LOCKHEED AMPHIBIAN AND FLYING BOAT HULLS,
EXPERIMENTS WITH A MODEL OF.

U.S. EXPERIMENTAL MODEL BASIN
NAVY YARD, WASHINGTON, D.C.

[redacted]

MAY, 1929

REPORT NO. 221

LOCKHEED AMPHIBIAN AND FLYING BOAT HULLS.

1. MODEL. The model, 1/16 scale, was furnished by the Lockheed Aircraft Co., Burbank, California. Wing floats were mounted on wing stubs in such manner that their position could be varied both vertically and horizontally. The float arrangement is shown in the photograph appended.

2. TEST DATA.

As Amphibian

Gross Load	Model	2.025 lbs.,	F.S. 8500 lbs.
Getaway speed	"	13.24 knots	F.S. 61 M.P.H.

As Flying Boat

Gross Load	Model	2.383 lbs.,	F.S. 10,000 lbs.
Getaway speed	"	15.19 knots	F.S. 70 M.P.H.

Center of gravity as per plan No. 7-XH-1. Corresponding trim by experiment 2.1° by stern as amphibian, 2.0° by the stern as Flying Boat.

Tow point and pivot at the C.G.

Load at any speed equals gross load minus lift applied.

Lift applied, $y = fv^2$, "f" being determined from the known value of "y" at the getaway speed and assumed constant for other speeds, no correction being applied for variation in trim.

No correction made for lift or drag effect of the wing stubs.

The lift was applied automatically by means of a vane towed under water independent of the model but attached to same through overhead pulley. The vane was calibrated before the test and set to exert a pull downward at the getaway speed equal to the gross load at rest. At intermediate speeds the lift varied as the square of the speed.

3. NATURE OF TEST.

(a) Free to trim, model uncontrolled, free to assume its natural trim when under way - Data obtained for curves of resistance, trim, and change of draft vs speed.

(b) Fixed trim, model controlled underway - Data obtained for curves of resistance, pitching moments, and change of draft, vs speed. By pitching moment is meant the amount of control necessary to maintain the angle of trim selected.

(c) Stability - Data obtained for curves of righting moments vs angle of trim and roll, zero speed. Curves of G.M. derived from moment curves.

4. TESTS.

Tests 1 to 7 inclusive were preliminary, to determine the position to set the side floats for the main tests. The position indicated by the lines scribed on the model was taken as a reference for the several variations tried. In each case the water line or the float was kept parallel to the assumed position.

1. Test 1 with side floats in the assumed position showed the need of extending the spray strips aft to the step. A blister from the main hull lapped up against the under side of the wing at speeds of 5 and 5.5 knots. The side floats were catching a lot of spray from the main hull. At these speeds the spray was leaving the hull abaft the brass strips. At lower speeds they were very effective.

2. Test 2 was identical with 1 except that the conventional type of spray strip was put on the model, extending from the brass strips to the step. This caused a slight increase in resistance at the hump but a decided improvement in spray conditions, the wing floats being clean and the blister below the wing.

3. In test 3 the floats were doing very little work being too high out of the water.

4 & 5. Submerging the floats deeper resulted in a small reduction in resistance where the models is getting up on the step but at lower speeds the floats were wetter, in test 5 the float throwing up a wave that almost reached the wing.

6. Test 6 with the floats moved forward gave results very similar to test 2.

7. In test 7 the floats were too far aft, the nose being right sloppy due to waves from the main hull.

As an amphibian the floats could be located vertically as in test 4 if desired, though the assumed position is considered the better. As a boat hull it is not advisable to submerge the floats deeper than test 2. The floats could be moved forward as much as for test 6 without any detrimental effect.

5. The general performance of the model was better as an amphibian than as a flying boat. On the latter test the blister at hump speeds rose against the under side of the wing at speeds between 4.5 and 5.75 knots. Just prior to the getaway the increase in resistance is due to spray from the step lapping up against the chine just abaft the step. The step is a little

shallow for best results at high speeds.

The general efficiency of the hull could be improved by locating the step further aft, about 2 ft. full size, 1-1/2 inches on the model. The present length of water line forward of the step is only about 50 percent of the total length which is not long enough for best results at hump speeds. A step 3 inches deep is suggested for this fore and aft position. The proportion of total water line length to beam is about right.

There was a little tendency to porpoise at speeds around 5 knots but the controls in the full size plane should readily dampen it out.

Mr. Fahy was present and took pictures during the test at the heavier loading which should give you an idea of the performance at hump speeds.

LOCKHEED AIRCRAFT Co

TEST MODEL OF AMPHIBIAN & FLYING BOAT HULL

GROSS LOAD: AS AMPHIBIAN, 8500# F.S.; 2.025# MODEL
" F.B. " 10,000# " ; 2.383 "

GETAWAY SPEED: AMPHIBIAN, 61 MPH - ; 13.24 KNOTS "
" F.B. , 70 - ; 15.19 - "

~~CENTER OF GRAVITY AS PER DR. No. 7-XH-1~~

SPEED RATIO (MODEL KNOTS TO F.S. M.P.H.) 4.605

LOAD & RESISTANCE RATIO 4195.

MOMENT RATIO 67,100.

MODEL FURNISHED - E.M.B. No. 2913 - 1/16 SCALE

TESTED APRIL 19 & 20, 1929.

-TESTS-

AMPHIBIAN

1 - FREE TO TRIM - SIDE FLOATS AS PER DRAWING - *
2 - " " " - " " " - SPRAY STRIPS EXTENDED TO STEP *
3 - " " " - " RAISED .2" - "
4 - " " " - " LOWERED .2" - "
5 - " " " - " " .4" - "
6 - " " " - " {AS IN 1 & 2 VERTICALLY BUT MOVED FOR'D .24" - "
7 - " " " - " {AS IN 1 & 2 VERTICALLY BUT MOVED AFT .66" - "

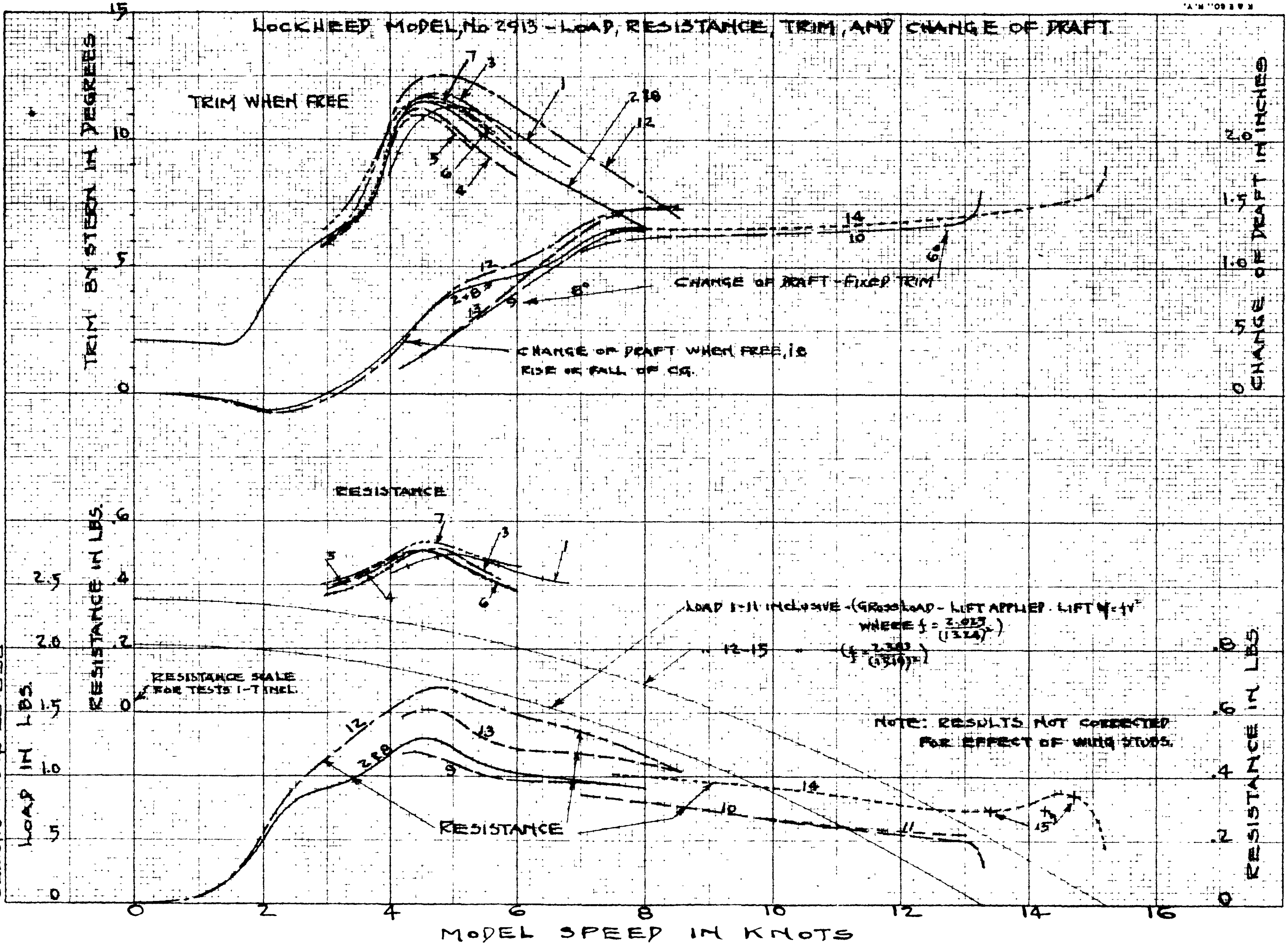
ABOVE TESTS TO DETERMINE POSITION OF SIDE FLOATS - SUBSEQUENT TESTS MADE WITH FLOATS AS IN TESTS 1 & 2.

8 - FREE TO TRIM - SAME AS TEST 2 *
9 - FIXED TRIM 8° BY THE STERN *
10 - " " 6° "
11 - " " 4° "

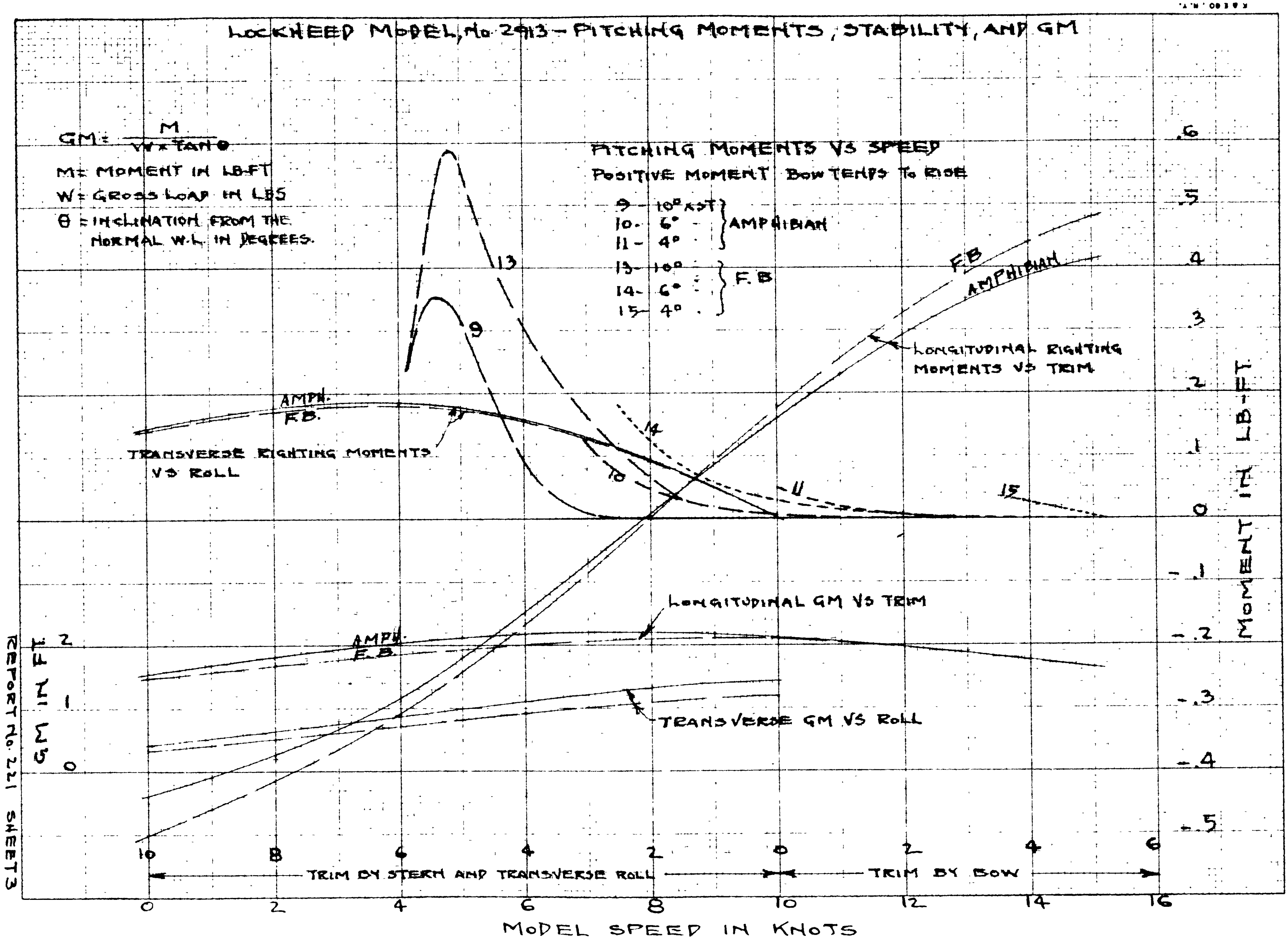
FLYING BOAT

12 - FREE TO TRIM
13 - FIXED TRIM 8° BY THE STERN
14 - " " 6° "
15 - " " 4° "

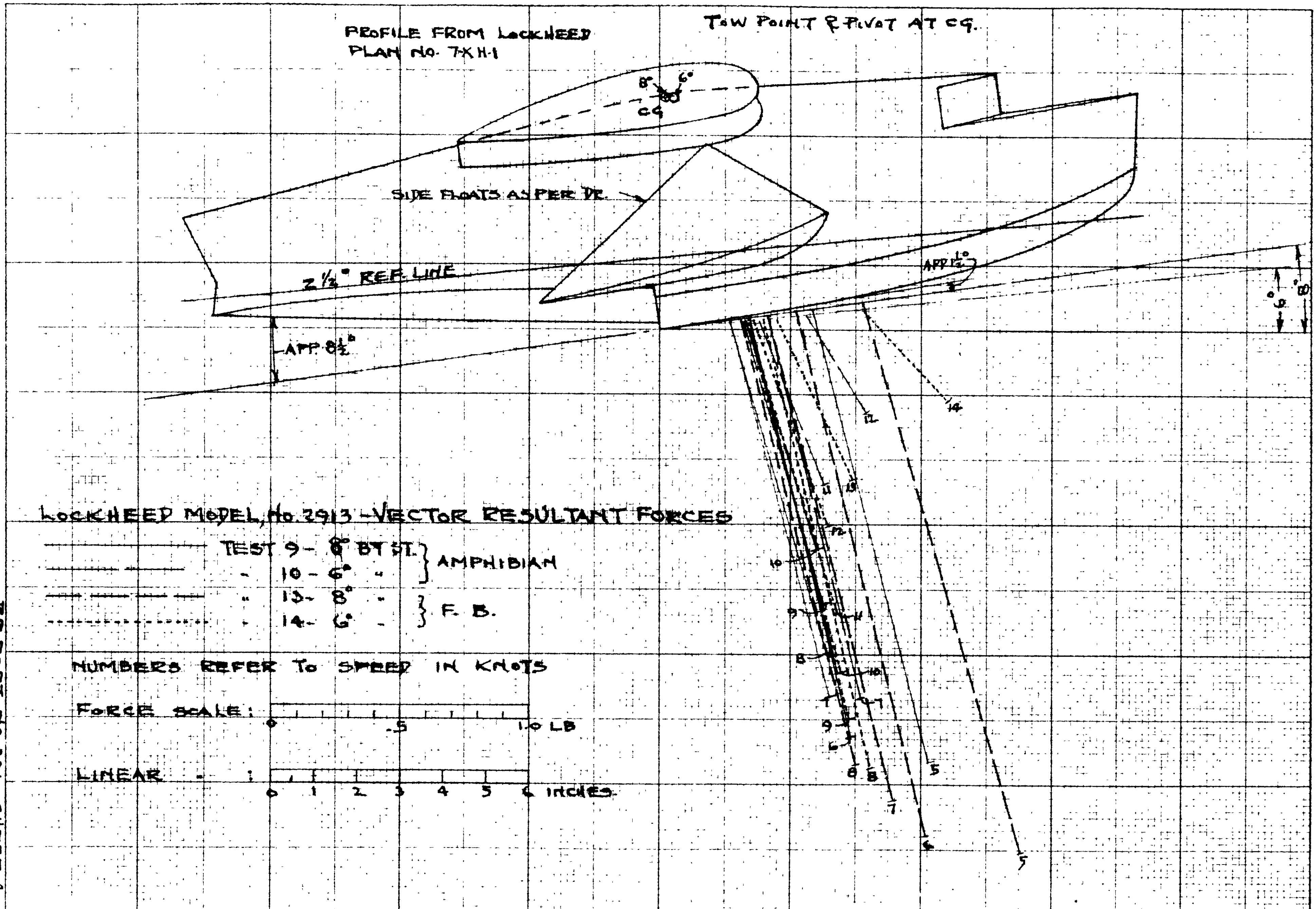
* TRIM POINTER 2½° XST WITH MODEL TRIMMED TO W.L. ON MODEL. MODEL TRIMMED 2.1° XST. AS AMPHIBIAN FOR CG. GIVEN, AND 2.0° AS FLYING BOAT INSTEAD OF 2½° AS PER DRAWING.

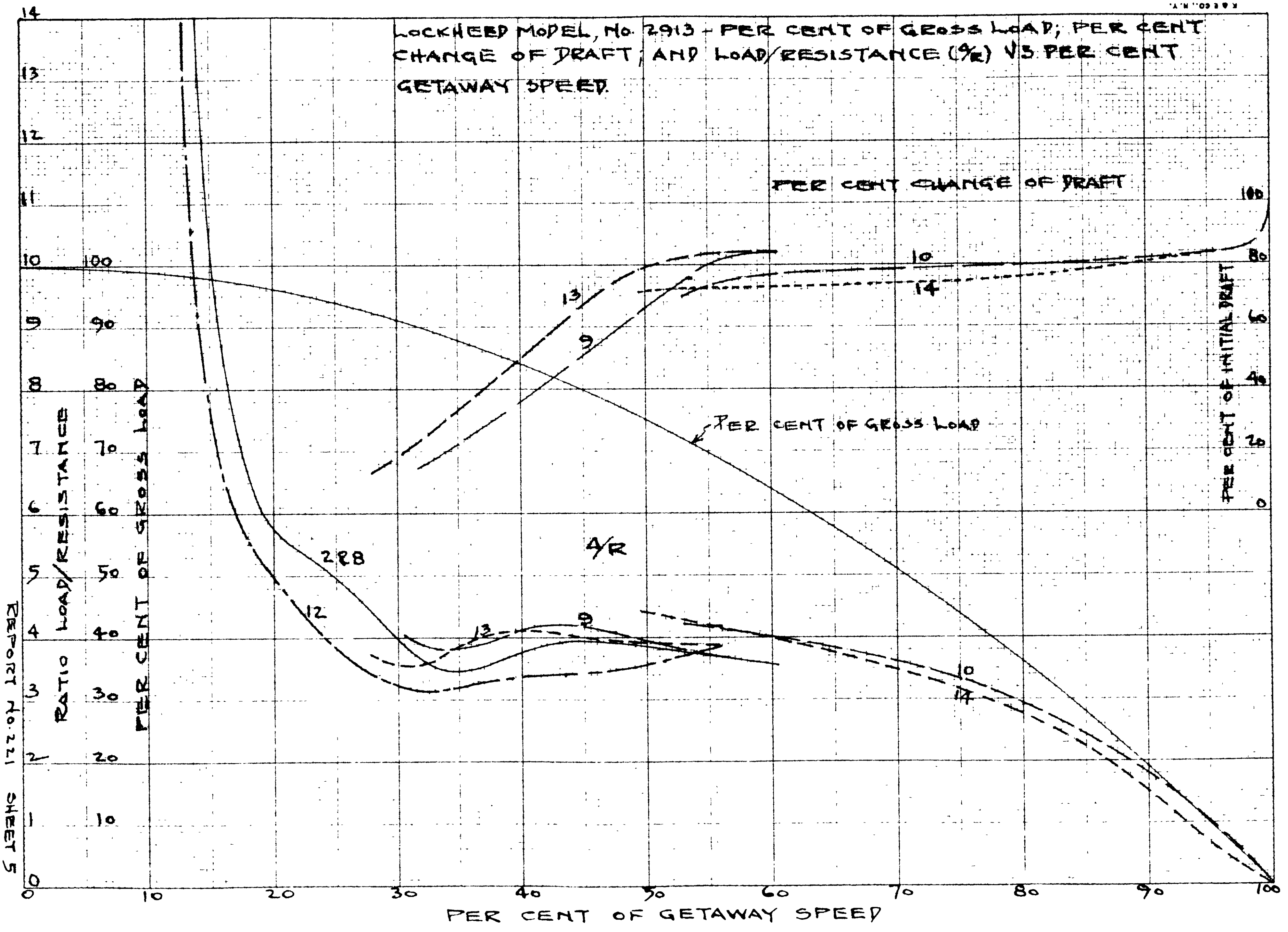


REPORT No. 2?1 SHEET 2


LOCKHEED MODEL No. 2913 – PITCHING MOMENTS, STABILITY, AND GM
GM = M / (W × TAN θ)
M = MOMENT IN LB-FT
W = GROSS LOAD IN LBS
θ = INCLINATION FROM THE NORMAL W.L. IN DEGREES.
PITCHING MOMENTS VS SPEED
POSITIVE MOMENT BOW TENDS TO RISE
9 – 10° AST
10 – 6°
11 – 4°
AMPHIBIAN
13 – 10°
14 – 6°
15 – 4°
F.B
LONGITUDINAL RIGHTING MOMENTS VS TRIM
TRANSVERSE RIGHTING MOMENTS VS ROLL
LONGITUDINAL GM VS TRIM
TRANSVERSE GM VS ROLL
AMPH.
F.B.
AMPHIBIAN
TRIM BY STERN AND TRANSVERSE ROLL
TRIM BY BOW
MODEL SPEED IN KNOTS
MOMENT IN LB-FT
GM IN FT
REPORT No. 221 SHEET 3

REPORT No. 221 SHEET 4





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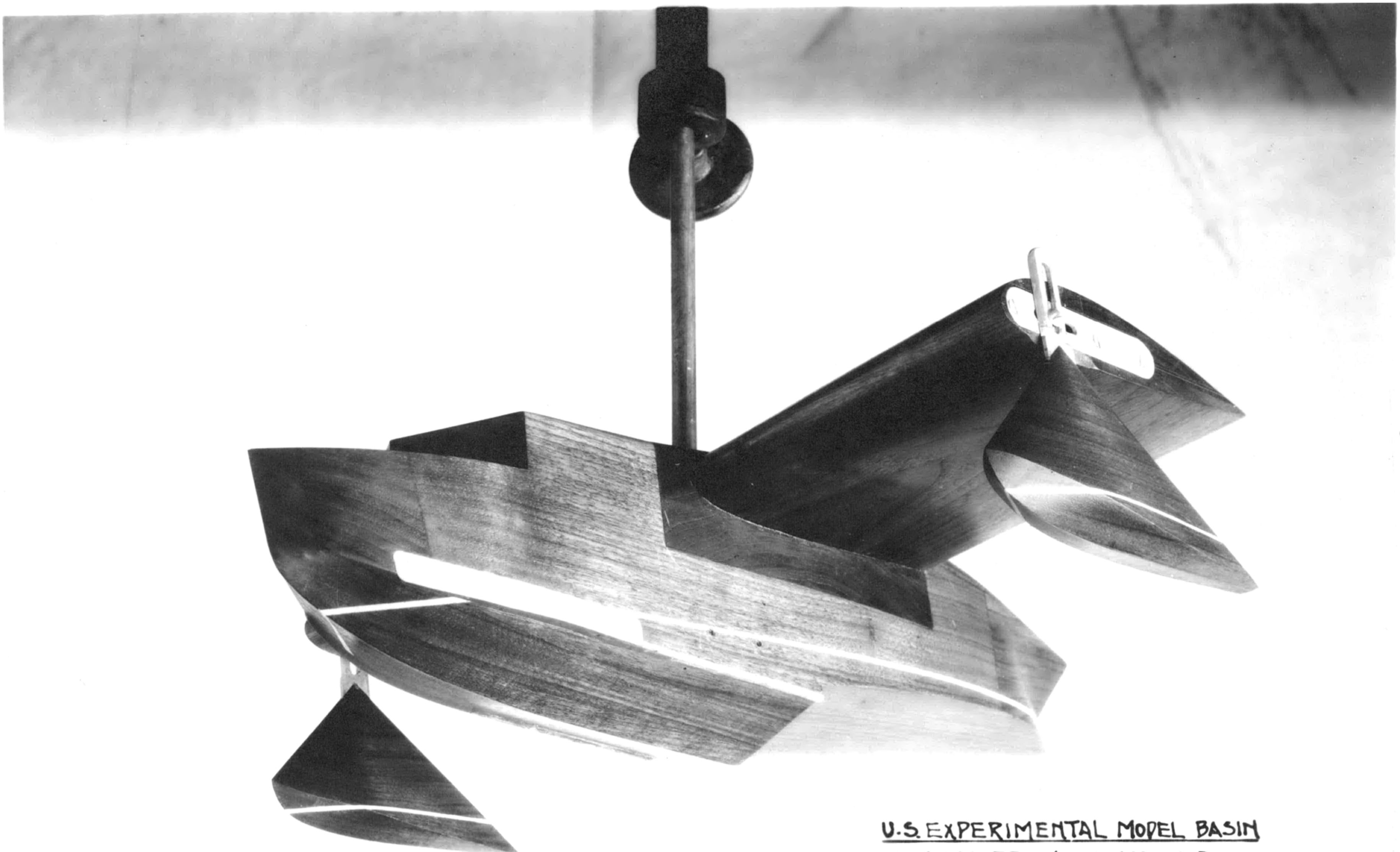

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