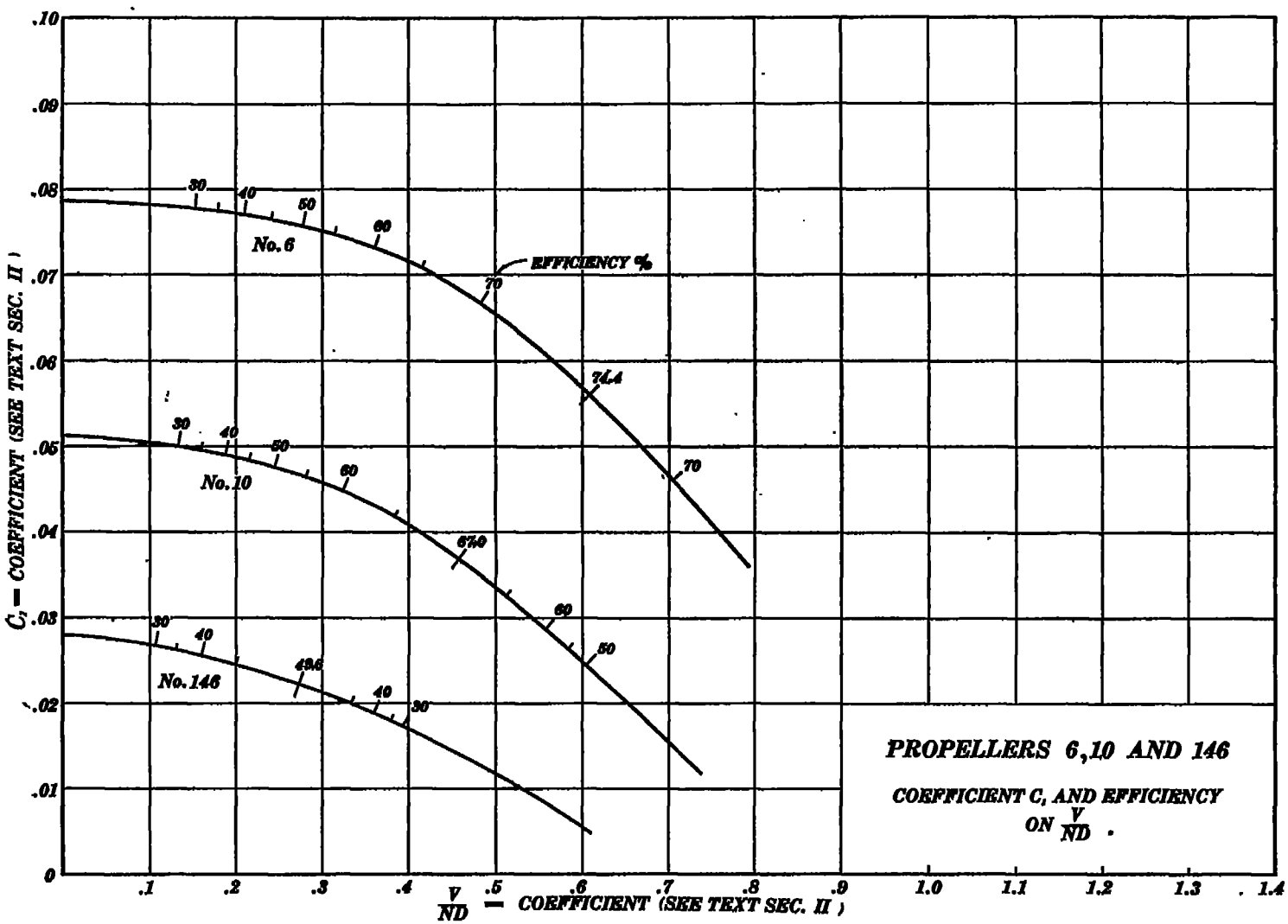

PROPELLERS 6,10 AND 146
COEFFICIENT C, AND EFFICIENCY ON V/ND .
EFFICIENCY %
No. 6
No. 10
No. 146
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
30
40
50
60
70
74.4
67.0
49.6

FIG. 24.

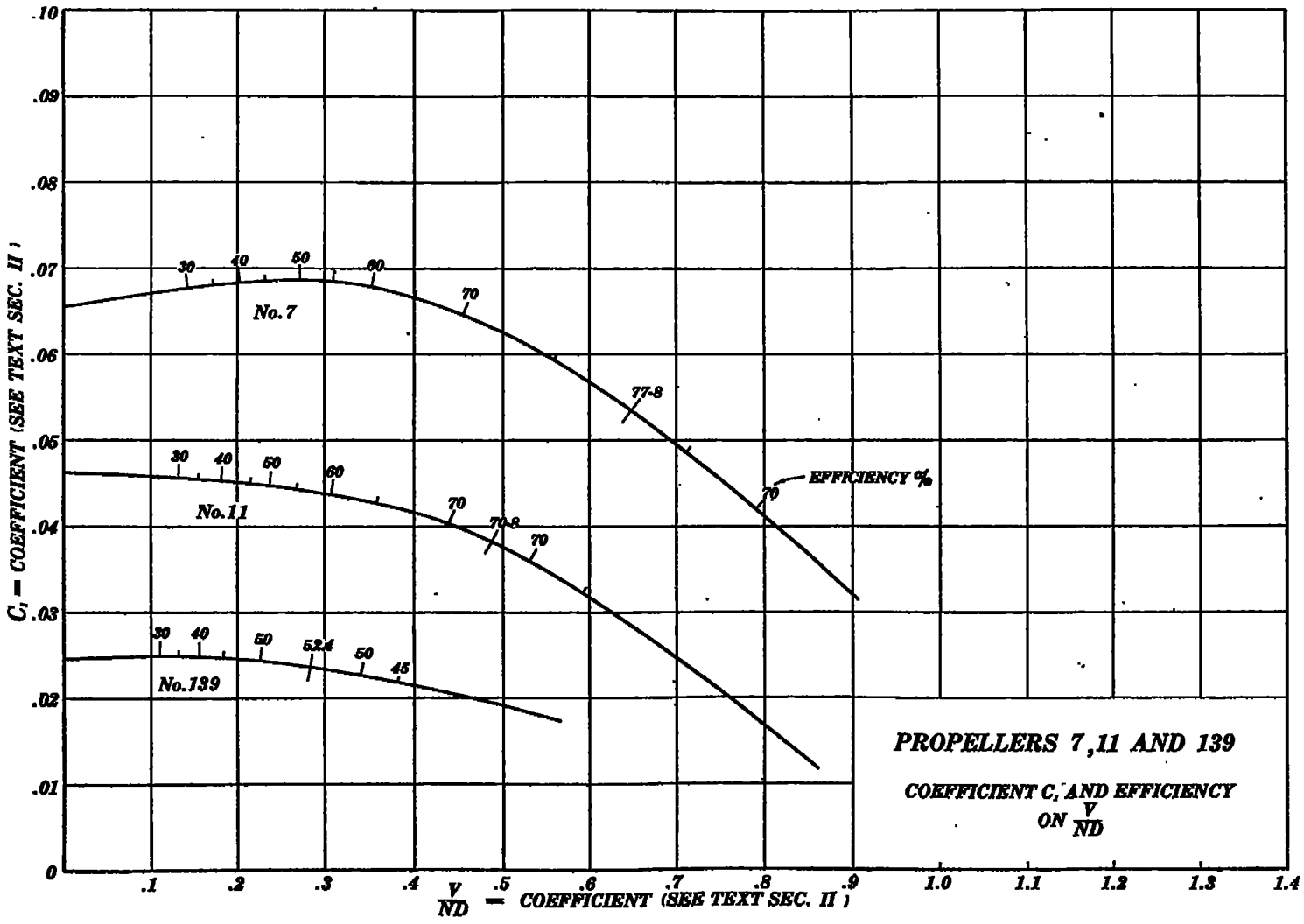

PROPELLERS 7, 11 AND 139
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)
No. 7
No. 11
No. 139
EFFICIENCY %
30
40
50
60
70
77.8
70.8
52.4
45
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 25.

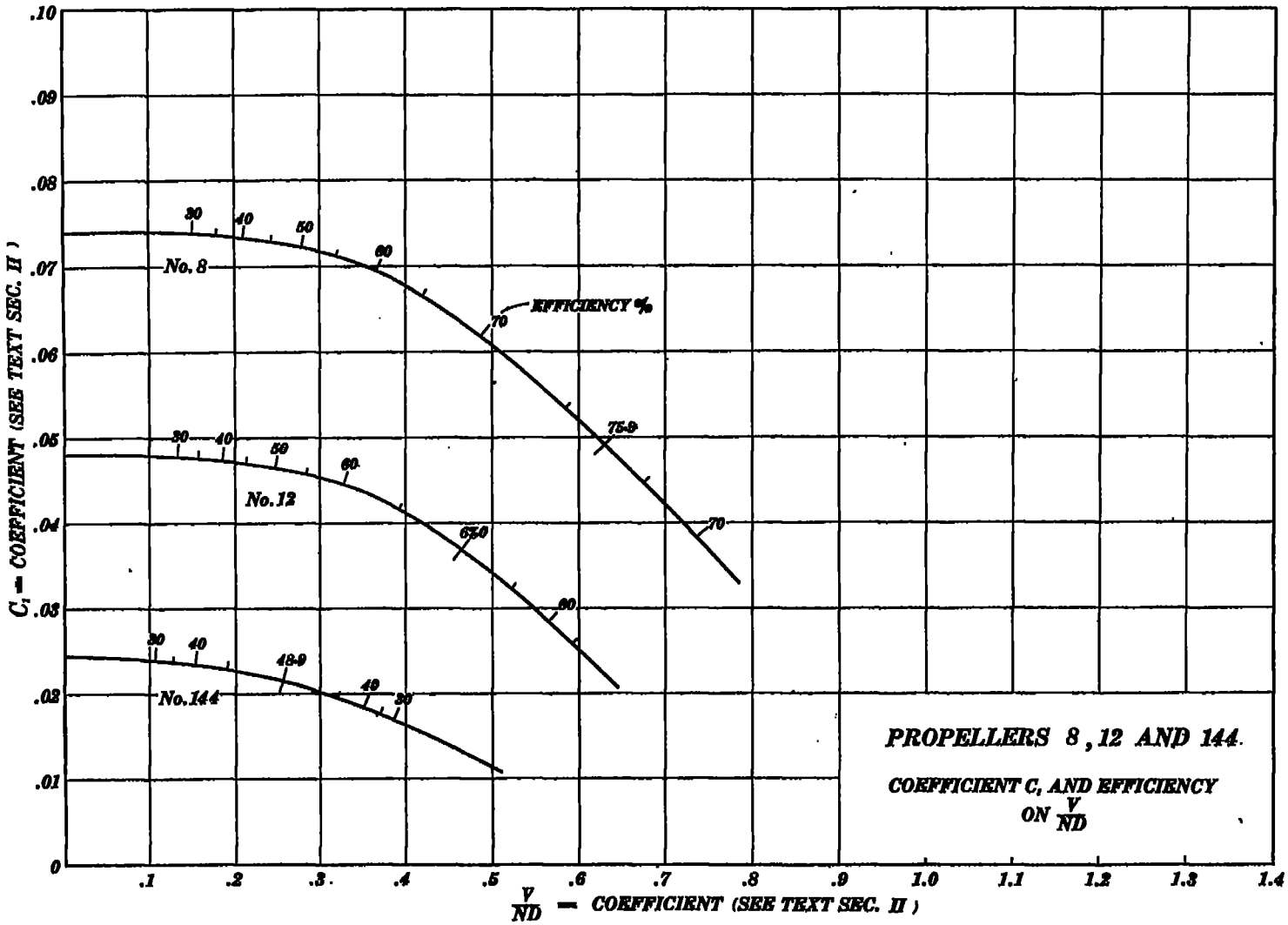

PROPELLERS 8, 12 AND 144.
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 8
No. 12
No. 144
30
40
50
60
70
75.9
67.0
48.9
80
C_1 = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 26.

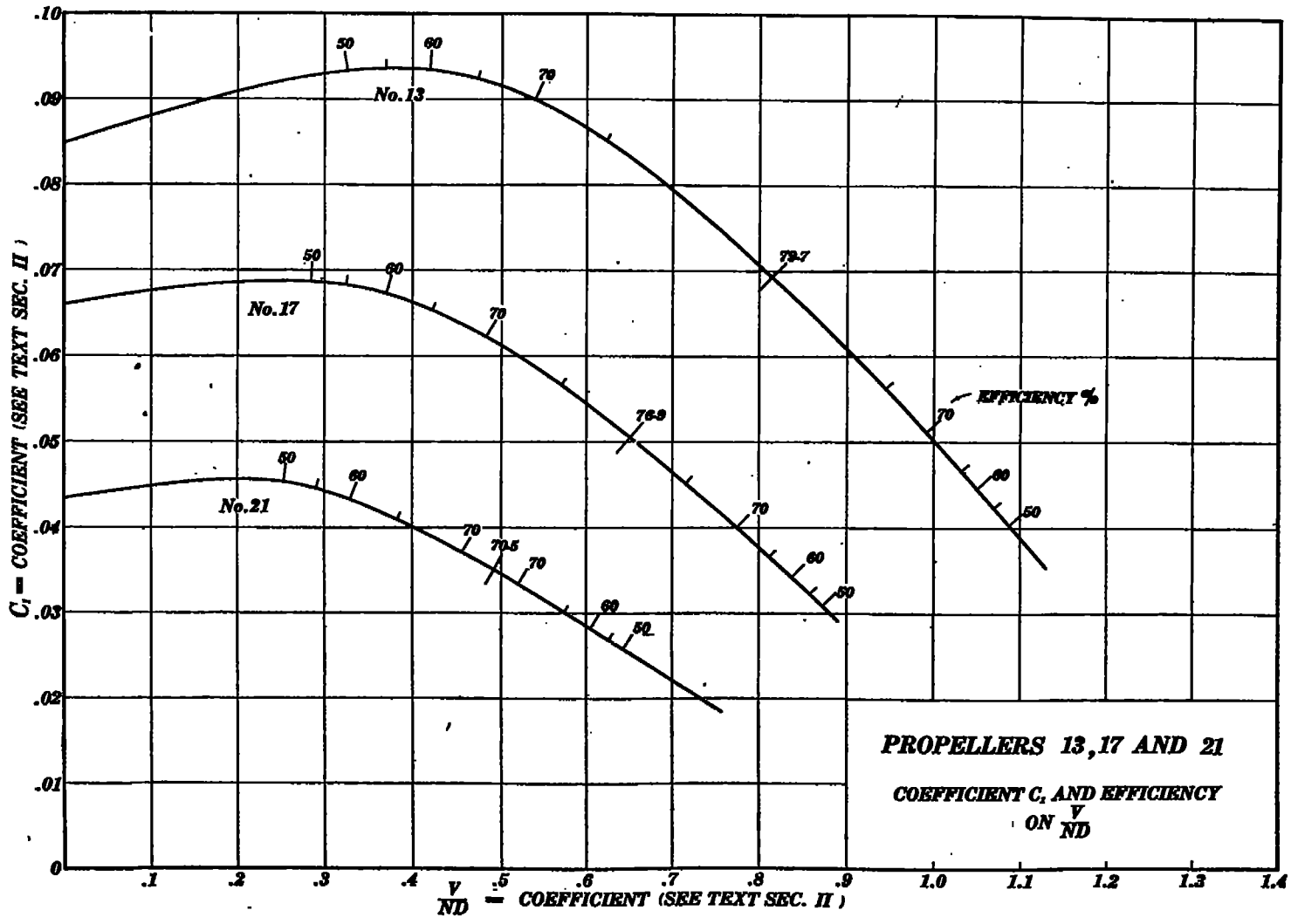

PROPELLERS 13, 17 AND 21
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
No. 13
No. 17
No. 21
EFFICIENCY %
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
50
60
70
79.7
76.9
70.5

FIG. 27.

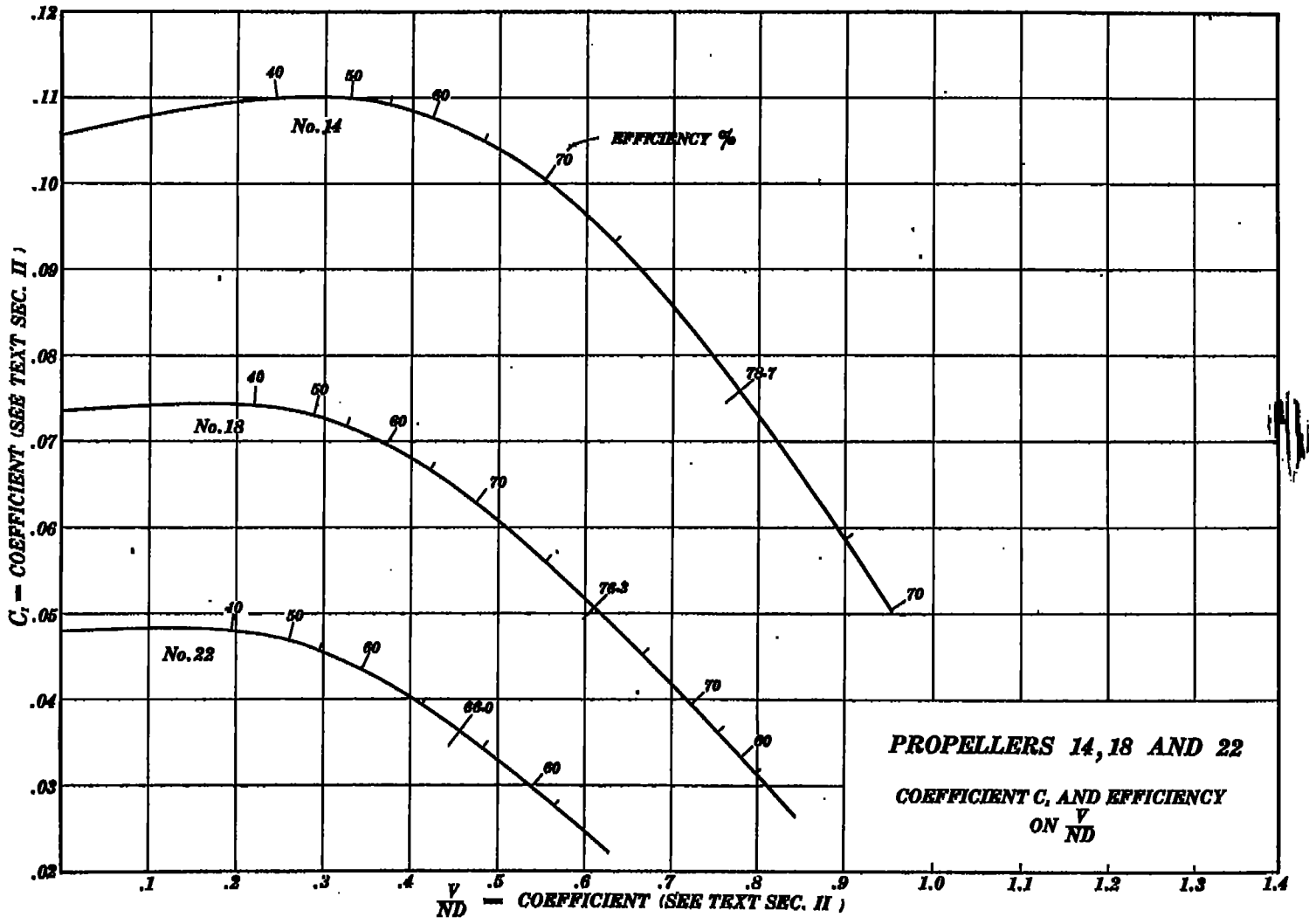

PROPELLERS 14, 18 AND 22
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 14
No. 18
No. 22
40
50
60
70
78.7
76.3
66.0
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.12
.11
.10
.09
.08
.07
.06
.05
.04
.03
.02
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 28.

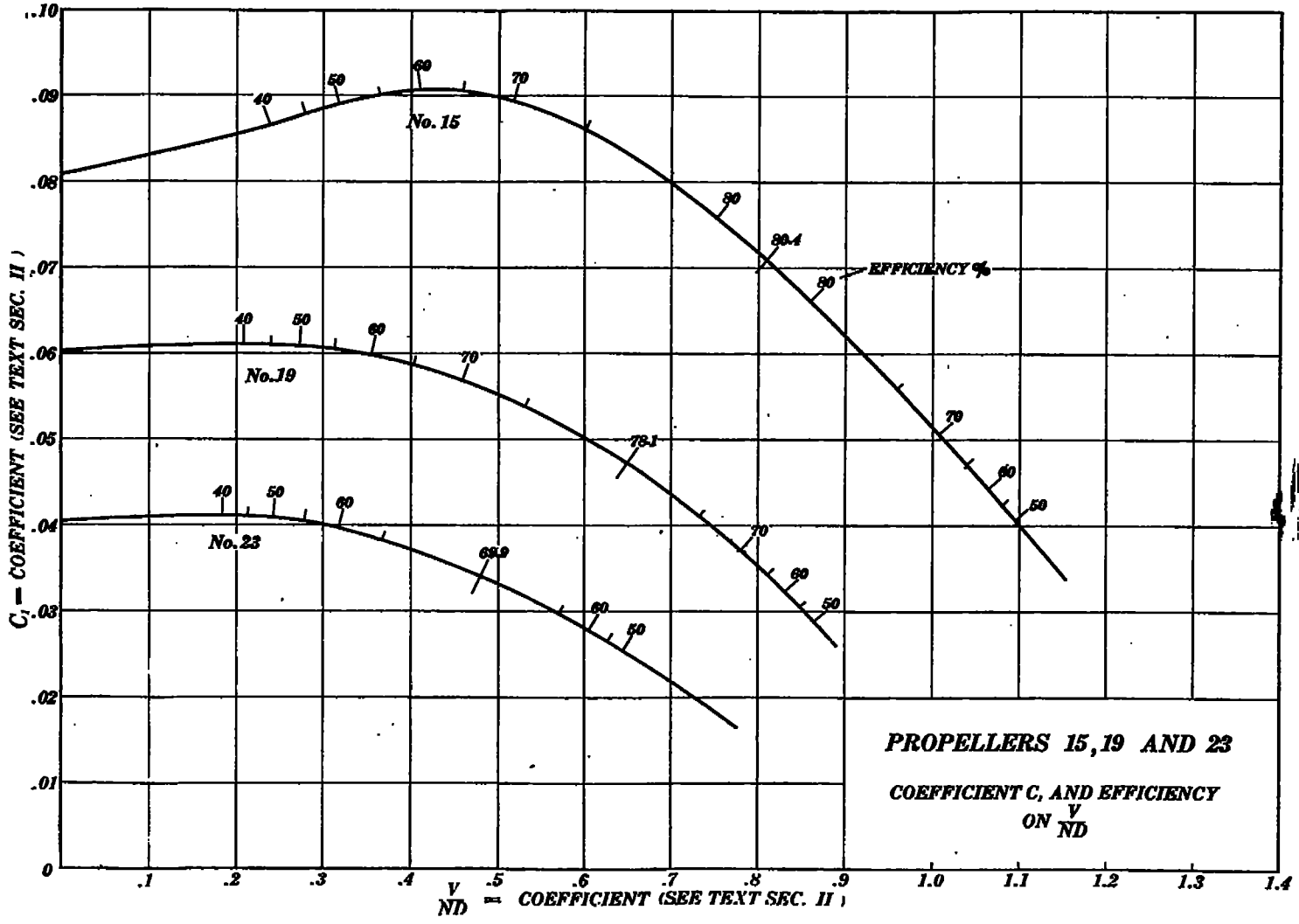

PROPELLERS 15, 19 AND 23
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 15
No. 19
No. 23
80.4
78.1
69.9
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 29.

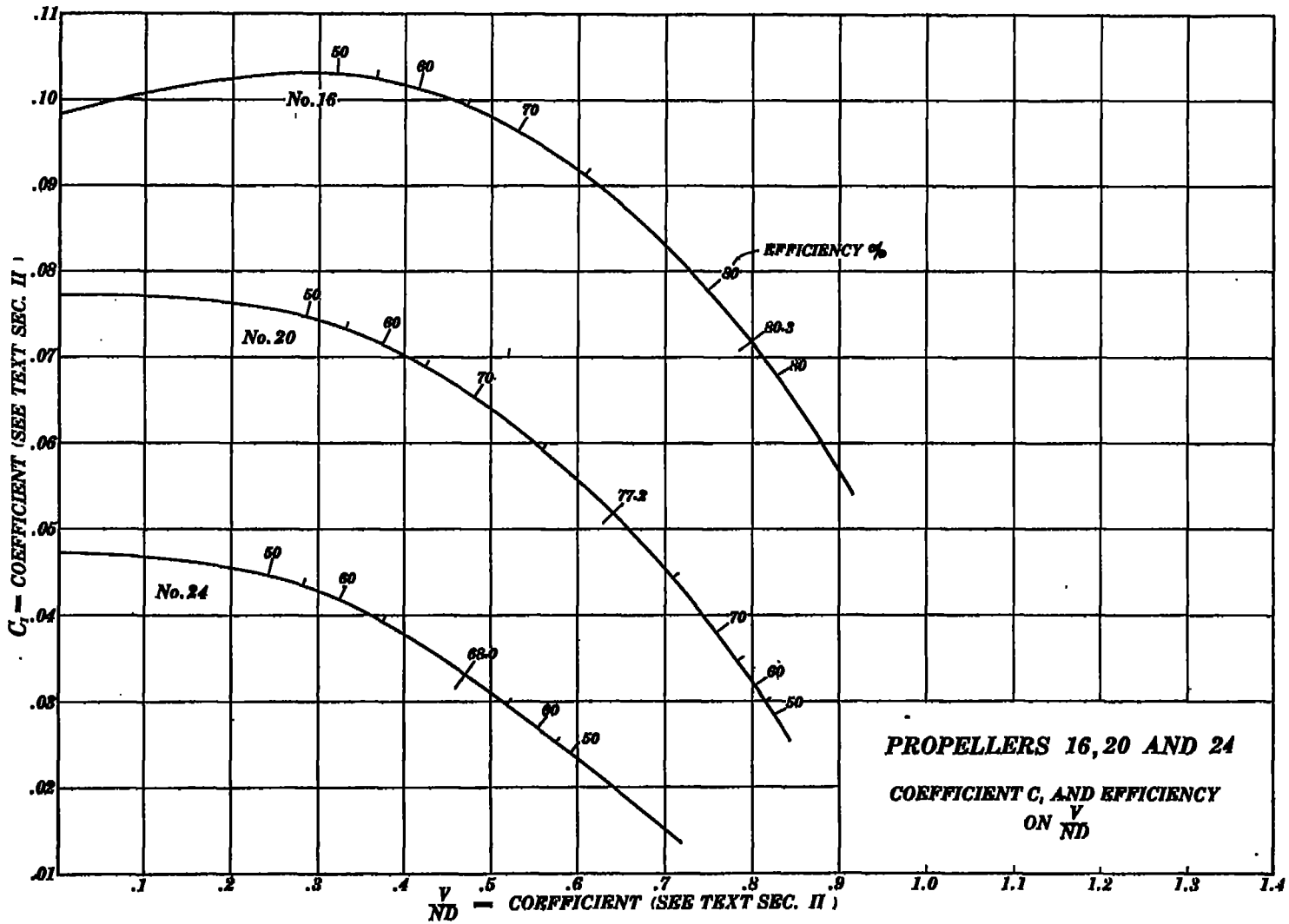

PROPELLERS 16, 20 AND 24
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 16
No. 20
No. 24
80.3
77.2
68.0
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

Fig. 30.

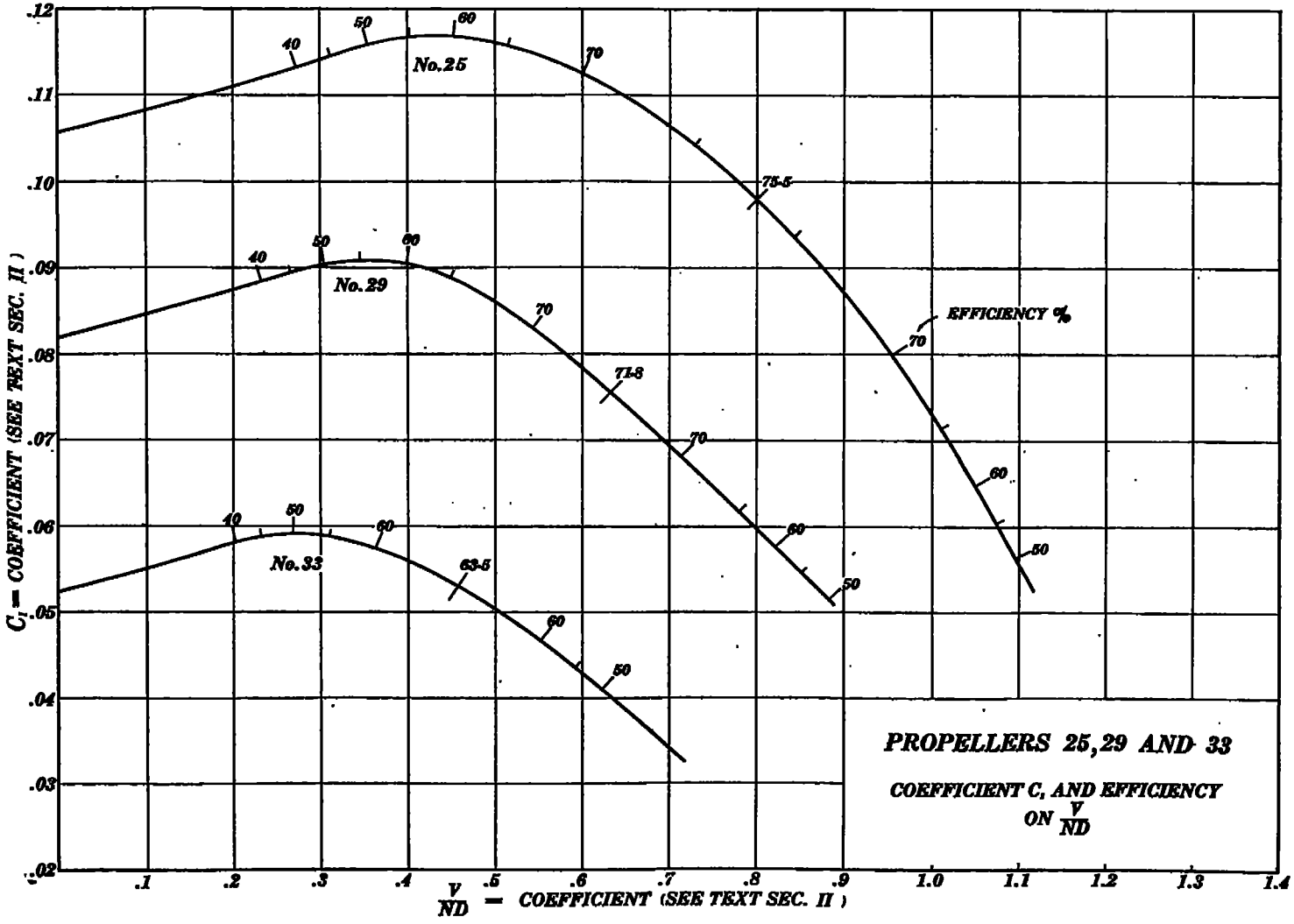

PROPELLERS 25,29 AND 33
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No.25
No.29
No.33
75.5
71.8
63.5
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 31.

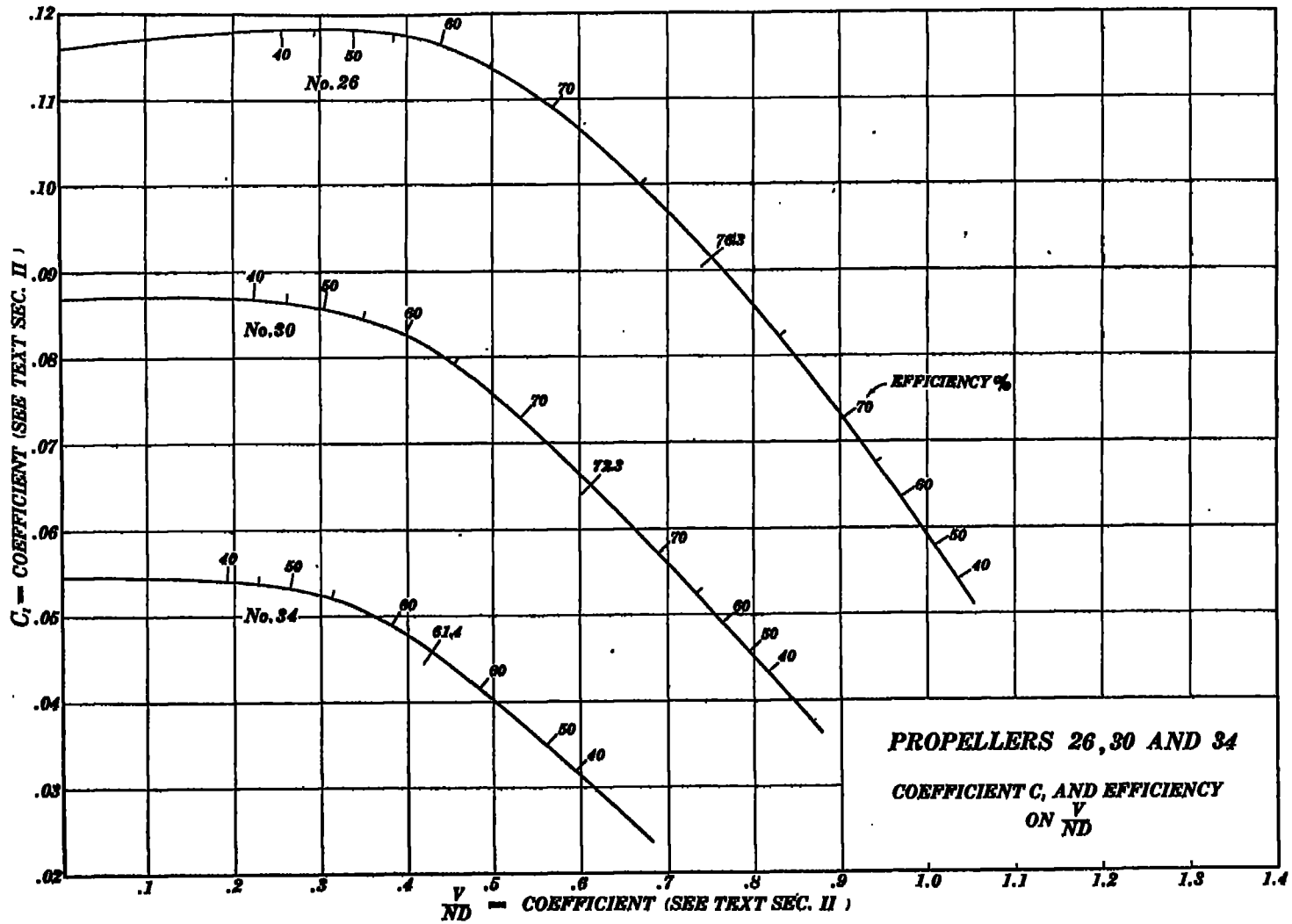

PROPELLERS 26, 30 AND 34
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 26
No. 30
No. 34
76.3
72.3
61.4
C = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 32.

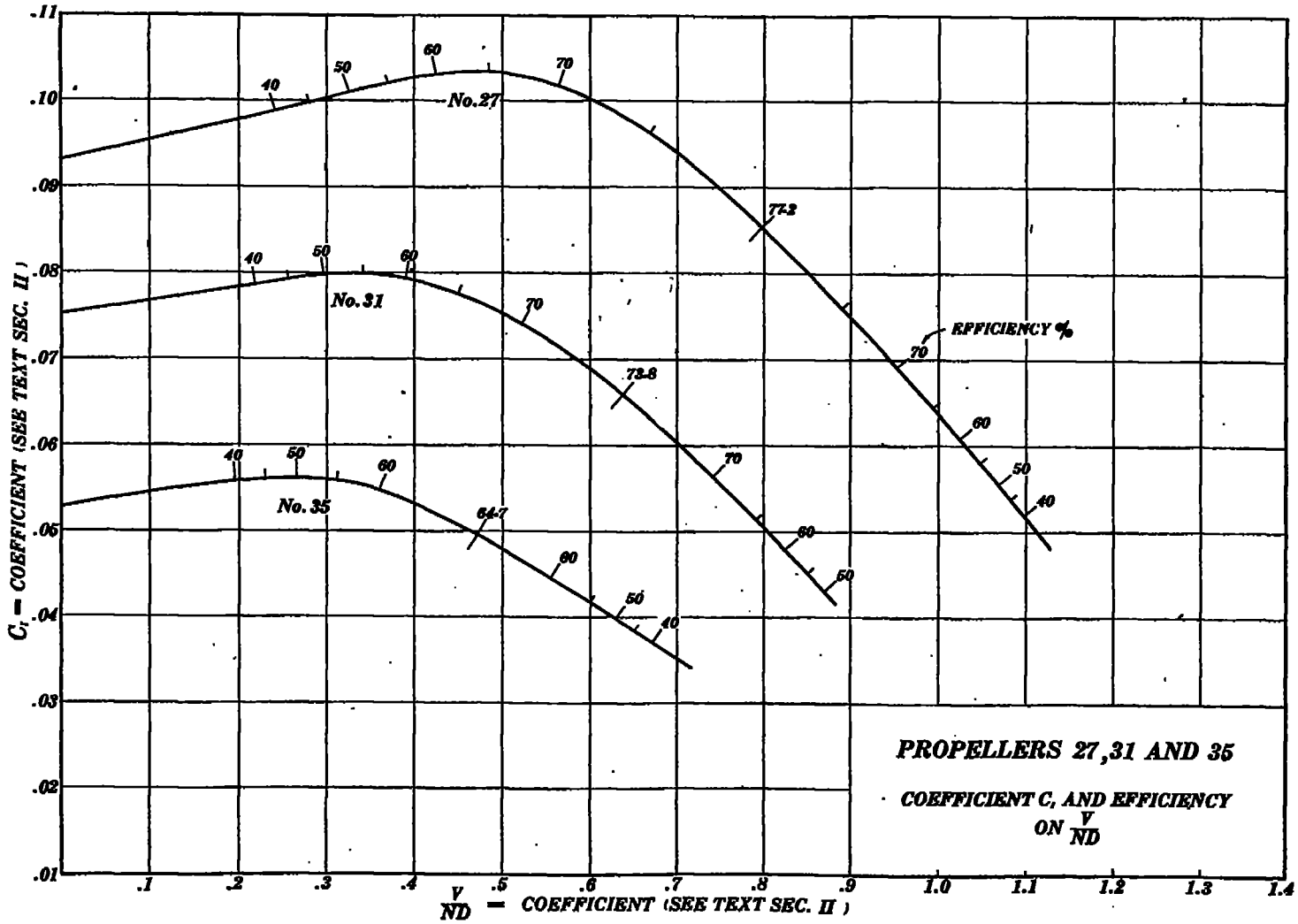

PROPELLERS 27,31 AND 35
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 27
No. 31
No. 35
EFFICIENCY %
77.2
72.8
64.7
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 33.

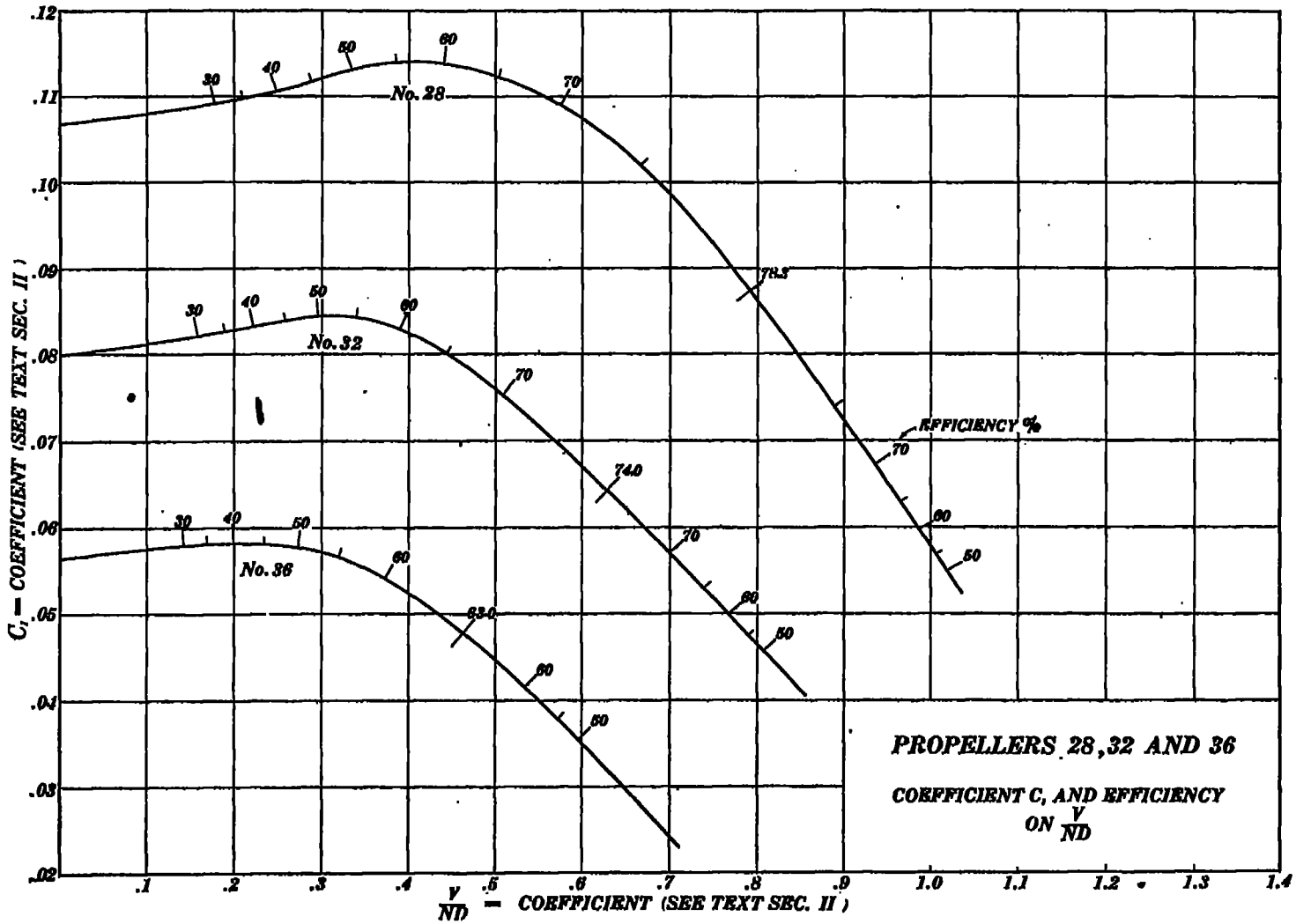

PROPELLERS 28, 32 AND 36
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 28
No. 32
No. 36
EFFICIENCY %
78.5
74.0
63.0
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 34.

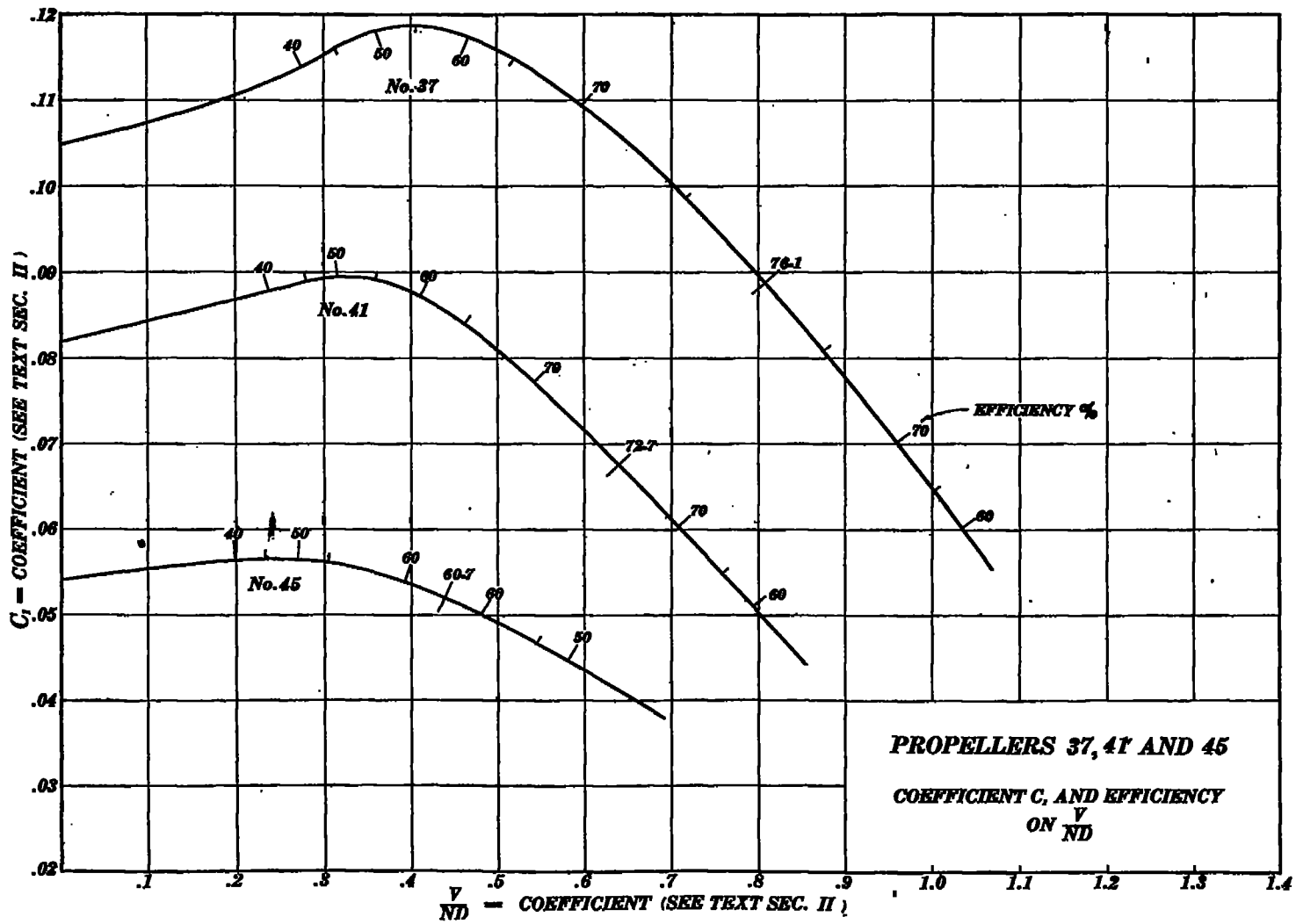

PROPELLERS 37, 41 AND 45
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
No. 37
No. 41
No. 45
EFFICIENCY %
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)

FIG. 35.

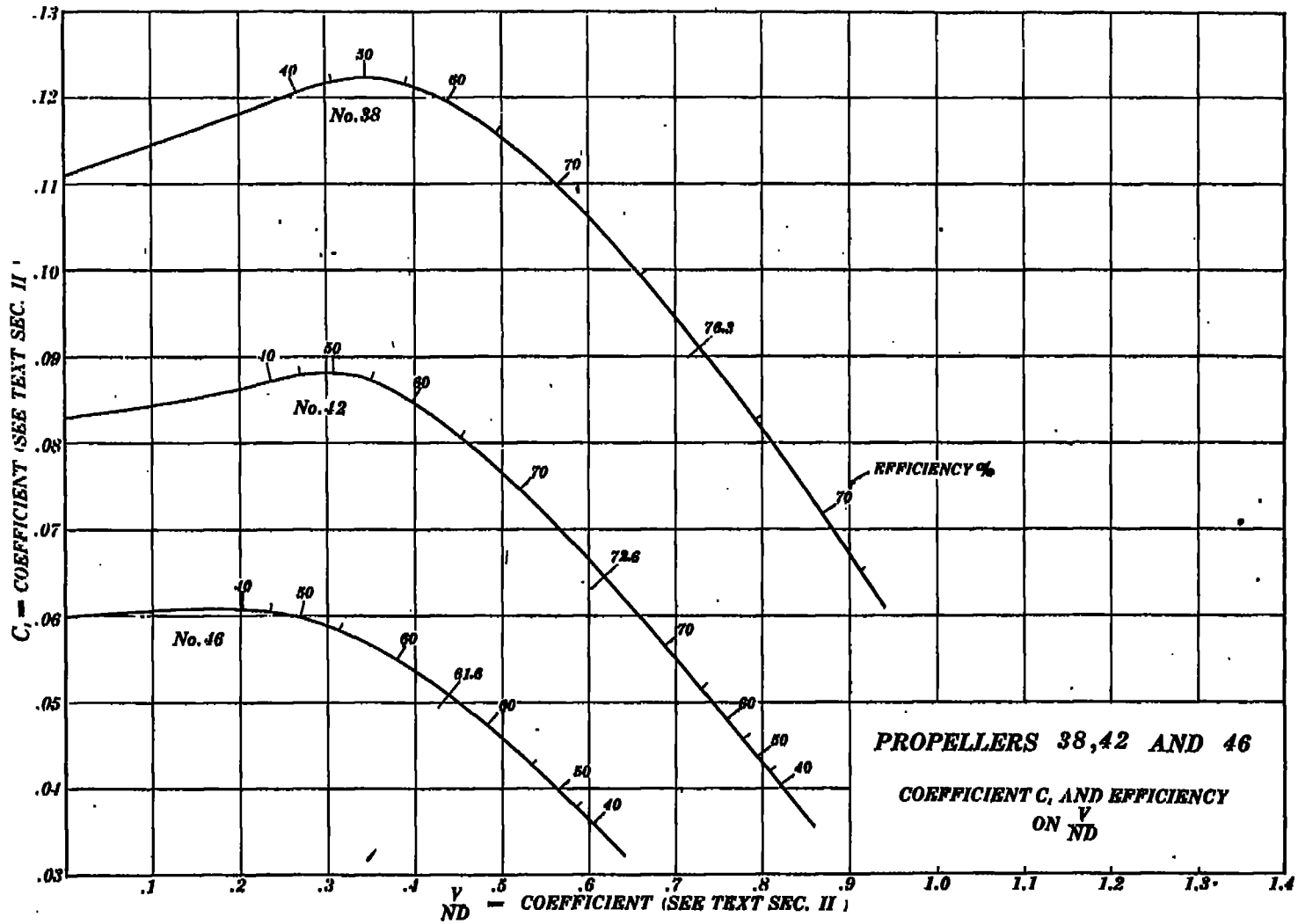

PROPELLERS 38,42 AND 46
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 38
No. 42
No. 46
76.3
72.6
61.6
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 38.

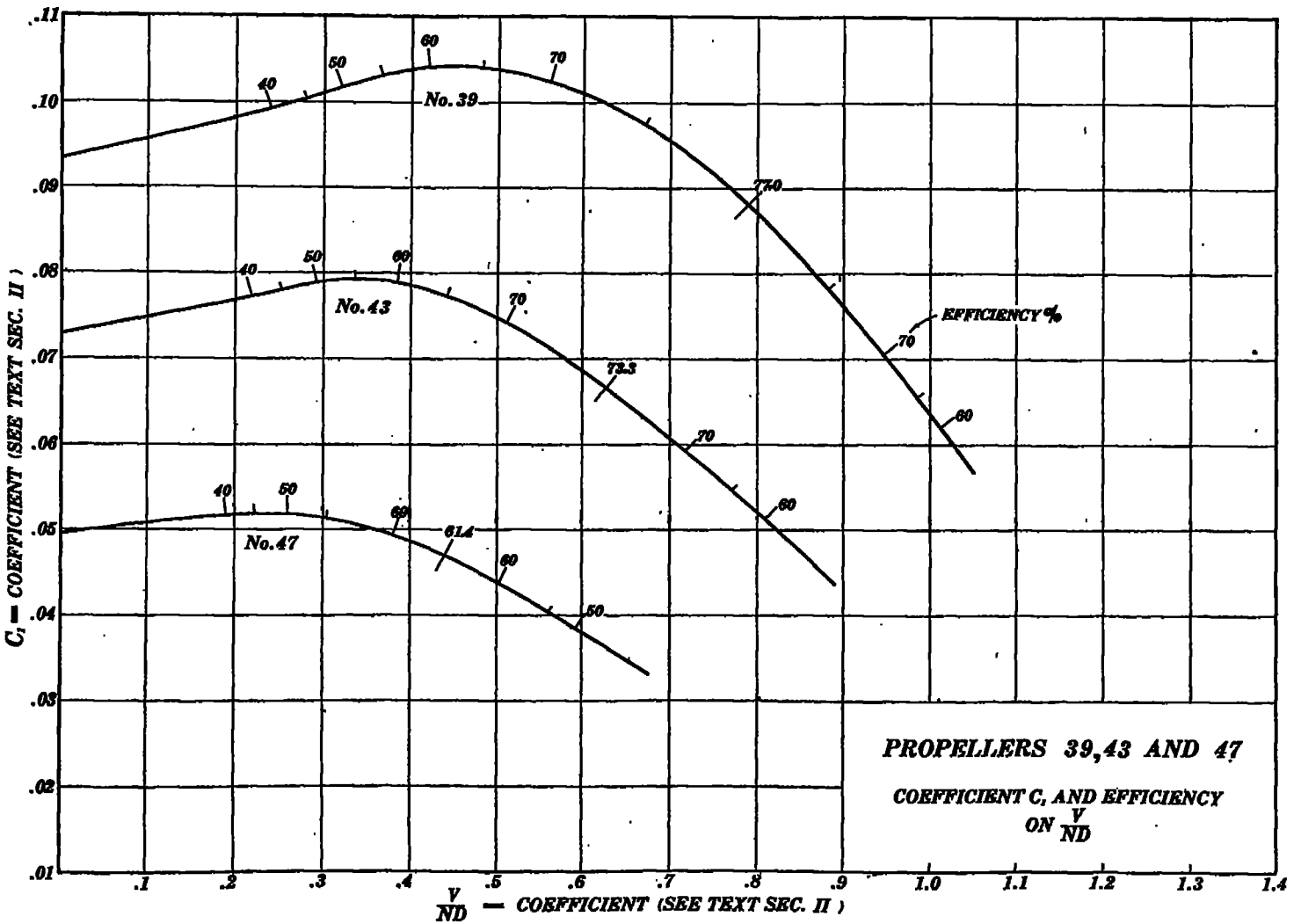

PROPELLERS 39, 43 AND 47
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 39
No. 43
No. 47
EFFICIENCY %
77.0
72.3
61.4
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 37.

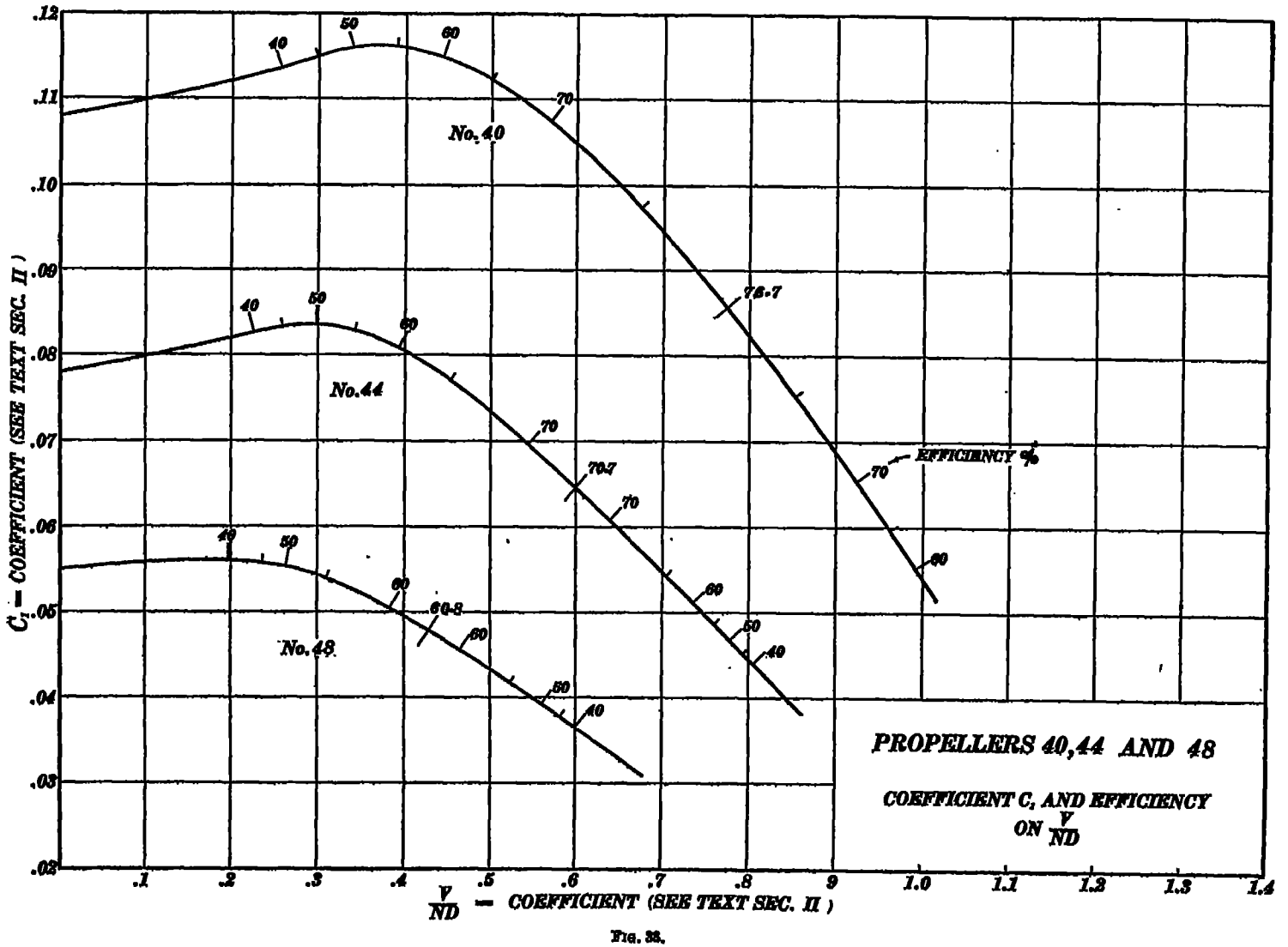

PROPELLERS 40,44 AND 48
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 40
No. 44
No. 48
EFFICIENCY %
C_1 = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 33.

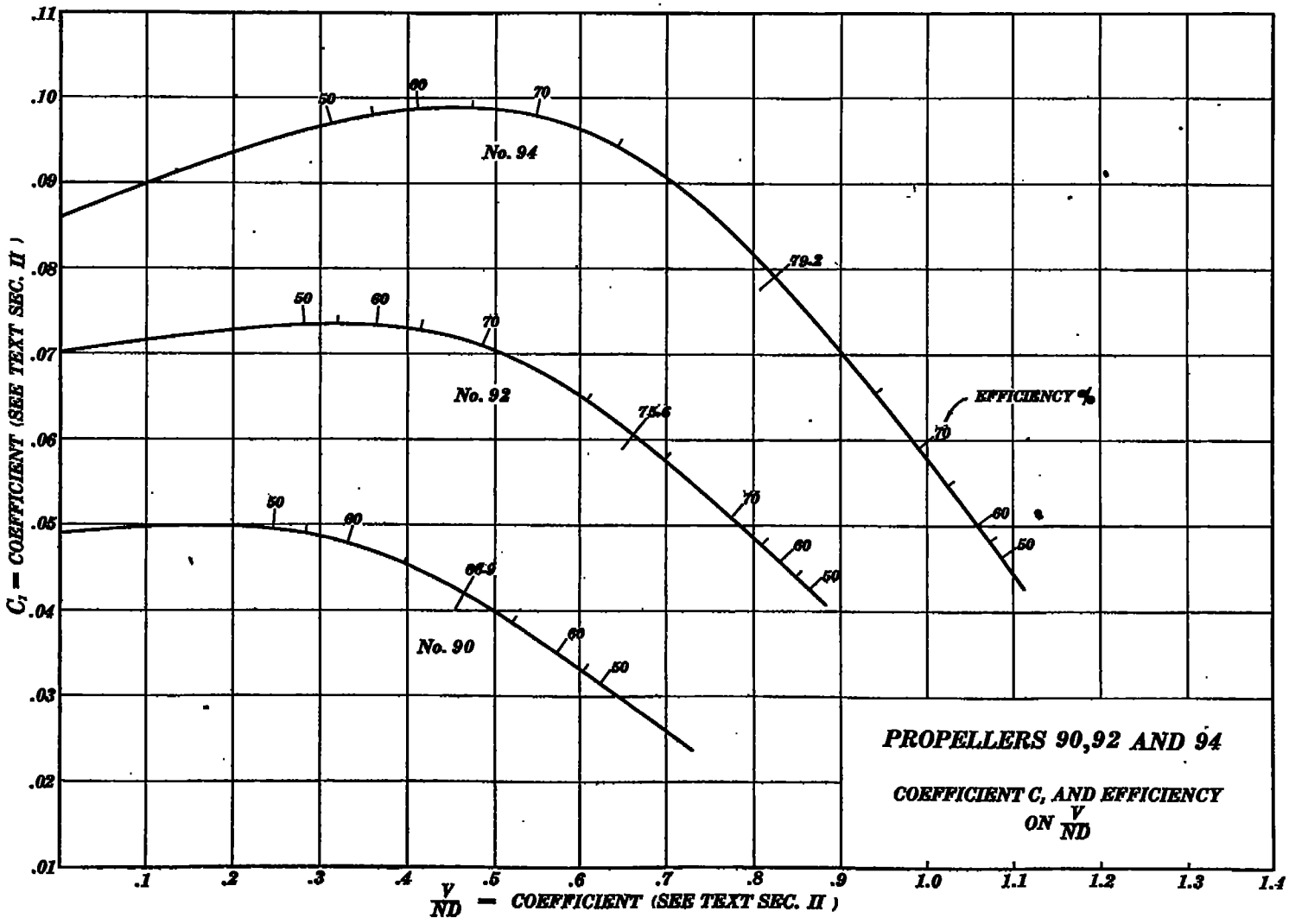

PROPELLERS 90,92 AND 94
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 94
No. 92
No. 90
EFFICIENCY %
79.2
75.6
66.9
50
60
70
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.01
.02
.03
.04
.05
.06
.07
.08
.09
.10
.11
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 30.

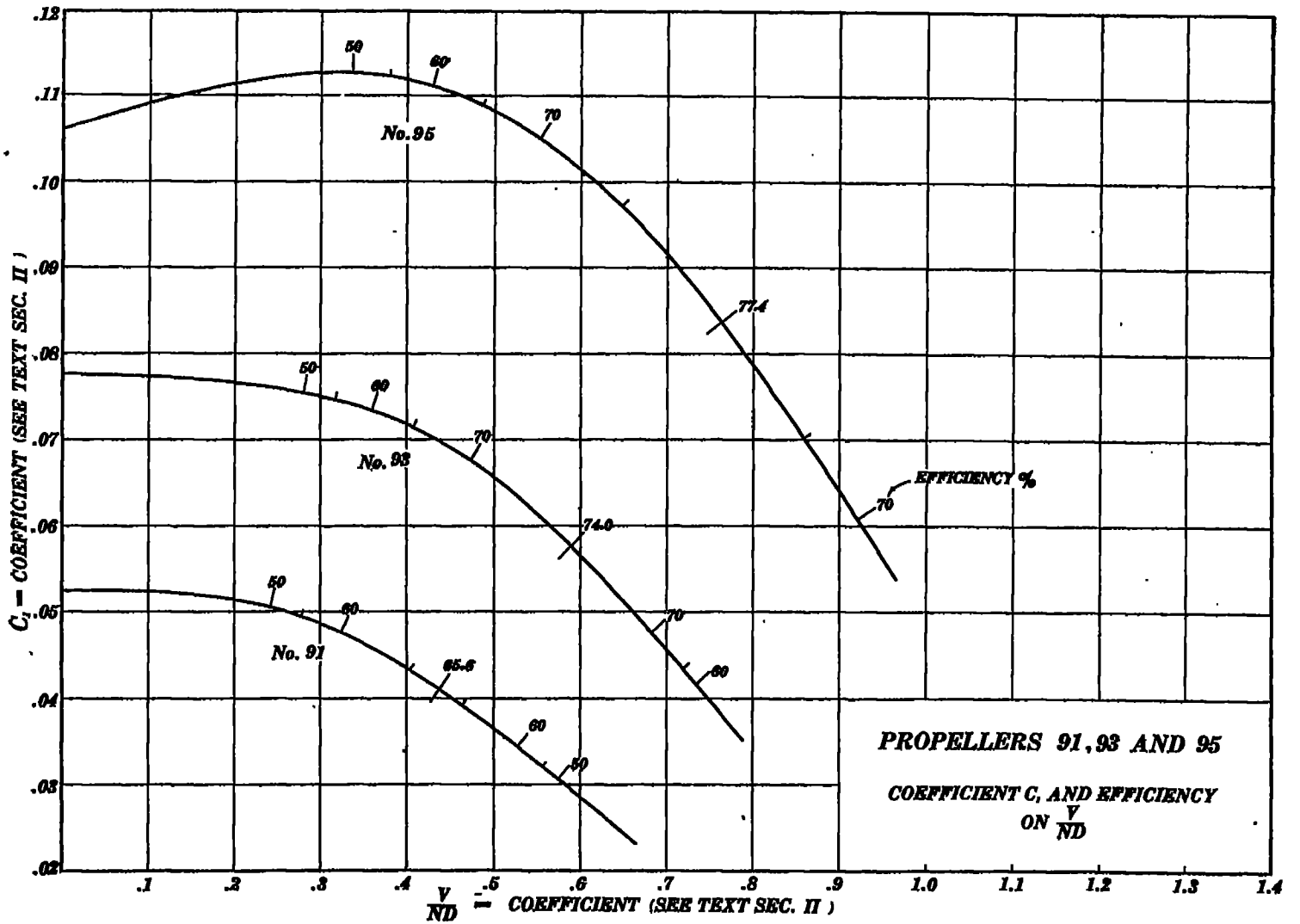

PROPELLERS 91, 93 AND 95
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 95
No. 93
No. 91
EFFICIENCY %
77.4
74.0
65.6
50
60
70
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 40.

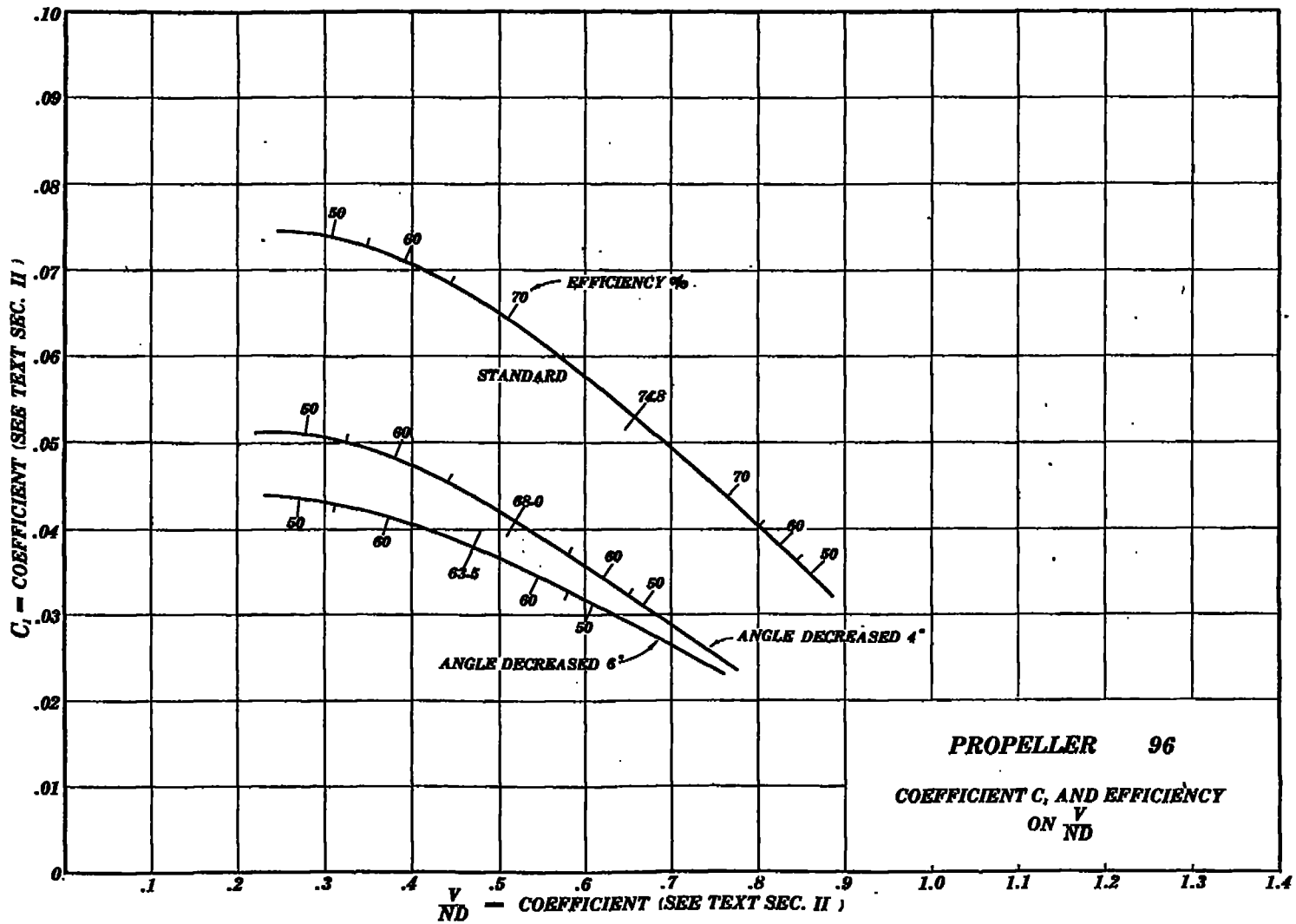

PROPELLER 96
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
STANDARD
ANGLE DECREASED 4°
ANGLE DECREASED 6°
74.8
68.0
63.5
50
60
70
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 41.

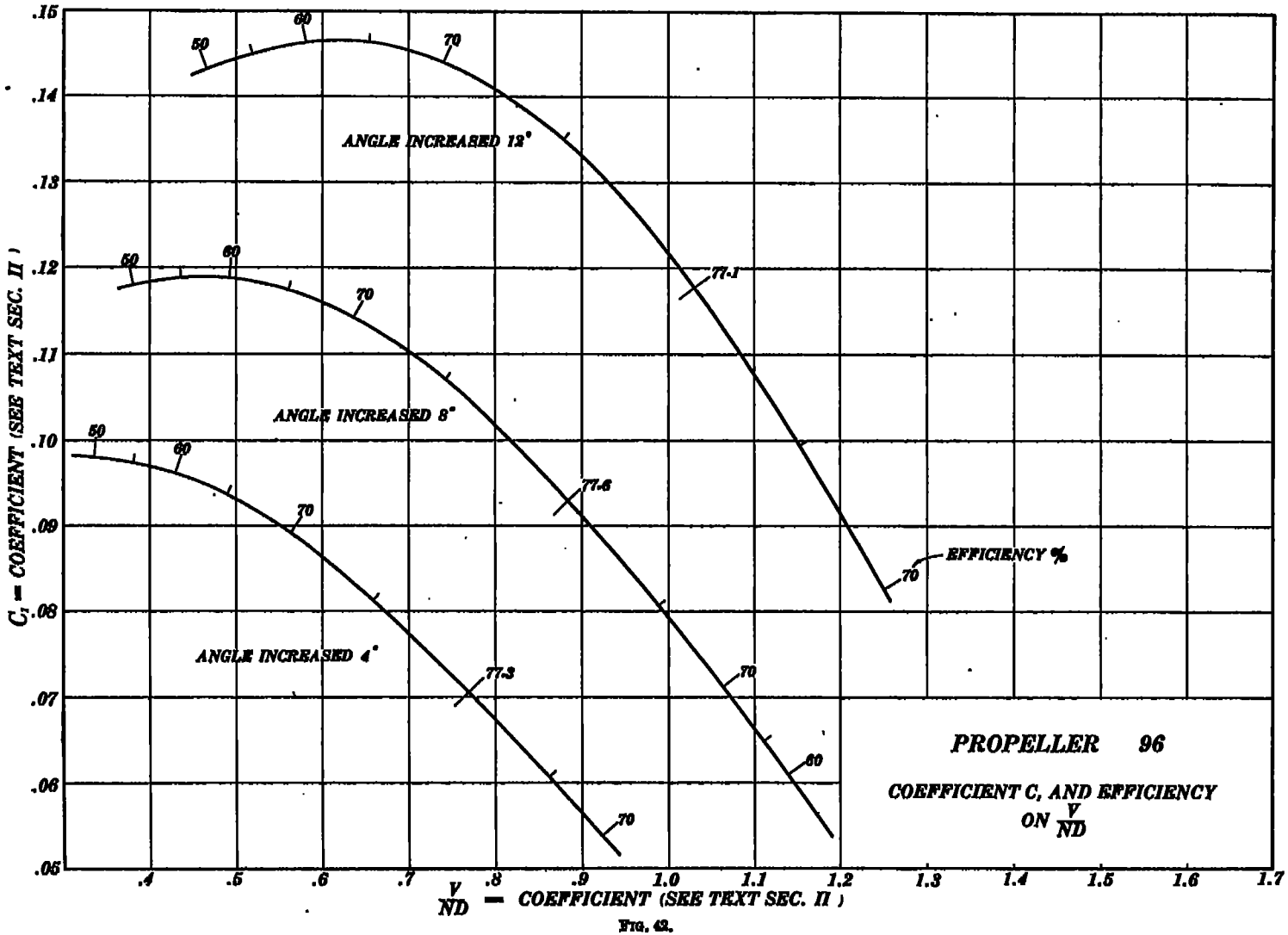

ANGLE INCREASED 12°
ANGLE INCREASED 8°
ANGLE INCREASED 4°
EFFICIENCY %
PROPELLER 96
COEFFICIENT C, AND EFFICIENCY ON V/ND
C_1 = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 42.

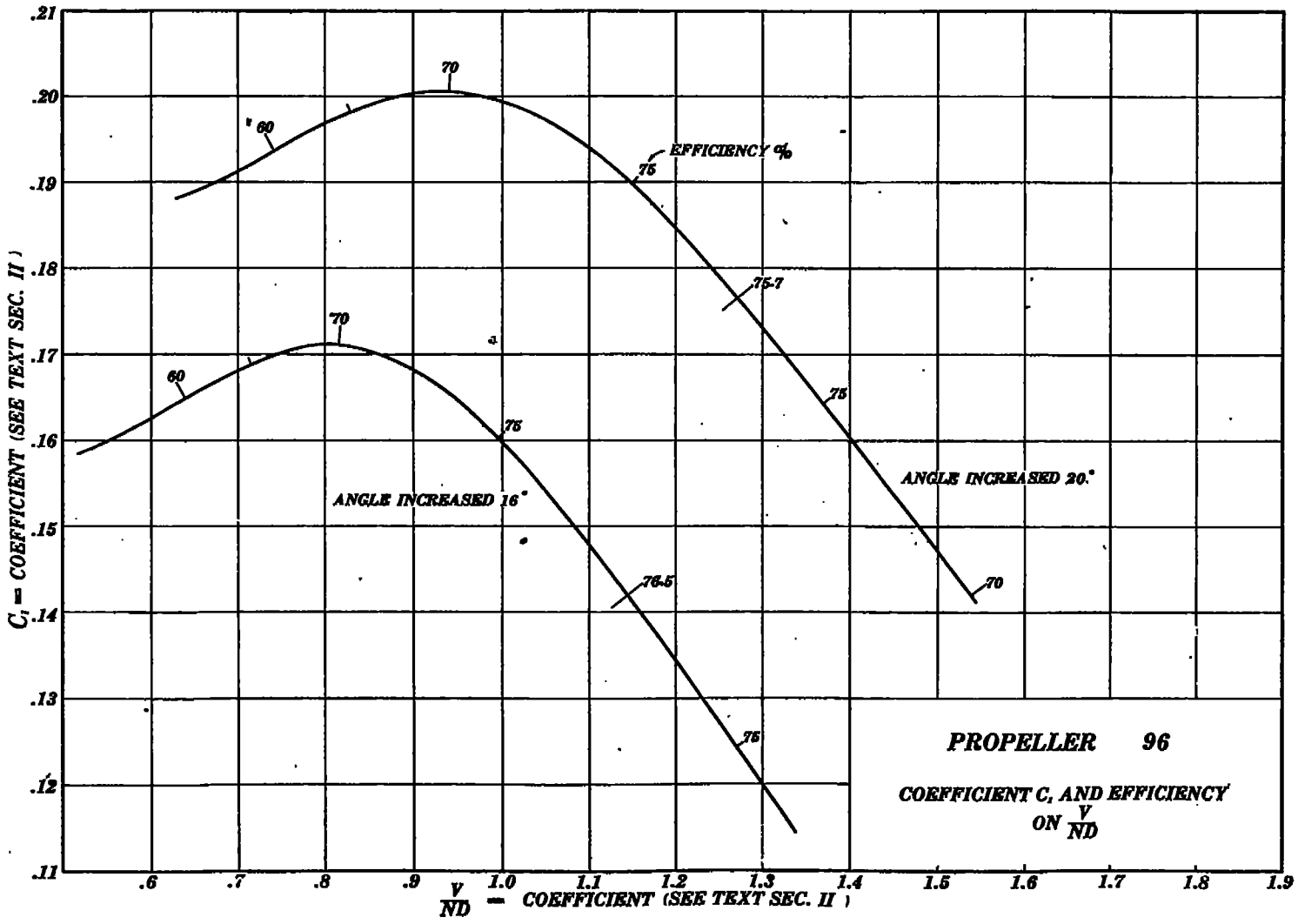

.21
.20
.19
.18
.17
.16
.15
.14
.13
.12
.11
C_T = COEFFICIENT (SEE TEXT SEC. II)
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)
EFFICIENCY %
60
70
75
75.7
75
70
60
70
75
76.5
75
ANGLE INCREASED 16°
ANGLE INCREASED 20°
PROPELLER 96
COEFFICIENT C, AND EFFICIENCY ON $\frac{V}{ND}$

FIG. 43.

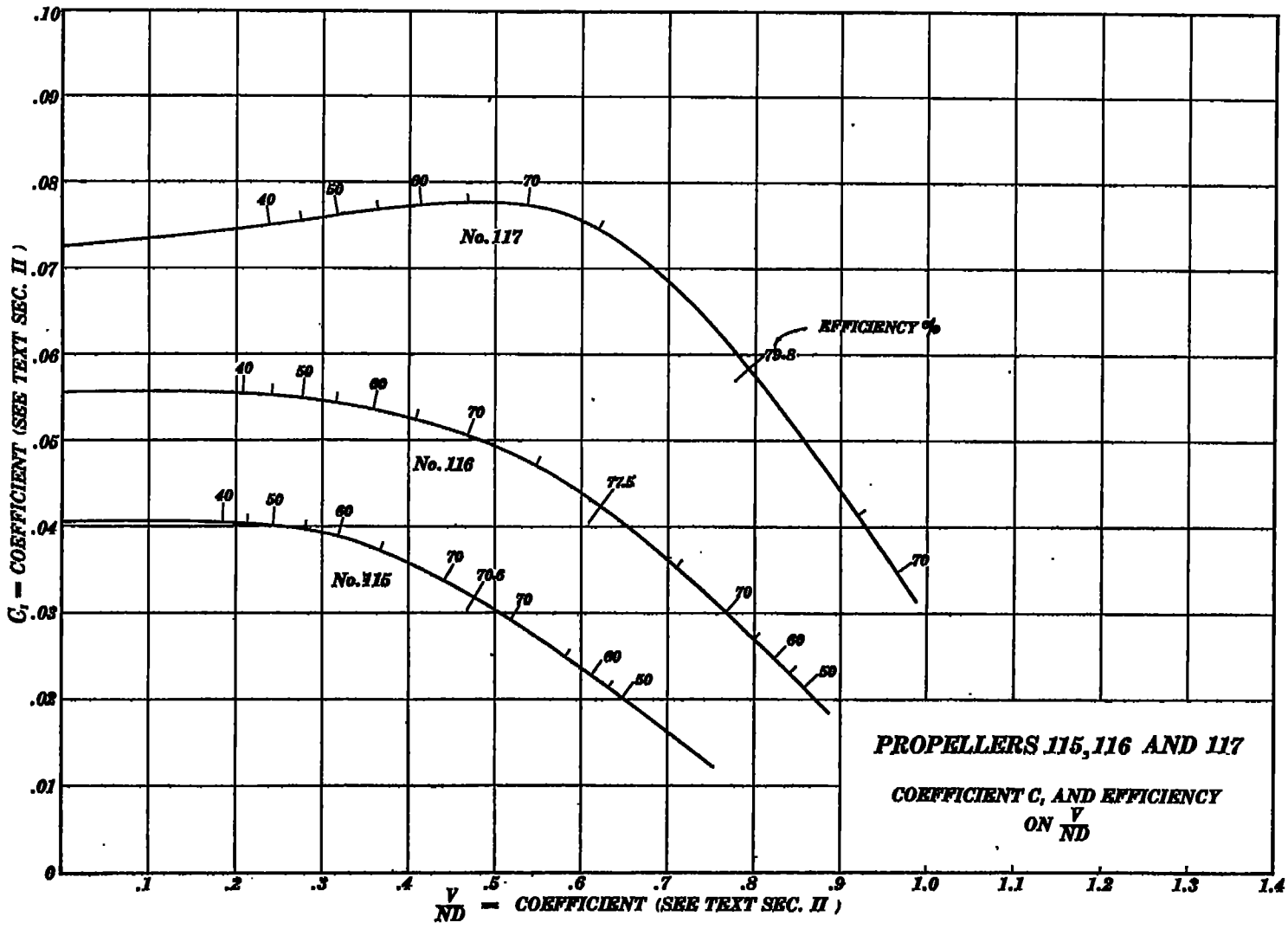

PROPELLERS 115, 116 AND 117
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 117
No. 116
No. 115
EFFICIENCY %
79.8
77.5
70.6
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 44.

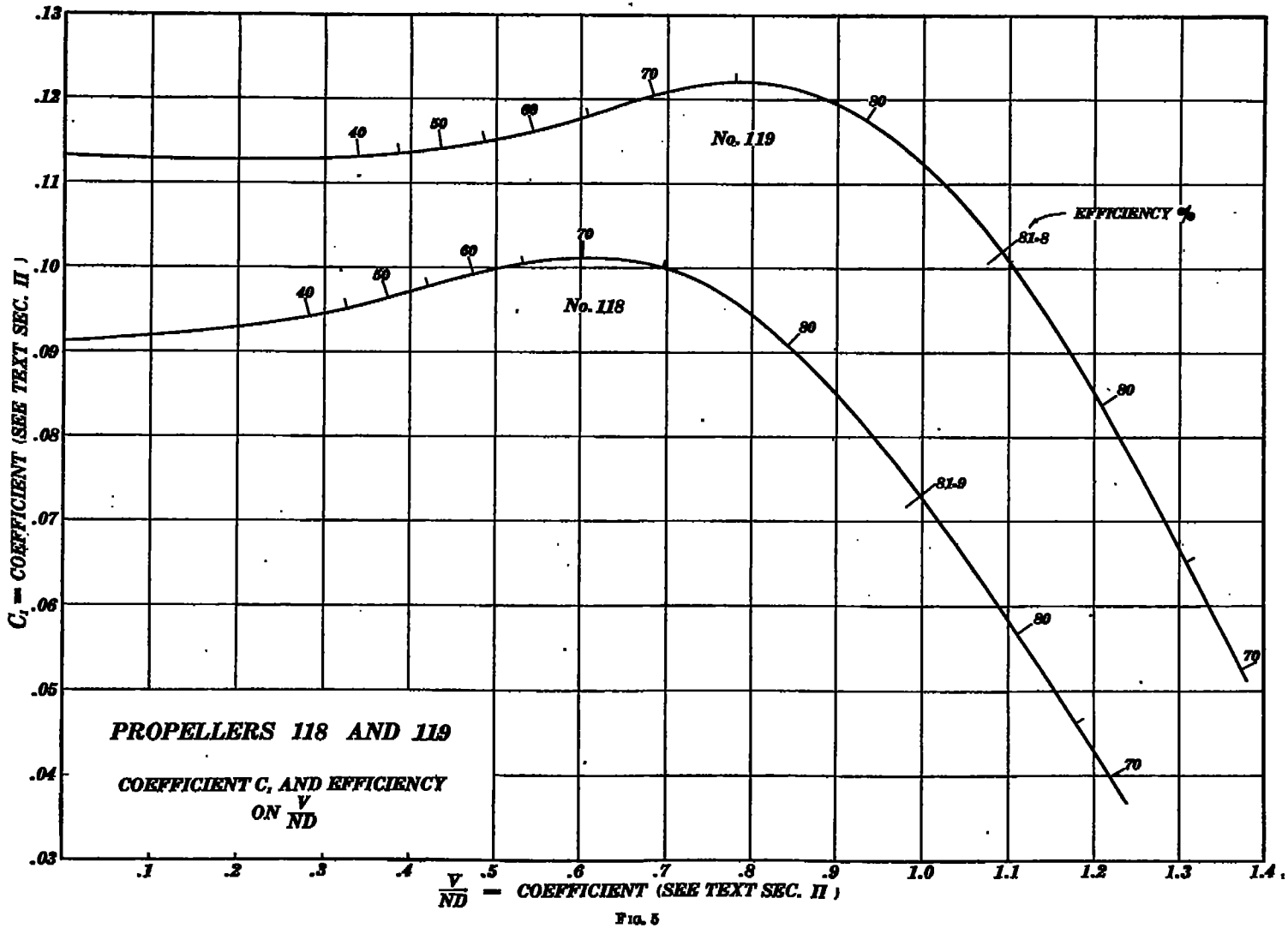

PROPELLERS 118 AND 119
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 119
No. 118
EFFICIENCY %
81.8
81.9
40
50
60
70
80
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.13
.12
.11
.10
.09
.08
.07
.06
.05
.04
.03
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 5

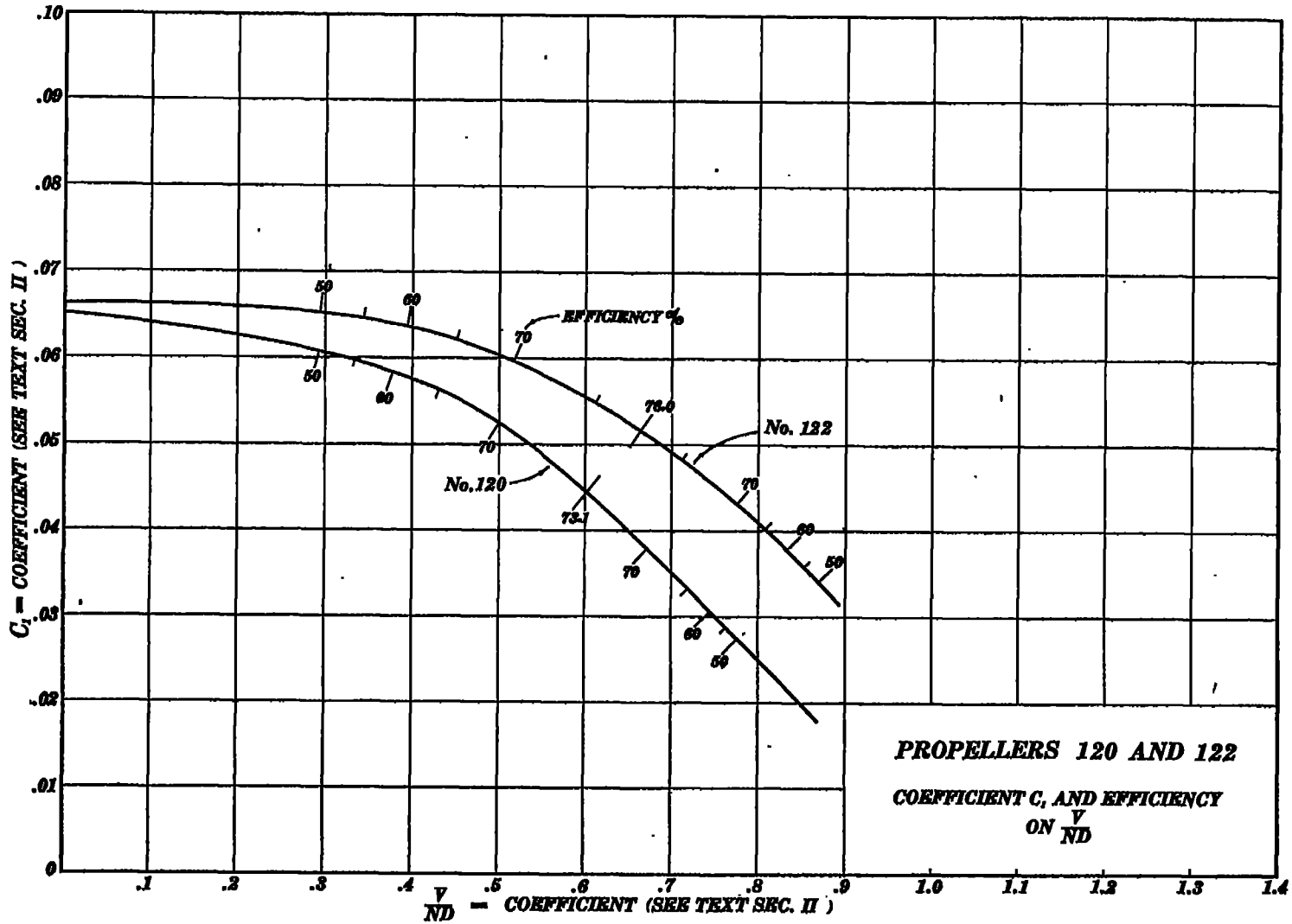

PROPELLERS 120 AND 122
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
EFFICIENCY %
No. 122
No. 120
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
50
60
70
76.0
73.1
80

FIG. 46.

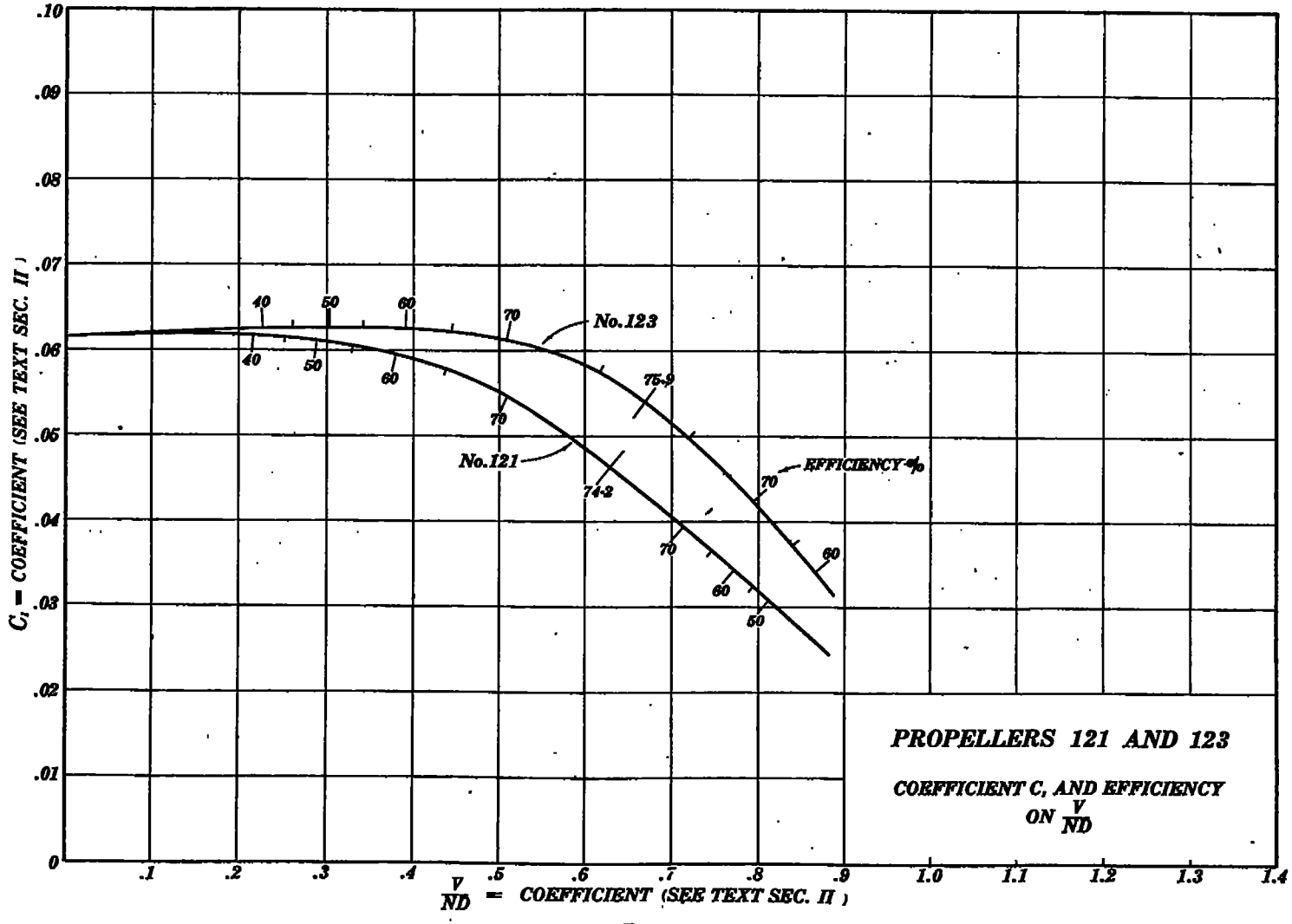

PROPELLERS 121 AND 123
COEFFICIENT C, AND EFFICIENCY ON V/ND
No.123
No.121
EFFICIENCY %
75.9
74.2
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 47

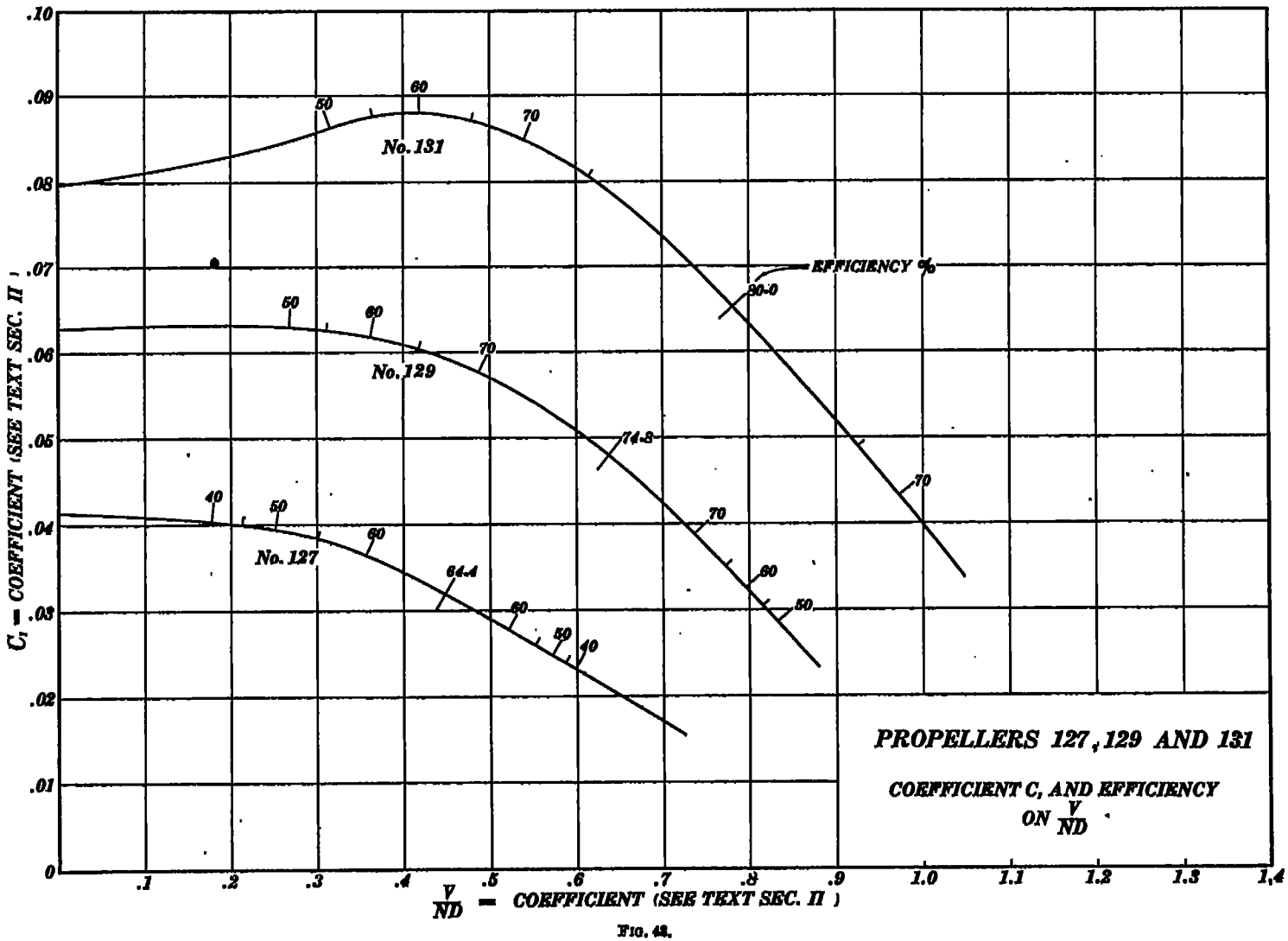

PROPELLERS 127, 129 AND 131
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No. 131
No. 129
No. 127
C_t = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.10
.09
.08
.07
.06
.05
.04
.03
.02
.01
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
60
50
70
30.0
74.8
64.4
40

FIG. 48.

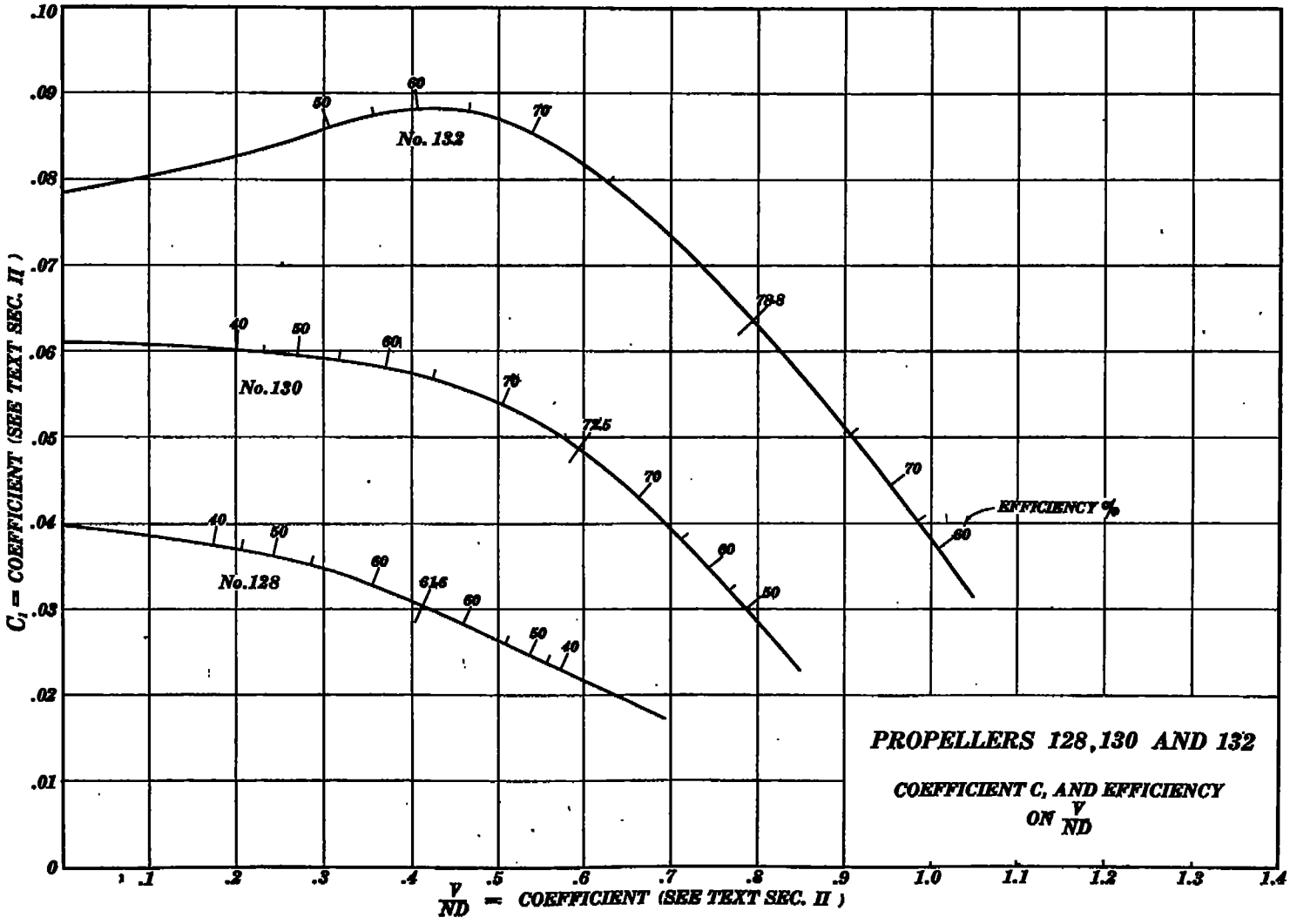

PROPELLERS 128, 130 AND 132
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 132
No. 130
No. 128
EFFICIENCY %
C_1 = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)

FIG. 49.

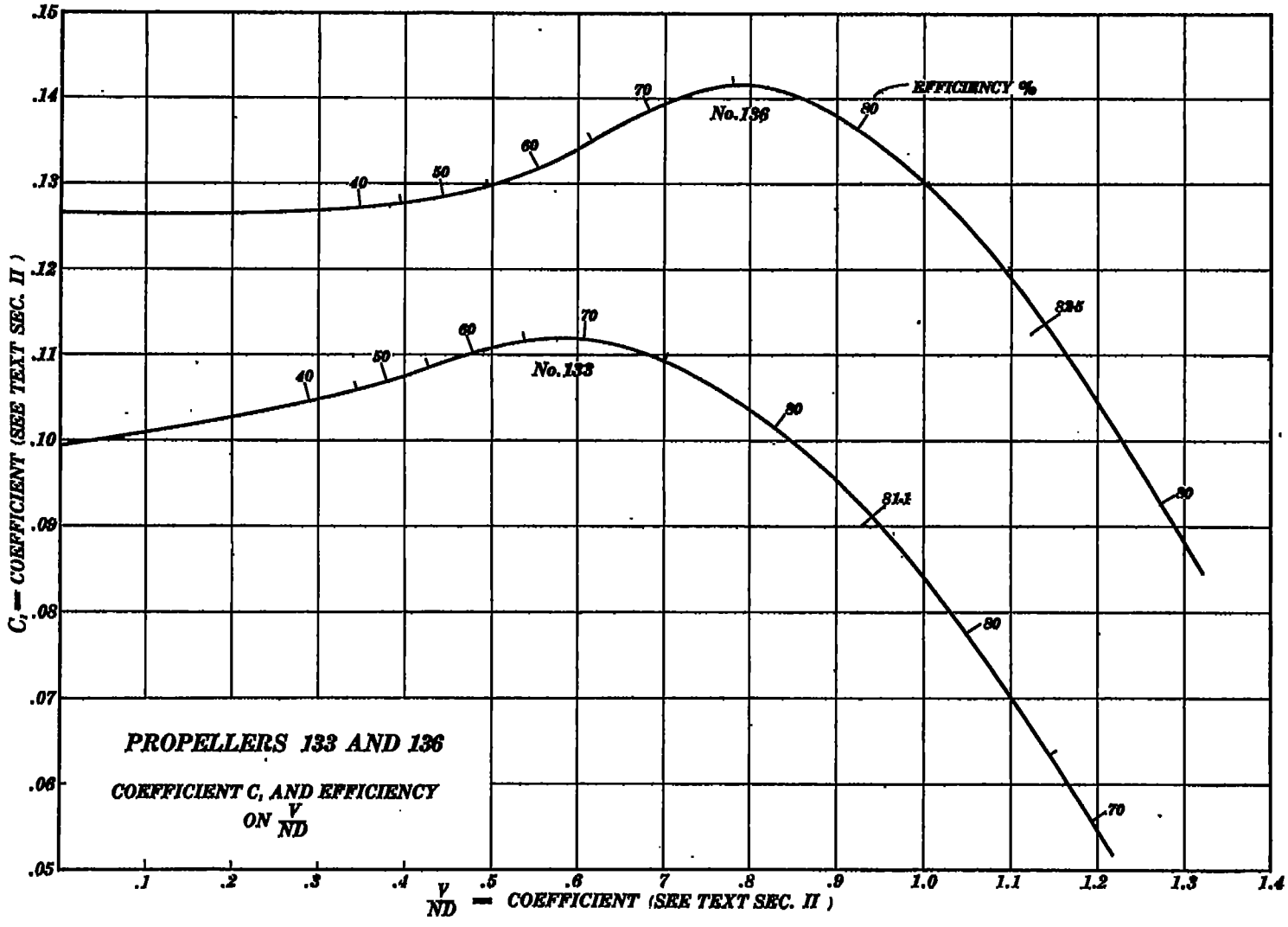

PROPELLERS 133 AND 136
COEFFICIENT C, AND EFFICIENCY ON V/ND
EFFICIENCY %
No.136
No.133
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.05
.06
.07
.08
.09
.10
.11
.12
.13
.14
.15
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4
40
50
60
70
80
82.5
81.1

FIG. 50.

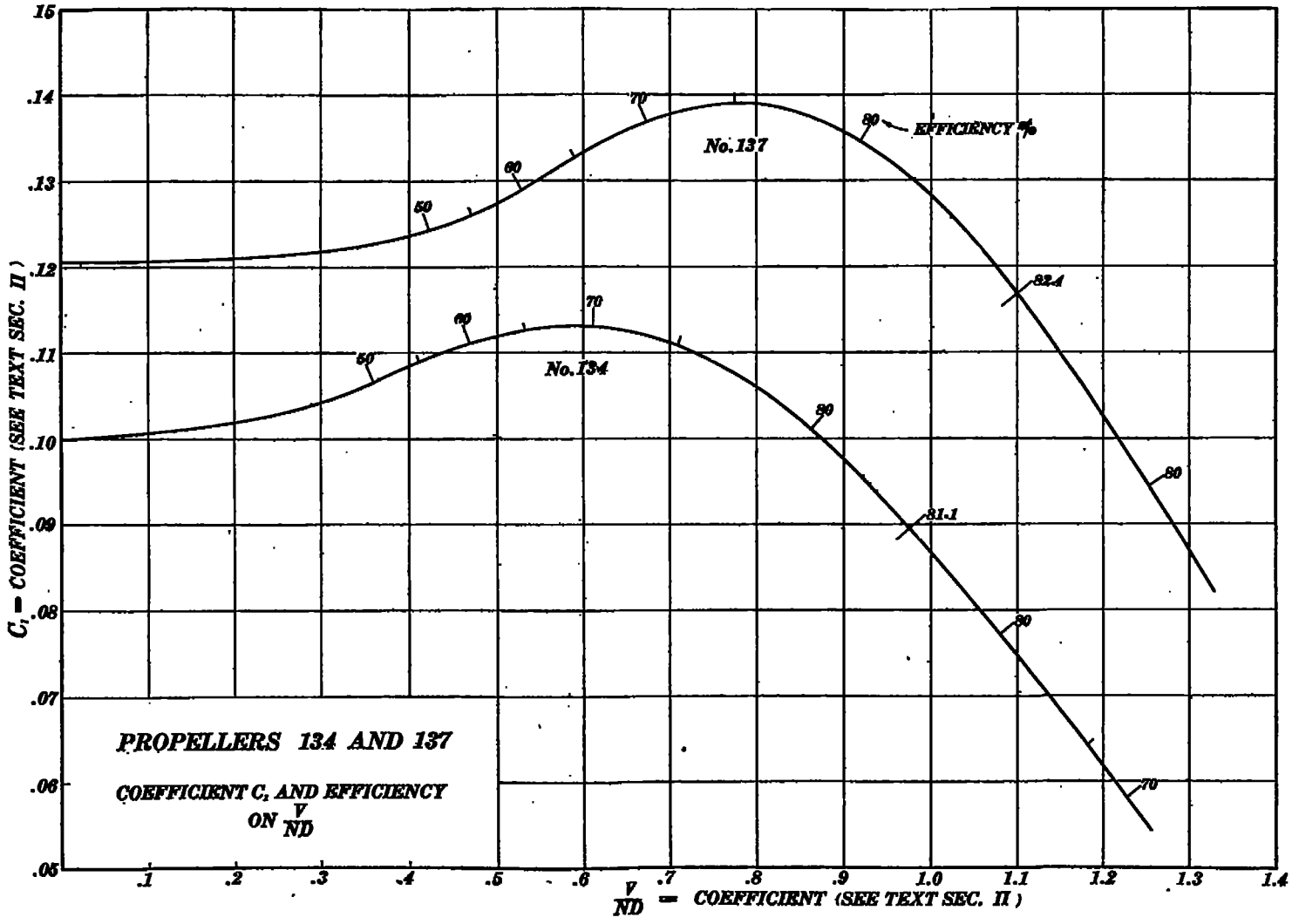

PROPELLERS 134 AND 137
COEFFICIENT C_t AND EFFICIENCY ON $\frac{V}{ND}$
No. 137
No. 134
EFFICIENCY %
82.4
81.1
C_t = COEFFICIENT (SEE TEXT SEC. II)
$\frac{V}{ND}$ = COEFFICIENT (SEE TEXT SEC. II)

FIG. 51.

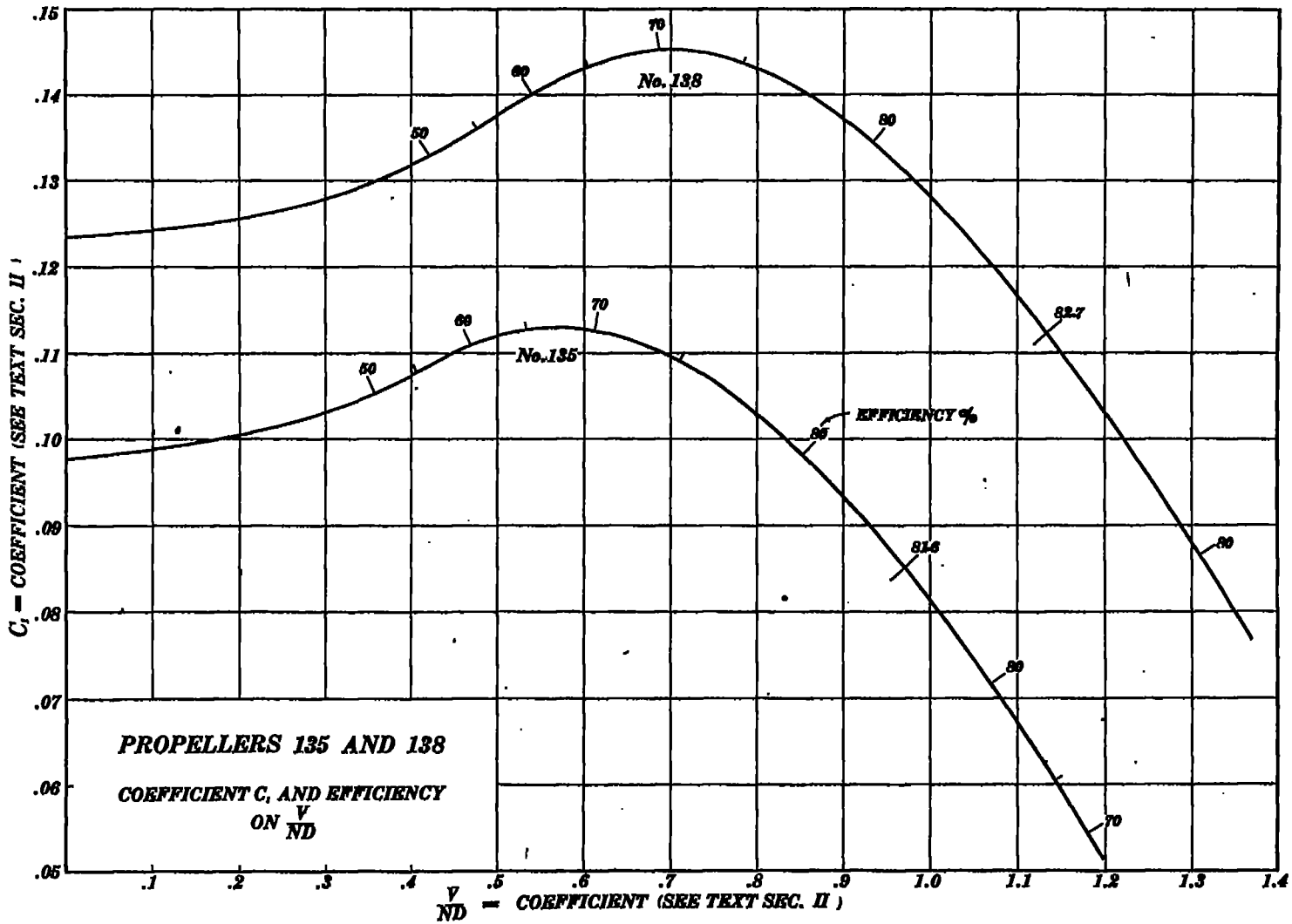

PROPELLERS 135 AND 138
COEFFICIENT C, AND EFFICIENCY ON V/ND
No. 138
No. 135
EFFICIENCY %
50
60
70
80
82.7
81.6
89
C, = COEFFICIENT (SEE TEXT SEC. II)
V/ND = COEFFICIENT (SEE TEXT SEC. II)
.15
.14
.13
.12
.11
.10
.09
.08
.07
.06
.05
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
1.4

FIG. 52.

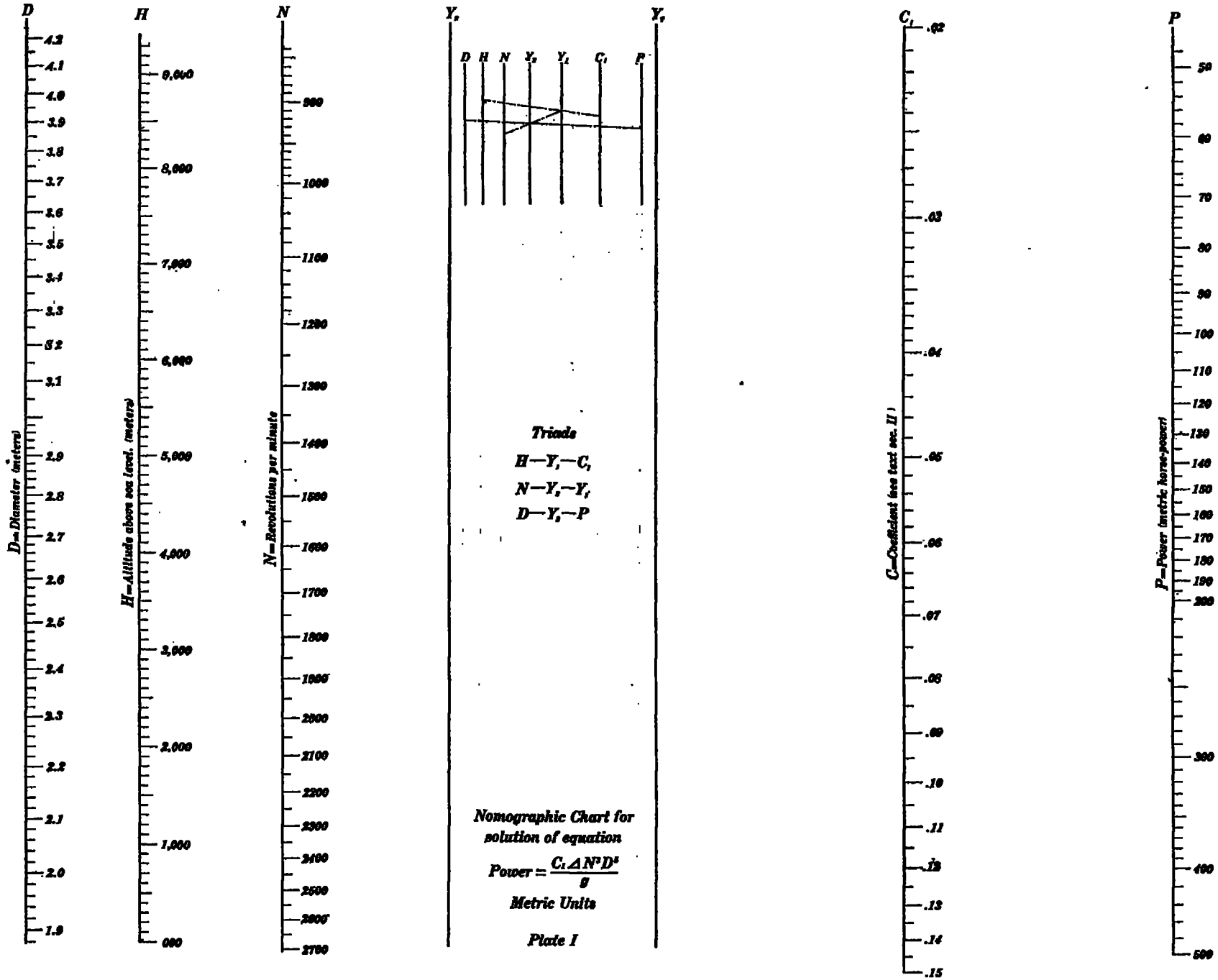
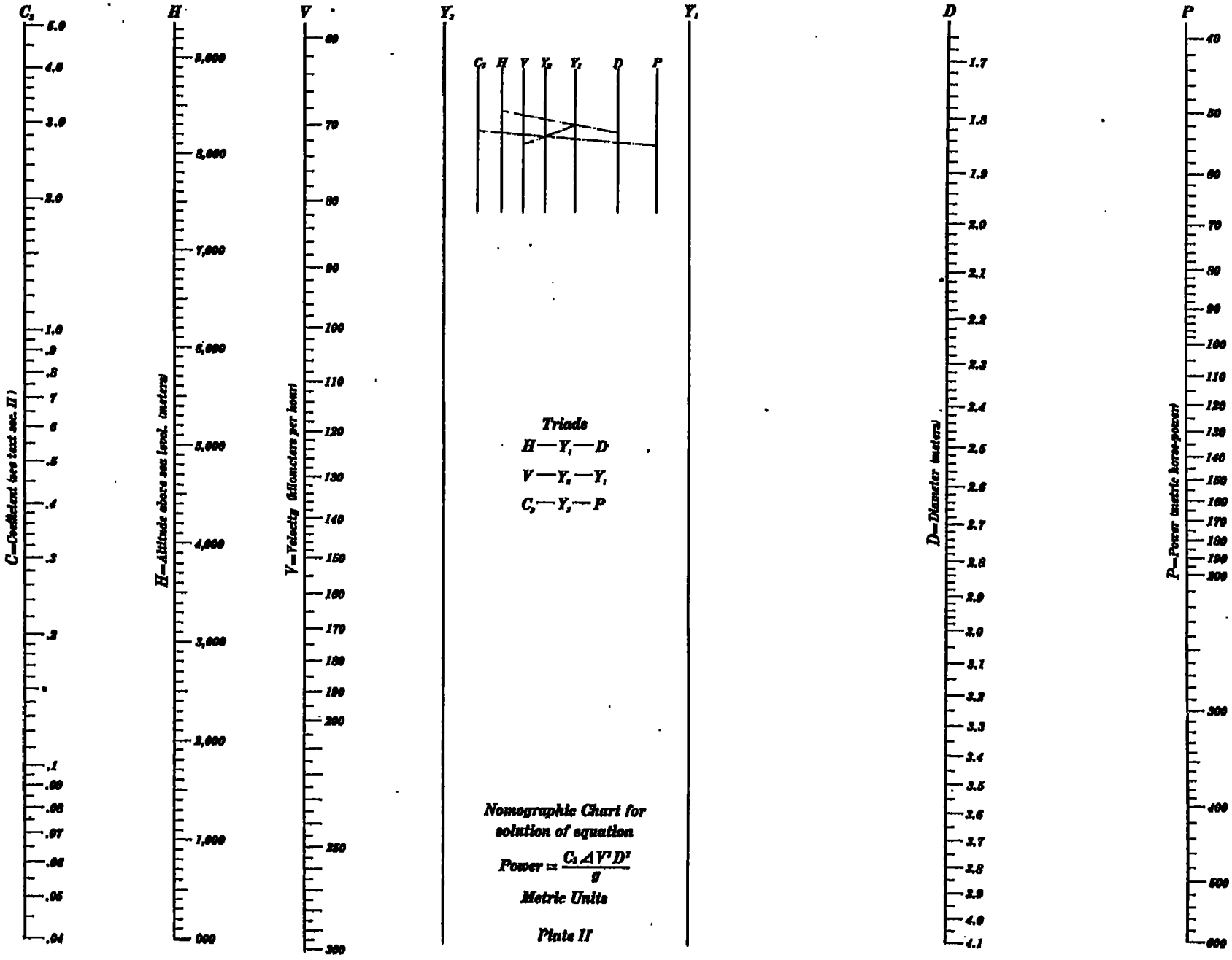
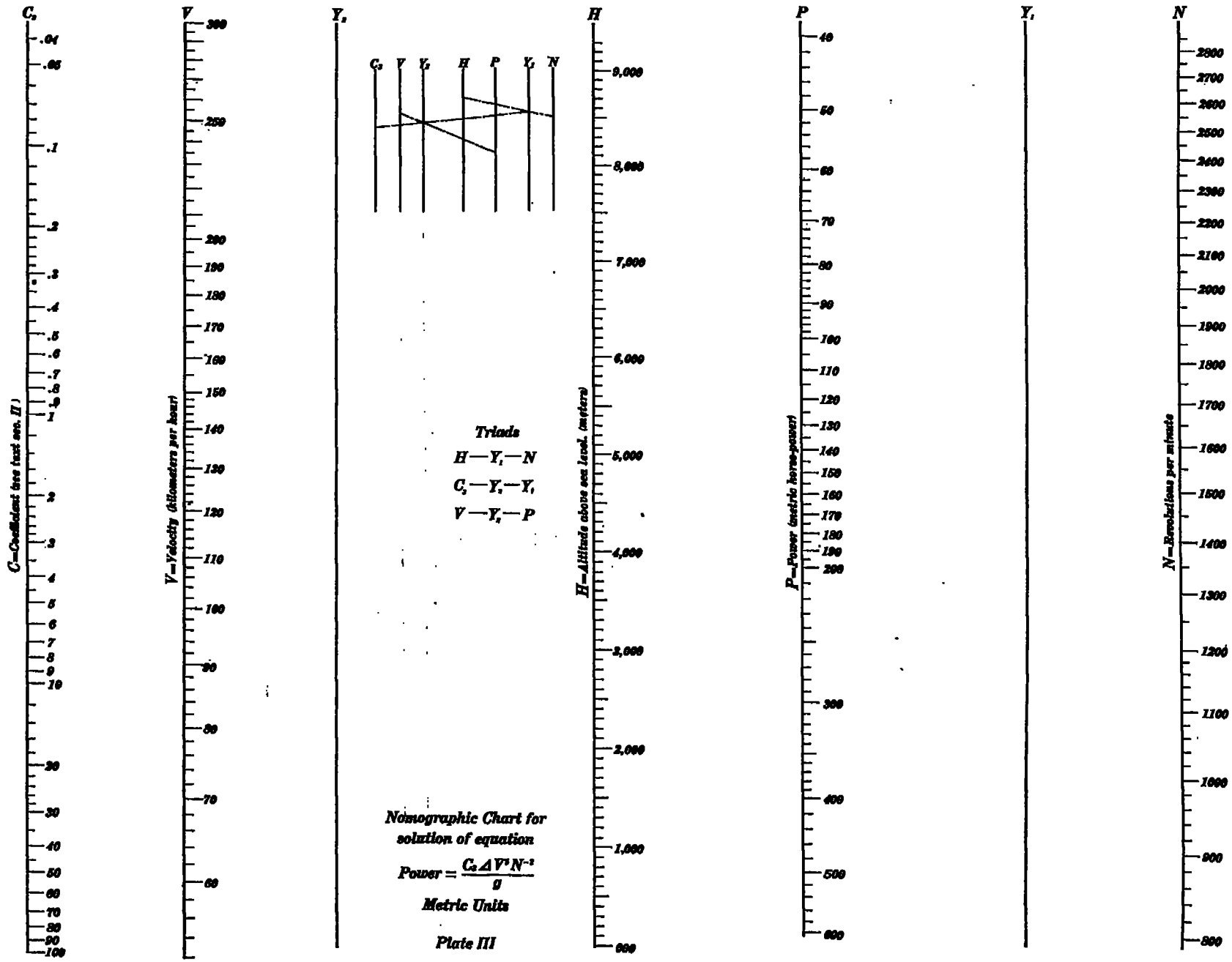

D
H
N
Y_2
Y_1
C_l
P
D=Diameter (meters)
H=Altitude above sea level (meters)
N=Revolutions per minute
C=Coefficient (see text sec. II)
P=Power (metric horse-power)
Triads
$H—Y_1—C_l$
$N—Y_2—Y_1$
$D—Y_2—P$
Nomographic Chart for solution of equation
$Power = \frac{C_l \Delta N^3 D^5}{g}$
Metric Units

Plate I


C_2
5.0
4.0
3.0
2.0
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.1
.09
.08
.07
.06
.05
.04
C=Coefficient (see text sec. II)
H
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
000
H=Altitude above sea level. (meters)
V
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
250
300
V=Velocity (kilometers per hour)
Y_2
Y_1
C_2 H V Y_2 Y_1 D P
Triads
$H—Y_1—D$
$V—Y_2—Y_1$
$C_2—Y_2—P$
Nomographic Chart for solution of equation
$Power = \frac{C_2 \Delta V^2 D^2}{g}$
Metric Units
Plate II
D
1.7
1.8
1.9
2.0
2.1
2.2
2.3
2.4
2.5
2.6
2.7
2.8
2.9
3.0
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
D=Diameter (meters)
P
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
300
400
500
600
P=Power (metric horse-power)

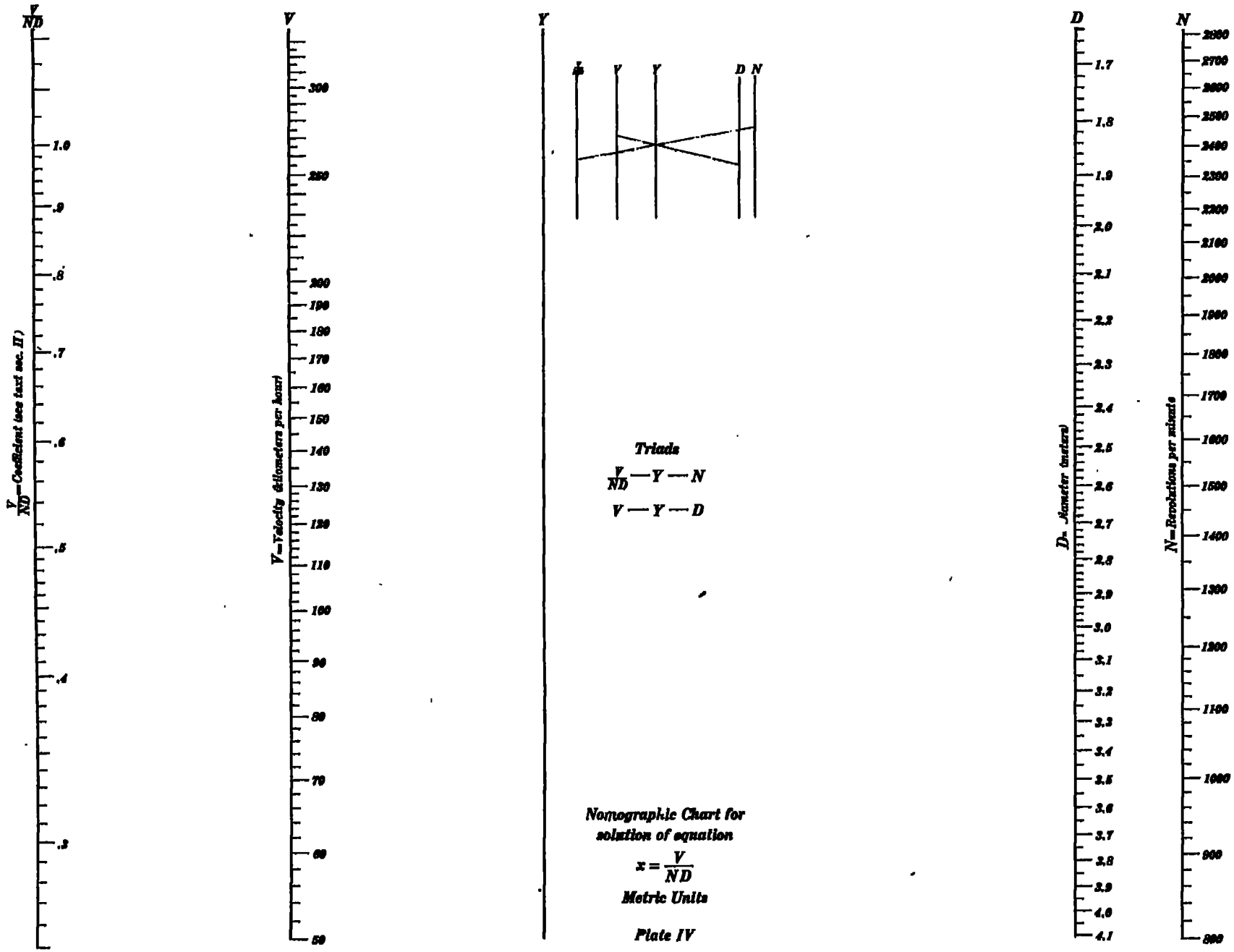


Nomographic Chart for solution of equation

$$\text{Power} = \frac{C_2 \Delta V^3 N^{-2}}{g}$$

Metric Units

Plate III

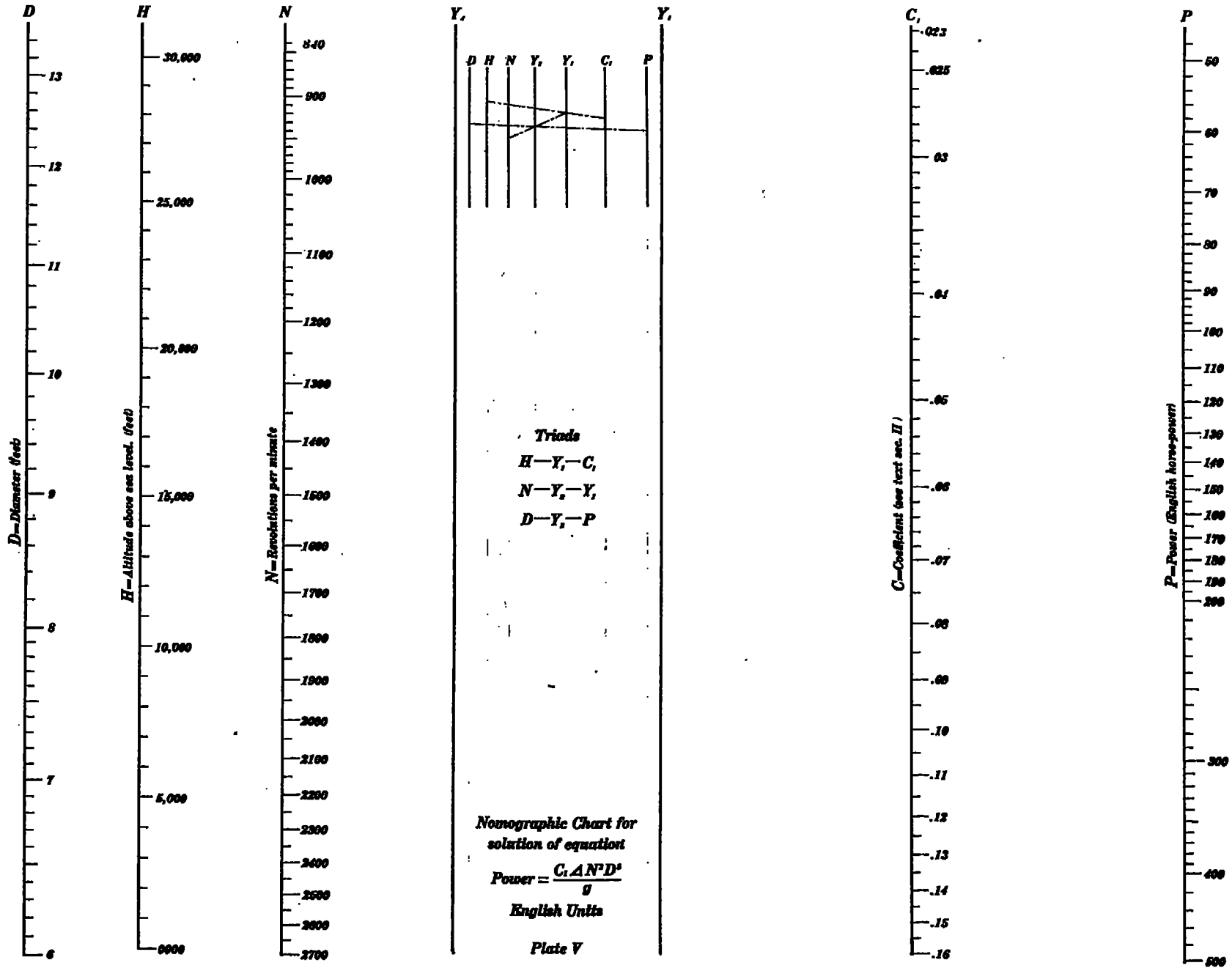


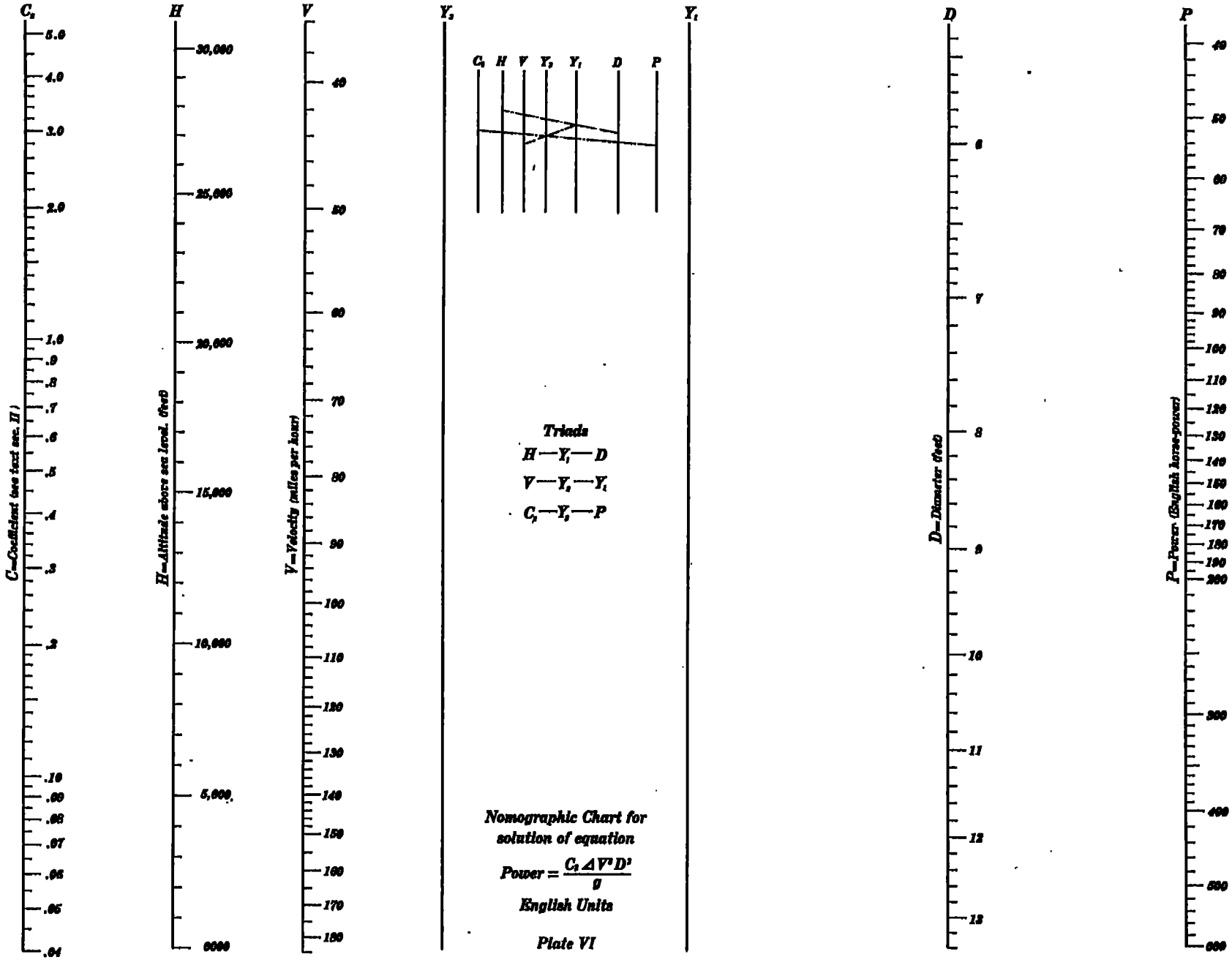
Nomographic Chart for solution of equation

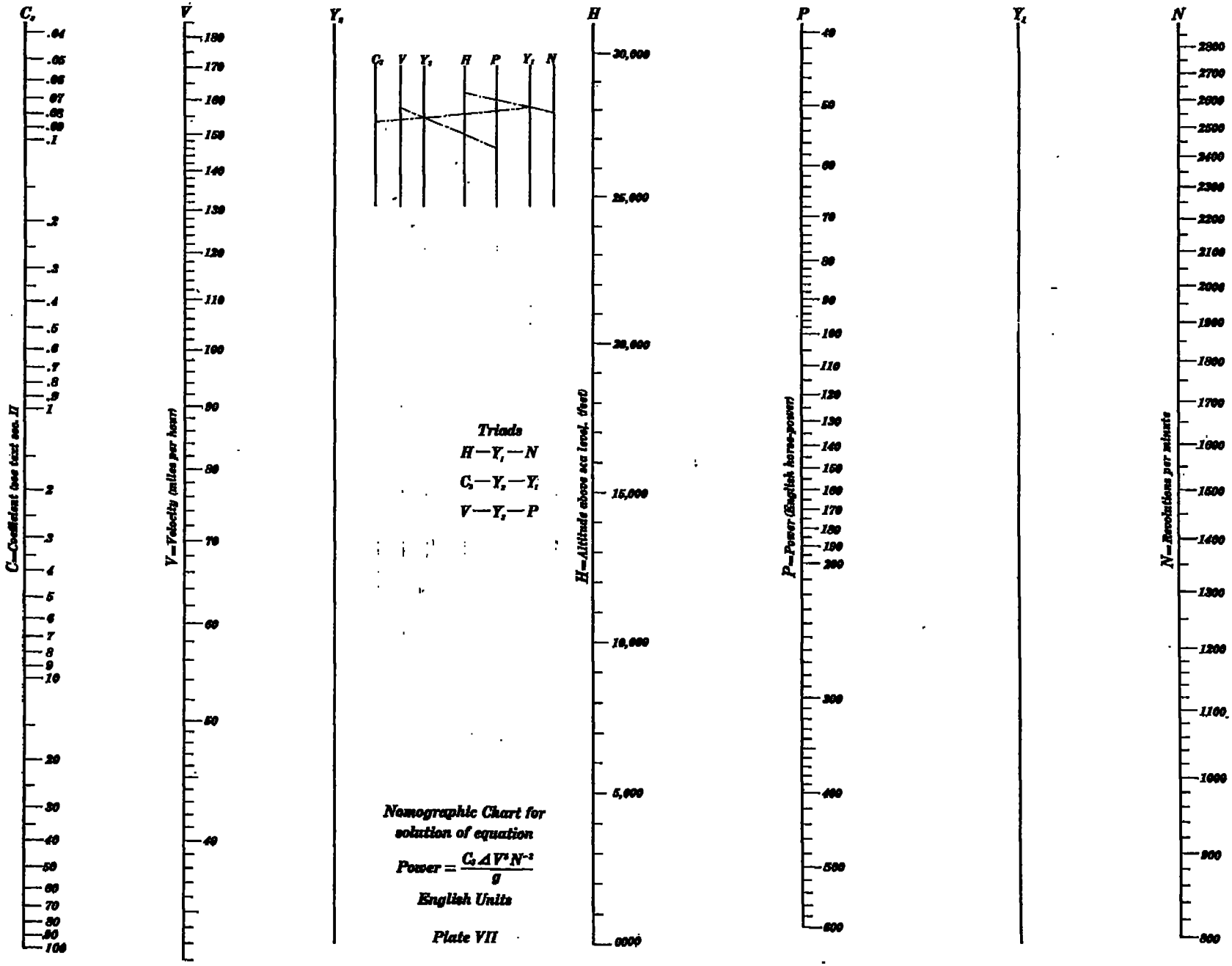
$$x = \frac{V}{ND}$$

Metric Units

Plate IV


D
D=Diameter (feet)
13
12
11
10
9
8
7
6
H
H=Altitude above sea level. (feet)
30,000
25,000
20,000
15,000
10,000
5,000
0000
N
N=Revolutions per minute
840
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
Y_2
Y_1
D H N Y_2 Y_1 C_1 P
Triads
$H—Y_1—C_1$
$N—Y_2—Y_1$
$D—Y_2—P$
Nomographic Chart for solution of equation
$Power = \frac{C_1 \Delta N^3 D^5}{g}$
English Units
Plate V
C_1
C_1=Coefficient (see text sec. II)
.025
.03
.04
.05
.06
.07
.08
.09
.10
.11
.12
.13
.14
.15
.16
P
P=Power (English horse-power)
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
300
400
500


C_2
C_2=Coefficient (see text sec. II)
5.0
4.0
3.0
2.0
1.0
.9
.8
.7
.6
.5
.4
.3
.2
.10
.09
.08
.07
.06
.05
.04
H
H=Altitude above sea level, (feet)
30,000
25,000
20,000
15,000
10,000
5,000
0000
V
V=Velocity (miles per hour)
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
Y_2
Y_1
C_2 H V Y_2 Y_1 D P
Triads
H—Y_1—D
V—Y_2—Y_1
C_2—Y_2—P
Nomographic Chart for solution of equation
$Power = \frac{C_2 \Delta V^3 D^2}{g}$
English Units
Plate VI
D
D=Diameter (feet)
6
7
8
9
10
11
12
13
P
P=Power (English horse-power)
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
300
400
500
600

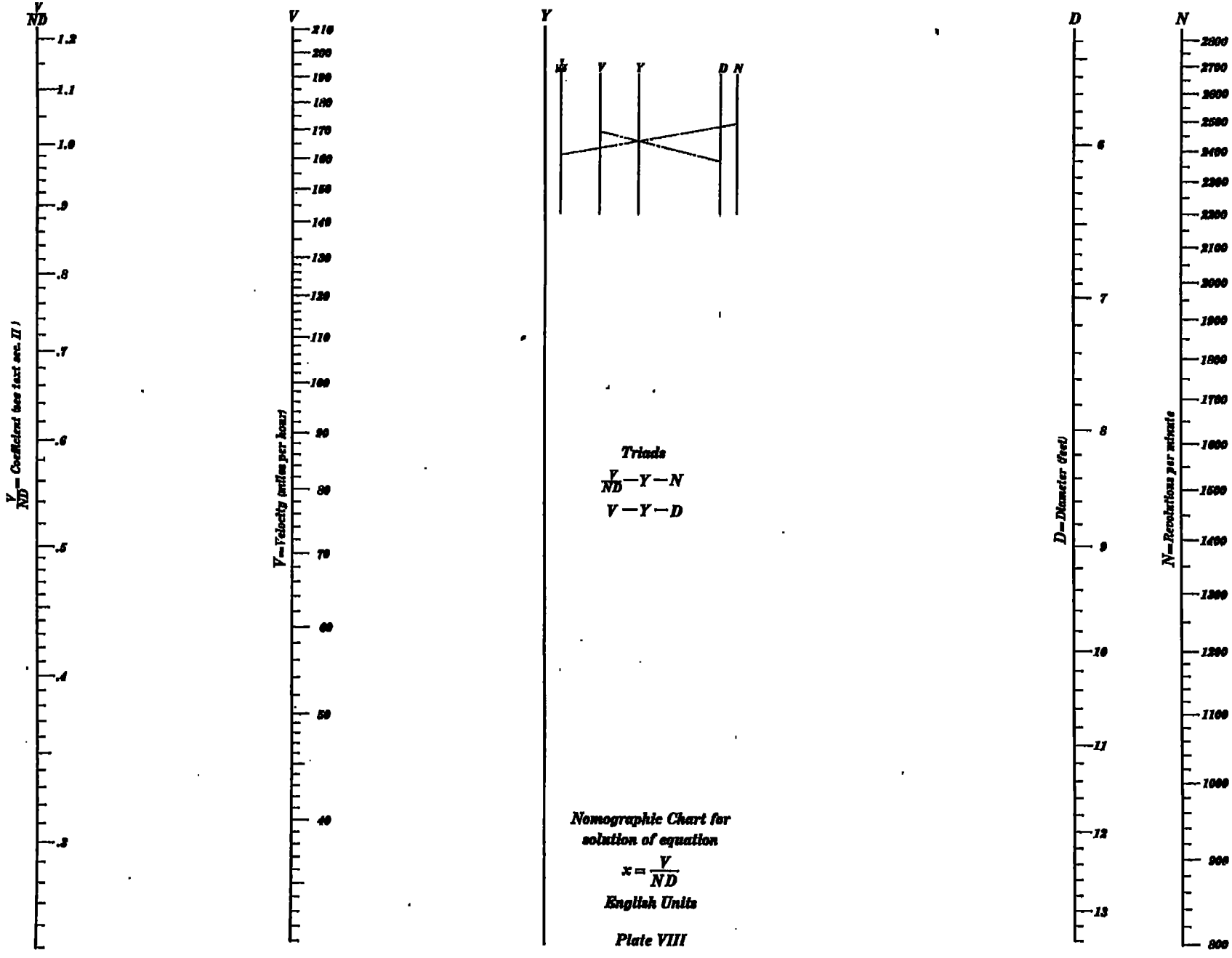


Nomographic Chart for solution of equation

$$Power = \frac{C_s \Delta V^3 N^{-2}}{g}$$

English Units

Plate VII



Nomographic Chart for solution of equation

$$x = \frac{V}{ND}$$

English Units

Plate VIII