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Test of 1/36-Scale Materiel Center Design Barrage Balloon X41K660 with Six
Different Tail Assemblies - Five-Foot Wind Tunnel Test No. 285

Young, D. W., Gilmore, J. H.

(Dayton, O.)

Air Materiel Command, Wright-Patterson Air Force Base,

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The X41K-660 barrage balloon model was tested to determine the effect of the different sizes and shapes of fins, as well as incidence of horizontal fins, on stability and longitudinal trim. The results showed that the angle of longitudinal trim about the cable junction is increased one degree for each degree decrease in incidence of the horizontal fins. In one assembly, fins were used which were thinner than in other assemblies and had the centroid of area farther aft; these fins produced better stability.

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Lighter-Than-Air (40)

Balloons, Barrage - Stability and
control (15652)

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WAR DEPARTMENT
AIR CORPS
MATERIEL DIVISION
DAYTON, OHIO

22771

RESTRICTED

AIR CORPS TECHNICAL REPORT

No. 4808

Test of 1/36-Scale Materiel Center Design Barrage
Balloon XLK60 with Six Different Tail Assemblies
Five-Foot Wind Tunnel Test No. 285
Title

BY

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RESTRICTEDTest of 1/36-Scale Model of Materiel CenterDesign Barrage Balloon X41K660With Six Different Tail Assemblies.(Five-Foot Wind Tunnel Test, No. 285)SUMMARY

The X41K660 barrage balloon model, designed and built by the Materiel Center was tested to determine its longitudinal and directional stability with six different tail assemblies.

Tests of assemblies 1, 2, and 4 were made to determine the change in stability and longitudinal trim due to changes in incidence of the horizontal fins. The longitudinal stability about the flying cable junction at the angle of pitch for trim was improved slightly as the fin incidence was increased negatively. The directional stability, however, about the cable junction was not affected by changing the fin incidence. The angle of trim was increased approximately one degree for each degree change in incidence of the horizontal fins.

In assembly No. 6 the lower vertical and horizontal fins were increased in size and made identical to the fins used on the top of assemblies 1, 2, and 4. The longitudinal stability was improved very slightly over assembly 1, but no change was observed in directional stability.

In assembly 8 the horizontal fins were those used in assembly 1, but with the leading and trailing edges extended with clay. The longitudinal stability for assembly 8 was practically identical to that of assembly 1. The vertical fins of assembly 8 were those used in

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assembly 6, but with the leading and trailing edges extended with clay. No change in directional stability is observed between assemblies 3 and 6.

Finally assembly 7, which had fins of a different plan form, was tested. With this type of fin the longitudinal and directional stability are greatly increased. The stability of this assembly was superior to that of any of the previous conditions reported.

DATES AND PLACE OF TEST

These tests were conducted in the Five-Foot Wind Tunnel at Wright Field from March 28 to April 1, 1941, and May 22 to May 23, 1941.

OBJECT

The object of these tests was to determine the effect of the different sizes and shapes of fins, as well as incidence of horizontal fins, on stability and longitudinal trim.

DESCRIPTION OF MODEL

The envelope was made of mahogany and hollowed out to a wall thickness of $5/8$ inch. The envelope used for all model conditions had a maximum diameter of 9.243 inches and a length of 28.365 inches. The fins were of mahogany with mahogany shoes made to fair the fins into the envelope for each angle of incidence of the horizontal fin. The seams of the fins for assemblies 1, 2, 4, 6, and 8 were parallel to the envelope contour at the point of attachment. However, assembly 7 had the seams running parallel to the center line of the envelope.

The following tail assemblies were tested:

| ASSEMBLY NO. | TOP VERTICAL | HORIZONTAL | | LOWER VERTICAL | REMARKS |
|--------------|-----------------------|-------------------------|-------------------------|---------------------|-----------------------------|
| | | LEFT | RIGHT | | |
| 1 | X41K431-1 | X41J433-1 | X41J433-1 | X41K432 | Horiz. fins 0° pitch. |
| 2 | X41K431-1 | X41J433-2 X41G516-1L | X41J433-2 X41G516-1R | X41K432 | Horiz. fins - -3° Pitch. |
| 4 | X41K431-1 | X41J433-2 X41G516-3L | X41J433-2 X41G516-3R | X41K432 | Horiz. fins - -8° Pitch. |
| 6 | X41K431-1 | X41K431-1 | X41K431-1 | X41K431 | Symmetrical |
| 7 | X41M1175 | X41M1175 | X41M1175 | X41M1175 | Symmetrical |
| 8 | X41K431-1 *Revised | X41J433-1 *Revised | X41J433-1 *Revised | X41K431 *Revised | |

* See sketch at end of report for details.

The model was mounted by means of a 7/16-inch diameter spindle attached at the center of buoyancy of the envelope and later referred to as the "center of rotation," or "C.R." The C.R. is located 10.33 inches aft of the nose on the center line of the envelope. The cable junction, about which the balloon is expected to be flown, is 10.667 inches below the center line of the envelope and 9.056 inches aft of the nose.

PROCEDURE

The model mounted on the N.P.L. balance was tested at 50 miles per hour air speed for all conditions. For each condition of the model, 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, with the following exceptions. Assemblies 4 and 6 were tested at 0 degrees pitch only and assembly 7 was tested at 0 and +10 degrees pitch. For assemblies 1, 2, 4 and 8, the model was tested for pitching moments for a range of pitch angles from 0 to ± 20 degrees at zero degrees yaw. For assemblies 6 and 7 the model was symmetrical in all four quadrants; hence, pitching moments were not measured but merely assumed to be equal to the corresponding yawing moments.

Support interference was determined by tests, and the observed values were corrected.

DISCUSSION OF RESULTS

Comparisons of graphs 42 and 44, which are a plot of the pitching moments about the flying cable junction for assemblies 1 and 2, respectively, indicate a slight improvement in longitudinal stability for assembly 2 at both the trim angle and zero degrees pitch. The fin incidence for No. 1 was 0 degrees and -3 degrees for No. 2. The angle of trim was +9.5 degrees for zero incidence and +12.5 degrees for -3 degrees incidence. Hence, there is a change in angle of trim of about one degree for each degree of change in incidence. Comparison of graphs 41 and 43 indicates no change in directional stability due to incidence of the fins.

Transfer of moments about the C.R. to the flying cable junction were not made for any of the remaining conditions, but sufficient data are given in this report to make this possible. Comparisons can be drawn from the graphs, which give the moments about the C.R.

Graph 25, Assembly 6, compared to Graphs 1 and 5, assembly 1,

indicates very slight improvement in longitudinal stability and no change in directional stability due to the increased horizontal and lower vertical fin area.

For assembly 8, the addition of horizontal fin area was accomplished by extending the leading and trailing edges of fins of assembly 1. As shown by graphs 33 and 5 of assemblies 8 and 1, respectively, the longitudinal stability was not changed. The addition of vertical fin area to the vertical fins which were used in assembly 6 caused no change in directional stability, graphs 29 and 25 of assemblies 8 and 6, respectively.

Assembly 7, the envelope fitted with fins which were thinner and different in plan form, was the best of any assembly tested. Graph 37 indicates that the model, at zero degrees pitch, is directionally stable about the C.R. for all yaw angles tested. At +10 degrees pitch, it is stable for all yaw angles tested, except -2 to +2 degrees, where it is neutrally stable. Stability about the flying cable junction would be even greater.

CONCLUSIONS

- (1) The angle of longitudinal trim about the cable junction is increased one degree for each degree decrease in incidence of the horizontal fins.
- (2) The fins used in assembly 7, which were thinner and had the centroid of area farther aft, produced better stability.
- (3) Except for assembly 7, longitudinal and directional stability for all other configurations tested was not changed to any degree.

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_D = 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. = 0.002378 (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

$$= \frac{57.3 S C_L}{2 \pi d^2} \left[1 - \frac{3}{10} \left(\frac{b}{d} \right)^4 \right]$$
- ΔC_D = Prandtl's wall correction for drag coefficient

$$= \frac{S C_D}{2 \pi d^2} \left[1 + \frac{3}{10} \left(\frac{b}{d} \right)^4 \right]$$
- L/D = lift drag ratio = C_L / C_D
- C_M = pitching moment coefficient = M / qeS
- 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_D = induced drag coefficient = $\frac{C_L^2}{\pi E. M. A. R.}$
- C_{D0} = profile drag coefficient
- C_{Dp} = parasite drag coefficient = C_D - (C_D)_i = C_D - C_D
- A = equivalent flat plate area = C_{Dp} S / 1.279

Positive lift forces are upstream, upward and to right viewed from the rear
 Positive force 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
MATERIEL CENTER BARRAGE BALLOON NO. X11K660

ASSEMBLY NO. 1

50 M.P.H. (Std-Air)
Test No. 285

Wright Field, March 28, 1941
Plotted on Graphs 1, 2, 3, and 4.

| Angle of Yaw (Deg.) | 0° PITCH | | | | +10° PITCH | | | | +20° PITCH | | | |
|---------------------|------------------------|----------------|-------|---------------------------------|------------------------|----------------|-------|---------------------------------|------------------------|----------------|-------|---------------------------------|
| | Gross Wind Force (Lb.) | Net Drag (Lb.) | C/D | Yaw Moment about C.R. (In.-Lb.) | Gross Wind Force (Lb.) | Net Drag (Lb.) | C/D | Yaw Moment about C.R. (In.-Lb.) | Gross Wind Force (Lb.) | Net Drag (Lb.) | C/D | Yaw Moment about C.R. (In.-Lb.) |
| 0 | +0.008 | .320 | +0.03 | -.16 | +0.008 | .417 | +0.02 | -.17 | -.097 | 1.048 | -.01 | +0.04 |
| +2 | .224 | .321 | .70 | +0.36 | .190 | .425 | .45 | +0.52 | +0.178 | 1.058 | +0.17 | .48 |
| 4 | .455 | .331 | 1.38 | .62 | .405 | .439 | .92 | .74 | .415 | 1.068 | .39 | .29 |
| 6 | .719 | .360 | 2.00 | .45 | .705 | .470 | 1.50 | .35 | .698 | 1.092 | .64 | -.47 |
| 10 | 1.379 | .457 | 3.02 | -1.46 | 1.351 | .584 | 2.31 | -1.85 | 1.329 | 1.201 | 1.11 | -2.74 |
| 15 | 2.319 | .758 | 3.06 | -5.44 | 2.291 | .874 | 2.62 | -6.22 | 2.217 | 1.485 | 1.49 | -6.92 |
| 20 | 3.373 | 1.228 | 2.75 | -11.81 | 3.325 | 1.357 | 2.45 | -12.64 | 3.180 | 1.946 | 1.63 | -13.10 |
| -2 | -.217 | .322 | -.67 | -.55 | -.183 | .424 | -.43 | -.76 | -.190 | 1.057 | -.18 | -.37 |
| -4 | -.452 | .330 | -1.37 | -.84 | -.411 | .445 | -.92 | -.97 | -.425 | 1.070 | -.40 | -.26 |
| -6 | -.708 | .364 | -1.95 | -.93 | -.680 | .471 | -1.44 | -.74 | -.696 | 1.093 | -.64 | +0.45 |
| -10 | -1.353 | .464 | -2.92 | +1.06 | -1.328 | .578 | -2.30 | +1.46 | -1.328 | 1.201 | -1.11 | 2.70 |
| -15 | -2.287 | .734 | -3.12 | 5.06 | -2.295 | .863 | -2.66 | 6.02 | -2.191 | 1.473 | -1.49 | 6.63 |
| -20 | -3.364 | 1.201 | -2.80 | 11.31 | -3.309 | 1.333 | -2.48 | 12.19 | -3.161 | 1.943 | -1.63 | 12.73 |

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TABLE III

MATERIEL CENTER BARRAGE BALLOON NO. X11K660
ASSEMBLY NO. 2

Wright Field, March 31, 1941
Plotted on Graphs 9,10,11 and 12.

50 M.P.H. (St'd-Air)
Test. No. 285

| Angle of Yaw (Deg.) | 0° PITCH | | | | +10° PITCH | | | | +20° PITCH | | | |
|---------------------|------------------------|----------------|-------|---------------------------------|------------------------|----------------|-------|---------------------------------|------------------------|----------------|-------|---------------------------------|
| | Gross Wind Force (Lb.) | Net Drag (Lb.) | C / D | Yaw Moment about C.R. (In.-Lb.) | Gross Wind Force (Lb.) | Net Drag (Lb.) | C / D | Yaw Moment about C.R. (In.-Lb.) | Gross Wind Force (Lb.) | Net Drag (Lb.) | C / D | Yaw Moment about C.R. (In.-Lb.) |
| 0 | + .001 | .336 | .00 | -.22 | -.011 | .411 | -.03 | -.13 | -.016 | .945 | -.02 | +.08 |
| +2 | .202 | .339 | +.60 | +.45 | +.185 | .419 | +.44 | +.54 | +.166 | .954 | +.17 | .42 |
| 4 | .432 | .350 | 1.23 | .74 | .396 | .433 | .91 | .81 | .406 | .960 | .42 | .35 |
| 6 | .699 | .379 | 1.84 | .57 | .677 | .458 | 1.48 | .33 | .700 | .993 | .71 | -.58 |
| 10 | 1.357 | .494 | 2.75 | -1.46 | 1.308 | .566 | 2.31 | -1.67 | 1.333 | 1.103 | 1.21 | -2.71 |
| 15 | 2.274 | .772 | 2.95 | -5.35 | 2.262 | .355 | 2.65 | -6.10 | 2.224 | 1.387 | 1.60 | -6.93 |
| 20 | 3.321 | 1.139 | 2.92 | -11.56 | 3.280 | 1.325 | 2.47 | -12.52 | 3.231 | 1.762 | 1.83 | -13.16 |
| -2 | -.219 | .337 | -.65 | -.61 | -.206 | .421 | -.49 | -.67 | -.203 | .954 | -.21 | -.29 |
| -4 | -.447 | .354 | -1.27 | -1.02 | -.425 | .436 | -.98 | -.82 | -.434 | .967 | -.45 | -.24 |
| -6 | -.720 | .390 | -1.85 | -.84 | -.701 | .464 | -1.51 | -.54 | -.713 | .996 | -.72 | +.45 |
| -10 | -1.363 | .496 | -2.75 | +1.16 | -1.355 | .570 | -2.33 | +1.65 | -1.352 | 1.103 | -1.23 | 2.65 |
| -15 | -2.300 | .765 | -3.01 | 5.21 | -2.312 | .872 | -2.65 | +6.27 | -2.228 | 1.334 | -1.61 | 6.57 |
| -20 | -3.333 | 1.227 | -2.72 | 11.42 | -3.330 | 1.339 | -2.46 | +12.45 | -3.206 | 1.859 | -1.72 | 12.69 |

TABLE IV
 MATERIEL CENTER BARRAGE BALLOON NO. X11K660
 ASSEMBLY NO. 2

Wright Field, March 31, 1941
 Plotted on Graphs 13, 14, 15 and 16.

50 M.P.H. (St'd-Air)
 Test No. 285

| Angle of Pitch (Deg.) | ° YAW | | L / D | Pitching Moment about C.R. (In-Lb.) |
|--------------------------------|---------------|----------------------|-------------|---|
| | Lift (Lb.) | Not Drag (Lb.) | | |
| 0 | -0.139 | 0.319 | -0.44 | +0.95 |
| +2 | +0.024 | 0.322 | +0.07 | 1.81 |
| 4 | 0.243 | 0.336 | 0.72 | 2.21 |
| 6 | 0.482 | 0.350 | 1.38 | 2.07 |
| 10 | 1.016 | 0.408 | 2.49 | 1.21 |
| 15 | 1.792 | 0.579 | 3.10 | -1.78 |
| 20 | 2.660 | 0.917 | 2.90 | -6.41 |
| -2 | -0.306 | 0.325 | -0.94 | +0.48 |
| -4 | -0.547 | 0.364 | -1.58 | 0.97 |
| -6 | -0.837 | 0.394 | -2.13 | 1.71 |
| -10 | -1.438 | 0.500 | -2.88 | 3.74 |
| -15 | -2.328 | 0.762 | -3.06 | 8.27 |
| -20 | -3.247 | 1.227 | -2.65 | 14.12 |

TABLE VI
 MATERIEL CENTER BARRAGE BALL ON NO. X11K660
 ASSEMBLY NO. 4

Wright Field, March 31, 1941.
 Plotted on Graphs 21, 22, 23 and 24.

50 M.P.H. (ST'd-Air)
 Test No. 255

| Angle of Pitch (Deg.) | 0° YAW | | | Pitching Moment about C.R. (In.-Lb.) |
|--------------------------------|--------------|----------------------|-------|--|
| | Lift (Lb) | Net Drag (Lb.) | L / D | |
| 0 | -0.5144 | .346 | -1.57 | +4.84 |
| +2 | -0.305 | .340 | -0.90 | 4.92 |
| 4 | -0.110 | .332 | -0.33 | 5.14 |
| 6 | +0.092 | .340 | +0.27 | 5.42 |
| 10 | .533 | .363 | 1.47 | 5.48 |
| 15 | 1.201 | .478 | 2.51 | 3.90 |
| 20 | 2.006 | .731 | 2.74 | .42 |
| -2 | -0.751 | .375 | -2.00 | 4.88 |
| -4 | -1.012 | .427 | -2.37 | 5.21 |
| -6 | -1.308 | .486 | -2.69 | 6.24 |
| -10 | -2.037 | .655 | -3.11 | 9.87 |
| -15 | -2.976 | 1.009 | -2.95 | 15.51 |
| -20 | -3.845 | 1.595 | -2.41 | 21.07 |

TABLE VII

MATERIEL CENTER BARRAGE BALLOON NO. X41K660

ASSEMBLY NO. 6

50 M.P.H. (Std.-Air)
Test No. 285Wright Field, April 1, 1941
Plotted on Graphs 25, 26, 27 and 28.

| Angle of Yaw (Deg.) | Gross Wind Force (lb.) | C / D | | Yaw Moment about C.R. (In.-Lb.) |
|------------------------------|---------------------------------|----------------------|-------|---|
| | | Net Drag (lb.) | | |
| 0 | -.006 | .321 | -.02 | -.03 |
| +2 | +.211 | .332 | +.64 | +.47 |
| 4 | .476 | .344 | 1.38 | .46 |
| 6 | .754 | .374 | 2.03 | .34 |
| 10 | 1.396 | .487 | 2.87 | 1.21 |
| 15 | 2.350 | .763 | 3.08 | -5.11 |
| 20 | 3.422 | 1.230 | 2.78 | -11.22 |
| -2 | -.201 | .321 | -.63 | -.77 |
| -4 | -.453 | .341 | -1.33 | -.94 |
| -6 | -.722 | .372 | -1.94 | -.93 |
| -10 | -1.375 | .474 | -2.70 | +.77 |
| -15 | -2.321 | .736 | -3.15 | 4.51 |
| -20 | -3.384 | 1.194 | -2.83 | 10.72 |

TABLE VIII
 MATERIEL CENTER BARRAGE BALLOON NO. X14K660

ASSEMBLY NO. 8

50 M.P.H. (Std-Air)
 Test No. 285

Wright Field, May 22, 1941
 Plotted on Graphs 29, 30, 31, and 32

| Angle of Yaw (Deg.) | 0° PITCH | | | | +10° PITCH | | | | +20° PITCH | | | |
|---------------------|----------|------------------------|----------------|--------------------------------------|------------|------------------------|----------------|--------------------------------------|------------|------------------------|----------------|--------------------------------------|
| | C/D | Gross Wind Force (Lb.) | Net Drag (Lb.) | Yawing Moment (In.-Lb.) (About C.R.) | C/D | Gross Wind Force (Lb.) | Net Drag (Lb.) | Yawing Moment (In.-Lb.) (About C.R.) | C/D | Gross Wind Force (Lb.) | Net Drag (Lb.) | Yawing Moment (In.-Lb.) (About C.R.) |
| 0 | -.06 | -.019 | .308 | -.26 | -.07 | -.029 | .396 | -.16 | -.04 | -.024 | .587 | -.27 |
| +2 | +1.71 | +1.220 | .310 | +1.28 | +1.43 | +1.171 | .400 | +1.50 | +1.29 | +1.170 | .595 | +1.40 |
| 4 | 1.50 | .499 | .333 | .50 | 1.00 | .436 | .407 | 1.01 | .63 | .379 | .606 | .70 |
| 6 | 2.15 | .777 | .362 | .38 | 1.58 | .722 | .458 | .67 | 1.24 | .781 | .632 | .18 |
| 10 | 3.10 | 1.488 | .480 | -1.39 | 2.46 | 1.432 | .583 | -1.49 | 1.87 | 1.397 | .746 | -2.13 |
| 15 | 3.25 | 2.543 | .783 | -5.94 | 2.72 | 2.487 | .915 | -6.18 | 2.33 | 2.373 | 1.019 | -6.31 |
| 20 | 2.92 | 3.787 | 1.298 | -13.18 | 2.61 | 3.645 | 1.391 | -12.90 | 2.29 | 3.444 | 1.503 | -12.42 |
| -2 | -.81 | -.253 | .314 | -.70 | -.59 | -.244 | .411 | -.79 | -.35 | -.207 | .598 | -.82 |
| -4 | -1.53 | -.500 | .326 | -1.16 | -1.19 | -.495 | .416 | -1.22 | -.83 | -.506 | .611 | -.92 |
| -6 | -2.24 | -.789 | .352 | -1.21 | -1.81 | -.787 | .436 | -.88 | -1.18 | -.765 | .649 | -.30 |
| -10 | -3.20 | -1.493 | .467 | +1.65 | -2.77 | -1.494 | .539 | +1.22 | -1.93 | -1.484 | .768 | +2.22 |
| -15 | -3.37 | -2.581 | .765 | 5.44 | -2.85 | -2.404 | .844 | 6.29 | -2.11 | -2.499 | 1.182 | 6.65 |
| -20 | -2.96 | -3.816 | 1.290 | 12.57 | -2.73 | -3.724 | 1.366 | 13.11 | -2.21 | -3.585 | 1.619 | 13.35 |

TABLE IX
MATERIEL CENTER BARRAGE BALLOON NO. XL1K660

ASSEMBLY NO. 8

50 M.P.H. (Std-Air)
Test no. 285.

Wright Field, May 23, 1941.
Plotted on Graphs 33, 34, 35, and 36.

0° YAW

| Angle of Pitch (deg.) | L / D | Lift (Lb.) | Net Drag (Lb.) | Pitching Moment (Lb.-In.) C. B. |
|--------------------------------|-------------|---------------|----------------------|--|
| 0 | -.027 | -.009 | +.313 | -.49 |
| +2 | +.472 | +.151 | .320 | +.49 |
| 4 | 1.236 | .377 | .328 | .64 |
| 6 | 1.878 | .657 | .350 | .20 |
| 10 | 2.820 | 1.244 | .441 | -1.54 |
| 15 | 3.142 | 2.143 | .682 | -5.84 |
| 20 | 2.867 | 3.153 | 1.100 | -12.39 |
| -2 | -.540 | -.187 | .317 | -1.18 |
| -4 | -1.253 | -.421 | .336 | -1.29 |
| -6 | -1.879 | -.695 | .370 | -.82 |
| -10 | -2.851 | -1.289 | .452 | +.93 |
| -15 | -3.163 | -2.196 | .694 | 5.34 |
| -20 | -2.841 | -3.209 | 1.129 | 11.85 |

TABLE X
 MATERIEL CENTER BARRAGE BALLOON NO. X41K660
 ASSEMBLY NO. 7

50 M.P.H. (St'd.-Air)
 Test No. 285

Wright Field, July 10, 1941
 Plotted on Graphs 37, 38, 39, and 40.

| Angle of Yaw (Deg.) | 0° PITCH | | | | 10° PITCH | | | |
|---------------------|------------------------|----------------|-------|---------------------------|------------------------|----------------|-------|---------------------------|
| | Gross Wind Force (Lb.) | Net Drag (Lb.) | C / D | Yaw Moment C.R. (Lb.-In.) | Gross Wind Force (Lb.) | Net Drag (Lb.) | C / D | Yaw Moment C.R. (Lb.-In.) |
| 0 | -.007 | .339 | -.02 | -.10 | -.036 | .471 | -.12 | +.17 |
| +2 | +.239 | .342 | +.70 | -.38 | +.208 | .479 | +.65 | .15 |
| 4 | .525 | .361 | 1.45 | -.90 | .452 | .493 | 1.35 | -.21 |
| 6 | .819 | .396 | 2.07 | -1.65 | .763 | .521 | 2.09 | -1.32 |
| 10 | 1.493 | .517 | 2.89 | -4.32 | 1.436 | .643 | 2.92 | -4.09 |
| 15 | 2.488 | .822 | 3.03 | -9.65 | 2.410 | .952 | 3.00 | -9.43 |
| 20 | 3.519 | 1.347 | 2.61 | -16.20 | 3.394 | 1.446 | 2.60 | -15.80 |
| -2 | -.276 | .340 | -.81 | +.29 | -.250 | .470 | -.80 | +.16 |
| -4 | -.557 | .359 | -1.55 | .66 | -.500 | .500 | -1.46 | .37 |
| -6 | -.858 | .391 | -2.19 | 1.44 | -.805 | .531 | -2.15 | 1.38 |
| -10 | -1.523 | .514 | -2.97 | 4.19 | -1.461 | .648 | -2.95 | 3.96 |
| -15 | -2.504 | .810 | -3.09 | 9.23 | -2.446 | .954 | -3.03 | 9.50 |
| -20 | -3.537 | 1.332 | -2.65 | 15.76 | -3.398 | 1.448 | -2.60 | 15.77 |

TABLE XI

MATERIAL CENTER BARRAGE BALLOON, NO. XLK660

MOMENTS ABOUT CABLE JUNCTION

ASSEMBLY NO. 1

50 M.P.H. (Std-Air)
Test No. 235.Wright Field, March 25, 1911.
Plotted on Graphs 41 and 42.

| Angle of Yaw (Deg.) | +10° Pitch Yawing Moment (Lb.-In.) | +20° Pitch Yawing Moment (Lb.-In.) | Angle of Pitch (Deg.) | 0° Yaw Pitching Moment (Lb.-In.) |
|------------------------------|---|---|--------------------------------|---|
| 0 | -.13 | +.05 | 0 | +2.04 |
| +2 | +.26 | .20 | +2 | 3.53 |
| 4 | .13 | -.33 | 4 | 3.20 |
| 6 | -.61 | -1.49 | 6 | 2.22 |
| 10 | -3.66 | -4.67 | 10 | -.70 |
| 15 | -9.31 | -10.12 | 15 | -7.08 |
| 20 | -17.40 | -17.70 | 20 | -14.92 |
| -2 | -.50 | -.06 | -2 | +2.24 |
| -4 | -.41 | +.37 | -4 | 2.42 |
| -6 | +.19 | 1.47 | -6 | 3.27 |
| -10 | 3.27 | 4.63 | -10 | 4.93 |
| -15 | 9.12 | 9.82 | -15 | 8.70 |
| -20 | 16.70 | 17.30 | -20 | 14.12 |

TABLE XII

MATERIEL CENTER BARRAGE BALLOON NO. X11F660

MOMENTS ABOUT CABLE JUNCTION

ASSEMBLY NO. 2

50 M.P.H. (Std.-Air)
Test No. 235Wright Field, March 31, 1941
Plotted on Graphs 43 and 44.

| Angle of Yaw (Deg.) | +10° Pitch Yawing Moment (Lb.-In.) | +20° Pitch Yawing Moment (Lb.-In.) | Angle of Pitch (Deg.) | 0° Yaw Pitching Moment (Lb.-In.) |
|------------------------------|---|---|--------------------------------|---|
| 0 | -.12 | +.10 | 0 | +4.70 |
| +2 | +.30 | +.17 | +2 | 5.10 |
| 4 | .26 | -.24 | 4 | 5.15 |
| 6 | -.60 | -1.59 | 6 | 4.52 |
| 10 | -3.31 | -4.62 | 10 | 2.23 |
| 15 | -9.16 | -10.05 | 15 | -3.37 |
| 20 | -17.02 | -17.80 | 20 | -10.92 |
| -2 | -.39 | 00 | -2 | +4.24 |
| -4 | -.24 | +.40 | -4 | 4.08 |
| -6 | +.41 | 1.47 | -6 | 6.06 |
| -10 | 3.48 | 4.60 | -10 | 8.45 |
| -15 | 9.42 | 9.76 | -15 | 12.50 |
| -20 | 17.03 | 17.30 | -20 | 19.20 |

SERIAL No. 1

PAGE 20

GRAPH 1

YAWING MOMENT DUE TO ANGLE OF YAW
M.D.D. BARRAGE BALLOON NO. 1464660
50 M.P.H. STANDARD AIR
5 FT. WIND TUNNEL TEST NO. 285
WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

YAWING MOMENT ABOUT C.G. IN LB-IN.

16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14

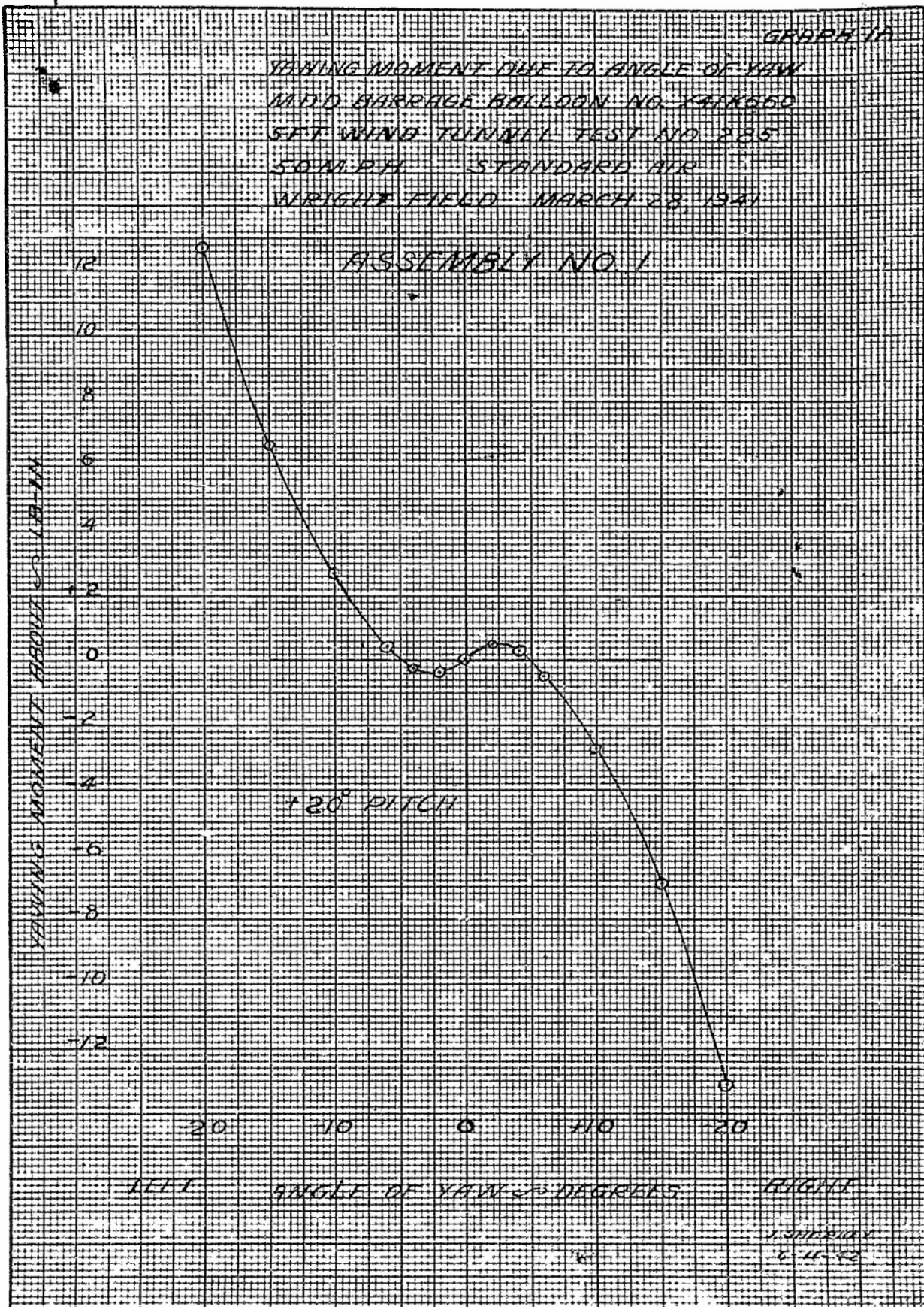
0° PITCH
0+10° PITCH

-20 -10 0 10 20

LEFT ANGLE OF YAW IN DEGREES

RIGHT
6-10-42

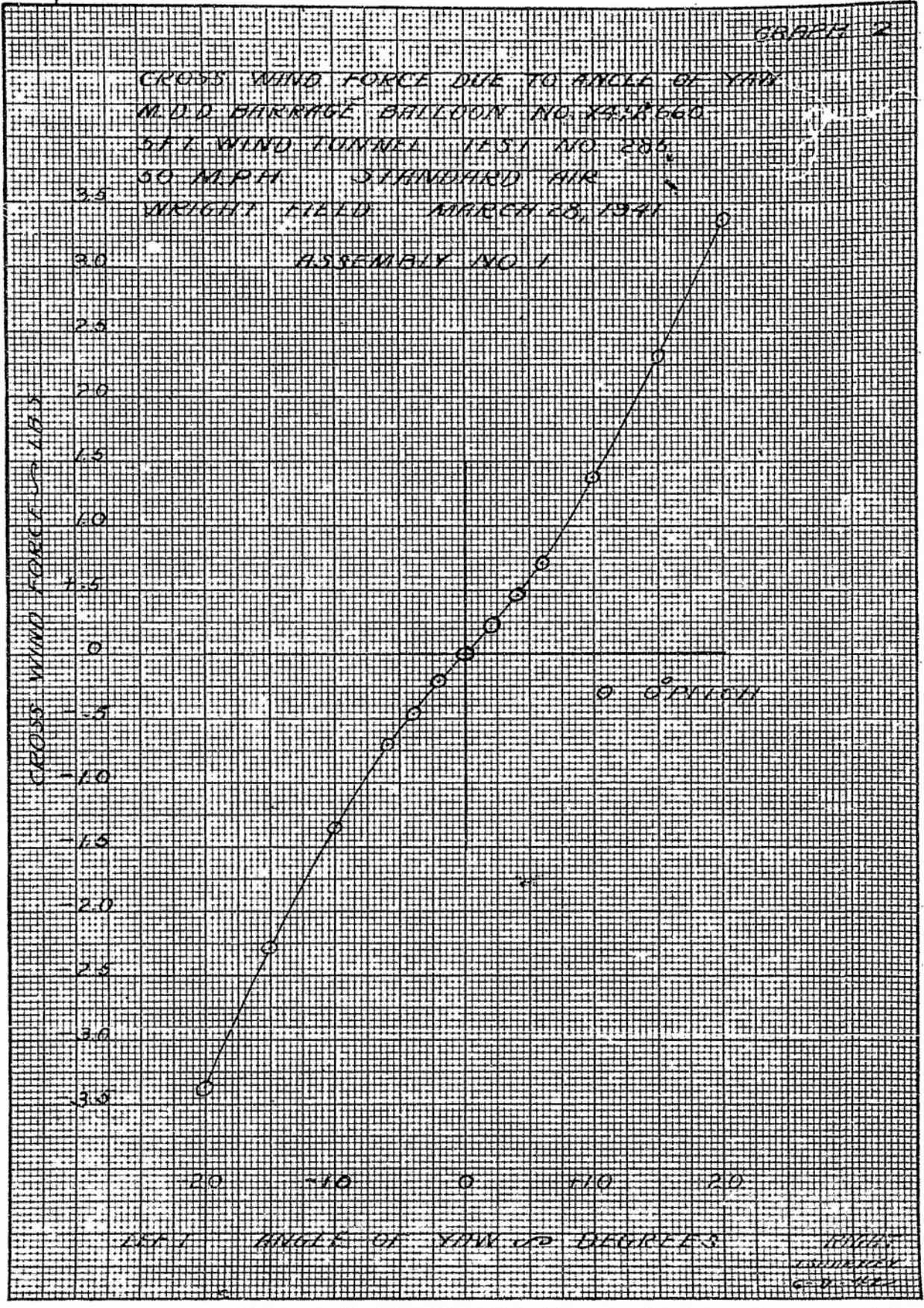
USE THIS SIDE



USE THIS SIDE

GRAPH 2

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 744R560
 5 FT WIND TUNNEL TEST NO. 285
 50 MPH STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941
 ASSEMBLY NO. 1

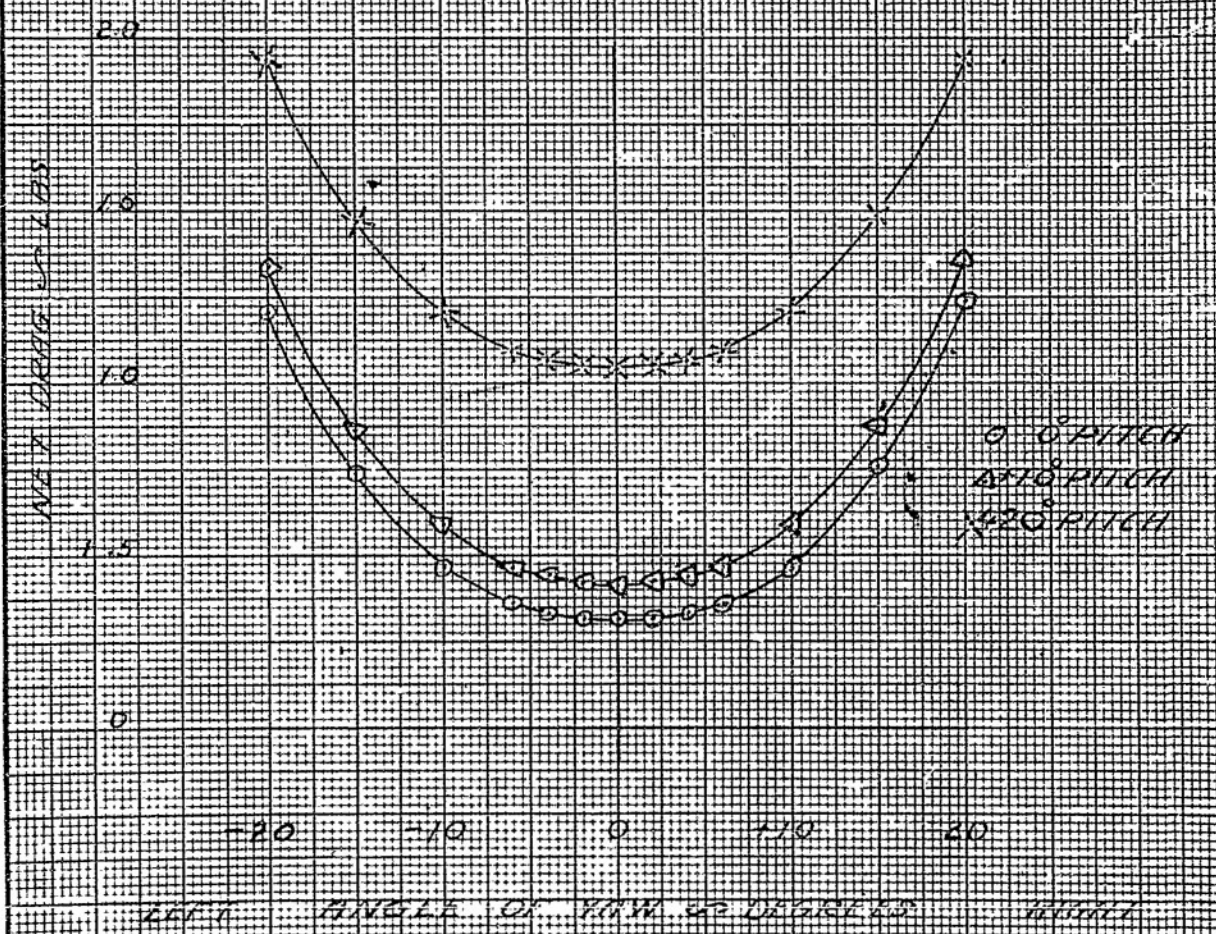


USE THIS SIDE

GRAPH 3

NET DRAG DUE TO ANGLE OF YAW
 M.I.D. BARRAGE BALLOON NO. 871K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1



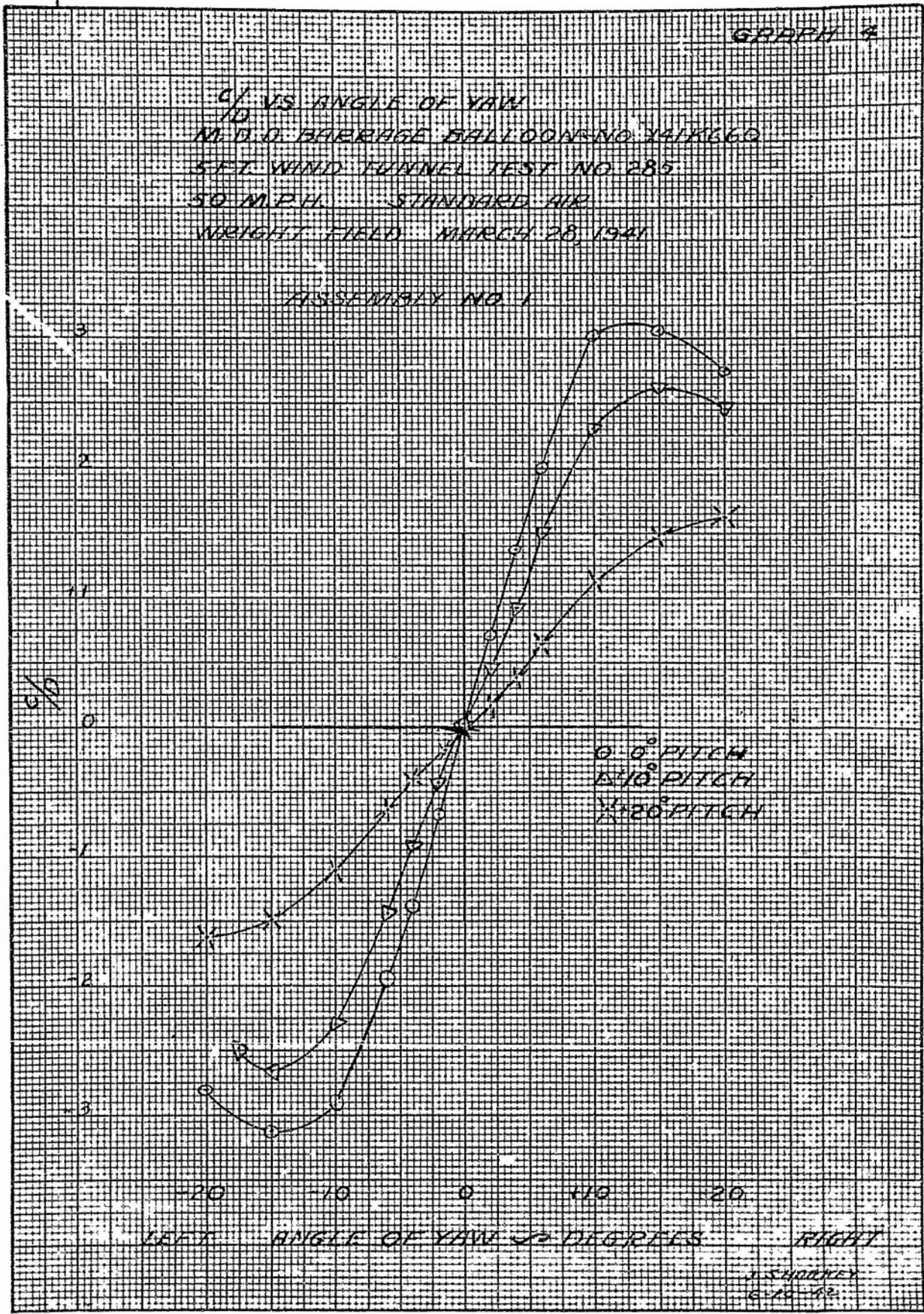
J. SHERMAN
 8-9-41

USE THIS SIDE

GRAPH 3

C_L VS ANGLE OF YAW
 M. D. J. BIERAGE BALLOON NO. 141X660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1



○ 0° PITCH
 △ 10° PITCH
 × 20° PITCH

LEFT ANGLE OF YAW 20 DEGREES RIGHT

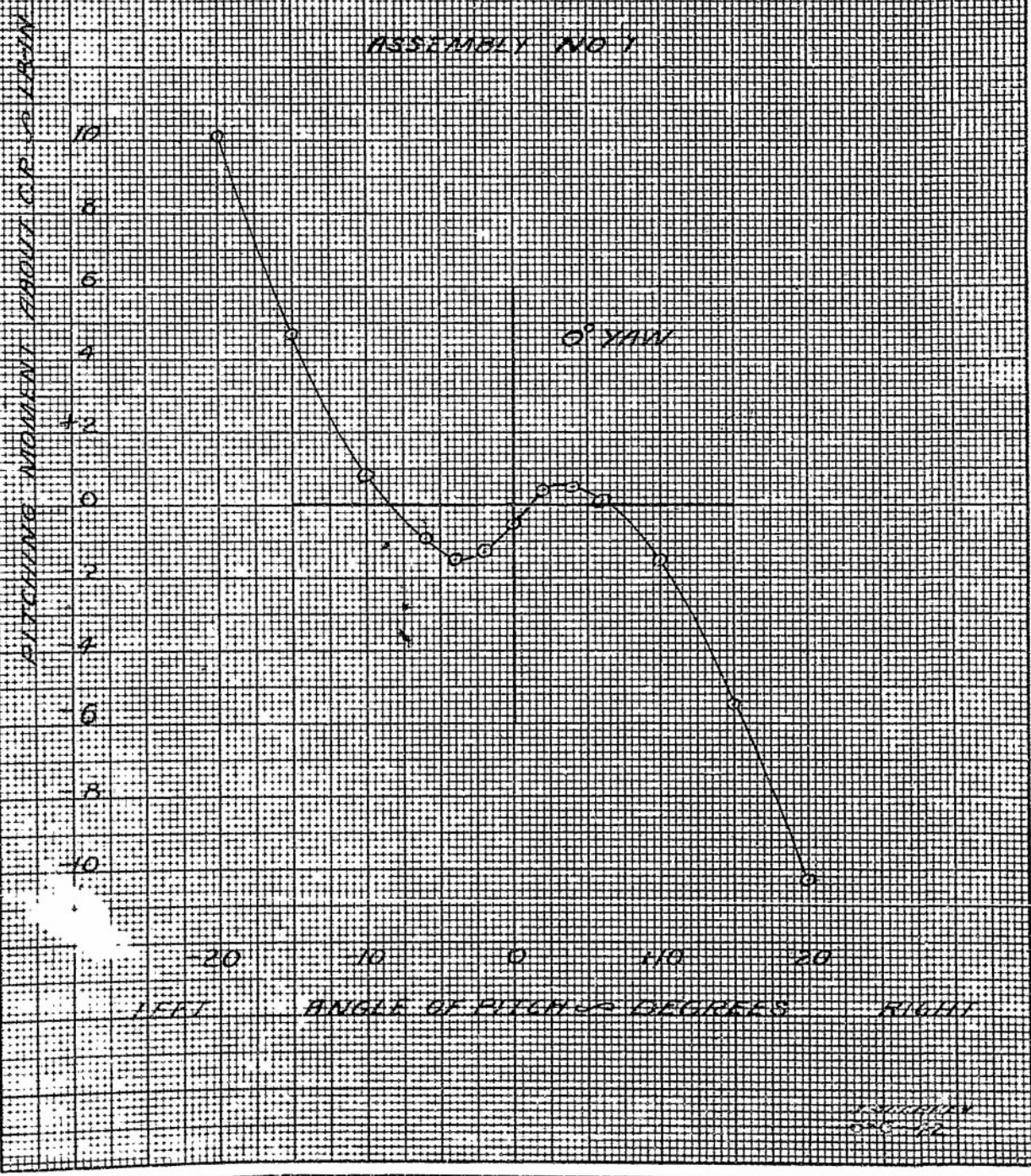
J. SHORLEY
 6-10-42

USE THIS SIDE

GRAPH 5

PITCHING MOMENT ABOUT C.R.
 M.D.N. BARRAGE BALLOON NO. 10000
 5 FT. WIND TUNNEL TEST NO. 286
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

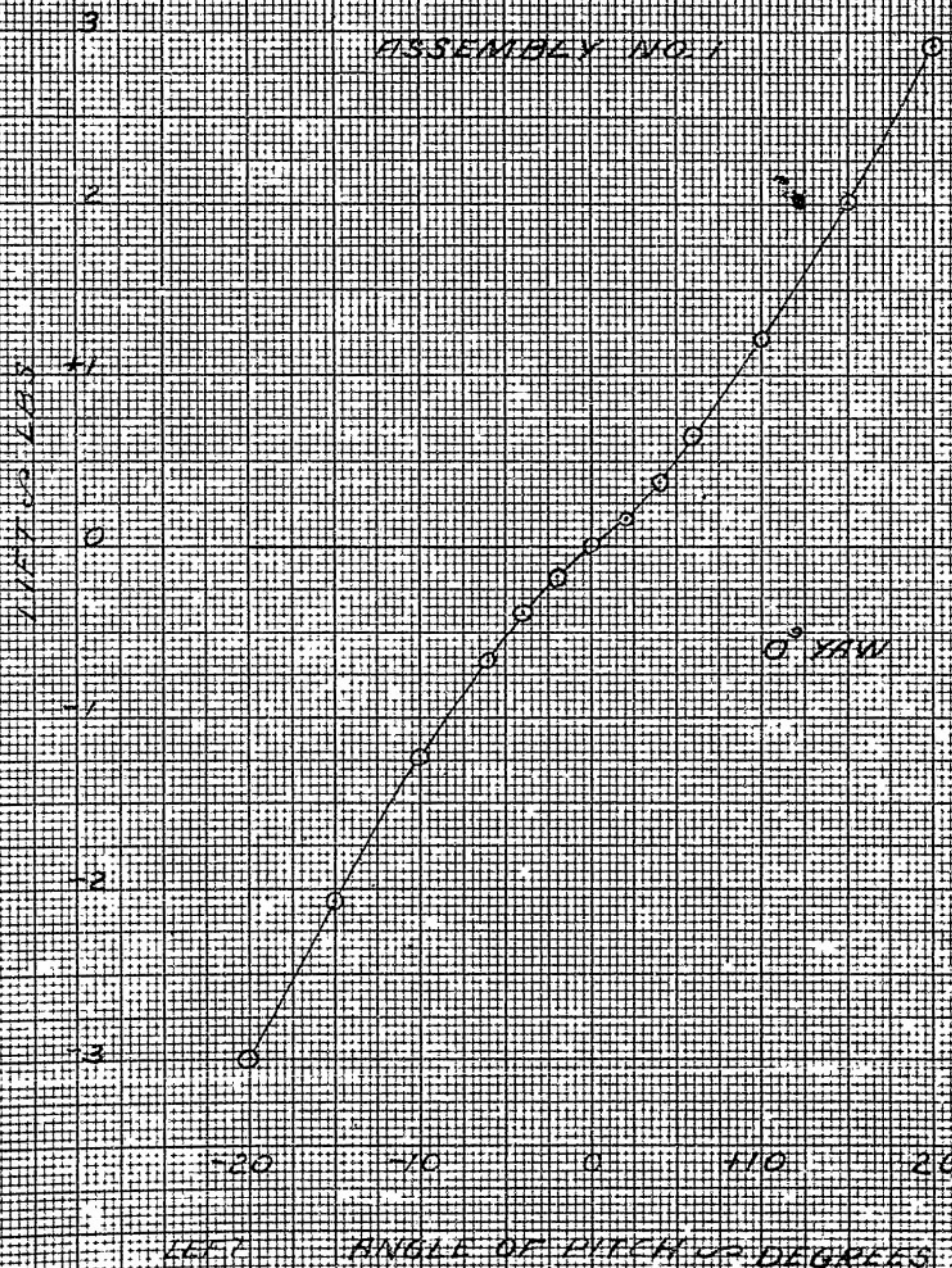


USE THIS SIDE

GRAPH 6

LIFT VS. ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41K650
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

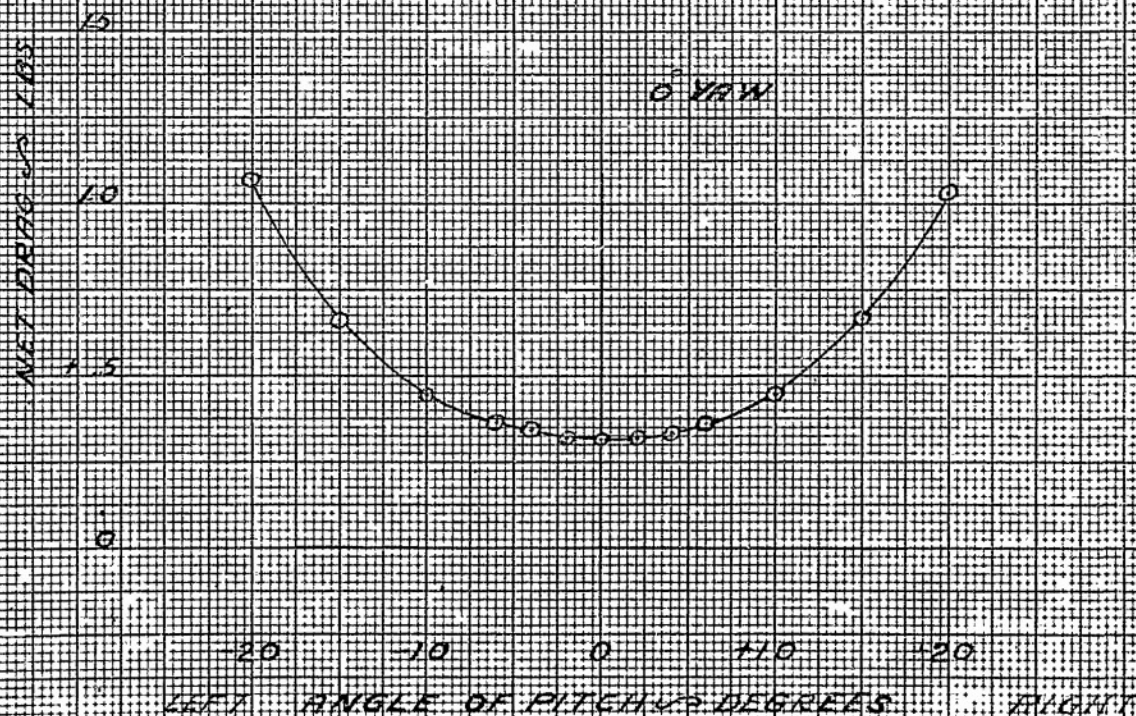


J. SHARKEY
 8-11-42

GRAPH 7

NET DRAG DUE TO ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41K660
 5 FT. WIND TUNNEL TEST NO 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

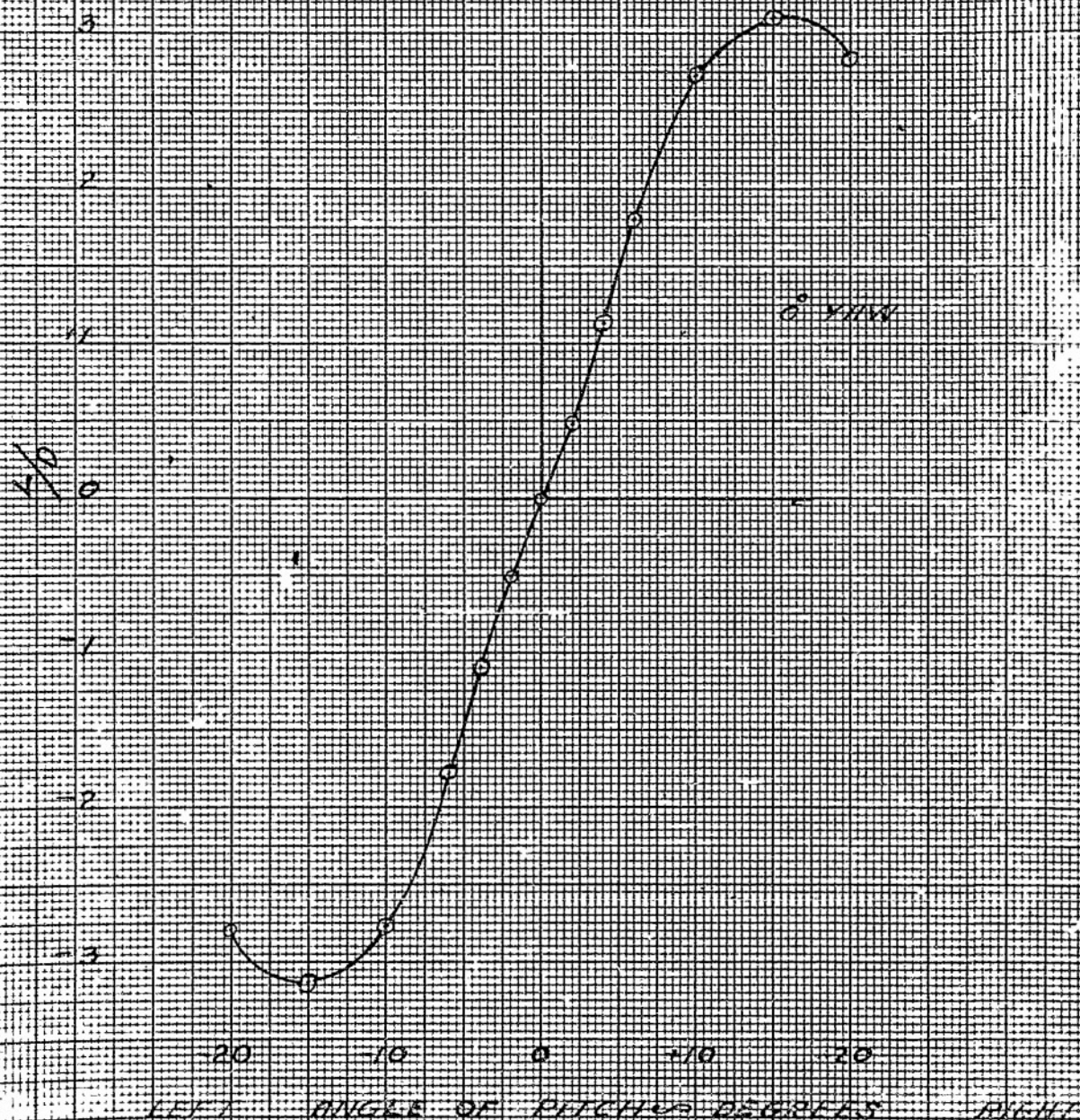


USE THIS SIDE

GRAPH B

$\frac{L}{D}$ VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON INFLATED
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

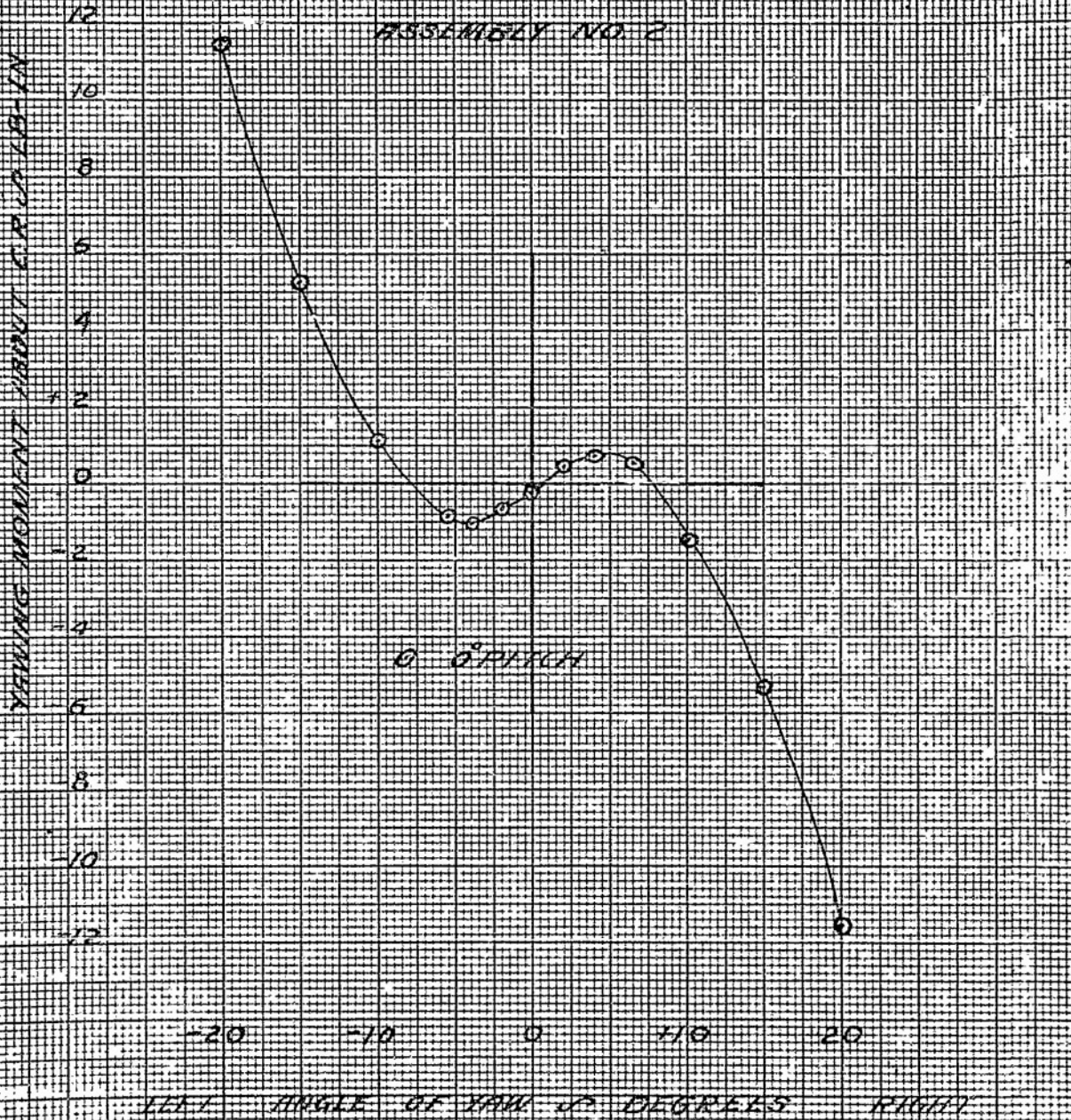


USE THIS SIDE

GRAPH 9

YAWING MOMENT DUE TO ANGLE OF YAW
M.O.D. BARRAGE BALLOON NO. XAIN 660
5 FT WIND TUNNEL TEST NO. 285
50 M.P.H. STANDARD AIR
WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2



0 0° YAW

LEFT ANGLE OF YAW IN DEGREES RIGHT

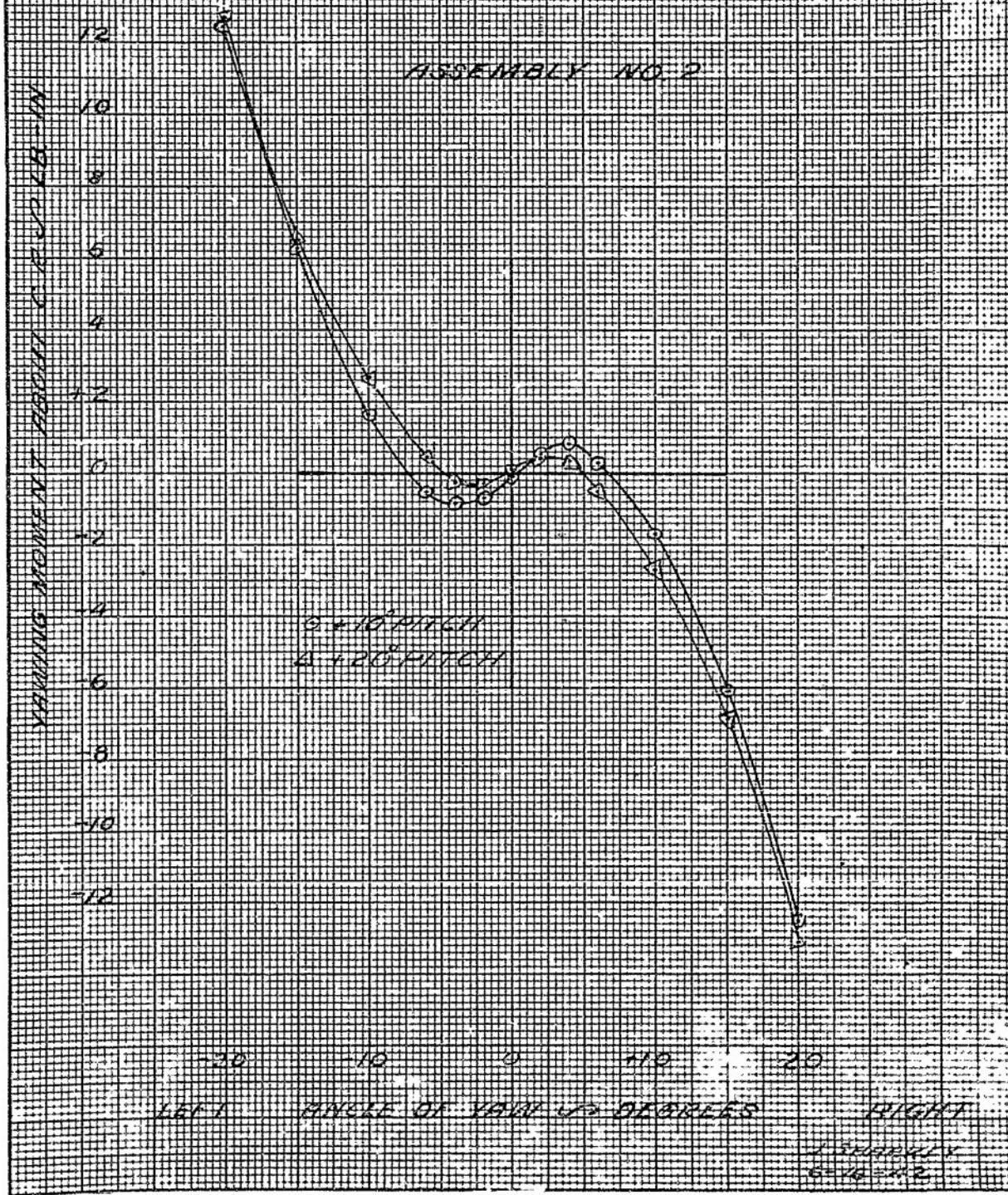
131017
6-13-41

SERIAL NO. 100

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GRAPH 9A

YAWING MOMENT DUE TO ANGLE OF YAW
M.D.D. BARRAGE BALLOON NO. 281K660
5 FT. WIND TUNNEL TEST NO. 285
5.0 MPH STANDARD AIR
WRIGHT FIELD MARCH 31, 1941



USE THIS SIDE

SERIAL NO. 1208

PAGE 32

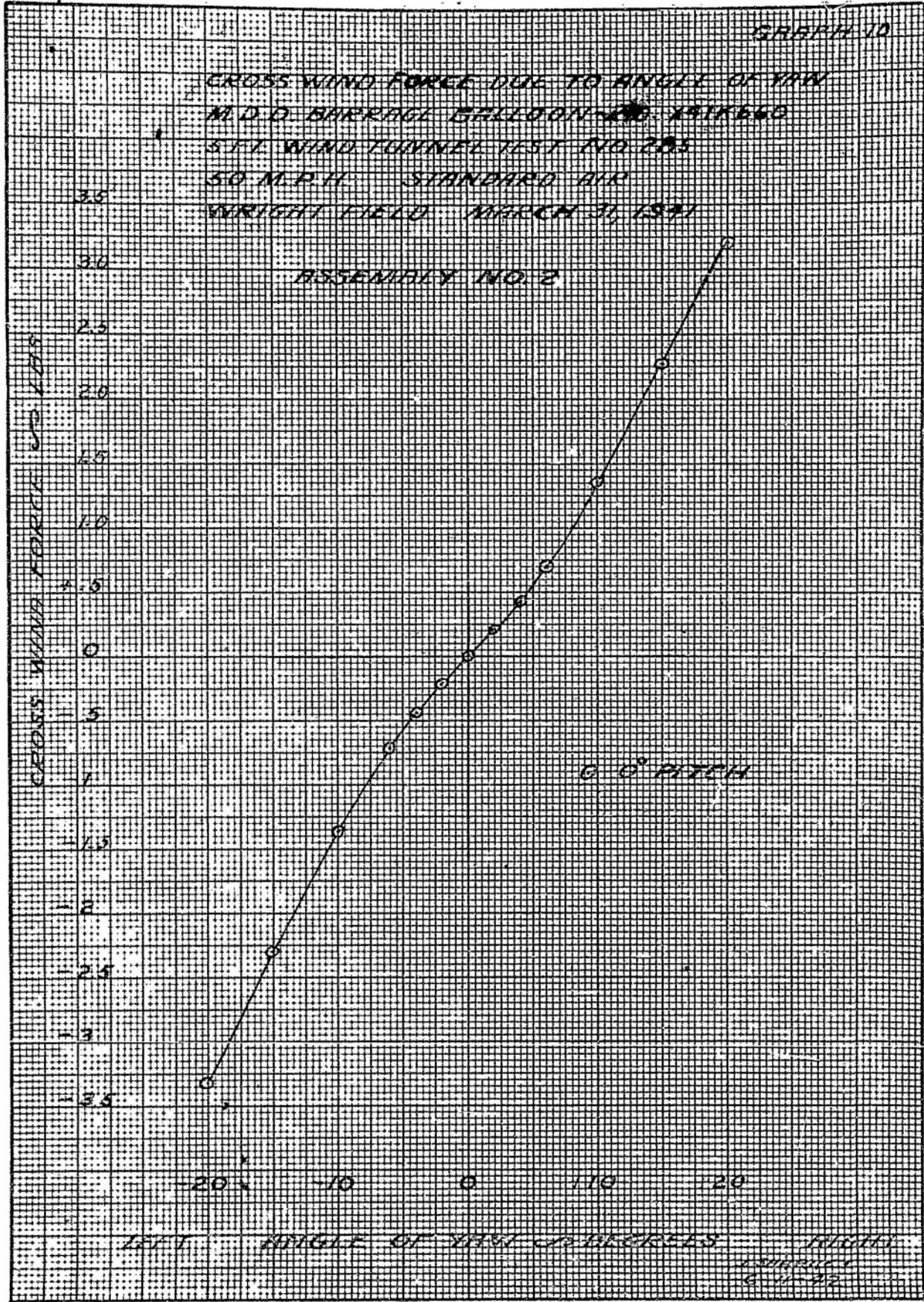
GRAPH 10

CROSS WIND FORCE DUE TO ANGLE OF YAW
M.D.O. BARRAGE BALLOON - NO. 1512660
S.T. WIND TUNNEL TEST NO. 285
50 M.P.H. STANDARD AIR
WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2

CROSS WIND FORCE IN LBS

0° PITCH



LEFT ANGLE OF YAW IN DEGREES RIGHT

USE THIS SIDE

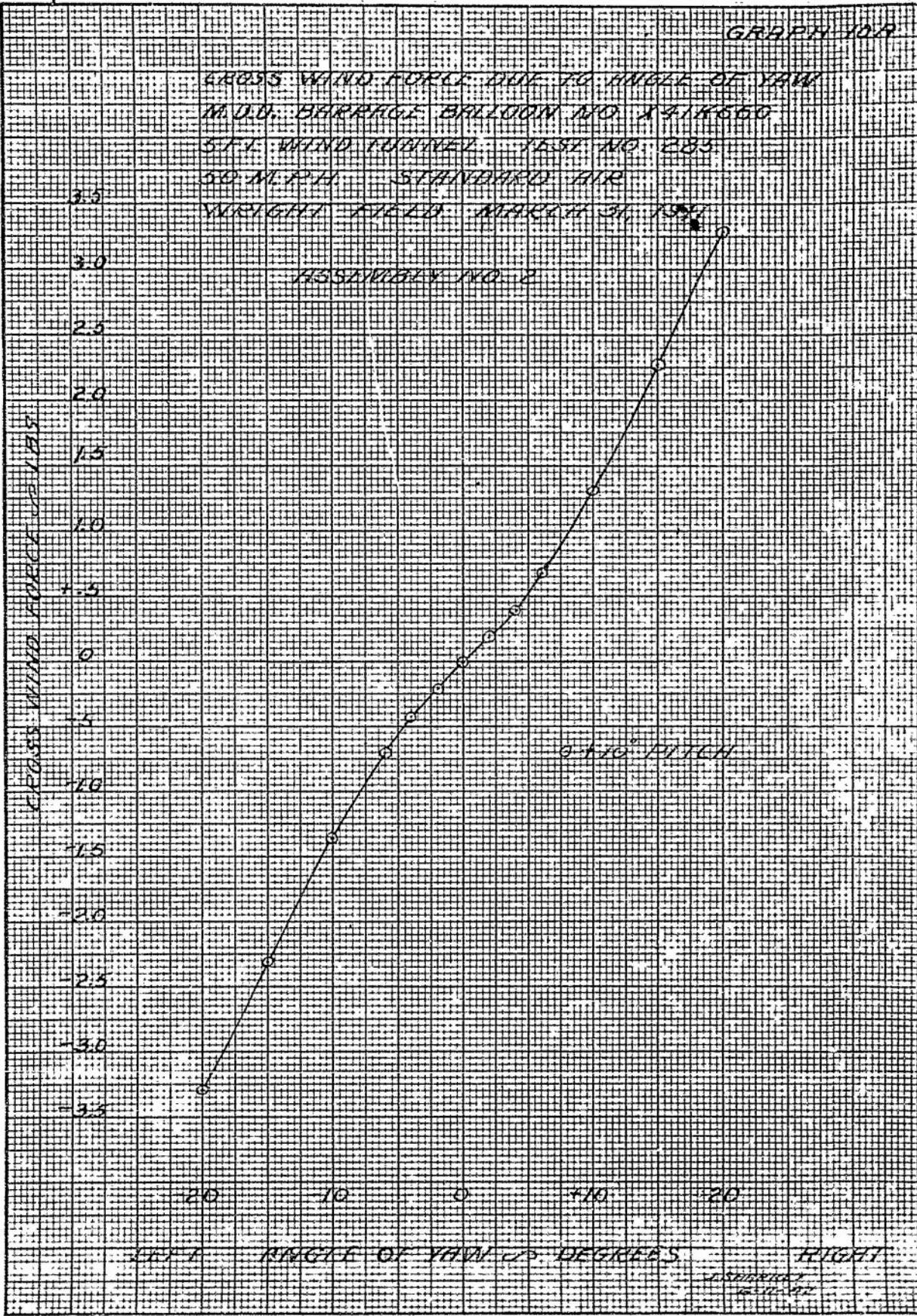
GRAPH 10A

GROSS WIND FORCE DUE TO ANGLE OF YAW
 M.O.D. BARRAGE BALLOON NO. A41K660
 57.1 WIND TURBINE TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2

GROSS WIND FORCE LBS

0-10° FITCH



LEFT ANGLE OF YAW IS DEGREES RIGHT

J. SHERRILL
 12-11-41

USE THIS SIDE

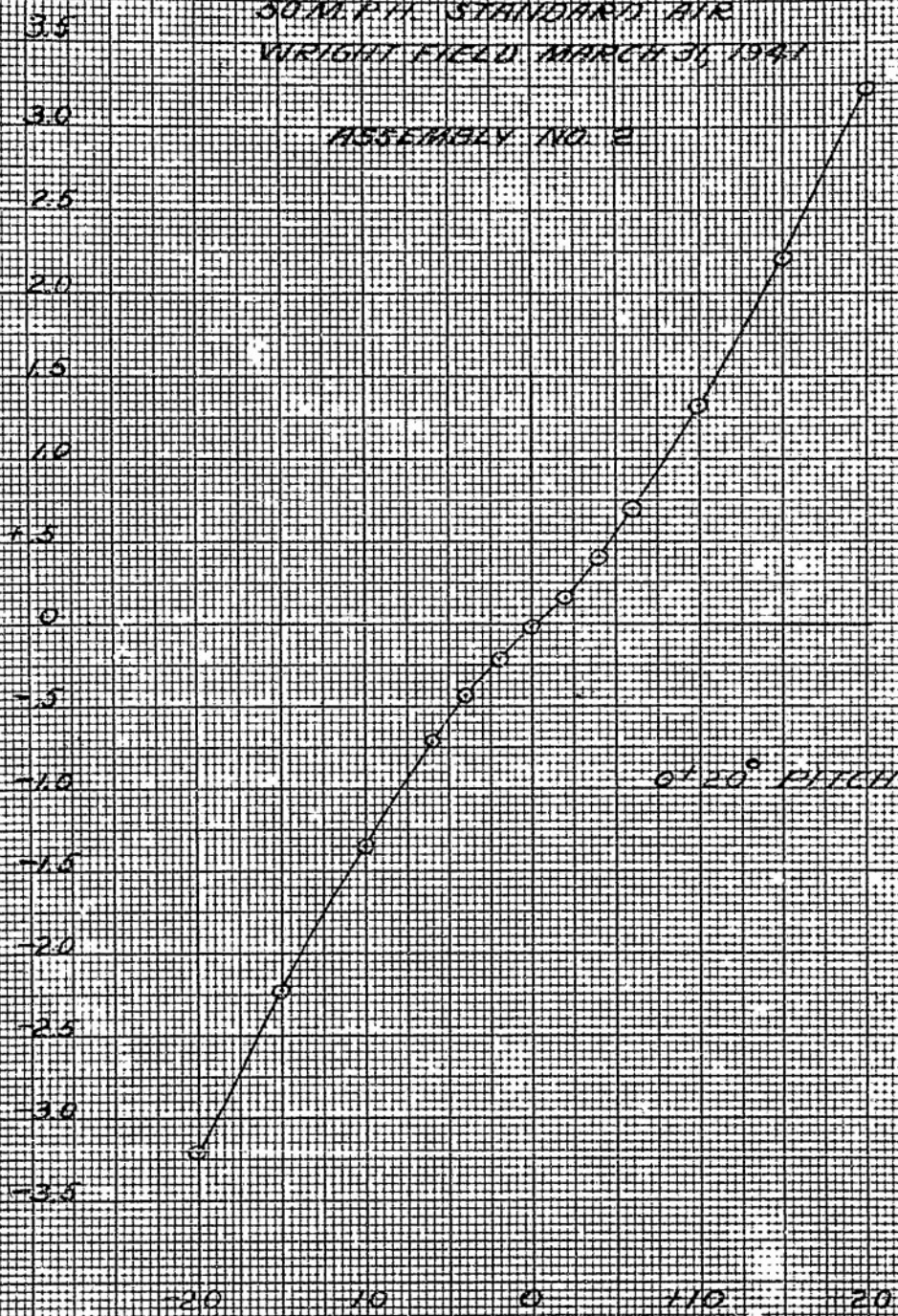
GRAPH 108

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. X41X660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1947

ASSEMBLY NO. 2

CROSS WIND FORCE IN LBS

0° 20' PITCH



LEFT ANGLE OF YAW IN DEGREES

RIGHT ANGLE OF YAW IN DEGREES

6-12-47

USE THIS SIDE

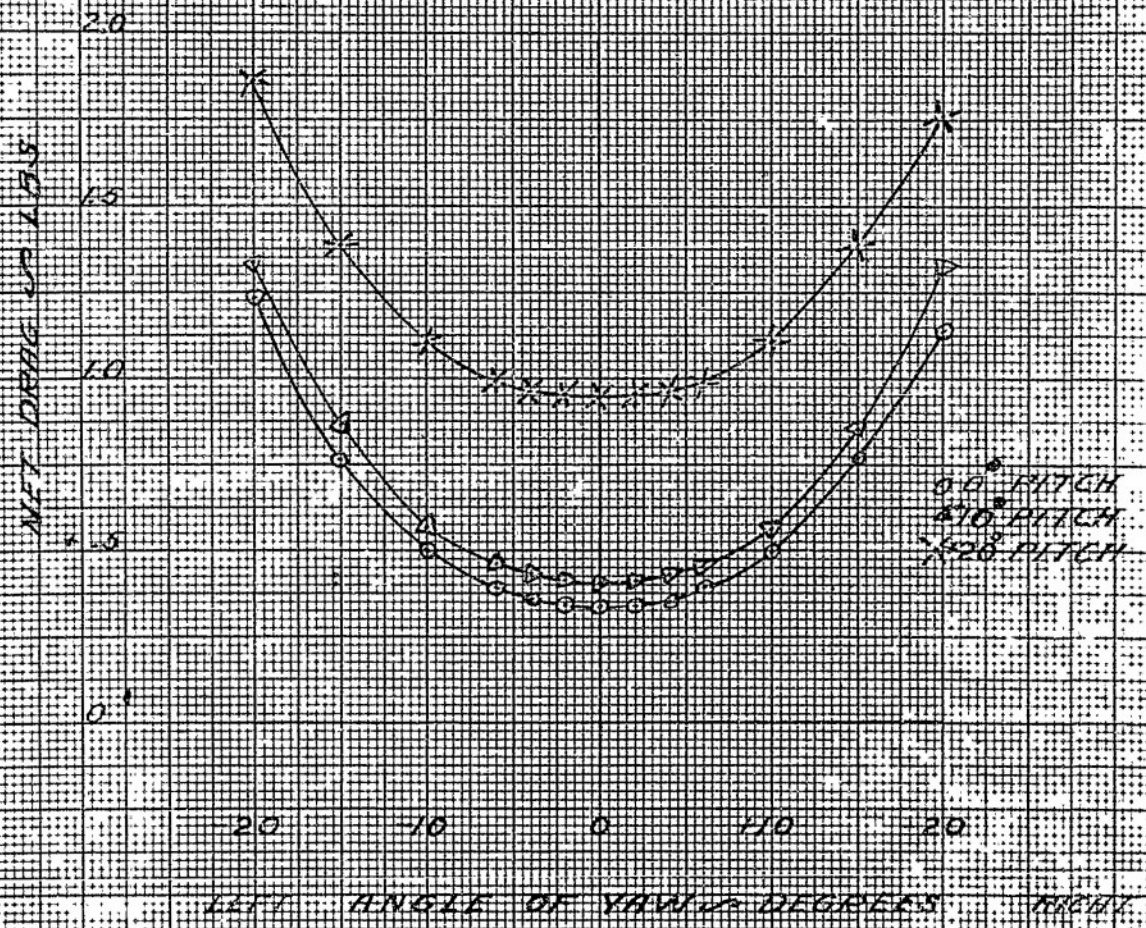
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GRAPH 11

NET DRAG DUE TO ANGLE OF YAW
M.D.D. BARRAGE BALLOON NO. 141K660
5 FT. WIND TUNNEL TEST NO. 285
50 M.P.H. STANDARD AIR
WRIGHT FIELD MARCH 31, 1927

ASSEMBLY NO. 2



13 MAR 1927
5-12-27

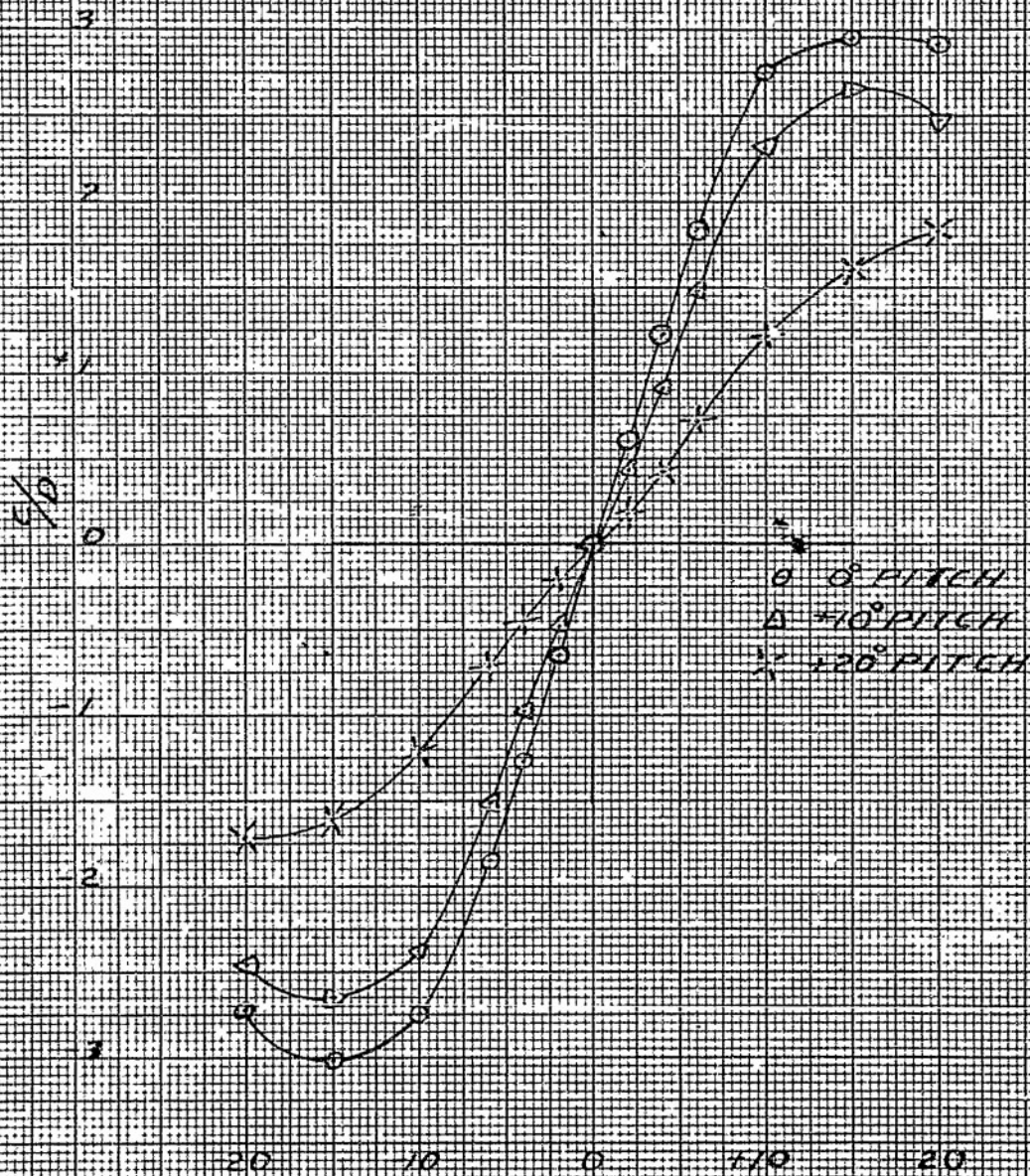
SERIAL NO. 5

PAGE 36

GRAPH 12

C_L/D VS ANGLE OF YAW
 M. D. D. BARRAGE BALLOON NO. X41K660
 5 FT WIND TUNNEL TEST NO. 285
 50 MPH. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2



○ 0° PITCH
 △ 10° PITCH
 × 20° PITCH

LEFT ANGLE OF YAW IN DEGREES

FIGHT
 15 MARCH
 1941

USE THIS SIDE

GRAPH 13

PITCHING MOMENT ABOUT C.R.
 M.D.D. BARRAGE BALLOON NO. 7417000
 5 FT. WIND TUNNEL TEST NO. 285
 WRIGHT FIELD MARCH 31, 1941
 50 MPH. STANDARD AIR

ASSEMBLY NO. 2

PITCHING MOMENT ABOUT C.R. LB-IN

14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12

-20 -10 0 10 20

LEFT ANGLE OF PITCH IN DEGREES RIGHT

0° YAW

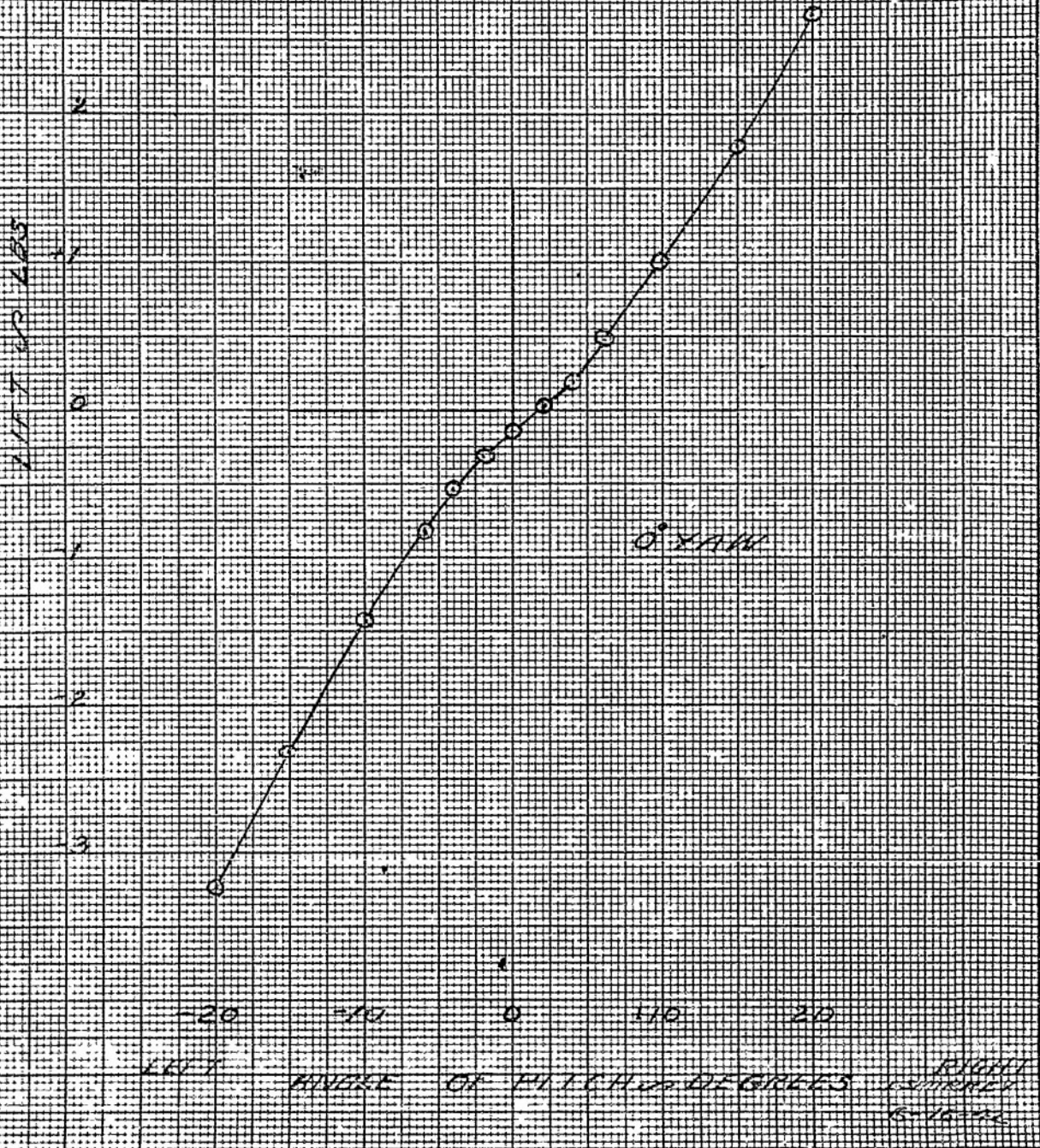
J. SHORREY
 6/11/41

USE THIS SIDE

GRAPH 14

EFT VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. 241165
 57' L. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2

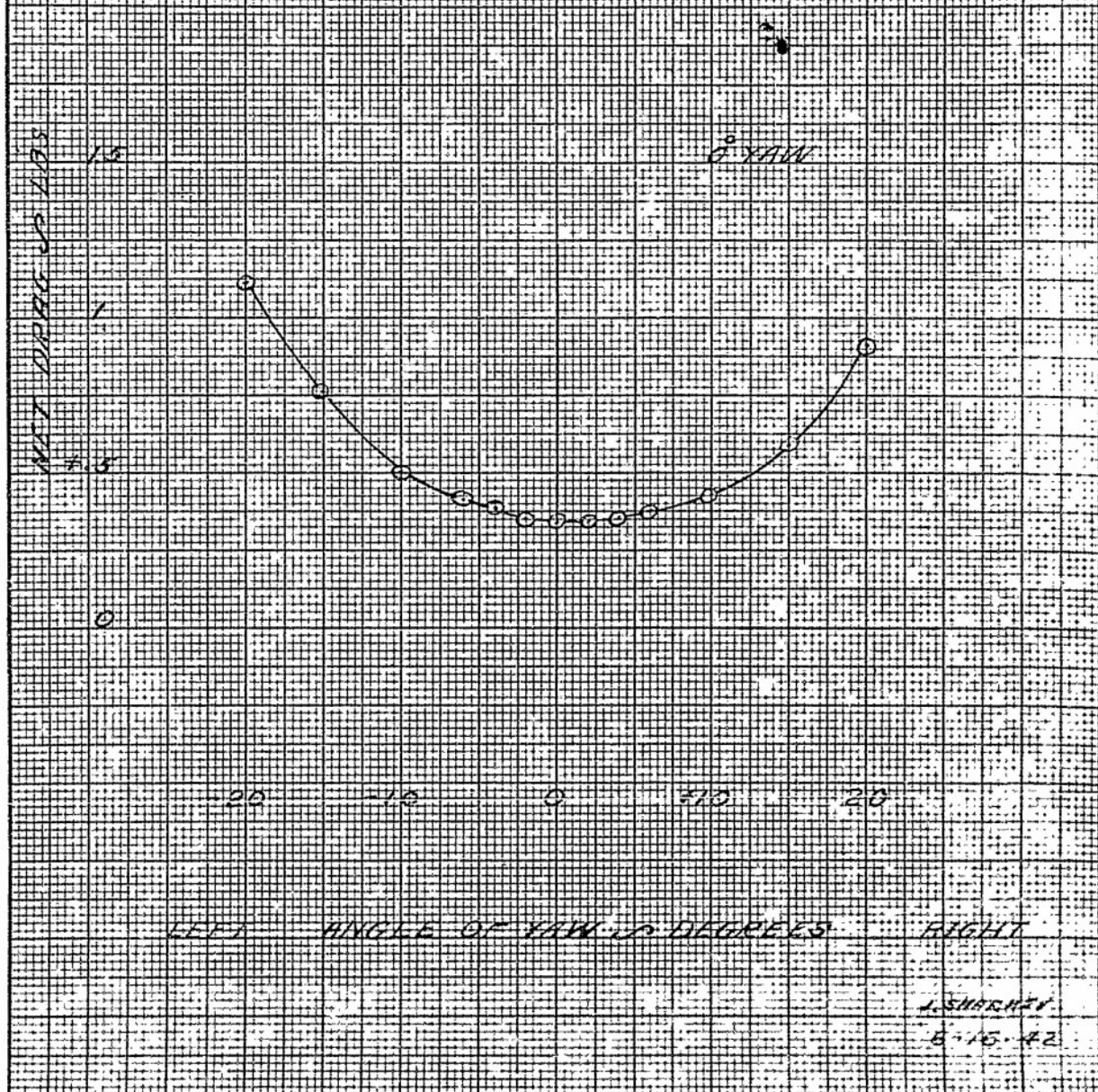


USE THIS SIDE

GRAPH 15

NET DRAG DUE TO ANGLE OF PITCH
 M.D.D. BARRAGE GALLOON NO. 1917660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2

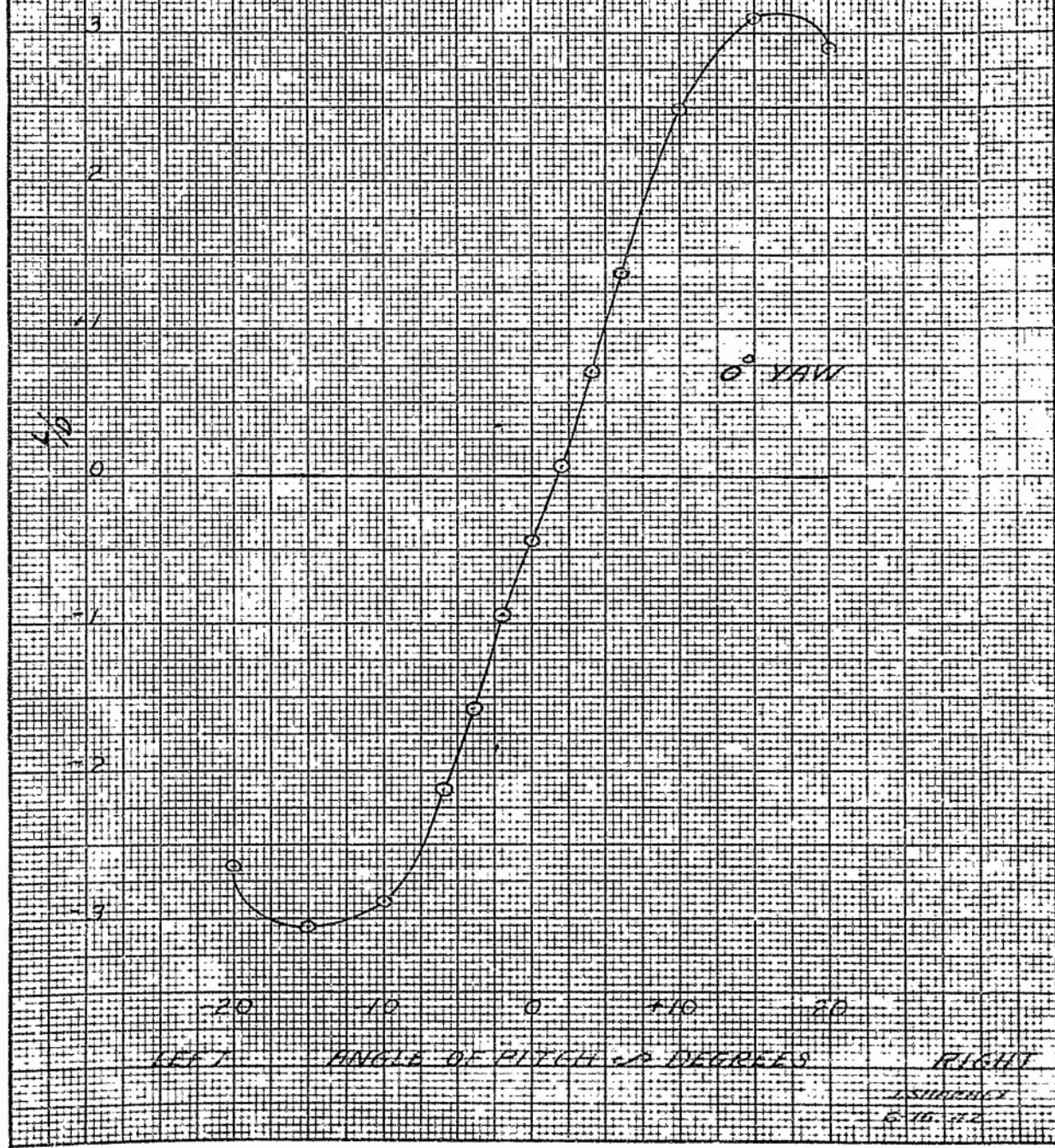


USE THIS SIDE.

GRAPH 16

C_L VS. ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41K660
 3 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1921

ASSEMBLY NO. 2



LEFT ANGLE OF PITCH - α DEGREES RIGHT

LS 1111111
 6-16-372

USE THIS SIDE

GRAPH 17

YAWING MOMENT DUE TO ANGLE OF YAW
 M.D.D. HARRAGE BALLOON NO. X411660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4

YAWING MOMENT ABOUT C.P. IN LB-IN

12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12

0° PITCH

-20 -10 0 10 20

LEFT ANGLE OF YAW IN DEGREES RIGHT

J. SHARKEY
 6-18-41

GRAPH 16

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 1411600
 3 FT. WIND TUNNEL TEST NO. 283
 30 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4

CROSS WIND FORCE IN LBS.

3.5
 3.0
 2.5
 2.0
 1.5
 1.0
 .5
 0
 .5
 1.0
 1.5
 2.0
 2.5
 3.0
 3.5

-20 -10 0 +10 20

LEFT ANGLE OF YAW IN DEGREES RIGHT

8° PITCH

J. SHREVEY
 6-17-41

USE THIS SIDE

SERIAL No. 1508

PAGE 15

GRAPH 15

NET DRAG DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO 14110660
 51' WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 2

NET DRAG IN LBS

0° PITCH

1.2

1.0

.5

0

20

10

0

10

20

LEFT

ANGLE OF YAW IN DEGREES

RIGHT

J. SHARKEY
M. 1-1-42

USE THIS SIDE

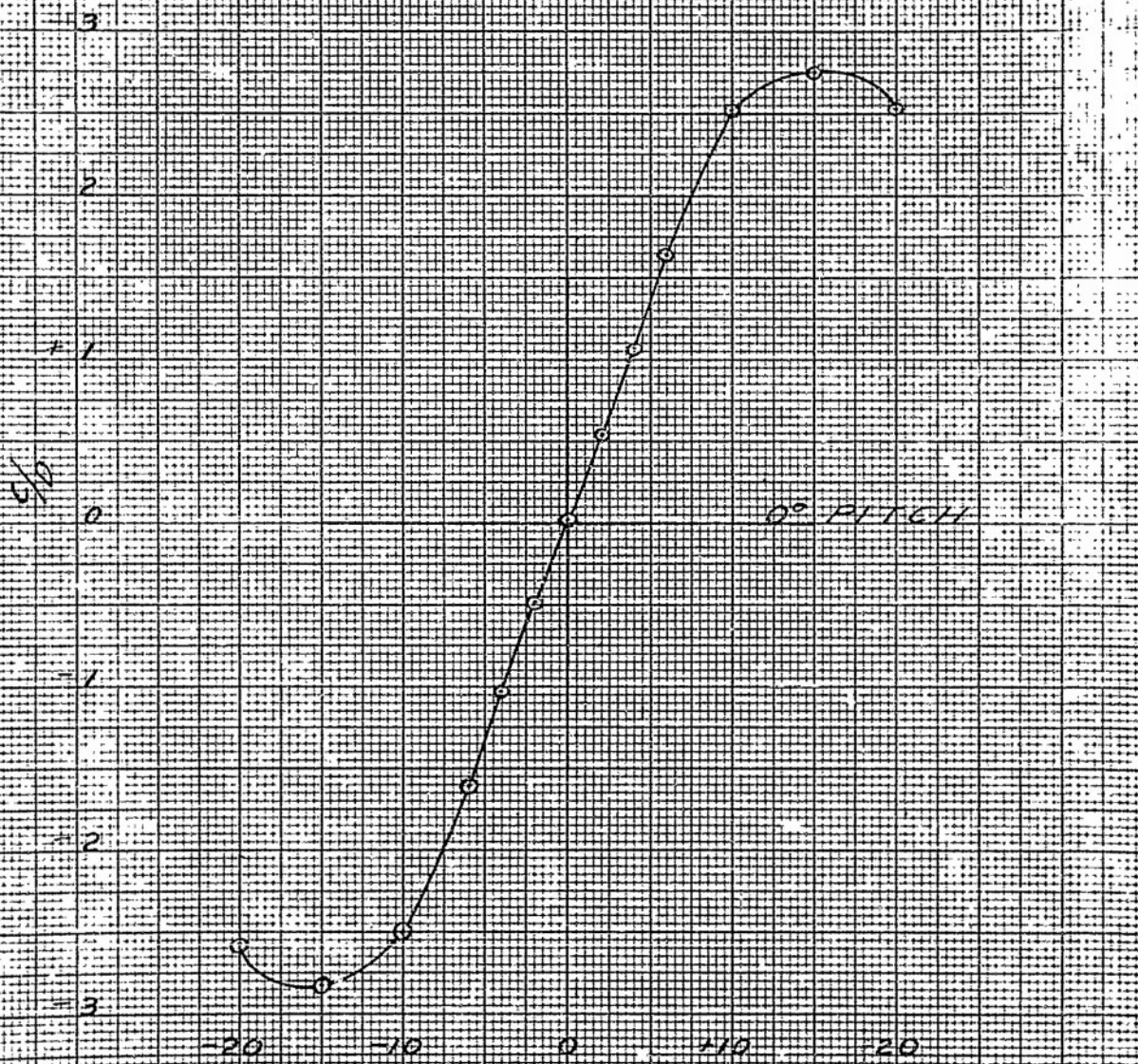
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GRAPH 20

C/D VS. ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 1411660
 5 FT. WIND TUNNEL TEST NO. 285
 50 MPH. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4



LEFT ANGLE OF YAW IN DEGREES RIGHT

J. SHARKEY
6-10-41

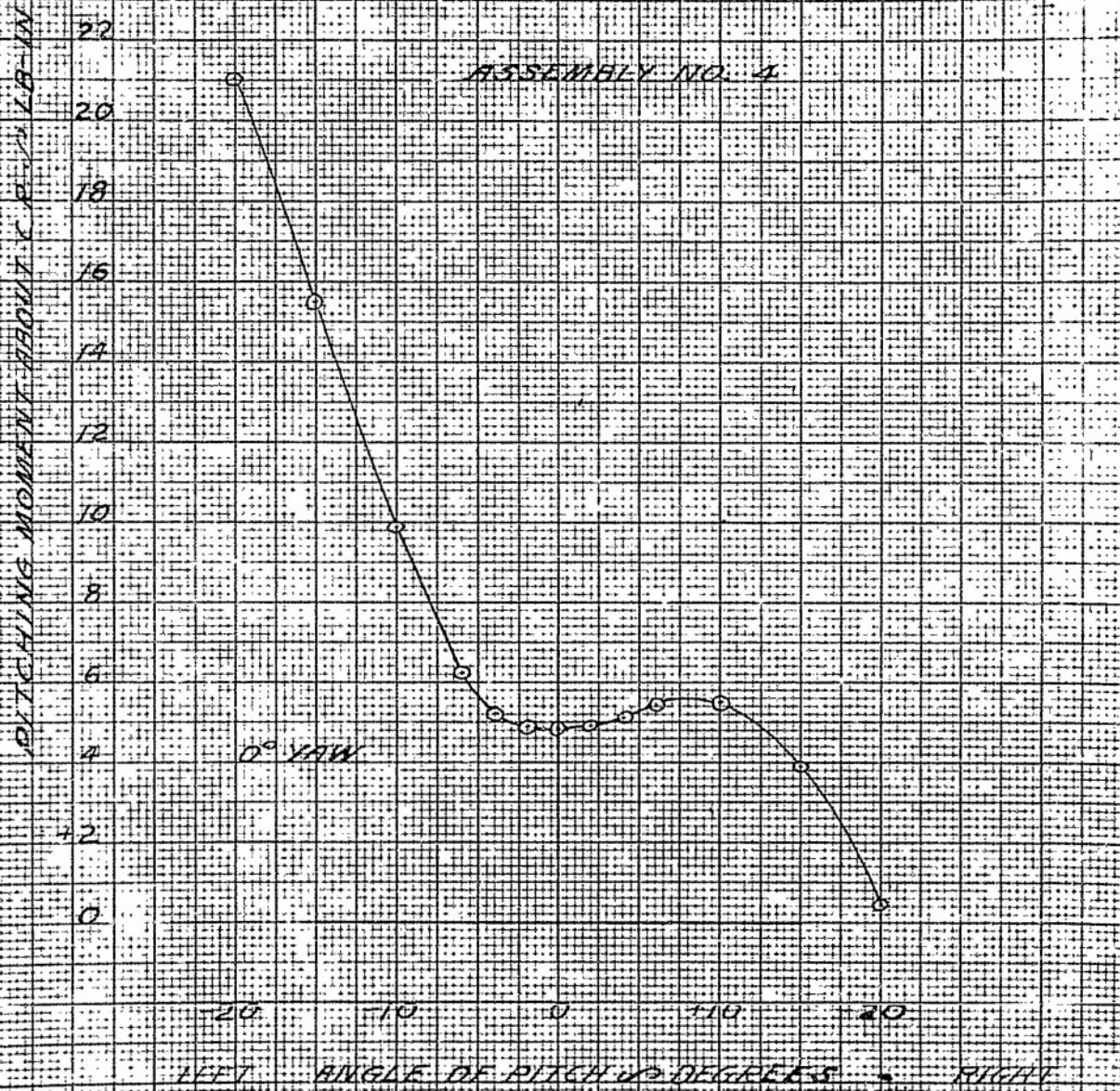
USE THIS SIDE

SERIAL No.

PAGE 7

GRAPH 21

PITCHING MOMENT ABOUT C.P.
 M.D.D. BARRAGE BALLOON NO. X411650
 3 FT. WIND TUNNEL TEST NO. 285
 WRIGHT FIELD MARCH 31, 1941
 30 M.P.H. STANDARD AIR



1.500000
 6-19-42

USE THIS SIDE .

SERIAL NO.

PAGE

GRAPH 22

LIFT VS. ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. 1411668
 5 FT WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4

LIFT COEFFICIENT

5
4
3
2
1
0
-1
-2
-3
-4

20 10 0 10 20

LEFT ANGLE OF PITCH IN DEGREES RIGHT

0° YAW

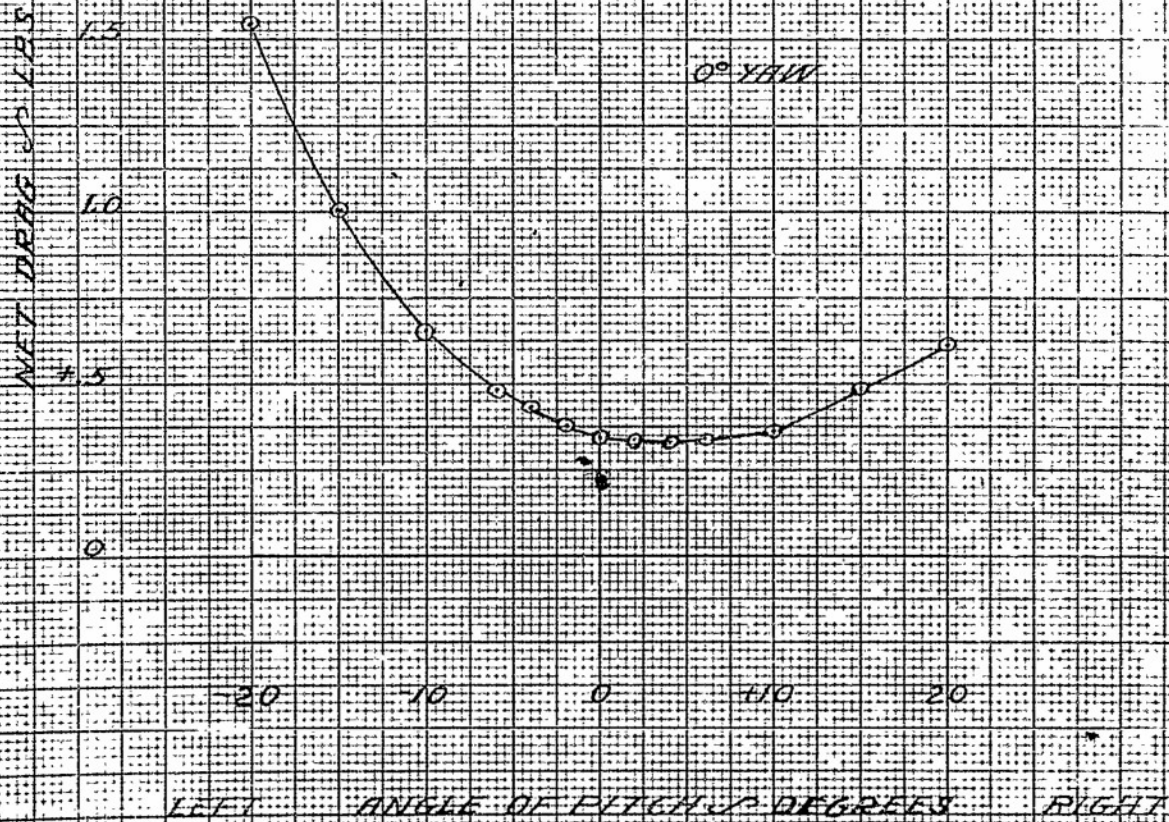
L. SHARKEY
 6-18-42

USE THIS SIDE

GRAPH 23

NET DRAG DUE TO ANGLE OF PITCH
 MDD BARRAGE BALLOON NO. 1411660
 5 FT. WIND FUNNEL TEST NO. 283
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4



J. SHANNON
 6-18-42

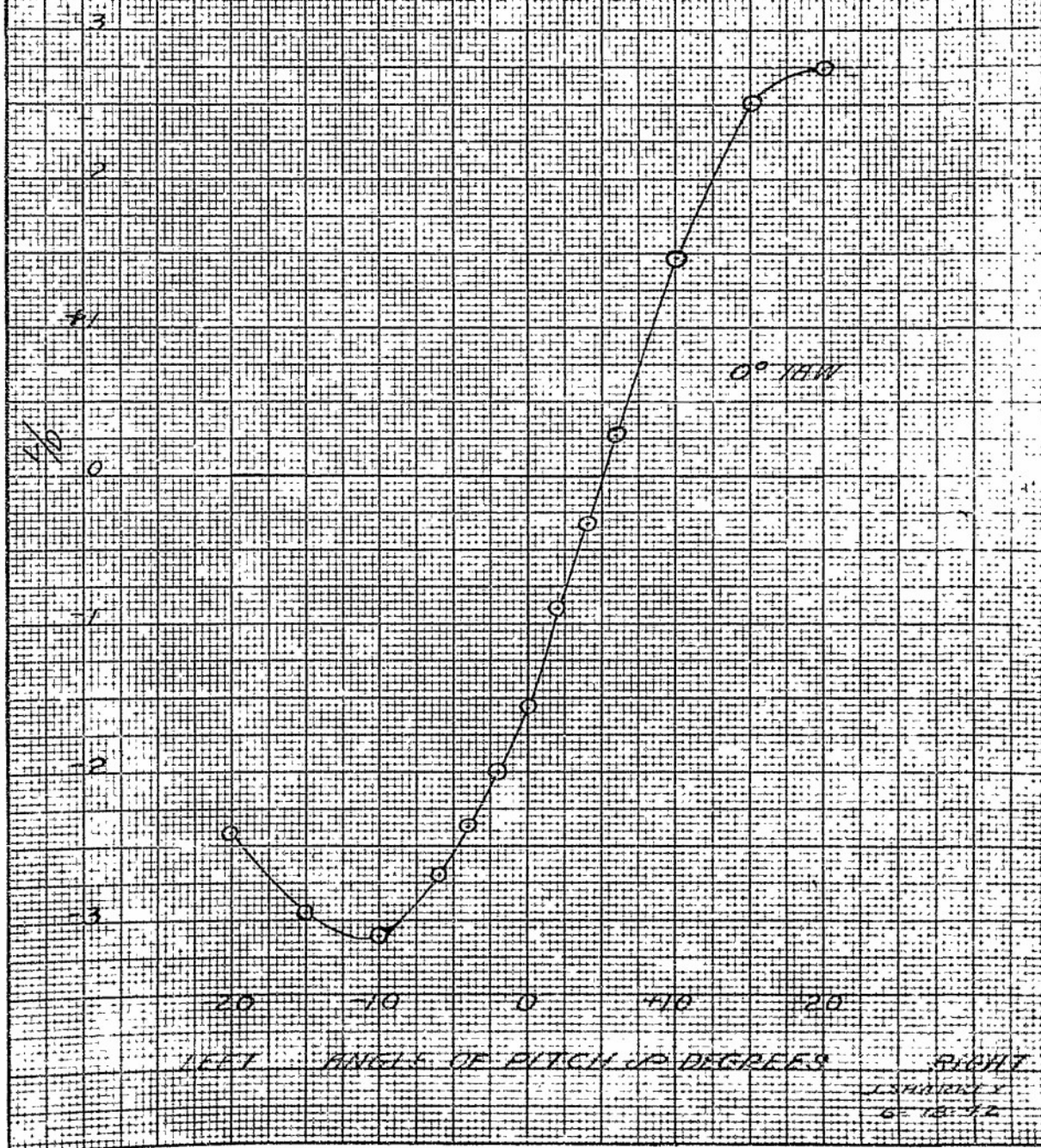
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PAGE 1

GRAPH 29

C_L VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 MPH. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4



USE THIS SIDE

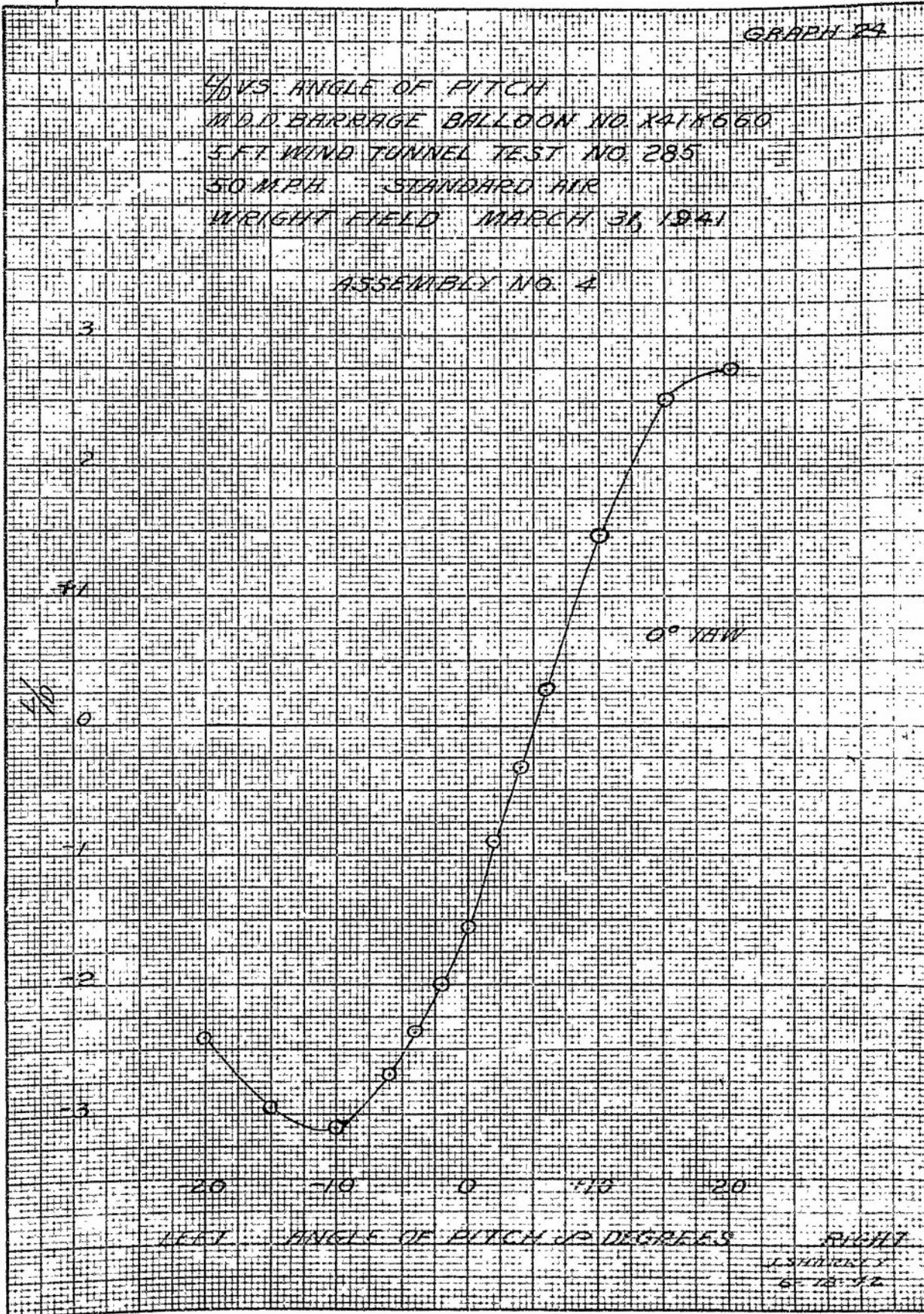
SERIAL No.

PAGE 1

GRAPH 24

$\frac{L}{D}$ VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941

ASSEMBLY NO. 4



USE THIS SIDE

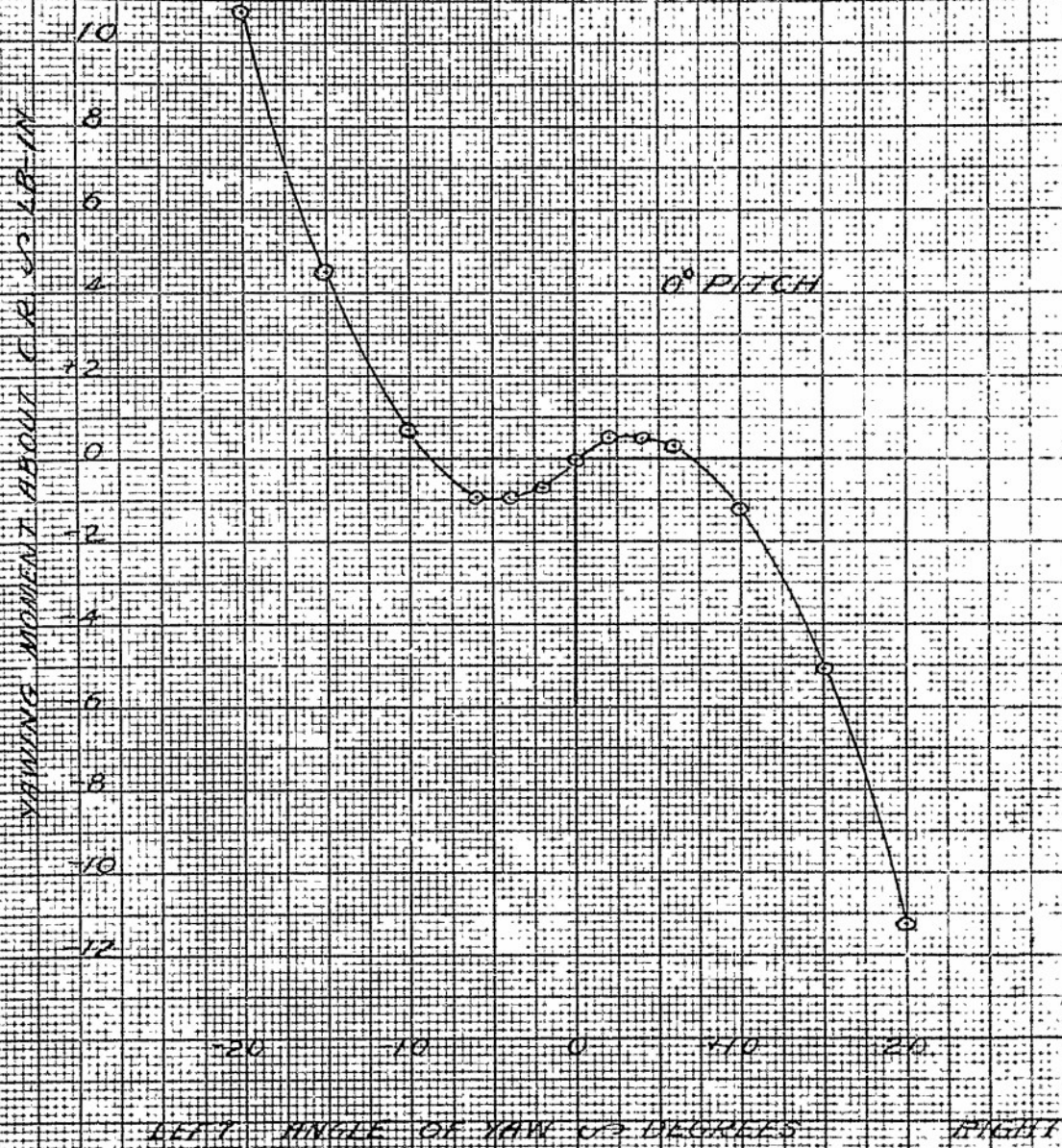
SERIAL No.

PAGE 10

GRAPH 25

YAWING MOMENT ABOUT C.R.
 M.D.D. BARRAGE BALLOON NO. X411660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD APRIL 1, 1941

ASSEMBLY NO. 6



J. S. GIBNEY
 6-19-42

SERIAL No.

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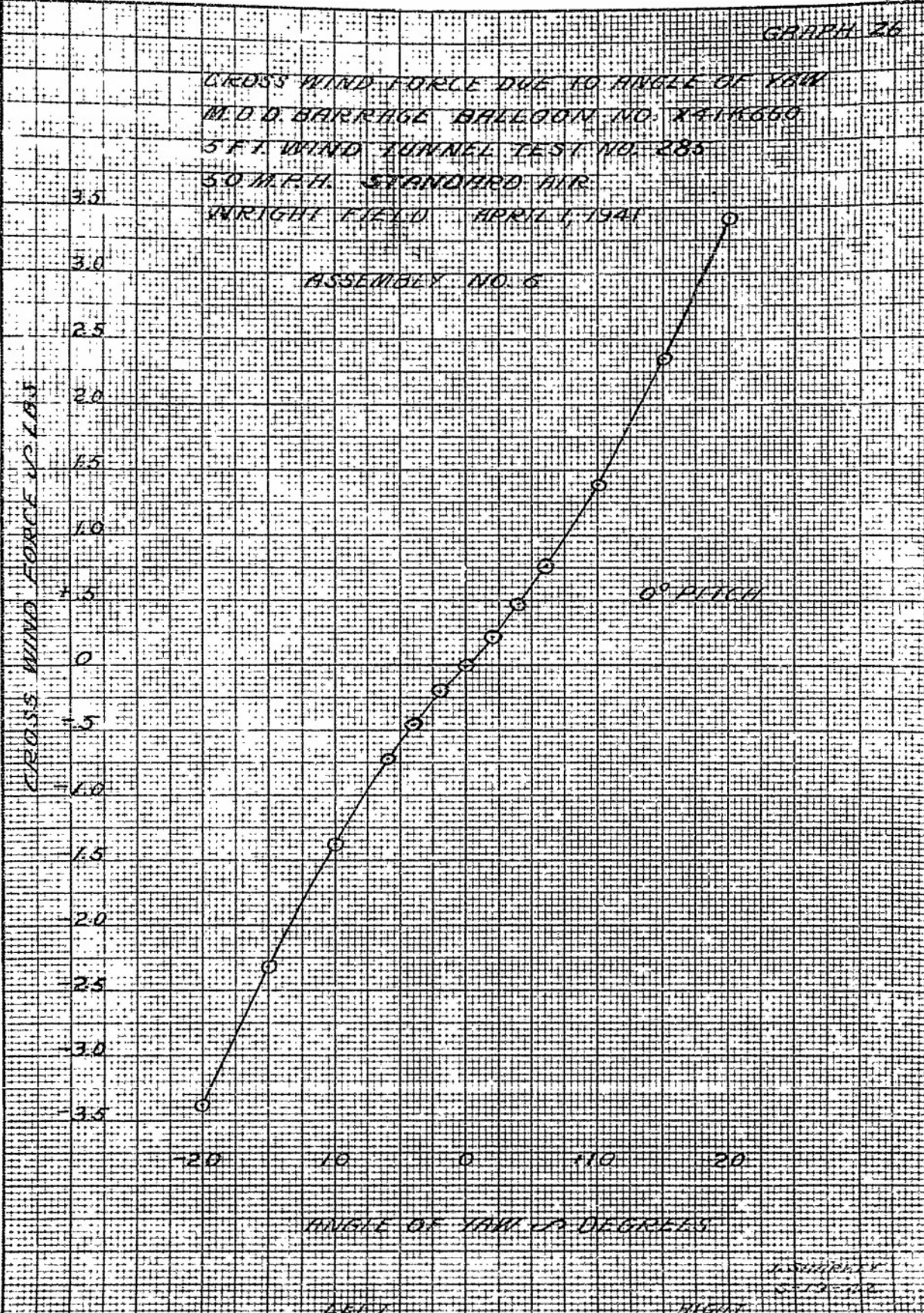
GRAPH 26

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 241K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 MPH STANDARD AIR
 WRIGHT FIELD APRIL 1, 1941

ASSEMBLY NO. 6

CROSS WIND FORCE IN LBS

0° PITCH



ANGLE OF YAW IN DEGREES

LEFT

RIGHT

USE THIS SIDE

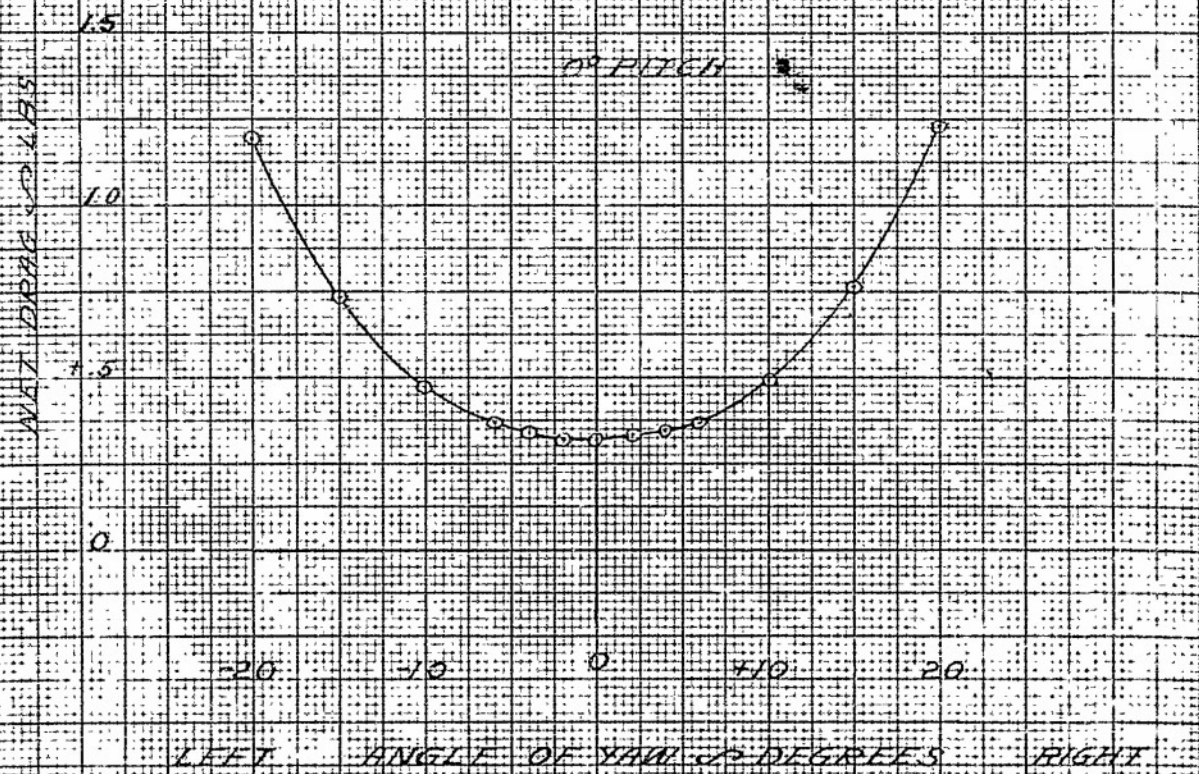
SERIAL No.

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GRAPH 27

NET DRAG DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. XATK660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD APRIL 1, 1941

ASSEMBLY NO. 6



J. S. ...
 6-19-42

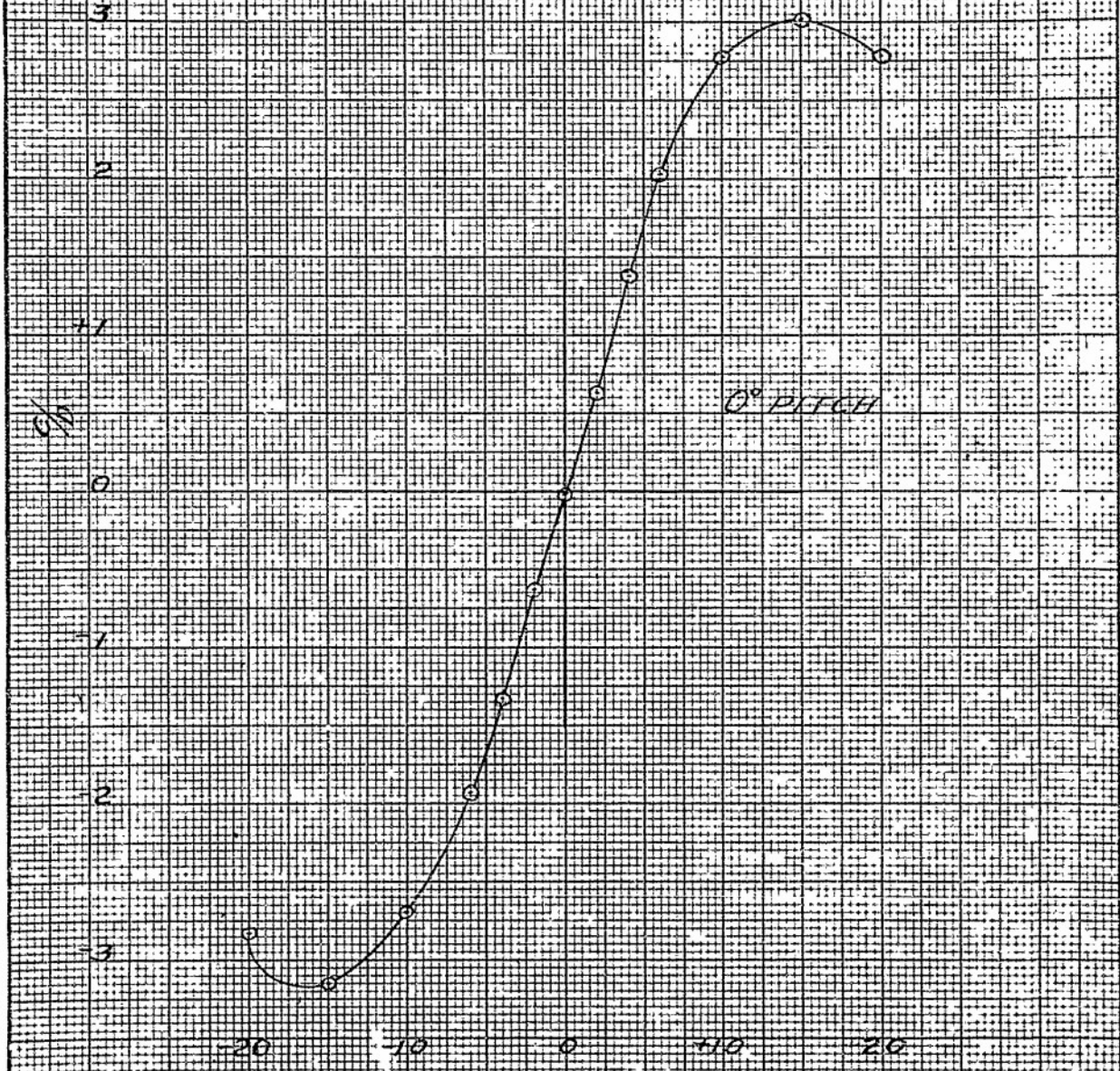
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GRAPH 28

C_L VS. ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 4411650
 51' WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD APRIL 1, 1941

ASSEMBLY NO. 6



ANGLE OF YAW IN DEGREES

LEFT

RIGHT

USE THIS SIDE

GRAPH 29

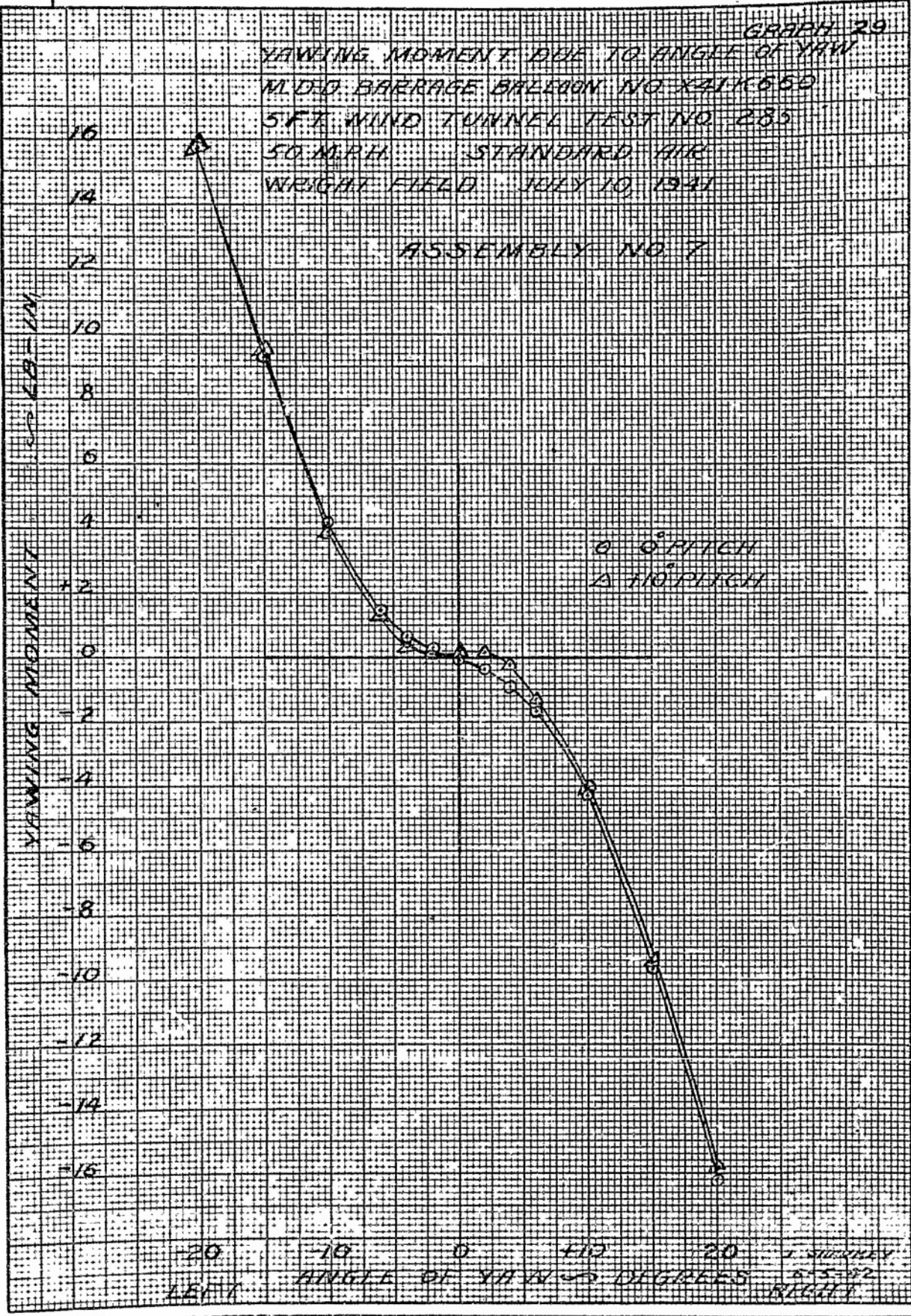
YAWING MOMENT DUE TO ANGLE OF YAW
 M.I.D.D. BARRAGE BALLOON NO. X21K650
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD JULY 10, 1941

ASSEMBLY NO. 7

LB-124

YAWING MOMENT

○ 0° PITCH
 △ 10° PITCH



LEFT -20 -10 0 10 20 RIGHT
 ANGLE OF YAW IN DEGREES

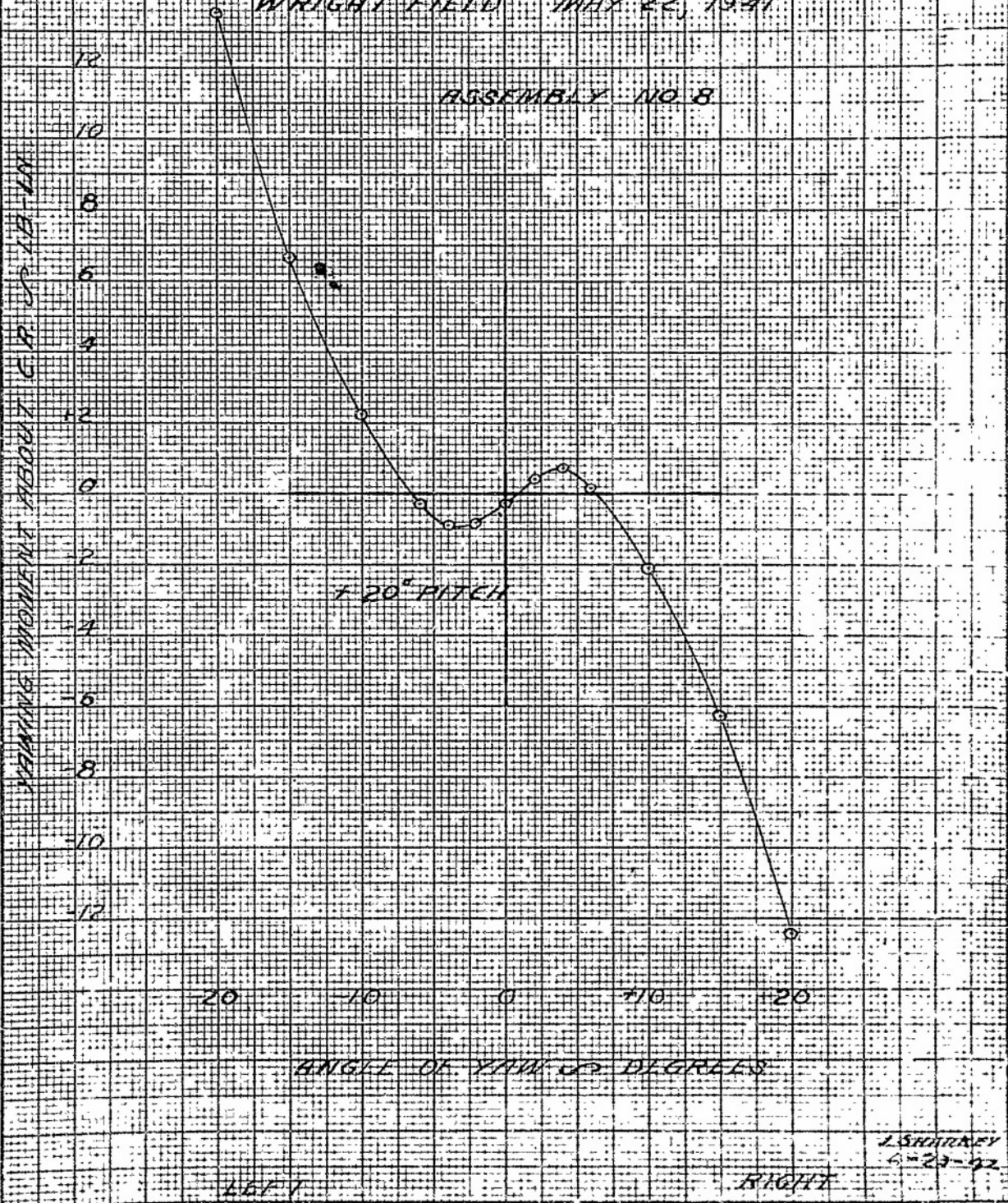
USE THIS SIDE

SERIAL NO.

PAGE

GRAPH 29A

YAWING MOMENT DUE TO ANGLE OF YAW
 M.E.D. BARRAGE BALLOON NO. X41K600
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 22, 1931

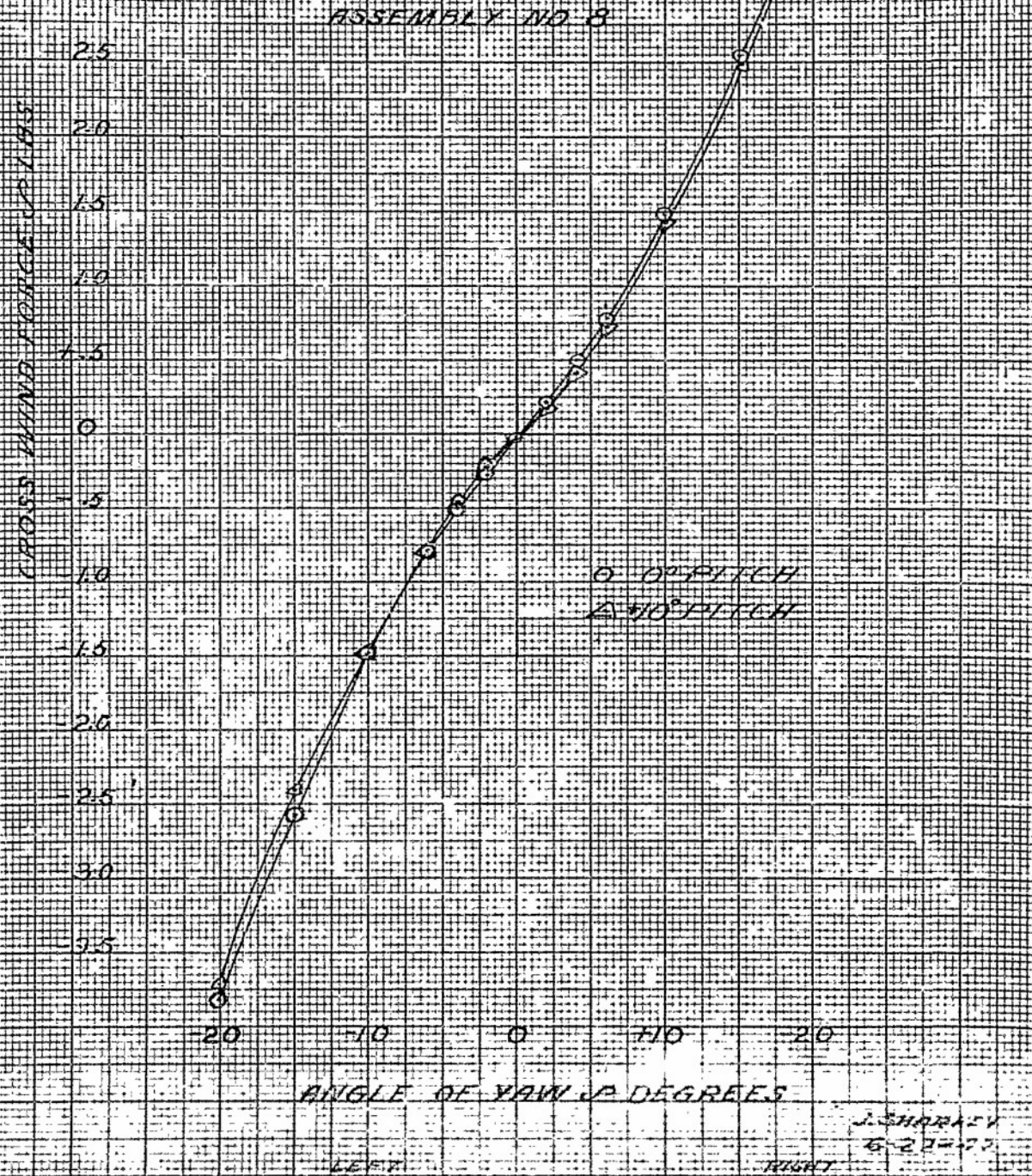


J. SHARKEY
6-23-32

USE THIS SIDE

GRAPH 30

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 241K660
 5 FT. WIND TUNNEL TEST NO. 283
 50 MPH STANDARD AIR
 WRIGHT FIELD MAY 22, 1941



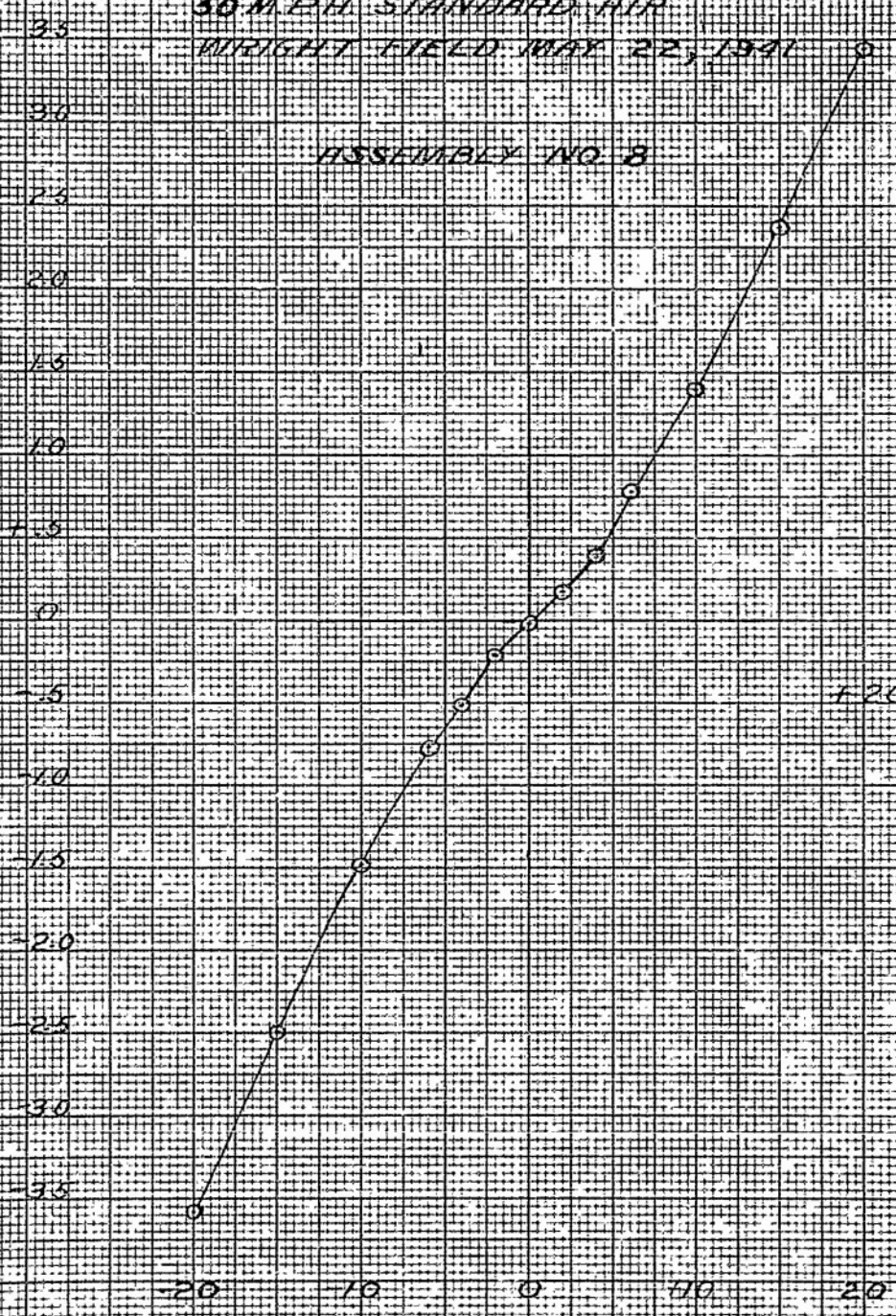
GRAPH 308

CROSS WIND FORCE DUE TO ANGLE OF YAW
 M.O.D. BARRAGE BALLOON NO. 141K650
 51 J. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 22, 1941

ASSEMBLY NO. 8

CROSS WIND FORCE IN LBS.

+20° PITCH



ANGLE OF YAW IN DEGREES

J. SHARPEY
5-23-42

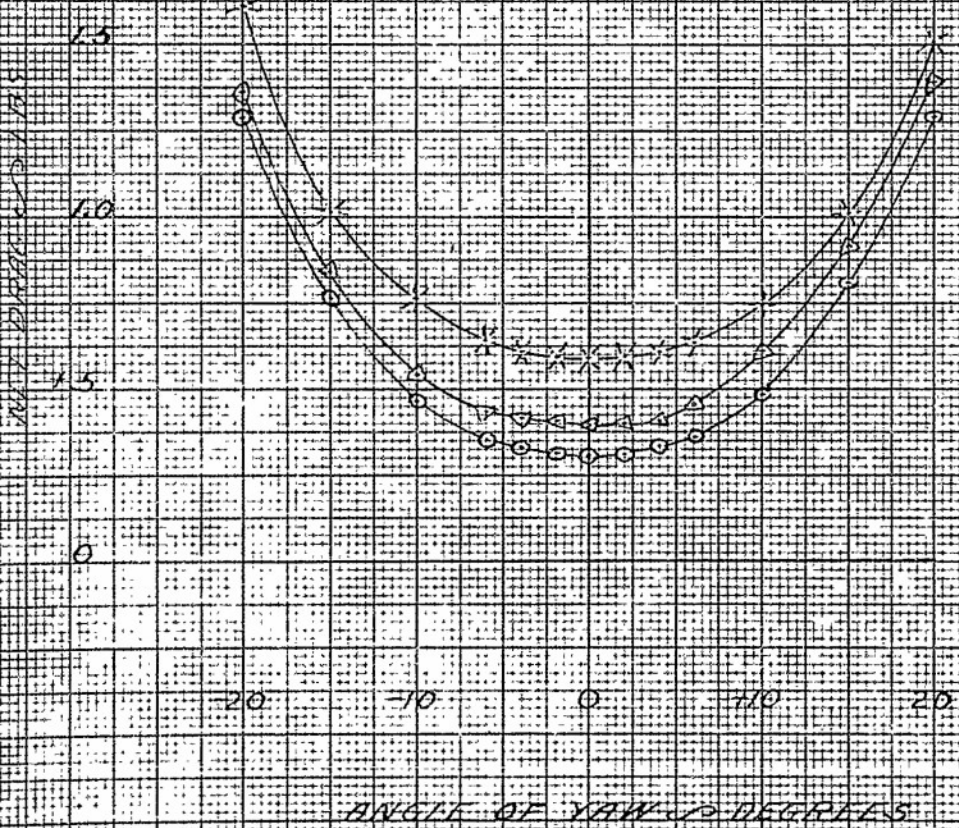
LEFT RIGHT

GRAPH 31

NET DRAG DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. X41K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 22, 1941

ASSEMBLY NO. 8

○ 0° PITCH
 △ 10° PITCH
 * 20° PITCH



LEFT

RIGHT

F. SHARKEY
 6-23-42

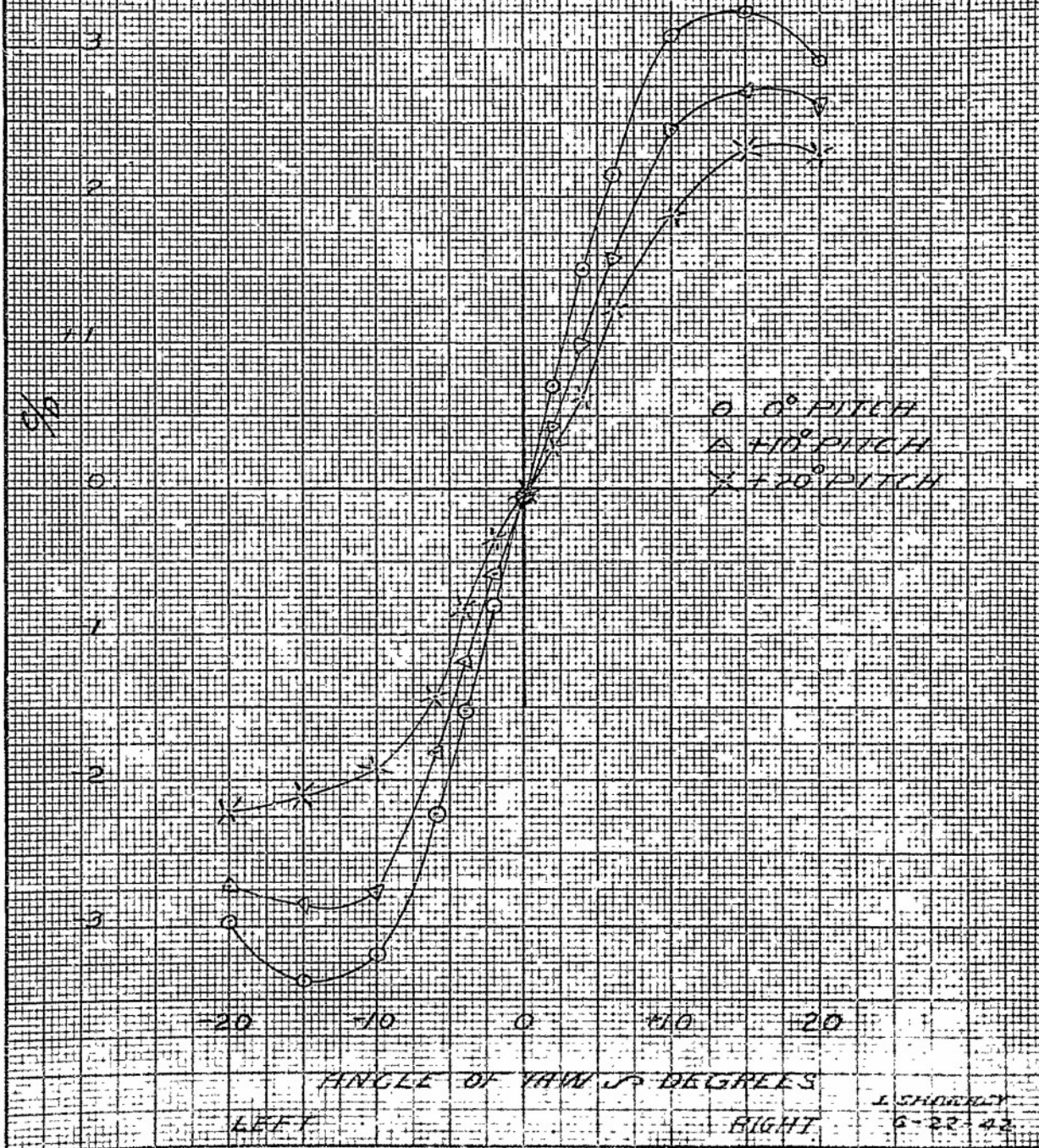
USE THIS SIDE

MD-50-A-W-17-3-12-42

GRAPH 32

C_D VS. ANGLE OF YAW
 M.D. BARRAGE BALLOON NO. X41K-660
 3 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 22, 1941

ASSEMBLY NO. 8



ANGLE OF YAW IN DEGREES

LEFT

RIGHT

J. SHORLEY
6-22-42

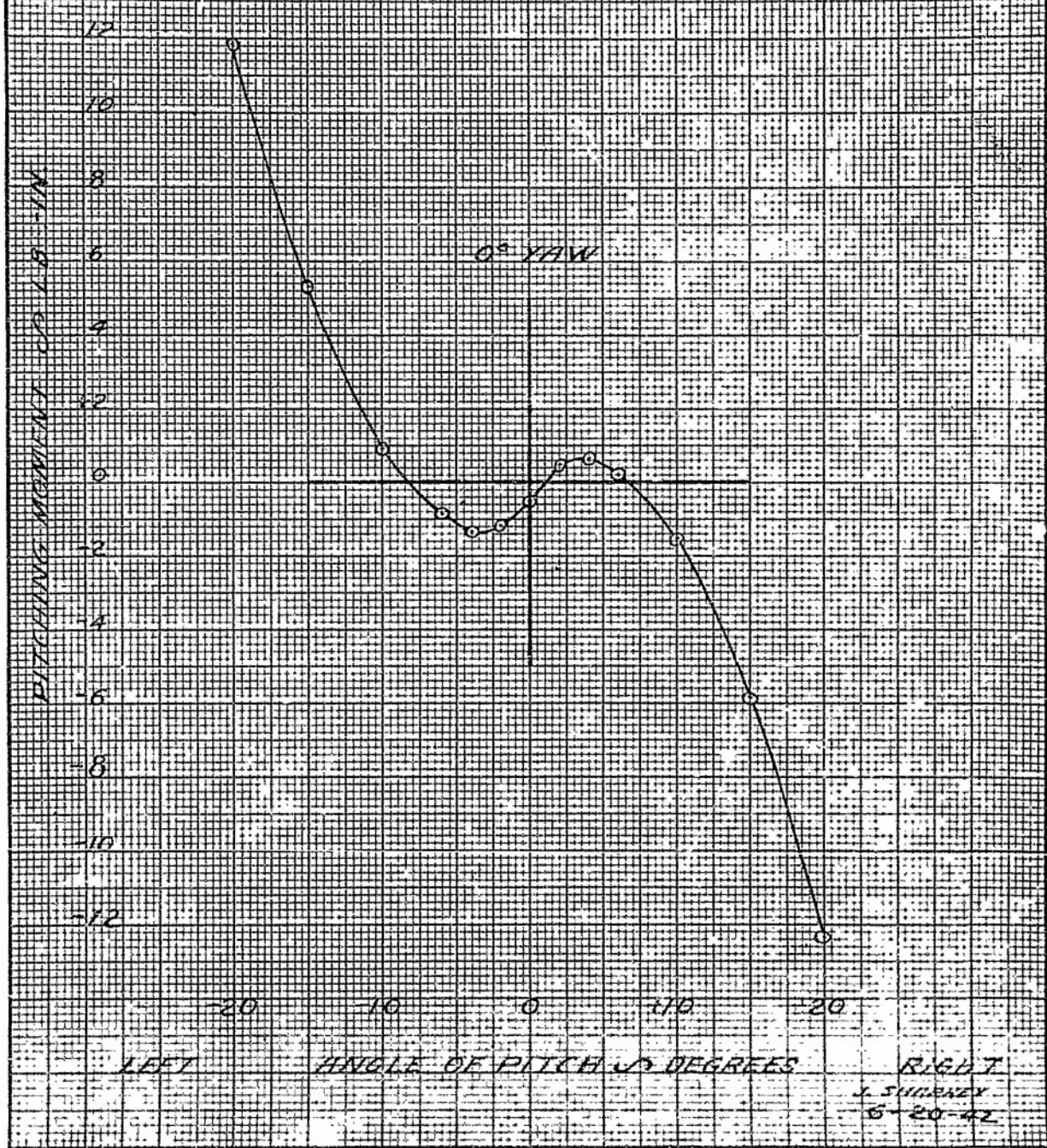
USE THIS SIDE

MSP-15-12-7-17-A-22-0401K

GRAPH 33

PITCHING MOMENT ABOUT C.P.
 M.D.D. BARRAGE BALLOON NO. X41K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 23, 1941

ASSEMBLY NO. 8



LEFT ANGLE OF PITCH IN DEGREES RIGHT
 J. SHURNEY
 5-20-41

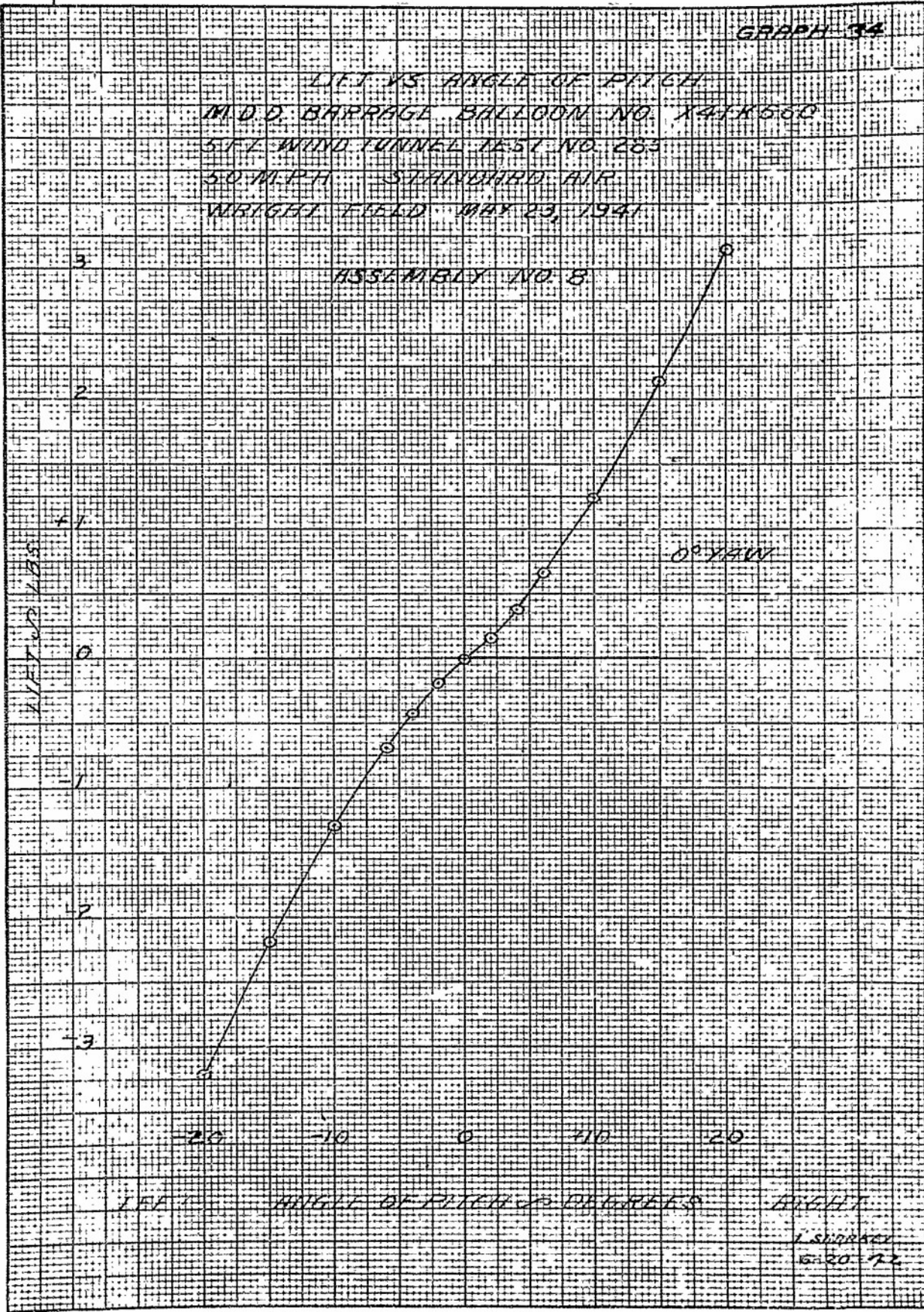
SERIAL No.

PAGE 00

GRAPH 34

LIFT VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. 141K550
 5 FT WIND TUNNEL TEST NO. 283
 50 MPH STANDARD AIR
 WRIGHT FIELD MAY 23, 1941

ASSEMBLY NO. 8



0° YAW

LEFT ANGLE OF PITCH DEGREES RIGHT

L. SHORR
6-20-72

USE THIS SIDE

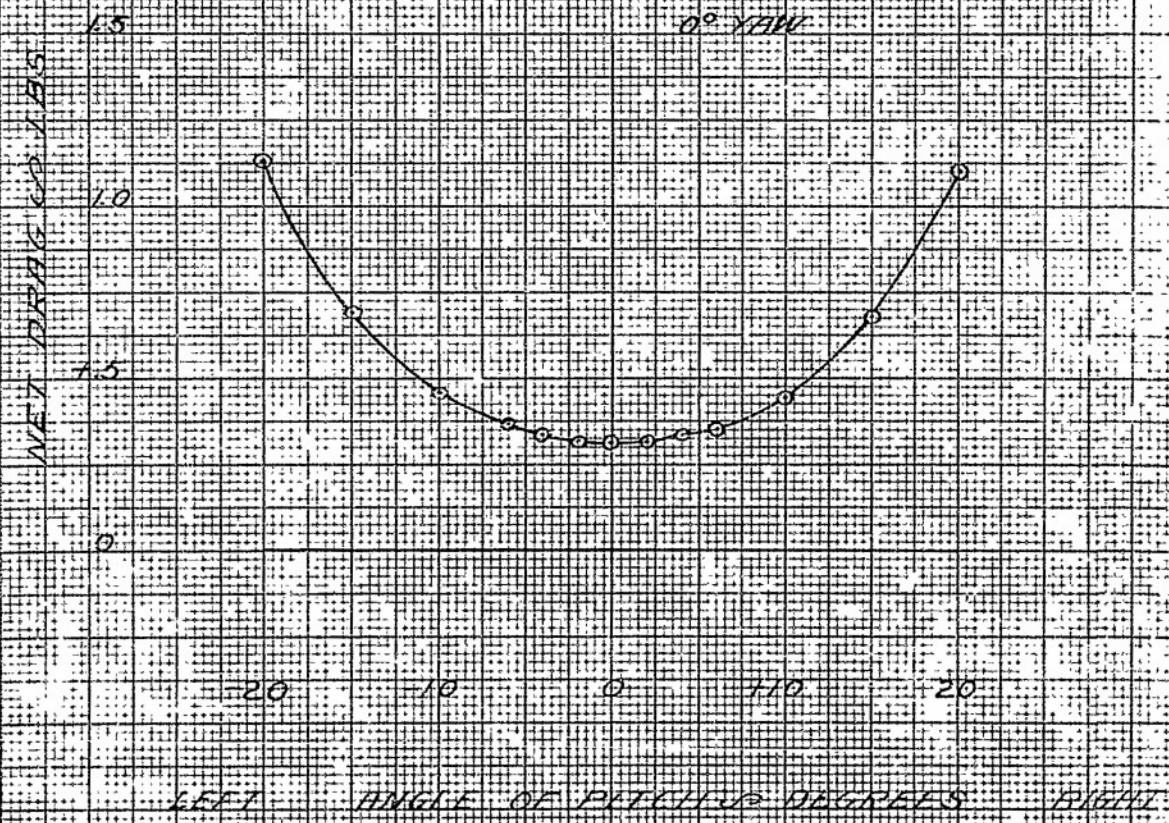
SERIAL No. 1802

PAGE 01

GRAPH 35

NET DRAG DUE TO ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41660
 5 FT. WIND TOWING TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 25, 1941

ASSEMBLY NO. B



154800
6-20-41

USE THIS SIDE

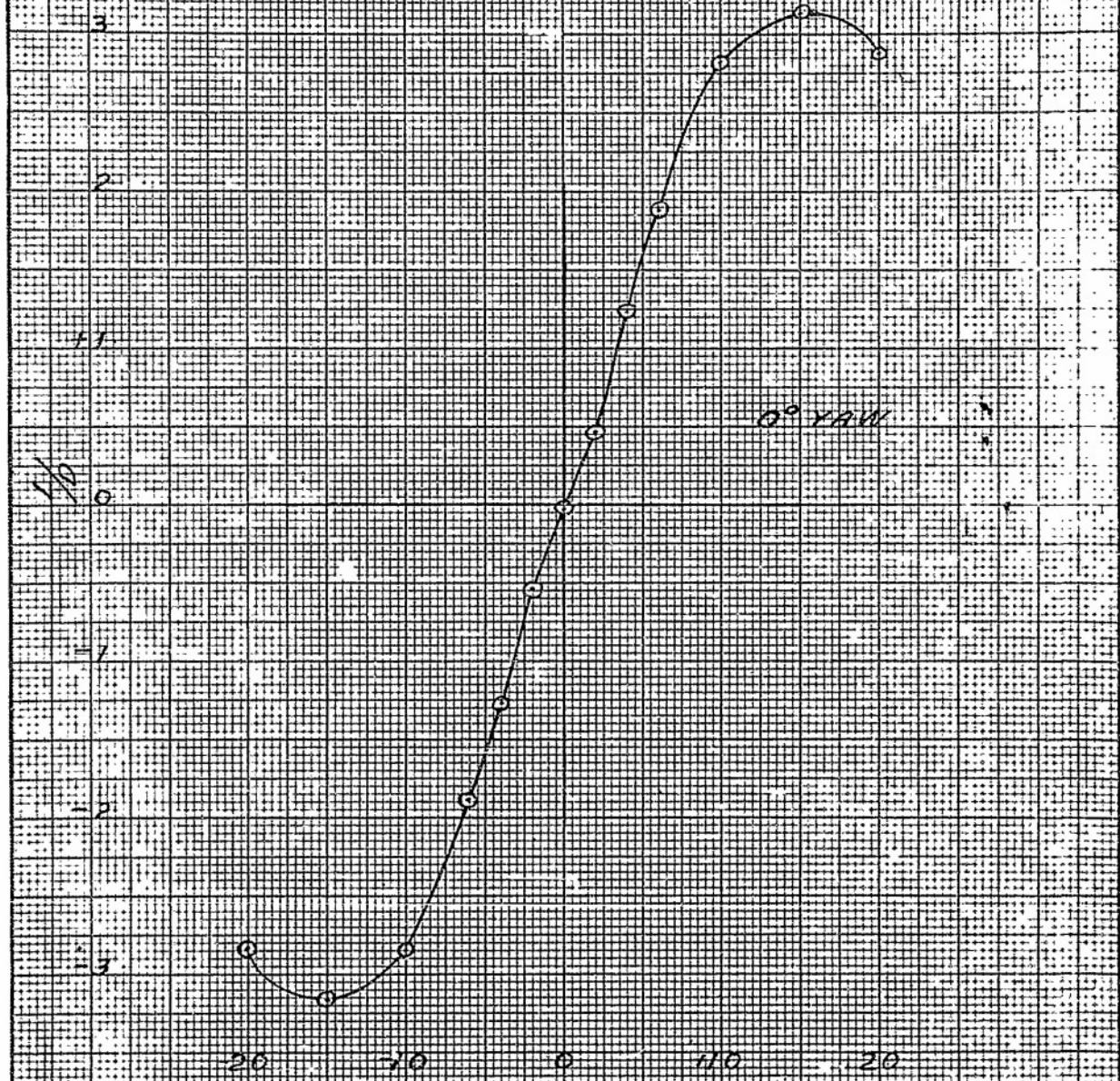
SERIAL No. 1103

PAGE 6

GRAPH 34

$\frac{1}{10}$ VS ANGLE OF PITCH
 M.D.D. BARRAGE BALLOON NO. X41R600
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MAY 23, 1941

ASSEMBLY NO. 8



LEFT ANGLE OF PITCH IN DEGREES RIGHT

ASSEMBLY NO. 8
6-20-42

USE THIS SIDE

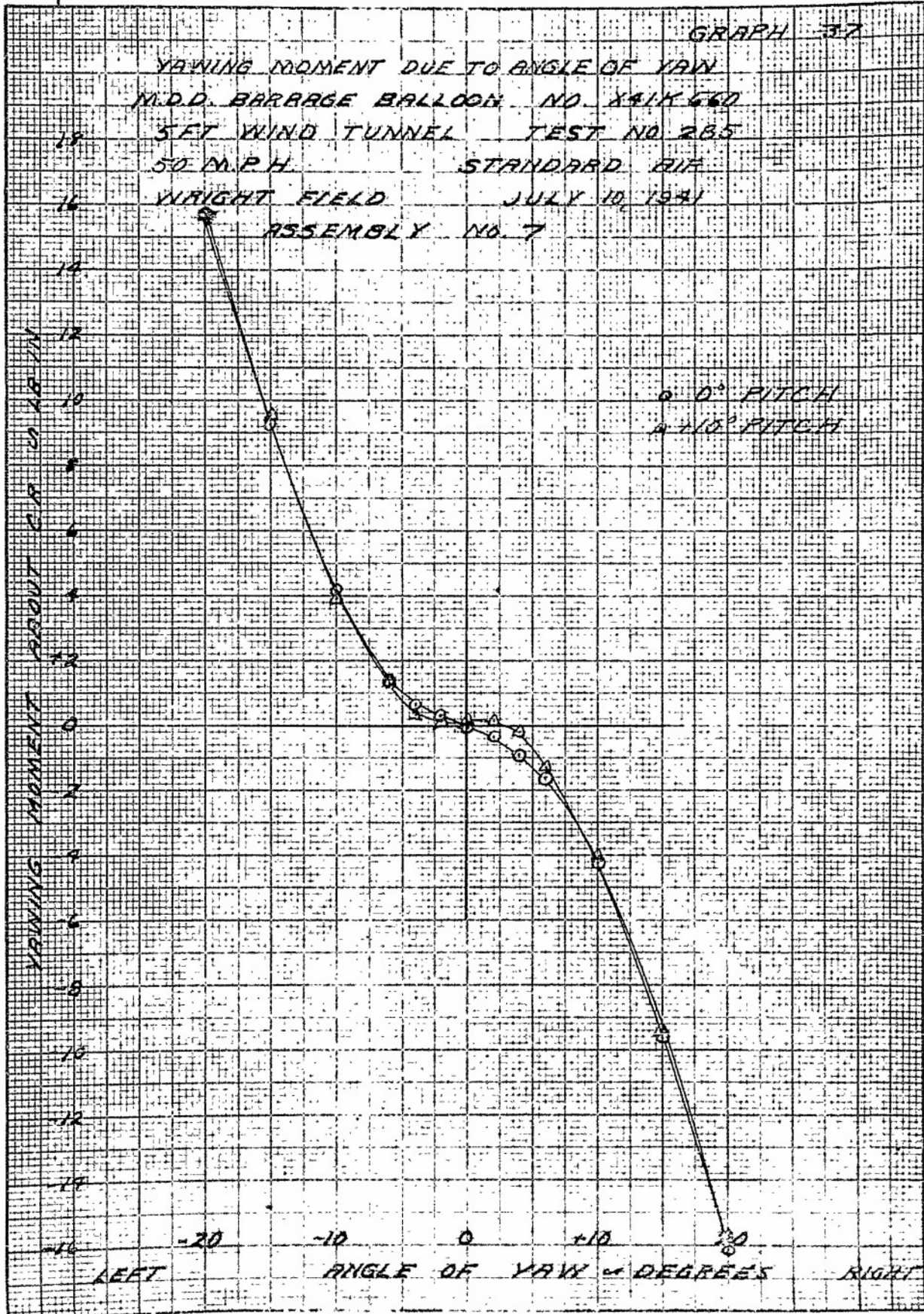
GRAPH 37

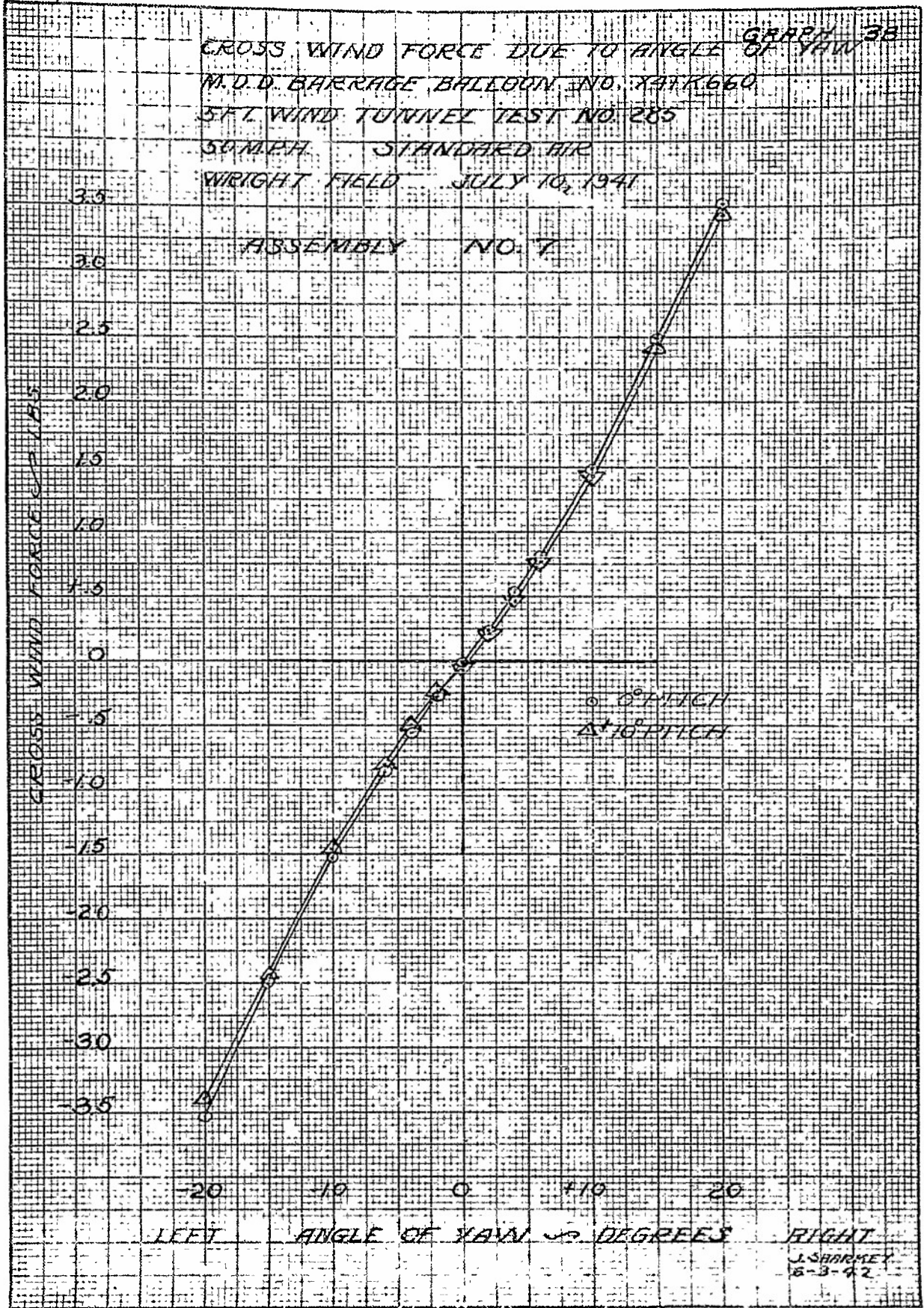
YAWING MOMENT DUE TO ANGLE OF YAW
 M.D.D. BARARGE BALLOON NO. X41X660
 5 FT WIND TUNNEL TEST NO 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD JULY 10, 1941
 ASSEMBLY NO. 7

YAWING MOMENT ABOUT C.G. IN LB IN

○ 0° PITCH
 △ 10° PITCH

LEFT -20 -10 0 +10 20 RIGHT
 ANGLE OF YAW - DEGREES



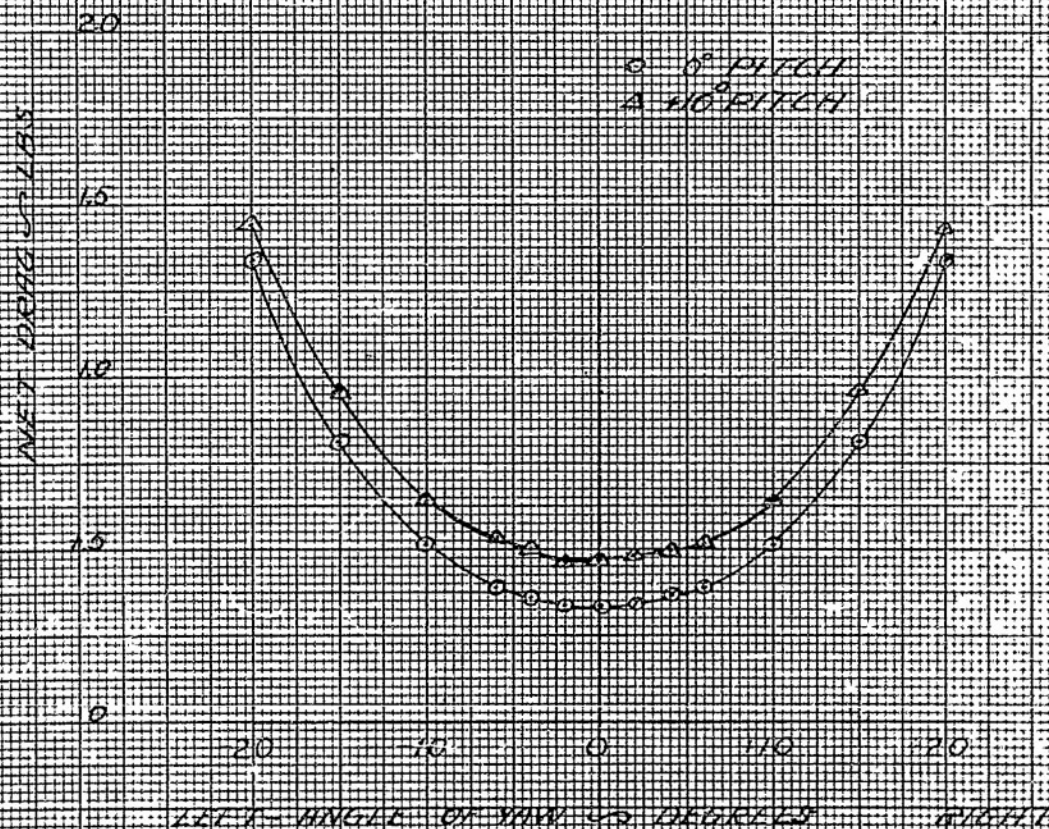


SERIAL NO. 303

PAGE 65

GRAPH 39

NET DRAG DUE TO ANGLE OF YAW
 M.D.D. BARRAGE BALLOON NO. 141K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD JULY 10, 1941
 ASSEMBLY NO. 1



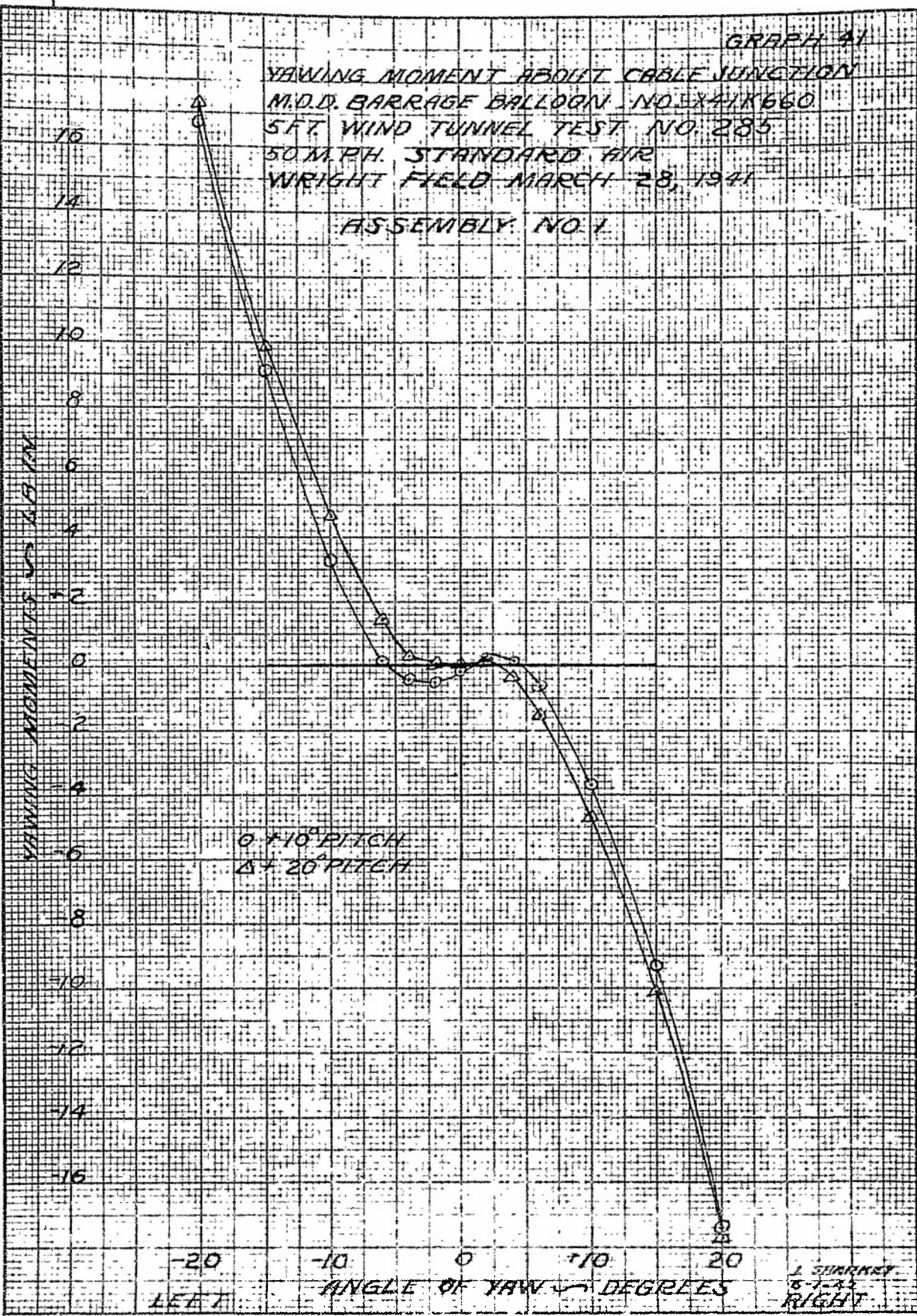
J. S. BARKLEY
 6-7-42

GRAPH 41

YAWING MOMENT ABOUT CABLE JUNCTION
 M.D.D. BARRAGE BALLOON NO. XA1K660
 5 FT WIND TUNNEL TEST NO. 285
 50 M.P.H. STANDARD AIR
 WRIGHT FIELD MARCH 28, 1941

ASSEMBLY NO. 1

YAWING MOMENTS VS DEG IN



0 + 10° PITCH
 10 + 20° PITCH

ANGLE OF YAW IN DEGREES

J. SHIRKEY
 5-7-41

GRAPH 42

PITCHING MOMENT ABOUT CABLE JUNCTION
 M.D.D. BARRAGE BALLOON NO. X4K680
 5 FT. WIND TUNNEL TEST NO 285
 50 MPH. STANDARD AIR
 WRIGHT FIELD. MARCH 28, 1941

ASSEMBLY NO 1

PITCHING MOMENTS IN LBS

16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16

-20
LEFT

-10

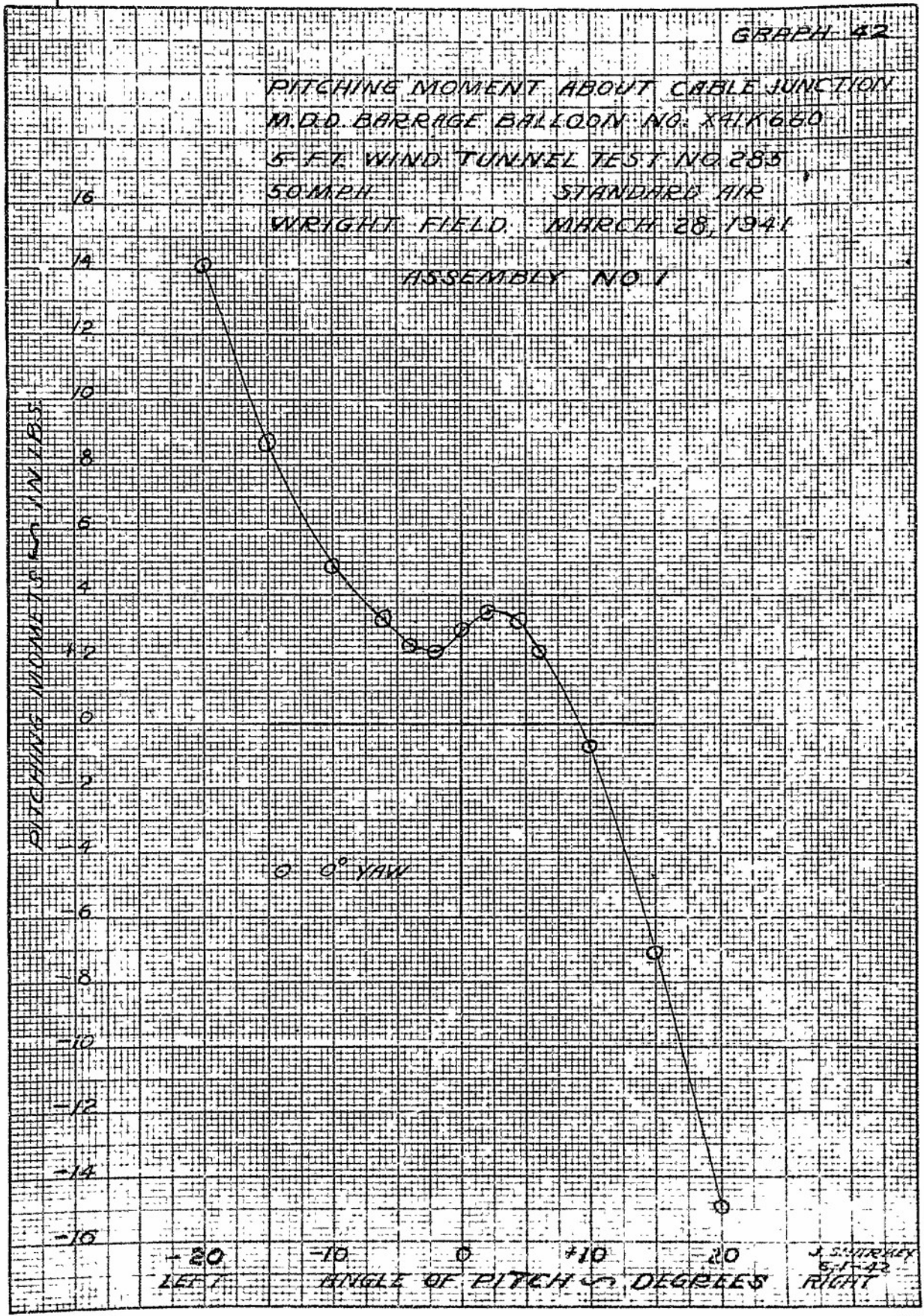
0

+10

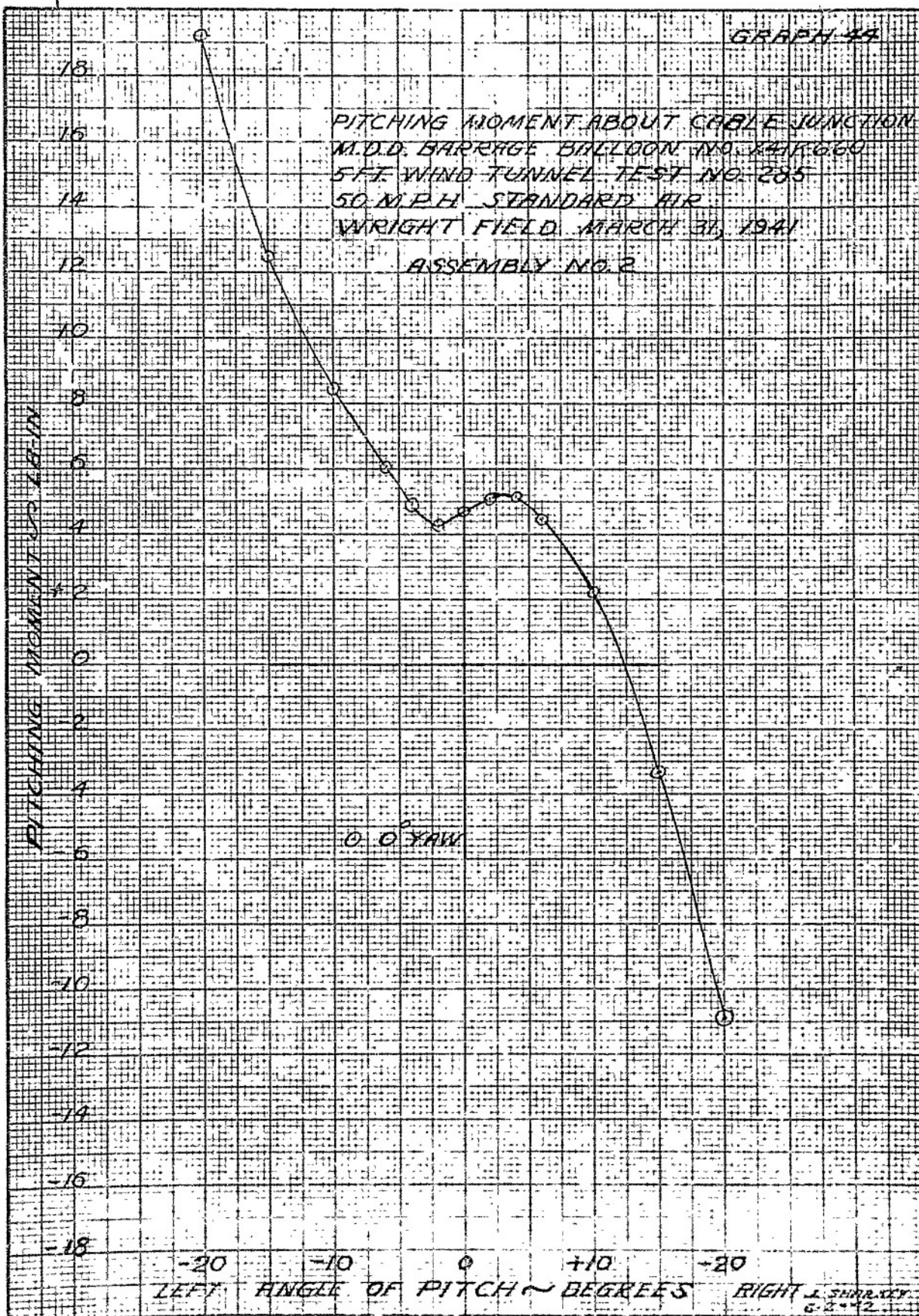
20

ANGLE OF PITCH IN DEGREES

J. S. STRAYK
 5-1-42
 RIGHT



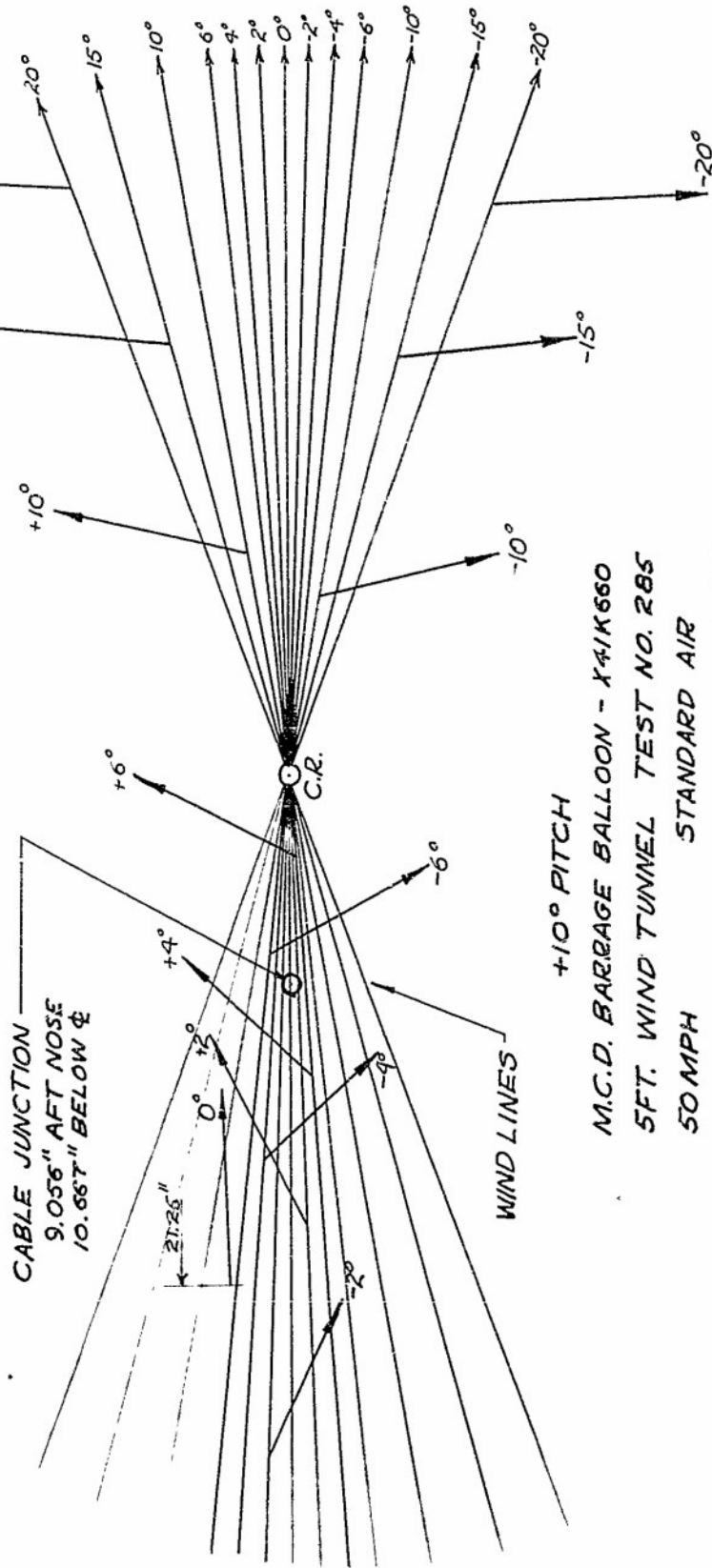
GRAPH 49



PLAN VIEW

C.R. 10.33" AFT NOSE ON
CENTERLINE OF ENVELOPE

CABLE JUNCTION
9.056" AFT NOSE
10.667" BELOW ϕ

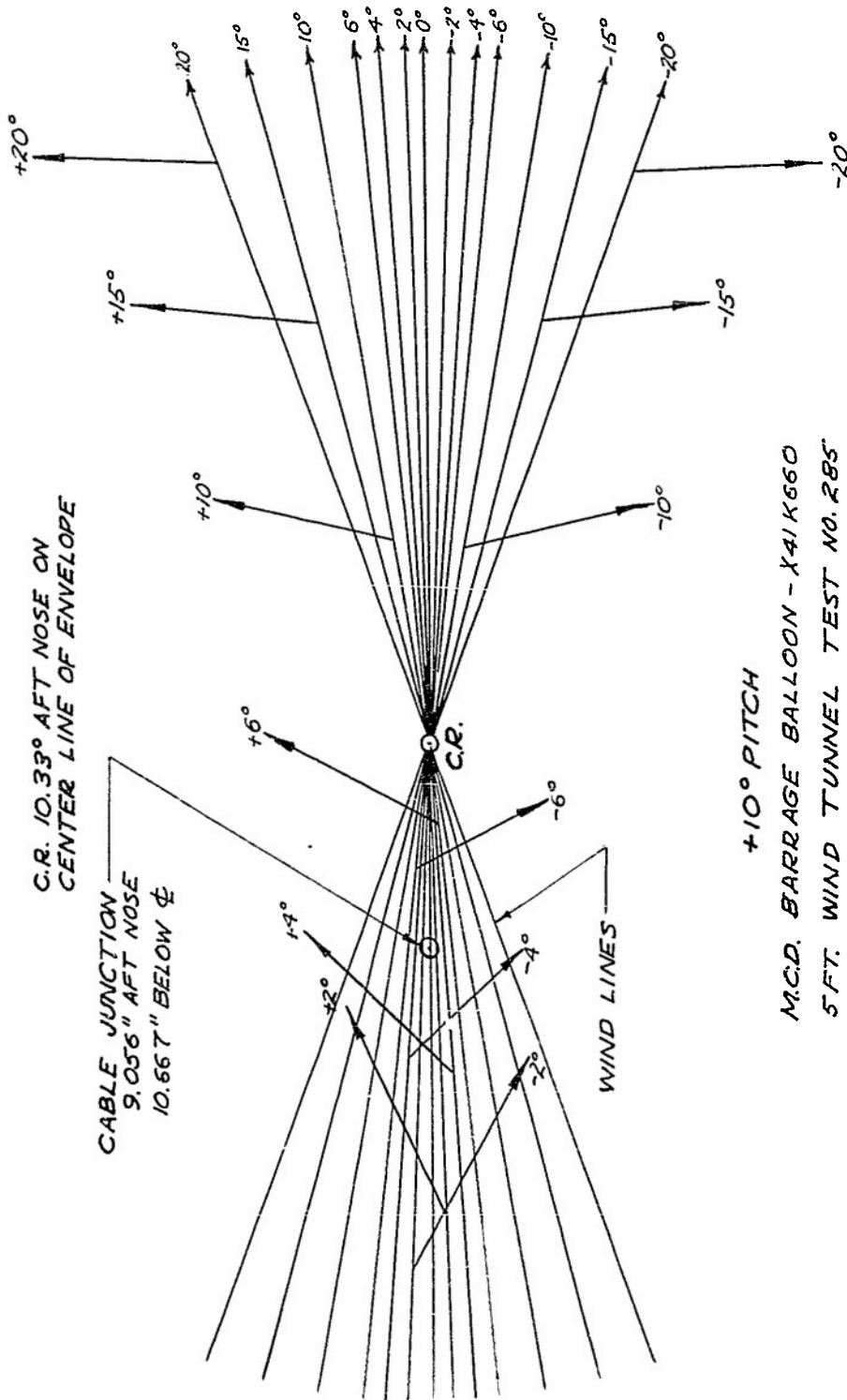


+10° PITCH
M.C.D. BARRAGE BALLOON - K4IK660
5FT. WIND TUNNEL TEST NO. 285
50 MPH STANDARD AIR
WRIGHT FIELD MARCH 28, 1941
ASSEMBLY NO. 1
VECTORS NOT DRAWN TO SCALE

PLAN VIEW

C.R. 10.33° AFT NOSE ON
CENTER LINE OF ENVELOPE

CABLE JUNCTION
9.056" AFT NOSE
10.567" BELOW ϕ



+10° PITCH

M.C.D. BARRAGE BALLOON - X41K660

5 FT. WIND TUNNEL TEST NO. 285

50 MPH STANDARD AIR

WRIGHT FIELD · MARCH 31, 1941

ASSEMBLY NO. 2

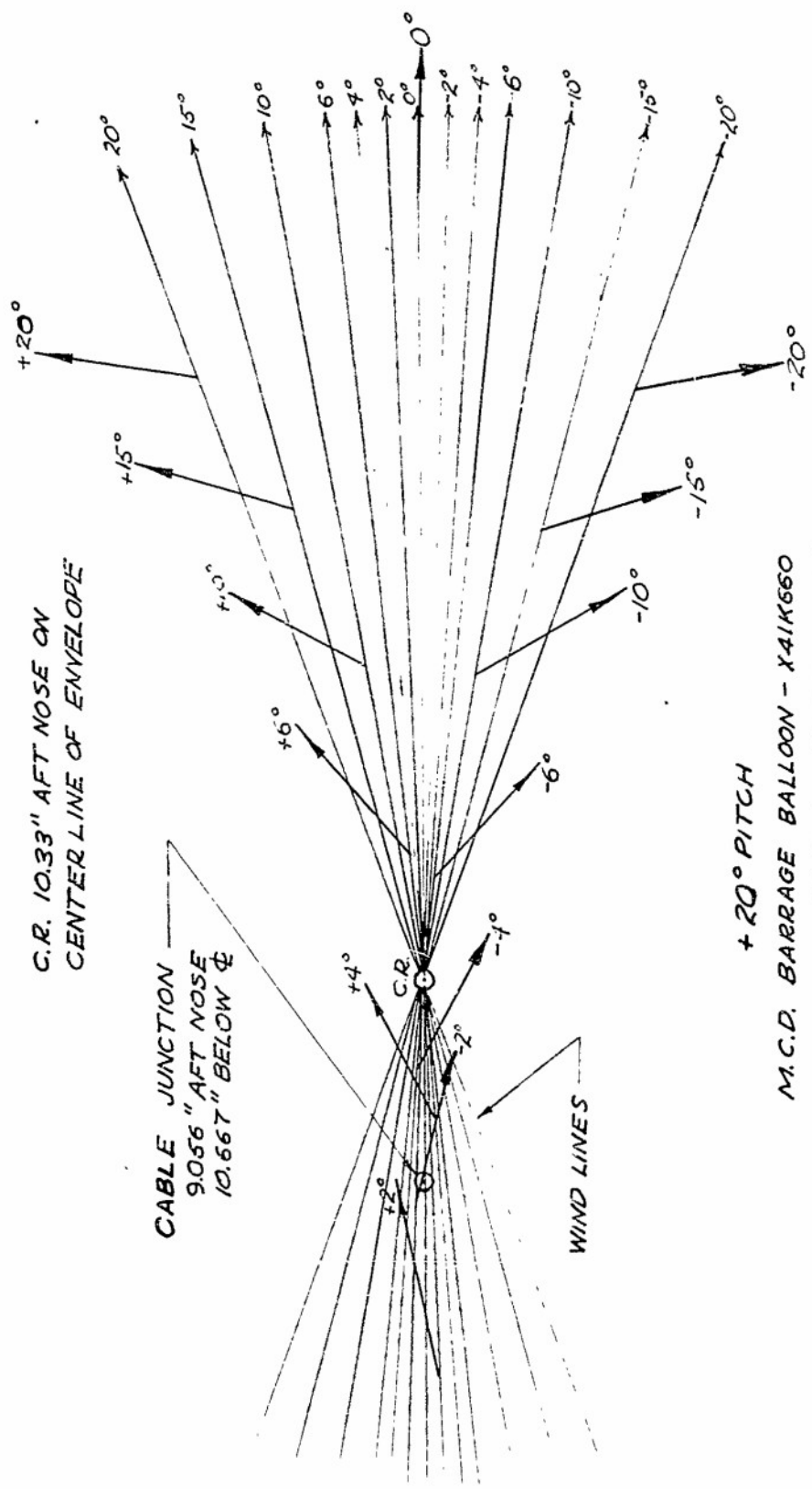
VECTORS NOT DRAWN TO SCALE

PLEASE USE THIS SIDE

PLAN VIEW

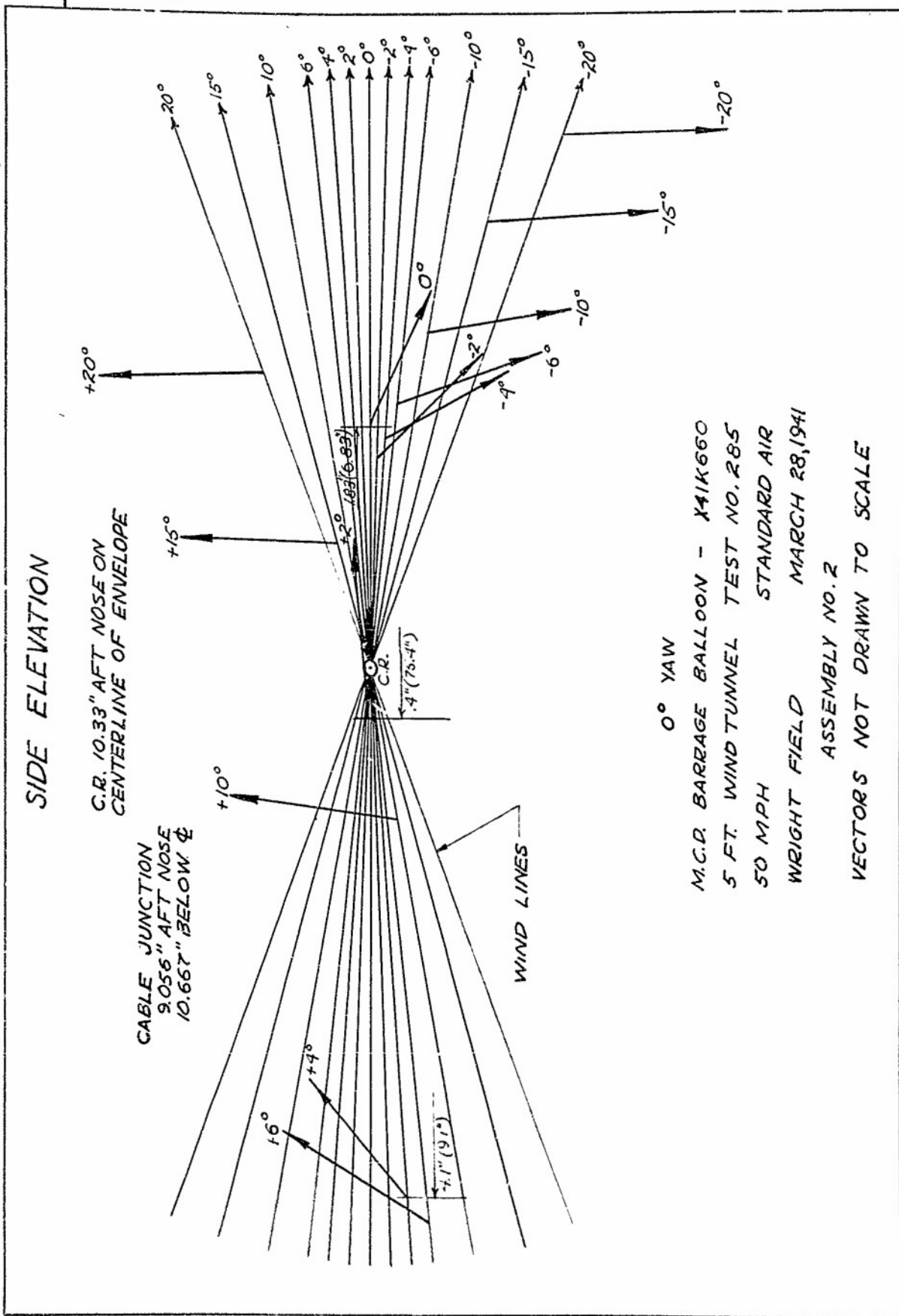
C.R. 10.33" AFT NOSE ON
CENTER LINE OF ENVELOPE

CABLE JUNCTION
9.056" AFT NOSE
10.667" BELOW Φ

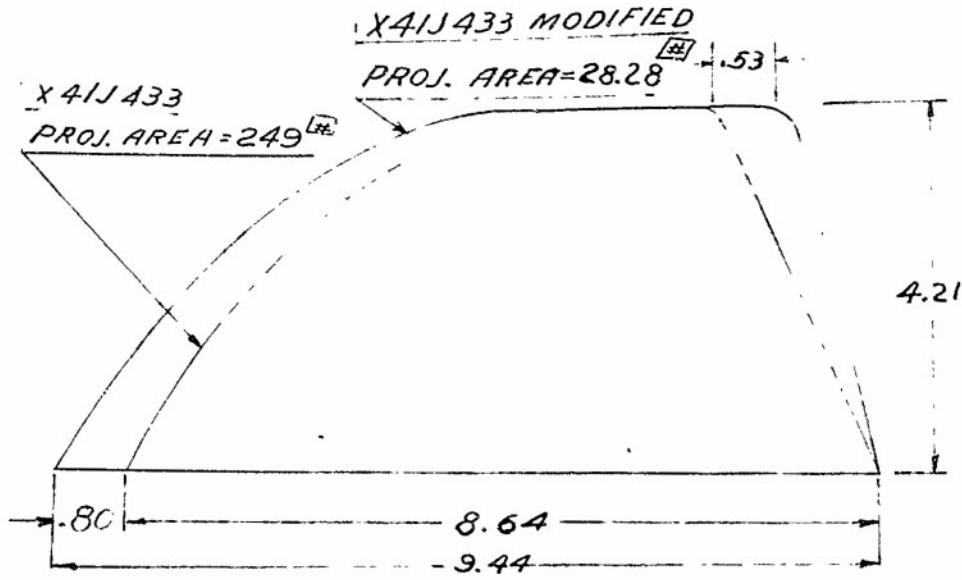


+ 20° PITCH
 M.C.D. BARRAGE BALLOON - X41K660
 5 FT. WIND TUNNEL TEST NO. 285
 50 MPH STANDARD AIR
 WRIGHT FIELD MARCH 31, 1941
 ASSEMBLY NO. 2
 VECTORS NOT DRAWN TO SCALE

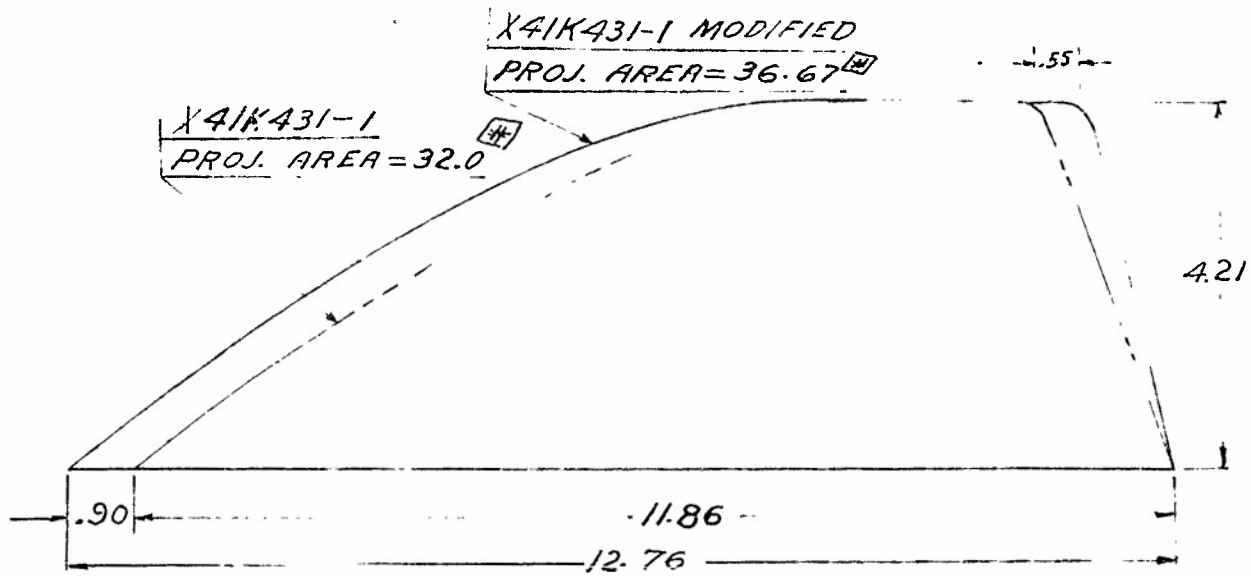
PLEASE USE THIS SIDE



PLEASE USE THIS SIDE



HORIZONTAL FIN



VERTICAL FIN

TRN. BY
J. SHIRKEY
6-23-44

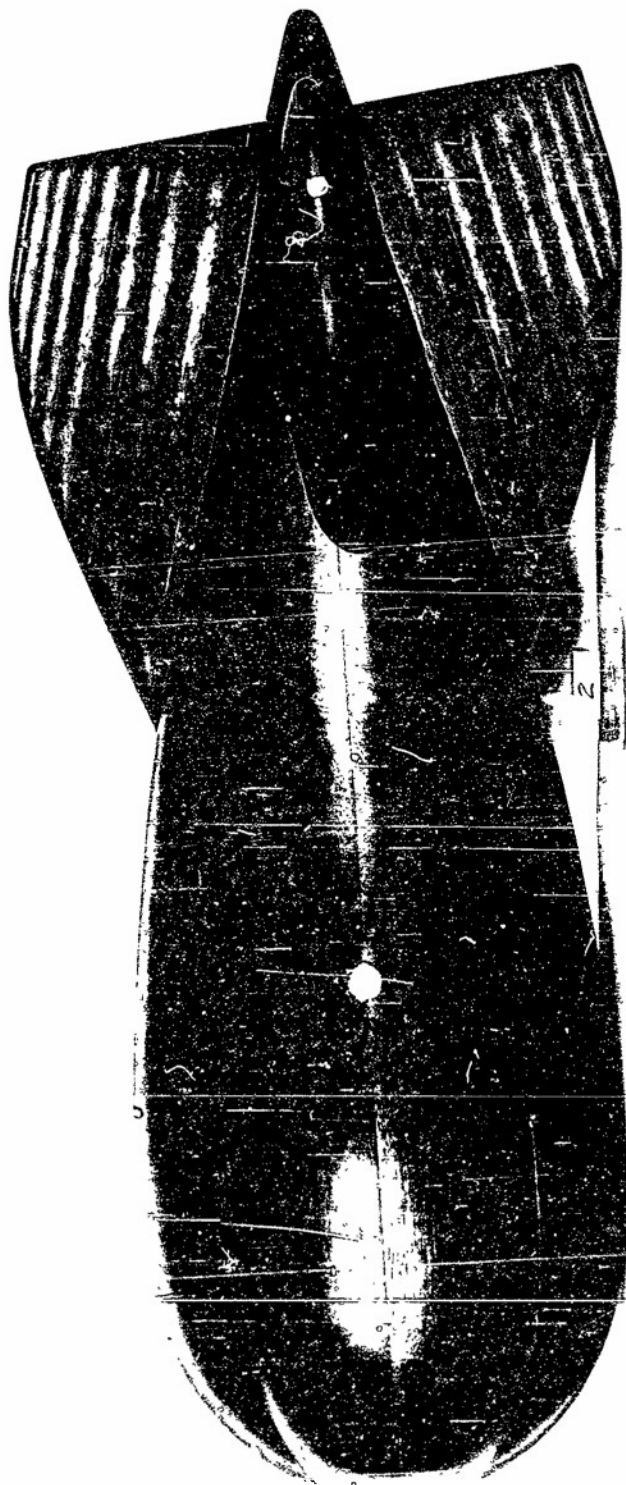
LIST OF PHOTOGRAPHS

| <u>NO.</u> | <u>TITLE</u> |
|------------|--|
| 79241 | Top View of Materiel Center Design Barrage Balloon X41K660 with Assembly 7 Fins. |
| 81536 | Side View of Materiel Center Design Barrage Balloon X41K660 with Assembly 2 Fins. |
| 81537 | Top View of Materiel Center Design Barrage Balloon X41K660 with Assembly 2 Fins. |
| 81538 | Rear View of Materiel Center Design Barrage Balloon X41K660 with Assembly 2 Fins. |
| 81539 | Side View of Materiel Center Design Barrage Balloon X41K660 with Assembly 4 Fins. |
| 81540 | Top View of Materiel Center Design Barrage Balloon X41K660 with Assembly 4 Fins. |
| 81541 | Rear View of Materiel Center Design Barrage Balloon X41K660 with Assembly 4 Fins. |
| 81542 | Side View of Materiel Center Design Barrage Balloon X41K660 with Assembly 6 Fins. |
| 81543 | Top View of Materiel Center Design Barrage Balloon X41K660 with Assembly 6 Fins. |
| 81544 | Rear View of Materiel Center Design Barrage Balloon X41K660 with Assembly 6 Fins. |
| 81937 | Side View of Materiel Center Design Barrage Balloon X41K660 with Assembly 1 Fins. |
| 81938 | Top view of Materiel Center Design Barrage Balloon X41K660 with Assembly 1 Fins. |
| 81939 | Rear View of Materiel Center Design Barrage Balloon X41K660 with Assembly 1 Fins. |

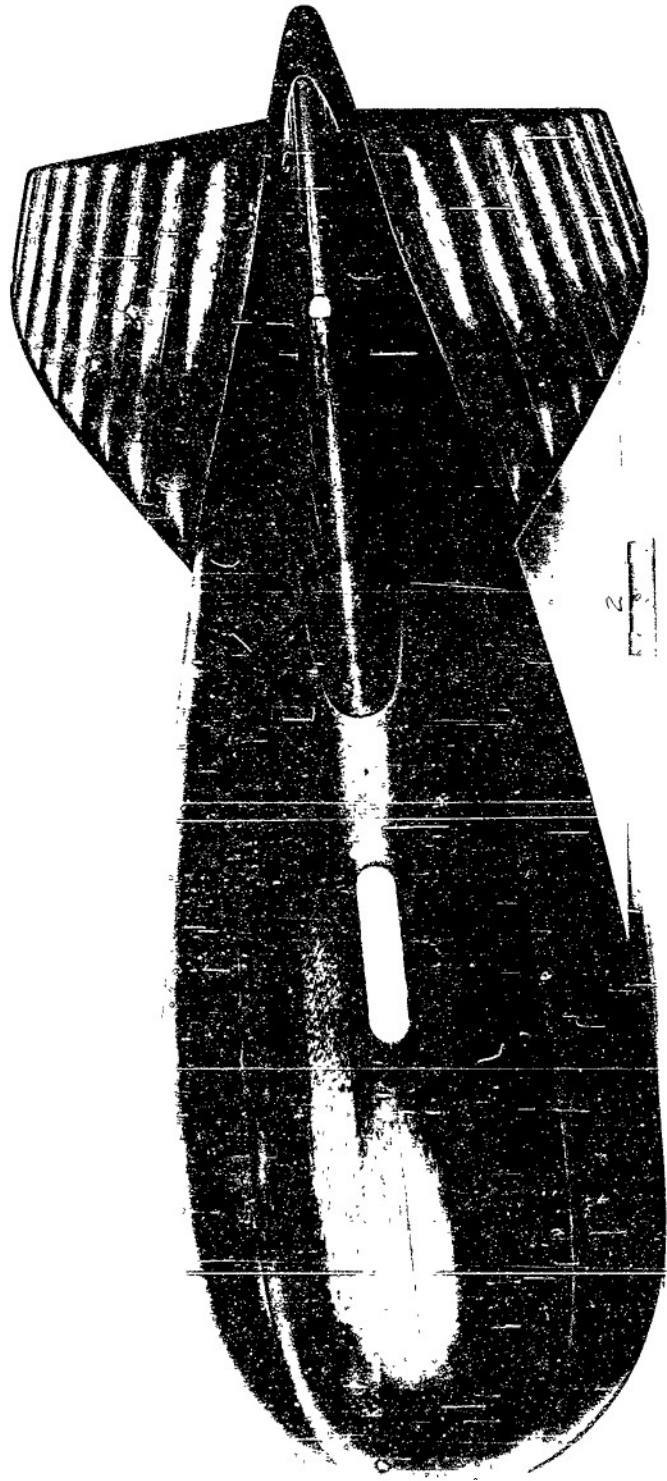
79241



81536



81537



81538



2

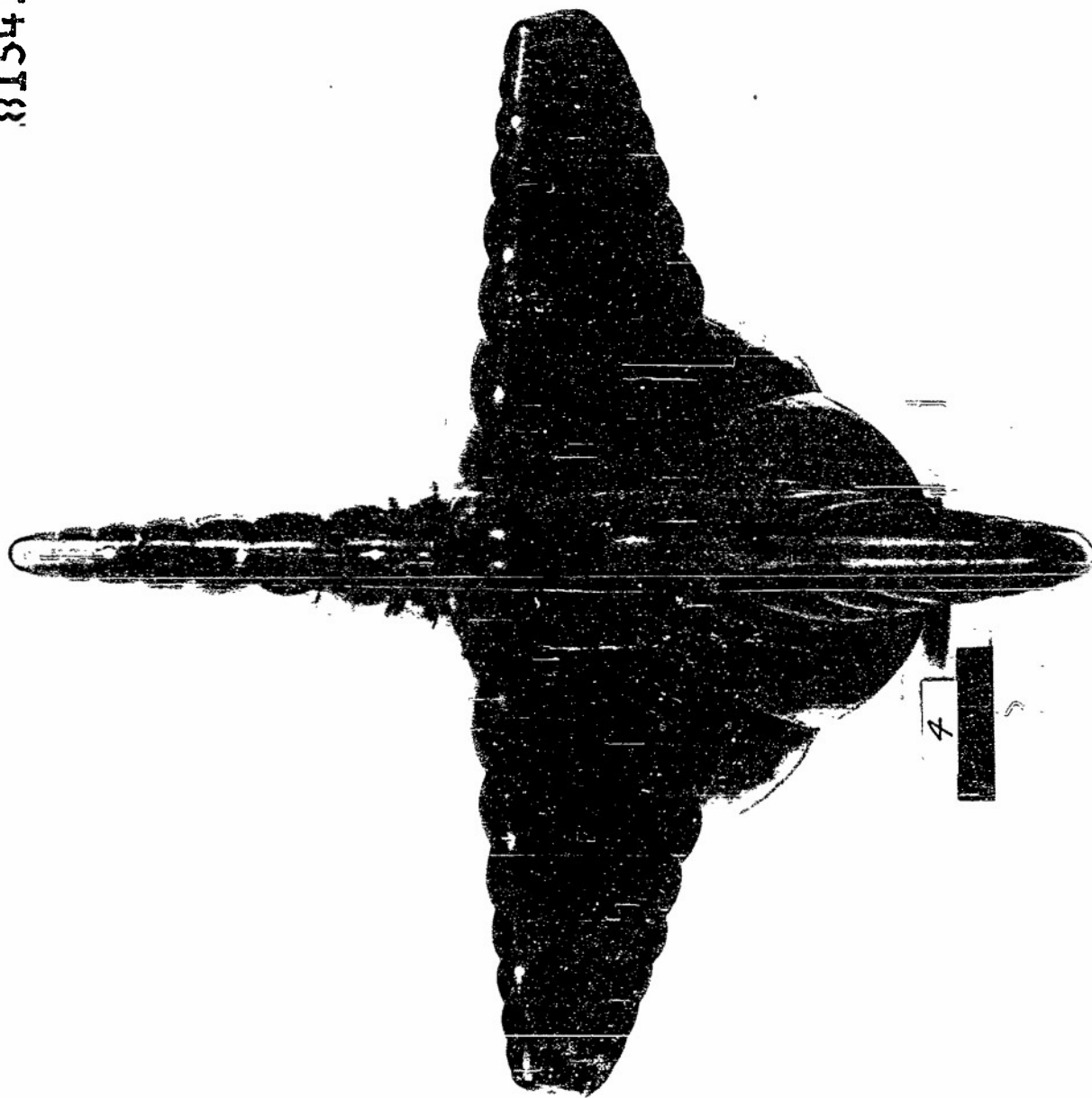
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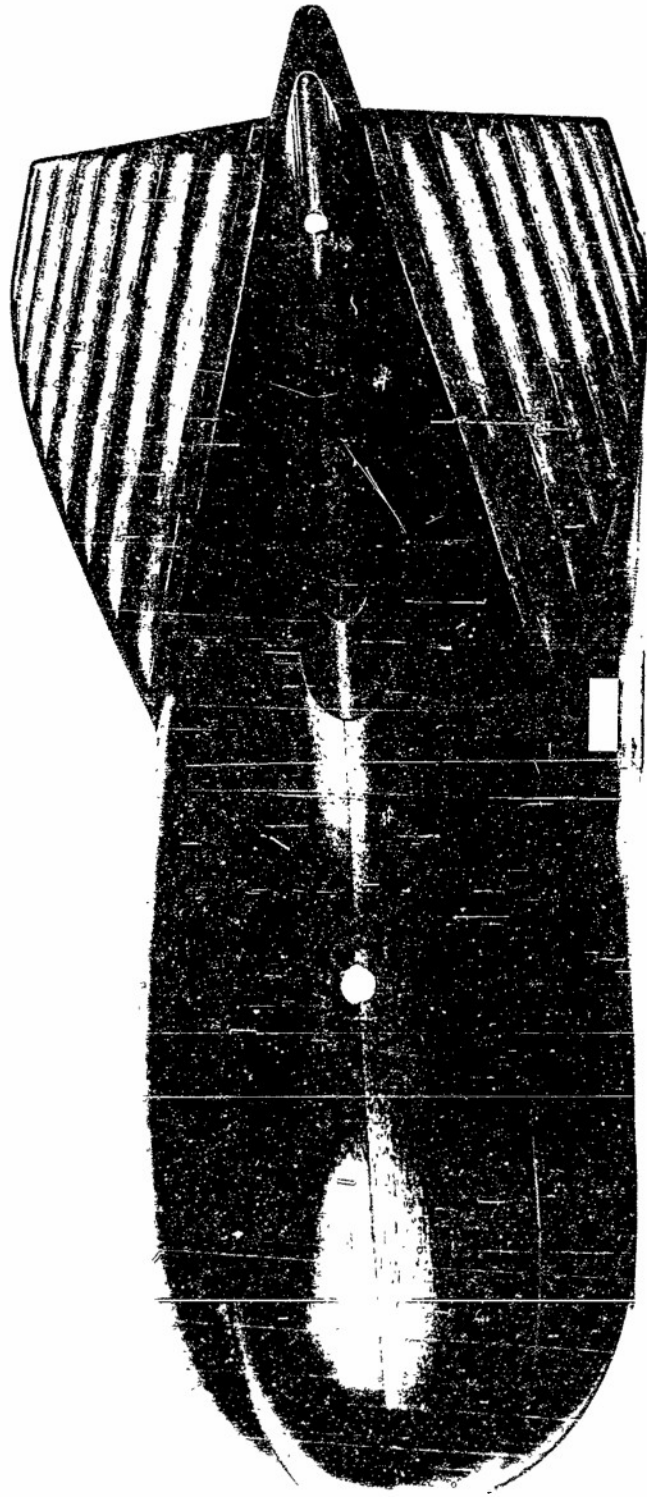
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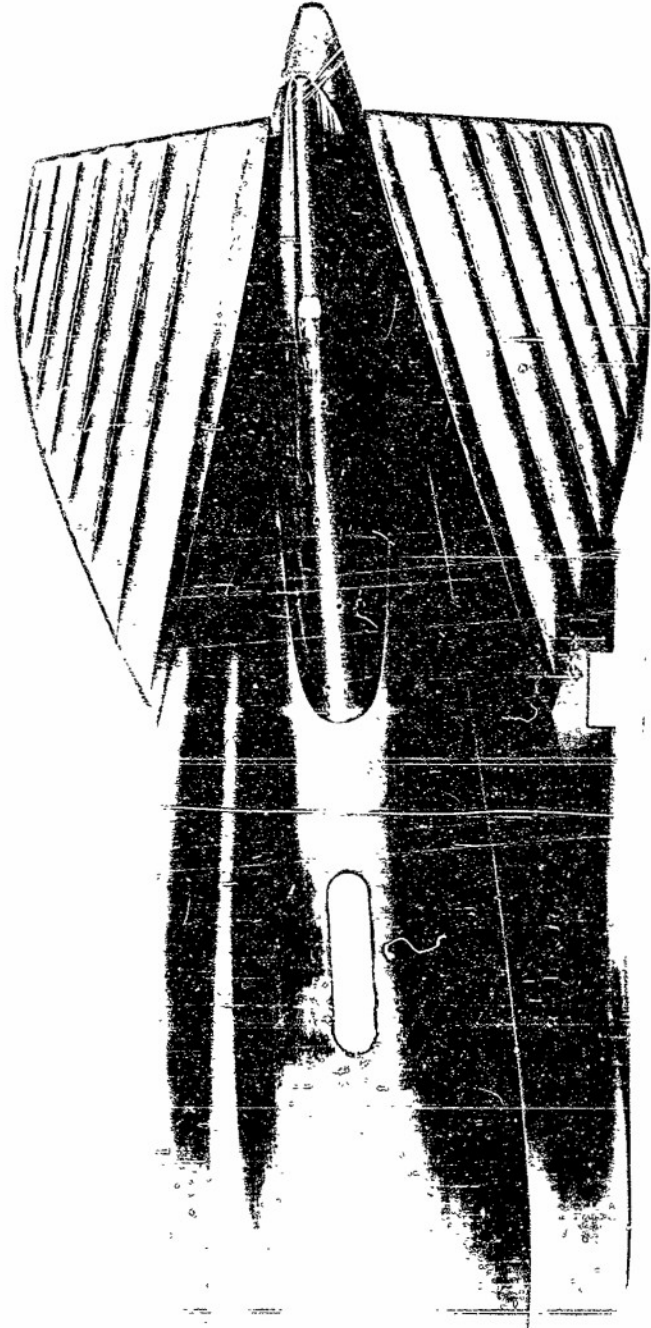
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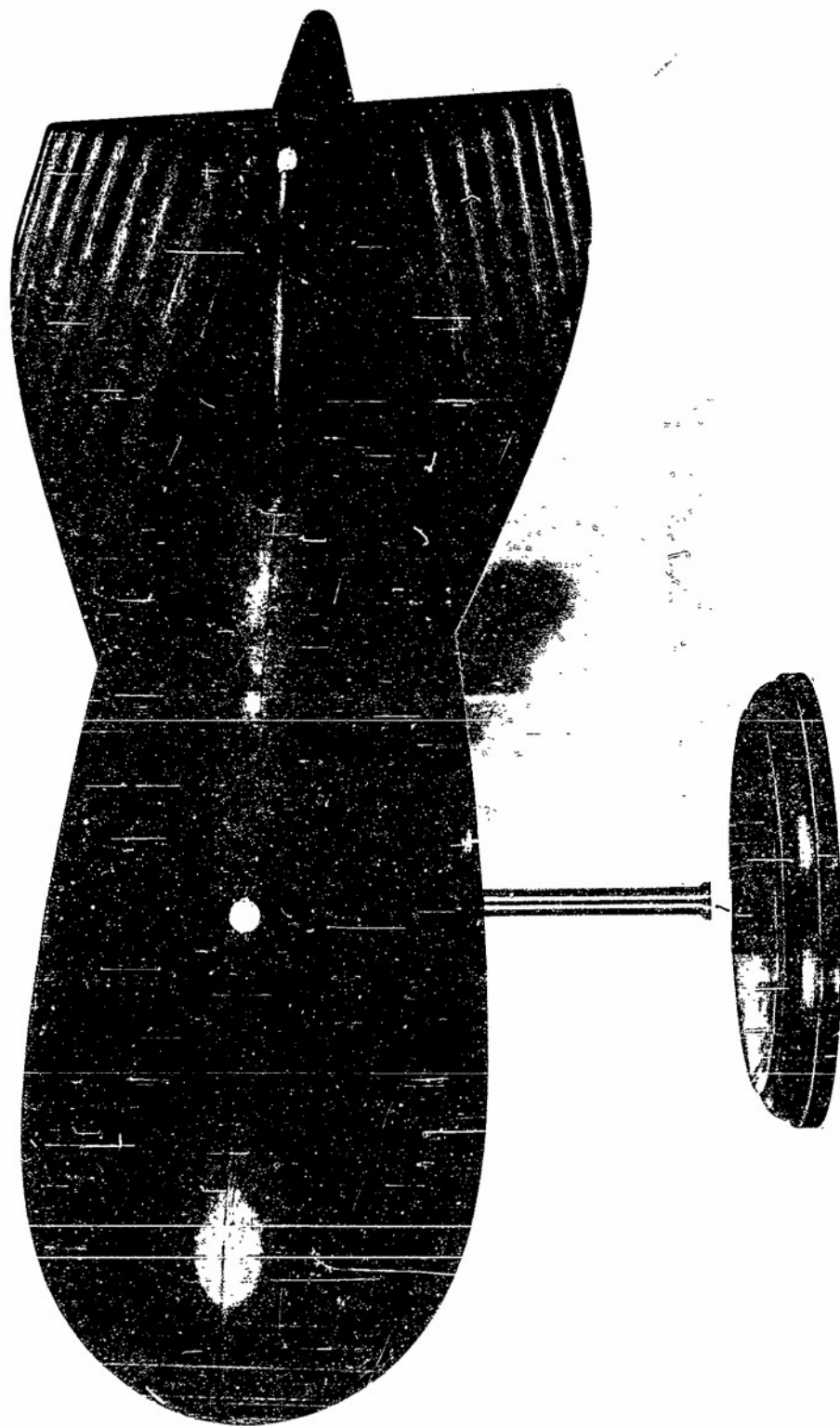
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81237



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81232

