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RESEARCH MEMORANDUM

U. S. Air Force

COMPARISON OF SHOCK-ABSORBER INSTALLATIONS ON THE PANTO-BASE CHASE C-123 AIRPLANE IN ROUGH-WATER LANDINGS

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COMPARISON OF SHOCK-ABSORBER INSTALLATIONS ON THE PANTO-BASE CHASE C-123 AIRPLANE IN ROUGH-WATER LANDINGS

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SUMMARY

An investigation of a 1/14-scale dynamically similar model of the panto-base version of the Chase C-123 airplane was conducted in one wave condition to determine the effects on the water landing accelerations and the landing behavior of hydro-skis mounted on shock absorbers. Two shock-absorber installations and a rigid-strut installation were investigated. One shock-absorber configuration employed a trimming-ski mechanism which permitted the hydro-skis to trim from the original angle of incidence of 0° to a positive or negative angle depending on the load condition and which allowed some translation. The other shock-absorber configuration employed a translating-ski mechanism that kept the hydro-skis near the original angle of incidence of 0°.

The behavior of the model was about the same with each of the shock-absorber installations; however, the translating-ski mechanism resulted in less tendency to skip and less trim change of the model during a landing run and greater deflection of the main-gear oleo strut. The maximum vertical accelerations were about 9 percent less and the average maximum vertical accelerations about 17 percent less with the trimming-ski mechanism and both maximum and average maximum vertical accelerations were about 33 percent less with the translating-ski mechanism than with the rigid-strut installation.

INTRODUCTION

A tank investigation of the hydrodynamic characteristics of a model of a proposed panto-base version of the Chase C-123 airplane is reported in reference 1. An additional investigation to determine some landing characteristics of two shock-absorber arrangements and a rigid-strut configuration in one wave condition has been requested by the U. S. Air Force and the results of these additional tests are reported herein.

The load-alleviating qualities of two shock-absorber installations and a rigid-strut installation were investigated by making landings perpendicular to oncoming waves and recording the vertical-impact accelerations. The shock-absorber deflections and the trim and speed of the model were also recorded during the landings in order to compare the behavior obtained with the three configurations.

DESCRIPTION OF MODEL

The general arrangement of the panto-base Chase C-123 airplane is shown in figure 1. In the fully extended position the hydro-skis are at an angle of incidence of 0° and their trailing edges are 2.33 feet (full scale) below the hull. The 1/14-scale dynamic model of the airplane shown in figure 2 is the same model described in reference 1 except for the shock-absorber mechanisms and the hydro-ski attachment linkages.

The shock-absorber mechanisms used in the present investigation were designed and built by Chase Aircraft Co., Inc., designers of the airplane. One shock-absorber configuration employed a trimming-ski mechanism which permitted the hydro-skis to trim from 0° angle of incidence to a positive or negative angle depending on the load condition and which allowed some translation (figs. 3 and 4). The other shock-absorber configuration employed a translating-ski mechanism that kept the hydro-skis near the original 0° angle of incidence (figs. 5 and 6).

The trimming-ski mechanism shown in figure 3 had the trailing edges of the hydro-skis in the extended position 32.9 feet (full scale) aft from the nose. The front strut contains a coil-spring shock absorber whereas the rear strut is a telescoping link and both are free to pivot about both ends. The middle drag link is fixed in length and pivoted about both ends. Thus, the hydro-ski may move from the fully extended position shown by the solid lines in figure 4 to the fully compressed position shown by the dashed lines.

The translating-ski mechanism shown in figure 5 had the trailing edges of the hydro-skis in the extended position 32.4 feet (full scale) aft from the nose. Both the front and rear drag links are fixed in length and pivoted about both ends. Thus, the hydro-skis may move from the fully extended position shown by the solid lines in figure 6 to the fully compressed position shown by the dashed lines. Tests with the rigid struts were made with the same hydro-ski location as was used for the extended position of the translating-ski mechanism.

The shock-absorber mechanisms were designed so that the main landing-gear oleo struts and tires served as the principal shock-absorbing elements in both the trimming-ski and translating-ski installations. The main landing-gear oleo struts were simulated on the model by the use of coil springs and liquid-filled cylinders with orifice plates. The shock absorption of the main landing-gear tires was simulated on the model by the use of coil springs and the tires shown in the model photographs of figures 3 and 5 served only as a fairing simulating the shape of the full-scale tires.

A comparison of total deflection (oleo strut and tire) with gross load obtained in dynamic-load drop tests for the full-scale and model installations is shown in figure 7. The maximum total deflection of each shock absorber (oleo strut and tire) is 18.55 inches (full scale) and the time required for total deflection is approximately 0.2 second (full scale), with a dynamic load of about 58,000 pounds.

APPARATUS AND PROCEDURE

All landings were made from the Langley tank no. 2 towing carriage with the fore-and-aft gear shown in figure 8. The model was towed from the normal center of gravity (27-percent mean aerodynamic chord), was free to trim and rise, and had about 4 feet of fore-and-aft freedom. Because of the added weight of the test equipment, the model was about 15 percent overweight. The actual test gross weight simulated 57,600 pounds, full scale. The model was balanced about the center of gravity, the flaps were down 45°, and landings were made at a trim of 8°. The trim was measured with respect to the fuselage keel line, and the smooth-water surface. A horizontal landing speed of 98 knots (full scale) and a vertical speed of about 11 fps were simulated in the tests. During the landings an electrically actuated trim brake, attached to the towing staff, fixed the trim of the model in the air during the initial approach. The trim brake was automatically released when a contact at the trailing edge of the ski touched the water.

All landings were made into oncoming waves 3 feet high and 150 feet long (full scale) generated by the wavemaker in the Langley tank no. 2. This is the same wave condition employed in the tests of reference 1.

The trim was recorded during each test by an electrical slide wire with a recording galvanometer. A strain-gage type of accelerometer mounted on the towing staff of the model measured the vertical accelerations at the center of gravity. The natural frequencies of the accelerometer and recording galvanometer were 265 cps and 150 cps, respectively, and both instruments were damped to about 65 percent of critical damping. Faired values of acceleration are presented in table I and figure 9; these data are for comparative purposes only.

RESULTS AND DISCUSSION

General.- Even though all landings were made perpendicular to the same size waves and at the same landing attitude and speed, the model contacted different portions of the waves on various landings. This difference in contact resulted in the variation in comparative values shown in table I. In general, the trimming-ski and the rigid-strut installation resulted in similar behavior characterized by a slight tendency to skip from the waves. The translating-ski installation showed an improvement in behavior in that the tendency to skip was lessened. A comparison of the values given in table I shows that the translating ski encountered generally lower accelerations.

Rigid struts.- Typical accelerations encountered during a landing run with the rigid-strut configuration are shown in figure 9(a). The maximum acceleration occurred most frequently on the first or second impact and occasionally as late as the eighth impact (see table I). During this landing test, the trim of the model varied from 8° to 16° (fig. 9(a)). The amplitude and frequency of the trim change varied, depending on the portions of the waves contacted by the model.

Trimming-ski mechanism.- Landings with the trimming-ski mechanism resulted in maximum vertical acceleration about 9 percent less and average maximum vertical acceleration about 17 percent less than that for the rigid-strut configuration. Figure 9(b) shows the accelerations encountered during a typical landing test. The maximum acceleration occurred most frequently on the first landing impact although maximum values were recorded as late as the tenth impact (table I). The change in trim sometimes varied as much as 16° during a landing run (fig. 9(b)). The average maximum deflection of the shock absorbers was about 50 percent of the total stroke.

Translating-ski mechanism.- Landings with the translating-ski mechanism resulted in maximum and average maximum vertical accelerations about 33 percent less than those for the rigid-strut configuration. Figure 9(c) shows the accelerations encountered during a typical landing test. The maximum accelerations occurred most frequently on the first landing impact although subsequent maximums were recorded as late as the eleventh impact (table I). During the test the trim of the model varied from 7° to 12° (fig. 9(c)). In general, the trim change encountered with this configuration was the smallest of the three configurations. The average maximum deflection of the shock absorbers was about 65 percent of the total stroke.

CONCLUDING REMARKS

The behavior of the model was about the same with each of the shock-absorber installations; however, the translating-ski mechanism resulted in less tendency to skip, less trim change of the model during a landing test, and greater deflection of the main-gear oleo strut. The maximum vertical accelerations were about 9 percent less and the average maximum vertical accelerations were about 17 percent less with the trimming-ski mechanism and both maximum and average maximum vertical accelerations were about 33 percent less with the translating-ski mechanism than with the rigid-strut installation.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., July 14, 1954.

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JKS

REFERENCE

1. Thompson, William C., and Fisher, Lloyd J.: Investigation of the Hydrodynamic Characteristics of the Panto-Base Chase C-123 Airplane. NACA RM SL54A28, 1954.

TABLE I.- MAXIMUM VERTICAL ACCELERATIONS FROM LANDING TESTS OF A 1/14-SCALE DYNAMIC MODEL OF THE PANTO-BASE CHASE C-123 AIRPLANE

[Waves, 3 ft × 150 ft; forward speed, 98 knots; sinking speed, 11 ft/sec; landing trim, 8°; flap deflection, 45°; weight, 57,600 lb; static accelerometer reading, 1 g; g, acceleration due to gravity, 32.2 ft/sec; all values are full scale]

Rigid struts		Trimming-ski mechanism		Translating-ski mechanism	
Maximum vertical acceleration, g	Landing impact number for maximum acceleration	Maximum vertical acceleration, g	Landing impact number for maximum acceleration	Maximum vertical acceleration, g	Landing impact number for maximum acceleration
5.7	2	5.2	1	4.5	1
7.2	3	4.3	3	4.4	5
4.8	3	5.1	1	3.2	7,8,9,10
3.2	1	4.0	6	3.6	2
4.5	1	7.7	1	4.2	2
4.7	7	4.5	5	4.3	2
6.1	2	3.6	5	3.6	2,6
6.0	1	7.2	1	3.9	1
7.4	2	6.2	1	3.6	1
7.2	2	5.6	1	4.0	10
5.6	1	5.8	5	4.5	1
8.4	2	3.7	1	3.9	1
7.0	2	4.8	3	4.4	1,6,8
6.9	2	6.0	1	4.8	1
5.8	7	4.3	7	4.4	1,11
5.6	8	3.2	4	4.0	6
6.3	1	3.9	1,7,8	4.4	1,5
5.8	6	5.2	7	4.5	1
4.7	2	6.1	1	4.8	7
7.1	2	4.5	10	3.6	7,9
6.4	1	5.0	6	4.1	8
7.5	1	3.5	6,8	3.8	3,5
6.4	2			4.5	6
5.1	6			5.6	1
6.6	1			3.3	1,9
6.1	1			3.6	3,6,7,8
6.9	2				
5.5	2				
7.8	2				

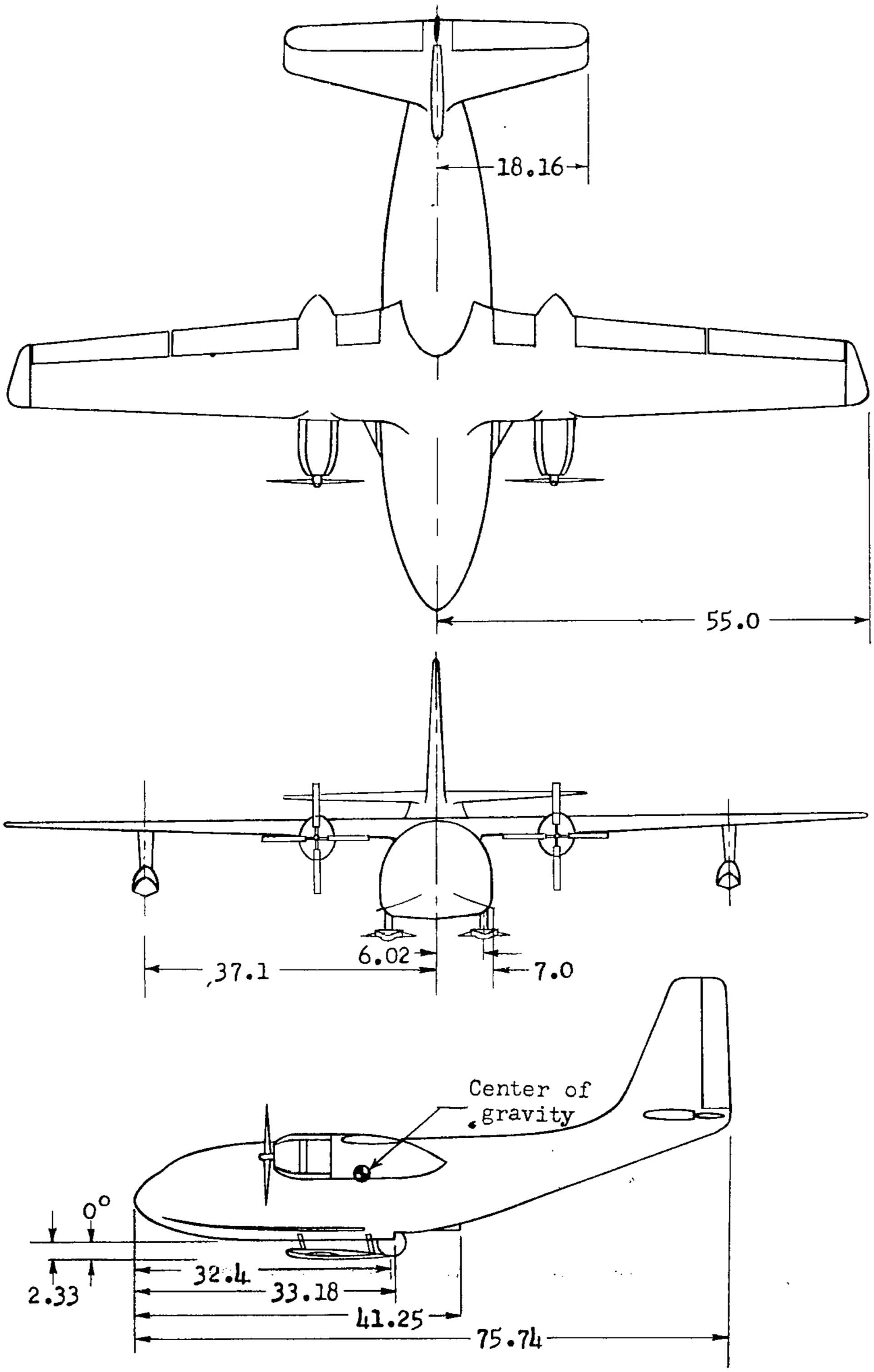
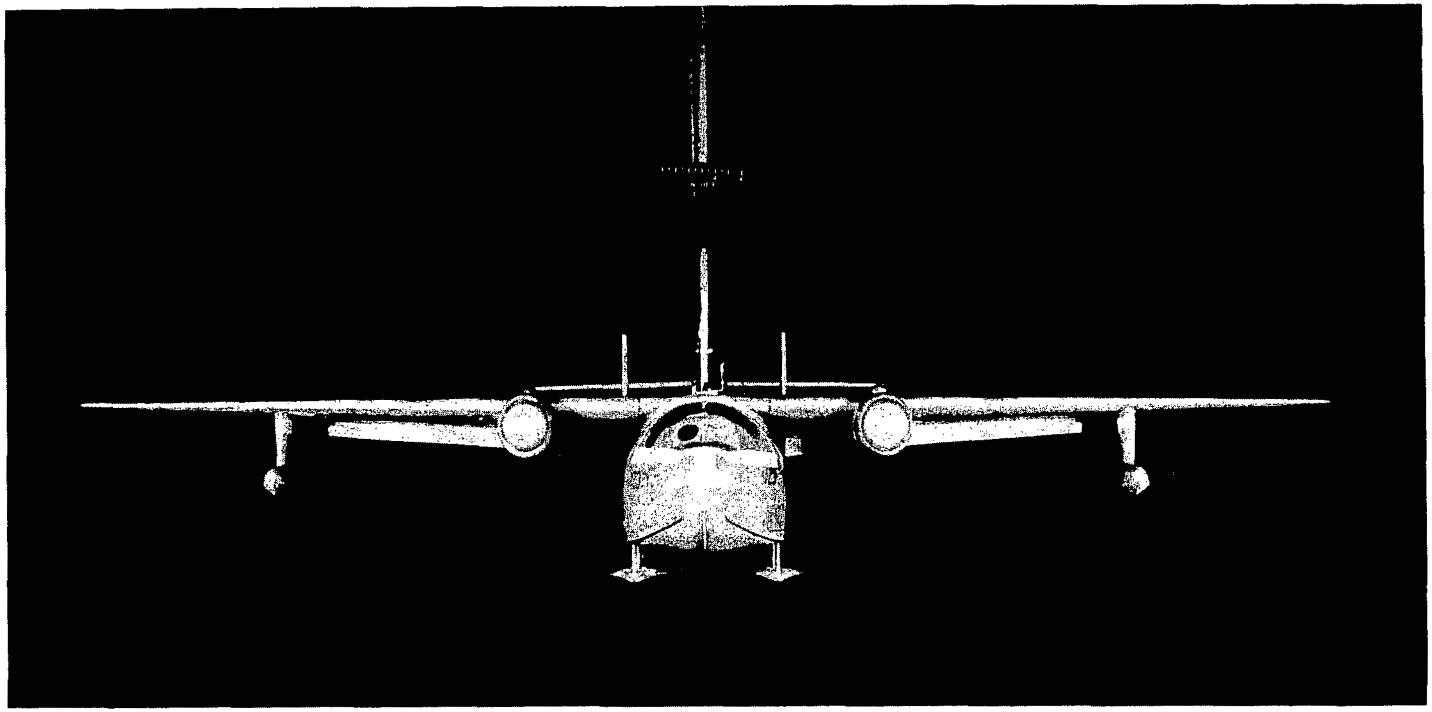


Figure 1.- Three-view drawing of the panto-base Chase C-123 airplane. All dimensions are in feet, full scale.



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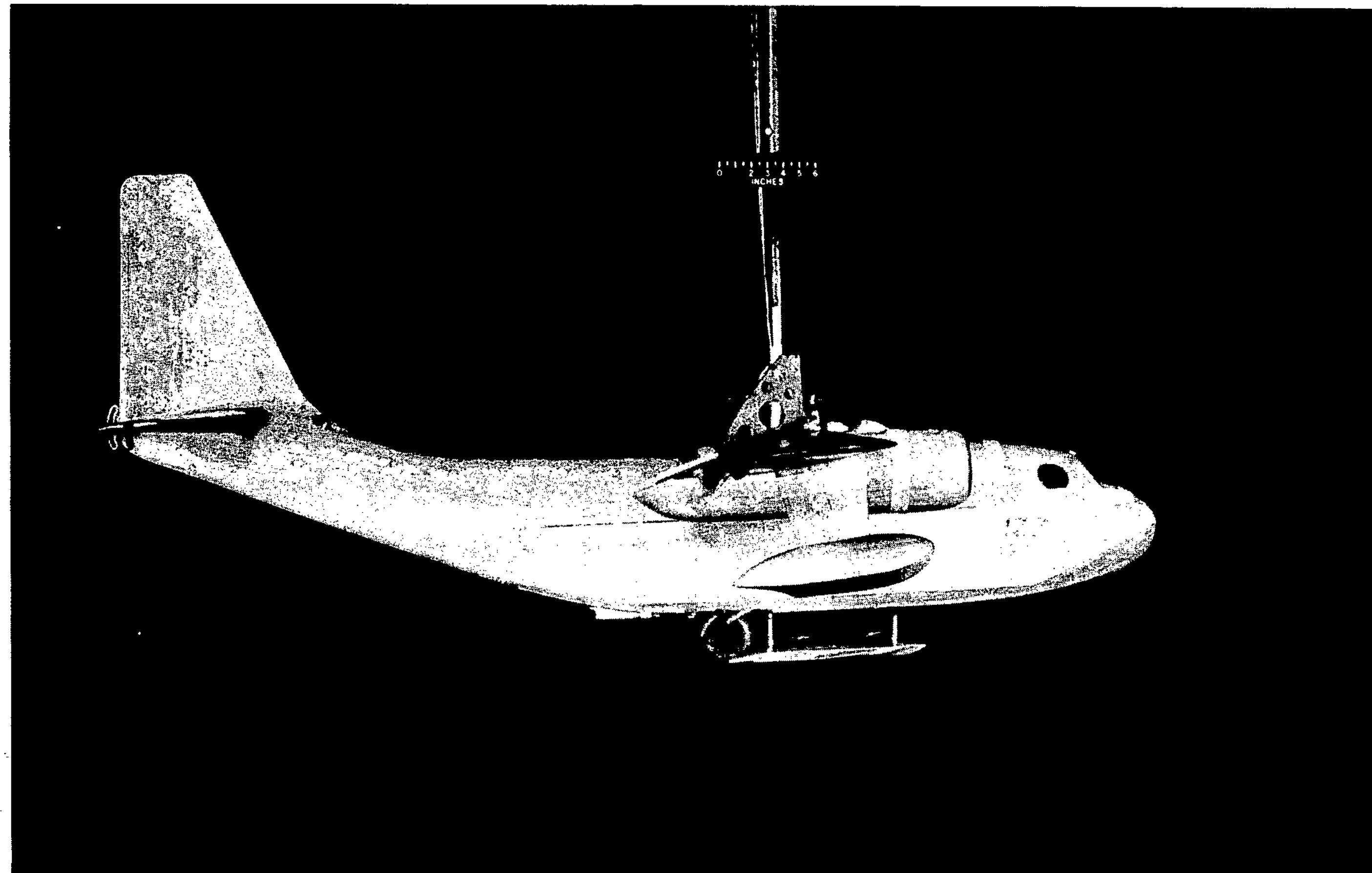
(a) Front view.

Figure 2.- The panto-base Chase C-123 model.



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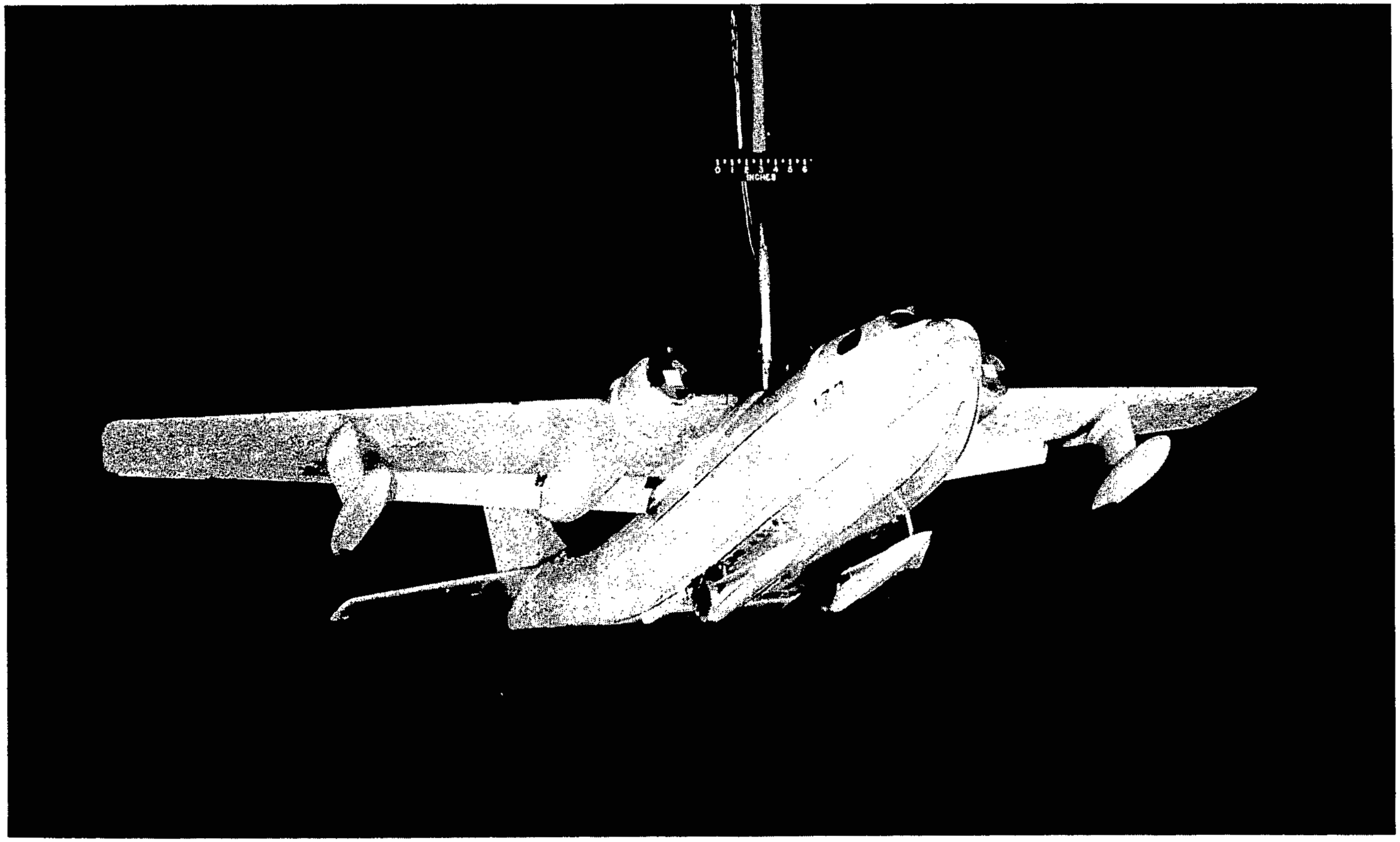
(b) Side view.

Figure 2.- Continued.



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(c) Three-quarter bottom view.

Figure 2.- Concluded.

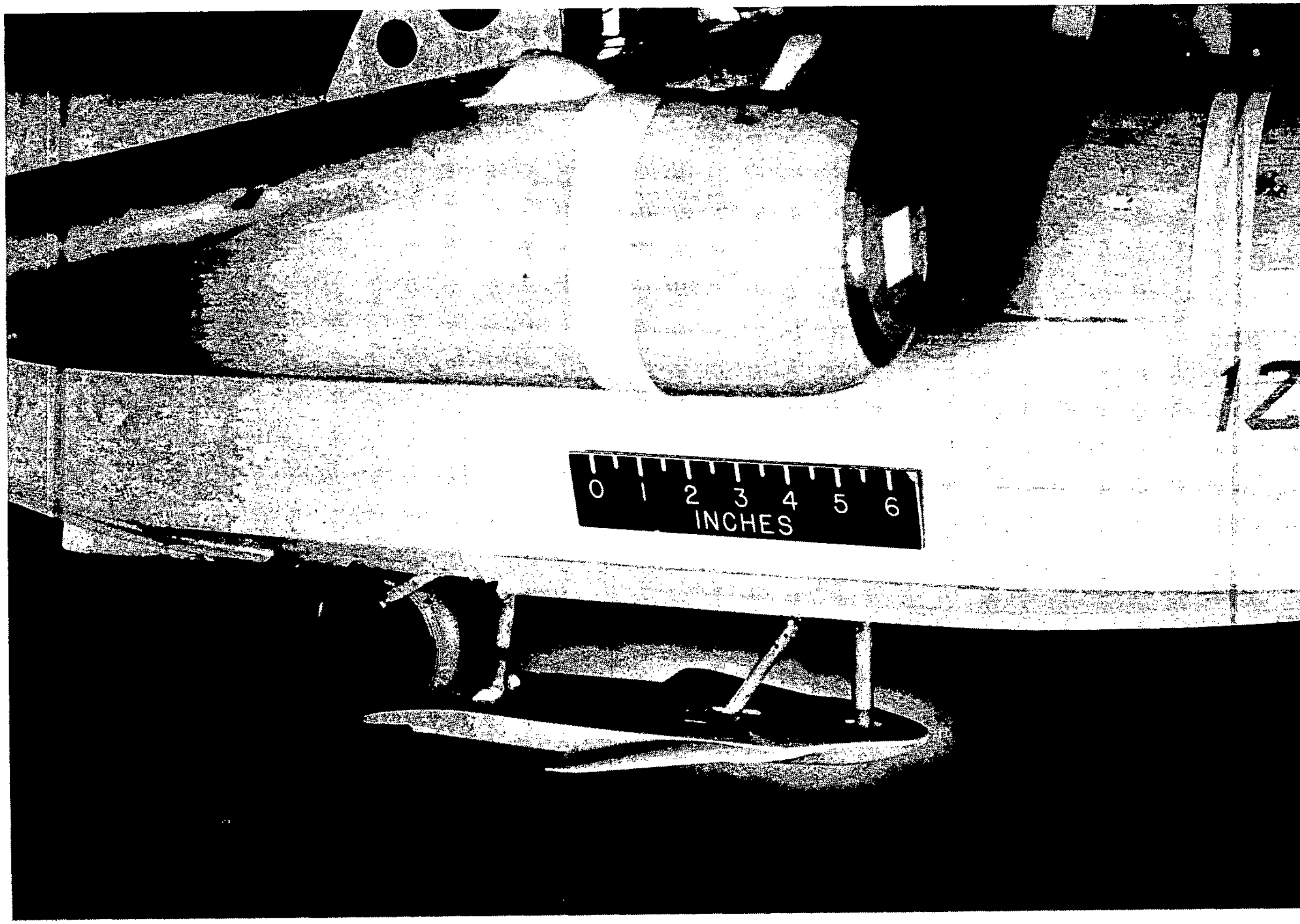

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Figure 3.- Trimming-ski mechanism installed on the panto-base Chase C-123 model.

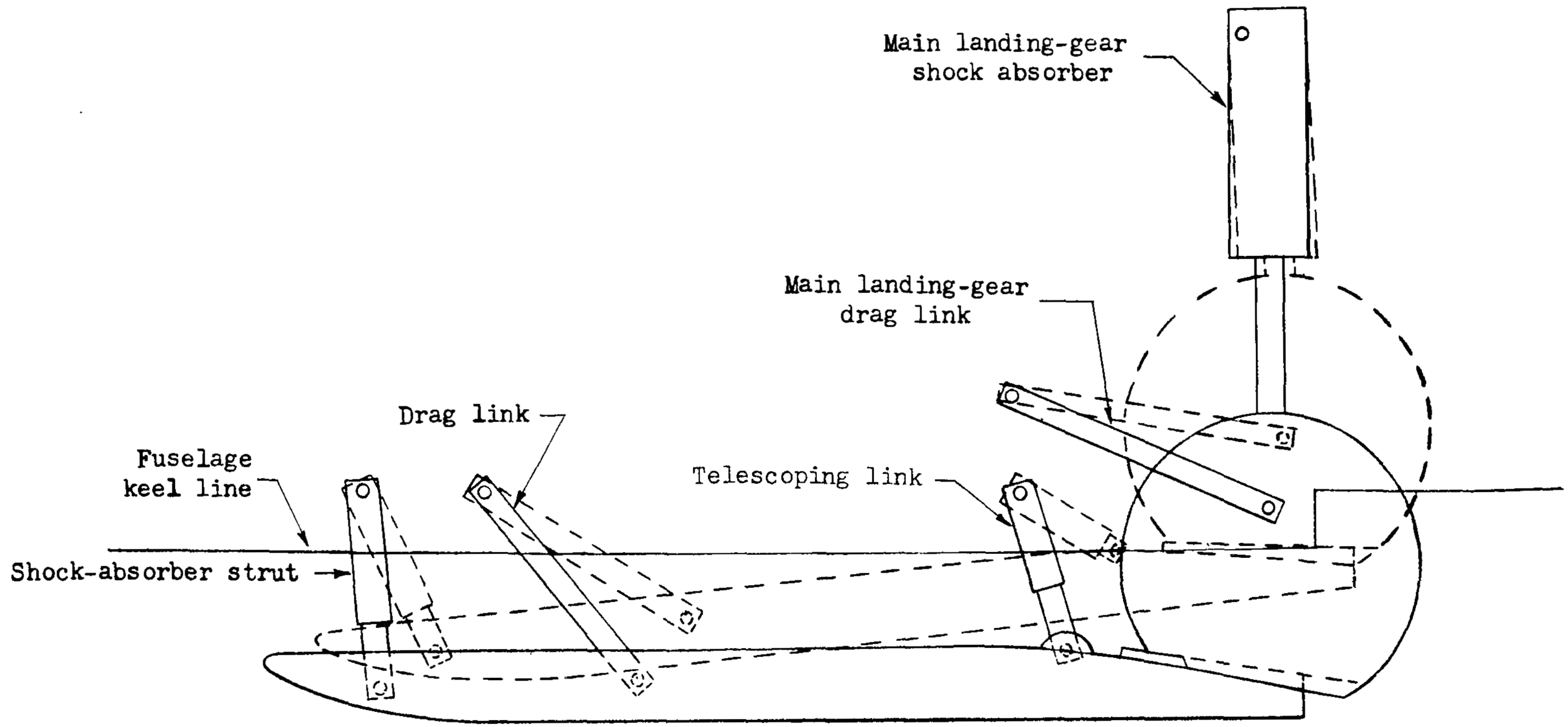

Figure 4.- Strut arrangement for the trimming ski showing the fully extended and fully compressed positions.

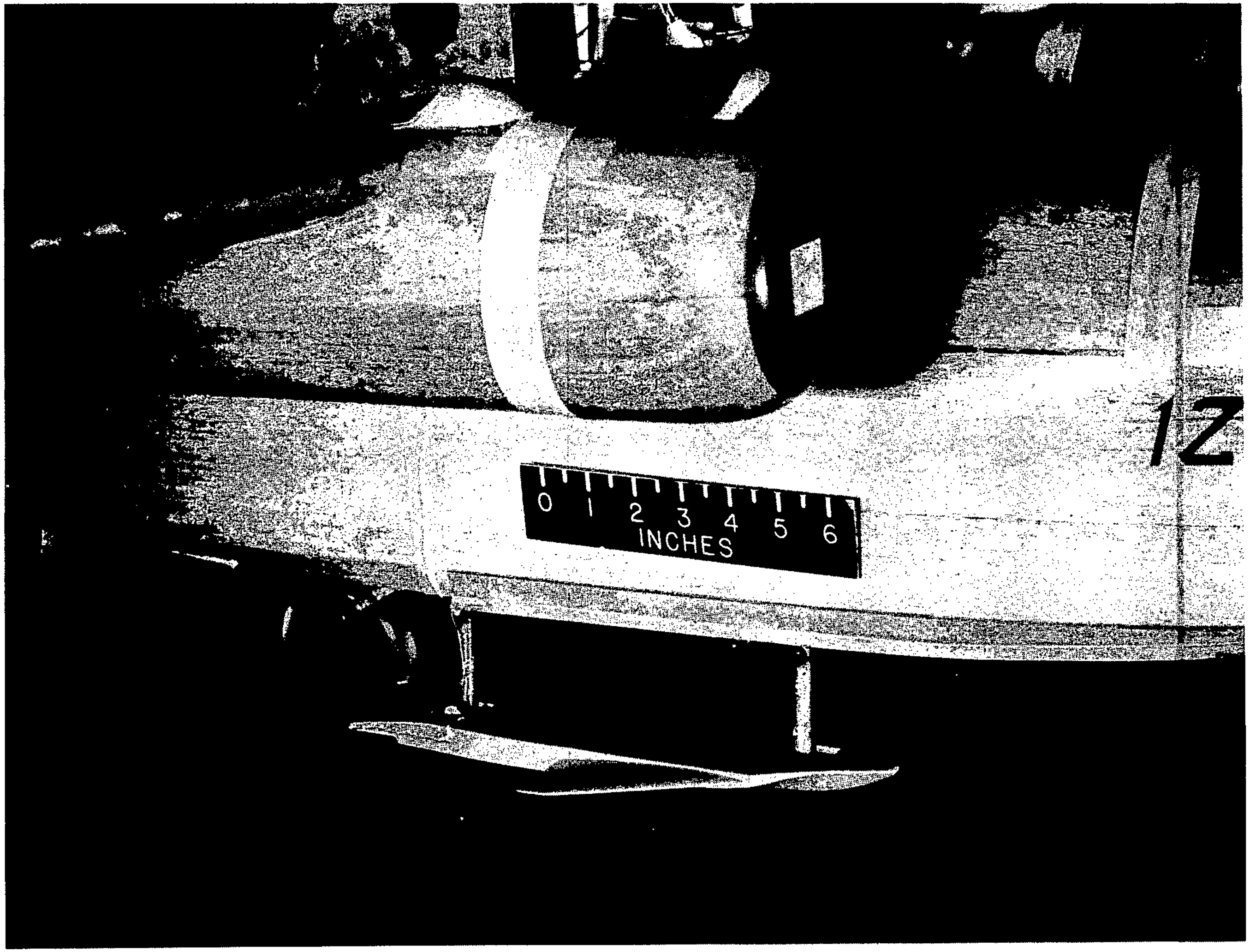

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Figure 5.- Translating-ski mechanism installed on the panto-base Chase C-123 model.

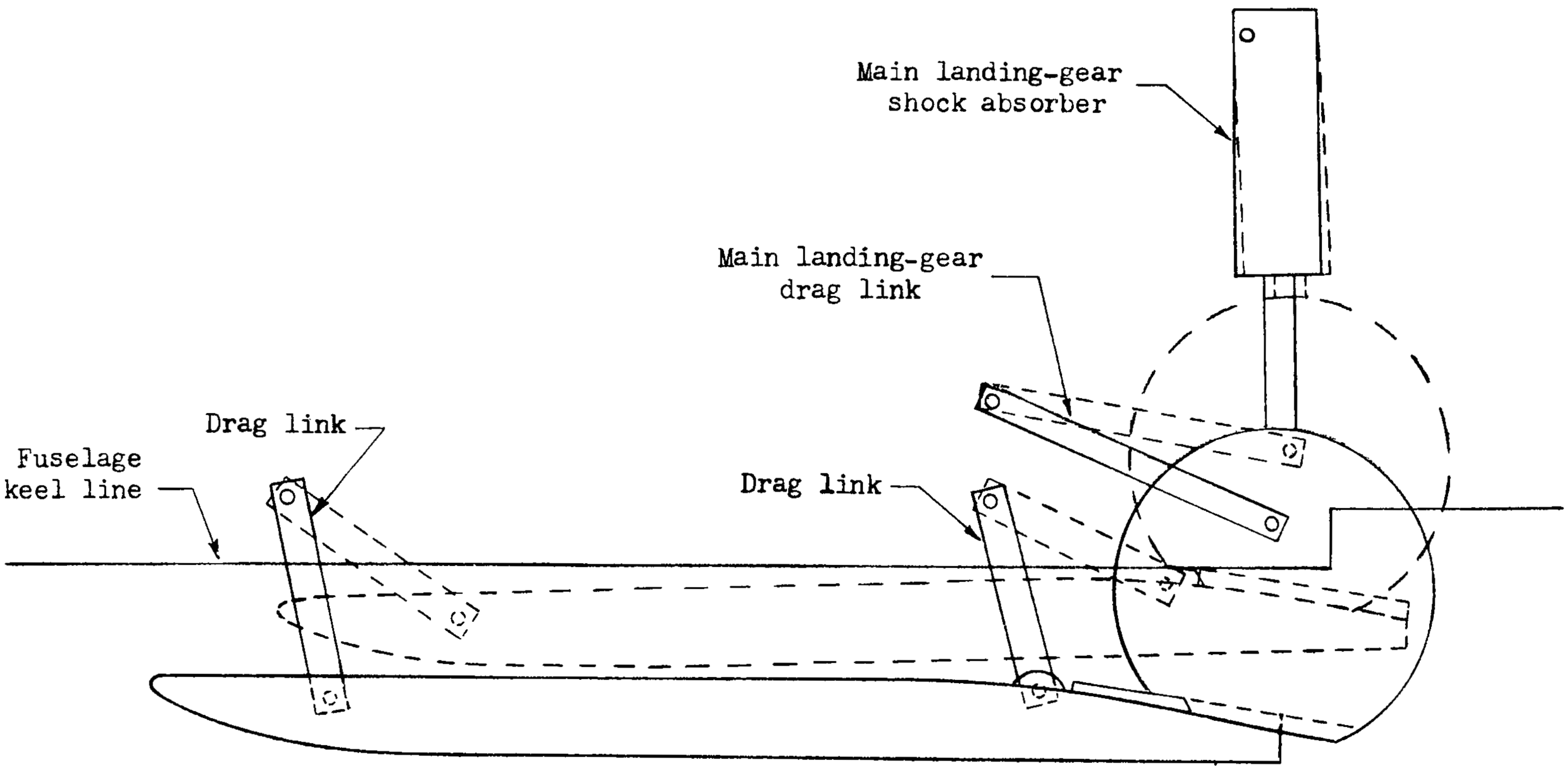

Figure 6.- Strut arrangement for the translating ski showing the fully extended and fully compressed positions.

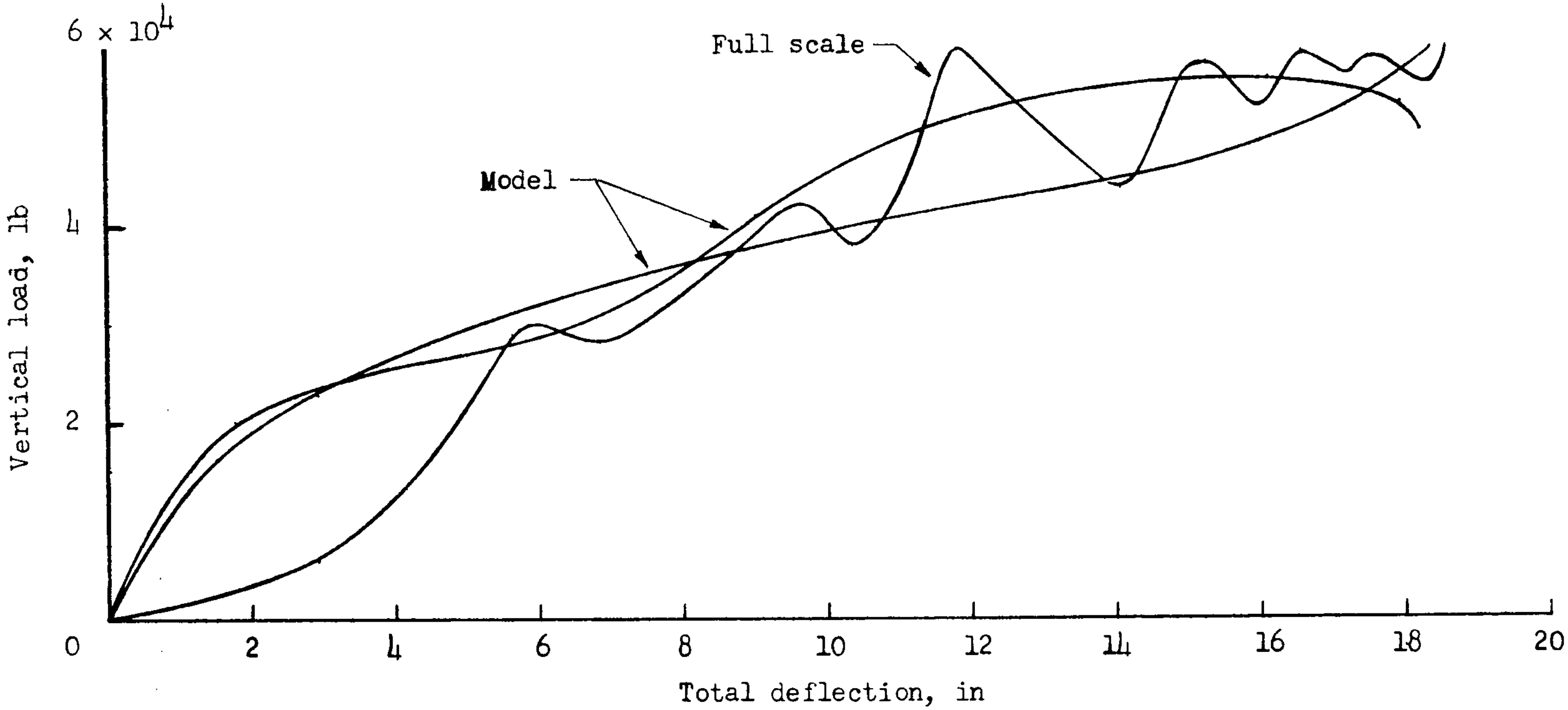

Figure 7.- Dynamic vertical load against total deflection for each of the two model main-gear shock absorbers and one full-scale shock absorber. All values are full scale.

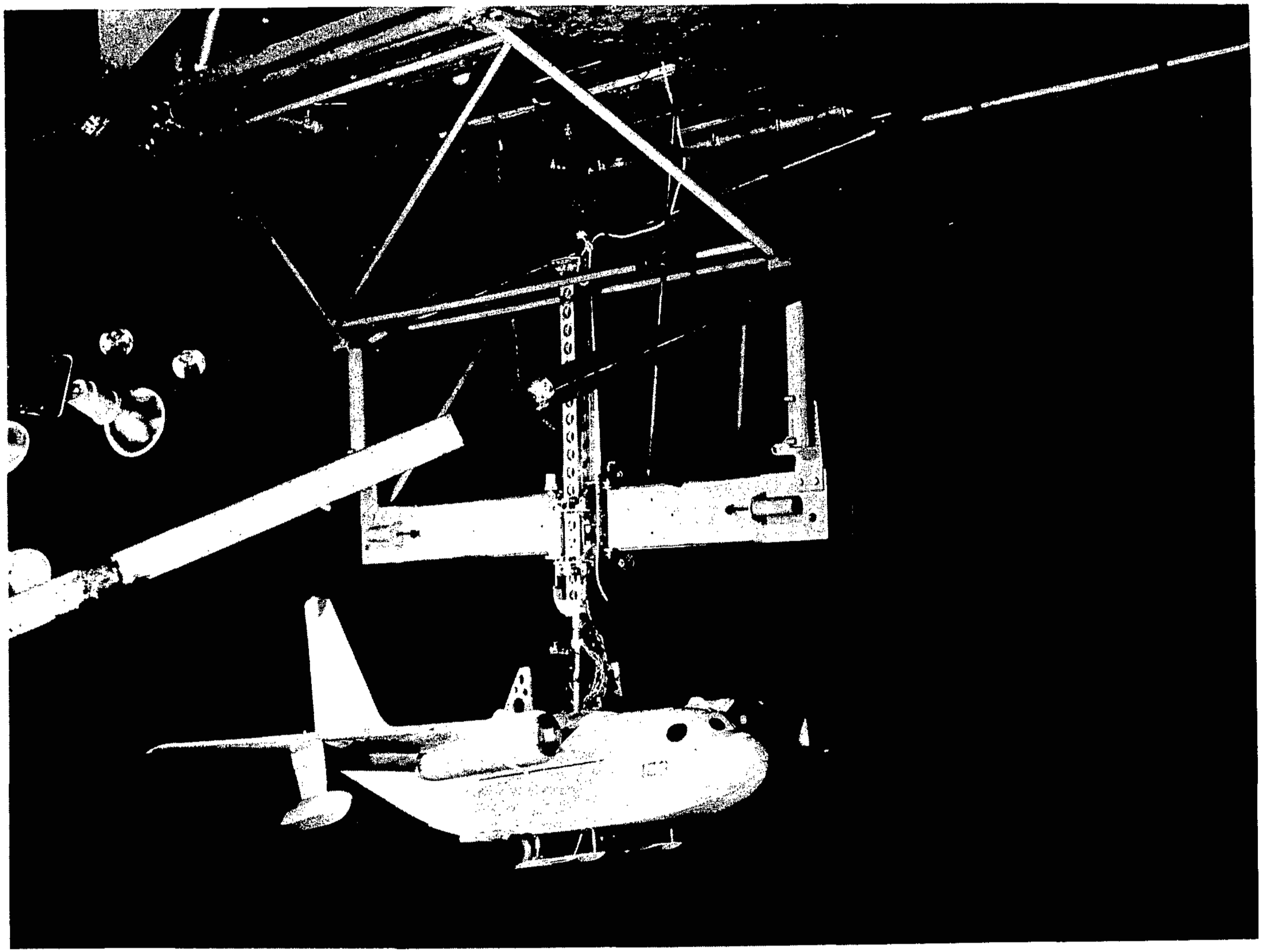

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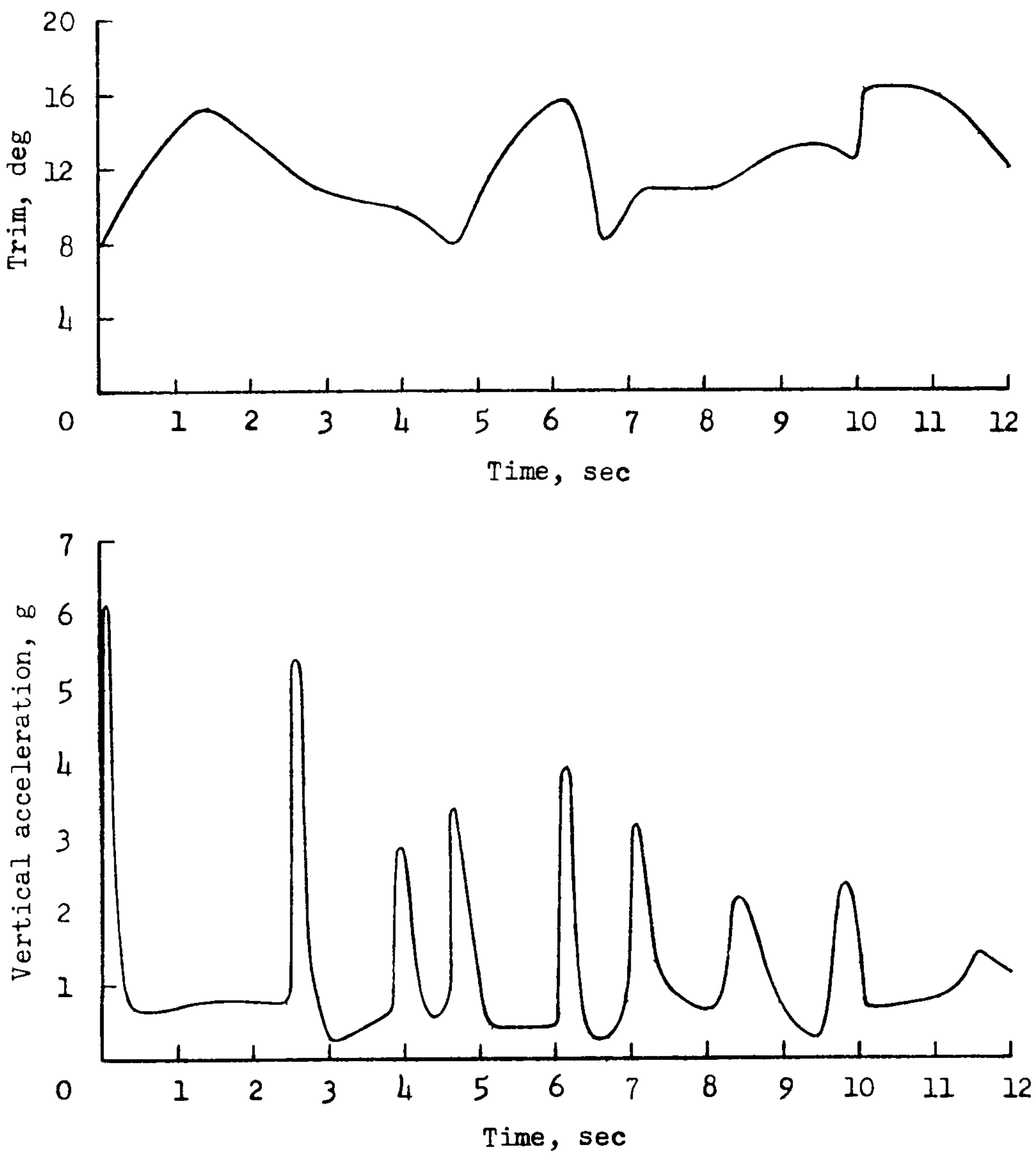
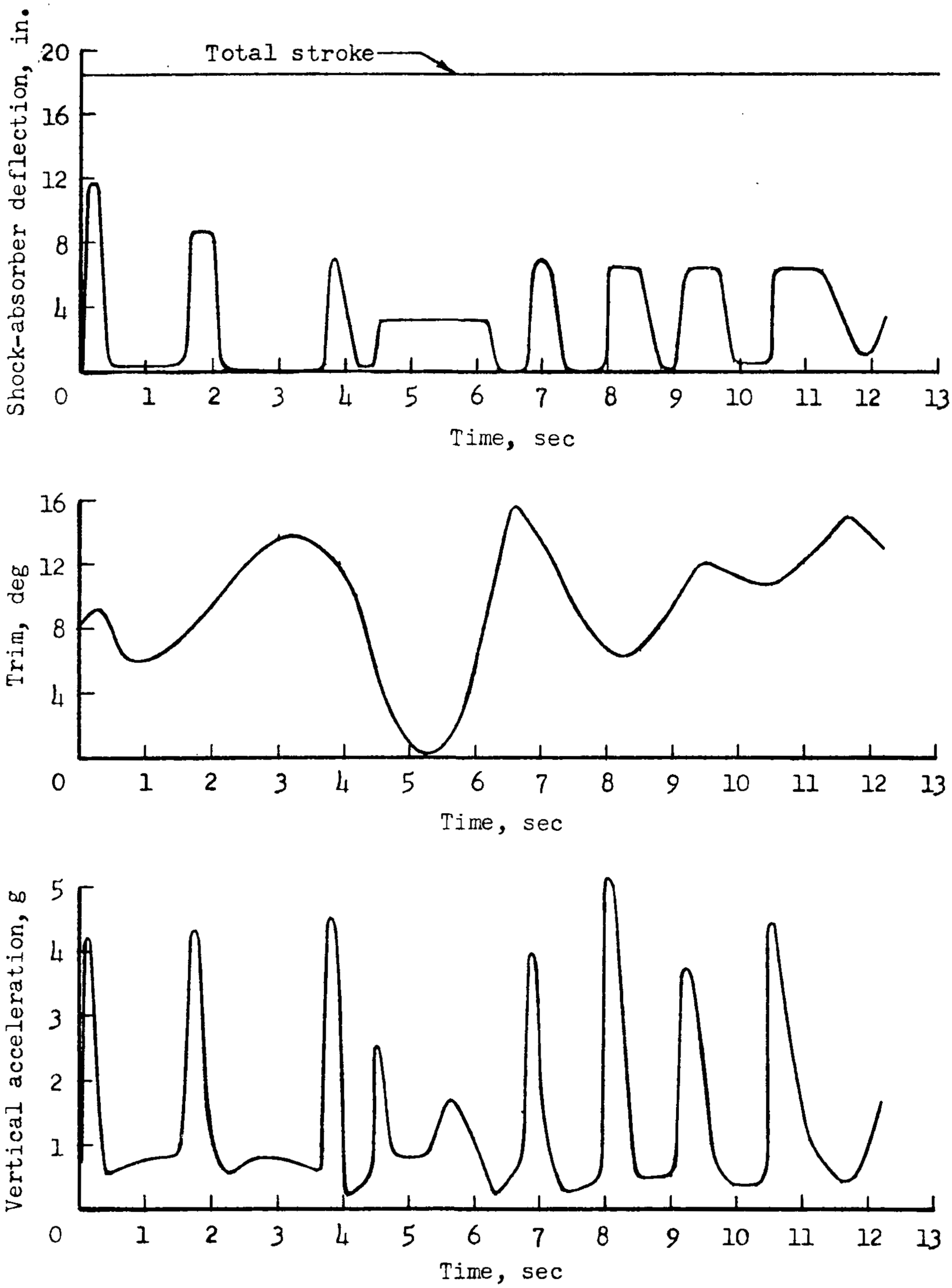
Figure 8.- The panto-base Chase C-123 model on the Langley tank no. 2 fore-and-aft gear.



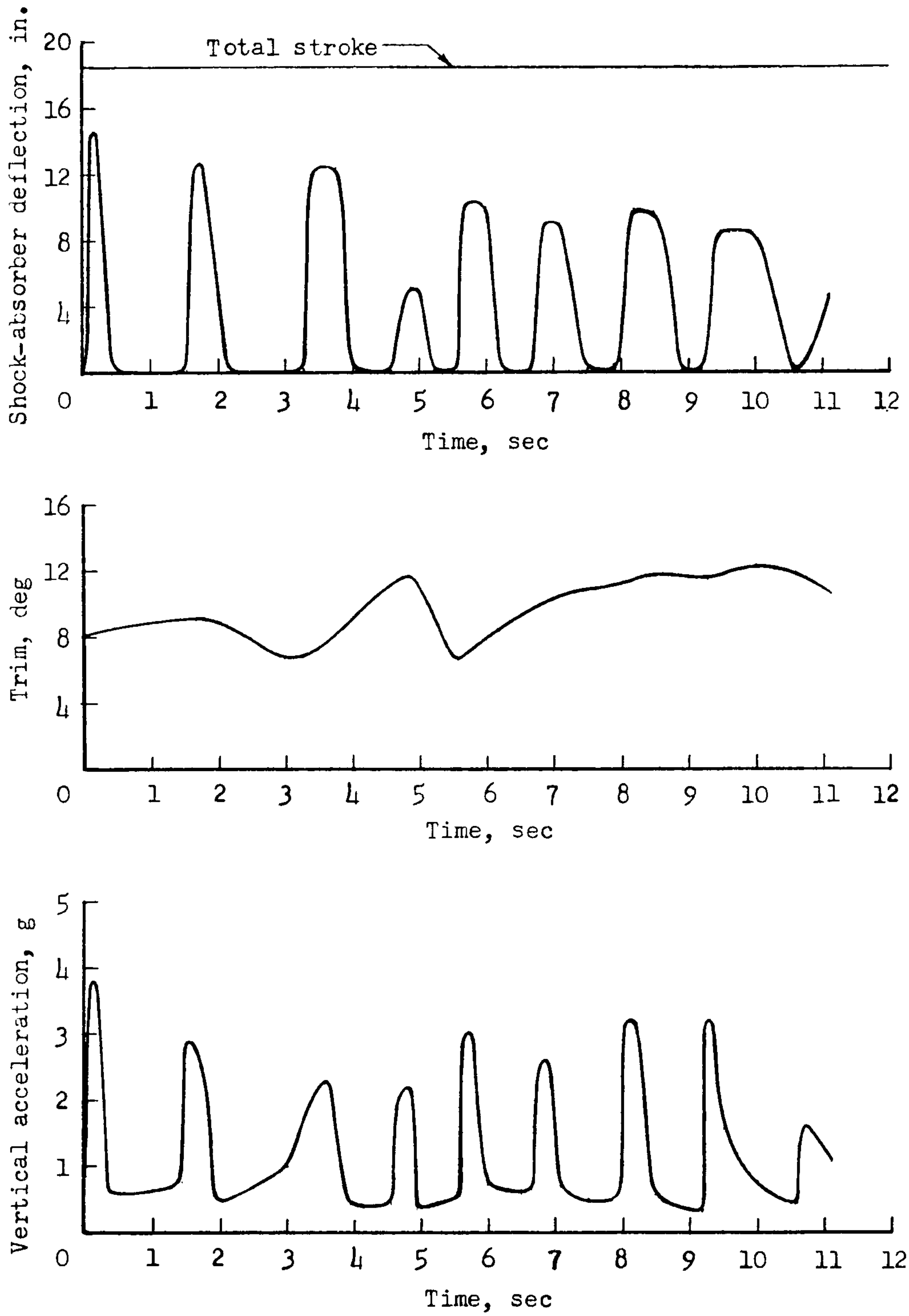
(a) Rigid strut.

Figure 9.- Curves for a typical landing run in waves 3 feet by 150 feet of the panto-base Chase C-123 model. All values are full scale.



(b) Trimming-ski mechanism.

Figure 9.- Continued.



(c) Translating-ski mechanism.

Figure 9.- Concluded.

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