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WRIGHT FIELD, DAYTON, OHIO

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REPORT NO. 4636

DATE May 1, 1941

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AIR CORPS TECHNICAL REPORT

TEST OF MATERIEL DIVISION BARRAGE BALLOON
MODEL WITH THREE DIFFERENT TAIL ARRANGEMENTS
FIVE FOOT WIND TUNNEL TEST NO. 253
TITLE

RESTRICTED

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION
WRIGHT FIELD, DAYTON, OHIO

MDAC-361-WF-5-15-40-10M

DATE May 1, 1941

WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

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AIR CORPS TECHNICAL REPORT

No. 1636

TEST OF MATERIEL DIVISION BARRAGE BALLOON

MODEL WITH THREE DIFFERENT TAIL ARRANGEMENTS.

FIVE FOOT WIND TUNNEL TEST NO. 253

Title

BY

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By direction of the Chief of the Materiel Division.

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Test of Materiel Division Barrage Balloon Model with Three Different Tail Arrangements

Five-Foot Wind Tunnel Test No. 253

SUMMARY

The barrage balloon model designed and built by the Materiel Division was tested to determine its longitudinal and directional stability. Three different tail arrangements were tested on the model.

The first tail arrangement consisted of two horizontal and two vertical fins as shown in photograph No. 69568, A.C. Drawing No. SL00961. This arrangement was unstable about the center of buoyancy.

The second tail arrangement consisted of two horizontal and two vertical fins as shown in photograph No. 69569, A.C. Drawing No. SL1H21-1. The model with this tail arrangement is longitudinally and directionally stable for angles of pitch or yaw from 0 to ± 20 degrees. Higher angles were not tested.

The third tail arrangement consisted of two horizontal, one upper and two lower fins as shown in photographs No. 69570 and 69571, A.C. Drawing No. SL1H21-2. The only difference between this condition and the previous one was the additional fin on the bottom. This change had no appreciable affect on the longitudinal stability but increased the directional stability about 40 per cent. The drag however was also increased about 20 per cent.

DATES AND PLACE OF TEST

This test was conducted in the Five-Foot Wind Tunnel at Wright Field from June 24 to August 8, 1940.

OBJECT

The object of this test was to determine the best of three different tail arrangements for a barrage balloon.

DESCRIPTION OF MODEL

The envelope was turned from mahogany and hollowed out to a wall thickness of 5/8 inch. The basic envelope, used for all model conditions, had a maximum diameter of 9 inches and length of 28.6 inches. The two types of fins used were made according to A.C. Drawings Nos. S4OG963 and S4OG1140. The tie-in seams of S4OG963 fins were made to run approximately parallel to the envelope contour at the aft end, while the S4OG1140 fins had the seams running parallel to the envelope axis. The three different model conditions consisted of the following tail arrangements.

Condition 1. A.C. Drawing No. S4OG961. Two horizontal and two vertical fins of the S4OG963 type. See photograph No. 69568.

Condition 2. A.C. Drawing No. S4OH21-1. Two horizontal and two vertical fins of the S4OG1140 type. See photograph No. 69569.

Condition 3. A.C. Drawing No. S4OH21-2. Two horizontal, one upper and two lower fins of the S4OG1140 type, the upper one was vertical, while each lower one was at an angle of 25 degrees to the vertical. See photographs Nos. 69570 and 69571.

PROCEDURE

The model was mounted on the N.P.L. Balance by a spindle attached at the center of buoyancy, or referred to later in this report as "CR" or center of rotation. The airspeed was 50 m.p.h. for all tests.

For each of the three conditions given in the "DESCRIPTION OF MODEL", cross wind force, drag and yawing moments about the CR were observed for a range of yaw angles from 0 to ± 20 degrees with the model set at 0, + 10, and + 20 degrees pitch. For the first and second condition the model was symmetrical in all four quadrants and hence pitching moments were not measured but merely assumed to be equal to the corresponding yawing moments. For the third condition, this symmetry did not exist, one fin was on top and two

were on bottom and hence the model had to be tested for pitching moments also. The range of pitch angles was from 0 to ± 20 degrees at zero degrees yaw.

A series of tests were also made to determine spindle interference on cross wind force, drag and yawing moments. The measured values were then corrected to eliminate the interference factor from the final values

DISCUSSION OF RESULTS

Condition 1. From graph 4 at zero degree pitch, the model is unstable about the CR for yaw angles up to ± 11 degrees, and unstable up to ± 9 degree at + 10 degrees pitch. At + 20 degree pitch, however, it is neutrally stable for angles of yaw up to about ± 4 degrees. As the yaw angle is increased, the model becomes more stable.

Condition 2. From graph 8 the model is stable about the CR for all yaw angles tested, at 0, + 10, and +20 degrees pitch.

Condition 3. Comparing graph 12 with graph 8, it is noted that the stability of condition 3 is increased about 40 per cent over that of condition 2, at small angles of yaw. This is due to the additional fin on the bottom.

Graph 16 indicates the longitudinal stability is about the same magnitude as the directional stability for this third model condition with five fins.

It is also noted that for all tail arrangements tested, an increase in directional stability results from an increase of pitch angle, particularly for small yaw angles.

The net drag of the model at zero pitch and zero yaw is increased 30 per cent from condition 1 to condition 2 and 59 per cent from condition 1 to condition 3.

CONCLUSIONS

Model condition 3, that is with five fins as shown on A.C. Drawing

-No. S41H21-2, photographs Nos. 69570 and 69571, is the most stable of the three conditions tested, However, model condition 2 with four fins, A.C. Drawing No. S41H21-1, photograph No. 69569 has less drag but the stability is also decreased. Model condition 1, A.C. Drawing No. S400961, photograph No. 69568 is least stable of the three conditions tested. This condition is unstable about the center of buoyancy at zero degrees pitch for yaw angles up to ± 11 degrees, and unstable up to ± 9 degrees at + 10 degrees pitch. At 20 degrees pitch it is neutrally stable for yaw angles up to ± 4 degrees.

REFERENCES

Air Corps Drawings:

S400961 - Model Assembly, Barrage Balloon.

S41H21-1 - Model Assembly, Barrage Balloon.

S41H21-2 - Model Assembly, Barrage Balloon.

WIND TUNNEL NOMENCLATURE

d	= diameter of wind tunnel at test section = 5 ft.
S	= wing area — sq. ft.
b	= wing span—ft.
c	= mean aerodynamic chord—ft. (m. a. c.)
E. M. A. R.	= equivalent monoplane aspect ratio
α	= angle of attack of longitudinal reference axis to wind—deg.
ψ	= angle of yaw relative to wind—deg.
δ_R	= angle of rudder relative to neutral position—deg.
δ_E	= angle of elevator relative to stabilizer—deg.
i_t	= angle of stabilizer relative to longitudinal reference axis—deg.
v	= airspeed—ft per sec.
V	= airspeed—m. p. h.
W	= weight of full scale airplane—lb.
M	= pitching moment—lb.-ft.
N	= yawing moment—lb.-ft.
L	= rolling moment—lb.-ft.
ρ	= mass density of air—slugs per cu. ft. = .002378 (standard air)
q	= $\rho v^2/2$ — lb. per sq. ft.
C_L	= lift coefficient = Lift/qS
C_D	= drag coefficient = Drag/qS
C_C	= cross-wind force coefficient = Cross-wind force /qS
$\Delta\alpha$	= Prandtl's wall correction for angle of attack $= \frac{57.3\, S\, C_L}{2\pi d^2}\left[1+\frac{3}{16}\left(\frac{b}{d}\right)^4+\dots\right]$
ΔC_D	= Prandtl's wall correction for drag coefficient $= \frac{S\, C_L^2}{2\pi d^2}\left[1+\frac{3}{16}\left(\frac{b}{d}\right)^4+\dots\right]$
L/D	= lift/drag ratio = C_L/C_D
C_m	= pitching moment coefficient = M/qcS
C_n	= yawing moment coefficient = N/qbS
C_l	= rolling moment coefficient = L/qbS
$\Delta C_m/\Delta\alpha$	= slope of "pitching moment versus angle of attack" curve at trim
$\Delta C_n/\Delta\psi$	= slope of "yawing moment versus angle of yaw" curve at zero yaw
$\Delta C_n/\Delta\delta_R$	= slope of "yawing moment due to rudder versus rudder angle" curve at zero rudder angle
C_{Di}	= induced drag coefficient = $\frac{C_L^2}{\pi \times \text{E. M. A. R.}}$
C_{Do}	= profile drag coefficient
C_{Dp}	= parasite drag coefficient = $C_D - (C_{Di} + C_{Do})$
A_e	= equivalent flat plate area = C_{Dp} S/1.279

Postive distances are upstream, upward and to right viewed from the rear
Positive forces are downstream, upward and to right viewed from the rear
Positive pitching moment is a stalling moment
Positive yawing moment is clockwise viewed from above
Positive rolling moment is clockwise viewed from the rear
Positive angles are in the same direction as moments
Positive stabilizer setting is with leading edge up referred to longitudinal reference axis
Positive elevator setting is with trailing edge down referred to stabilizer
Positive rudder setting is with trailing edge left referred to neutral position and viewed from the rear
Angle of attack of thrust line is referred to wind

Table I

BARRAGE BALLOON

50 M.P.H. (Standard Air)
Test No. 253

Wright Field June 27, 1940
Plotted on Graphs 1, 2, 3 and 4

4 - Fins Model Assembly S4003961

Angle of Yaw	0° Pitch				+ 10° Pitch				+ 20° Pitch			
	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.
0	- .0303	.3823	- .08	- .05	- .0379	.5511	- .07	+ .14	- .0169	1.0494	- .02	- .08
+ 2	+ .1468	.3799	+ .39	+ .98	+ .1140	.5543	+ .26	.75	+ .2110	1.0534	+ .20	- .06
4	.3663	.3990	.92	1.39	.4729	.5744	.82	.86	.4199	1.0541	.40	- .06
6	.6587	.4431	1.49	1.50	.6844	.6045	1.13	.84	.7050	1.0751	.66	- .36
10	1.3044	.5627	2.32	.47	1.1201	.7243	1.55	- .51	1.2451	1.1835	1.05	-1.27
15	2.2120	.8402	2.63	-1.61	2.1009	.9621	2.18	-2.49	2.0054	1.4408	1.39	-3.75
20	3.2101	1.2775	2.51	-7.21	2.9191	1.3214	2.21	-5.70	2.7911	1.8139	1.54	-7.38
- 2	- .2490	.3841	- .65	- .63	- .2429	.5556	- .44	- .36	- .2429	1.0478	- .23	- .06
- 4	- .5142	.4108	-1.25	- .89	- .4992	.5774	- .87	- .61	- .5012	1.0558	- .48	+ .12
- 6	- .7784	.4507	-1.72	- .97	- .7592	.6116	-1.24	- .57	- .7617	1.0860	- .70	.40
- 10	-1.3848	.5817	-2.37	- .33	-1.3748	.7350	-1.86	+ .33	-1.2738	1.2046	-1.06	1.19
- 15	-2.2668	.8435	-2.70	+2.56	-2.1865	.9759	-2.24	2.51	-2.0360	1.4570	-1.40	3.81
- 20	-3.2179	1.2798	-2.52	+6.74	-3.0166	1.3490	-2.23	5.67	-2.8306	1.8255	-1.55	7.11

Table II

BARRAGE BALLOON

50 M.P.H. (Standard Air)
Test No. 253

Wright Field July 1, 1940
Plotted on Graphs 5, 6, 7, and 8

4 - Fins Model Assembly 841R21-1

Angle of Yaw	0° Pitch				+ 10° Pitch				+ 20° Pitch			
	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lbs	Drag lb.	C/D	Yaw Moment About CR lb.in.
0	- .0409	.4981	- .08	+ .12	- .0434	.6251	- .07	+ .16	- .0414	1.2626	- .03	+ .16
+ 2	+ .2590	.5030	+ .51	- .05	+ .2750	.6378	+ .43	- .36	+ .2695	1.2711	+ .21	- .56
4	.5639	.5271	1.07	- .58	.5584	.6539	.85	- .87	.5489	1.2981	.42	- 1.44
6	.8994	.5719	1.57	- 1.01	.9079	.7070	1.28	- 1.44	.8954	1.3385	.67	- 2.06
10	1.6426	.7270	2.26	- 2.64	1.6216	.8538	1.70	- 3.15	1.5326	1.4649	1.05	- 3.66
15	2.5754	1.0369	2.48	- 5.55	2.5429	1.1658	2.16	- 6.20	2.3799	1.7396	1.37	- 6.65
20	3.5619	1.5300	2.33	- 9.93	3.4644	1.6030	2.16	-10.28	3.2274	2.1713	1.49	-10.68
- 2	- .3364	.5066	- .66	+ .49	- .3469	.6393	- .54	+ .72	- .3424	1.2756	- .27	+ 1.03
- 4	- .6787	.5357	-1.27	.91	- .6657	.6718	- .99	1.15	- .6697	1.3002	- .52	1.89
- 6	- .9972	.5863	-1.70	1.41	- .9367	.7184	-1.30	1.70	- .9757	1.3365	- .73	2.58
- 10	-1.7173	.7470	-2.30	3.05	-1.7123	.8660	-1.98	3.61	-1.6148	1.4676	-1.10	4.31
- 15	-2.7085	1.0770	-2.51	6.21	-2.7005	1.2028	-2.24	6.98	-2.5295	1.7755	-1.42	7.61
- 20	-3.7036	1.5020	-2.46	10.42	-3.6286	1.6820	-2.16	10.77	-3.3821	2.2450	-1.51	11.42

Table III

BARRAGE BALLOON

50 M.P.H. (Standard Air)
Test No. 253

Wright Field July 1, 1940
Plotted on Graphs 9, 10, 11, and 12

5 - Fins Model Assembly S41H21-2

Angle of Yaw	0° Pitch				+ 10° Pitch				+ 20° Pitch			
	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.	Cross Wind Force lb.	Drag lb.	C/D	Yaw Moment About CR lb.in.
0	- .0624	.6078	- .10	+ .32	- .0434	.6251	- .07	+ .16	- .0404	1.2476	- .03	+ .27
+ 2	+ .2745	.6101	+ .45	- .32	+ .2750	.6378	+ .43	- .36	+ .3445	1.2571	+ .27	- 1.10
4	.5894	.6356	.93	- .87	.5614	.6539	.86	- .87	.6849	1.2961	.53	- 2.31
6	.9719	.6843	1.42	- 1.46	.9079	.7070	1.28	- 1.44	1.0694	1.3523	.79	- 3.30
10	1.7601	.8515	2.07	- 3.56	1.6216	.8538	1.90	- 3.15	1.7991	1.5170	1.19	- 5.69
15	2.8379	1.2070	2.35	- 7.56	2.5429	1.1658	2.16	- 6.20	2.6609	1.8305	1.45	- 8.85
20	3.6974	1.6075	2.30	-11.53	3.4644	1.6030	2.16	-10.28	3.5114	2.2970	1.53	-13.13
- 2	- .4119	.6141	- .67	+ .96	- .3469	.6393	- .54	+ .72	- .4269	1.2606	- .34	+ 1.82
- 4	- .7757	.6507	-1.19	1.56	- .6657	.6718	- .99	1.15	- .8042	1.3022	- .62	2.97
- 6	-1.1212	.7008	-1.60	2.17	- .9367	.7184	-1.30	1.70	-1.1547	1.3508	- .85	4.01
- 10	-1.9118	.8782	-2.18	4.34	-1.7147	.8660	-1.98	3.61	-1.8898	1.5305	-1.23	6.29
- 15	-3.0190	1.2607	-2.39	8.47	-2.7005	1.2028	-2.25	6.98	-2.7900	1.8710	-1.49	9.63
- 20	-4.0991	1.8265	-2.24	13.32	-3.6286	1.6820	-2.16	10.77	-3.6556	2.3705	-1.54	13.84

Table IV

BARRAGE BALLOON

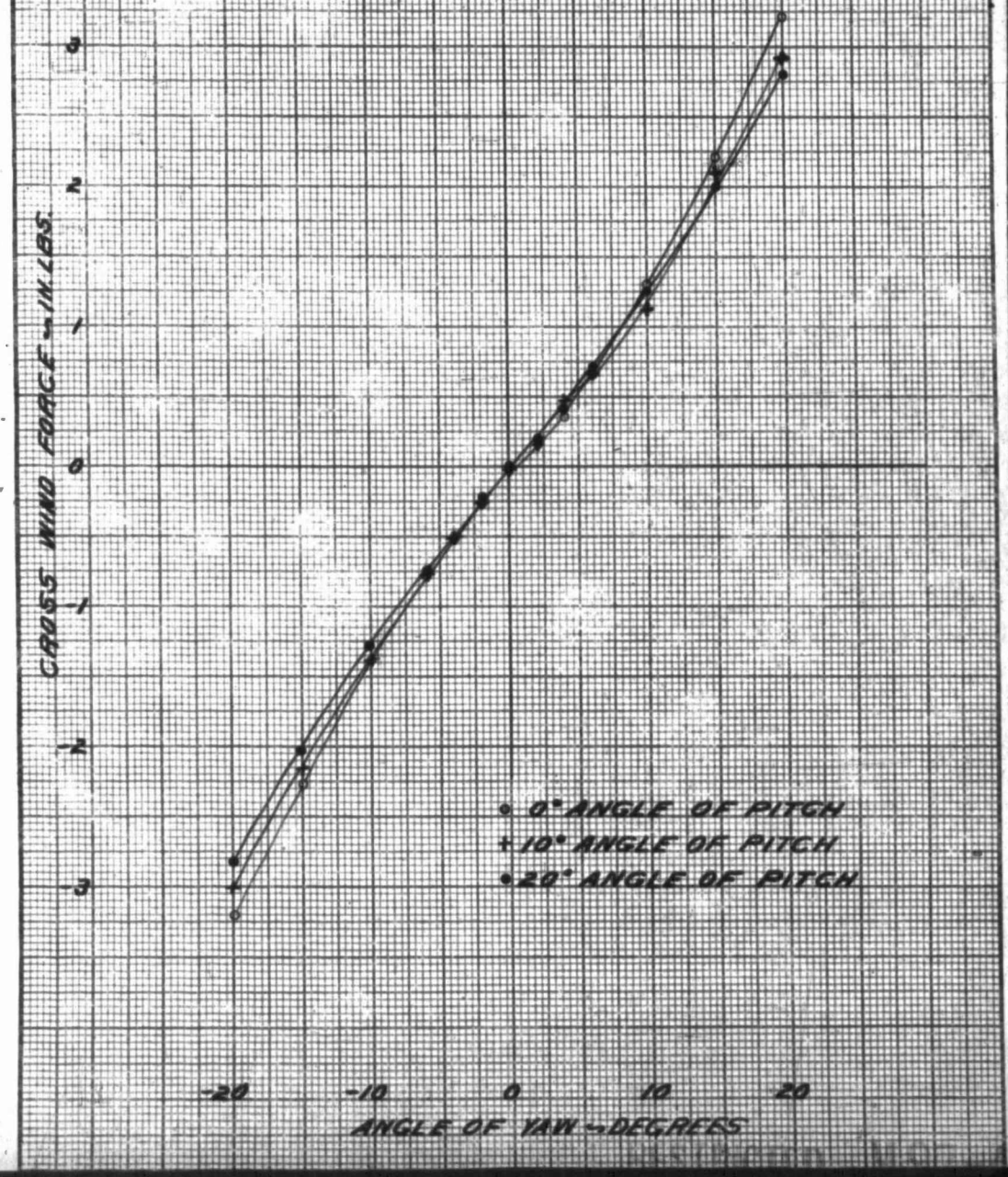
50 M.P.H. (Standard Air)
Test No. 253

Wright Field July 1, 1940
Plotted on Graphs 13, 14, 15, and 16

5 - Fins Model Assembly S4lH21-2

Angle of Pitch	0° Yaw			
	Lift lb.	Drag lb.	L/D	Pitching Moment About CR lb.in.
0	- .2724	.5691	- .48	+ 1.15
+ 2	+ .0705	.5636	+ .13	.47
4	.3804	.5831	.65	- .01
6	.7544	.6298	1.20	- .60
10	1.4766	.7680	1.92	- 2.38
15	2.4794	1.0545	2.35	- 5.77
20	3.4664	1.4940	2.32	-10.08
- 2	- .6014	.5966	-1.01	+ 1.73
- 4	- .9507	.6462	-1.47	2.27
- 6	-1.2727	.7113	-1.79	2.76
-10	-2.0503	.9045	-2.27	4.76
-15	-3.0180	1.2945	-2.33	8.27
-20	-4.0216	1.8385	-2.19	13.06

CROSS WIND FORCE VS ANGLE OF YAW GRAPH NO. 1
MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JUNE 27, 1940
50 M.P.H. STANDARD AIR
4 FINS MODEL ASSEMBLY 540G961



DRAG VS. ANGLE OF YAW — GRAPH NO. 2

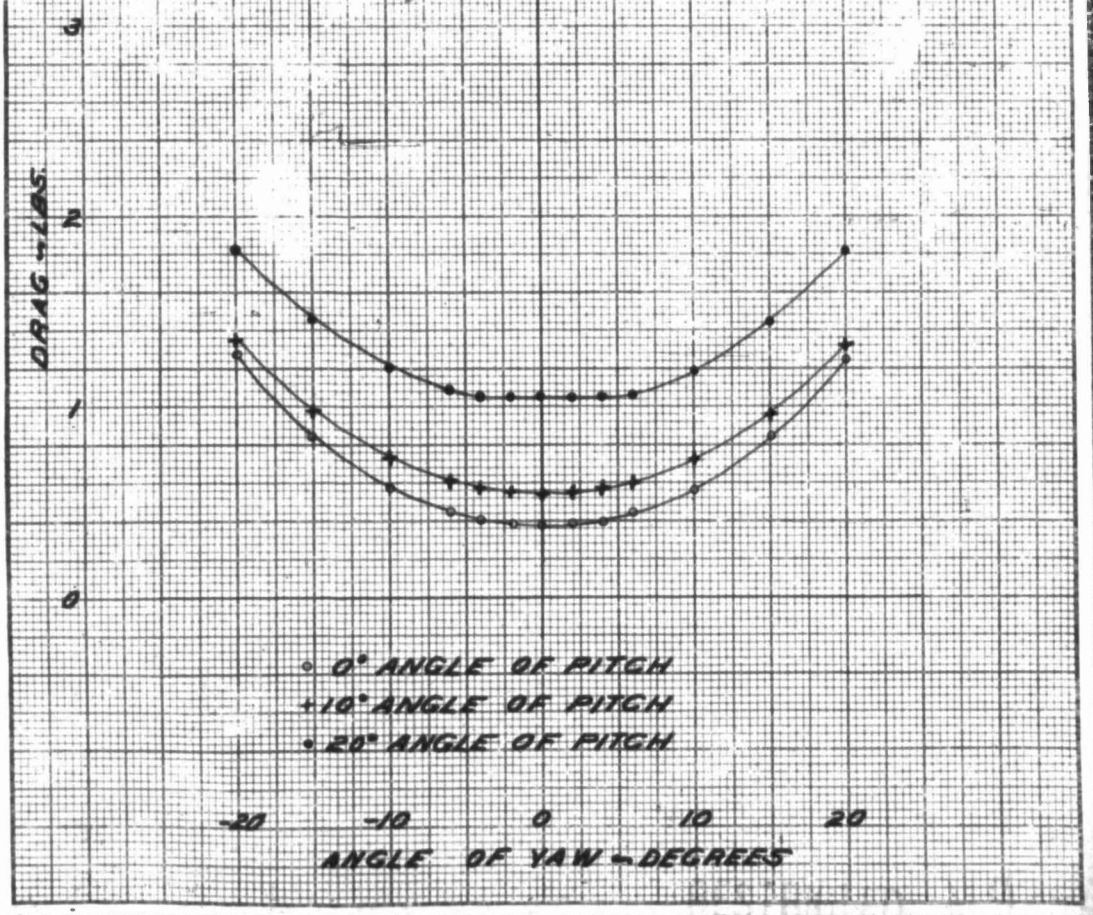
MODEL OF BARRAGE BALLOON

5 FT. WIND TUNNEL TEST NO 253

WRIGHT FIELD JUNE 27, 1940

50 M.P.H. STANDARD AIR

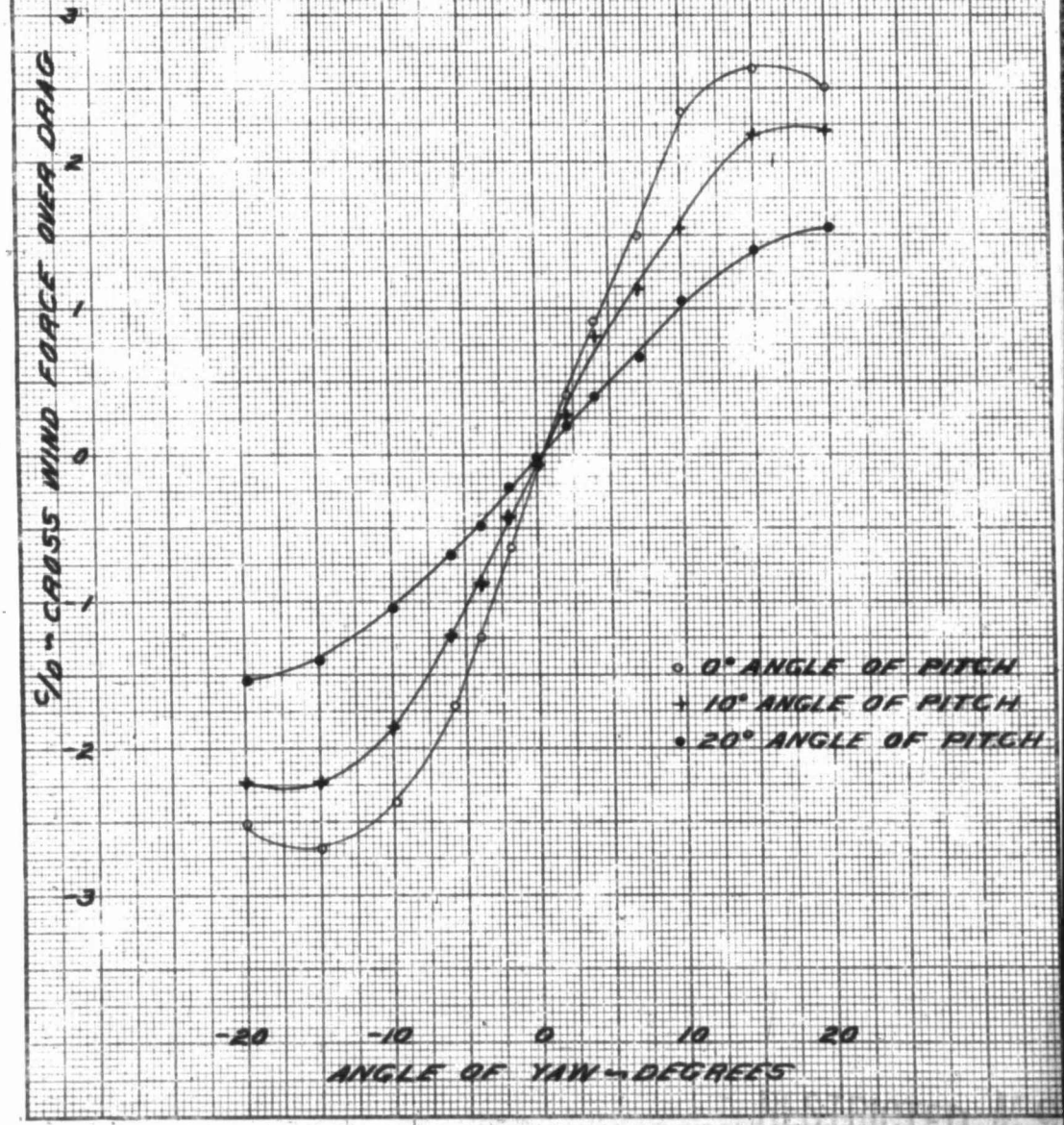
4 FINS MODEL ASSEMBLY 5406961



GRAPH NO. 3

C_D VS. ANGLE OF YAW

MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JUNE 27, 1940
50 M.P.H. STANDARD AIR
4 FINS MODEL ASSEMBLY 540C981



SERIAL NO. 1087

YAW MOMENT VS. ANGLE OF YAW — GRAPH NO. 4

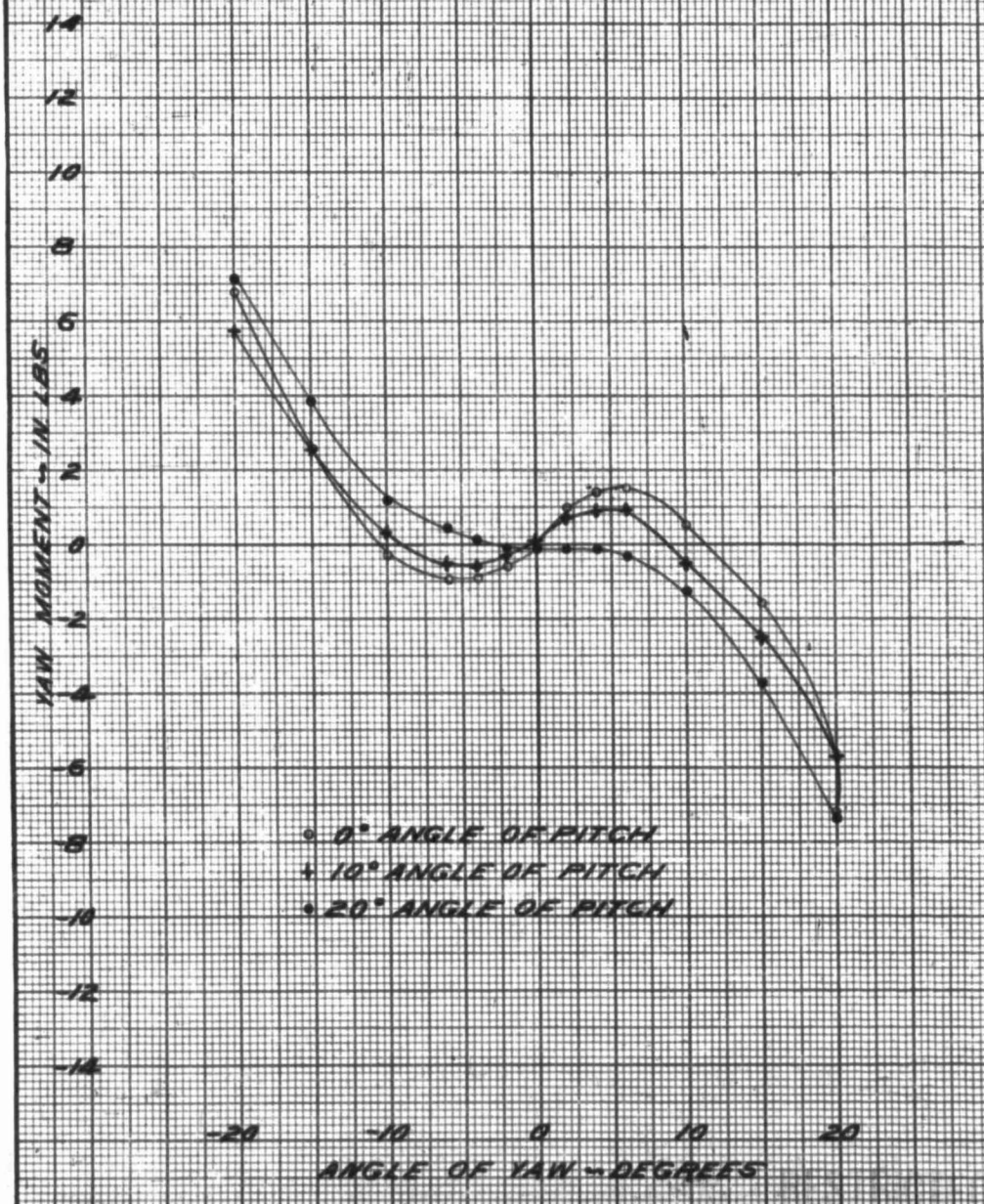
MODEL OF BARRAGE BALLOON

5' FT. WIND TUNNEL TEST NO. 253

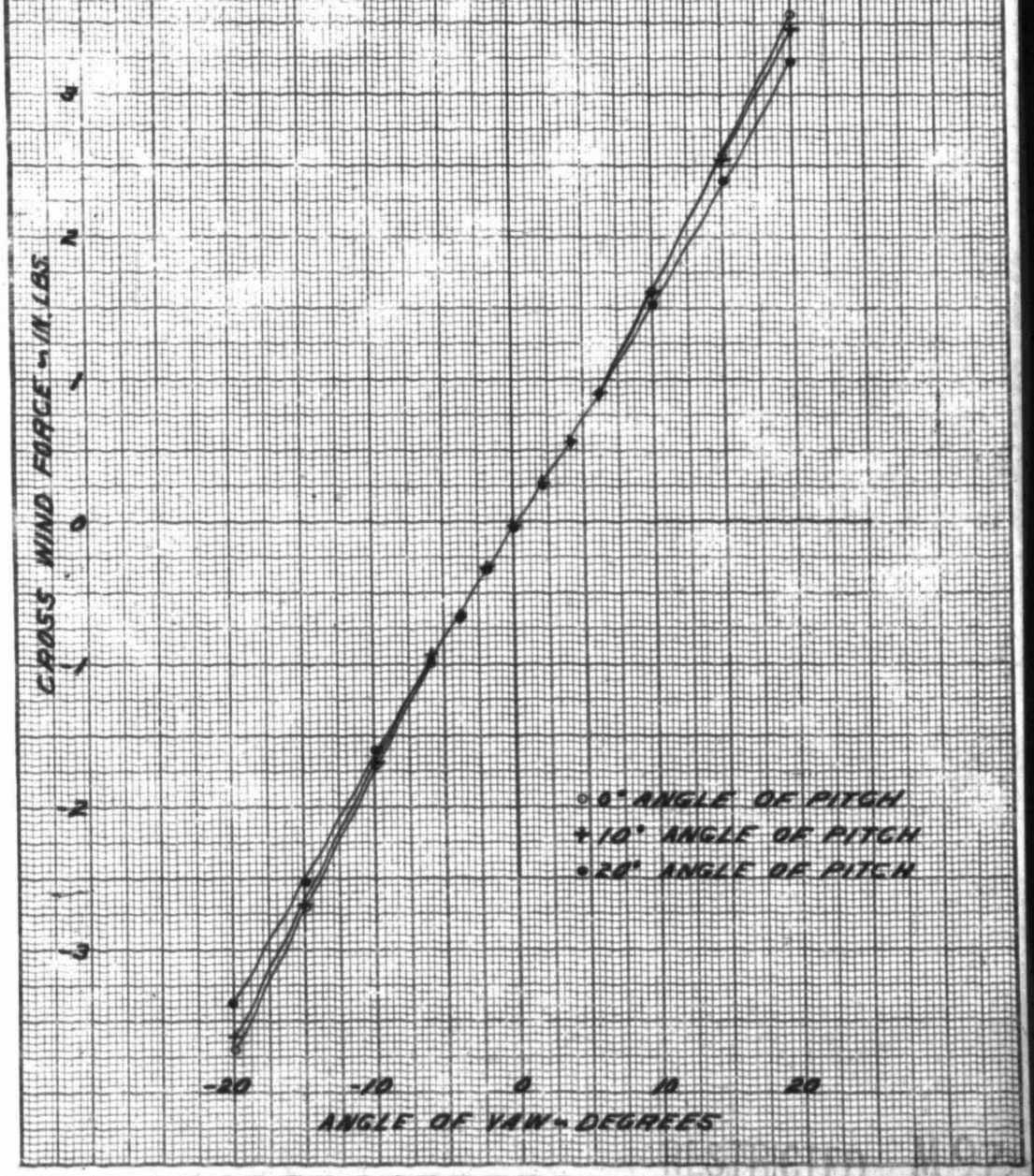
WRIGHT FIELD JUNE 27, 1940

50 M.P.H. STANDARD AIR

4 FINS MODEL ASSEMBLY 5-40C-961



CROSS WIND FORCE VS ANGLE OF YAW GRAPH NO.5
MODEL OF BARRAGE BALLOON
5 FT WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H. STANDARD AIR
4 FINS MODEL ASSEMBLY 54H21-1



SERIAL NO. 4636

DRAG VS. ANGLE OF YAW GRAPH NO. 6

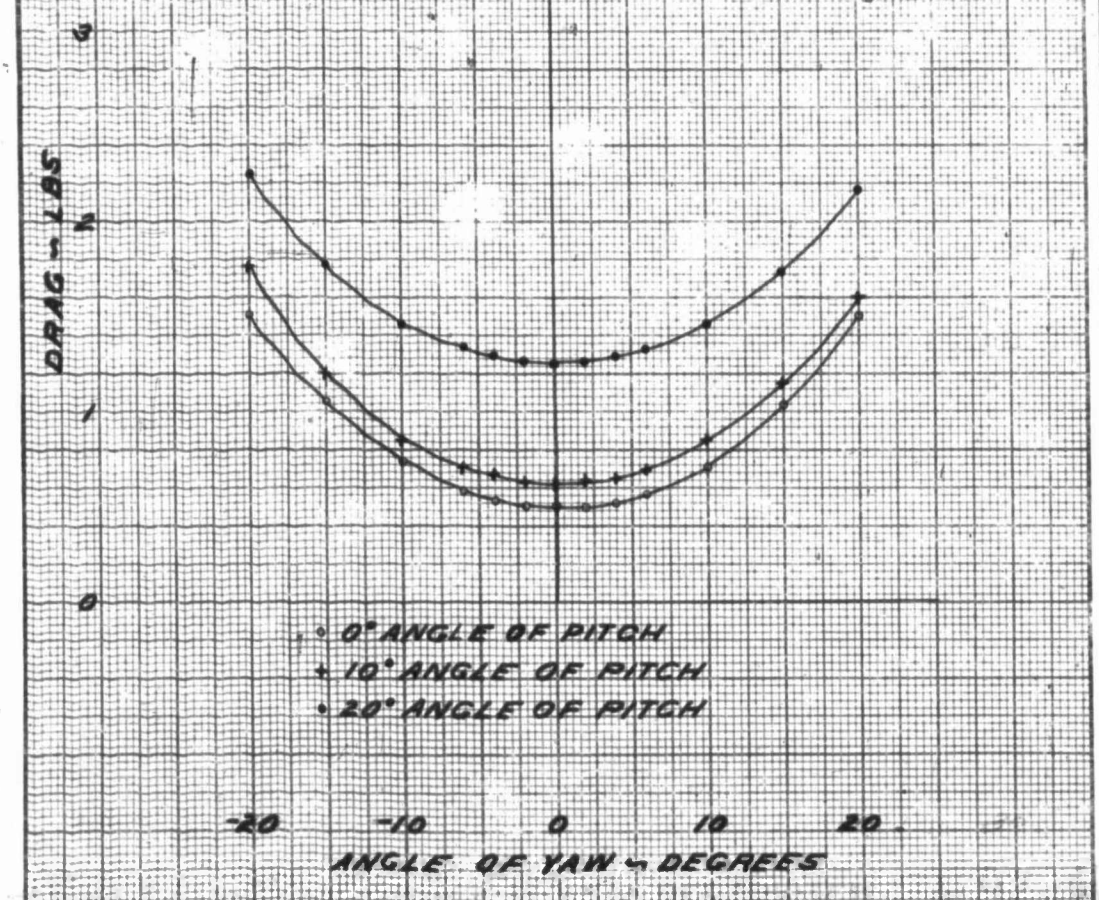
MODEL OF BARRAGE BALLOON

5 FT. WIND TUNNEL TEST NO. 253

WRIGHT FIELD JULY 1, 1940

50 M.P.H. STANDARD AIR

4 FINS MODEL ASSEMBLY 5-41H21-1



GRAPH No. 7

C_D VS. ANGLE OF YAW

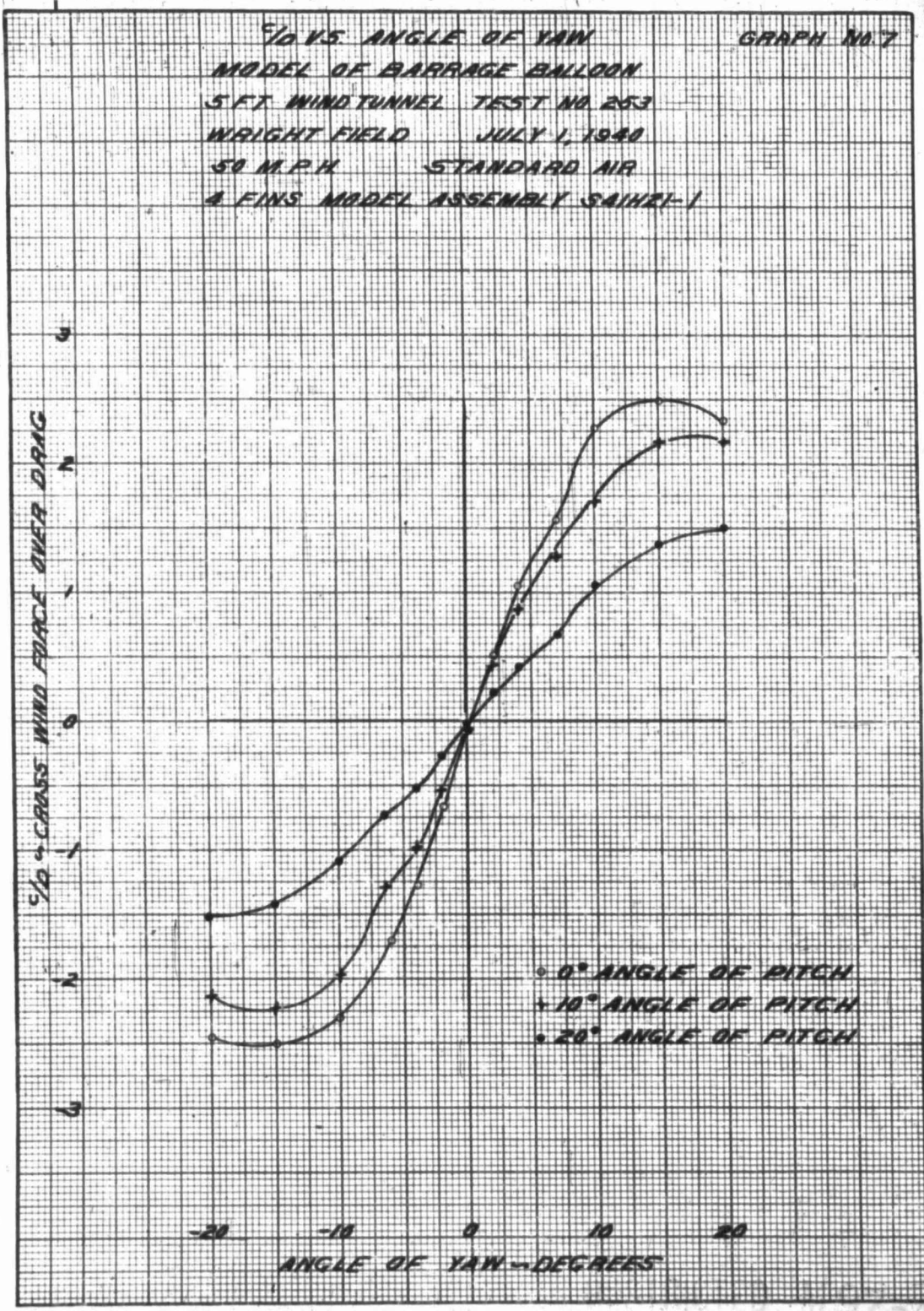
MODEL OF BARRAGE BALLOON

5 FT. WIND TUNNEL TEST NO. 253

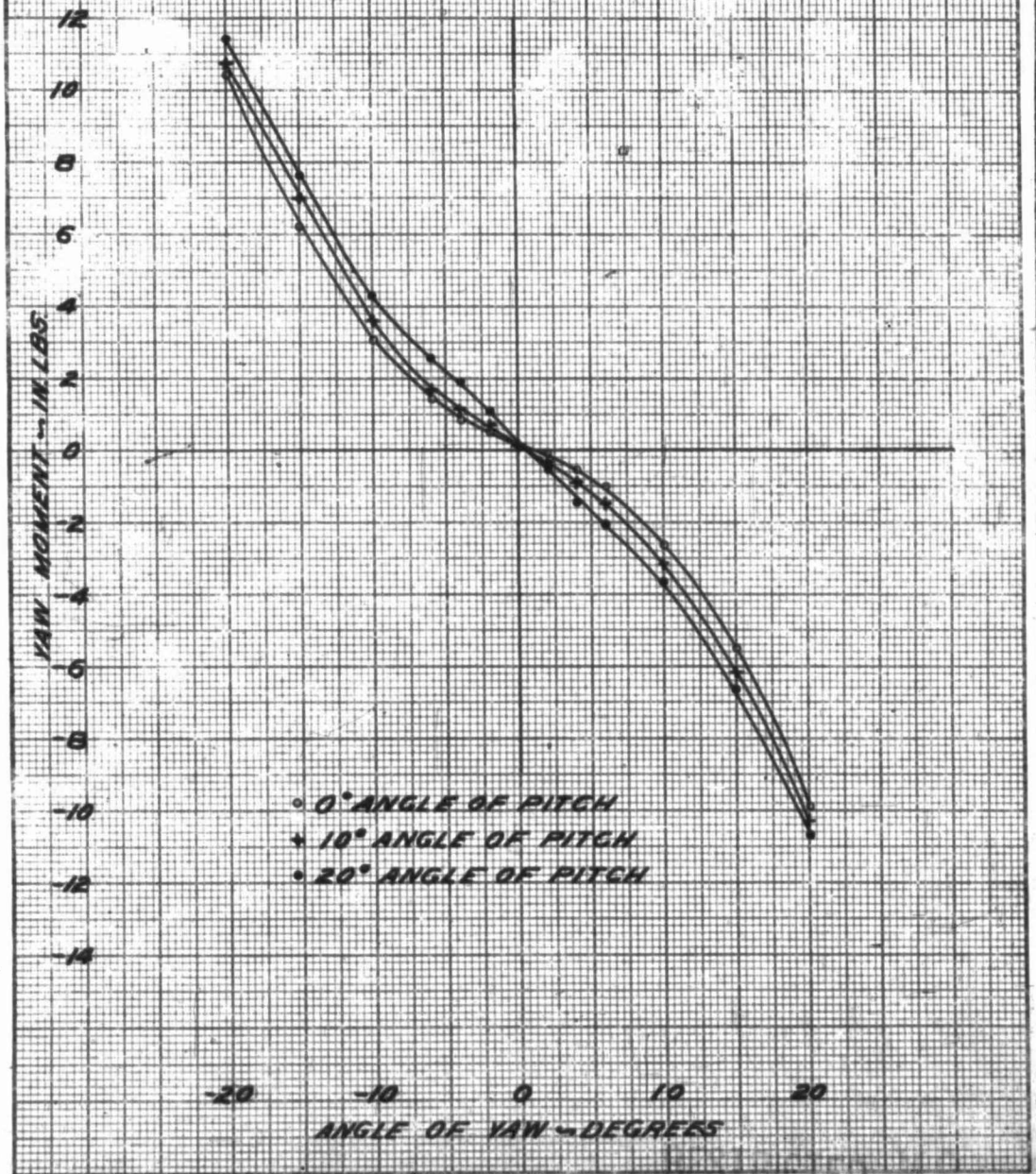
WRIGHT FIELD JULY 1, 1940

50 M.P.H. STANDARD AIR

4 FINS MODEL ASSEMBLY SAIHZI-1

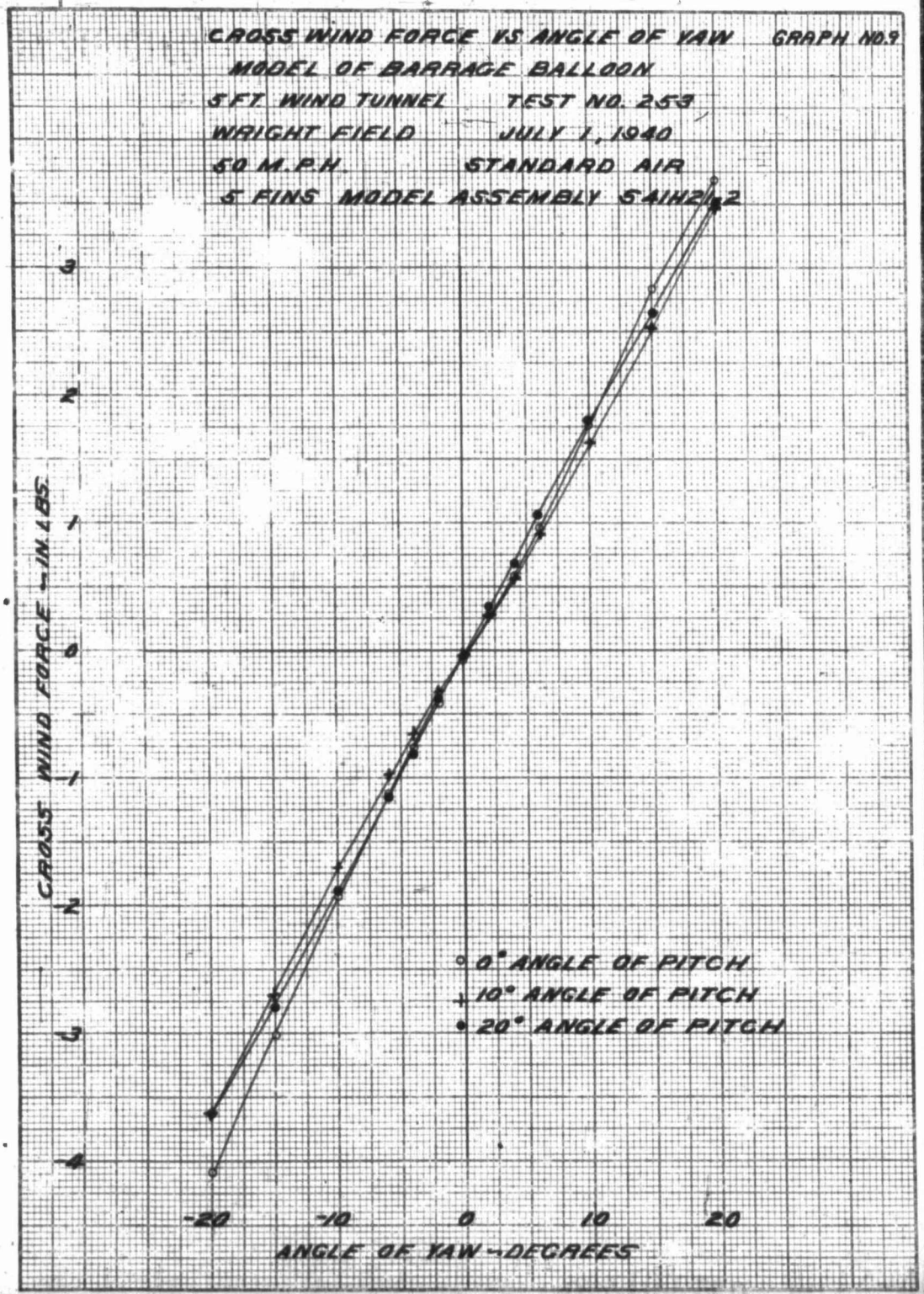


YAW MOMENT VS ANGLE OF YAW GRAPH NO. 8
MODEL OF BARRAGE BALLOON
8 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H. STANDARD AIR
4 FINS MODEL ASSEMBLY 5AIH21-1

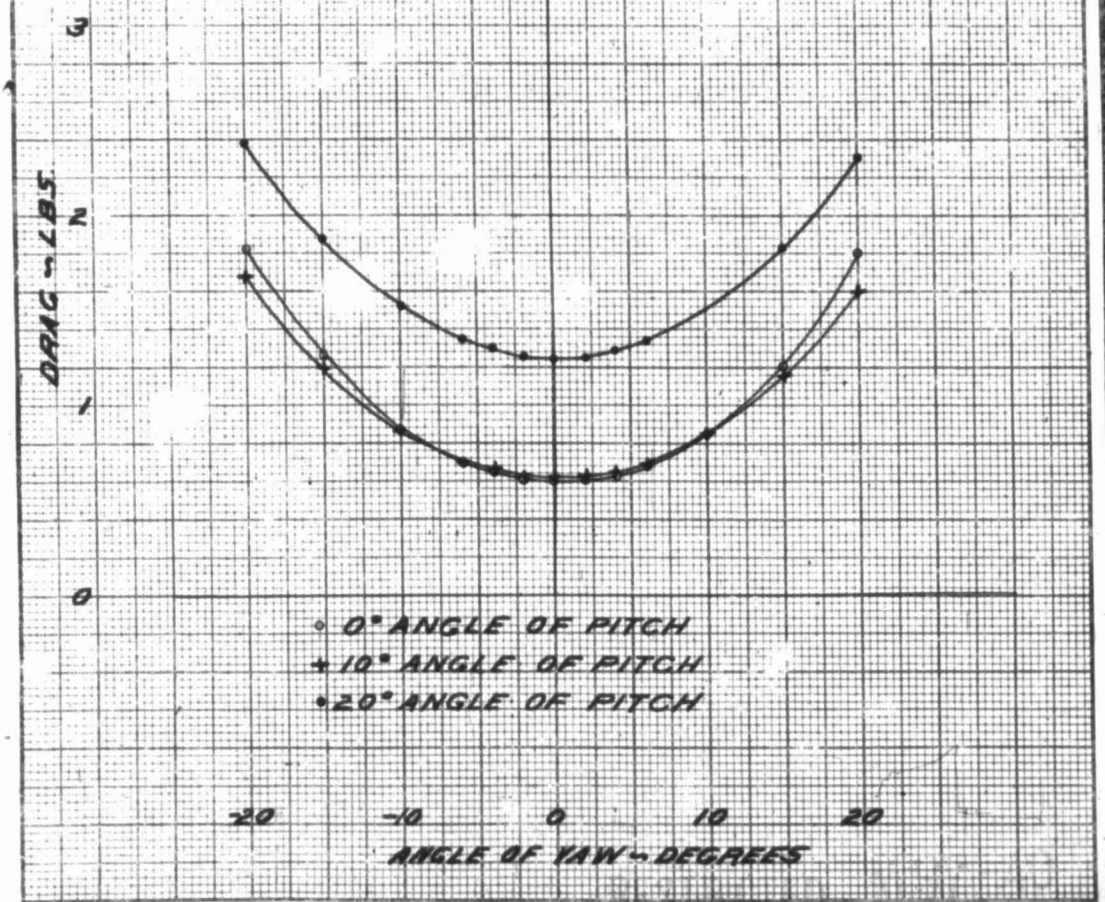


SERIAL NO. 463

CROSS WIND FORCE VS ANGLE OF YAW GRAPH NO. 9
MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
60 M.P.H. STANDARD AIR
5 FINS MODEL ASSEMBLY 54IH2 1/2

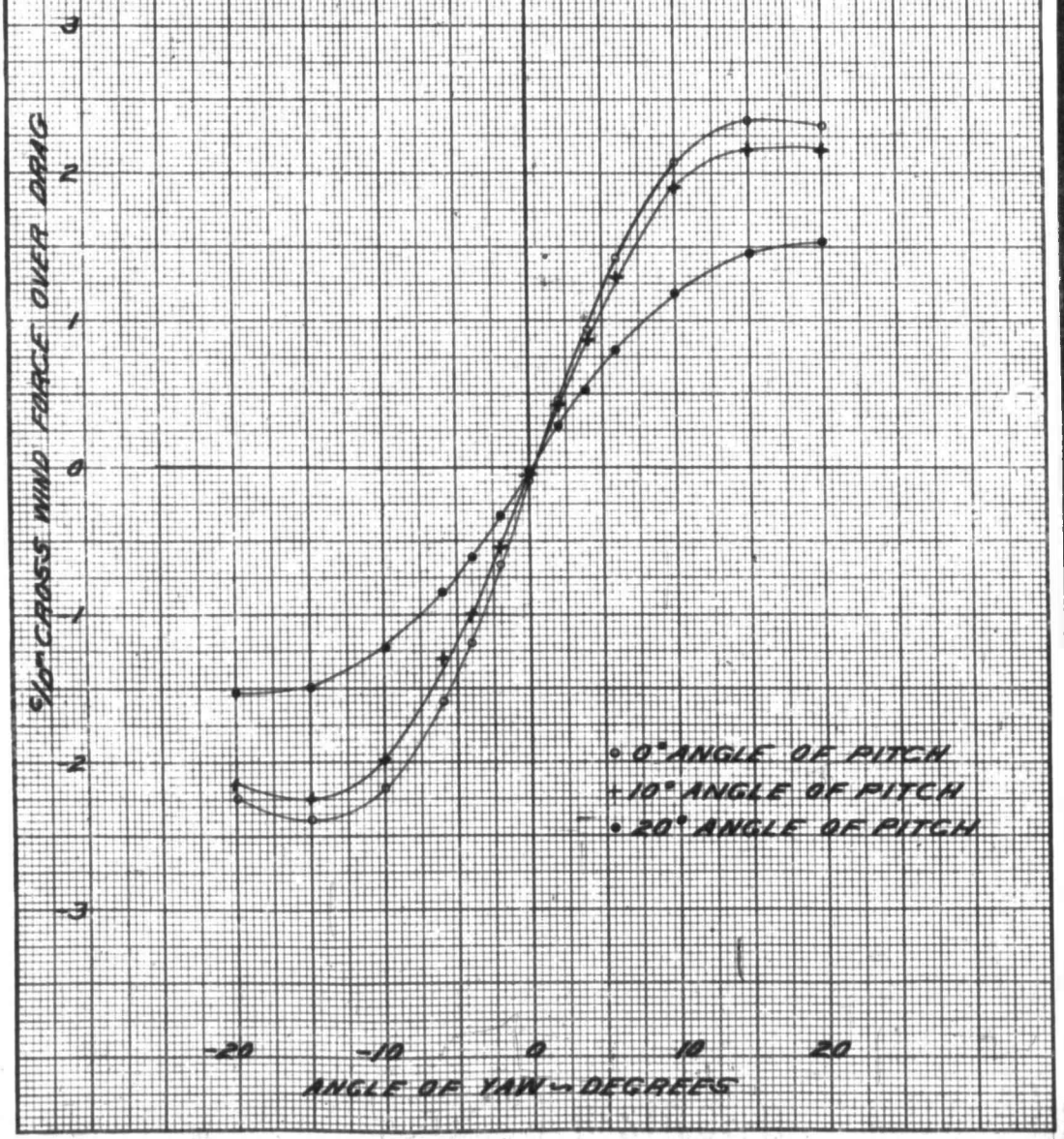


DRAG VS ANGLE OF YAW GRAPH NO. 10
MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H. STANDARD AIR
5 FINS MODEL ASSEMBLY 5A1H21-2



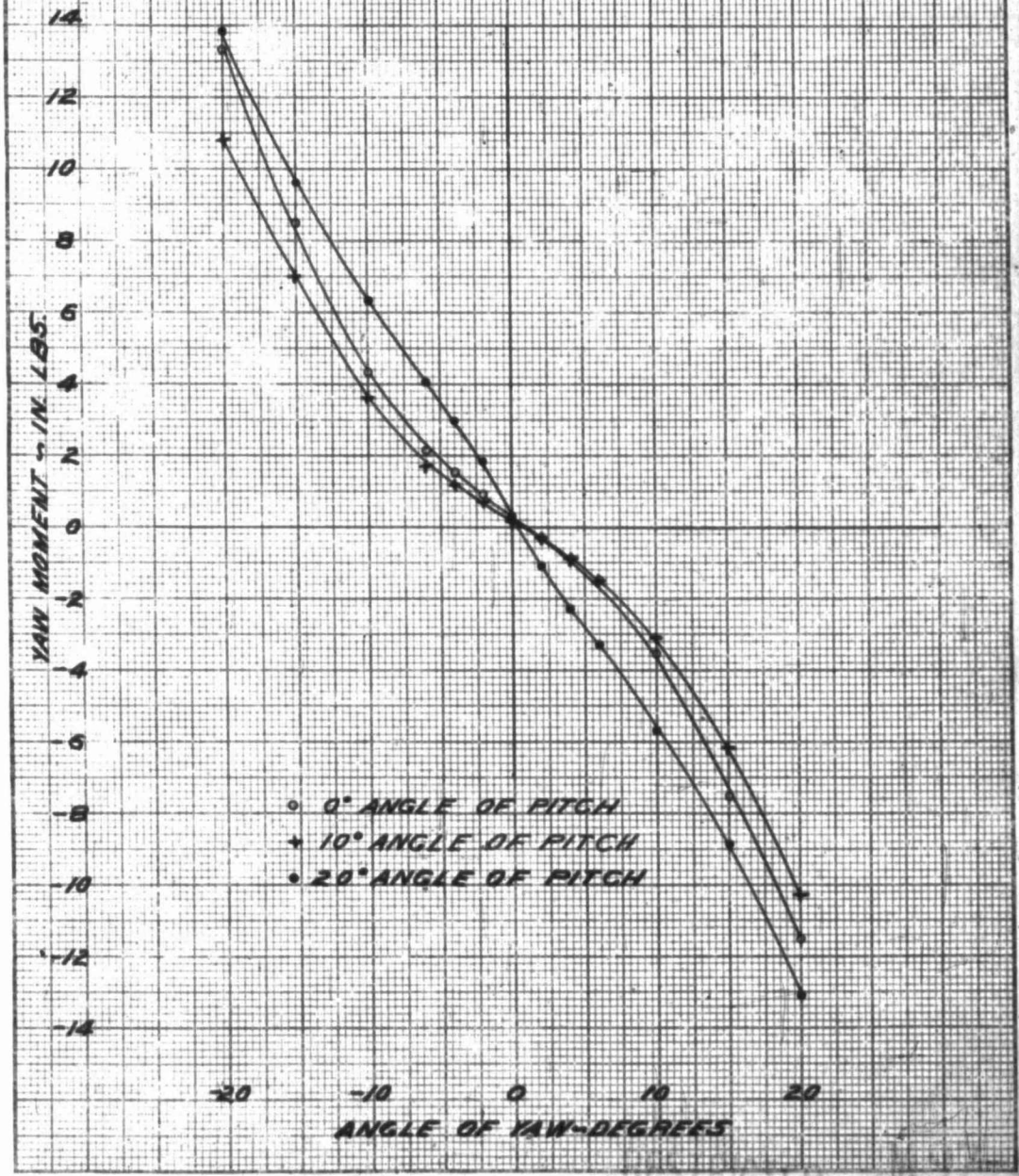
GRAPH NO. 11

C_{lo} VS ANGLE OF YAW
MODEL OF BARRAGE BALLOON
5FT WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
30 M.P.H. STANDARD AIR
5 FINS MODEL ASSEMBLY 541H21-2



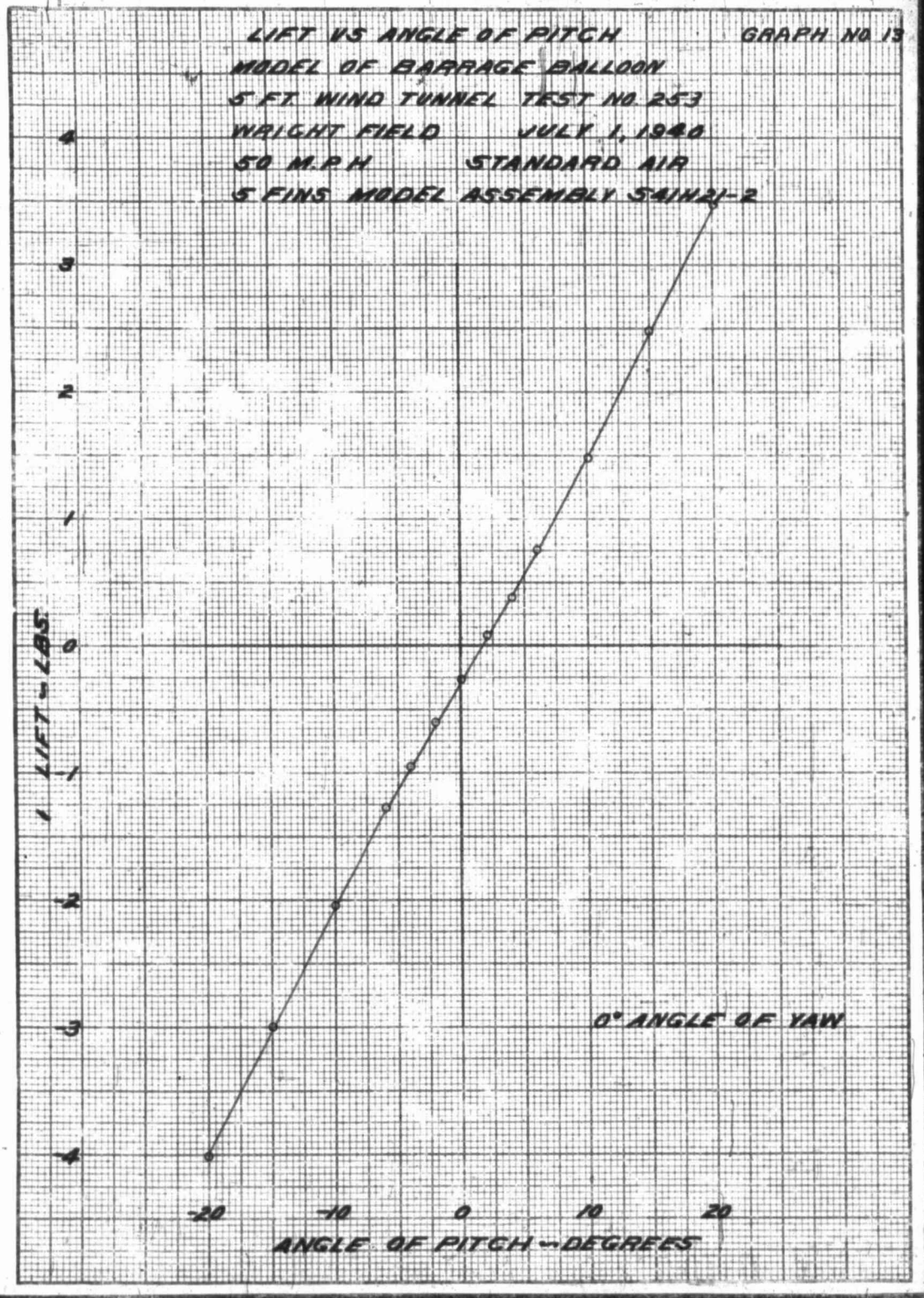
SERIAL No. 635

YAW MOMENT VS ANGLE OF YAW GRAPH NO. 12
MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H. STANDARD AIR
5 FINS MODEL ASSEMBLY 541H21-2



SERIAL No. 4636 PAGE 24

LIFT VS ANGLE OF PITCH GRAPH NO 13
MODEL OF BARRAGE BALLOON
5 FT. WIND TUNNEL TEST NO. 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H STANDARD AIR
5 FINS MODEL ASSEMBLY 541N21-2



DRAG VS ANGLE OF PITCH — GRAPH NO. 14

MODEL OF BARRAGE BALLOON

5 FT WIND TUNNEL TEST NO. 263

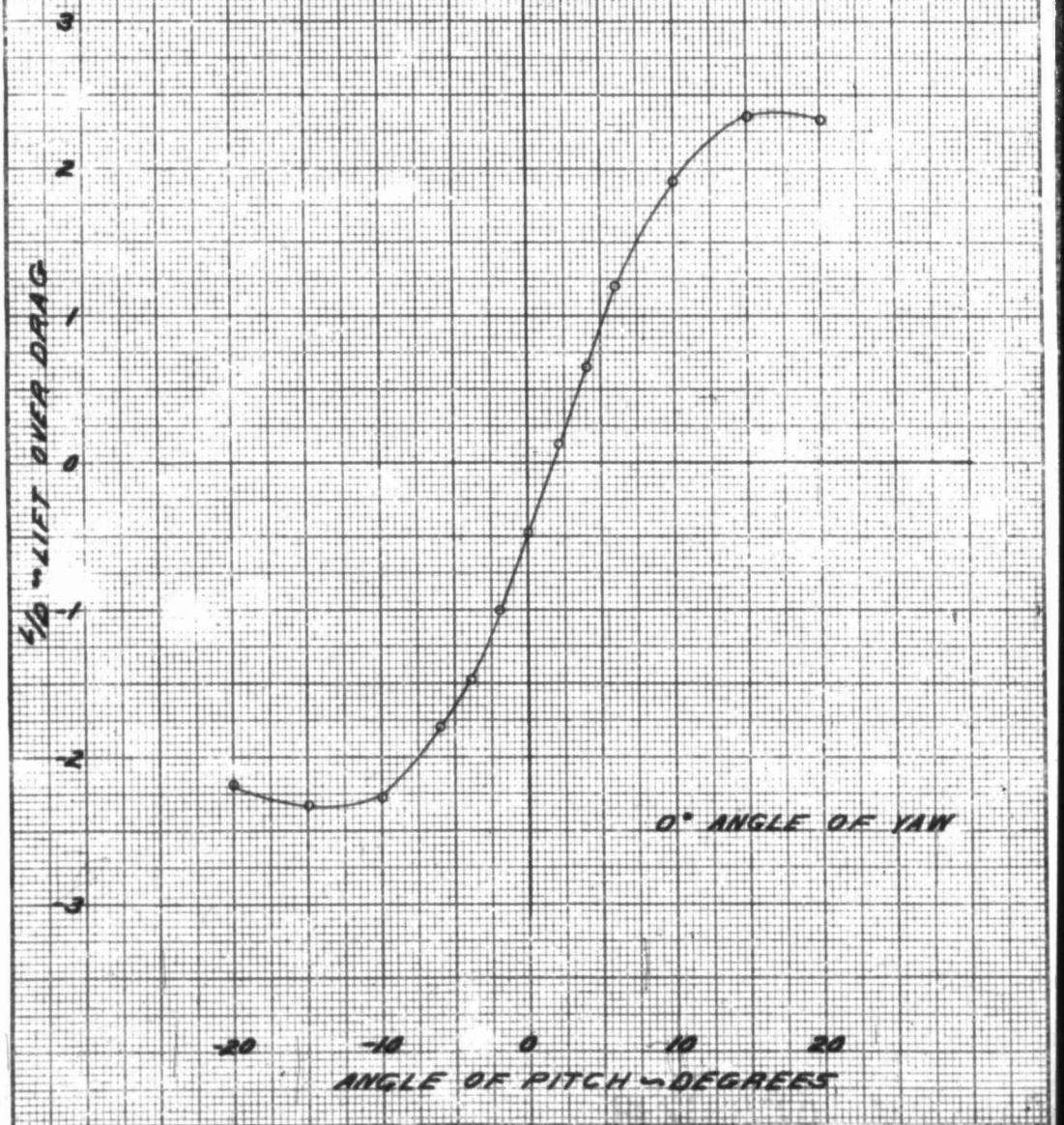
WRIGHT FIELD JULY 1, 1940

50 M.P.H. STANDARD AIR

5 FINS MODEL ASSEMBLY 541H21-2

GRAPH NO. 15

L/D VS. ANGLE OF PITCH
MODEL OF BARRAGE BALLOON
5 FT WIND TUNNEL TEST NO 253
WRIGHT FIELD JULY 1, 1940
50 M.P.H. STANDARD AIR
5 FINS MODEL ASSEMBLY 541H21-2



SERIAL NO.

PITCHING MOMENT VS. ANGLE OF PITCH GRAPH NO. 16

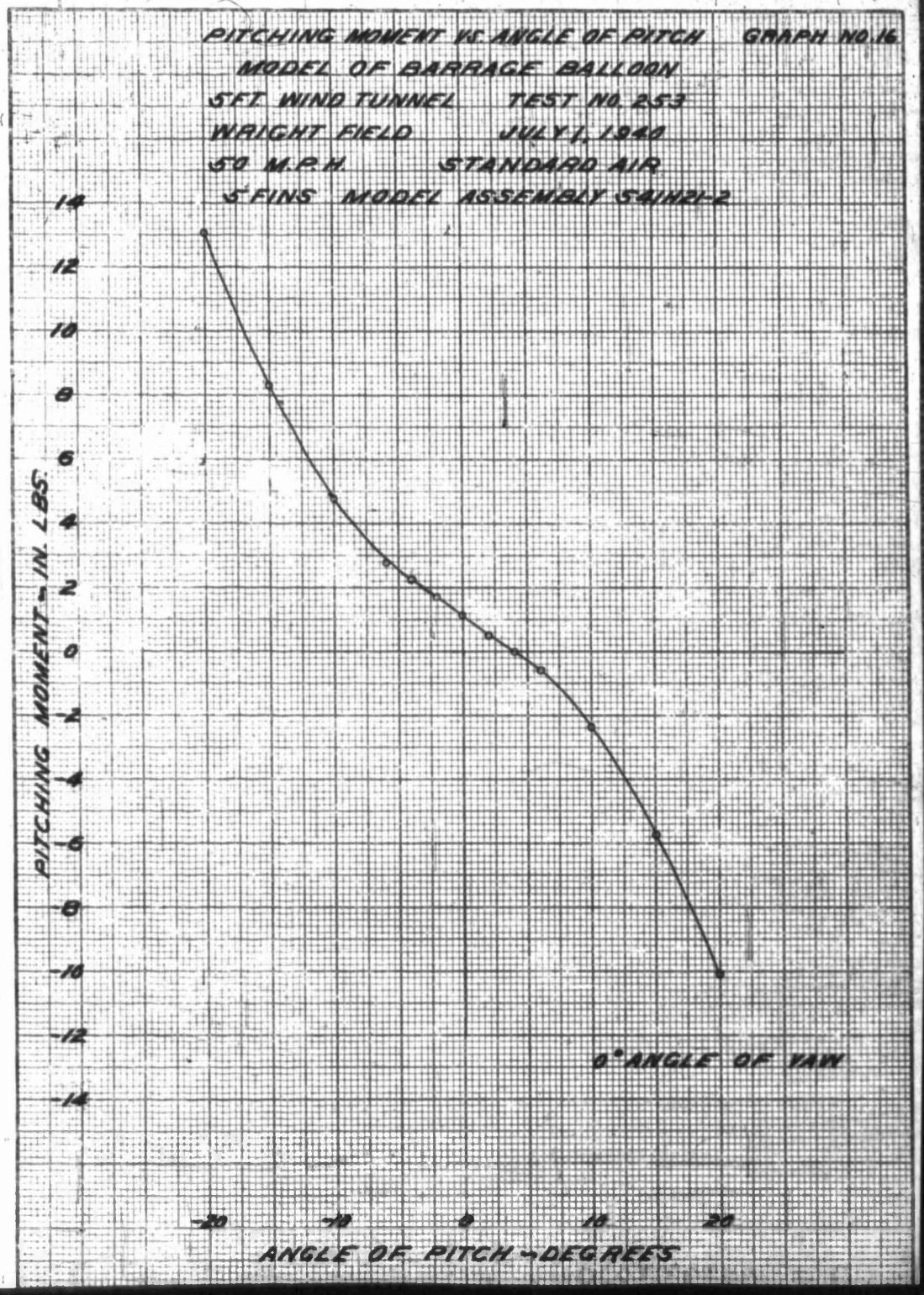
MODEL OF BARRAGE BALLOON

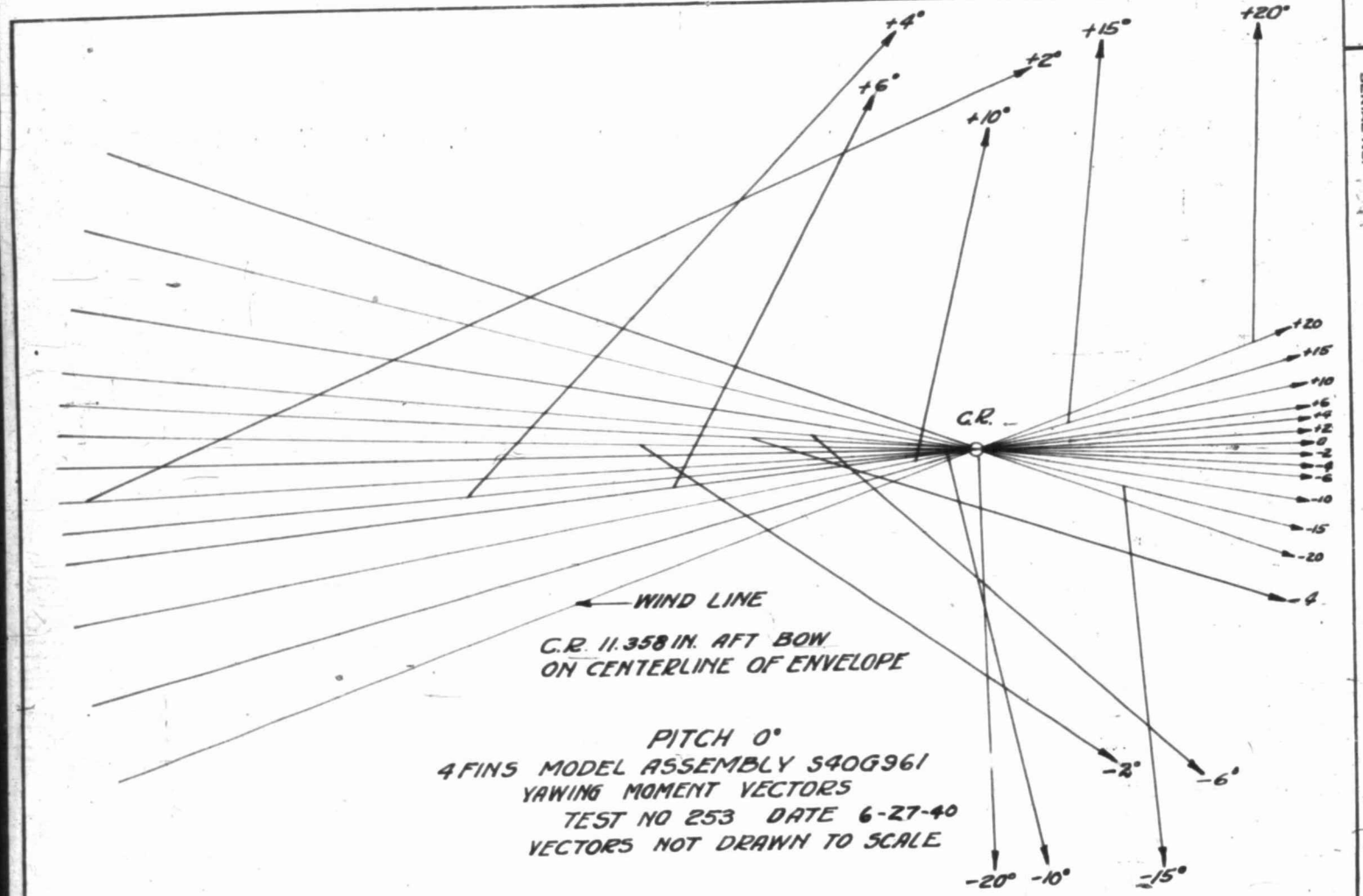
5 FT. WIND TUNNEL TEST NO. 253

WRIGHT FIELD JULY 1, 1940

50 M.P.H. STANDARD AIR

5 FINS MODEL ASSEMBLY 5A1N21-2





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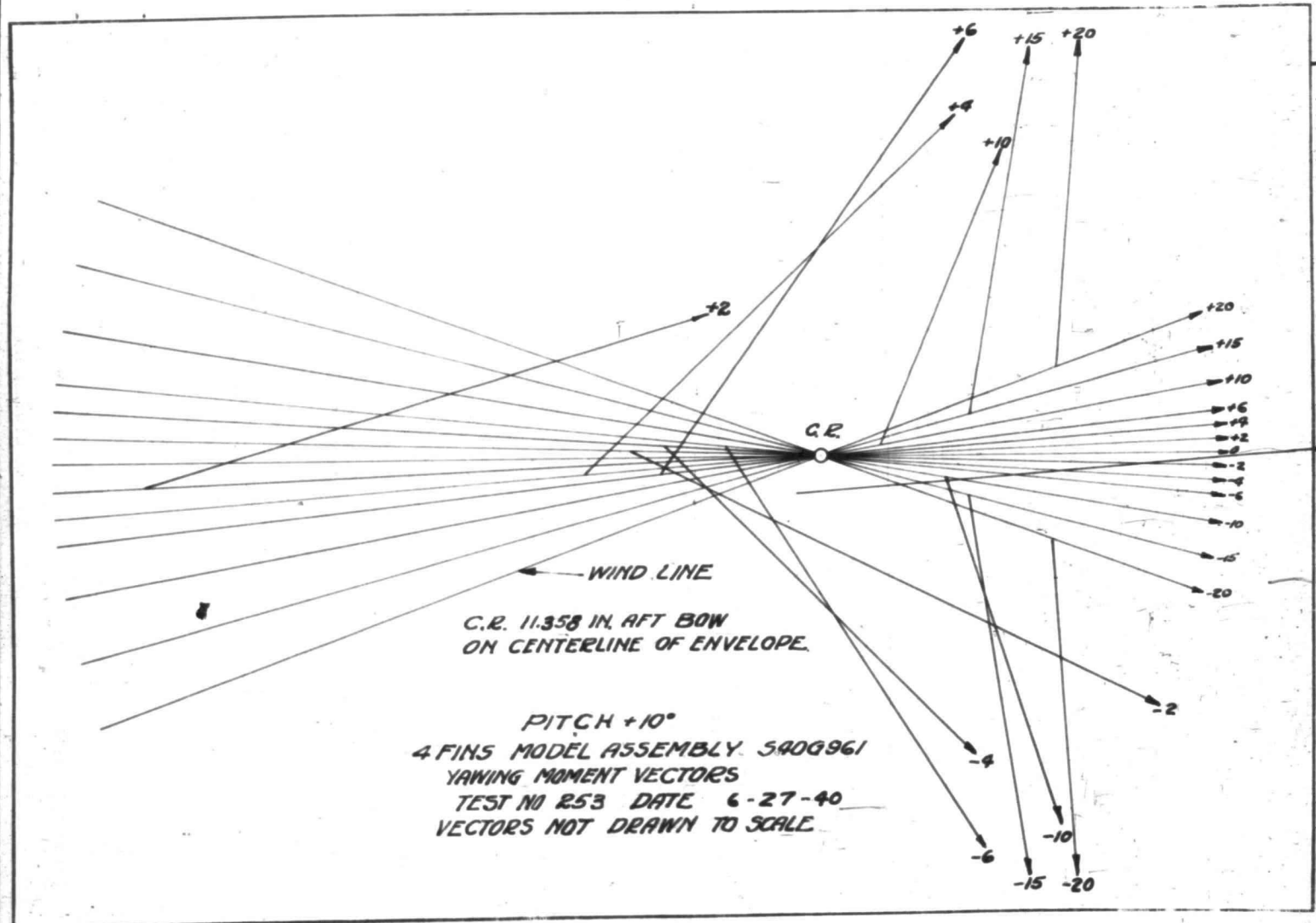
+6
+15
+20
+4
+10
+2
+20
+15
+10
+6
+4
+2
0
-2
-4
-6
-10
-15
-20
C.R.
WIND LINE
C.R. 11.358 IN. AFT BOW
ON CENTERLINE OF ENVELOPE.
PITCH +10°
4 FINS MODEL ASSEMBLY 5406961
YAWING MOMENT VECTORS
TEST NO 253 DATE 6-27-40
VECTORS NOT DRAWN TO SCALE
-2
-4
-6
-10
-15
-20
SERIAL NO.
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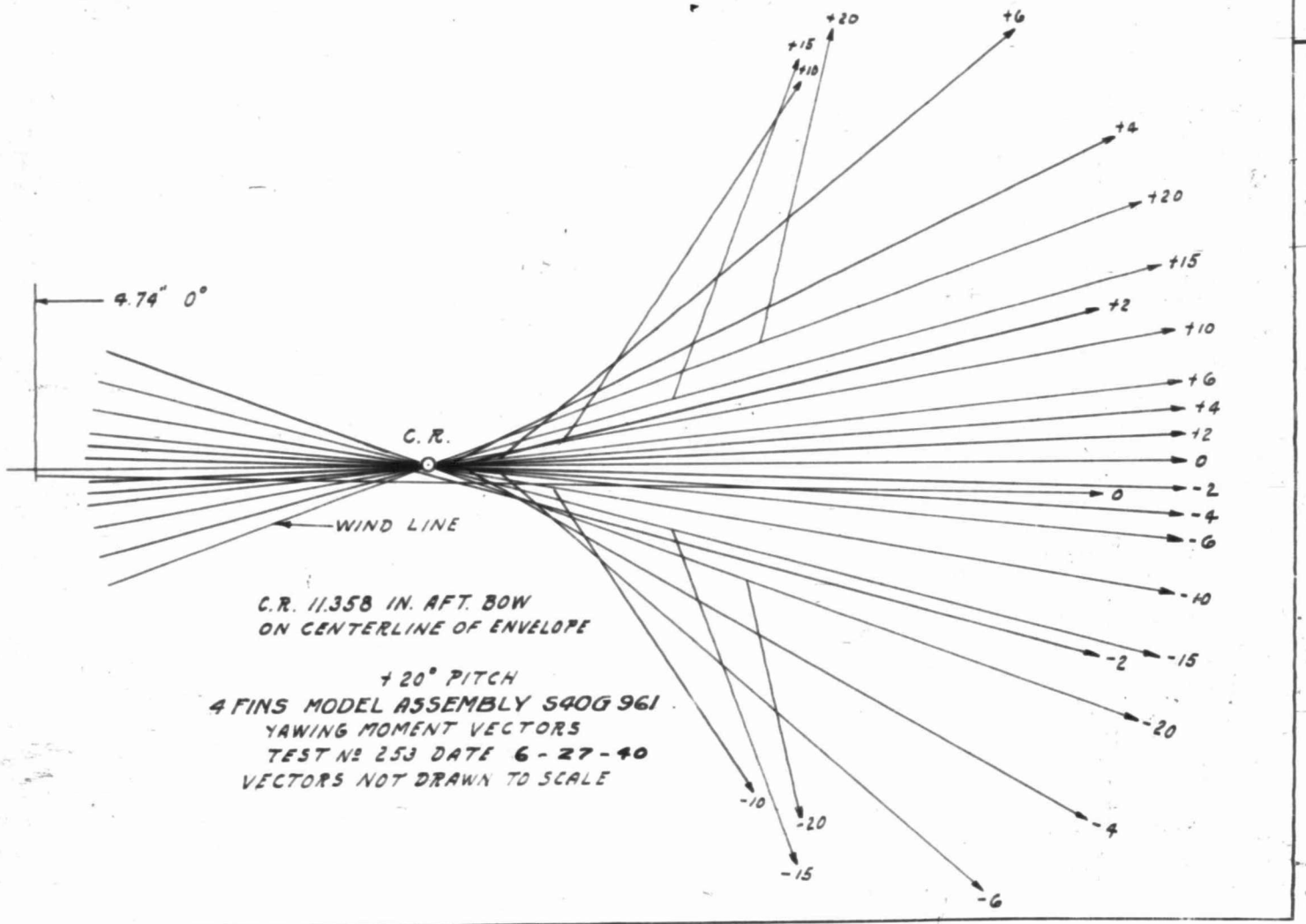


C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

+20° PITCH

4 FINS MODEL ASSEMBLY S40G 961

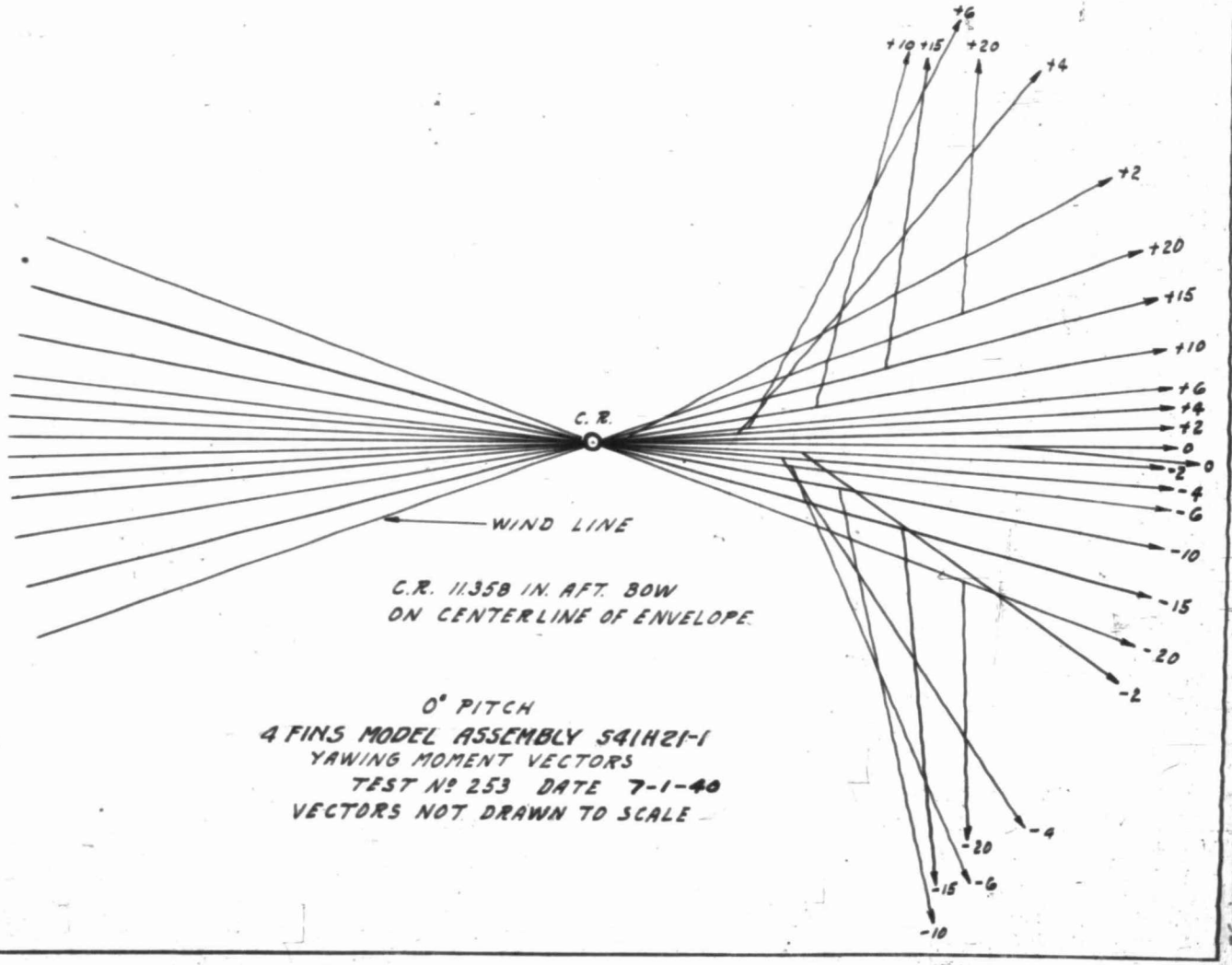
YAWING MOMENT VECTORS

TEST Nº 253 DATE 6-27-40

VECTORS NOT DRAWN TO SCALE

SERIAL NO.

PAGE



C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

0° PITCH

4 FINS MODEL ASSEMBLY 541H21-1

YAWING MOMENT VECTORS

TEST Nº 253 DATE 7-1-40

VECTORS NOT DRAWN TO SCALE

SERIAL NO.

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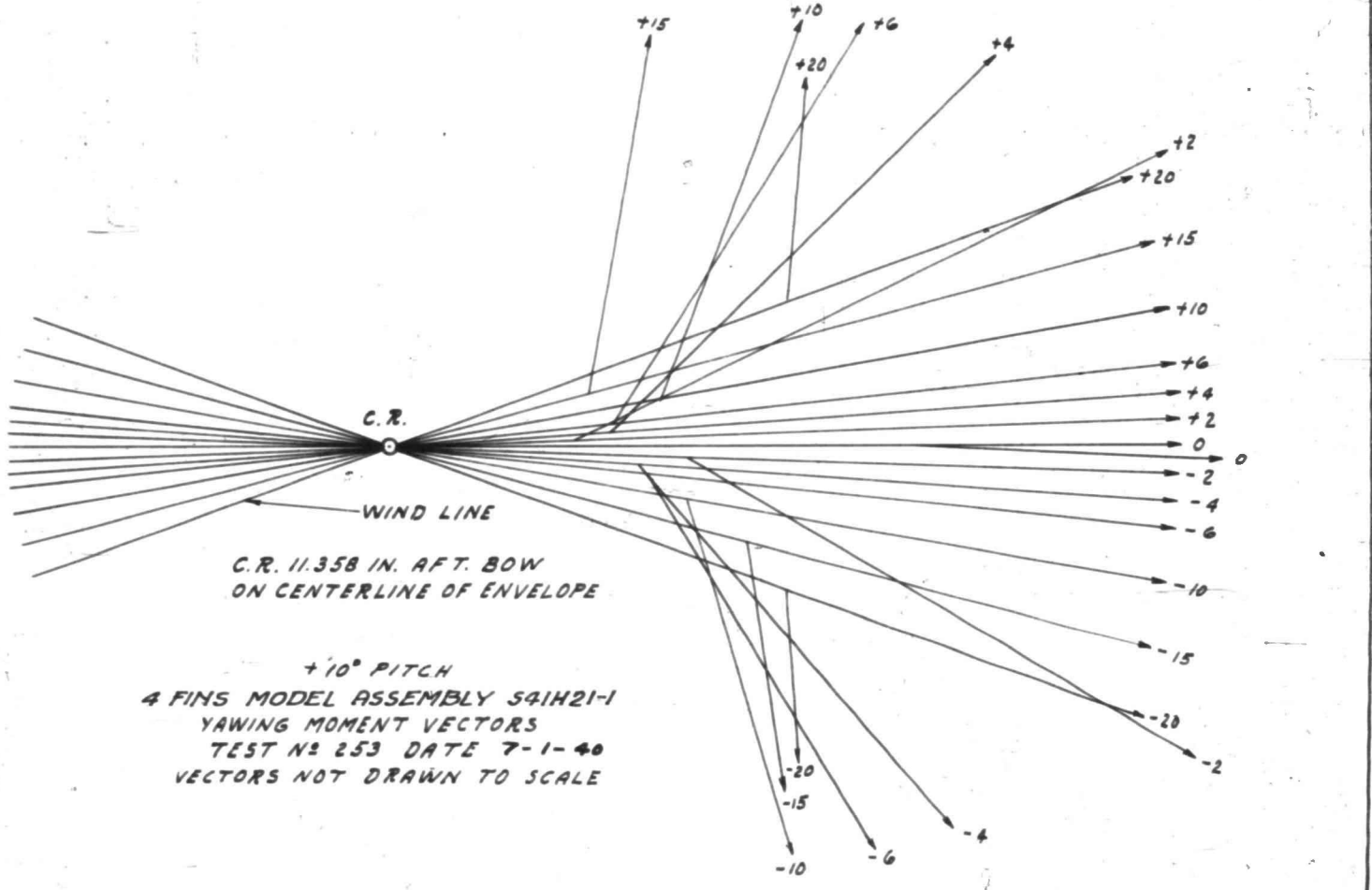
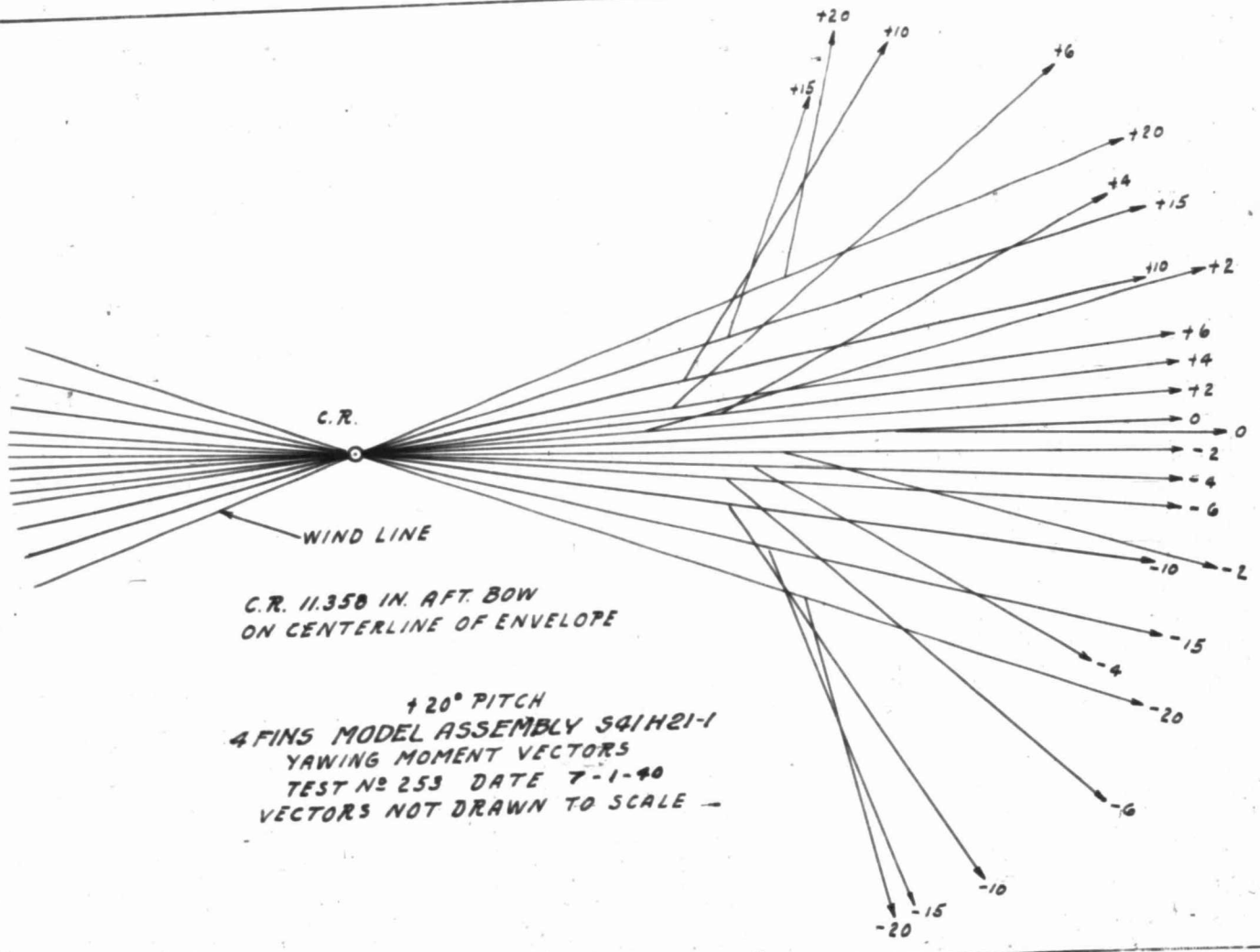


C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

+10° PITCH
4 FINS MODEL ASSEMBLY S41H21-1
YAWING MOMENT VECTORS
TEST Nº 253 DATE 7-1-40
VECTORS NOT DRAWN TO SCALE

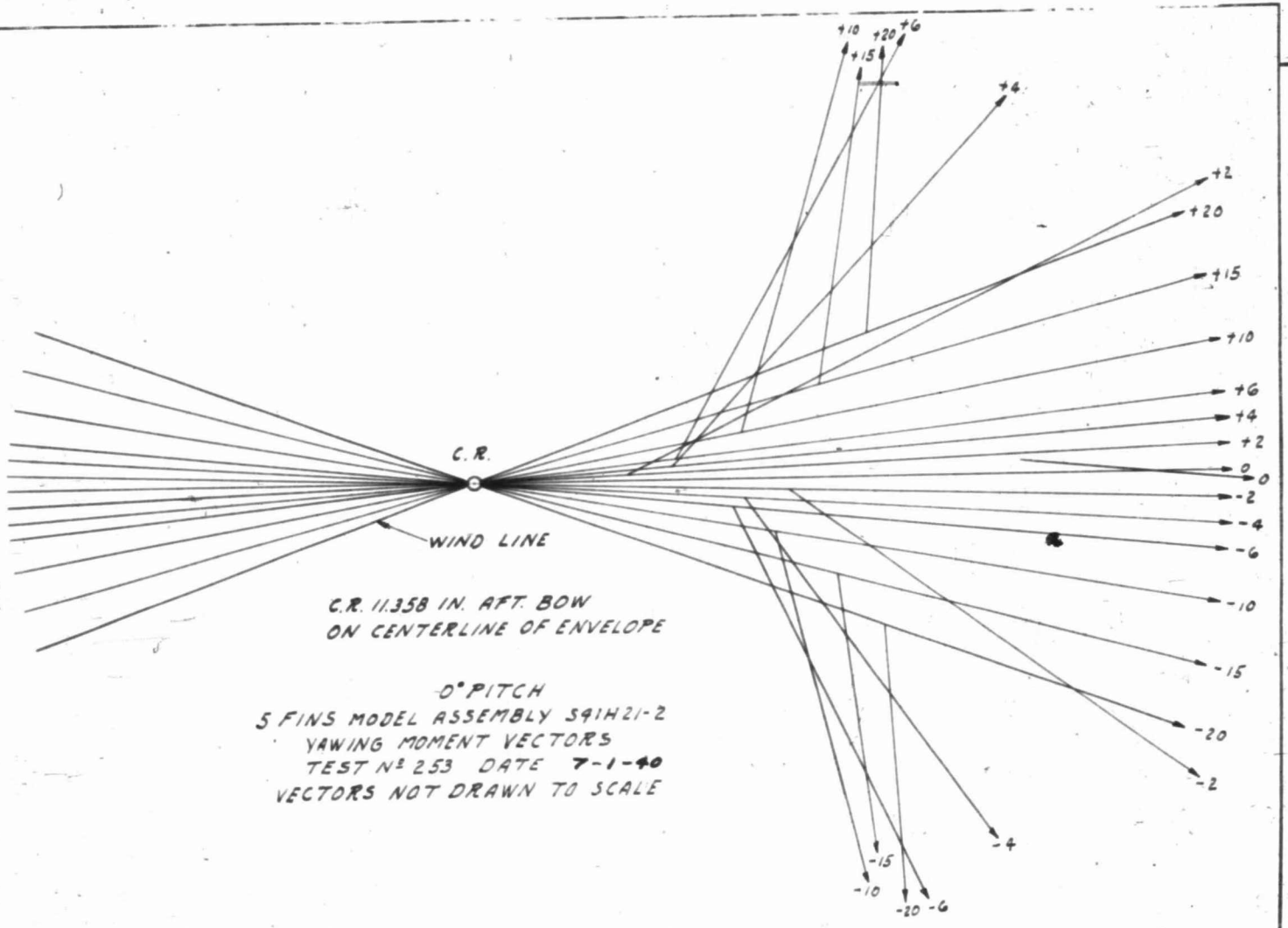
SERIAL NO. 1635



C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

+20° PITCH
4 FINS MODEL ASSEMBLY 341H21-1
YAWING MOMENT VECTORS
TEST Nº 253 DATE 7-1-40
VECTORS NOT DRAWN TO SCALE —

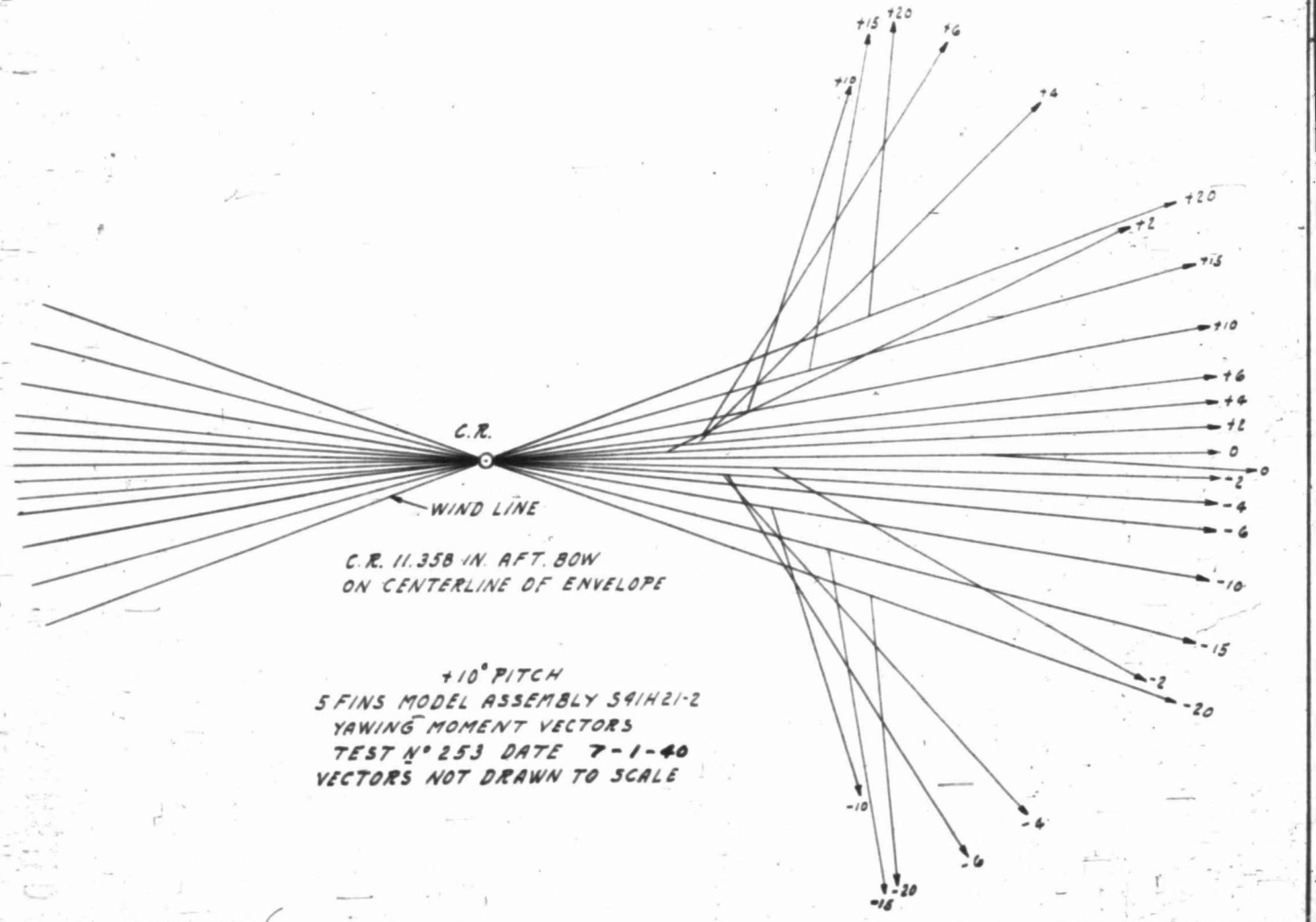
SERIAL NO.



C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

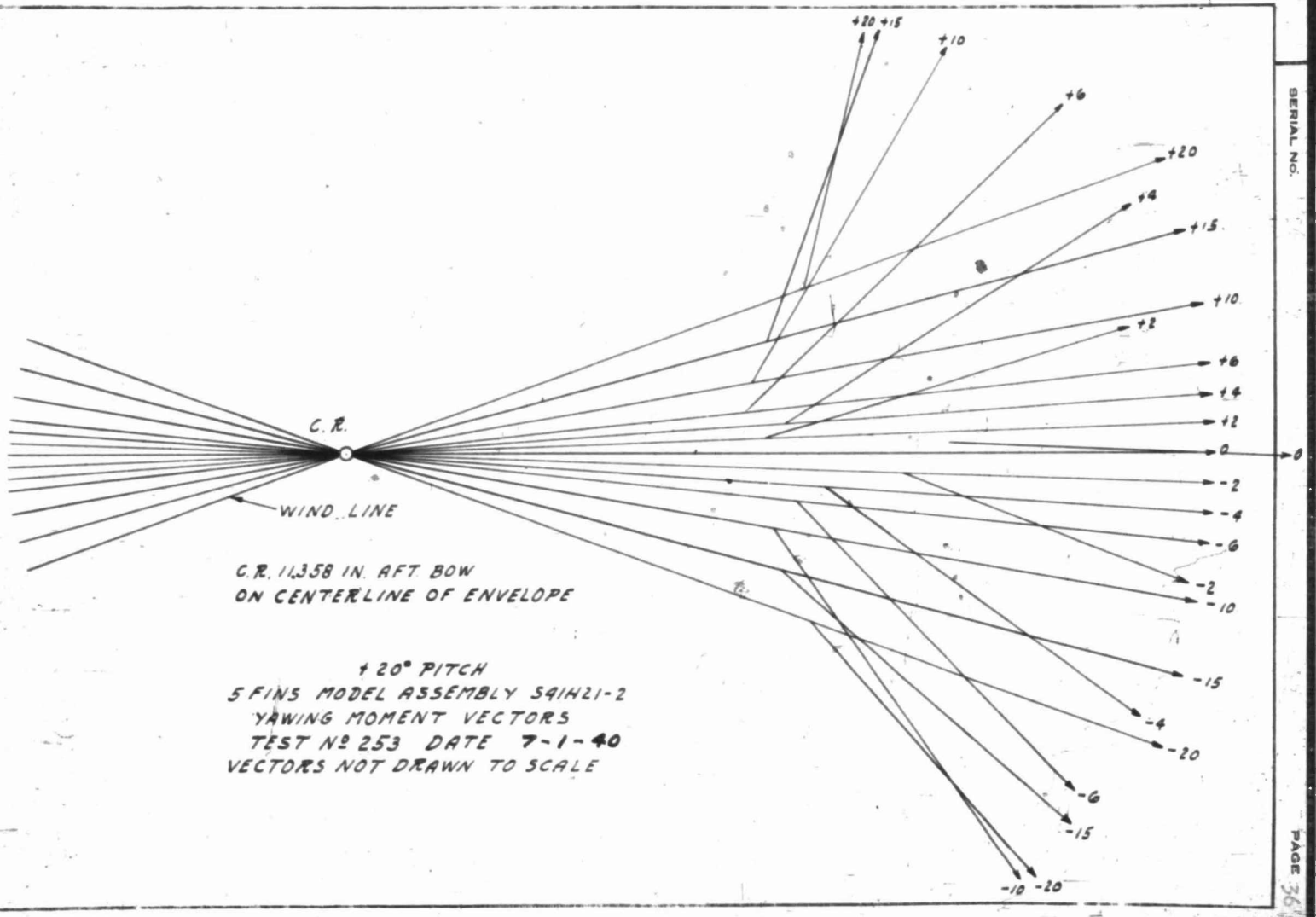
0° PITCH
5 FINS MODEL ASSEMBLY S41H21-2
YAWING MOMENT VECTORS
TEST Nº 253 DATE 7-1-40
VECTORS NOT DRAWN TO SCALE

SERIAL NO.



C.R. 11.358 IN. AFT. BOW
ON CENTERLINE OF ENVELOPE

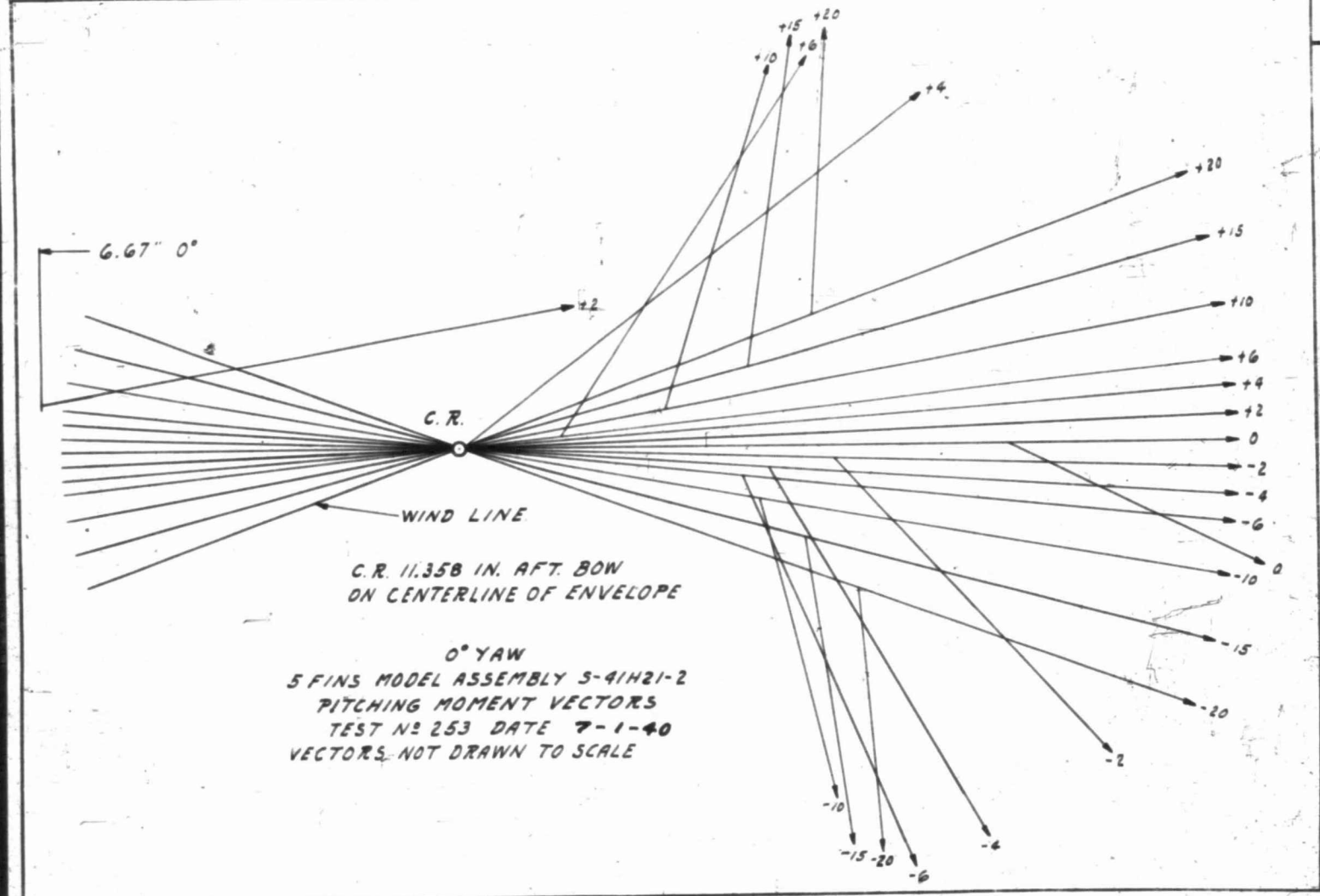
+10° PITCH
5 FINS MODEL ASSEMBLY S41H21-2
YAWING MOMENT VECTORS
TEST N° 253 DATE 7-1-40
VECTORS NOT DRAWN TO SCALE



C.R. 11.358 IN. AFT BOW
ON CENTERLINE OF ENVELOPE

+ 20° PITCH
5 FINS MODEL ASSEMBLY S91H21-2
YAWING MOMENT VECTORS
TEST Nº 253 DATE 7-1-40
VECTORS NOT DRAWN TO SCALE

SERIAL NO.



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List of Photographs

Photo Number	Title
69568	Top view of Barrage Balloon Model with four fins, AC Drawing No. SL00963; Assembly, AC Drawing No. SL00961.
69569	Top view of Barrage Balloon Model with four fins, AC Drawing No. SL0G1140; Assembly, AC Drawing No. SL1H21-1.
69570	Top view of Barrage Balloon Model with five fins, AC Drawing No. SL0G1140; Assembly, AC Drawing No. SL1H21-2.
69571	Side view of Barrage Balloon Model with five fins, AC Drawing No. SL0G1140; Assembly, AC Drawing No. SL1H21-2.

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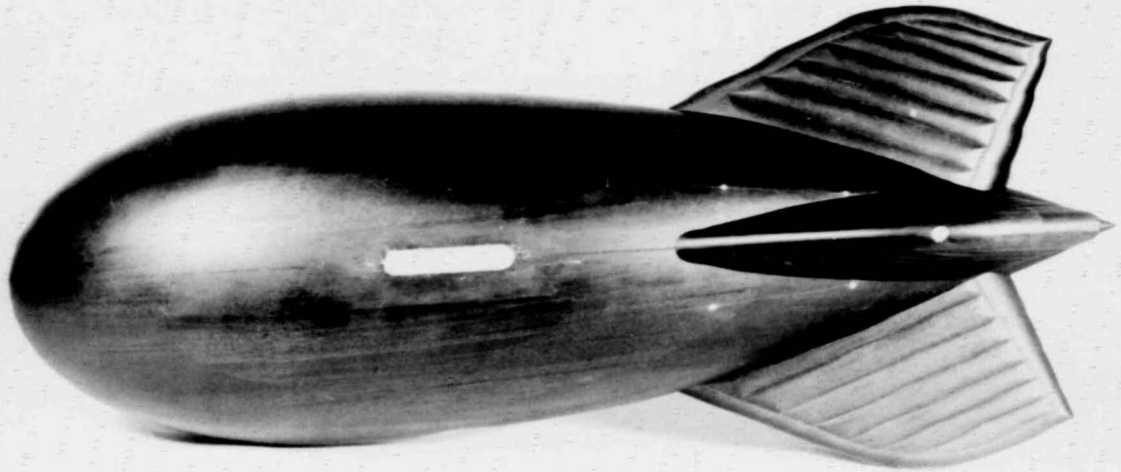
M 97-40

GD5C11



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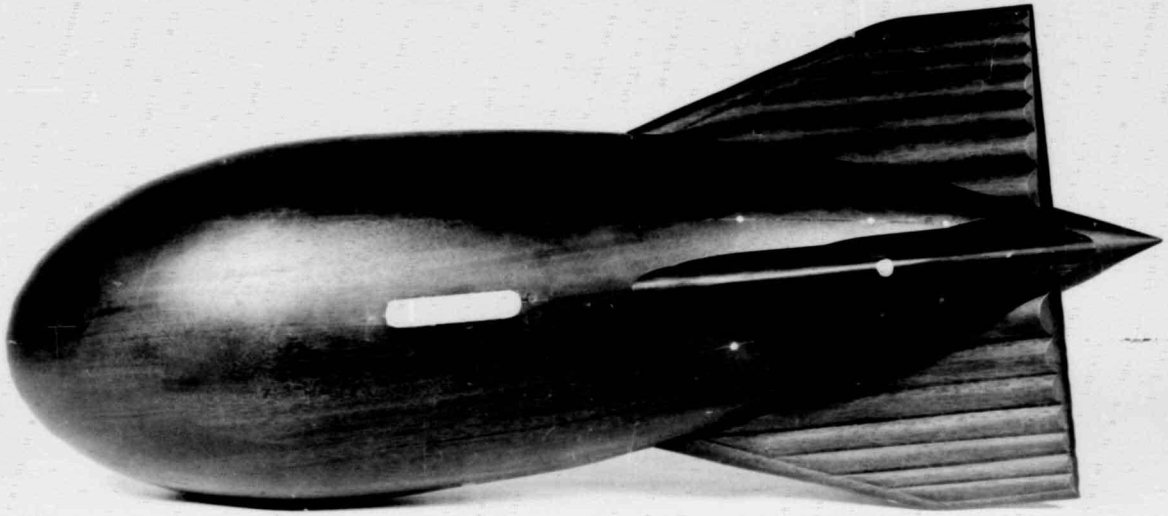

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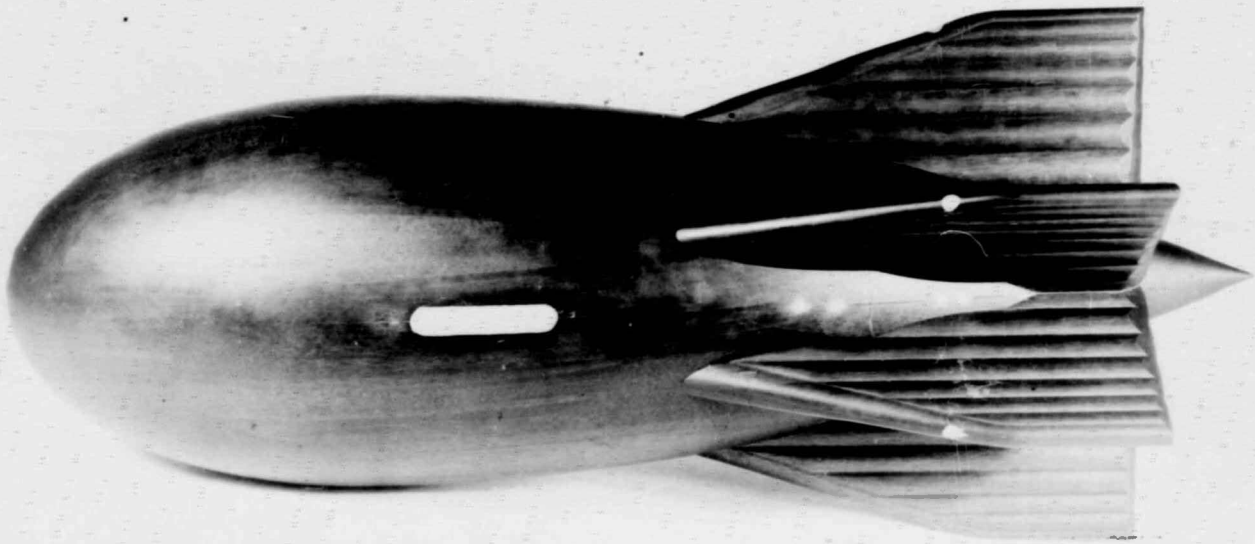

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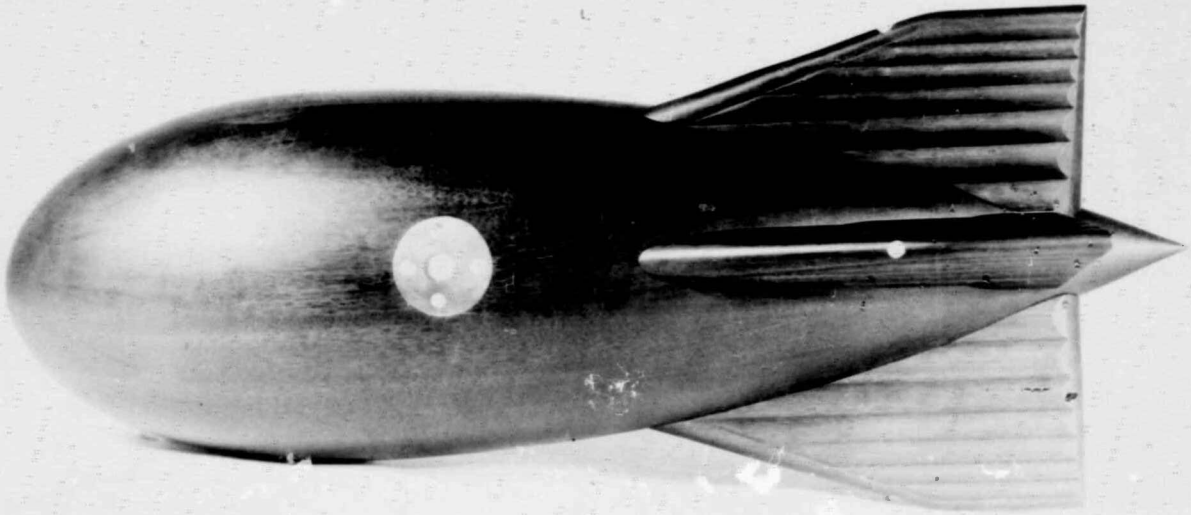

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TITLE: Test of Materiel Division Barrage Balloon Model With Three Different Tail Arrangements 5 Foot Wind Tunnel Test No. 253 129800

AUTHOR(S): Young, D. W.

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ABSTRACT:

Tests were made to determine the best of three different tail arrangements for a barrage balloon. The first arrangement consisted of two horizontal and two vertical fins. This arrangement was unstable about the center of buoyancy. The second tail arrangement, consisting of two different horizontal and vertical fins, was longitudinally and directionally stable for angles of pitch or yaw from 0 to ± 20°. Higher angles were not tested. The third tail arrangement consisted of two horizontal, one upper and two lower fins. The only difference between this condition and the previous one was the additional fin on the bottom. This change had no appreciable effect on the longitudinal stability but increased the directional stability about 40%. The drag was also increased about 20%.

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TECHNICAL INDEX

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