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Test of 1/37.5-Scale Materiel Division Design Barrage Ballons X41F1365, X41F1366,
and X41F1367 (Five-Foot Wind Tunnel Test Nos. 317 and 324)
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Air Materiel Command, Wright-Patterson Air Force Base, Dayton, O

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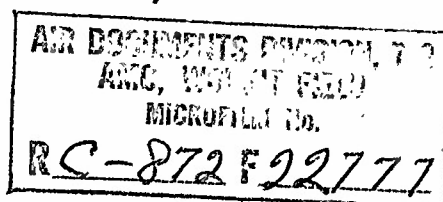
R-4774

May '42 Restr. U.S. Eng. 71 photos, tables, diagr, graphs

Tests were conducted to determine the best location for the maximum diameter of the envelope (barrage ballon) with regard to stability, and also the change in longitudinal trim angle caused by a change in the horizontal fin incidence. Results indicate an improvement in longitudinal and directional stability as maximum diameter is moved forward, and an increase in trim angle about the flying cable junction of 1° per degree negative horizontal fin movement.

Copies of this report obtainable from Air Documents Division; Attn: MCIDXD
Lighter-Than-Air (40) Balloons, Barrage - Stability
and control (15653)

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DATE May 16, 1942

WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

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AIR CORPS TECHNICAL REPORT

No. 4774

TEST OF 1/37.5-SCALE MATERIEL DIVISION DESIGN
BARRAGE BALLOONS XL1F1365, XL1F1366, AND XL1F1367
(FIVE-FOOT WIND TUNNEL TEST NOS. 317 AND 324)
Title

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Experimental

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TEST OF 1/37.5-SCALE MODEL OF
MATERIEL DIVISION DESIGN BARRAGE BALLOONS,
NO'S. X41F1365, X41F1366, AND X41F1367
(FIVE-FOOT WIND TUNNEL TEST NO'S. 317 & 324)

SUMMARY

Two series of wind tunnel tests were undertaken by the Materiel Division. The first series, Test No. 317, investigated the effect on directional and longitudinal stability caused by moving the maximum diameter of the envelope forward. The second series, Test No. 324, was run at a later date to determine the effect on the longitudinal trim and stability, placing the horizontal fins at a negative angle of incidence.

Results of the first series of tests on the three envelopes, each with the same fins, indicates an improvement in longitudinal and directional stability as the maximum diameter is moved forward.

The second series of tests indicates an increase in trim angle, about the flying cable junction, of one degree for each degree of negative movement of the horizontal fins. This relation was found to hold for both models which were tested, Nos. X41F1365 and X41F1366.

DATES AND PLACE OF TEST

The first test was conducted in the Five-Foot Wind Tunnel at Wright Field from November 1 to 4, 1941, and the second test was run on December 22, 1941.

OBJECT

The object of these tests was first to determine the best location for the maximum diameter of the envelope with regard to stability and second,

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to determine the change in longitudinal trim angle caused by a change in the incidence of the horizontal fins.

DESCRIPTION OF MODEL

Balloon	X41F1365	X41F1366	X41F1367
Length (inches)	24.3	24.21	25.3
Maximum Diameter (inches)	9.0	9.00	9.0
Position of Max. Diameter (Percentage of length)	30.0	28.10	25.8
C.R. Location (Inches aft of nose)	9.477	9.00	9.199

The envelopes and fins of the three models were made of mahogany, and the envelope was hollowed out to a wall thickness of approximately 0.8 inch. The seams of the fins were parallel to the contour of the envelope at the point of attachment. The same fins were used on the three models. For the tests with horizontal fins placed at -3 and -6 degrees to the center line, mahogany shoes or fairings were made to join the fins to the envelope.

PROCEDURE

The models were mounted on a 7/16-inch diameter spindle attached at the center of buoyancy of the envelope, referred to in this report as the "C.R." The cable junction, about which the full-scale balloons are expected to be flown is located for the model 10.24 inches below the center line of the envelope and 7.36 inches aft of the nose for all three envelopes.

In test No. 317 for each of the conditions tested, cross wind force, drag, and yawing moments about the C.R. were observed for a range of yaw angles from 0 to ± 20 degrees with the model set at 0, $+10$, and $+20$ degrees pitch. Lift, drag, and pitching moments were also observed for a range of pitch angles from 0 to ± 20 degrees at zero degrees yaw. The test air speed was 50 miles per hour for all tests, except the yawing moment tests conducted

on the X41F1366 model, which were made at an air speed of 60 miles per hour.

Test No. 324 consisted of tests to determine the effect of incidence of the horizontal fins. Models X41F1365 and X41F1366 were both tested with horizontal fins set at -3 and -6 degrees. Lift, drag, and pitching moments were observed for a range of pitch angles from -20 to +20 degrees, at zero degrees yaw. No yawing moment tests were made for these conditions.

All data were corrected for support interference.

DISCUSSION OF RESULTS

Graphs 1 through 8 are values obtained from Model X41F1365, which has a maximum diameter at 30.0 percent aft of the nose. Graphs 9 through 16 give the values for Model X41F1366, the maximum diameter of which is 28.1 percent aft of the nose.

Graphs 17 through 24 include the values obtained from model X41F1367, which has its maximum diameter at 25.8 percent aft of the nose.

Comparison of graph 17 with graphs 1 and 9, in each case a plot of the yawing moments about the C.R., indicates some improvement as to directional stability for the X41F1367 model. Similarly, a comparison of graphs 5, 13, and 21 indicates a slight improvement in longitudinal stability.

The yawing moments were transferred from the C.R. to the flying cable junction for Model X41F1365. Inspection of these moments, graph 33, indicates the model is directionally stable at zero degrees pitch for all yaw angles tested, except from -2 to +3 degrees, when it is neutrally stable. At +10 degrees pitch the model becomes directionally unstable for angles of yaw from -4 to +4 degrees. Then at +20 degrees pitch it is directionally stable through the entire range of yaw angles tested. In a major portion of tests conducted on other barrage balloon models, the directional stability improves as the pitch angle is increased. However, in this test the directional stability decreased as the pitch angle was increased from 0 to +10 Deg. then in-

creased with an increase in pitch angle from +10 to +20 degrees.

Graph 34 is a plot of the pitching moments about the flying cable junction for the X41F1365 model with fins at zero, -3, and -6 degrees. This graph indicates that a horizontal fin setting of 0 degrees, trims the model for +9 degrees pitch, whereas a -3 degree setting trims for +12.5 degrees and a -6 degree setting produces trim at +15.5 degrees pitch. Briefly, a decrease of one degree in the incidence increases the angle of pitch for trim approximately one degree. Graph 34 also indicates that longitudinal stability, at the angle of pitch for trim, is not altered appreciably by a change in incidence of the horizontal fins. However, at zero degrees pitch, the stability is improved as the incidence of the horizontal fins is increased negatively. The moments given in this report are aerodynamic moments only and do not include the static moment of the gas, envelope, and fin combination.

CONCLUSION

Both directional and longitudinal stability are improved slightly as the maximum diameter of the envelope is moved forward from 30 percent to 25.8 percent of the envelope length.

The angle of longitudinal trim is increased approximately one degree for each degree decrease in incidence of the horizontal fins.

REFERENCES

<u>A.C. Drawing No.</u>	<u>Title</u>
X41F1365	Model Assembly, Barrage Balloon, Wind Tunnel, Envelope A
X41F1366	Model Assembly, Barrage Balloon, Wind Tunnel, Envelope B
X41F1367	Model, Assembly, Barrage Balloon, Wind Tunnel, Envelope C

RESTRICTED 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_n	= angle of elevator relative to stabilizer—deg.
i_s	= 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
Δa	= Prandtl's wall correction for angle of attack $= \frac{57.3 S C_L}{2 \pi d^2} \left[1 + \frac{3}{16} \left(\frac{b}{d} \right)^4 + \right]$
ΔC_D	= Prandtl's wall correction for drag coefficient $= \frac{S C_L^2}{2 \pi d^2} \left[1 + \frac{3}{16} \left(\frac{b}{d} \right)^4 + \right]$
L/D	= lift/drag ratio = C_L / C_D
C_m	= pitching moment coefficient = $M / q b S$
C_n	= yawing moment coefficient = $N / q b S$
C_l	= rolling moment coefficient = $L / q b S$
$\Delta C_m / \Delta \alpha$	= 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
$\Delta C_l / \Delta \delta_R$	= slope of "yawing moment due to rudder versus rudder angle" curve at zero rudder angle
C_{Di}	= induced drag coefficient = $\frac{C_L^2}{\pi E. M. A. R.}$
C_{Do}	= profile drag coefficient
C_{Dp}	= parasite drag coefficient = $C_D - (C_{Di} + C_{Do})$
A_e	= equivalent flat plate area = $C_{Dp} S / 1.279$

Positive 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

Wright File 8-17-37-190

Aug. 1, 1937

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TABLE I

MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1F1365

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graphs 1, 2, 3, 4

Angle of Yaw Deg.	0° Pitch				+10° Pitch				+20° Pitch			
	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.
0	-.020	.296	-.07	-.32	+.013	.395	+.03	-.25	+.022	.918	+.02	-.22
+2	+.220	.301	+.73	+.24	.219	.402	.54	+.35	.249	.927	.27	.00
4	.479	.315	1.52	.52	.451	.420	1.07	.96	.503	.943	.53	+.11
6	.761	.354	2.15	.62	.746	.453	1.65	.83	.778	.972	.80	-.08
10	1.394	.468	2.98	.00	1.403	.576	2.44	-.22	1.364	1.084	1.26	-.95
15	2.353	.743	3.16	-2.52	2.341	.848	2.76	-2.91	2.309	1.373	1.68	-3.89
20	3.424	1.179	2.90	-6.66	3.339	1.285	2.60	-6.74	3.223	1.817	1.77	-7.71
-2	-.256	.305	-.84	-.81	-.200	.399	-.50	-.87	-.206	.924	-.22	-.51
-4	-.529	.322	-1.64	-1.04	-.419	.419	-1.00	-1.47	-.443	.939	-.47	-.69
-6	-.812	.359	-2.26	-1.22	-.699	.452	-1.55	-1.43	-.716	.968	-.74	-.53
-10	-1.427	.467	-3.06	-.46	-1.317	.552	-2.39	-.58	-1.319	1.058	-1.25	+.44
-15	-2.395	.731	-3.28	+2.17	-2.276	.812	-2.80	+2.07	-2.252	1.323	-1.70	3.22
-20	-3.456	1.169	-2.96	6.42	-3.302	1.237	-2.67	6.22	-3.196	1.765	-1.81	7.24

TABLE II

MATERIAL DIVISION DESIGN BARRAGE BALLOON XL1F1365

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graphs 5, 6, 7, 8

Angle of Pitch Deg.	0° Yaw			
	Lift	Net Drag	L/D	Pitching Moment About C.R.
	Lb.	Lb.		Lb.-In.
0	-.016	.298	-.05	-.28
+2	+.131	.309	+.42	+.54
4	.346	.322	1.07	.90
6	.603	.348	1.73	.72
10	1.184	.436	2.72	-.63
15	2.013	.650	3.10	-3.45
20	2.832	.995	2.90	-7.13
-2	-.179	.306	-.59	-1.03
-4	-.405	.326	-1.24	-1.16
-6	-.680	.350	-1.94	-.76
-10	-1.256	.439	-2.86	+.45
-15	-2.081	.651	-3.20	3.47
-20	-2.964	1.007	-2.95	7.42

TABLE III
MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1FT366

60 M.P.H. Standard Air
Test No. 317

Wright Field, November 3, 1941.
Plotted on Graphs 9, 10, 11, 12

Angle of Yaw Deg.	0° Pitch			+10° Pitch			+20° Pitch		
	Cross Wind Force Lb.	Net Drag Lb.	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	Yaw Moment About C.R. Lb.-In.
0	-0.22	.409	-.04	-.013	.566	-.03	-.031	1.232	-.03
+2	-.721	.421	+.76	+.231	.562	+.41	+.273	1.235	+.23
4	-.717	.449	1.60	.510	.576	.89	.563	1.255	.45
6	1.137	.504	2.20	.917	.617	1.49	.929	1.298	.72
10	2.004	.666	3.01	1.829	.771	2.37	1.754	1.431	1.23
15	3.374	1.044	3.20	3.113	1.132	2.75	3.029	1.799	1.68
18	3.834	1.140	3.16	3.646	1.329	2.74	3.566	2.010	1.77
17									
-2	-.357	.423	-.84	-.236	.571	-.50	-.321	1.245	-.28
-4	-.727	.454	-1.60	-.577	.595	-1.03	-.621	1.267	-.49
-6	-1.140	.503	-2.24	-1.006	.643	-1.57	-.972	1.310	-.74
-10	-2.004	.643	-3.12	-1.832	.727	-2.40	-1.798	1.440	-1.25
-15	-3.236	1.024	-3.22	-3.240	1.153	-2.81	-3.126	1.807	-1.73
-20	-4.719	1.611	-2.93	-4.565	1.725	-2.65	-4.463	2.419	-1.85

TABLE IV

MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1F1366

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 3, 1941
Plotted on Graphs 13, 14, 15, 16

Angle of Pitch Deg.	0° Yaw			
	Lift	Net Drag	L/D	Pitching Moment About C.R. Lb.-In.
	Lb.	Lb.		
0	-.011	.290	-.05	-.36
+2	+.150	.297	+.51	+.09
4	.347	.317	1.09	.29
6	.546	.336	1.63	.54
10	1.065	.419	2.54	-.52
15	1.851	.610	3.03	-2.51
20	2.619	.918	2.89	-7.10
-2	-.214	.302	-.71	-.66
-4	-.383	.319	-1.20	-1.15
-6	-.593	.343	-1.73	-1.12
-10	-1.166	.427	-2.73	+.45
-15	-1.955	.625	-3.13	3.49
-20	-2.777	.968	-2.87	7.37

TABLE V

MATERIEL DIVISION DESIGN BARAGE BALLOON XL171367

30 M.P.H. Standard Air
Test No. 317

Wright Field, November 1, 1941
Plotted on Graphs 17, 18, 19, 20

Angle of Yaw Deg.	0° Pitch				+10° Pitch				+20° Pitch			
	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.	Cross Wind Force Lb.	Net Drag Lb.	C/D	Yaw Moment About C.R. Lb.-In.
-2	-0.53	.302	-1.11	-.34	-.046	.392	-.12	-.31	-.061	.912	-.07	-.02
4	.197	.394	+1.65	+1.08	+1.161	.394	+1.41	+1.32	+1.147	.925	+1.16	+1.14
6	.457	.320	1.43	.45	.383	.410	.93	.89	.385	.930	.41	.33
10	.730	.351	2.03	.53	.632	.440	1.55	.79	.656	.964	.68	.22
15	1.400	.466	3.00	-.68	1.331	.546	2.44	-.56	1.265	1.056	1.20	-1.01
20	2.383	.728	3.27	-3.62	2.310	.784	2.95	-3.66	2.250	1.329	1.69	-4.47
	3.475	1.155	2.95	-8.08	3.333	1.241	2.69	-8.10	3.230	1.749	1.85	-8.80
-2	-0.286	.308	-.93	-.79	-.247	.402	-.51	-.86	-.283	.922	-.31	-.40
-4	-.540	.329	-1.64	-1.12	-.420	.419	-1.15	-1.33	-.530	.945	-.56	-.48
-6	-.533	.370	-2.22	-1.13	-.785	.451	-1.74	-1.03	-.812	.974	-.83	-.33
-10	-1.513	.483	-3.13	+1.19	-1.455	.569	-2.56	+1.45	-1.438	1.072	-1.34	+1.13
-15	-2.415	.750	-3.30	3.26	-2.432	.840	-2.90	4.56	-2.383	1.351	-1.76	4.46
-20	-3.541	1.198	-2.95	7.91	-3.461	1.278	-2.71	3.21	-3.368	1.791	-1.88	8.91

TABLE VI

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1367

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 1, 1941
Plotted on Graphs 21, 22, 23, 24

Angle of Pitch Deg.	0° Yaw			
	Lift	Net Drag	L/D	Pitching Moment About C.R.
	Lb.	Lb.		Lb.-In.
0	-.009	.305	-.03	-.18
+2	+.140	.312	+.45	+.63
4	.354	.331	1.07	.81
6	.609	.353	1.73	.46
10	1.203	.442	2.72	-.94
15	2.031	.646	3.14	-4.20
20	2.938	1.012	2.90	-8.57
-2	-.150	.307	-.49	-.96
-4	-.367	.327	-1.12	-1.09
-6	-.638	.349	-1.83	-.68
-10	-1.221	.434	-2.81	+.81
-15	-2.057	.639	-3.22	4.00
-20	-2.916	.983	-2.97	8.06

TABLE VII

MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1F1365

50 M.P.H. Standard Air
Test No. 324

Wright Field, December 22, 1941
Plotted on Graphs 25, 26, 27, 28

Angle of Pitch Degrees	-3° Horizontal Fins				-6° Horizontal Fins			
	Net		Pitching Moment About C.R. Lb.-Ins.		Net		Pitching Moment About C.R. Lb.-Ins.	
	Lift	Drag	L/D		Lift	Drag	L/D	
	Lbs.	Lbs.			Lbs.	Lbs.		
0	-0.246	+0.307	-0.80	+1.05	-0.442	+0.327	-1.35	+3.11
+5	+0.246	.313	+ .79	2.28	+ .077	.320	+ .24	3.70
10	0.874	.376	2.32	1.84	.661	.354	1.87	3.62
15	1.642	.538	3.05	- .25	1.384	.491	2.82	2.17
20	2.445	.809	3.02	-3.40	2.164	.720	3.00	- .56
-5	-0.797	.369	-2.16	+0.78	-1.028	.410	-2.51	+3.19
+10	-1.551	.497	-3.12	2.72	-1.793	.636	-2.82	5.50
-15	-2.422	.767	-3.16	6.11	-2.657	.953	-2.79	9.11
-20	-3.304	1.184	-2.79	10.30	-3.556	1.408	-2.53	13.67

TABLE VIII

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1366

50 M.P.H. Standard Air
Test No. 324Wright Field, December 22, 1941
Plotted on Graphs 29, 30, 31, 32

-3° Horizontal Fins					-6° Horizontal Fins				
Angle of Pitch Degrees	Net			Pitching Moment About C.R. lb.-ins.	Net			Pitching Moment About C.R. lb.-ins.	
	Lift lbs.	Drag lbs.	L/D		Lift lbs.	Drag lbs.	L/D		
0	-0.220	+0.300	-0.73	+1.14	-0.447	+0.319	-1.40	+3.20	
+5	+ .254	.309	+ .82	2.14	+ .053	.312	+ .17	3.49	
10	.838	.381	2.20	1.66	.603	.358	1.68	3.38	
15	1.539	.534	2.88	-.45	1.249	.477	2.62	2.04	
20	2.299	.801	2.87	-3.61	1.966	.675	2.91	-.56	
-5	-0.684	.357	- 1.92	+0.83	-0.971	.402	-2.41	+3.12	
-10	-1.421	.482	- 2.95	2.98	-1.752	.583	-3.01	5.92	
-15	-2.240	.724	- 3.09	6.24	-2.614	.882	-2.96	9.77	
-20	-3.062	1.125	- 2.72	10.38	-3.408	1.345	-2.54	13.94	

TABLE IX

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graphs 33, 34

Angle of Yaw Degrees	0° Pitch Yawing Moment Lb.-In.	+10° Pitch Yawing Moment Lb.-In.	+20° Pitch Yawing Moment Lb.-In.	Angle of Pitch Degrees	0° Yaw Pitching Moment Lb.-In.
0	- .28	- .28	- .27	0	+2.65
+2	- .25	- .14	- .60	+2	3.29
4	- .56	- .04	-1.07	4	3.16
6	-1.06	- .86	-1.93	6	2.18
10	-3.08	-3.38	-4.22	10	-1.05
15	-7.74	-8.18	-9.37	15	-6.92
20	-14.31	-14.60	-15.45	20	-14.50
-2	- .24	- .41	- .01	-2	+2.45
-4	+ .13	- .52	+ .38	-4	2.82
-6	.58	+ .15	1.20	-6	3.64
-10	2.70	2.37	3.57	-10	5.53
-15	7.50	7.20	8.53	-15	8.15
-20	14.16	13.70	14.86	-20	13.64

TABLE X

MATERIEL DIVISION DESIGN BARRAGE BALLOON X41F1365

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 324Wright Field, November 4, 1941
Plotted on Graph 34

Angle of Pitch Degrees	-3° Horiz. Fin	-6° Horiz. Fins
	0° Yaw Pitching Moment Lb.-In.	0° Yaw Pitching Moment Lb.-In.
0	4.73	7.40
+5	4.64	7.33
10	2.14	4.56
15	-2.82	.50
20	-9.49	- 5.95
- 5	5.63	+ 8.66
-10	8.50	12.95
-15	11.92	17.54
-20	17.74	23.01

TED

TABLE XI

MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1F1366

MOMENTS ABOUT CABLE JUNCTION

50 M.P.H. Standard Air
Test No. 324Wright Field, November 4, 1941
Plotted on Graph 35

Angle of Pitch Degrees	-3° Horiz. Fins	-6° Horiz. Fins
	0° Yaw Pitching Moment Lb.-In.	0° Yaw Pitching Moment Lb.-In.
0	4.70	6.46
+ 5	4.47	6.45
10	2.16	4.57
15	-2.60	.67
20	-8.99	-4.38
- 5	5.45	8.50
-10	8.45	12.56
-15	12.70	17.51
-20	17.51	22.80

TABLE XII

MATERIEL DIVISION DESIGN BARRAGE BALLOON XL1F1366

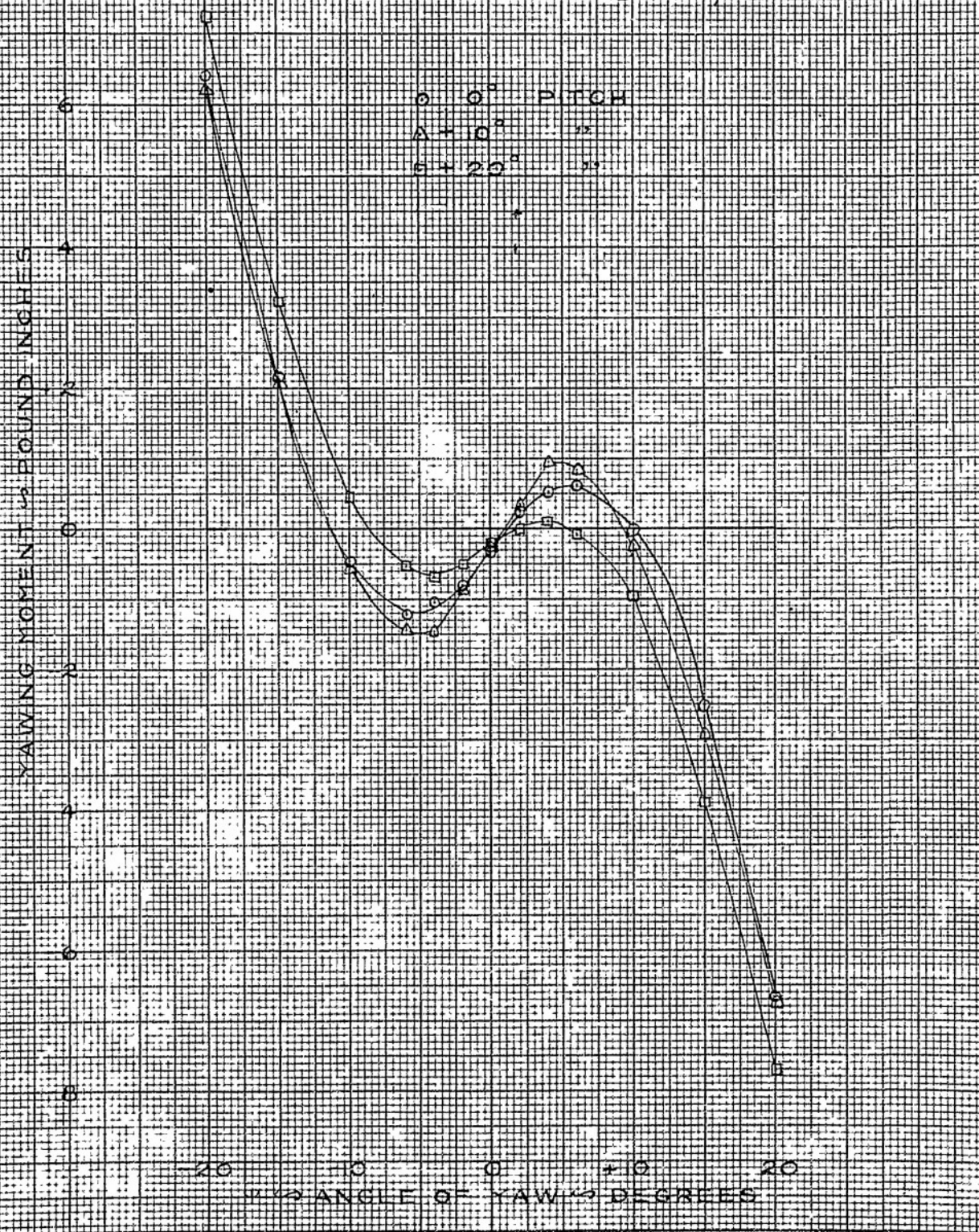
MOMENTS ABOUT CABLE JUNCTION

60 M.P.H. Standard Air
Test No. 317

Wright Field, November 4, 1941
Plotted on Graph 36

Angle of Pitch Degrees	0° Horiz. Fins
	0° Yaw Pitching Moment Lb.-In.
0°	2.82
+2	2.75
4	2.52
6	2.14
10	-.51
15	-6.33
20	-13.75
- 2	+2.87
- 4	2.76
- 6	3.05
-10	5.28
-15	9.15
-20	+13.33

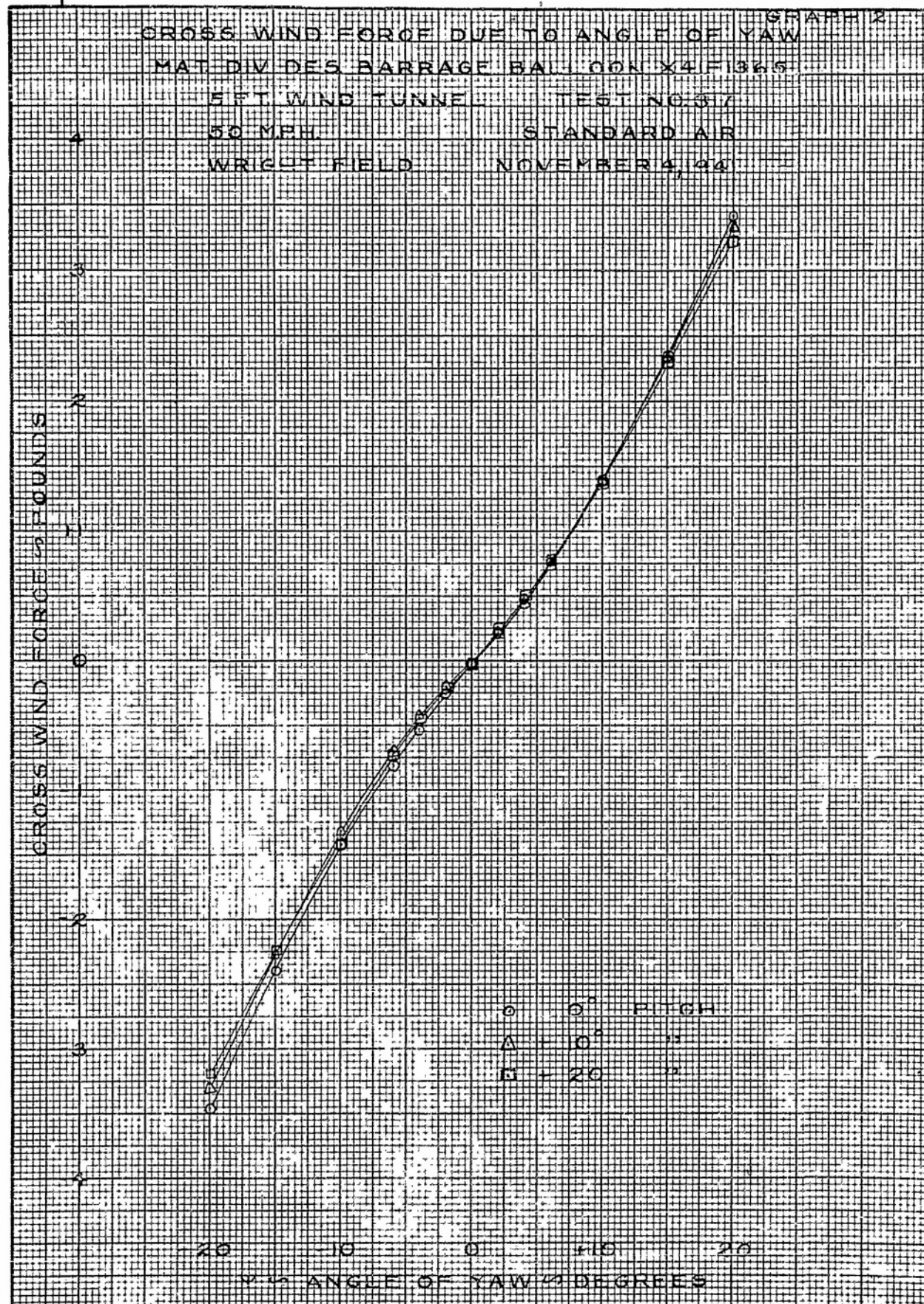
GRAPH
 YAWING MOMENT DUE TO ANGLE OF YAW
 MAT. DIV. OF BARRAGE BALLOON X4F1365
 5 FT WIND TUNNEL TEST NO. 317
 50 MPH STANDARD AIR
 WRIGHT FIELD NOVEMBER 4, 1914



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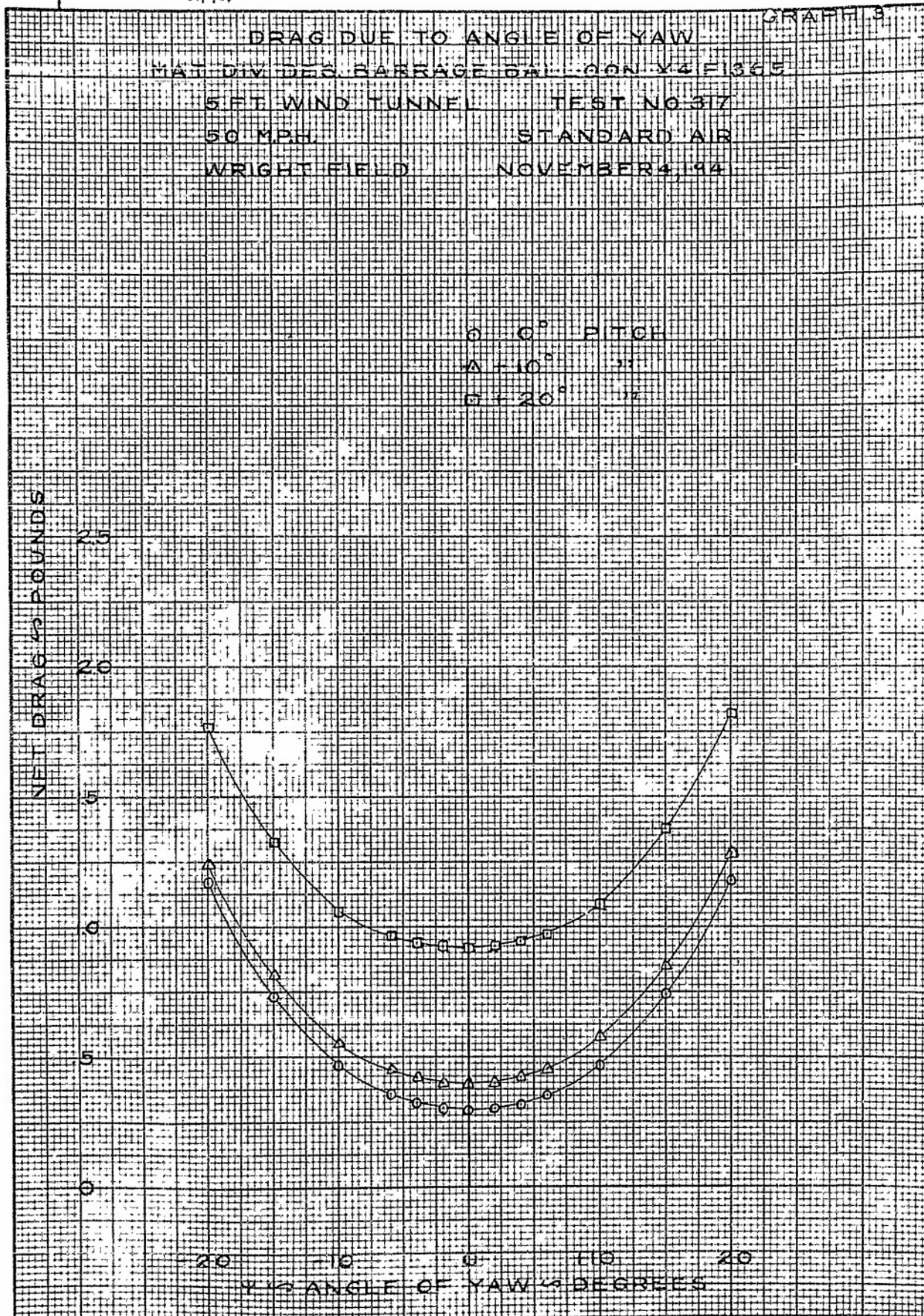
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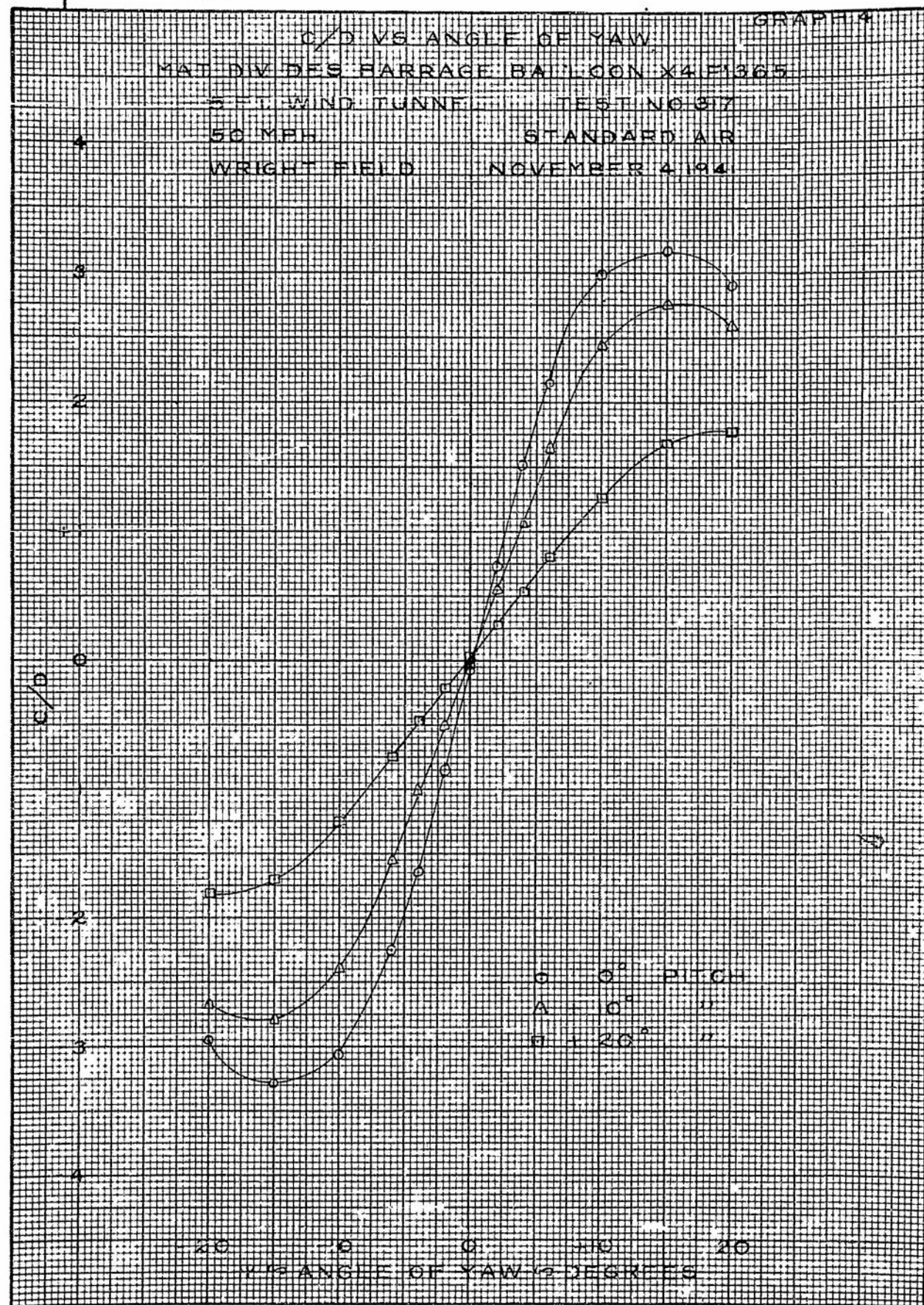
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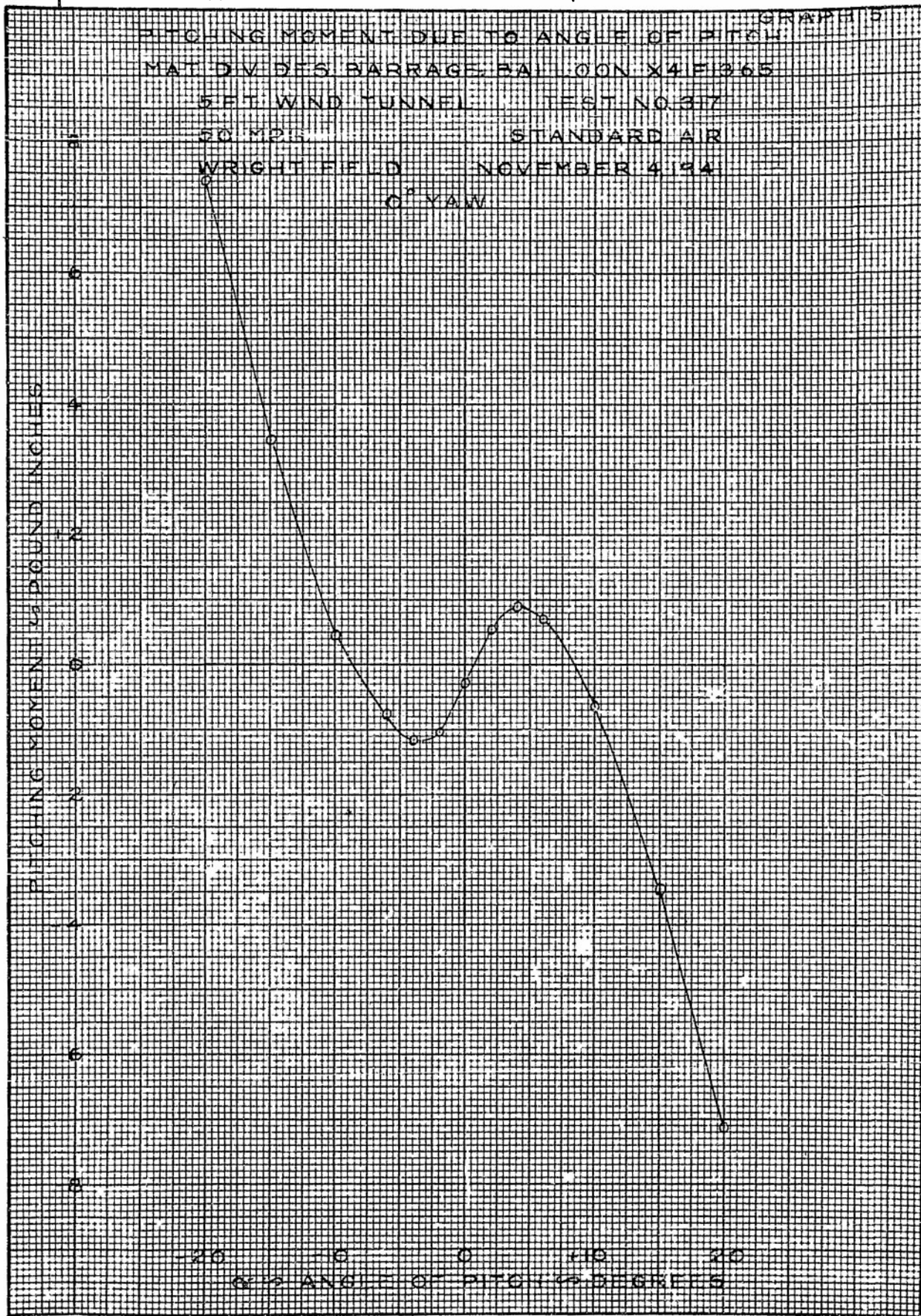
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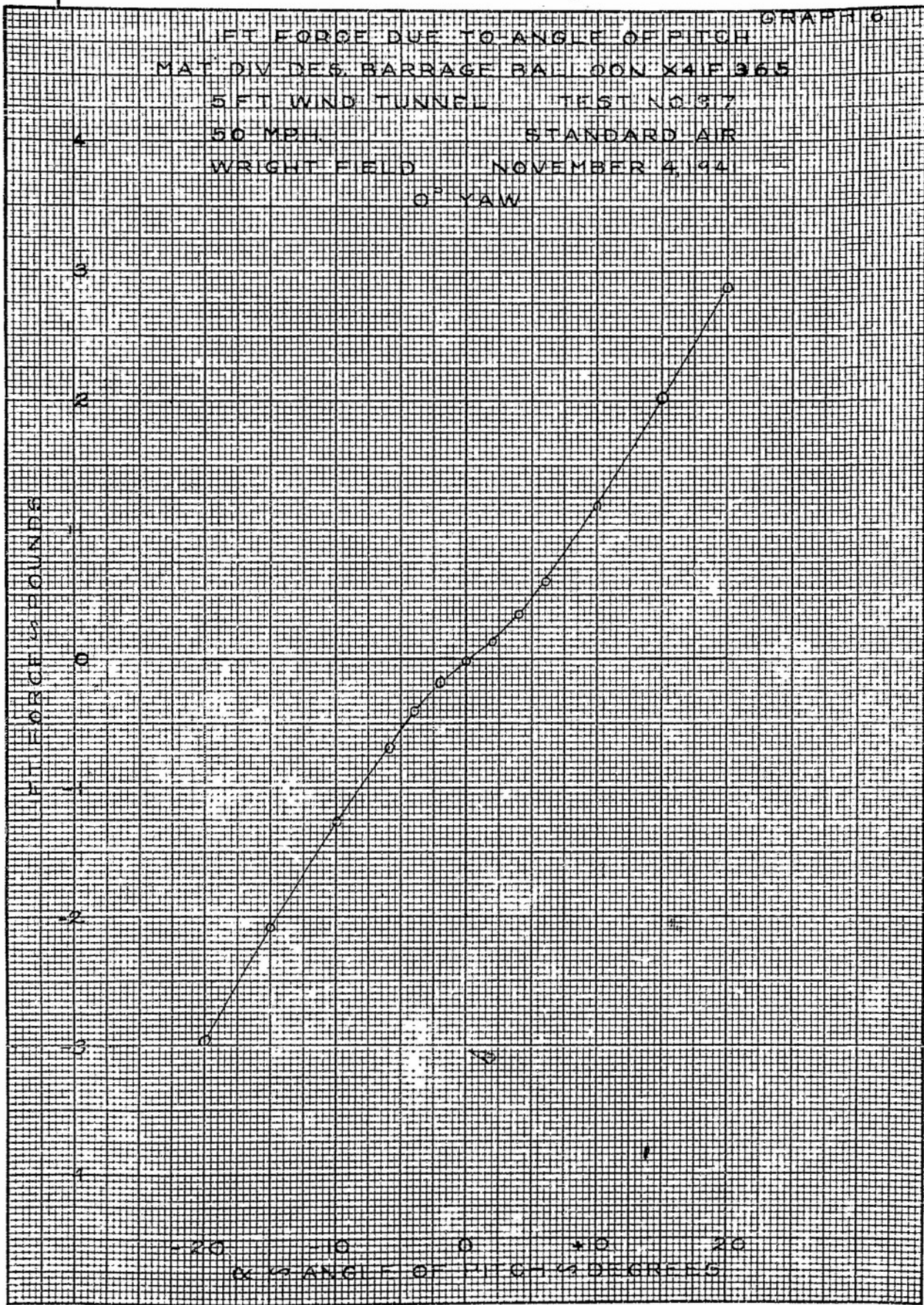
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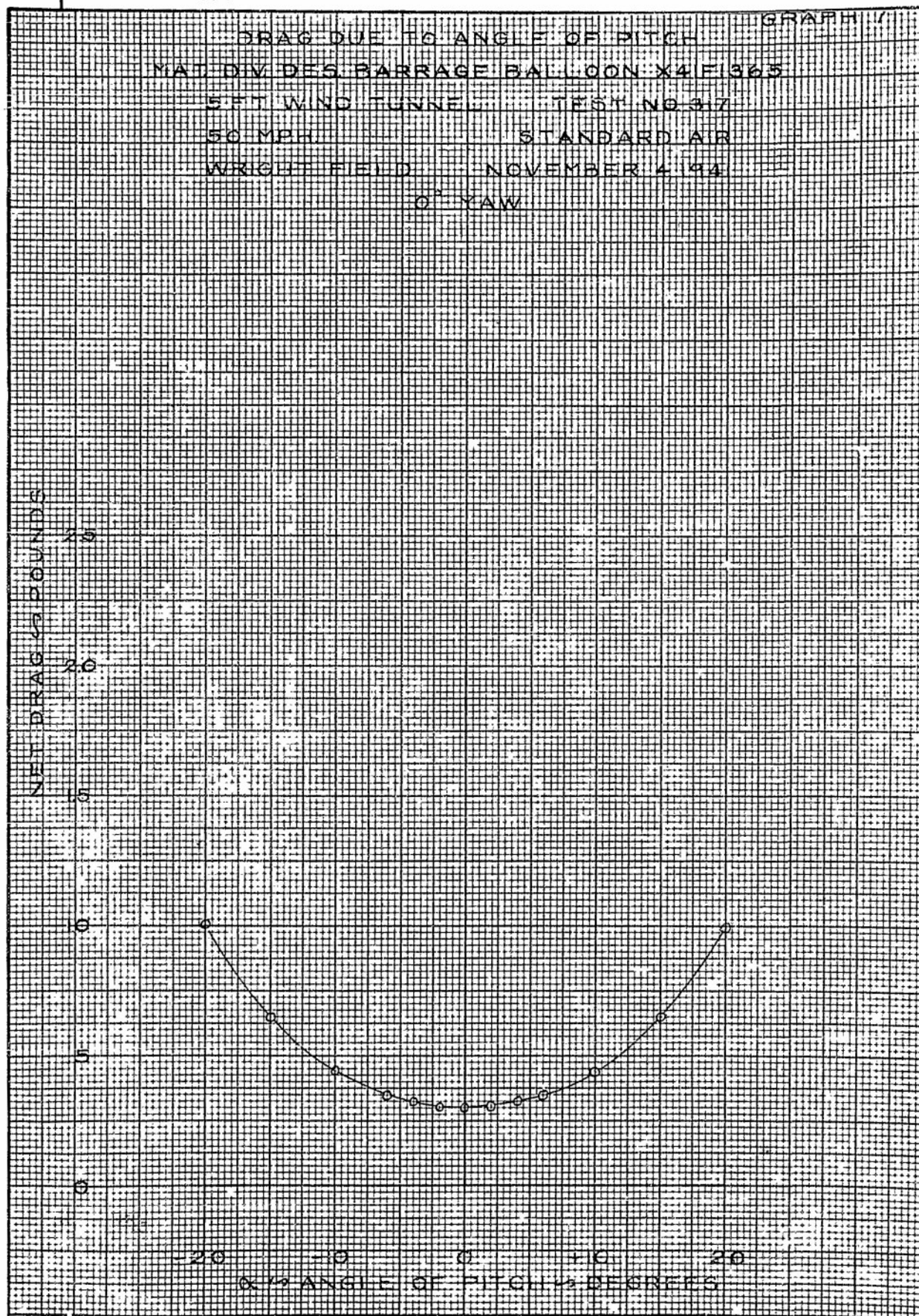
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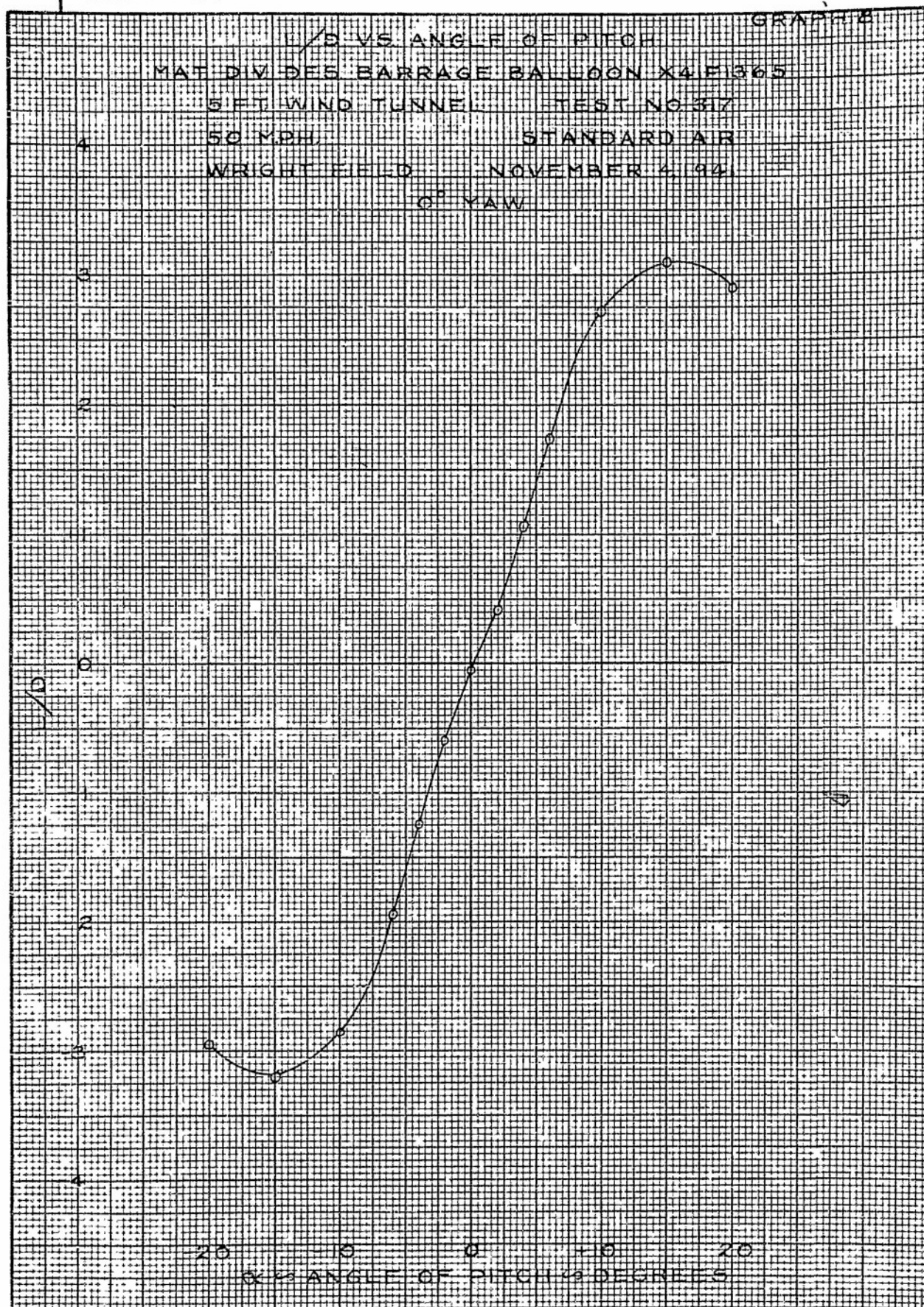
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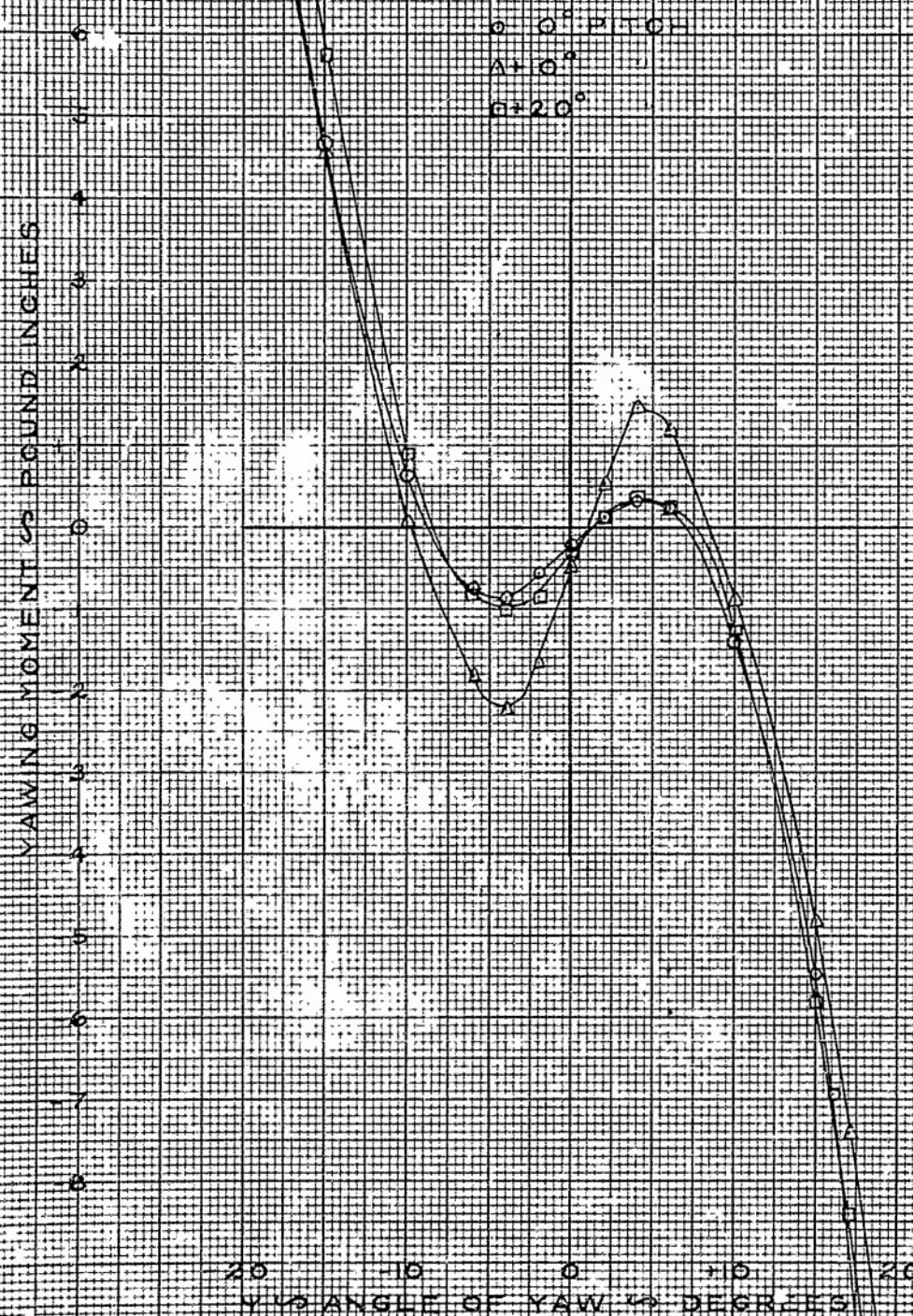
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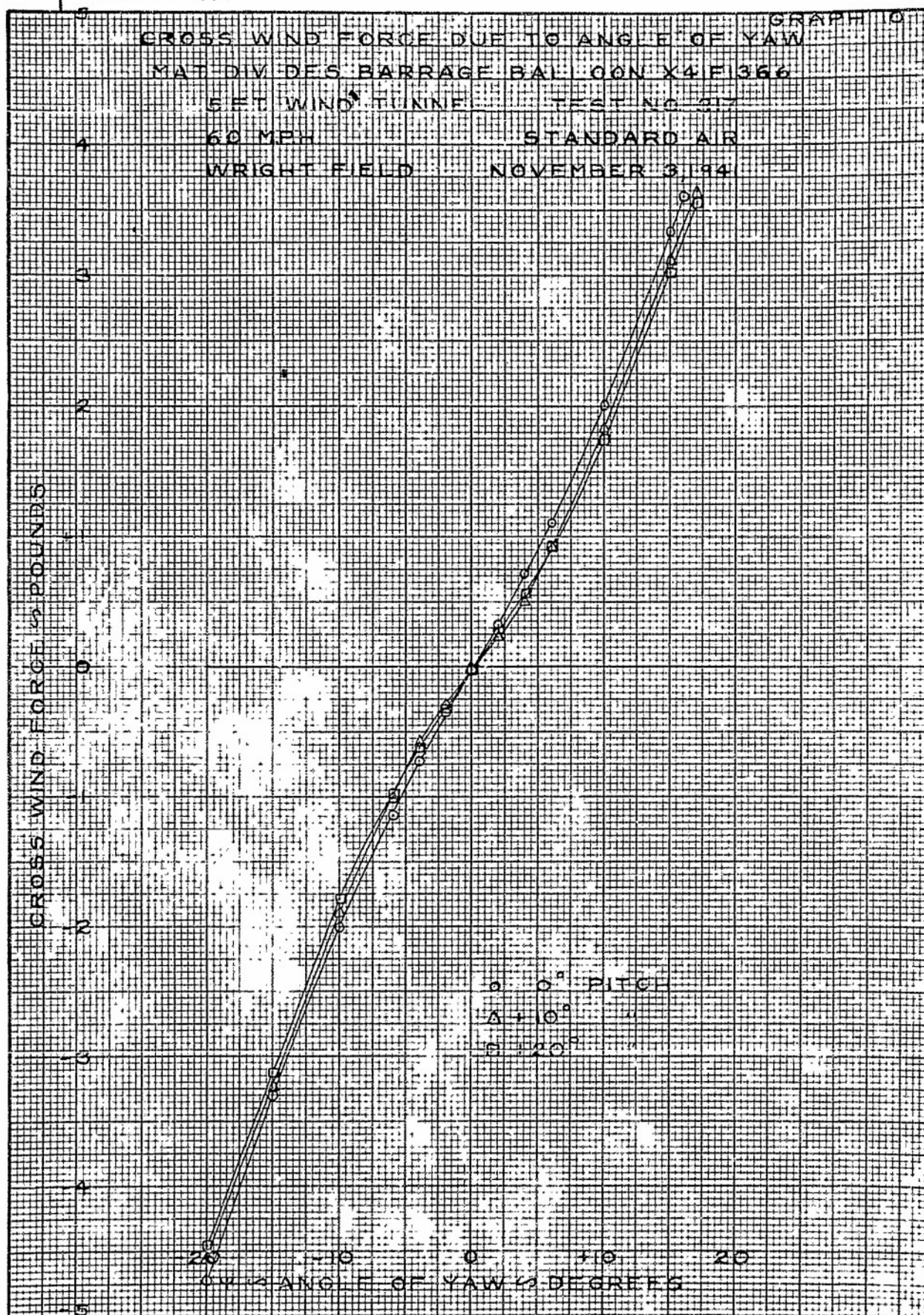
YAWING MOMENT DUE TO ANGLE OF YAW
MAT DIV DES BARRAGE BAL CON X4 F1366
5 FT WIND TUNNEL TEST NO 317
60 MPH STANDARD AIR
WRIGHT FIELD NOVEMBER 3, 1944



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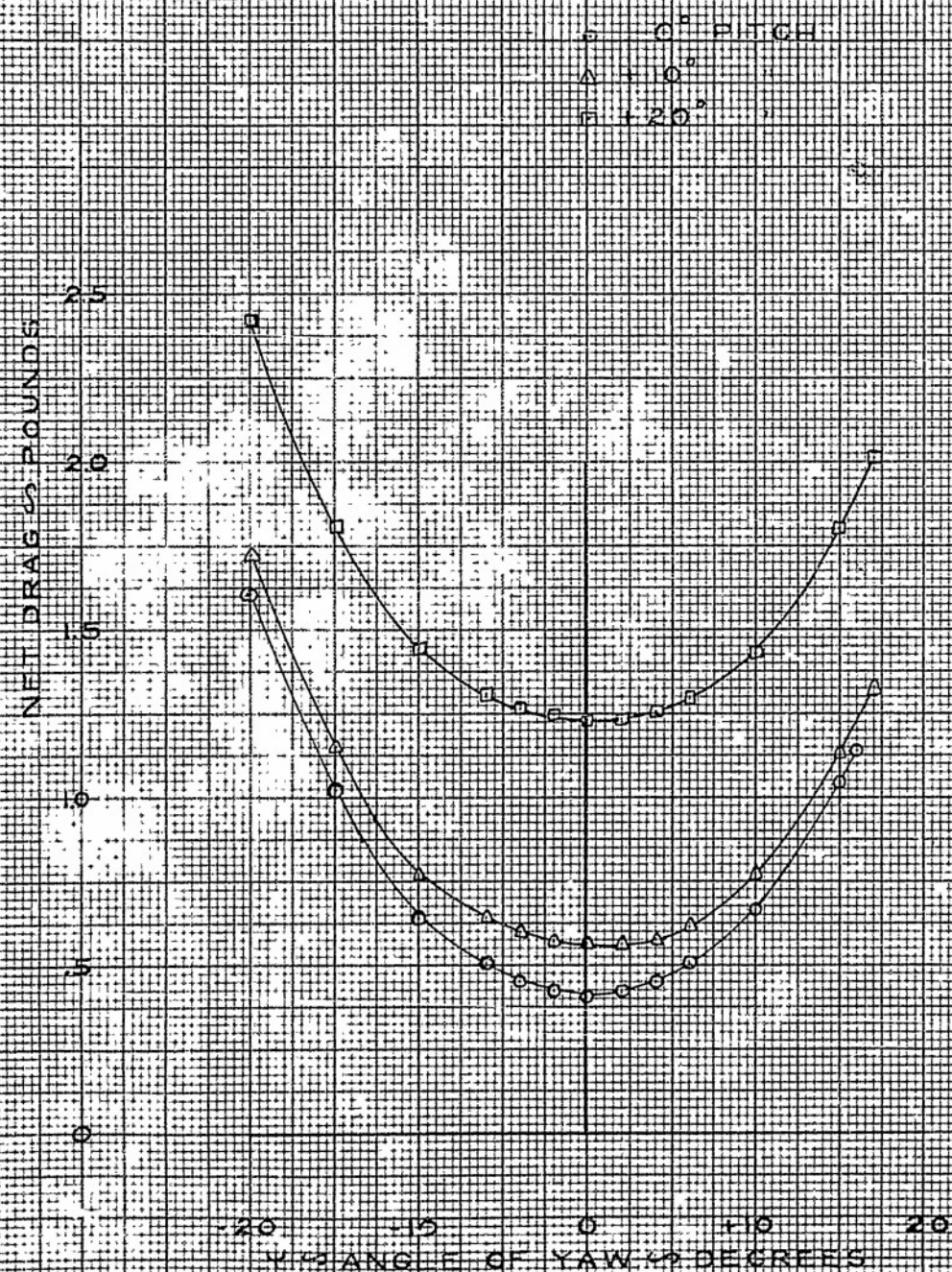


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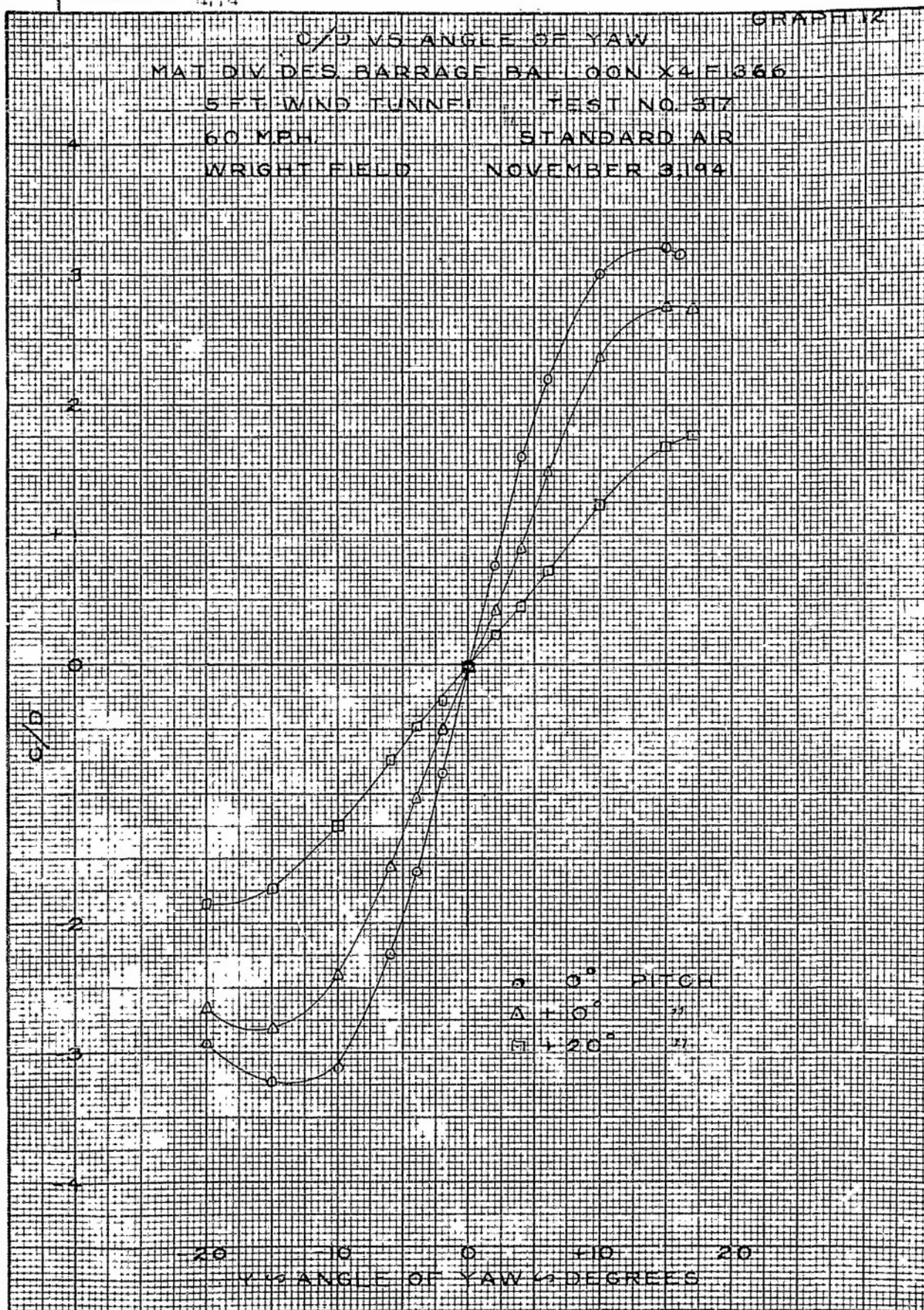
DRAG DUE TO ANGLE OF YAW GRAPH
 MAT DIV DES BARRAGE BAL CON X4F1366
 5 FT WIND TUNNEL TEST NO 317
 50 MPH STANDARD AIR
 WRIGHT FIELD NOVEMBER 3, 1914



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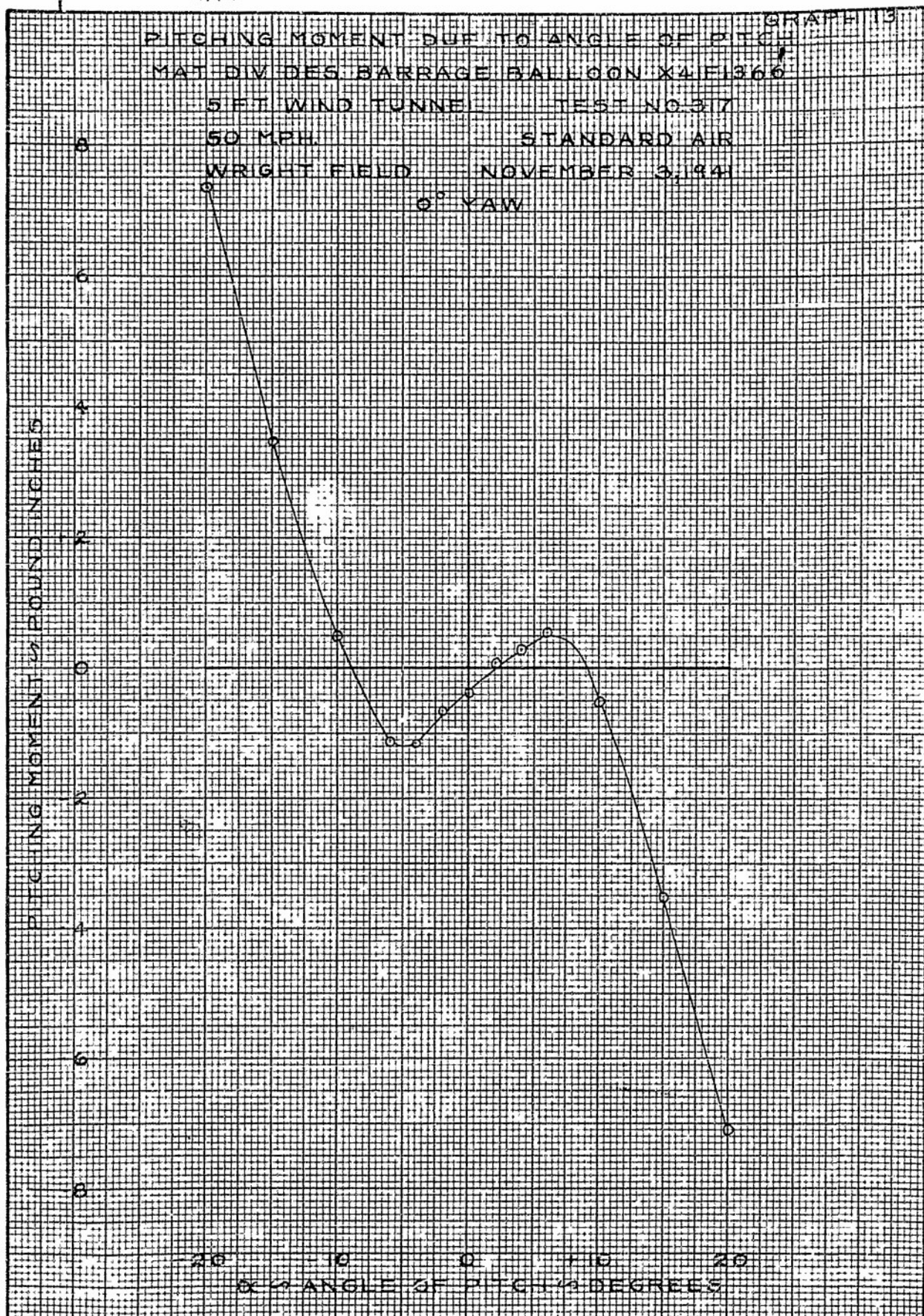
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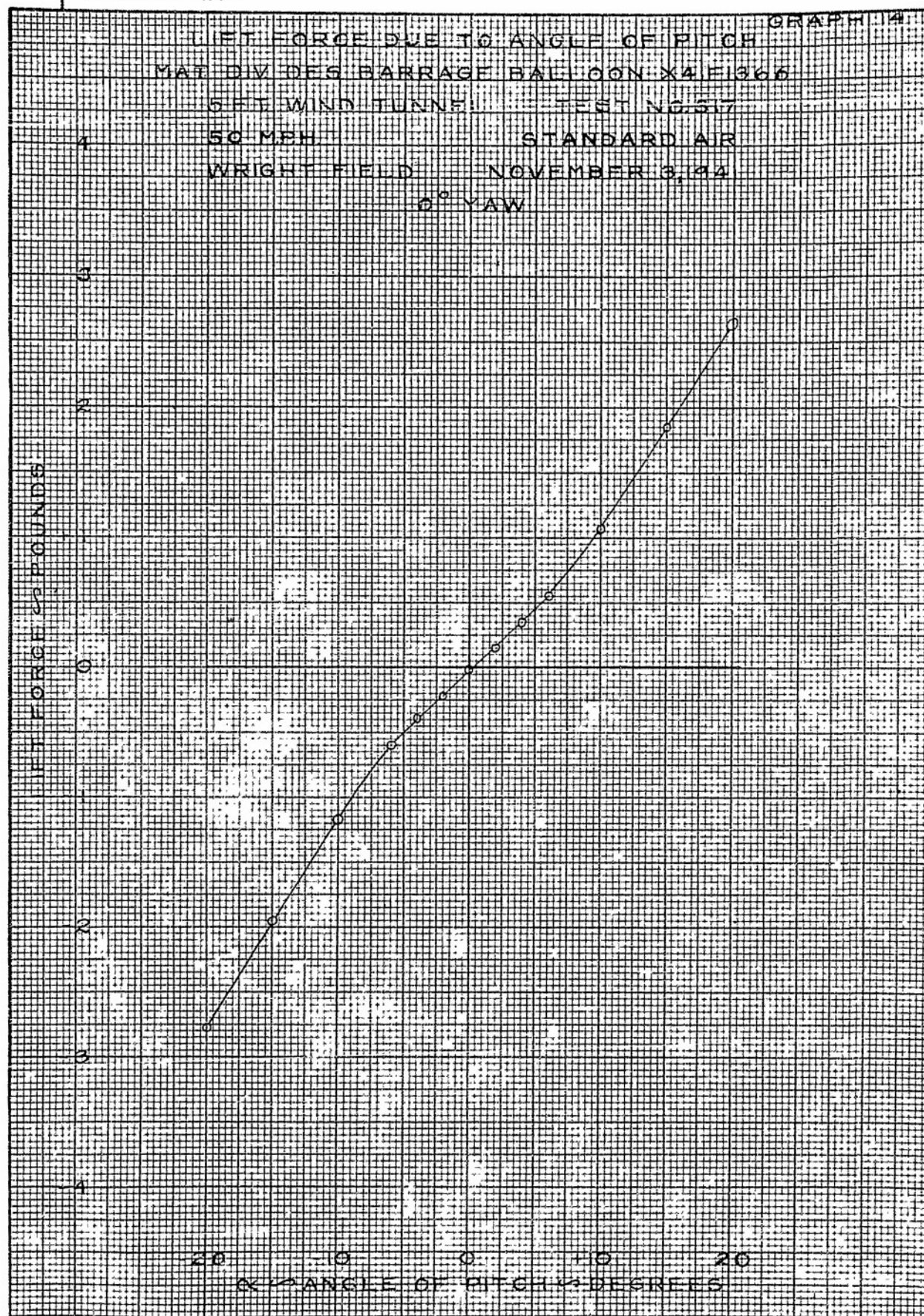
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PAGE

DRAG DUE TO ANGLE OF PITCH

GRAPH 15

NAV DIV DES BARRAGE BAL CON X4 F1366

5 FT WIND TUNNEL TEST NO 317

50 MPH STANDARD AIR

WRIGHT FIELD NOVEMBER 3, 1914

0° YAW

NET DRAG IN POUNDS

25

20

15

10

5

0

-20

-10

0

10

20

ANGLE OF PITCH IN DEGREES

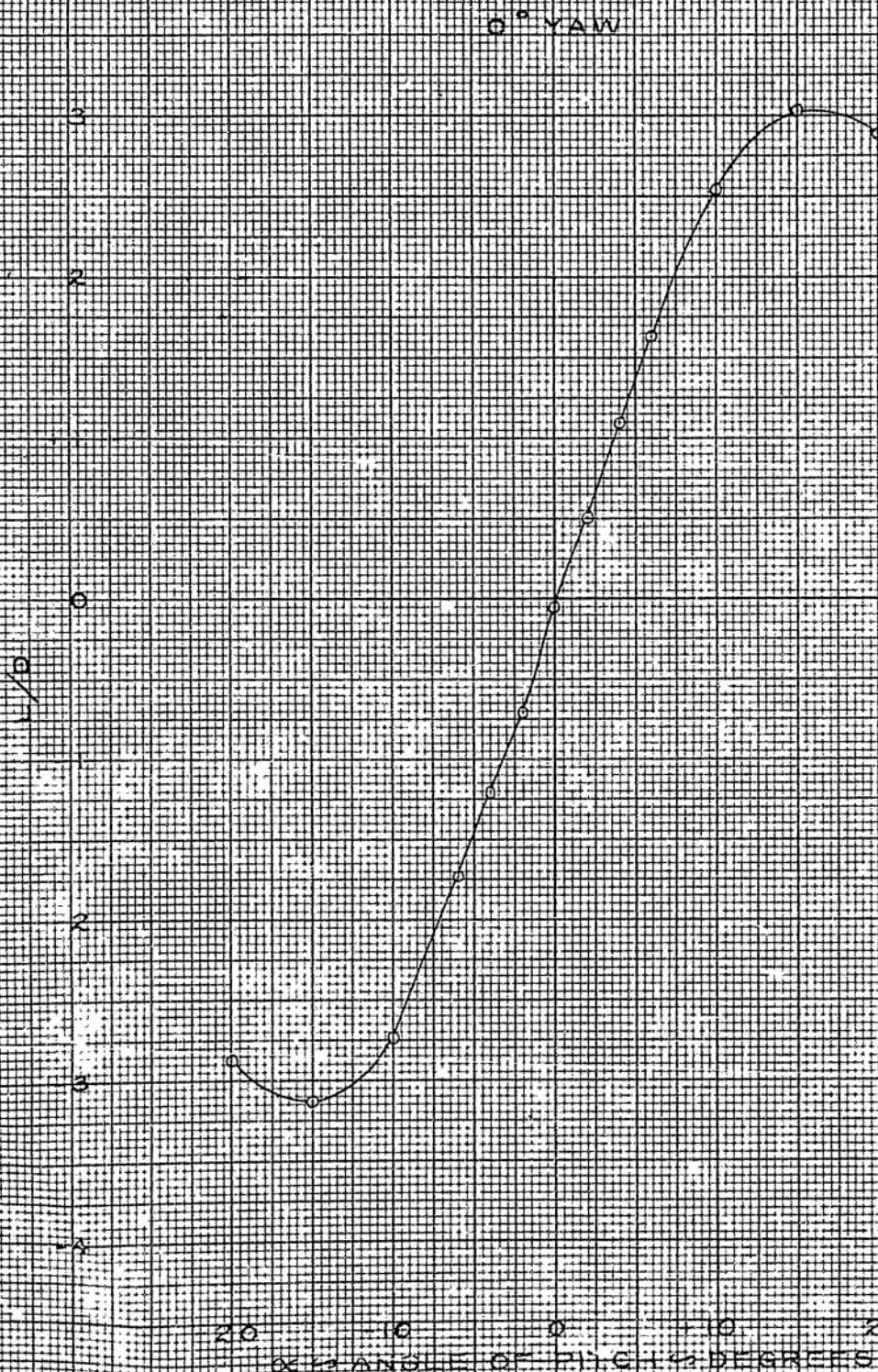
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PAGE

GRAPH 16

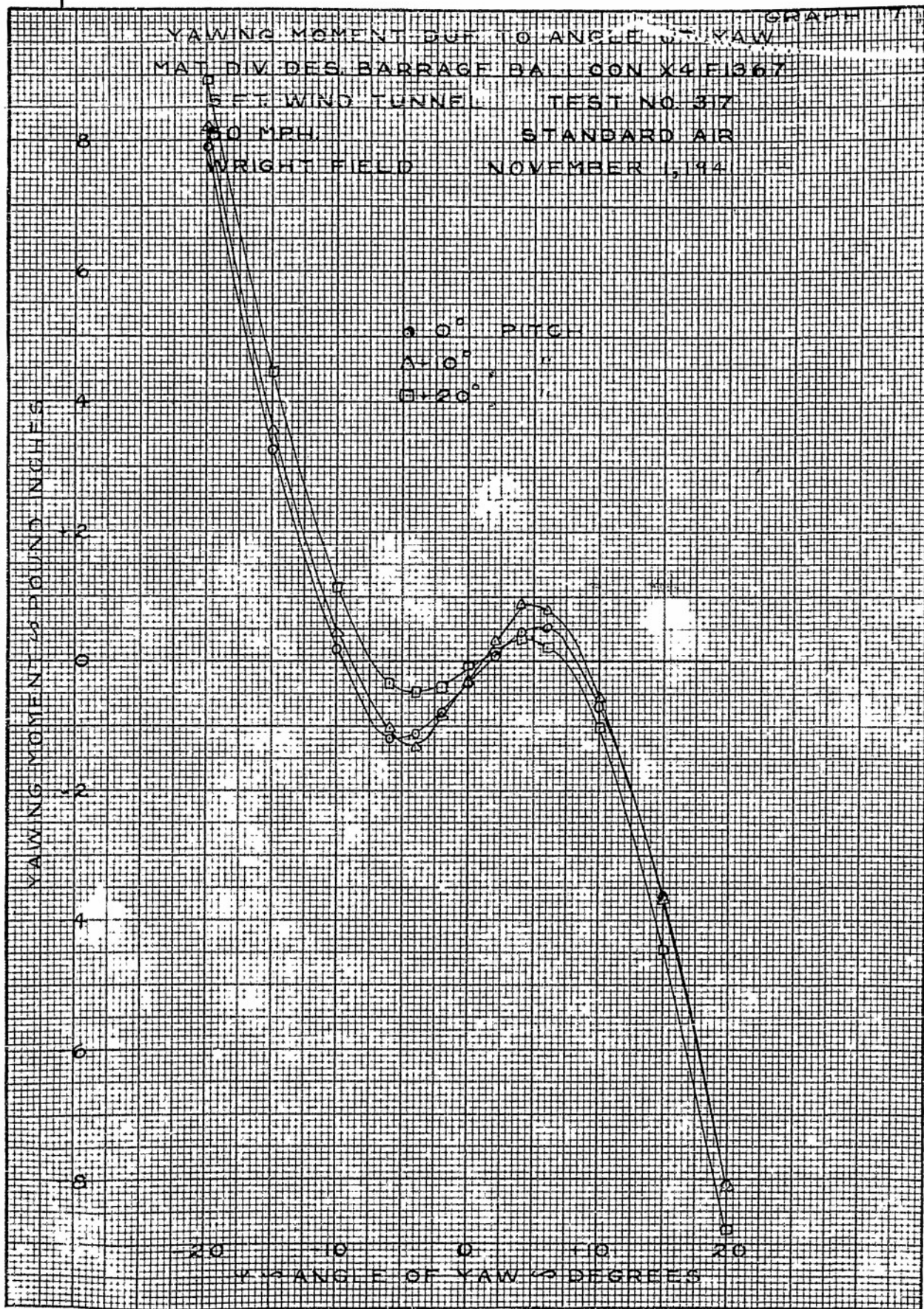
C/D VS ANGLE OF DITCH
 MAT DIV DES BARRAGE BAL CON X4 F1366
 5 FT WIND TUNNEL TEST NO 317
 50 MPH STANDARD AIR
 WRIGHT FIELD NOVEMBER 3, 94
 0° YAW



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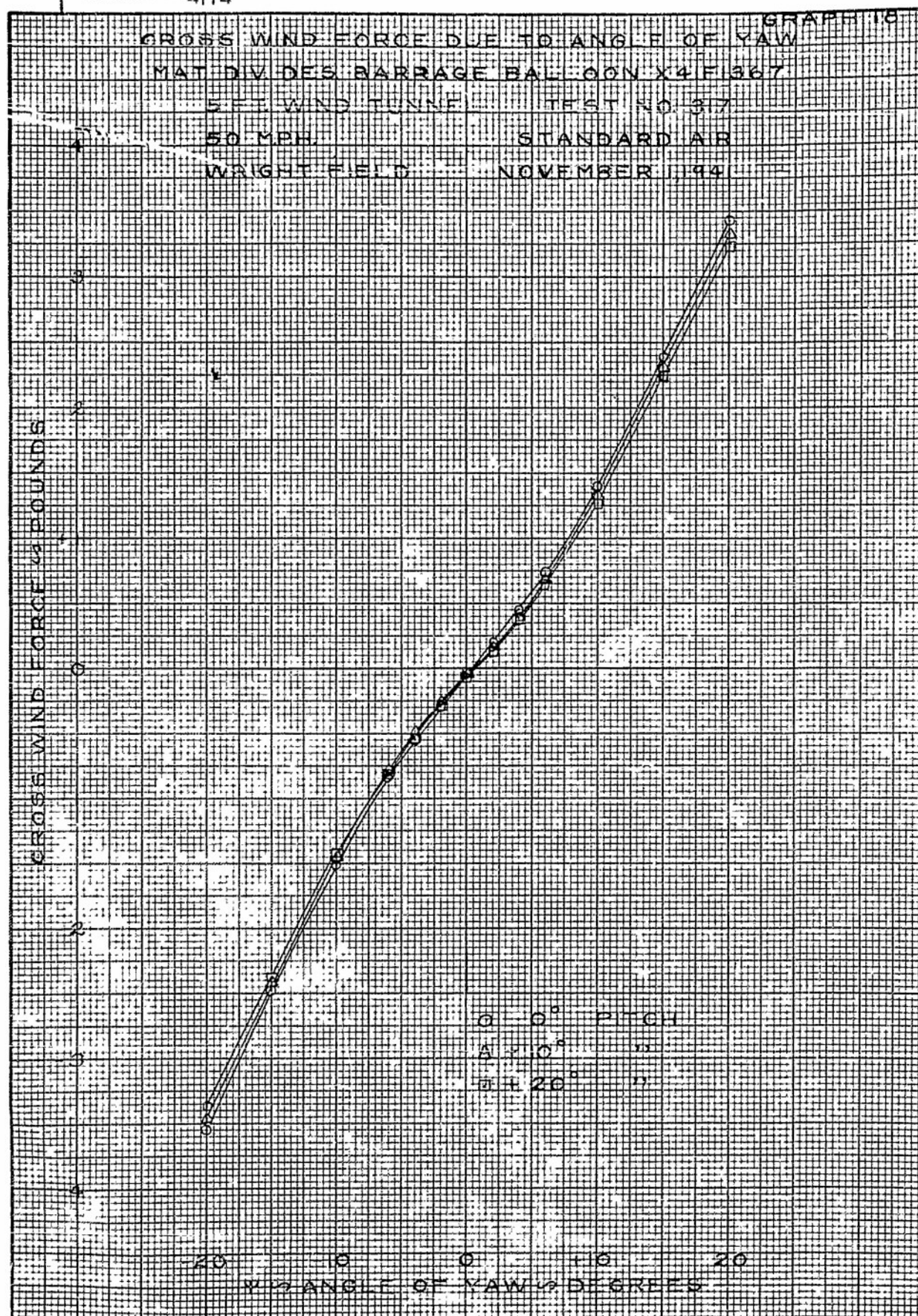
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PAGE

GRAPH 10

DRAG DUE TO ANGLE OF YAW
 MAT. DIV. DES. BARRAGE BAL. CON. 241F1367
 5 FT. WIND TUNNEL TEST NO. 317
 50 MPH. STANDARD AIR
 WRIGHT FIELD NOVEMBER 1944

○ 0° PITCH
 △ +10°
 □ +20°

NET DRAG IN POUNDS

2.5

2.0

1.5

1.0

0.5

0.0

0.0

-20

-10

0

+10

+20

ANGLE OF YAW IN DEGREES

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PAGE

GRAPH 20

C/D VS ANGLE OF YAW

MAT DIV DES BARRAGE RAIL COON X4F 367

5 FT WIND TUNNEL

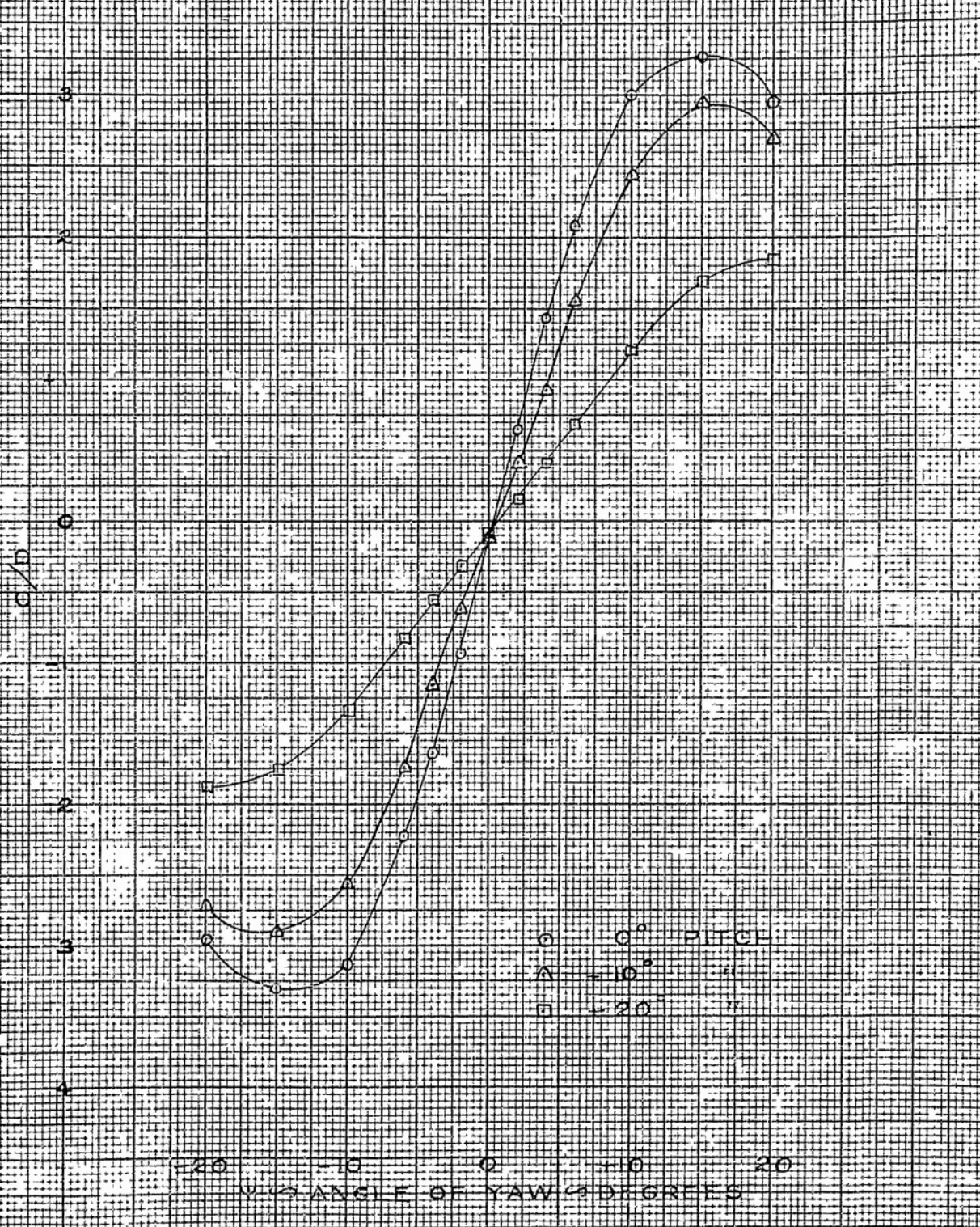
TEST NO 317

50 MPH

STANDARD AIR

WRIGHT FIELD

NOVEMBER 1941



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PAGE

GRAPH 21

PITCHING MOMENT DUE TO ANGLE OF PITCH

MAT DIV DES BARRAGE BALL COIN X4 F1367

5 FT WIND TUNNEL TEST NO 317

50 MEHL STANDARD AIR

WRIGHT FIELD NOVEMBER 1944

0° YAW

PITCHING MOMENT IN POUND INCHES

20 0 0 0 20

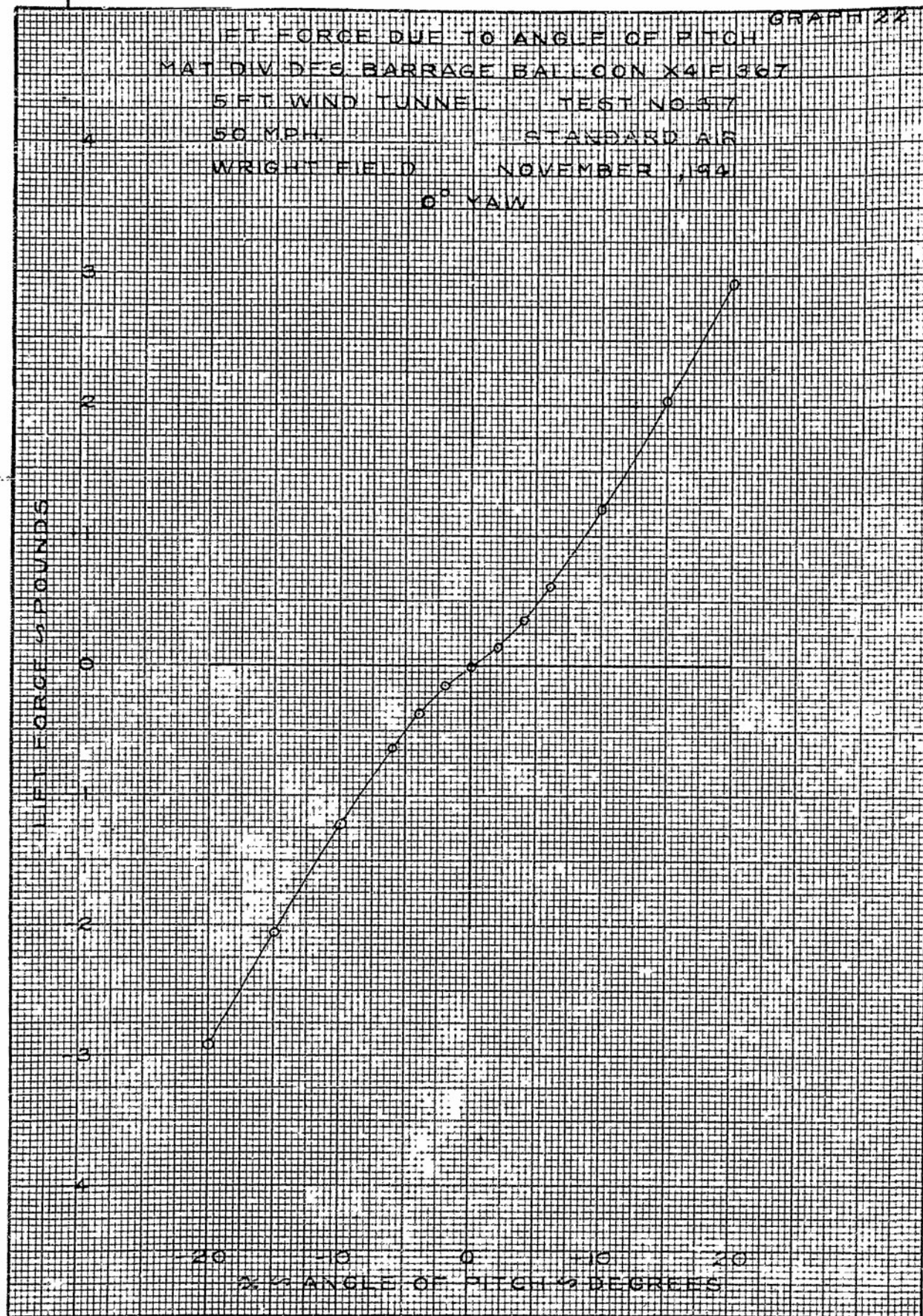
ANGLE OF PITCH IN DEGREES

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GRAPH 22



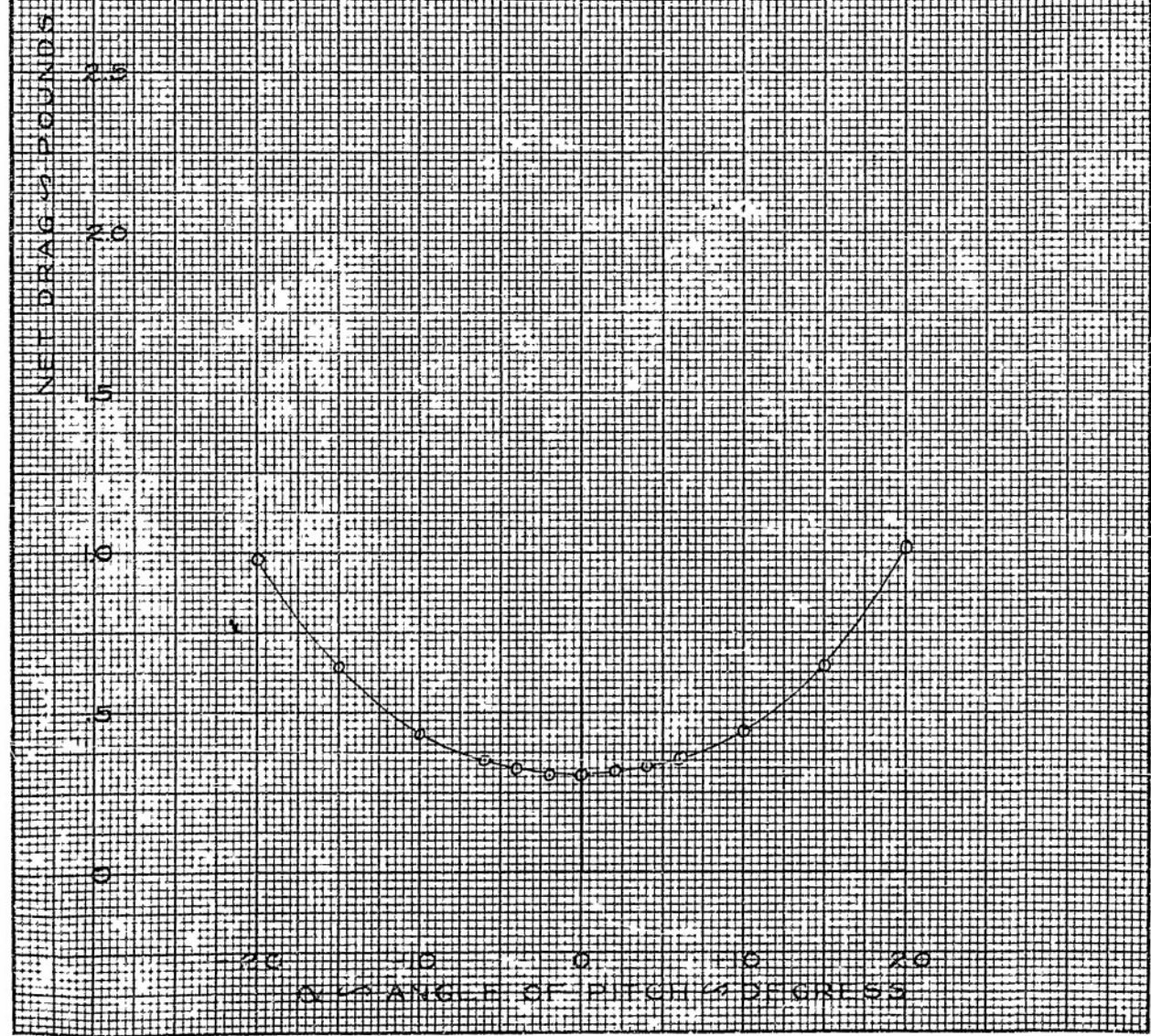
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GRAPH 20

DRAG DUE TO ANGLE OF PITCH
 MAT DIV DES BARRAGE BALLOON X4 F1367
 5 FT WIND TUNNEL TEST NO 317
 50 MPH STANDARD AIR
 WRIGHT FIELD NOVEMBER 1, 1914
 0° YAW



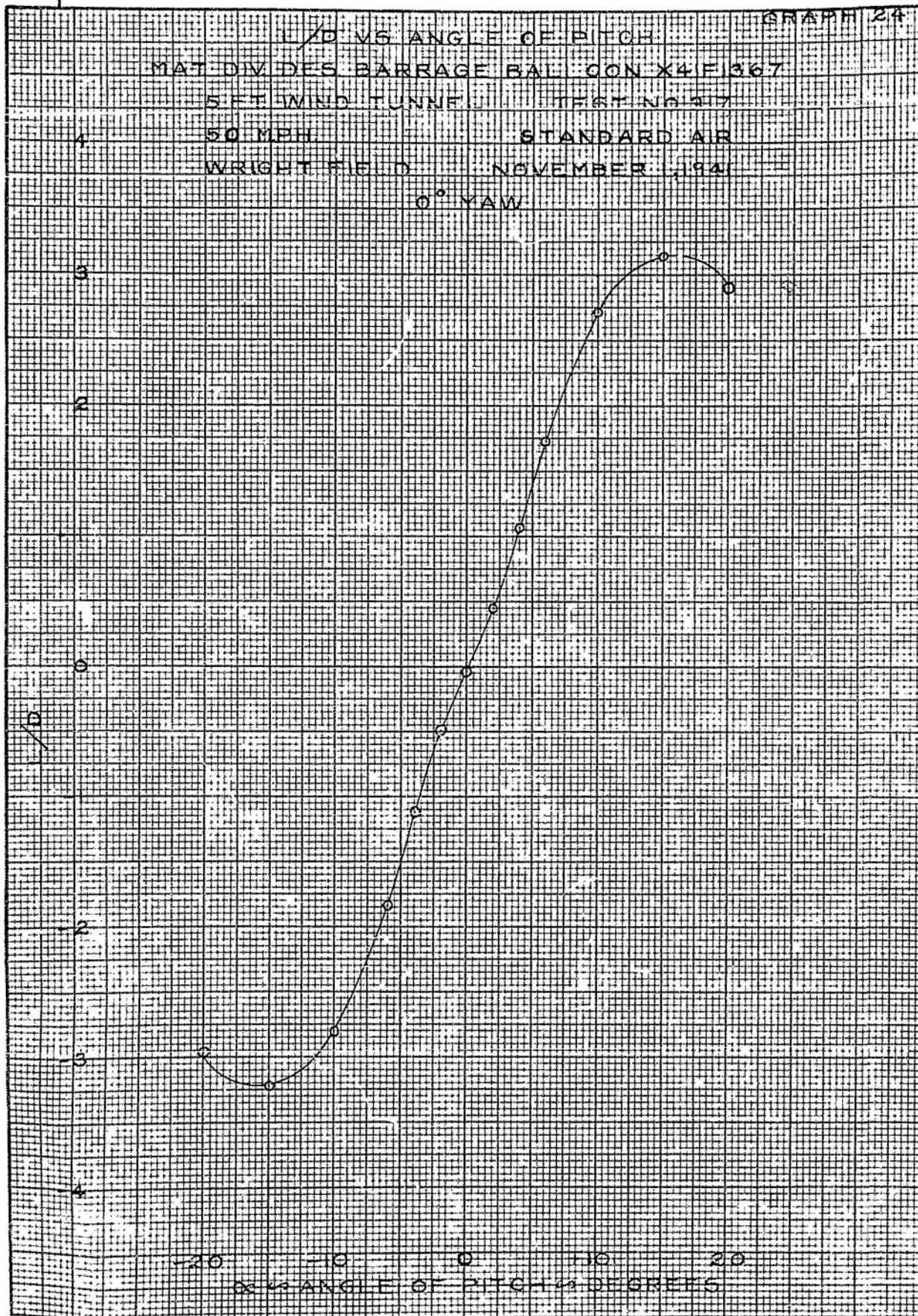
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GRAPH 24

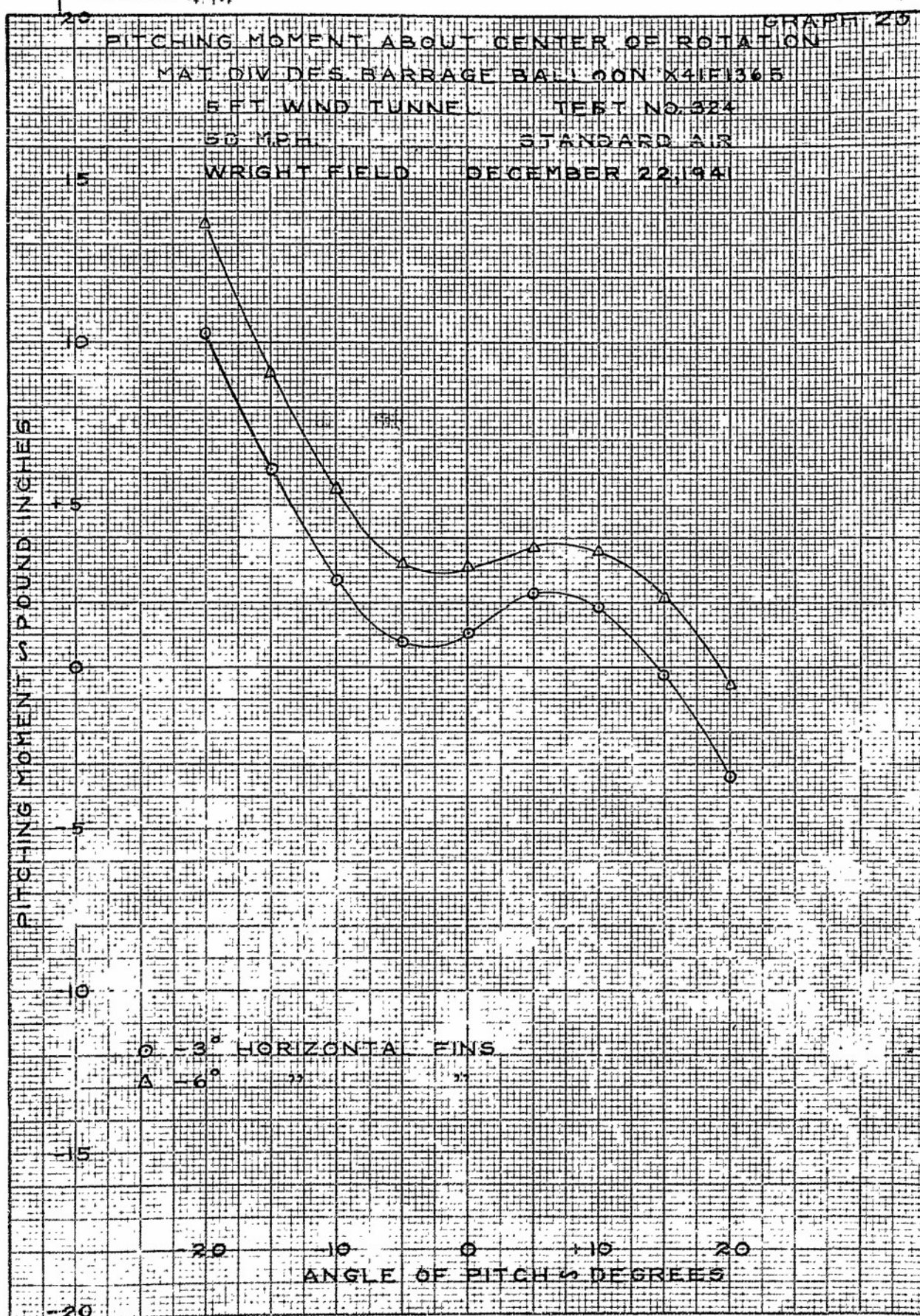
L/D VS ANGLE OF PITCH
 MAT DIV DES BARRAGE BAL CON X4 F 367
 5 FT WIND TUNNEL TEST NO 47
 50 MPH STANDARD AIR
 WRIGHT F15 D NOVEMBER 1941
 0° YAW



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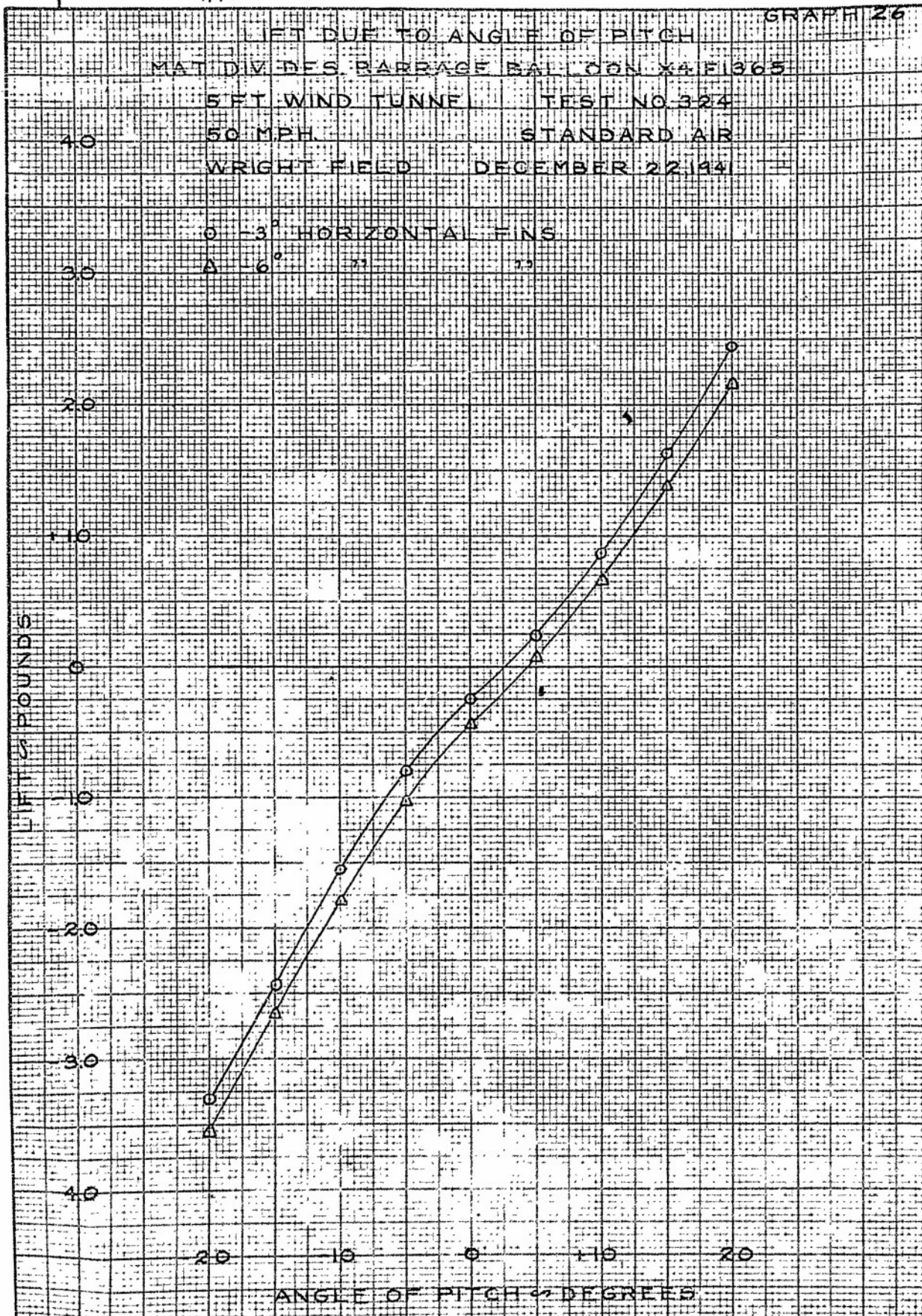


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GRAPH 26



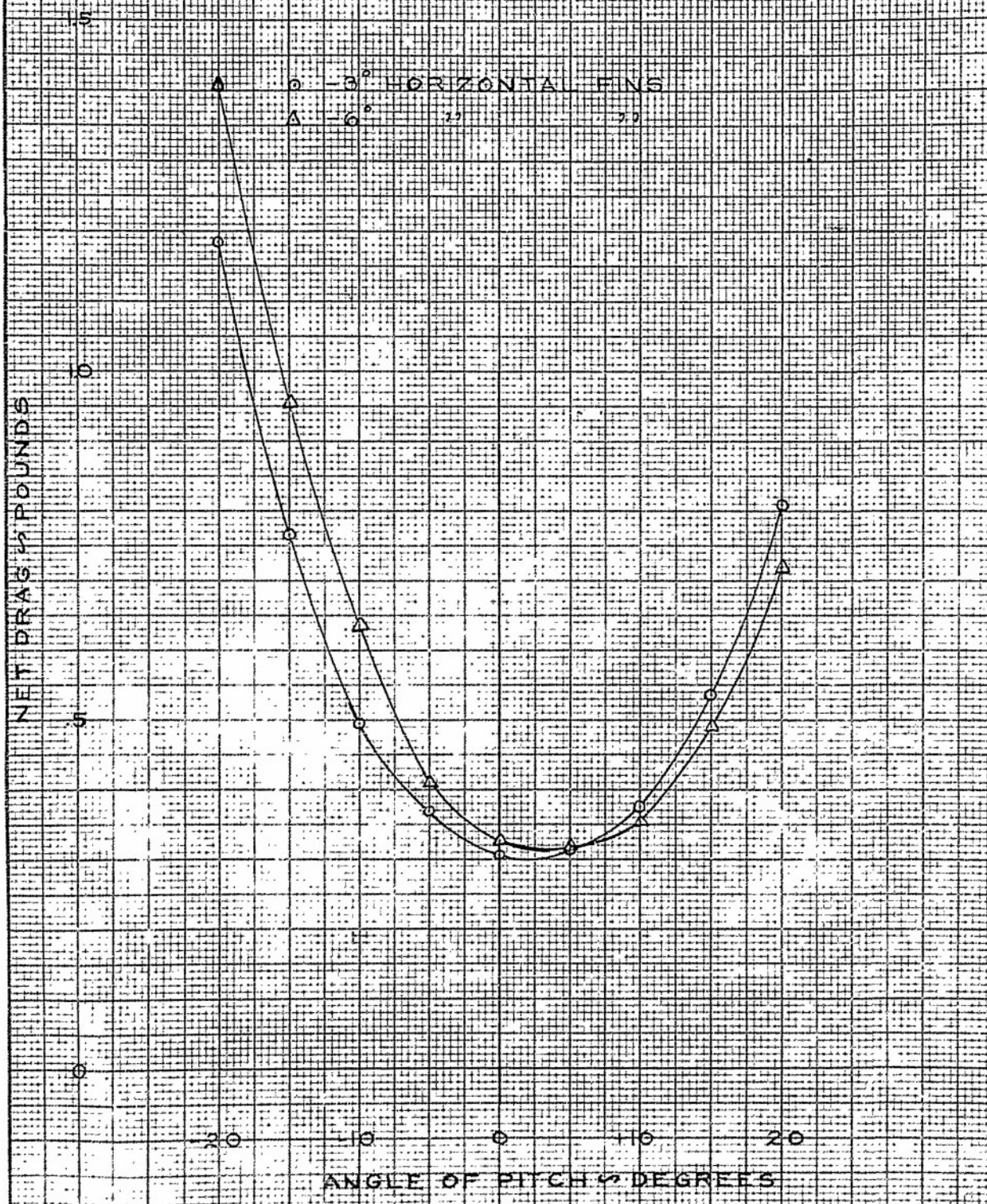
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PAGE 1

GRAPH 27

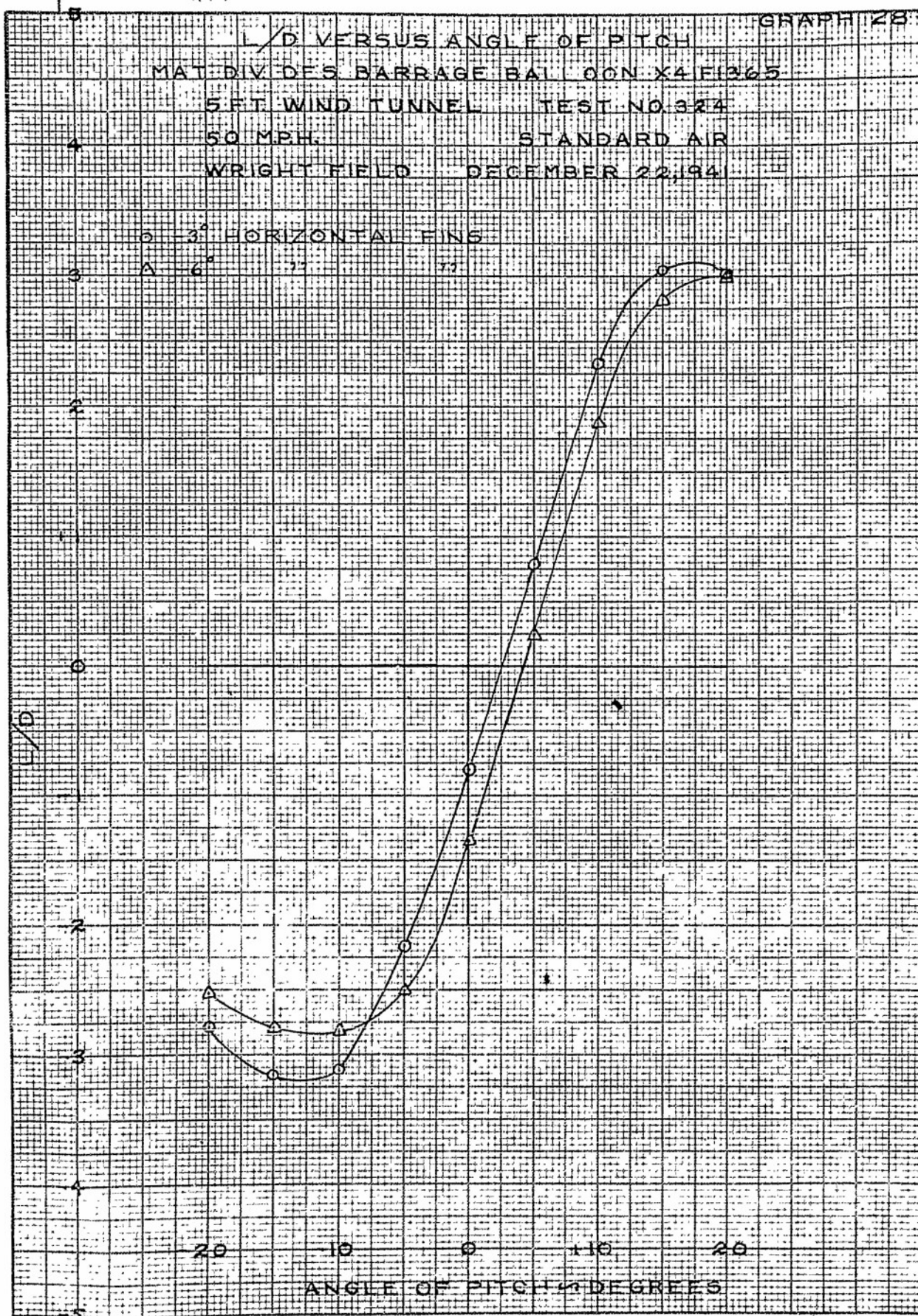
DRAG VERSUS ANGLE OF PITCH
MAT DIV DES BARRAGE BALLOON X4F365
5 FT WIND TUNNEL TEST NO. 324
50 MPH STANDARD AIR
WRIGHT FIELD DECEMBER 22, 1941



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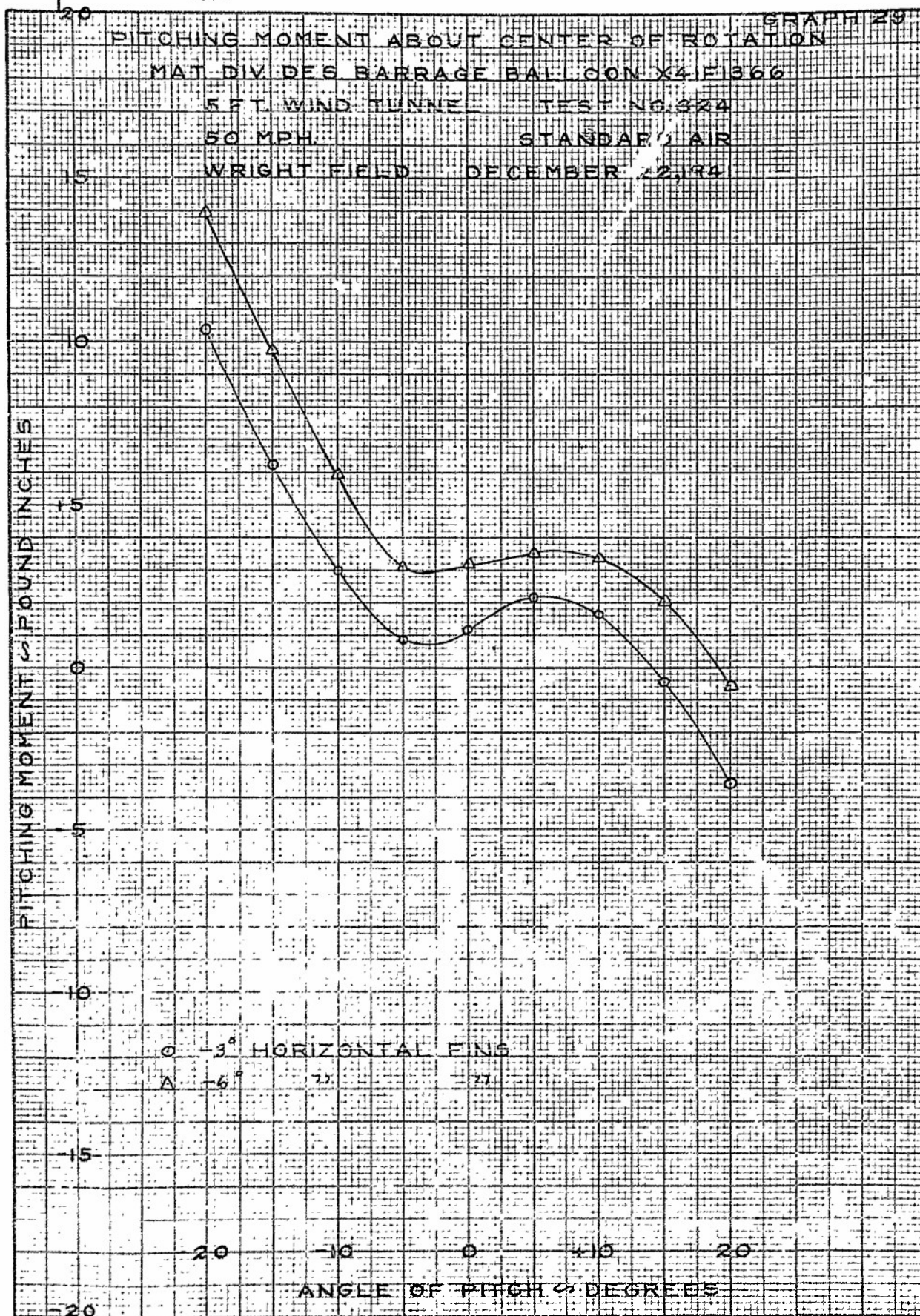
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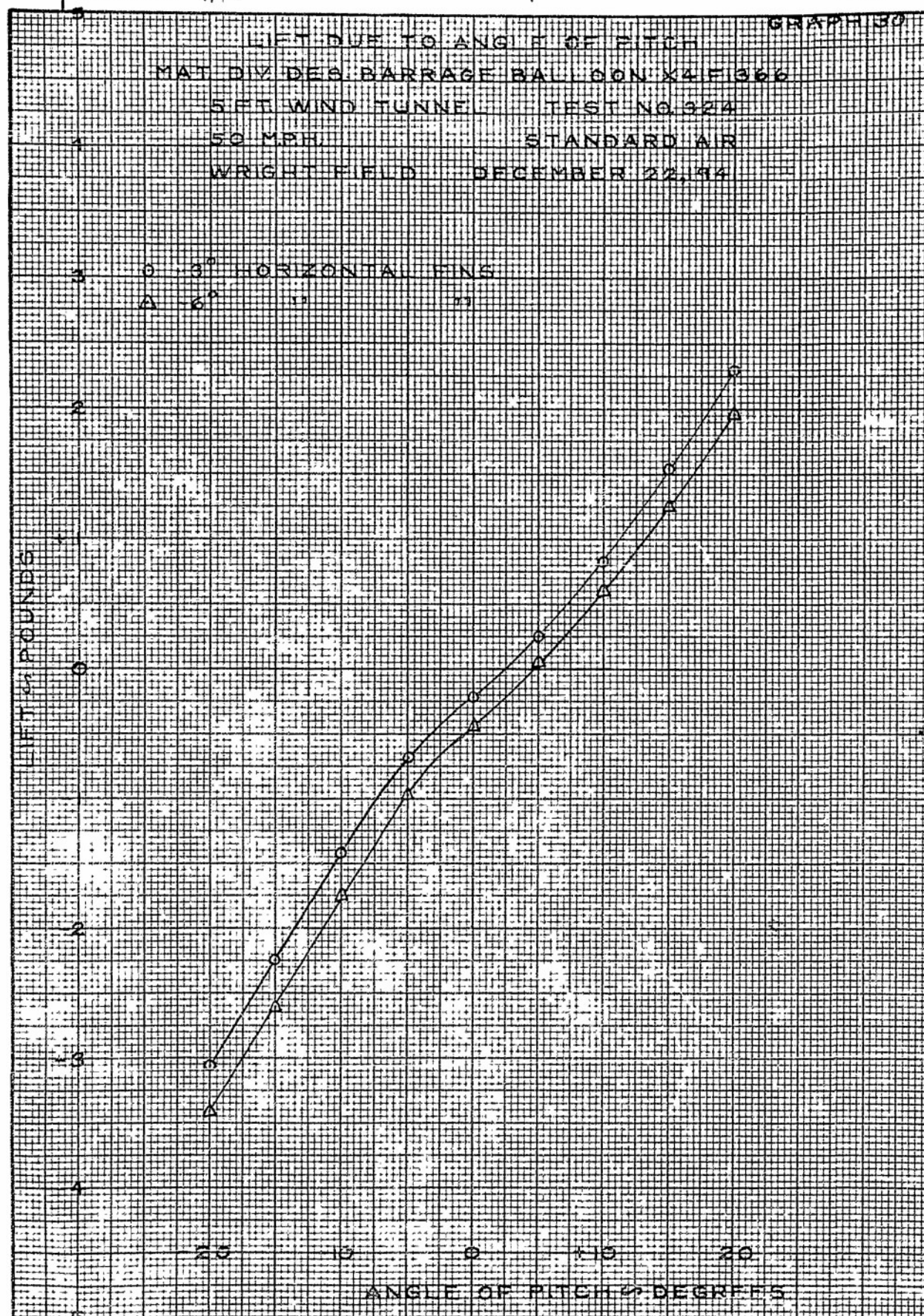
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DRAG VERSUS ANGLE OF PITCH

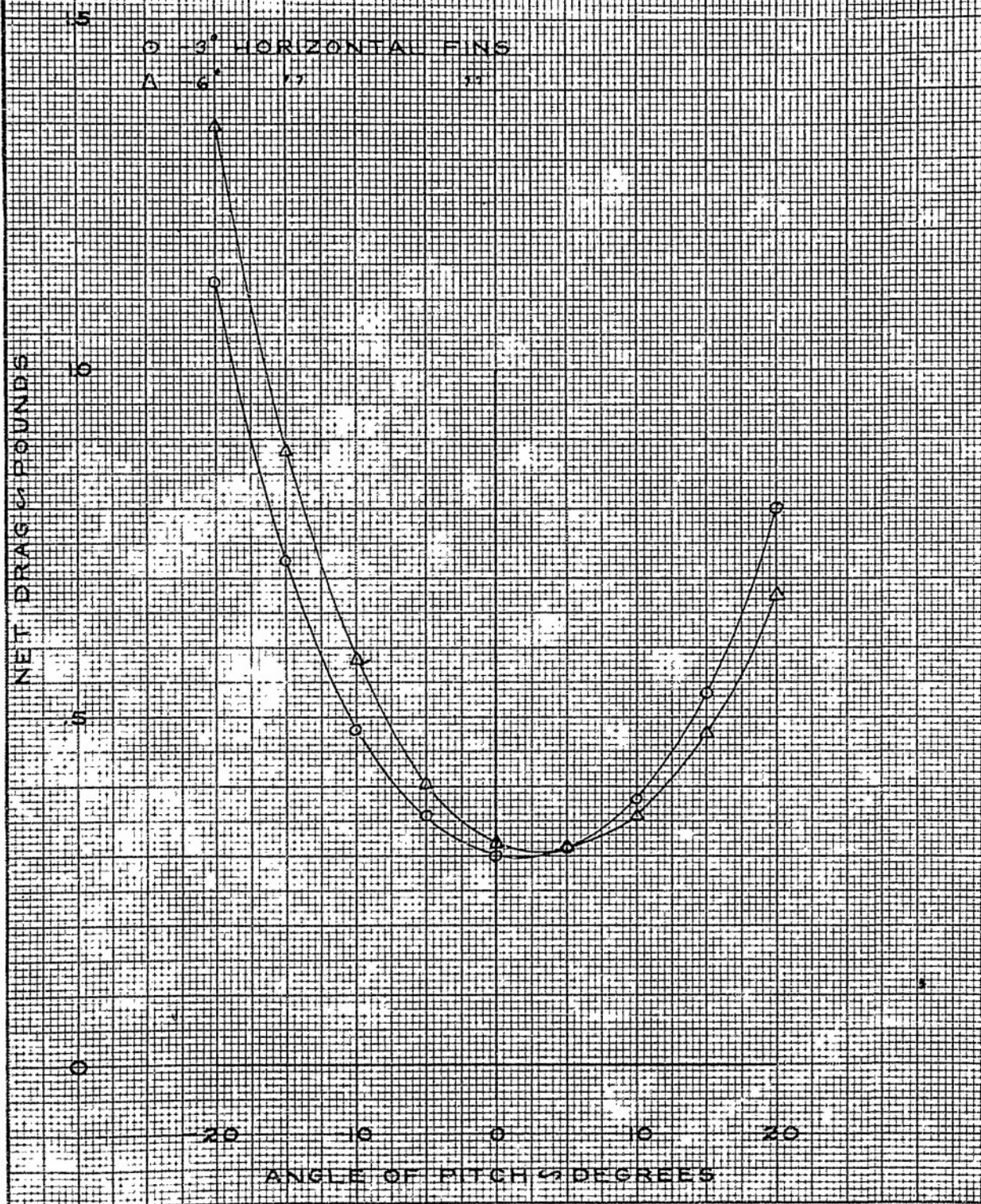
MAT DIV DES. BARRAGE BALLOON X4 F366

5 FT WIND TUNNEL TEST NO. 324

50 MPH

STANDARD AIR

WRIGHT FIELD DECEMBER 22, 1914

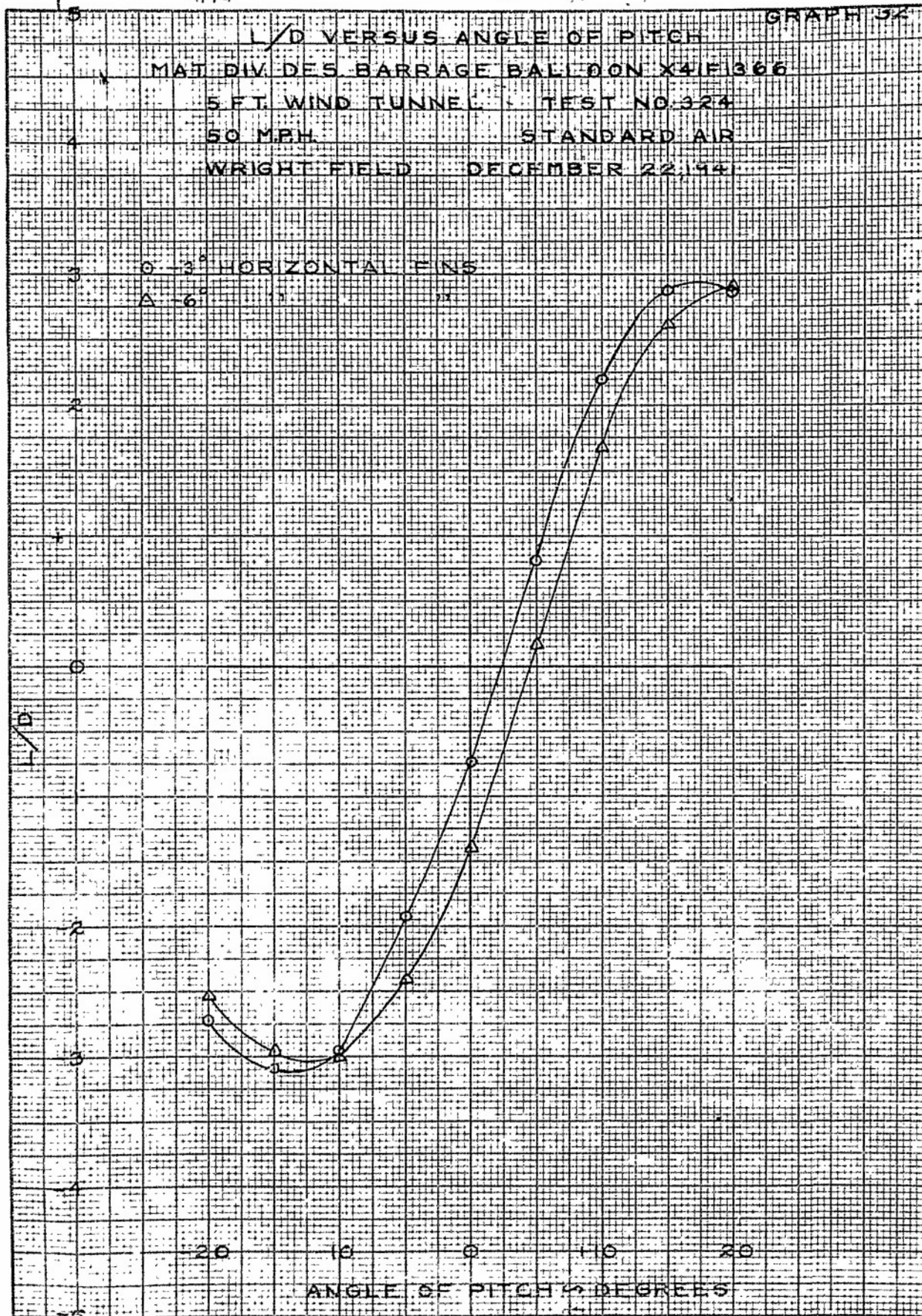


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GRAPH 52



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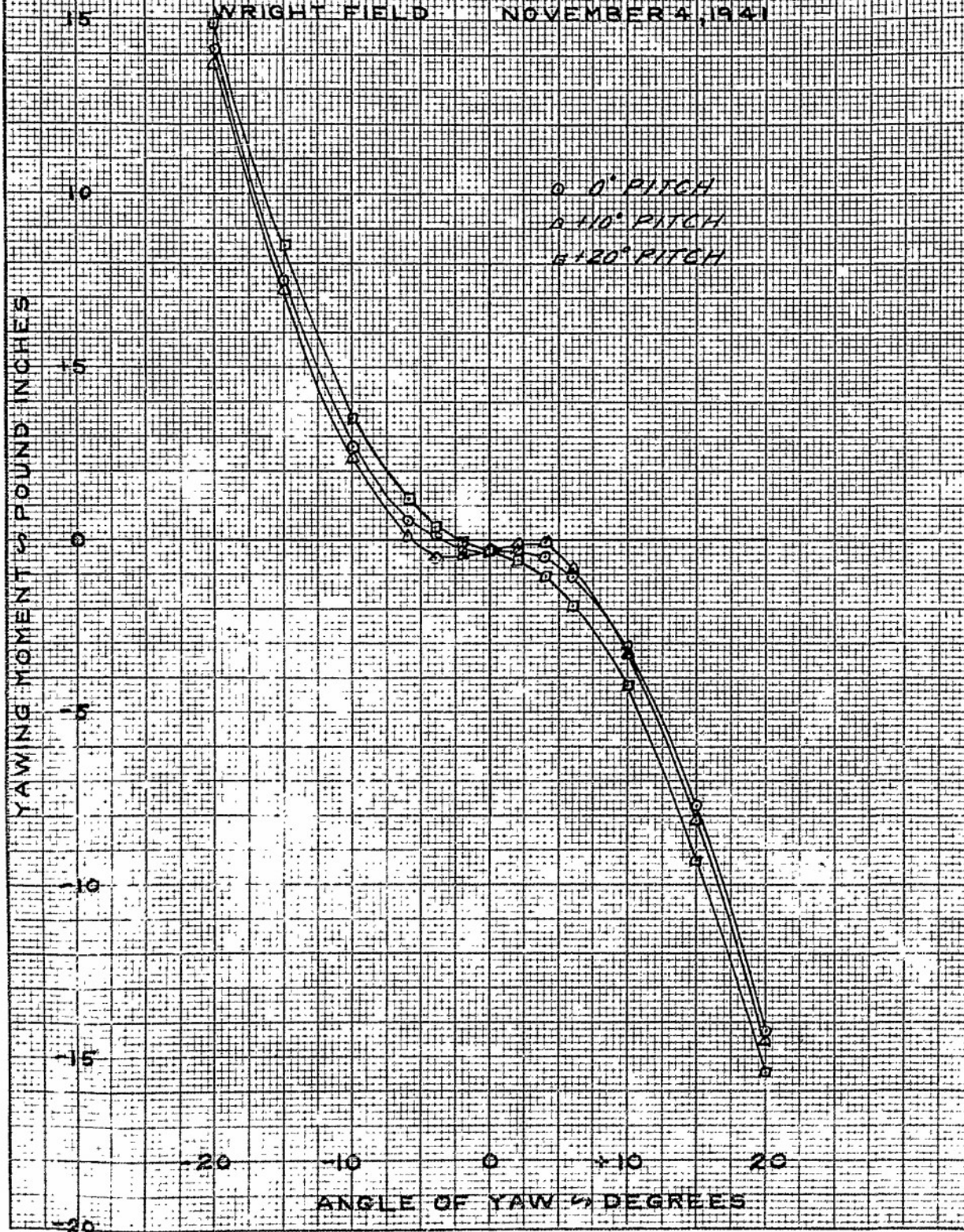
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GRAPH 33

YAWING MOMENT ABOUT CABLE JUNCTION
MAT-DIV-DES BARRAGE BALLOON X4IF 365
5 FT. WIND TUNNEL TEST NO. 317
50 MPH. STANDARD AIR
WRIGHT FIELD NOVEMBER 4, 1941



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PAGE

GRAPH 34

PITCHING MOMENT ABOUT CABLE JUNCTION
 MAT. DIV. DES. BARRAGE BALLOON X4F1365
 5 FT. WIND TUNNEL TEST NO. 324
 55 M.P.H. STANDARD AIR
 WRIGHT FIELD DECEMBER 22, 1941

PITCHING MOMENT IN POUND INCHES

25
20
15
10
5
0
-5
-10
-15

ANGLE OF PITCH IN DEGREES

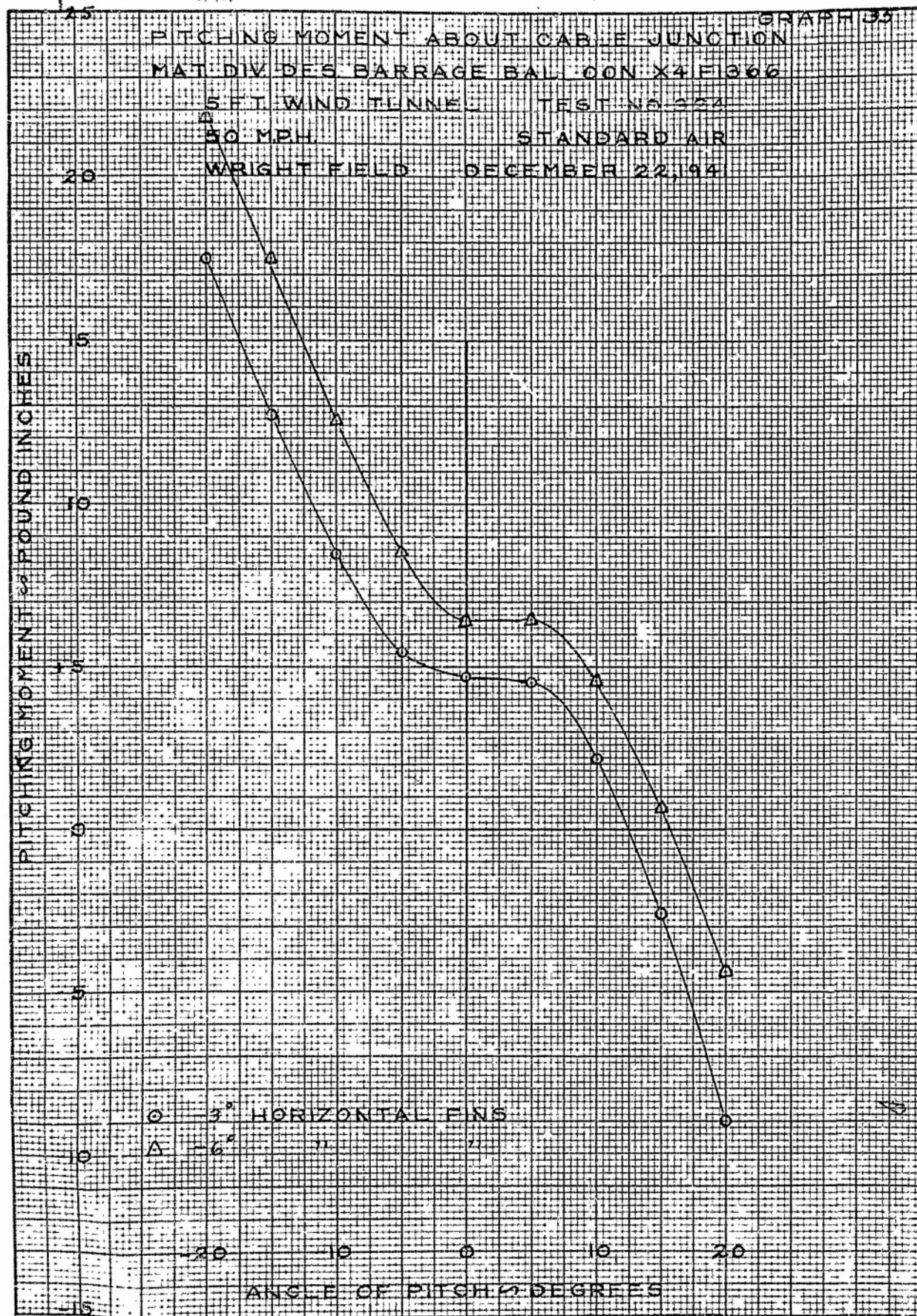
0 0° HORIZONTAL FINS
 Δ -3° " "
 □ -6° " "

20 -10 0 10 20

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SERIAL NO.

PAGE



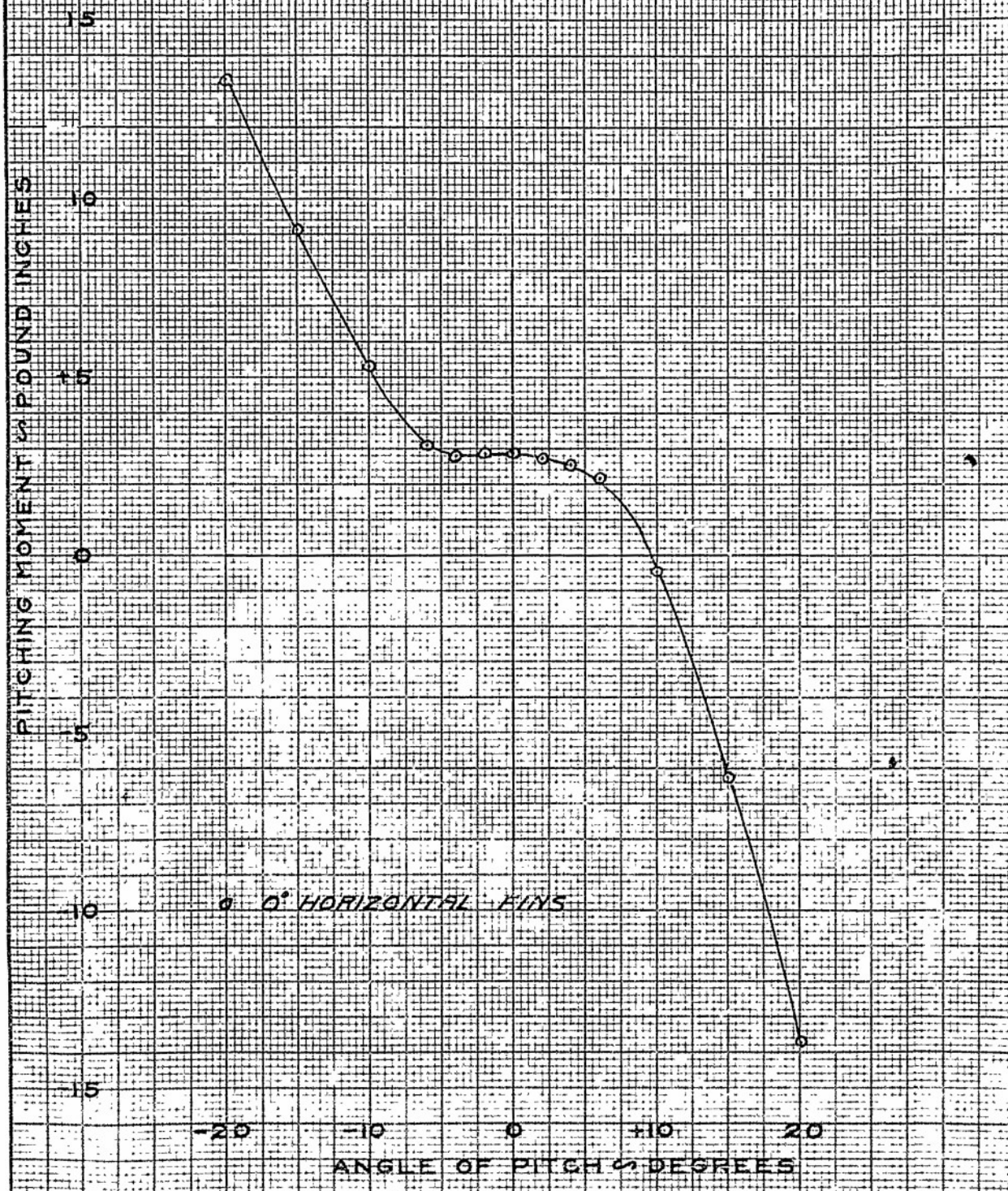
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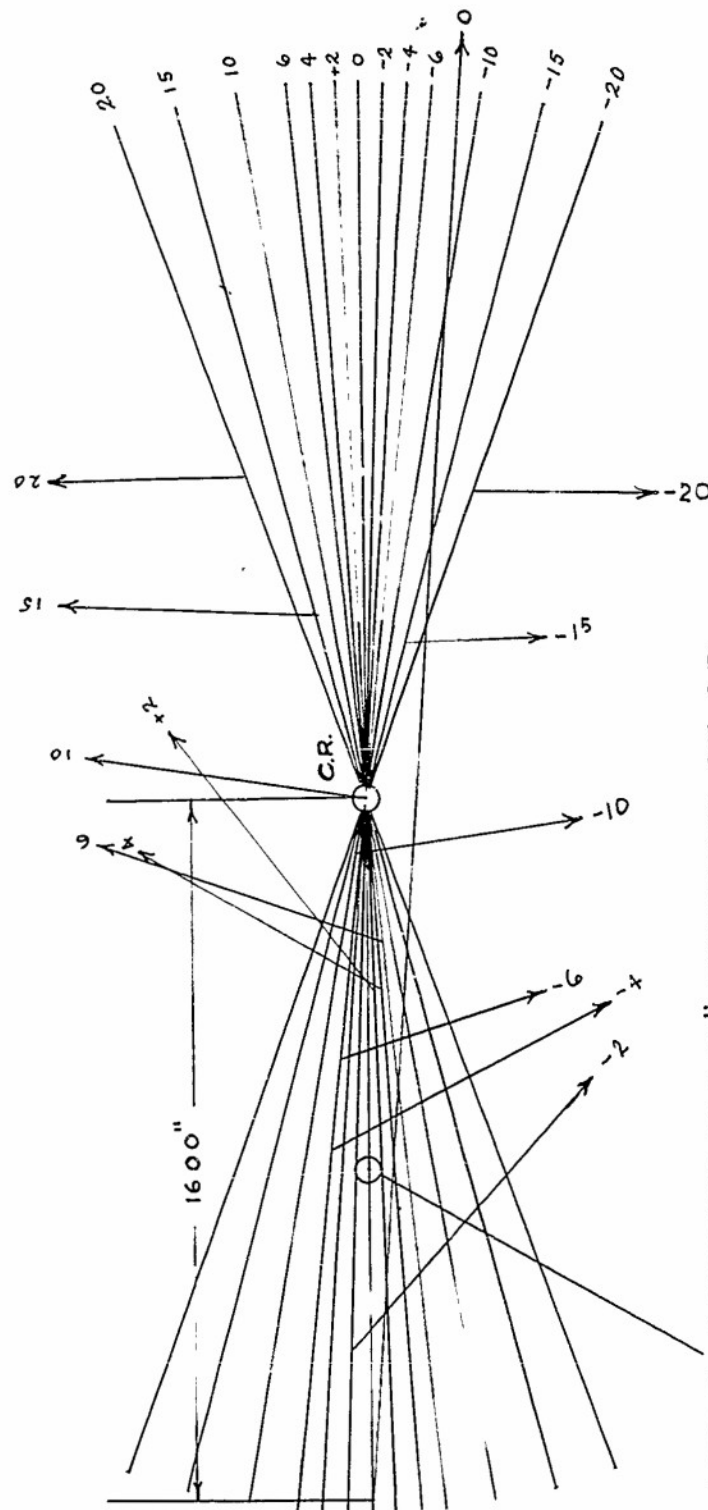
GRAPH 36

PITCHING MOMENT ABOUT CABLE JUNCTION
 MAT DIV DES BARRAGE BALLOON X4F1366
 6 FT WIND TUNNEL TEST NO. 317
 20 MEM STANDARD AIR
 WRIGHT FIELD NOVEMBER 4, 1941



USE THIS SIDE

YAWING MOMENT VECTORS AT ZERO DEGREES PITCH
MAT. DIV. DES. BARRAGE BALLOON X4IF1365 0° HOR. FINS
5 FT. WIND TUNNEL TEST NO. 317
50 MP.H. STANDARD AIR
WRIGHT FIELD NOVEMBER 4, 1941

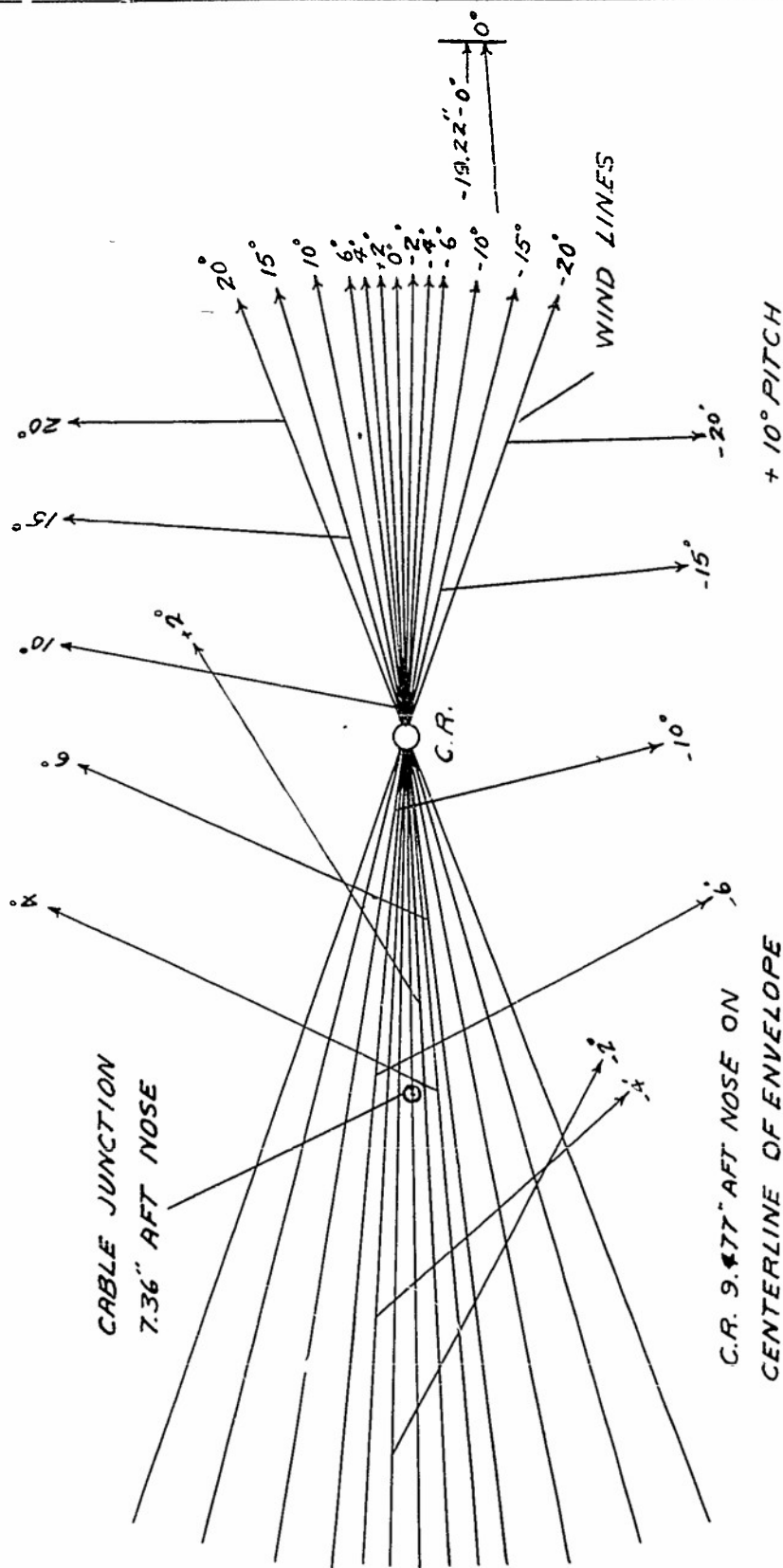


CABLE JUNCTION IS 2.12" FORWARD OF C.R.
AND 10.24" BELOW, PERPENDICULAR TO CENTERLINE

PLEASE USE THIS SIDE

2

PLAN VIEW



+ 10° PITCH

MAT. DIV. DES. BARRAGE BALLOON X4F/365
 5FT. WIND TUNNEL TEST NO. 317
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD NOVEMBER 4, 1941
 VECTORS NOT DRAWN TO SCALE

C.R. 9.477" AFT NOSE ON
 CENTERLINE OF ENVELOPE

PLEASE USE THIS SIDE



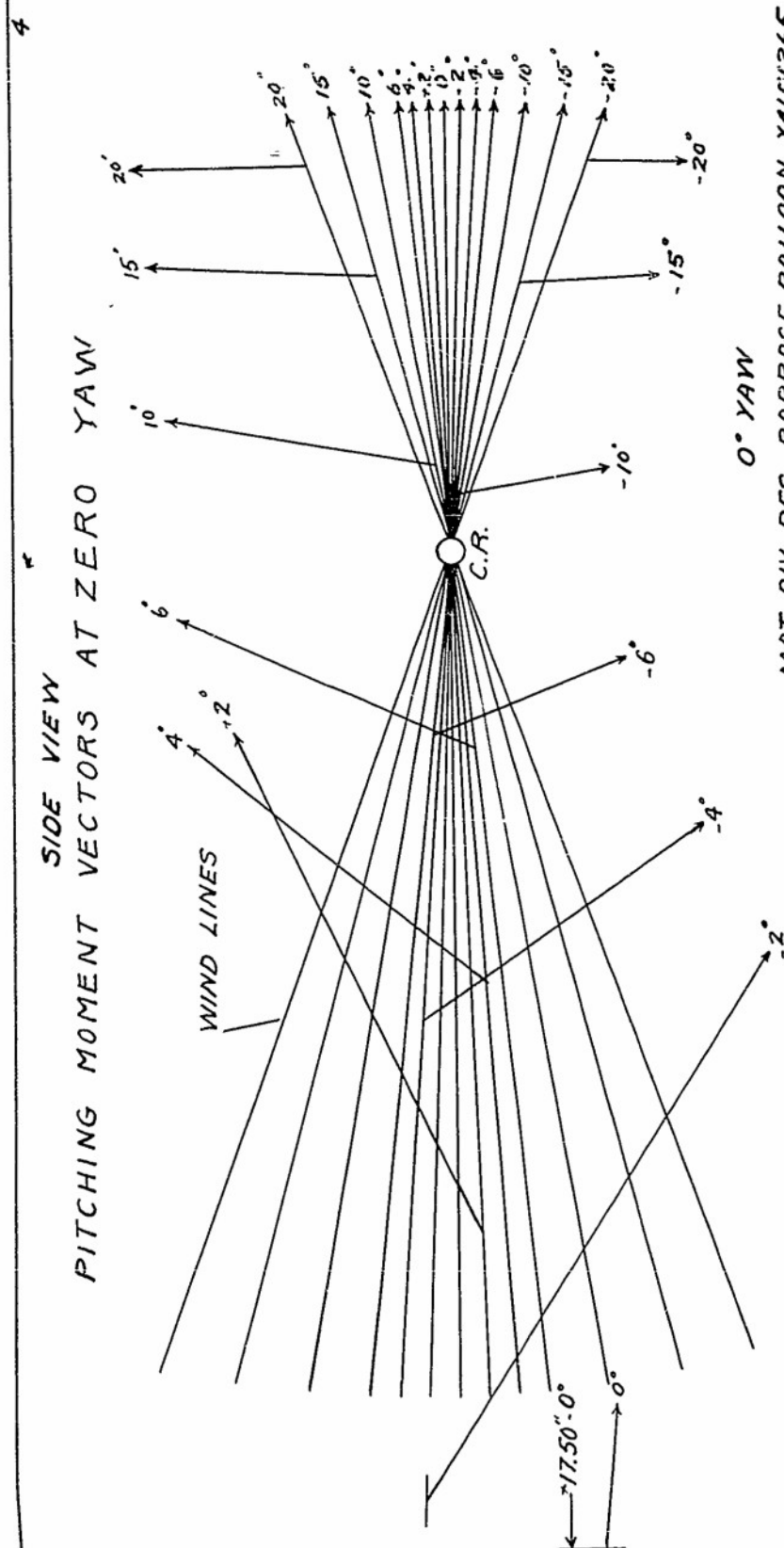
5FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 11, 1941

VECTORS NOT DRAWN TO SCALE

PLEASE USE THIS SIDE



0. YAW

MAT. DIV. DES. BARRAGE BALLOON X4/FI365

5FT. WIND TUNNEL TEST NO. 317

50 M.P.H. STANDARD AIR

WRIGHT FIELD NOVEMBER 4, 1941

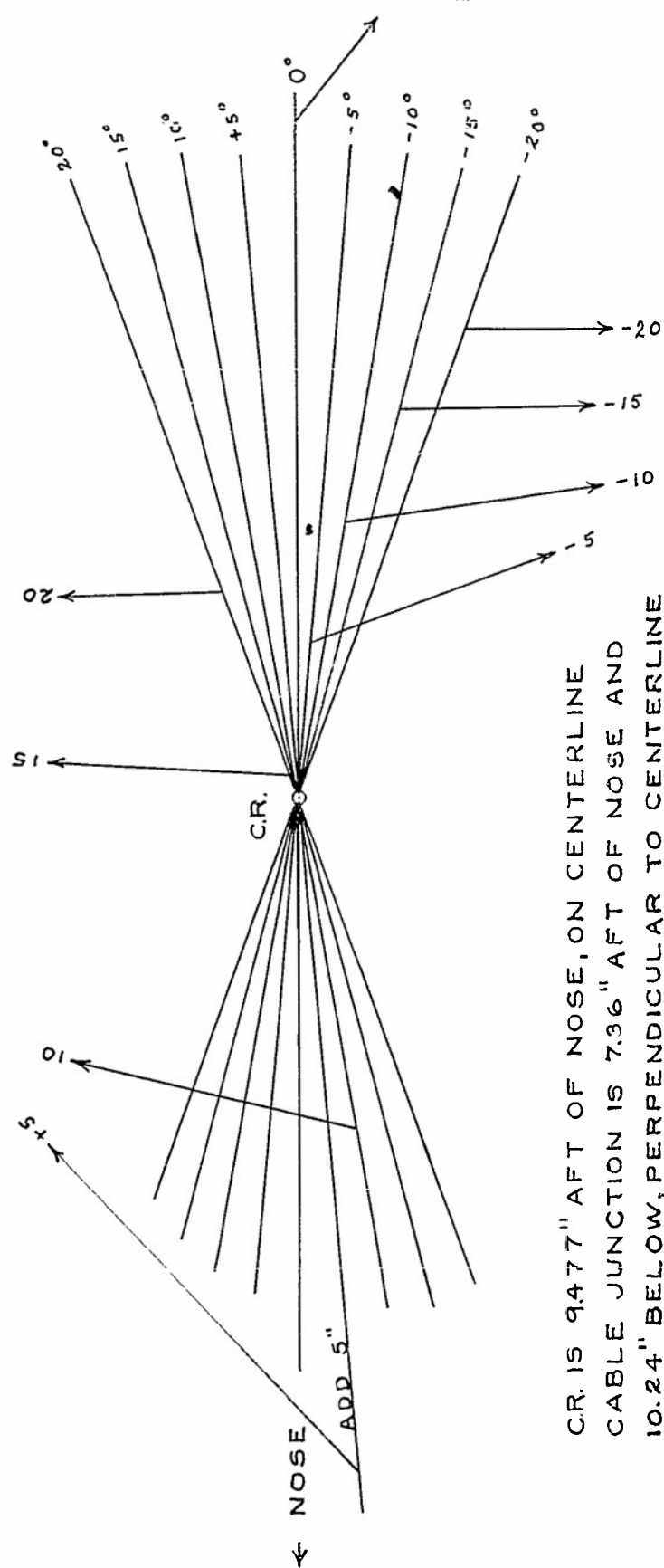
VECTORS NOT DRAWN TO SCALE

C.R. 9.477" AFT NOSE ON
CENTERLINE OF ENVELOPE

CABLE JUNCTION 10.24" BELOW
CENTERLINE OF ENVELOPE AND
7.36" AFT NOSE

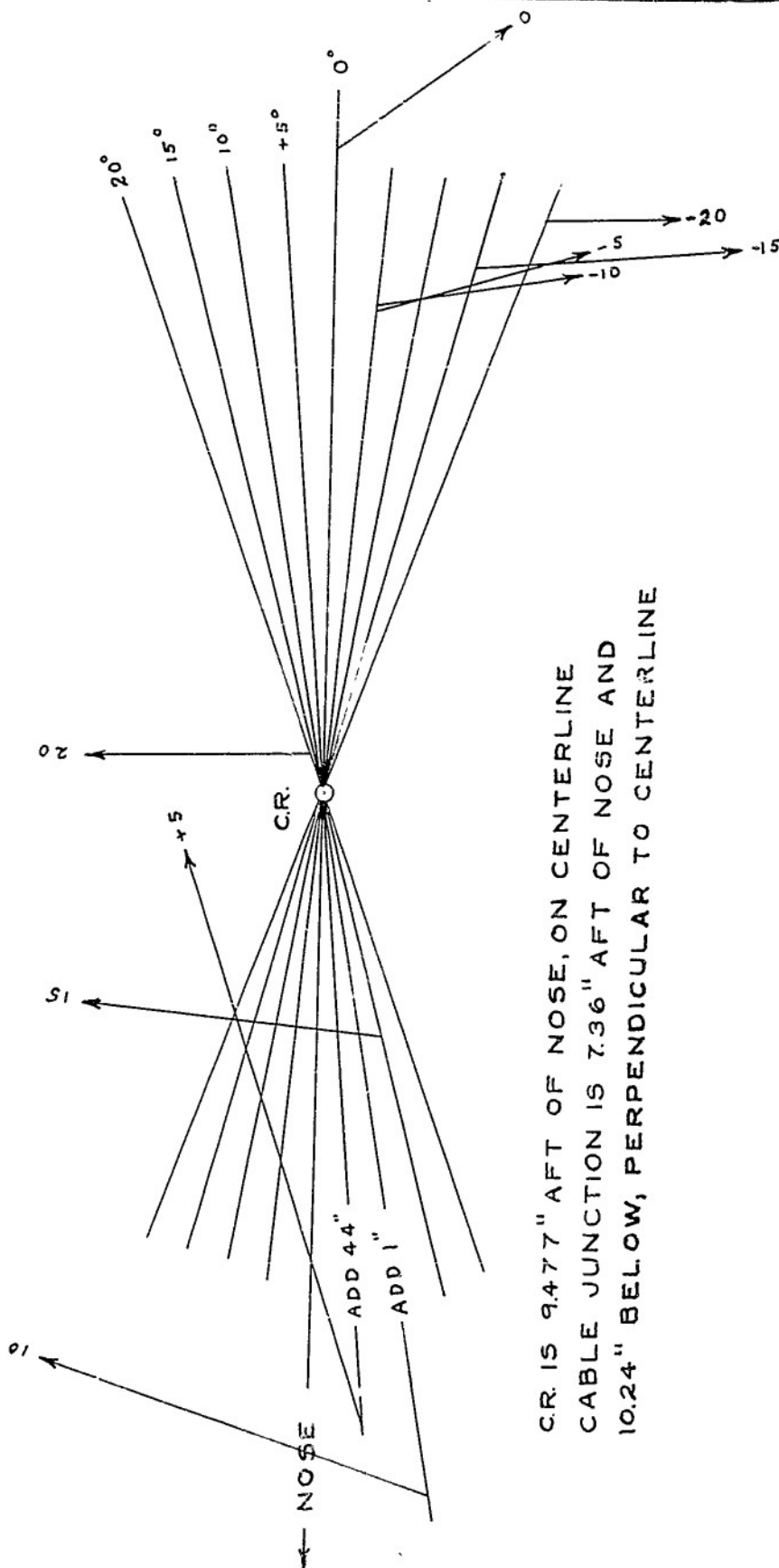
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PITCHING MOMENT VECTORS AT ZERO DEGREES YAW
 MAT. DIV. DES. BARRAGE BALLOON X4IF1365 -3° HOR. FINS
 TEST NO. 324
 STANDARD AIR
 DECEMBER 22, 1941
 5 FT. WIND TUNNEL
 50 M.P.H.
 WRIGHT FIELD



C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE
 CABLE JUNCTION IS 7.36" AFT OF NOSE AND
 10.24" BELOW, PERPENDICULAR TO CENTERLINE

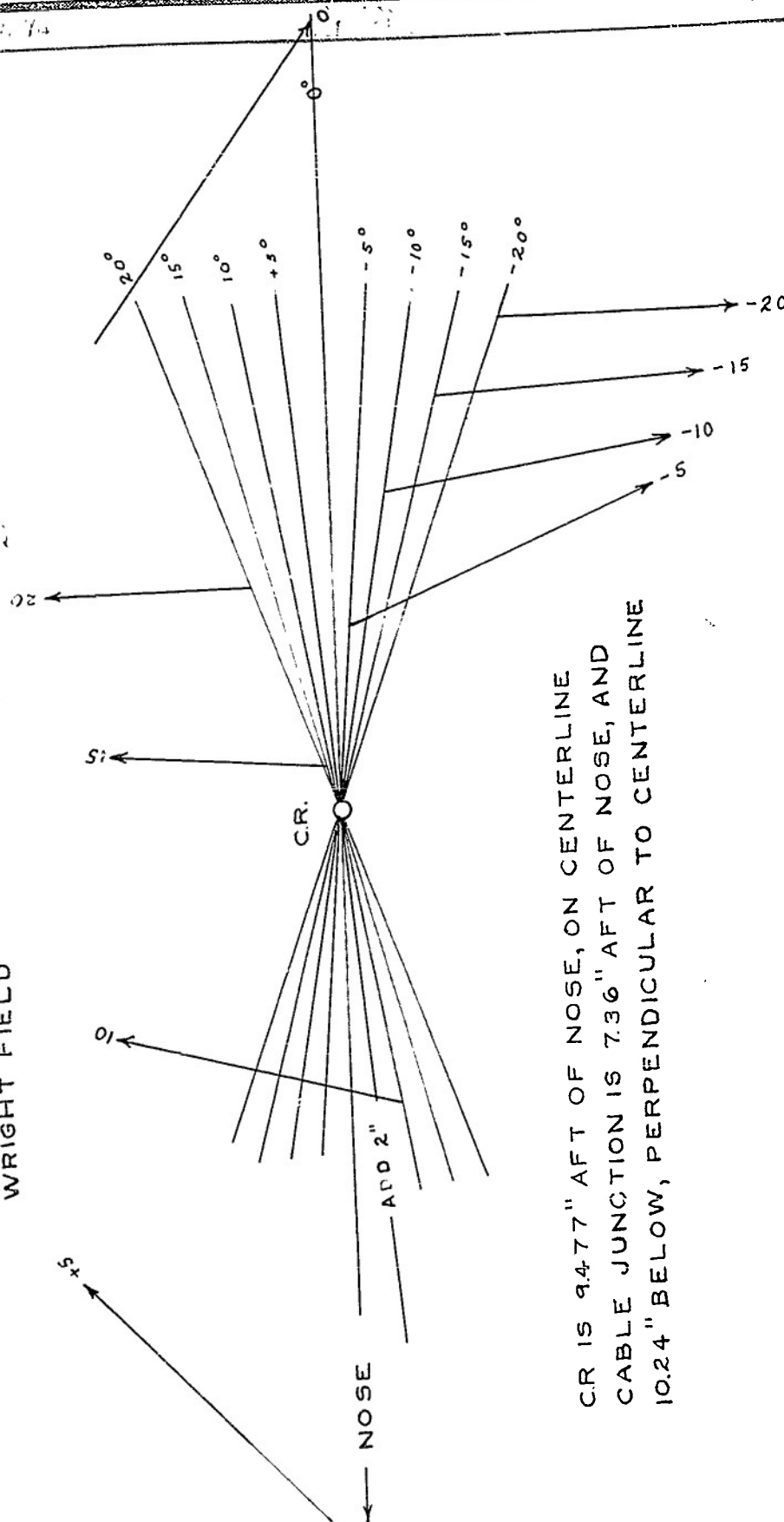
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW
 MAT. DIV. DES. BARRAGE BALLOON X41F1365 -6° HOR. FINS
 TEST NO. 324
 STANDARD AIR
 DECEMBER 22, 1941
 5 FT. WIND TUNNEL
 50 MPH.
 WRIGHT FIELD



C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE
 CABLE JUNCTION IS 7.36" AFT OF NOSE AND
 10.24" BELOW, PERPENDICULAR TO CENTERLINE

SERIAL NO. 1, 14

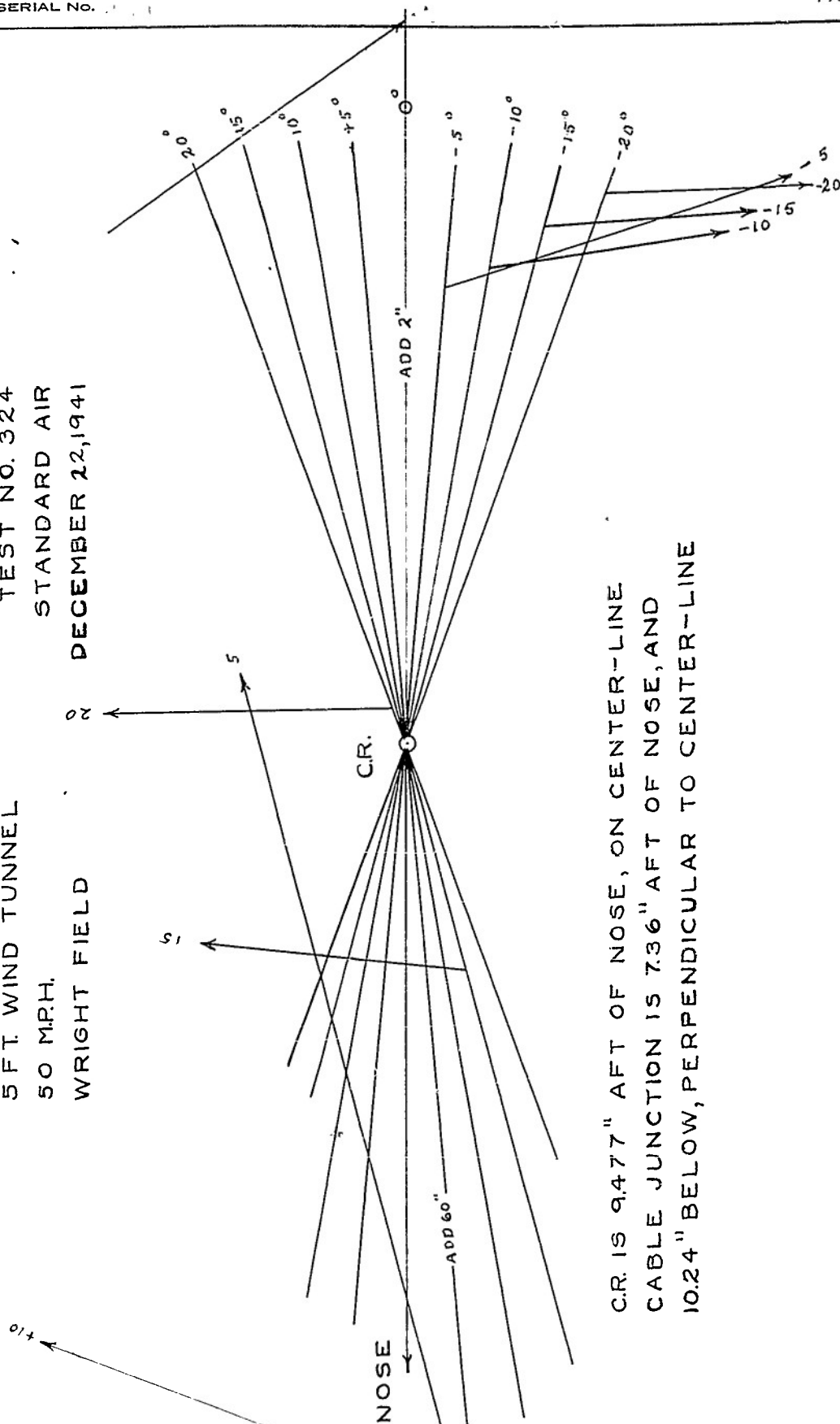
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW
 MAT. DIV. DES. BARRAGE BALLOON X4F1366 -3° HOR. FINS
 TEST NO. 324
 STANDARD AIR
 DECEMBER 22, 1941
 5 FT. WIND TUNNEL
 50 MPH.
 WRIGHT FIELD



C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE
 CABLE JUNCTION IS 7.36" AFT OF NOSE, AND
 10.24" BELOW, PERPENDICULAR TO CENTERLINE

PLEASE USE THIS SIDE

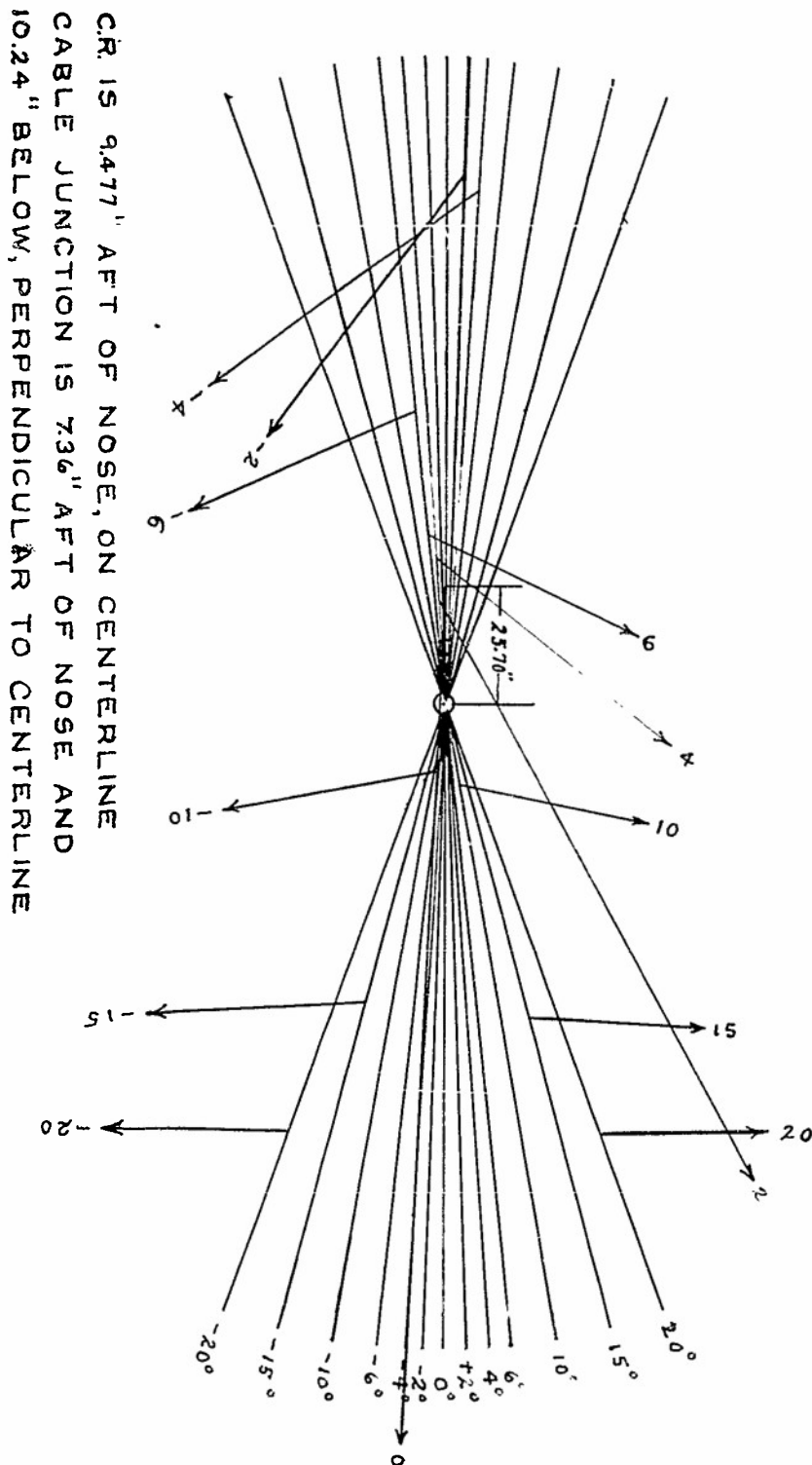
PITCHING MOMENT VECTORS AT ZERO DEGREES YAW
MAT. DIV. DES. BARRAGE BALLOON X41F1366-6° HOR. FINS
5 FT. WIND TUNNEL
TEST NO. 324
50 M.P.H.
STANDARD AIR
WRIGHT FIELD 2 DECEMBER 22, 1941



C.R. IS 9.477" AFT OF NOSE, ON CENTER-LINE
CABLE JUNCTION IS 736" AFT OF NOSE, AND
10.24" BELOW, PERPENDICULAR TO CENTER-LINE

PLEASE USE THIS SIDE

PITCHING MOMENT VECTORS AT ZERO DEGREES YAW
 MAT. DIV. DES. BARRAGE BALLOON X4F1366 0° HOR. FINS
 5 FT. WIND TUNNEL
 60 M.P.H.
 WRIGHT FIELD
 TEST NO. 324
 STANDARD AIR
 NOVEMBER 3, 1941

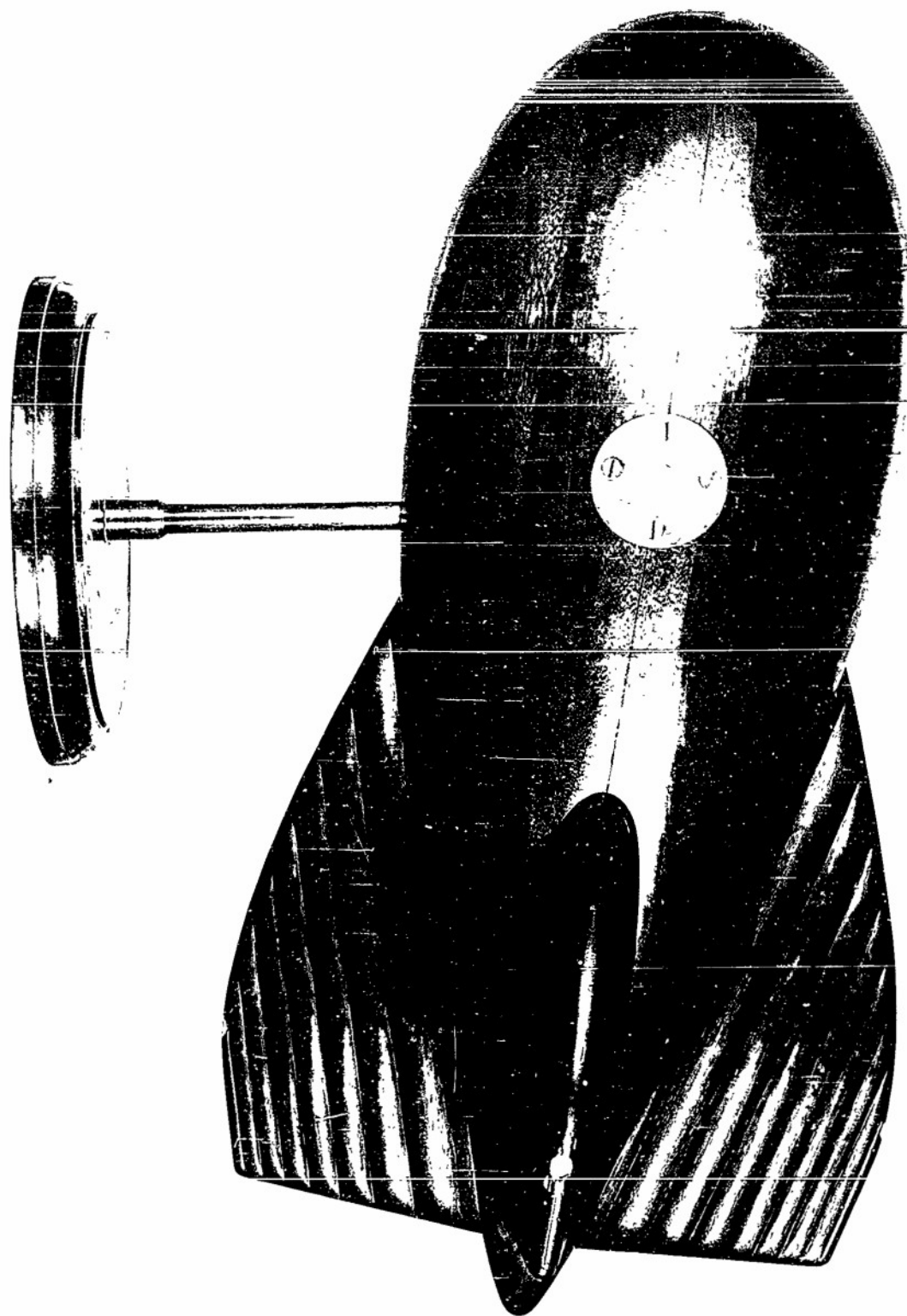


C.R. IS 9.477" AFT OF NOSE, ON CENTERLINE
 CABLE JUNCTION IS 7.36" AFT OF NOSE AND
 10.24" BELOW, PERPENDICULAR TO CENTERLINE

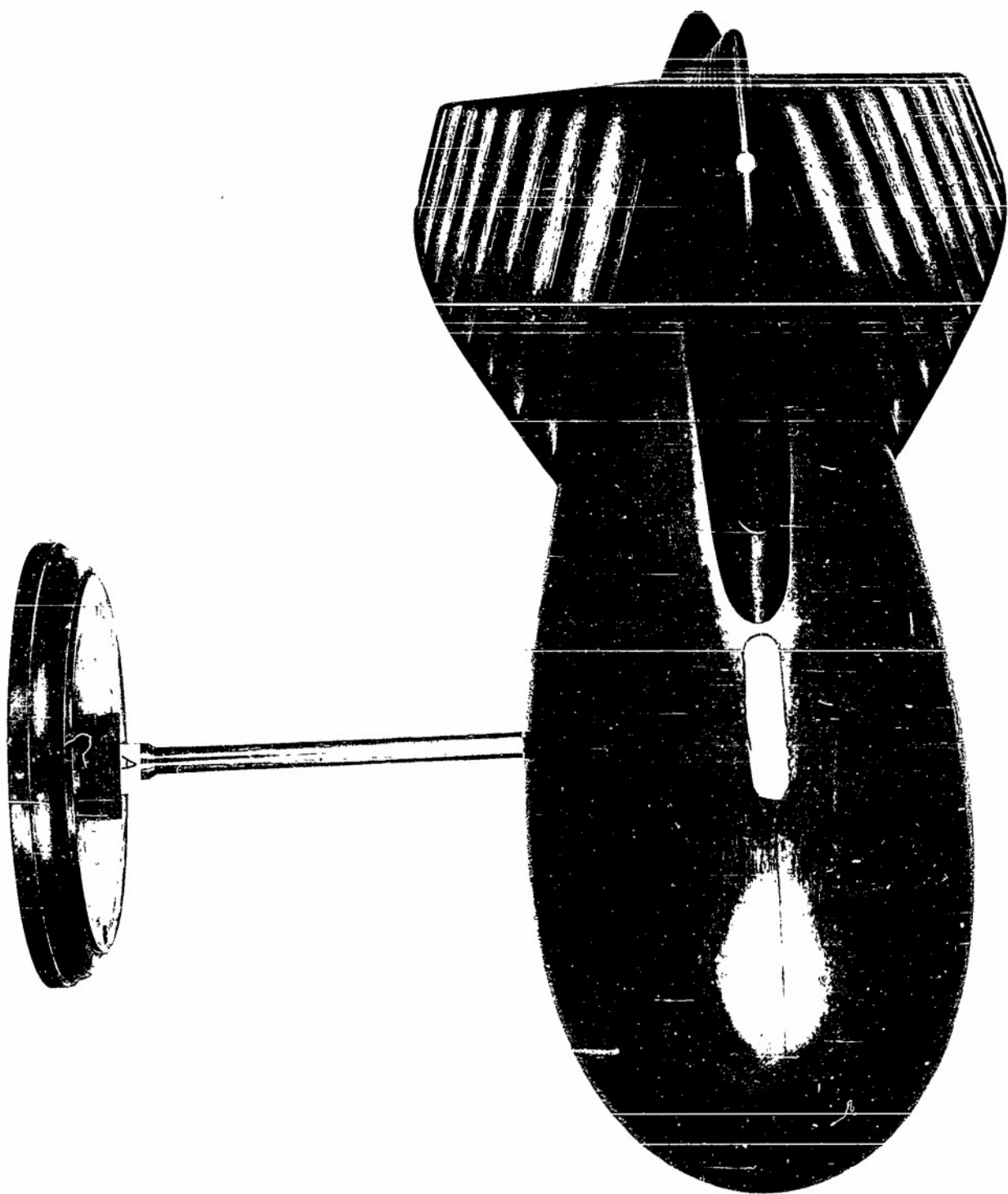
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LIST OF PHOTOGRAPHS

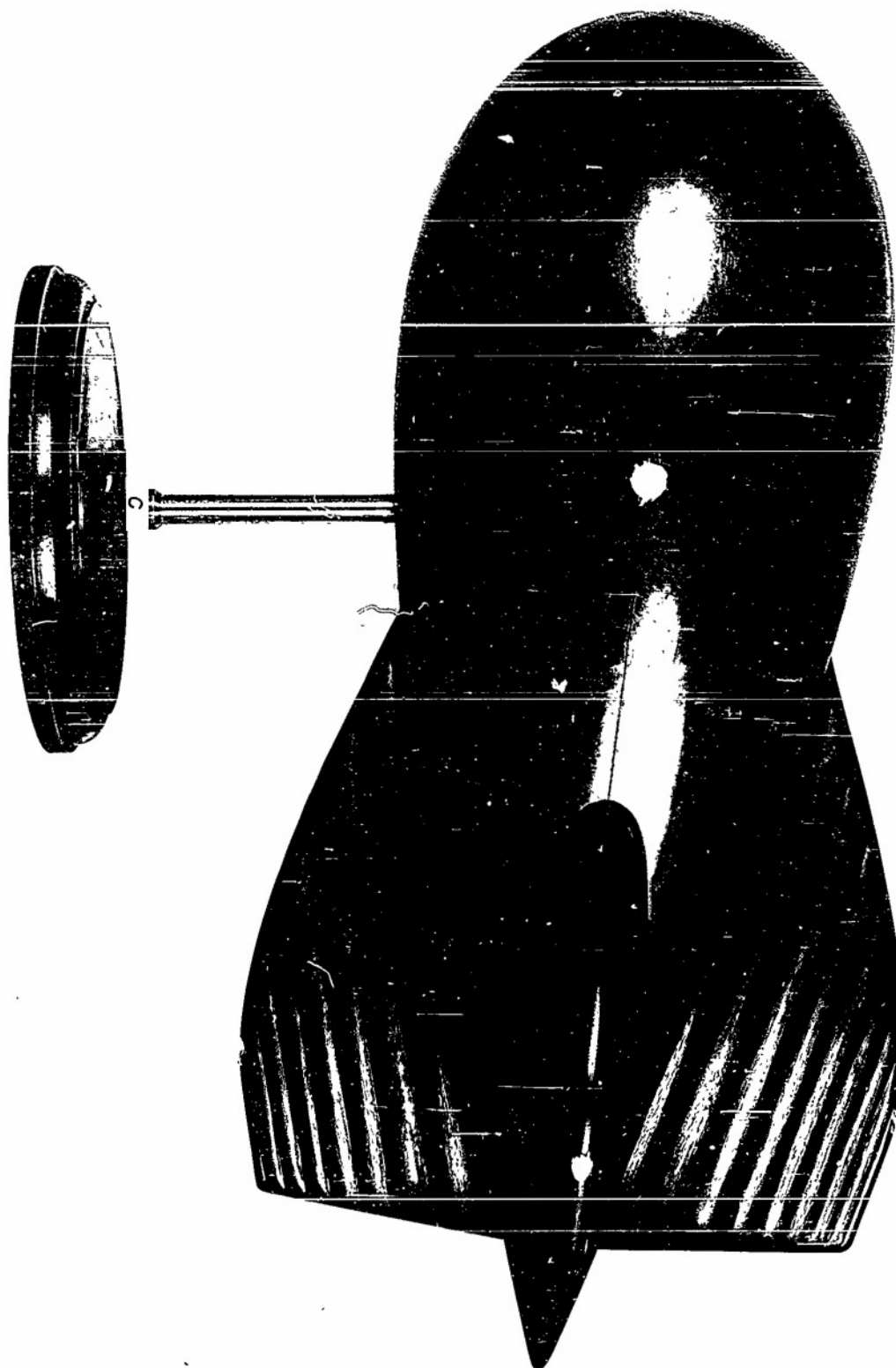
<u>NO.</u>	<u>TITLE</u>
81949	Top view of Materiel Division Design Barrage Balloon X41F1365, Envelope A
81948	Side view of Materiel Division Design Barrage Balloon X41F1365, Envelope A
81953	Top view of Materiel Division Design Barrage Balloon X41F1366, Envelope B
81952	Side view of Materiel Division Design Barrage Balloon X41F1366, Envelope B
81951	Top view of Materiel Division Design Barrage Balloon X41F1367, Envelope C
81950	Side view of Materiel Division Design Barrage Balloon X41F1367, Envelope C



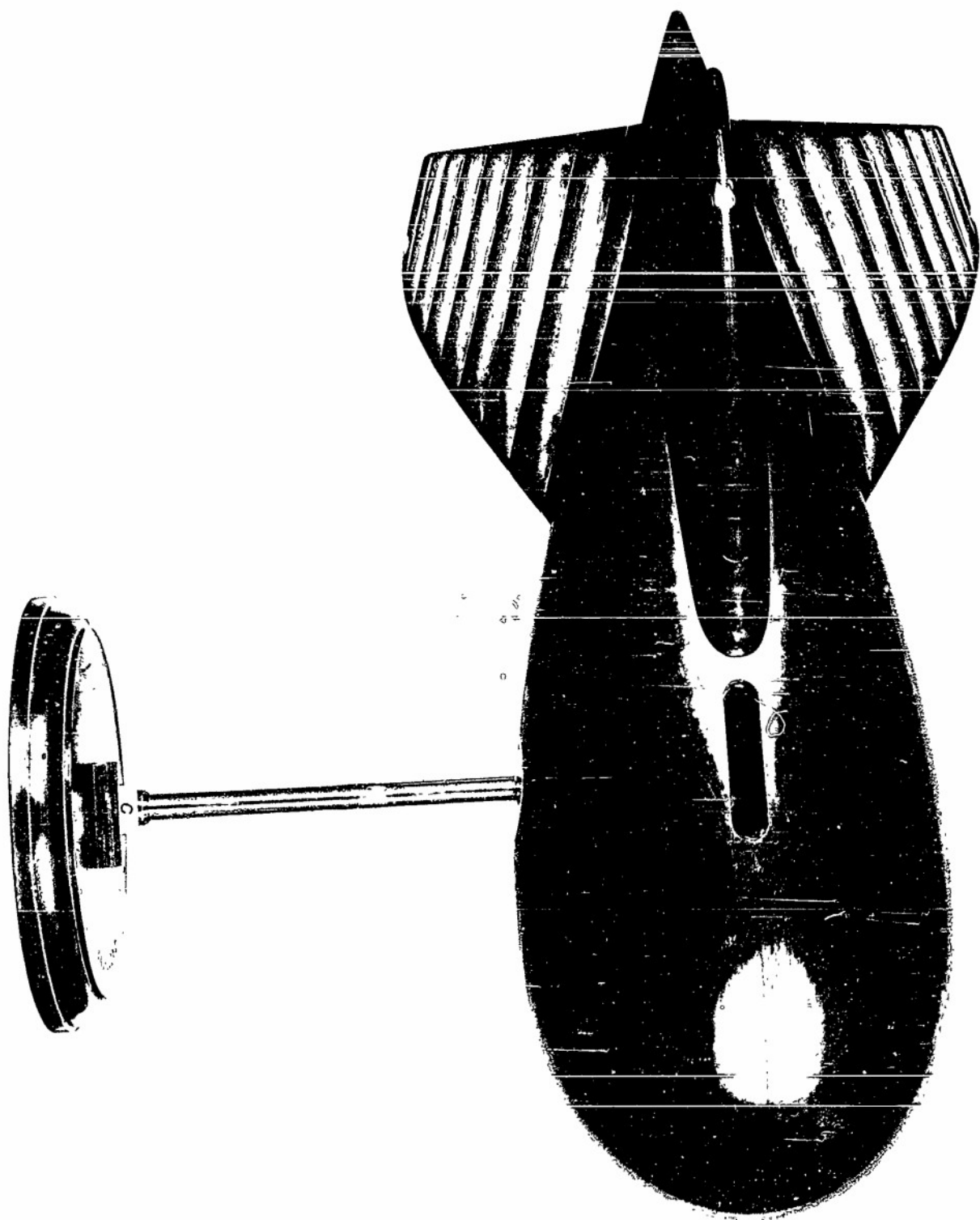
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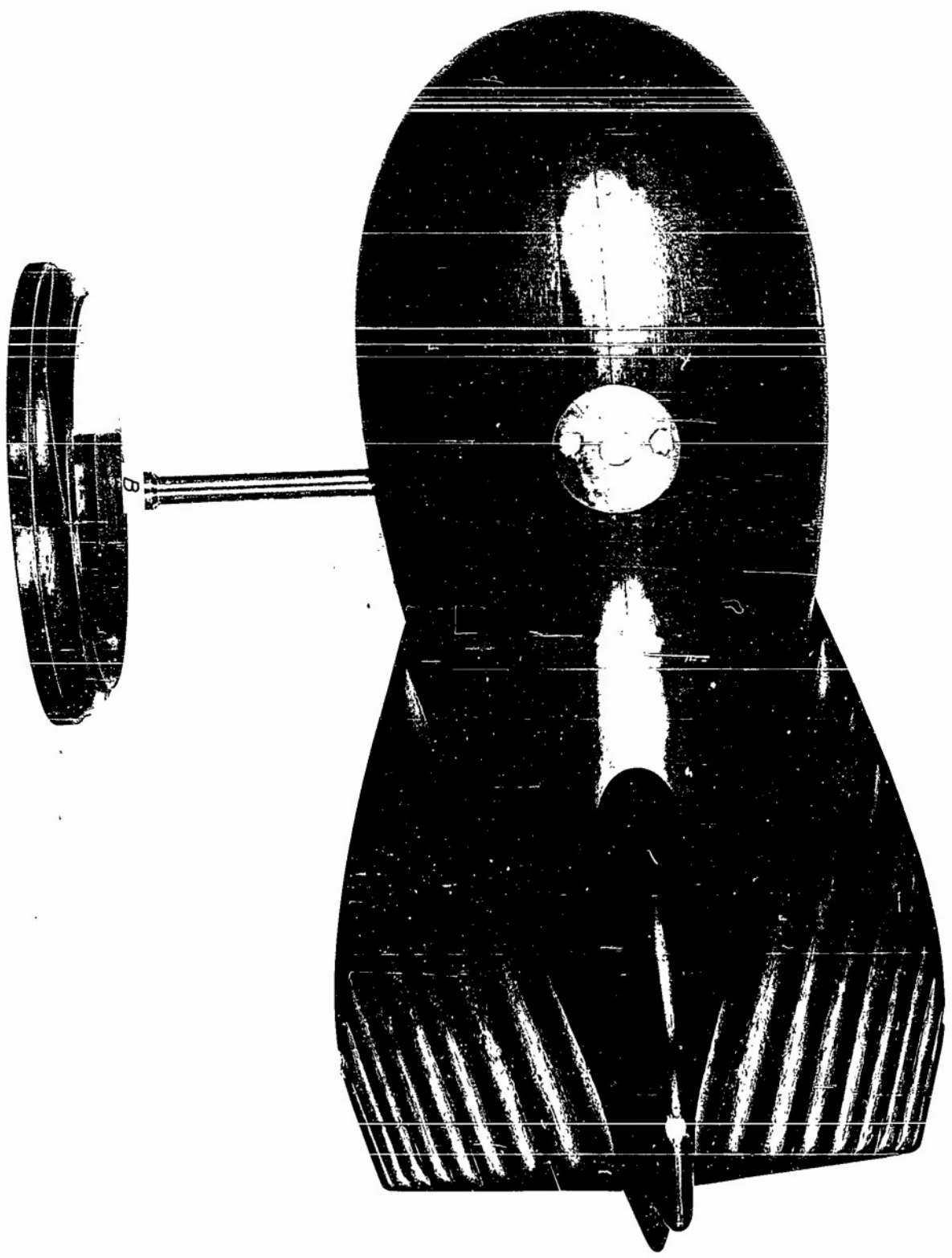
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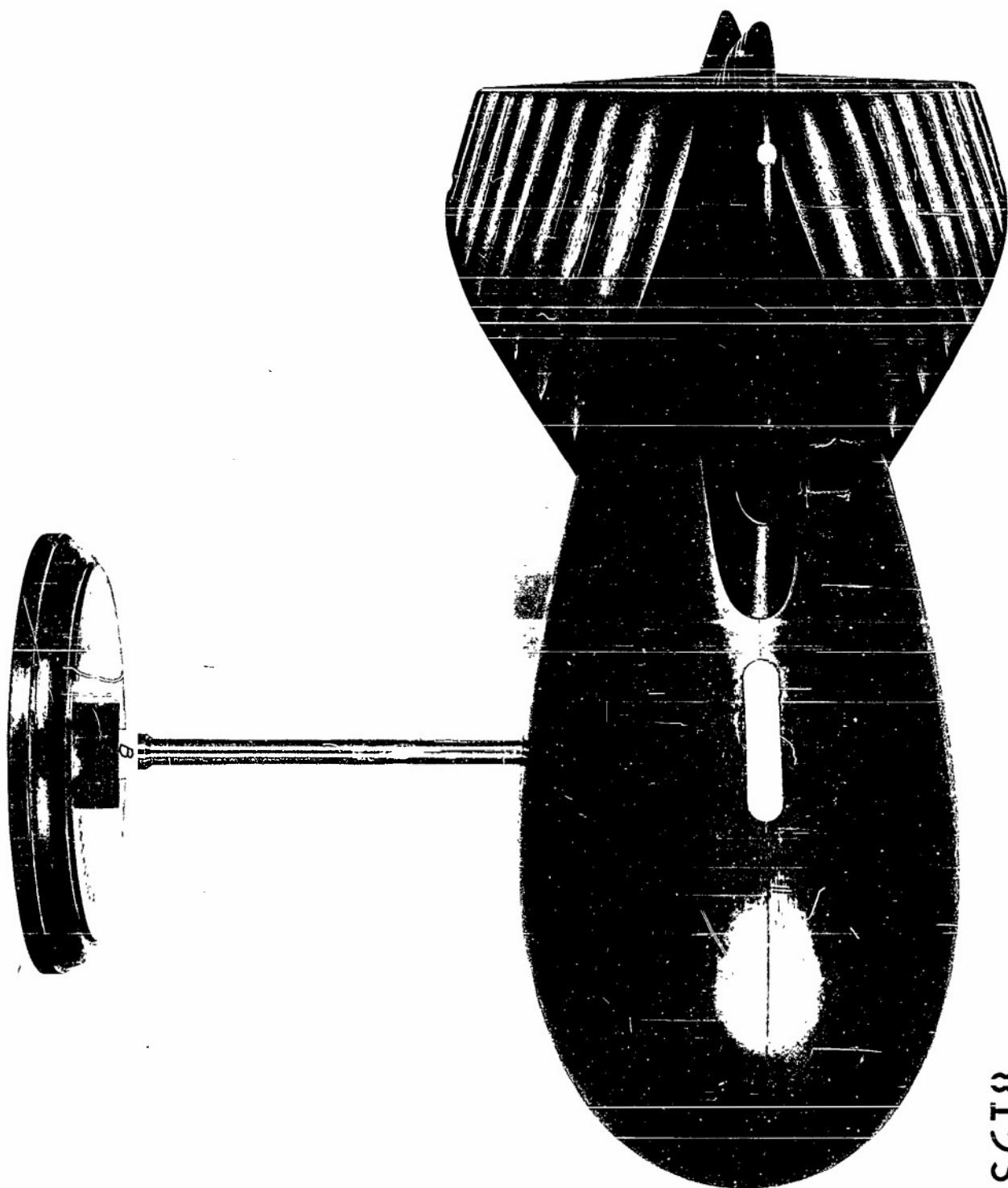
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