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U.S. ARMY

TEST & EVALUATION COMMAND

FINAL REPORT
OF THE ENGINEERING TEST OF THE
STABILITY AND CONTROL CHARACTERISTICS
OF THE
OH-[redacted]H EQUIPPED WITH THE XM-1 ARMAMENT KIT

APRIL 1964

(8)

HEADQUARTERS
U.S. ARMY AVIATION TEST ACTIVITY
EDWARDS AFB, CALIFORNIA

[redacted]

U. S. ARMY AVIATION TEST ACTIVITY

FINAL REPORT OF
ENGINEERING TEST OF THE
STABILITY AND CONTROL CHARACTERISTICS
OF THE
OH-13H EQUIPPED WITH THE XM-1 ARMAMENT KIT

ATA PROJECT NO. 62-30

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ABSTRACT

This report presents the results of a stability and control evaluation of the OH-13H helicopter with gross weight increases up to 2750 pounds and XM-1 armament kit installation. The program was conducted by the U. S. Army Aviation Test Activity, Edwards Air Force Base, California. Authorization for the program was contained in DF TCMAC-EH-13 from Transportation Materiel Command, St. Louis, Missouri, dated 11 May 1962. The primary purpose of this evaluation was the flight certification of the OH-13H equipped with the XM-1 armament kit.

In general over the flight envelope tested, the installation of the XM-1 armament kit and the corresponding increase in gross weight does not adversely affect the handling qualities of the OH-13 helicopter. Control response and control sensitivity are slightly increased with an increase in gross weight.

At higher gross weights, the range of C.G. travel should be reduced from the present limits of 82.0 inches forward and 89.0 inches aft to 83.0 inches forward and 85.75 inches aft. With a forward C.G. location of 83.0 inches and a gross weight of 2750 pounds, rearward flight is limited to 10 knots and the sideward flight to 20 knots.

A nose-up pitching moment is experienced during takeoff, when power available, weight and altitude combinations are such that hovering skid height is limited to one foot or less. This pitch-up occurs at the point of transition and requires full forward cyclic control to prevent the aircraft from settling and striking the ground.

A divergent longitudinal oscillation exists during climb at the gross weights and configurations tested. The period of this oscillation is approximately 14 - 16 seconds and is not objectionable to the pilot. It is relatively easy to maintain best climb speed and no unusual control position or movement is required to damp this oscillation.

The overall results of level flight gun firing show that there is very little tendency for the helicopter to deviate from stabilized flight.

Relocating the ground handling wheels to the front of the landing gear skid tubes proved to be a valuable safety feature. Taxiing, takeoffs and especially autorotational landings were performed with a greater degree of safety.

Design of the armament control box, located on the collective pitch control head, is unsatisfactory. It should be redesigned, so that in left sideward flight, lateral control is not restricted by "pinching" the pilot's left leg between the control box and the cyclic stick.

PART I - GENERAL

FINAL REPORT OF
ENGINEERING TEST OF THE
STABILITY AND CONTROL CHARACTERISTICS
OF THE
OH-13H EQUIPPED WITH THE XM-1 ARMAMENT KIT

PART I - GENERAL

A. REFERENCES

A list of references will be found in Annex A, Part III.

B. AUTHORITY

1. Authorization for this program was contained in DF TCMAC-EH-13 from the U. S. Army Transportation Materiel Command, St. Louis, Missouri, dated 11 May 1962.

2. The primary purpose of this evaluation was the flight certification of the OH-13 series helicopters equipped with the XM-1 armament kit.

C. DESCRIPTION OF TEST MATERIEL

1. The XM-1 armament kit is designed for use on the OH-13F, OH-13G and OH-13H helicopters. It consists of the following components:

a. Two 30 caliber machine guns

b. Machine gun mounts

c. Pneumatic gun charging assemblies

d. Sight assembly

e. Armament Controls

The interchangeable machine guns are installed on the helicopter landing gear cross tubes and can be quickly removed from the mounts. The pneumatic charger assemblies control the charging and safetying operation of the guns. Solenoids are utilized to actuate the triggers. Each mount assembly contains a buffer assembly to reduce recoil and counter-recoil. Gun elevation is controlled by an electrically operated elevating mechanism that contains limit switches that permit gun elevation from zero degrees to a positive 9 degrees. Ammunition is carried in a box attached to the forward end of each gun mount.

2. The OH-13H is a three-place, single-rotor helicopter with a conventional tail rotor and is manufactured by Bell Helicopter Corporation. It is powered by a Lycoming 0-435-23 reciprocating engine derated to 240 brake horsepower at 3200 engine rpm (takeoff power limited to five minutes) and 220 brake horsepower at 3100 engine rpm for maximum continuous power.

D. <u>BACKGROUND</u>

1. The XM-1 armament kit was developed by the Department of the Army to provide observation-type helicopters with fire suppression capability against enemy ground fire. Installation of the XM-1 armament kit on the OH-13H helicopter results in a maximum gross weight requirement of 2750 pounds, which is an increase of 200 pounds above the previous maximum gross weight of 2550 pounds.

2. The flight certification of the OH-13H/XM-1 combination was performed in two phases. The first phase was a performance evaluation conducted at the higher gross weight with and without the XM-1 armament kit installed. The results of the performance evaluation are presented in Reference 10, Annex A, Part III. The second phase was the stability and control evaluation presented in this report.

3. A structural investigation was conducted at the increased gross weight by Bell Helicopter Company, under Contract AF 33(600) 36104. The results of this investigation are presented in Reference 9, Annex A, Part III.

E. TEST OBJECTIVES

The test objectives were as outlined in Section B.2, Part I.

F. FINDINGS

1. General

Because of a lack of data for the stability and control characteristics of the OH-13H, it was necessary to first evaluate the basic OH-13 helicopter in a clean configuration at a gross weight of 2550 pounds to obtain base line data. Then the XM-1 armament kit was installed and the helicopter was re-evaluated at a gross weight of 2750 pounds.

2. Hovering, Sideward and Rearward Flight

Control positions were recorded in hover, sideward, rearward and forward flight in ground effect. These tests were conducted with the XM-1 kit installed and also in a clean configuration. All in-ground-effect flights were at 355 rotor rpm and at a forward C.G. (Station 81.45 and 83.32) location. A truck, with a calibrated speedometer, was used as a pace vehicle. These results are presented as a function of true airspeed in Figures 1 through 4, Part II.

During lift-off to a hover, the directional control change requires the normal left pedal input. Lateral and longitudinal cyclic control position movement and forces are satisfactory. The collective pitch control is not boosted and rigging balance causes an undesirable down-force during the initial portion of the lift-off.

Engine rpm control is very difficult when full throttle is required for lift-off and during hover. The twist grip will turn approximately 10 degrees after the carburetor butterfly valve is fully open. This condition gives the pilot a false impression that there is more power available when actually full power has already been obtained.

In sideward flight, lateral control displacement is non-linear with change in airspeed. The position gradient shows a tendency to flatten and this is most pronounced above 20 knots.

The aircraft has sufficient lateral control to achieve 30 knots sideward flight. However, with a forward C.G. of 83.0 inches and within the speed range of 20 - 30 knots sideward flight, only marginal aft longitudinal control remains. A 10 percent margin of control effectiveness is required for maneuvering and control of the aircraft in gusty conditions (Reference MIL-H-8501, paragraph 3.3.4). This requirement limits sideward flight to 20 knots.

During left sideward flight in the 10 - 15 knot range, a rapid right pedal displacement is required to maintain stabilized left sideward flight. No unusual pedal displacement is required in right sideward flight. For this reason, the aircraft is easier to fly to the right than to the left.

As shown in Figure E, Annex E, the armament control box is mounted on the collective pitch stick. In left sideward flight it is possible to "pinch" the pilot's left leg between the control box and the lateral cyclic control, and thereby limit available left lateral control. This is especially true when the pilot is wearing a parachute and must sit forward in the seat.

Longitudinal control displacement within the speed range of 20 knots true airspeed forward to 20 knots TAS rearward is non-linear. With a forward C.G. of 83.0 inches, rearward flight is limited to 20 knots TAS by full aft longitudinal control displacement. Airspeed in rearward flight is reduced to 10 knots TAS when maintaining the required 10 percent margin (reference MIL-H-8501A, paragraph 3.2.1) of aft longitudinal control effectiveness.

Control positions from hover to transition are satisfactory except at gross weight-altitude combinations where the hovering skid height is limited by power available to one foot or less. Under these conditions at a mid C.G. location, full forward cyclic is required to compensate for the pitch-up encountered on passing through translational lift. Occasionally, full forward cyclic was insufficient to prevent the helicopter from slowing, settling and contacting the ground. This condition does not necessarily represent an adverse handling quality, but increases the difficulty of achieving maximum takeoff performance.

3. Climb, Level Flight and Autorotation

Control positions were recorded during climb, level flight and autorotation. These tests were conducted with a forward and a mid C.G. location both with the XM-1 kit installed and in a clean configuration. All tests were conducted at 344 rotor rpm. The results are presented as a function of calibrated airspeed in Figures No. 5 through 10, Part II.

Longitudinal control displacement with change in airspeed is non-linear. This is most pronounced near the extremes of the level flight envelope. This condition exists at heavy gross weight with the XM-1 kit installed and also at a light gross weight in a clean configuration. The longitudinal control gradients, however, generally comply with the requirements of MIL-H-8501A, paragraph 3.2.10.

Minimum safe airspeed in autorotation with a forward C.G. of 83.0 inches is 22 knots calibrated airspeed. At this airspeed, only 10 percent of aft longitudinal control displacement remains to maneuver or control the aircraft.

Directional control effectiveness is adequate in low speed autorotation.

4. Control Positions During Gun Firing

Control positions were recorded during gun firing at the following test conditions:

a. Hover

b. Left and right sideward flight

c. Takeoff at point of translational lift

d. Level flight at various arispeeds

e. Landing approach

Hovering gun firing tests were flown at an average density altitude of 3050 feet, average gross weight of 2620 pounds, mid C.G. location and 355 rotor rpm. All other gun firing tests were flown at an average gross weight of 2660 pounds and 344 rotor rpm.

In the search for the most critical gun firing condition, the left and right gun were fired separately at zero and 9 degrees elevation. This was done at all conditions listed above, except during takeoff and landing. Qualitative gun firing flights were conducted that included firing the left or right gun in left and right sideslip flight at various airspeeds. Quantitative results are presented as control position time histories in Figures No. 13 through 27, Part II.

The most critical firing condition experienced occurred while firing the right gun at zero degrees elevation in hovering flight. This is not a normal condition and would be experienced only when the left gun jammed. In this condition, the helicopter yawed right, developing into a yawing right turn with a tendency for the nose to pitch down. In all hovering conditions, firing the guns at 9 degrees elevation produced less nose-down pitching than firing at zero degrees elevation.

The results of firing single guns at various speeds in level and sideslip flight did not produce any unusual results. There was a slight tendency for the helicopter to yaw in the direction of the gun that was firing.

With both guns firing, there was only a slight and easily controllable tendency for the helicopter to pitch nose down. The overall results of level flight gun firing show that there is very little tendency for the helicopter to deviate from stabilized flight.

An increased vibration was noted at all gun firing data points. This vibration was felt throughout the airframe, but it was not objectionable.

5. Static Longitudinal Stability

a. Climb

Static longitudinal stability in a climb was determined by recording control position with a change in airspeed from a trim climb speed of 45 knots. After stabilizing in a 45-knot climb, airspeed was increased and decreased from trim by forward and aft displacement of the longitudinal cyclic control. It was the intent to vary airspeed with collective pitch fixed; however, in the light weight climb, collective pitch was increased slightly in order to maintain 344 rotor rpm at the higher speeds. These tests were conducted both with the XM-1 armament kit installed and in a clean configuration at a mid C.G. location and 344 rotor rpm.

The results of these tests are presented in Figures No. 28 and 29, Part II. The static longitudinal stability in a climb is positive with the position gradients becoming neutral at approximately 20 knots IAS above and below the trim airspeed.

b. Level Flight

Static longitudinal stability in level flight was evaluated at two trim speeds, 35 and 65 knots calibrated airspeed. These tests were conducted at the same conditions as listed above. The results, presented in Figures No. 30 through 33, Part II, show that level flight static longitudinal stability is positive within the speed range tested, except for normal reversal during translation.

The static longitudinal speed stability control position gradients generally comply with the requirements of MIL-H-8501A, paragraph 3.1.10.

c. Autorotation

Static longitudinal stability was evaluated in autorotation at a trim calibrated airspeed of 55 knots. These tests were conducted at the same conditions as listed in the climb section.

The results, presented in Figures No. 34 and 35, Part II, show that autorotational static longitudinal stability is positive and generally in compliance with the requirements of MIL-H-8501A.

6. Longitudinal Stability and Controllability

a. Longitudinal Dynamic Stability

Dynamic stability parameters, as indicated by the response to a longitudinal pulse-type control displacement, were determined at zero, 35, 45 and 65 knots calibrated airspeed. These tests were conducted in hover, climb, level and autorotational flight conditions with the XM-1 kit installed and in a clean configuration. Hovering flight tests were conducted in ground effect at 355 rotor rpm and a mid C.G. location. All other flight conditions were at an average density altitude of 5000 feet, 344 rotor rpm and a mid C.G. location. Pulse inputs were made using a removable control stop and were approximately 2 inches in magnitude and held approximately one-half second. Typical time histories of these tests are presented in Figures No. 36 through 45, Part II.

In climbing flight, the oscillations that follow a disturbance are divergent. This disturbance can be an external source (gust) or an intentional control deflection as described above.

As shown in Figures No. 11, 12 and 36 through 39, Part II, the period is approximately 14 seconds and the amplitude is more than doubled in this time. This characteristic does not comply with the requirements of MIL-H-8501A, paragraph 3.2.1(c). It is, however, relatively easy to maintain best climb speed, and no unusual control position or movement is required to control this oscillation.

This divergent oscillation was first discovered while recording fixed control positions in a climb. With controls fixed, the first indication of the start of this oscillation is a plus or minus one knot variation in airspeed. This variation in airspeed becomes progressively greater with time as the oscillation becomes divergent.

Figures No. 11 and 12, Part II, are time histories of longitudinal oscillations in a climb that were excited by an external source (gust) with controls fixed. The period was not greatly affected by changes in airspeed, gross weight or C.G. location. The period is sufficiently long so as not to be objectionable to the pilot during normal flight conditions.

During level flight, an aft longitudinal pulse produces an oscillation that is neutral or lightly damped. A forward longitudinal pulse produces a divergent oscillation. In both cases, the oscillation has a period of approximately 14 - 16 seconds and is easy to damp out with normal control movements and the requirements of MIL-H-8501A are generally met.

During autorotation, a forward longitudinal pulse produces an oscillation that is neutral to slightly damped with a period of approximately 14 - 16 seconds. An aft longitudinal pulse produces a divergent oscillation with a period of approximately 10 - 12 seconds and the requirements of MIL-H-8501A are generally met.

During hovering flight, in ground effect, forward and aft pulses produce divergent oscillations with a period of approximately 10 seconds.

b. Longitudinal Control Sensitivity

Control sensitivity as used in the report is defined as the maximum angular acceleration obtained per inch of control displacement. Longitudinal sensitivity was obtained by measuring the maximum angular acceleration resulting from longitudinal step control displacements of various magnitudes. These tests were conducted in a hover and at various airspeeds while in climb, level and autorotational flight conditions with the XM-1 kit installed and in a clean configuration. Hovering flight testing was conducted in ground effect, with a mid C.G. location at 355 rotor rpm.

Longitudinal control sensitivity data obtained during hovering and level flight is summarized in Figure No. 47, Part II. Climb, level and autorotational flight test conditions were at average density altitudes of 5000 and 9000 feet, forward and mid C.G. location, all at 344 rotor rpm.

Longitudinal control sensitivity is satisfactory. As shown in the summary plot, longitudinal control sensitivity is affected by power (as a function of blade angle), altitude and direction of control displacement. At a given altitude, control sensitivity is greater at high power settings, high blade angles, and drops to a minimum at low power settings (approximately 35 knots calibrated airspeed). Longitudinal control sensitivity is also greater at the heavy gross weight, with the XM-1 kit installed, than at the light gross weight and clean configuration. At a light gross weight, an increase in altitude increases the control sensitivity. The opposite is true at a heavy gross weight where an increase in altitude decreases the control sensitivity. At a light gross weight, greater longitudinal control sensitivity is obtained with an aft control displacement than with a forward control displacement. Time required to reach maximum pitching acceleration, after control displacement, varied from 0.37 to 0.48 seconds and generally met the requirements of MIL-H-8501A.

c. Longitudinal Control Response

The maximum rate response per inch of control displacement is a measure of the maneuvering characteristics. The maximum pitch rate response to longitudinal control displacements of various magnitudes was obtained under the same conditions as described for control sensitivity. Data obtained in level flight is summarized in Figure No. 46, Part II.

The longitudinal control response of the OH-13H is satisfactory. As shown in the summary plot, longitudinal control response is affected primarily by power and altitude. At 5000 feet, the response is greater at high power settings and is a minimum at approximately 35 knots calibrated airspeed. Also, pitch response is greater at heavy gross weights than at light gross weights. At light gross weights, an increase in altitude increases longitudinal control response. The opposite is true at heavy gross weights where an increase in altitude decreases longitudinal control response. The time required to reach maximum pitch rates after control displacement varied from 1.00 to 1.96 seconds.

7. Lateral Stability and Controllability

a. Lateral Dynamic Stability

Dynamic stability parameters, as indicated by the response to a lateral pulse-type control input, were determined at zero, 35, 45 and 65 knots calibrated airspeed. These tests were conducted in hover, climb, level and autorotational flight conditions with the XM-1 kit installed and also in a clean configuration. Hovering flight testing was conducted in ground effect at 355 rotor rpm and a mid C.G. location. All other flight conditions were at an average density altitude of 5000 feet, 344 rotor rpm and a mid C.G. location. Lateral cyclic pulse inputs were made using a removable control stop and were approximately 2 inches in magnitude and held approximately one-half to three-fourths second. Typical time histories of these tests are presented in Figures No. 66 through 69, Part II.

The lateral dynamic stability is satisfactory. Lateral disturbances produce a slow divergent longitudinal oscillation coupled with a well damped lateral oscillation. An increase in altitude at all gross weights and C.G. loadings tested decreased the damping, but the dynamic stability was satisfactory at all conditions tested.

b. Lateral Control Sensitivity

The lateral control sensitivity of the OH-13H was obtained by measuring the maximum angular acceleration resulting from lateral step control displacements of different magnitudes. These tests were conducted at a hover and at various airspeeds while in climb, level and autorotational flight with XM-1 kit installed, and in a clean configuration. Hovering flight testing was conducted in ground effect with a mid C.G. location and 355 rotor rpm. Climb, level and autorotational test conditions were: density altitudes of 5000 and 9000 feet, forward and mid C.G. location, and 344 rotor rpm. The level flight lateral control sensitivity data is summarized in Figure No. 71, Part II.

Lateral control sensitivity is considered to be satisfactory. As shown in the summary plot, lateral control sensitivity is affected by power, density altitude and direction of control displacement. Control sensitivity is greater at high power settings and is a minimum at approximately 35 knots calibrated airspeed.

Also, lateral control sensitivity is greater at the heavy gross weights with XM-1 kit installed than at the light gross weights and in the clean configuration.

At the light gross weights, an increase in altitude increases lateral control sensitivity. The opposite is true at the heavy gross weights, where an increase in altitude decreases lateral control sensitivity. At an altitude of 5000 feet, greater lateral control sensitivity is obtained with a right control displacement than with a left control displacement. The opposite is true, however, at 9000 feet where greater control sensitivity is obtained with a left lateral control displacement than with a right lateral displacement.

The time required to reach maximum rolling accelerations varies from 0.32 to 0.42 seconds.

c. Lateral Control Response

The maximum roll rate response to lateral control displacements of various magnitudes was obtained under the same conditions as described for lateral control sensitivity. Data obtained in level flight is summarized in Figure No. 70, Part II.

The lateral control response of the OH-13 is satisfactory. As shown in the summary plot, lateral control response is affected by power (as a function of blade angle), altitude and direction of control displacement. Lateral control response is greater at high power settings and is a minimum at approximately 35 knots calibrated airspeed. At the light gross weight and clean configuration, an increase in altitude increases the lateral control response. At the heavy gross weight, an increase in altitude decreases lateral control response slightly. A right lateral control displacement produces a slightly greater lateral control response than a left lateral control displacement. The time to reach maximum roll rate varies from 0.82 to 1.30 seconds.

8. Static Lateral-Directional Stability

a. Static lateral-directional stability was investigated by determining the pedal position and lateral stick position required to maintain various sideslip angles. These tests were conducted at a heavy gross weight with the XM-1 kit installed and at a light gross weight in a clean configuration. All climbs and autorotations were performed at 45 knots calibrated airspeed, 344 rotor rpm and mid C.G. location. Level flight tests were conducted at 35 and 65 knots calibrated airspeed, 344 rotor rpm and mid C.G. location. The results are presented in Figures No. 90 through 97, Part II.

b. The OH-13H helicopter possesses positive, control-fixed, directional stability and positive effective dihedral in both powered and autorotative flight. The only unusual control position occurred in climb at a heavy gross weight where an excessive amount of forward cyclic control was necessary to maintain a stabilized 45 knot climb, (reference Figure No. 90, Part II). This longitudinal trim change, plus the normal lateral trim change required, tends to give the pilot the false impression that static lateral stability becomes neutral at large sideslip angles.

9. Directional Stability and Controllability

a. Directional Dynamic Stability

Stability parameters, as indicated by the response to a directional pulse-type control input, were determined at zero, 35, 45 and 65 knots calibrated airspeed. These tests were conducted in hovering, climbing, level and autorotational flight conditions with the XM-1 kit installed and in a clean configuration. Hovering flight testing was conducted in ground effect at 355 rotor rpm and mid C.G. location. All other flight conditions were at an average density altitude of 5400 feet, 344 rotor rpm and mid C.G. location. Directional control pulse inputs were made using a removable control stop and were approximately one inch in magnitude and held approximately one-half second. Typical time histories of these tests are presented in Figures No. 98 through 101, Part II.

The directional dynamic stability of the OH-13H helicopter is satisfactory. The oscillations that follow a disturbance were damped in less than two cycles with only a slight couple in pitch and roll.

b. Directional Control Sensitivity

Directional control sensitivity was evaluated by measuring the maximum angular acceleration resulting from directional control displacements of various magnitudes. These tests were conducted at a hover and at various airspeeds while in climb, level and autorotational flight with the XM-1 kit installed and in a clean configuration. Hovering tests were conducted in ground effect with a mid C.G. location and 355 rotor rpm. Climb, level and autorotational flight conditions were at average density altitudes of 5000 and 9000 feet, forward and mid C.G. locations, and 344 rotor rpm. Level flight directional control sensitivity data is summarized in Figure 103, Part II.

The directional control sensitivity of the OH-13H is satisfactory and meets the requirements of MIL-H-8501, paragraph 3.3.5. As shown in the summary plot, control sensitivity to the right is nearly constant, whereas the control sensitivity to the left varies with airspeed. In a hover, greater control sensitivity is obtained with a left pedal displacement than with a right pedal displacement. Left directional control sensitivity decreases with an increase in forward velocity. Above 20 knots calibrated airspeed directional control sensitivity is greater to the right than to the left.

c. Directional Control Response

The maximum yaw rate response to directional control displacements of different magnitudes, was obtained under the same conditions as described for directional control sensitivity. Data obtained in level flight is summarized in Figure No. 102, Part II.

Directional control response is satisfactory. As shown in the summary plot, directional control response varies with airspeed. Maximum control response is obtained in a hover and decreases with an increase in forward velocity. Greater control response is obtained with a right pedal displacement than with a left pedal displacement of the same magnitude. The time required to reach maximum yaw rate varies from approximately 1.0 second in forward flight to approximately 3.0 seconds in hovering flight.

G. CONCLUSIONS

In general, the installation of the XM-1 armament kit, with the corresponding increase in gross weight, does not adversely affect the handling qualities of the OH-13 series helicopter. Control response and control sensitivity are increased with an increase in gross weight.

At gross weights above 2550 pounds, the range of C.G. travel should be reduced from the present limits of 82.0 inches forward and 89.0 inches aft to 83.0 inches forward and 85.75 inches aft. At a forward C.G. location of 83.0 inches and a gross weight of 2750 pounds, rearward flight is limited to 10 knots and sideward flight to 20 knots. The aft limit is based upon the most aft C.G. attainable using practical loading conditions with the armament kit installed. This value was the most aft condition that could be attained during testing.

A nose-up pitching moment is experienced during takeoff when power available, weight and altitude combinations are such that hovering skid height is limited to one foot or less. This pitch-up occurs at the point of transition and requires full forward cyclic control to prevent the aircraft's settling and striking the ground.

A divergent longitudinal oscillation exists during climb at the gross weights and configurations tested. The period of this oscillation, however, is approximately 14 - 16 seconds and, therefore, is not objectionable to the pilot. It is relatively easy to maintain best climb speed, and no unusual control position or movement is required to damp this oscillation or maintain best climb speed.

The results of stability tests conducted during gun firing revealed that there is very little tendency for the helicopter to deviate from stabilized flight. The most critical gun firing condition occurred while firing the right gun at zero degrees elevation in hovering flight. This is not a normal condition and would be experienced only when the left gun jammed. In this condition the helicopter yawed to the right, developing into a yawing right turn with the nose pitching down. In all hovering conditions, firing the guns at maximum elevation (9 degrees) produced less nose down pitching than at zero degrees elevation.

Design of the armament control box, located on the collective pitch control, is unsatisfactory. It should be redesigned so that in left sideward flight, lateral control displacement is not restricted by "pinching" the pilot's left leg between the control box and the cyclic stick.

H. RECOMMENDATIONS

As a result of the Engineering Tests discussed in this report, the following recommendations are made concerning the OH-13H with the XM-1 armament kit installed:

1. The allowable range of center-of-gravity travel should be changed from the present limits of 82.0 inches forward, 89.0 inches aft to 83.0 inches forward, 85.75 inches aft.

2. Because of the resultant increase in gross weight with the kit installed and the decrease in performance in ground effect, the helicopter should be modified so that the ground handling wheels may be mounted on the forward end of the skid tubes to assist during running takeoffs.

3. The armament control box, located on the collective pitch control, should be redesigned so that full lateral cyclic control is available.

4. A warning should be included in the Operator's Manual to alert the pilot: (a) to the characteristic large nose-up pitching moment that is experienced during takeoffs under conditions of high gross weight and limited excess power; and (b) to the fact that when using full throttle approximately 10 degrees of throttle twist grip is available.

PART II - GRAPHICAL ANALYZED TEST DATA

FIG. NO. 1

CONTROL POSITIONS IN SIDEWARD FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

IN GROUND EFFECT

G.W-LB	H_D-FT	CG-IN	RPM
2650	1250	81.45 (FWD)	355

NOTE: TAILS DENOTE DUPLICATE POINTS

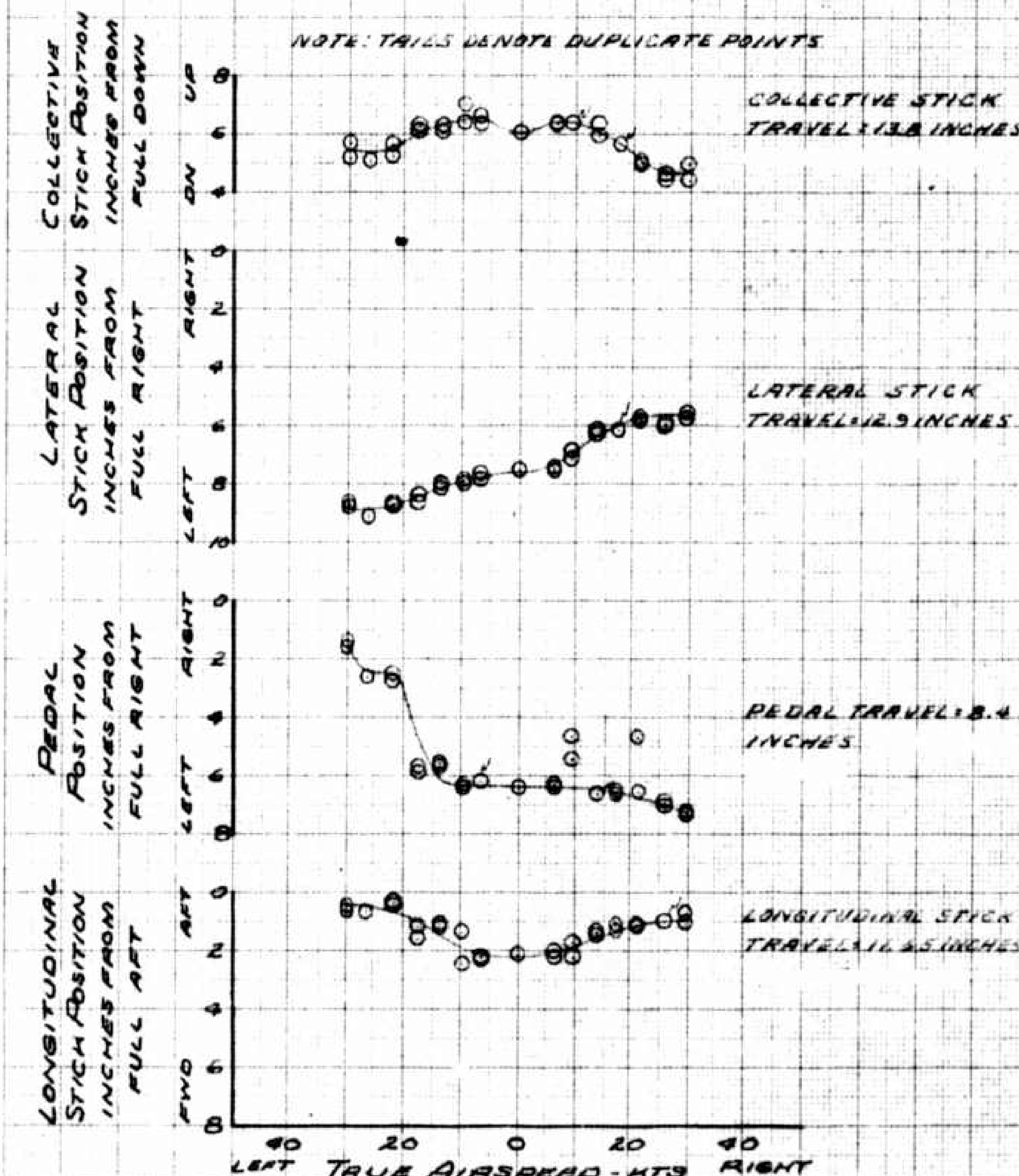

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FIG. No. 2

CONTROL POSITIONS IN SIDEWARD FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

IN GROUND EFFECT

G.W.-LB	H_D-FT	C.G.-IN	RPM
2455	1250.	83.32 (FWD)	355

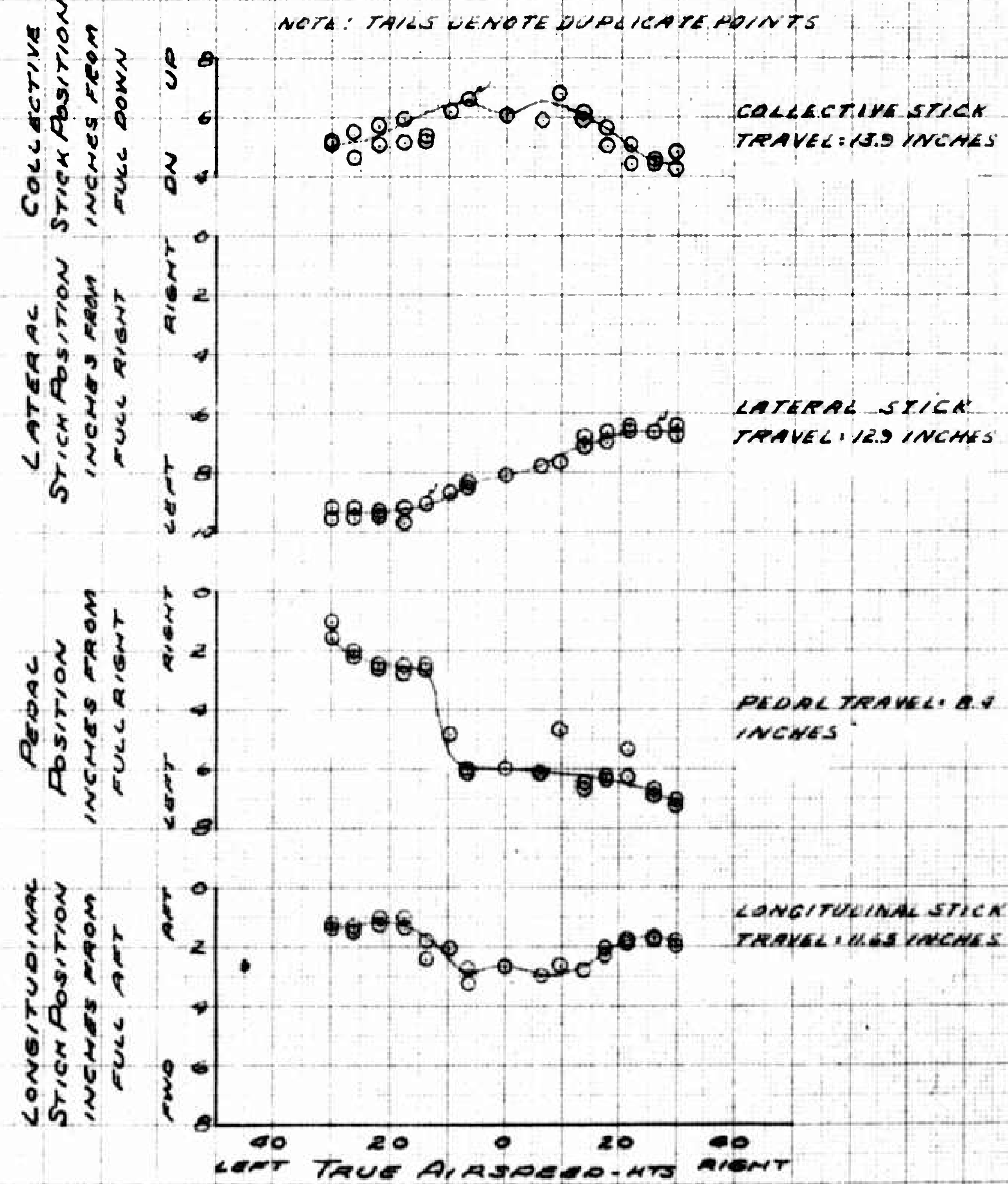

FIG. No. 3

CONTROL POSITIONS IN FORWARD AND REARWARD FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

IN GROUND EFFECT

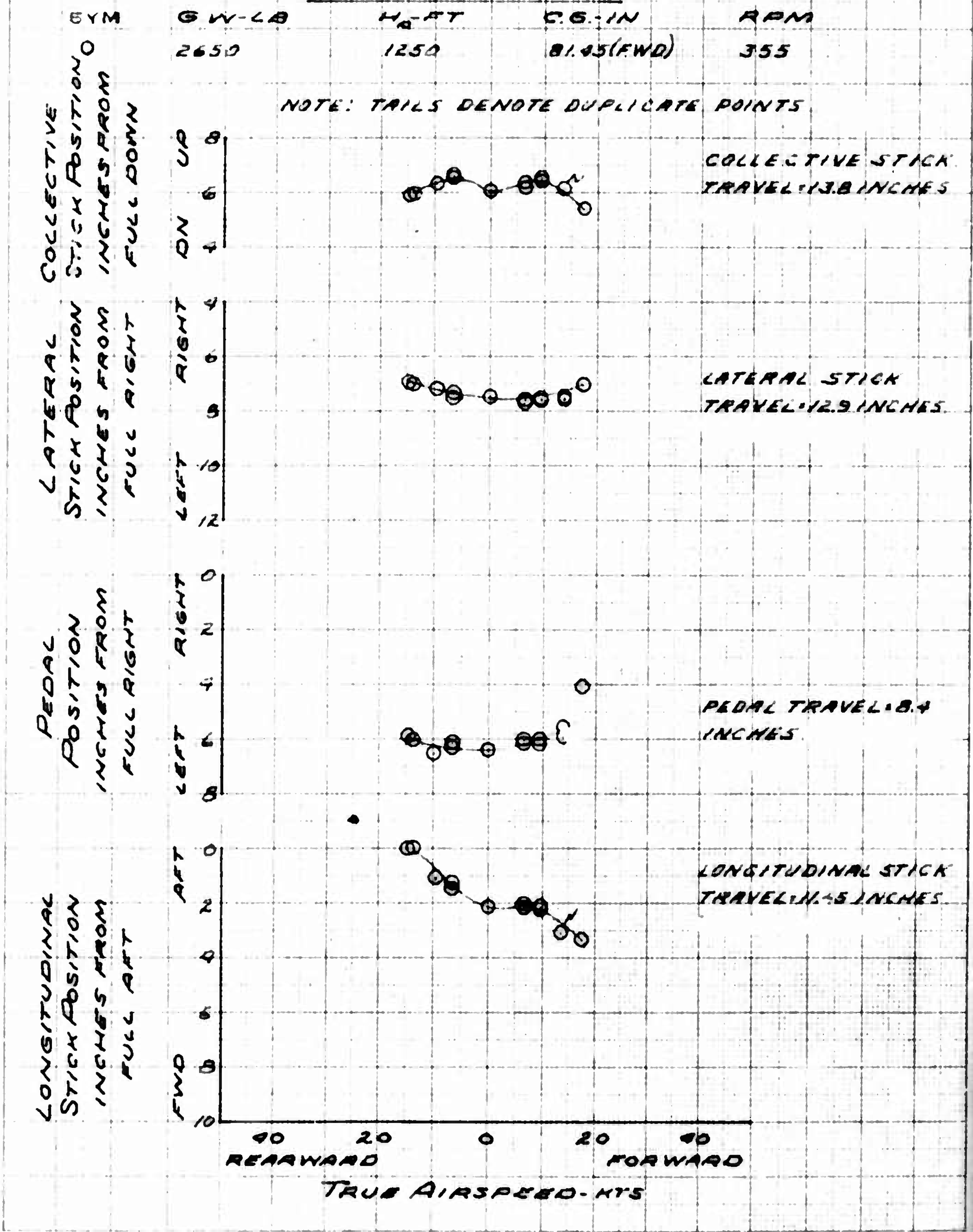

FIG. NO. 4

CONTROL POSITIONS IN FORWARD AND REARWARD FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

IN GROUND EFFECT

SYM	G.W-LB	H_D-FT	C.G-IN	RPM
O	2455	1250	83.32(FWD)	355

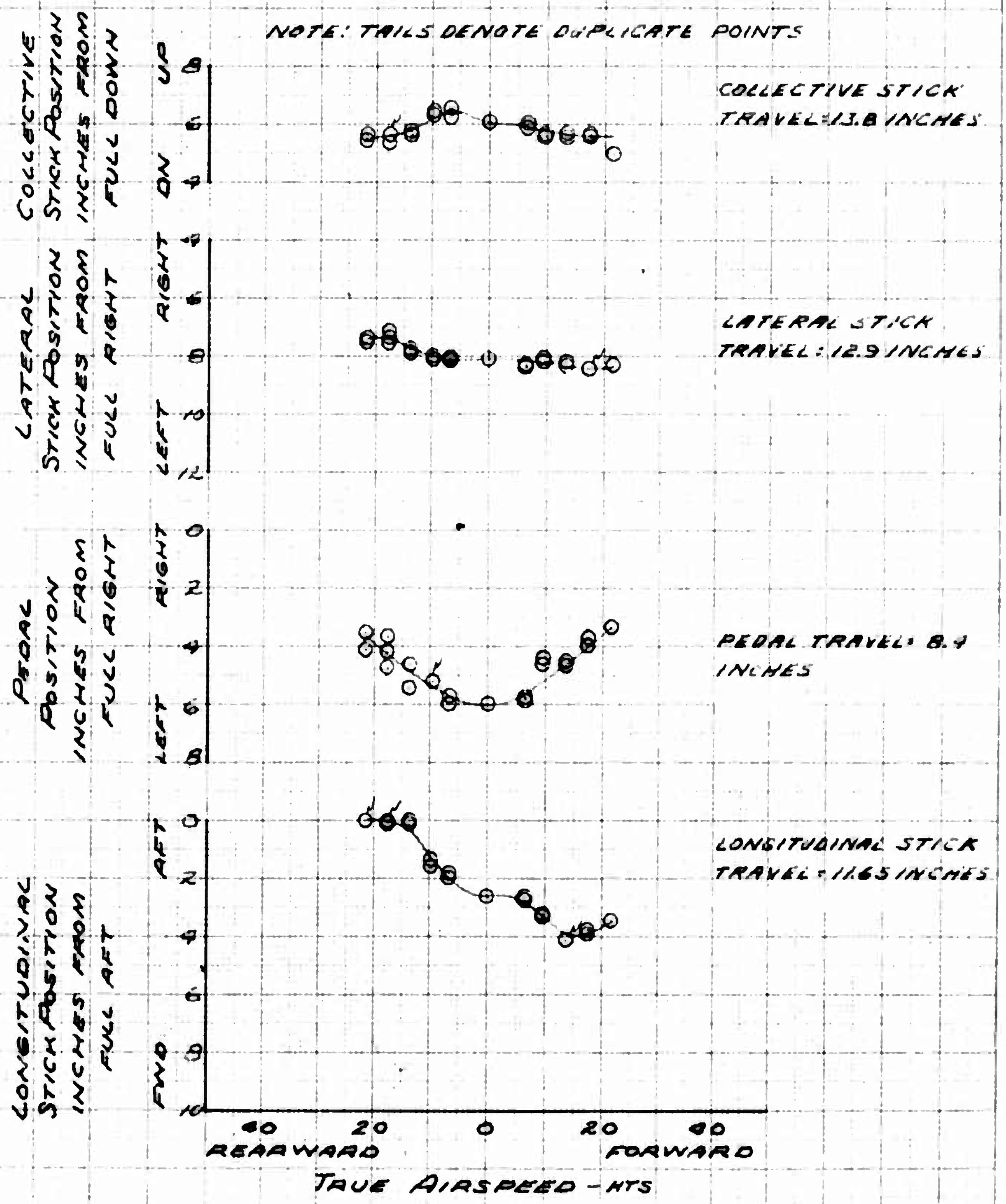

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FIG. No. 5

CONTROL POSITIONS IN CLIMB AND AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	G.W.-LB	H_D-FT	C.G.-IN	RPM
□	CLIMB	2710	5200	83.1 (FWD)	344
○	AUTOROTATION	2710	5300	83.1 (FWD)	344

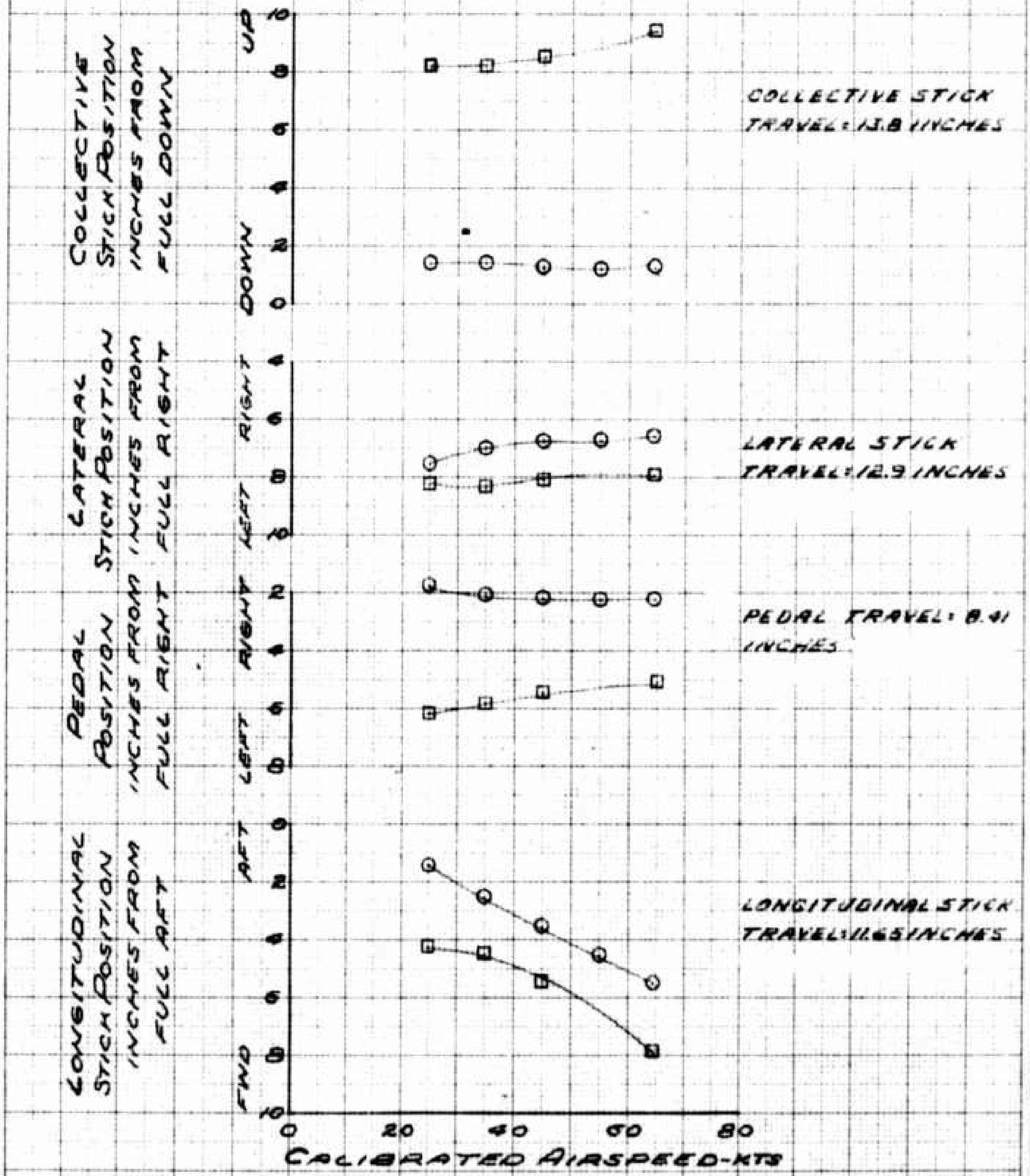

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FIG NO. 6

CONTROL POSITIONS IN CLIMB AND AUTOROTATION

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	FLT CONDITION	AVG G.W.-LB	AVG H_D-FT	AVG C.G.-IN.	RPM
□	CLIMB	2465	4100	82.37 (FWD)	344
○	AUTOROTATION	2465	3745	82.37 (FWD)	344

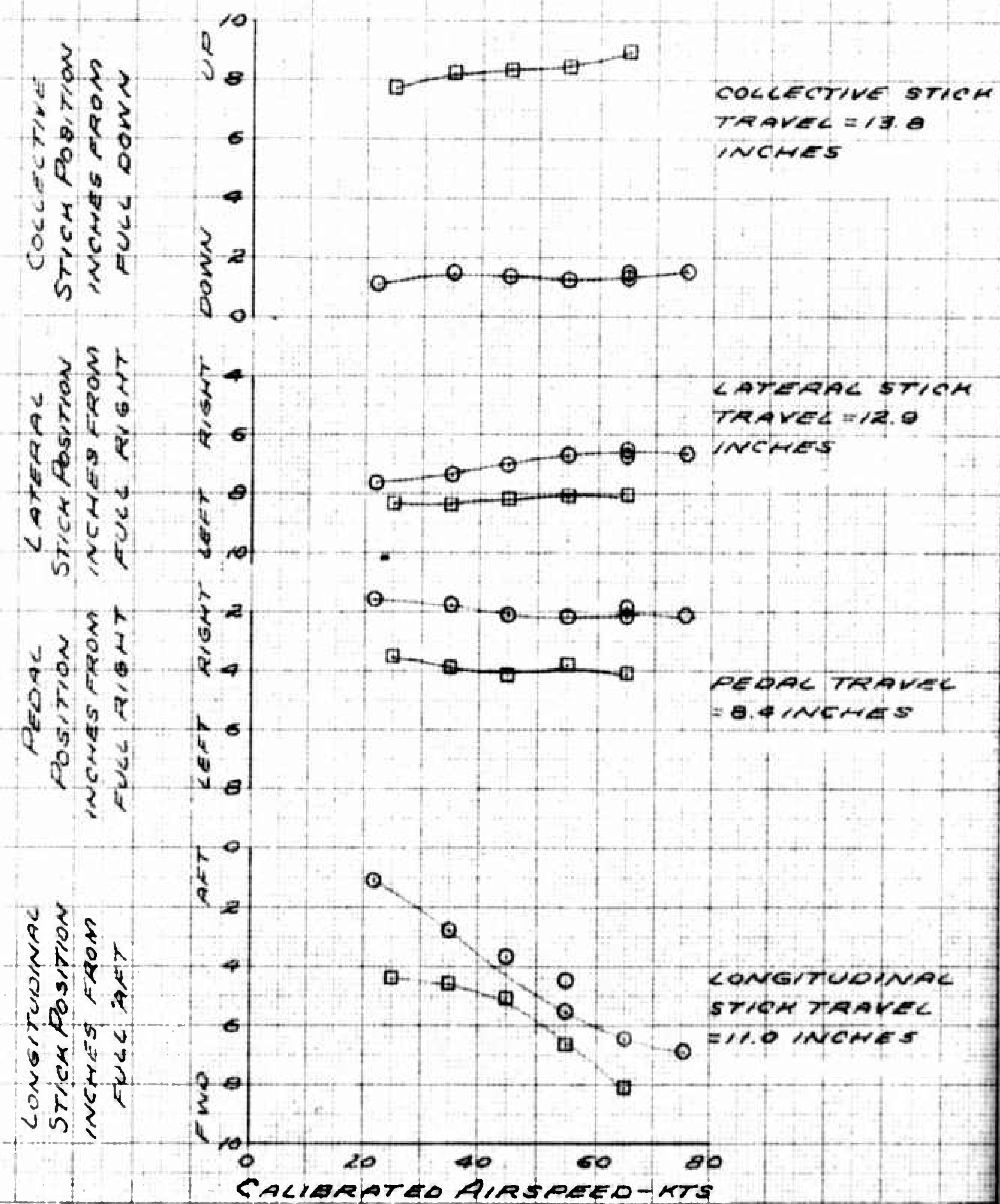

FIG. NO. 7

CONTROL POSITIONS IN CLIMB AND AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	G.W-LB	H_D-FT	CG-IN	RPM
□	CLIMB	2722	5600	85.35(MID)	344
○	AUTOROTATION	2722	5560	85.35(MID)	344

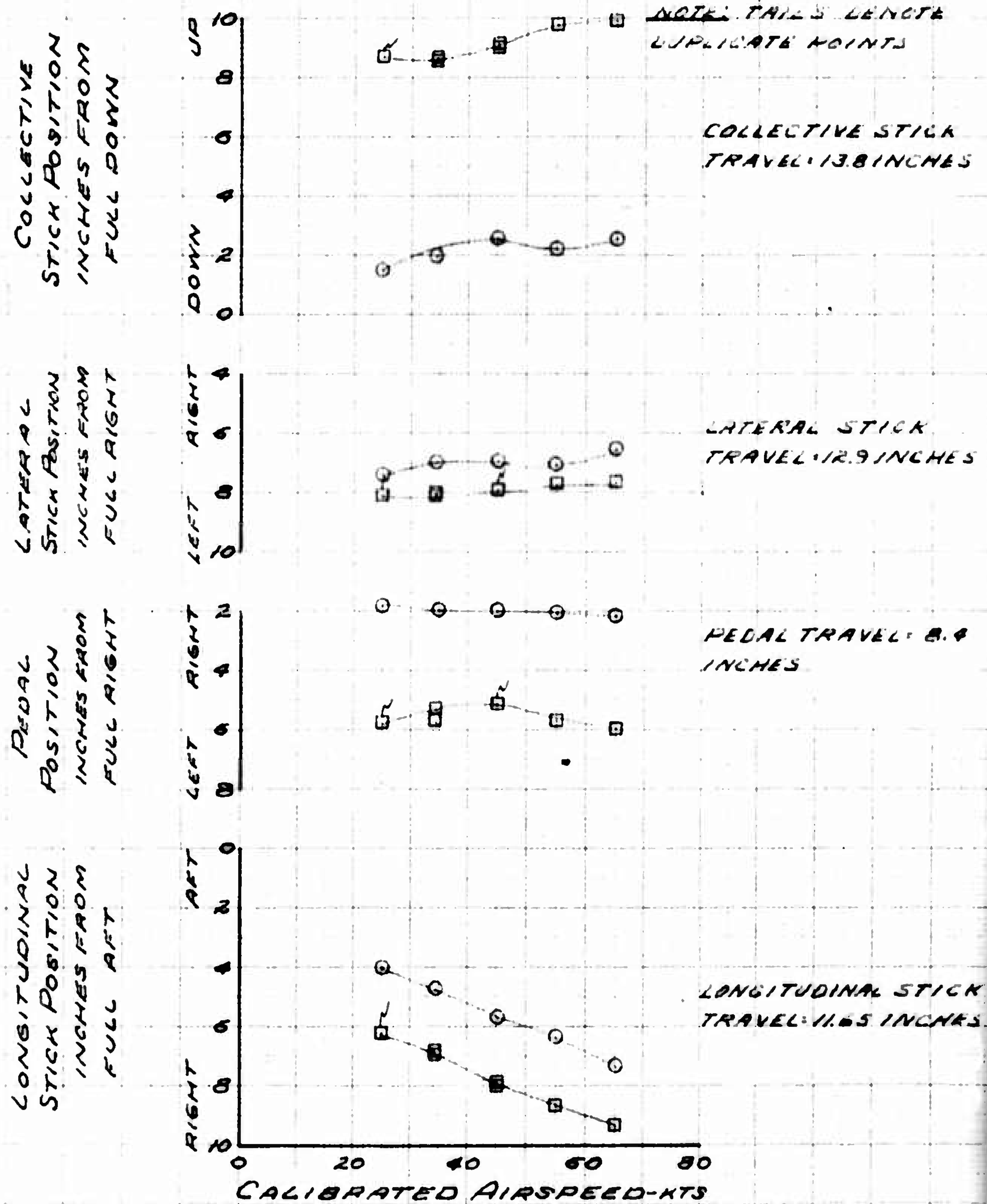

Fig No. 8

Control Positions in Climb and Autorotation

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	FLT CONDITION	G.W-LB	H_P-FT	C.G.-IN	RPM
□	CLIMB	2480	4400	84.65 (MID)	344
○	AUTOROTATION	2480	4050	84.65 (MID)	344

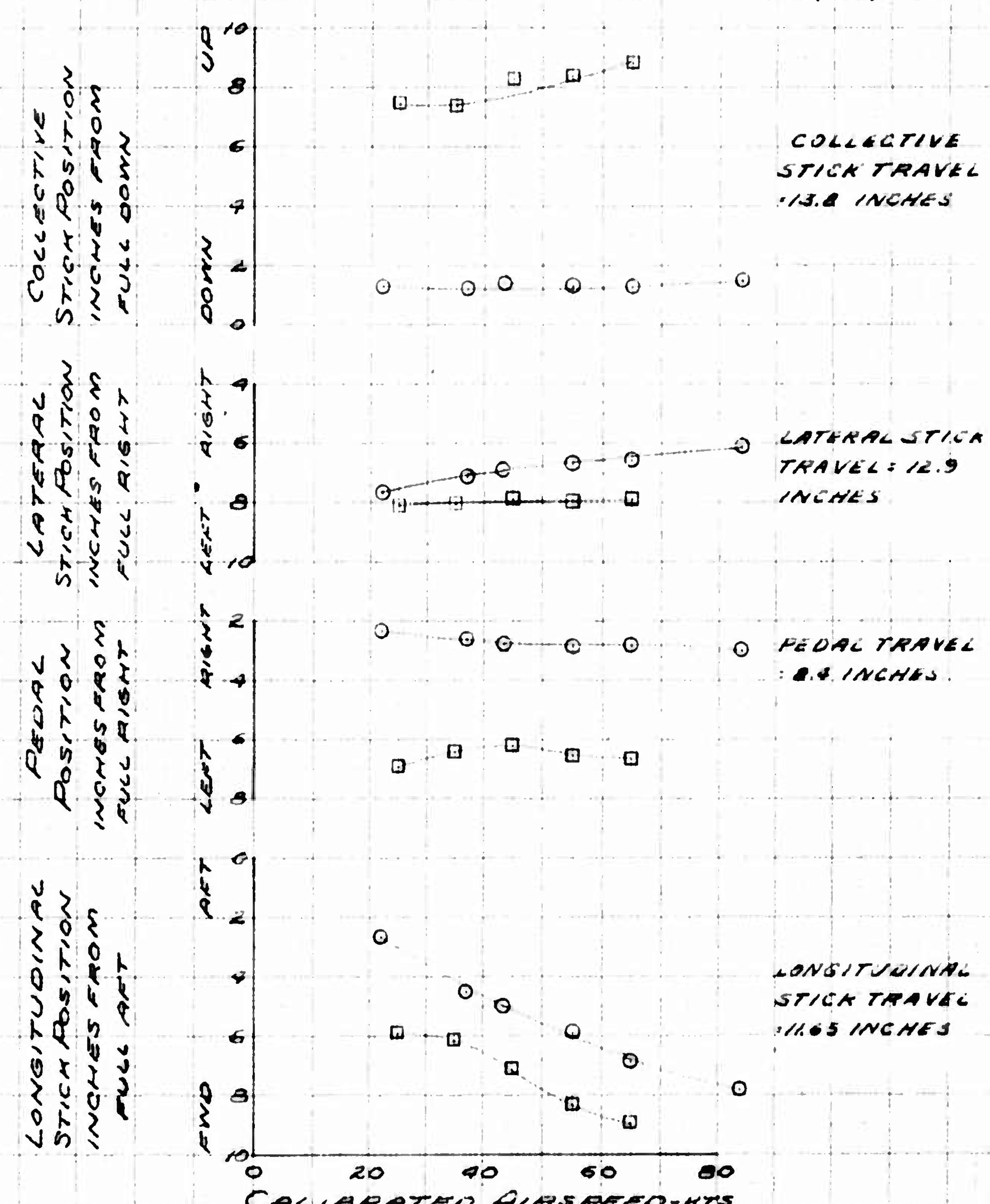

Fig. No. 9

Control Positions in Level Flight

OH-13H S/N 57-6234

XM-1 Armament Kit Installed

Sym	G.W.-LB	H_p-FT	C.G.-IN	RPM
□	2710	5100	83.10(FWD)	344
○	2720	6000	85.05(MID)	344

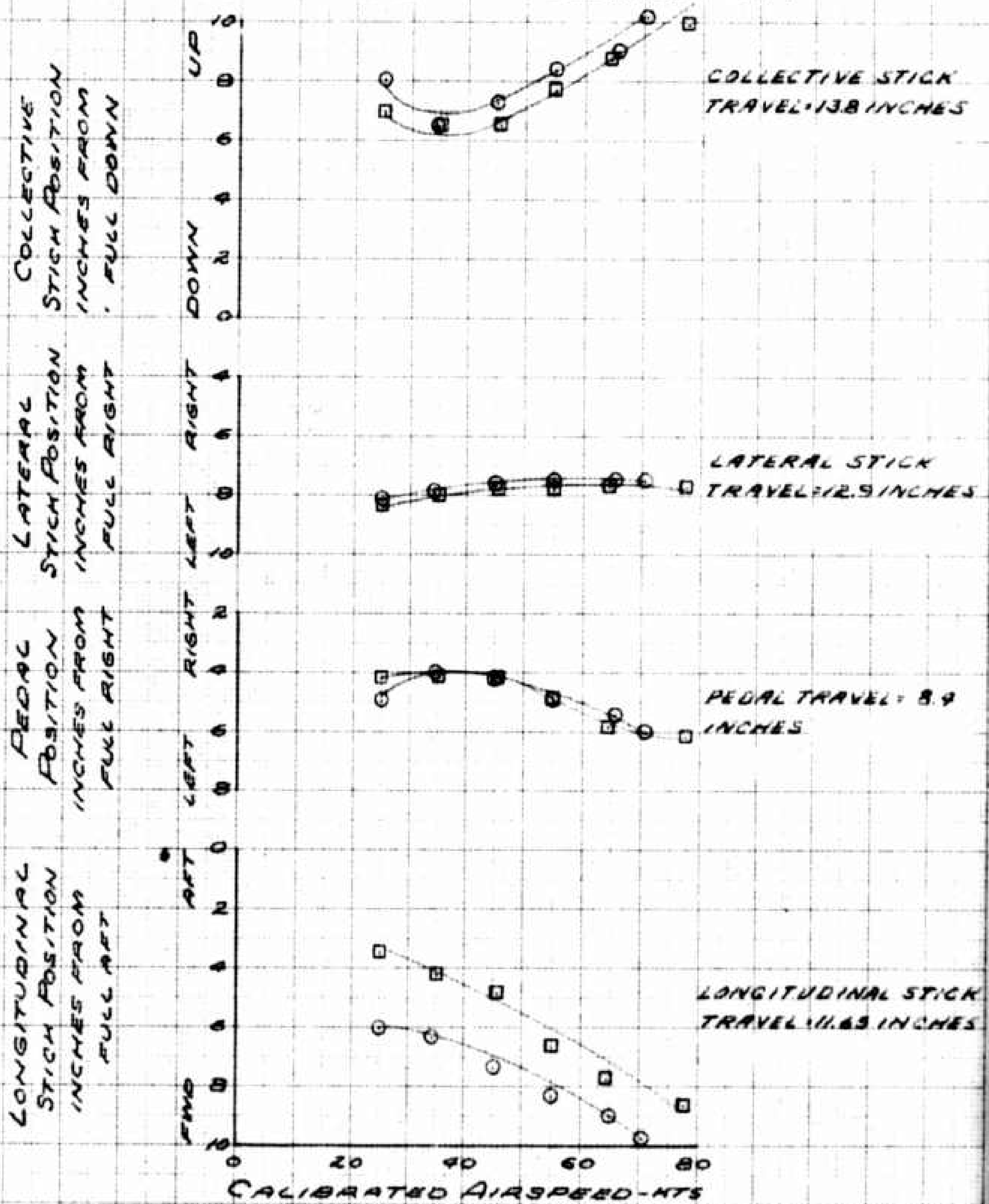

FIG. No. 10

CONTROL POSITIONS IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	G.W.-LB	H_p-FT	C.G.-IN	RPM
□	2465	4760	82.37 (FWD)	344
○	2485	4920	84.65 (MID)	344

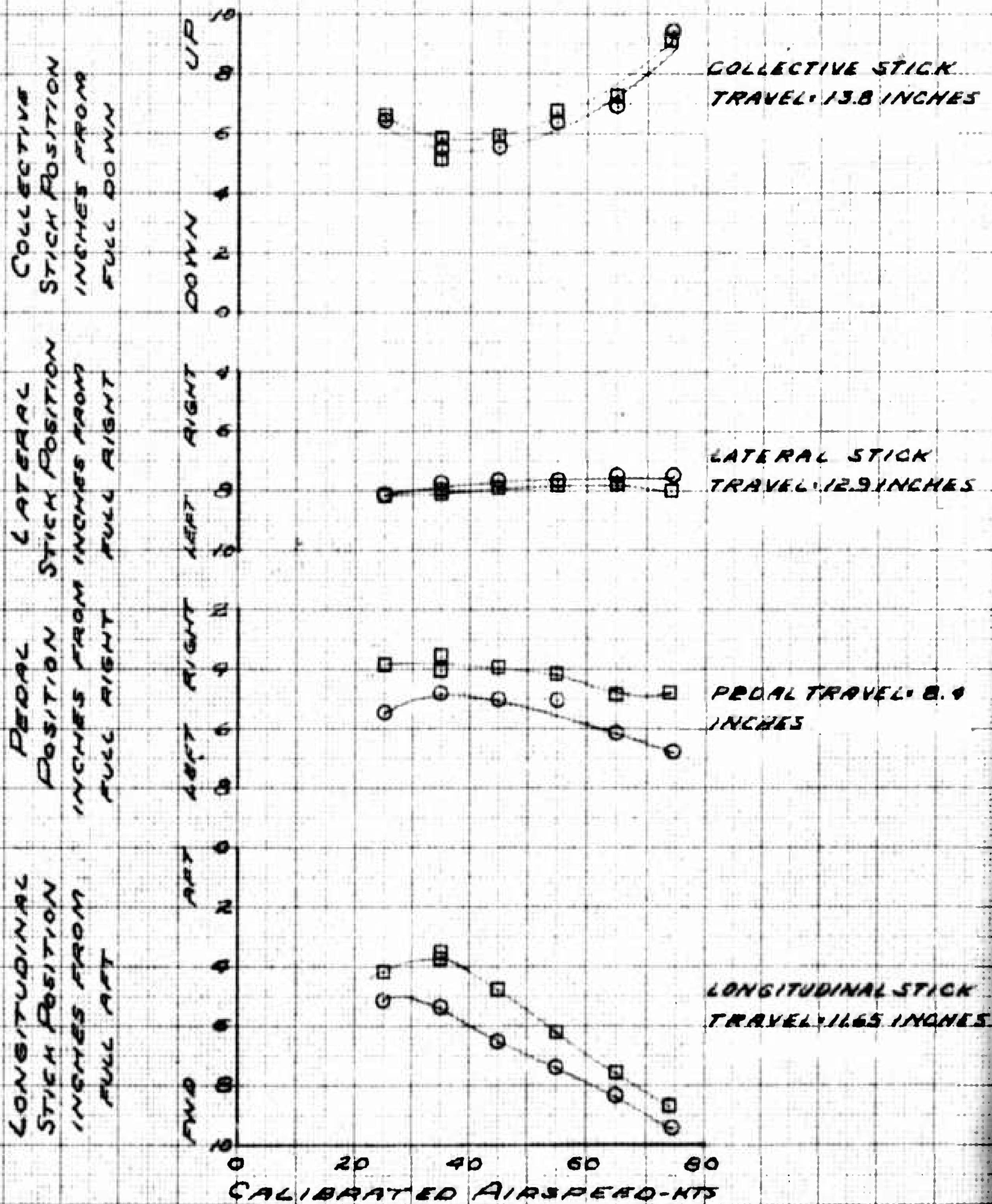

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FIG. NO. 11
LONGITUDINAL OSCILLATION IN A CLIMB
CONTROLS FIXED
CLEAN CONFIGURATION
OH-13H S/N 56-6239
V_C = 45 KTS G.W. = 2485 LBS C.G = 89.65 IN.

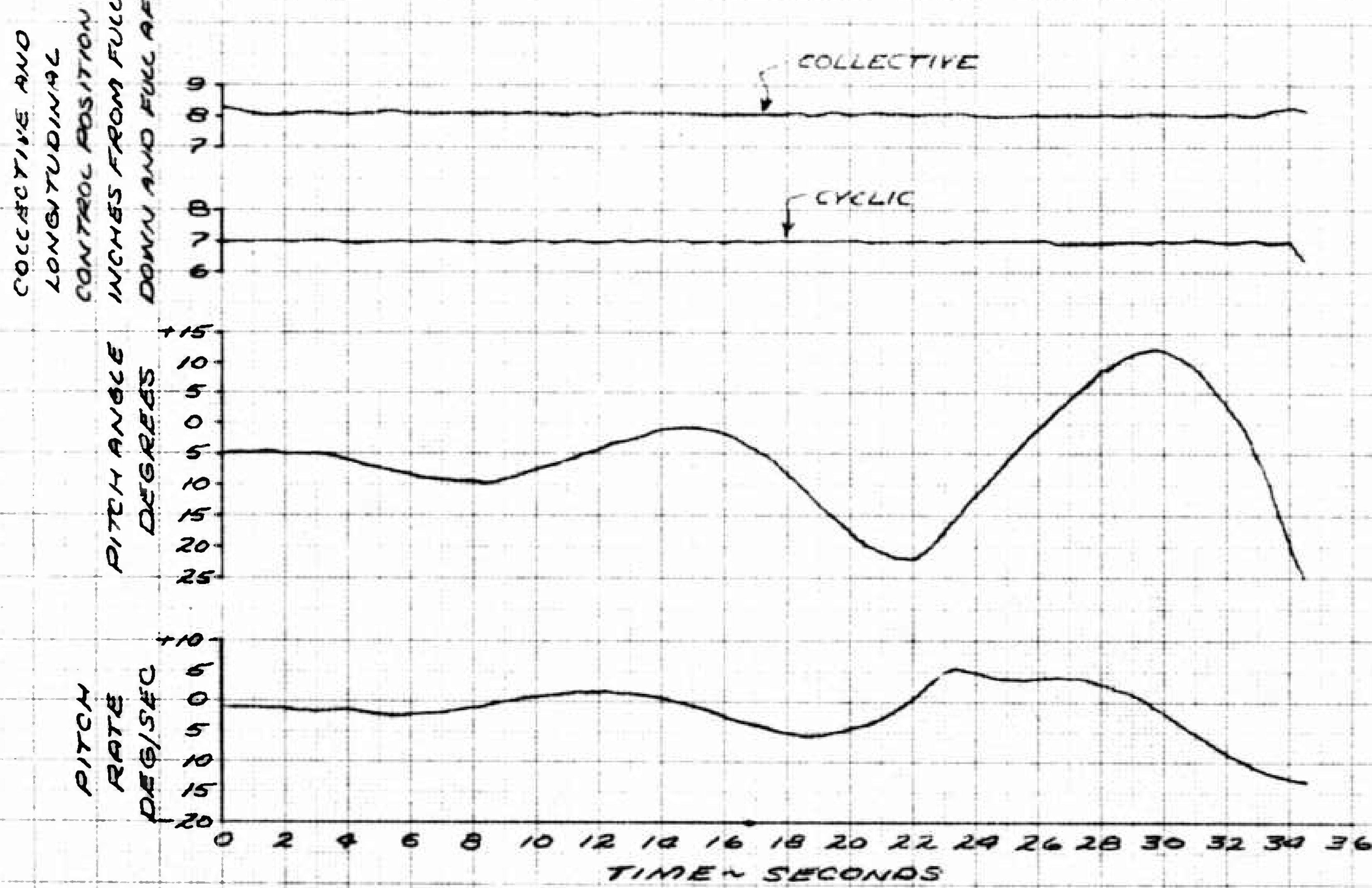

FIG NO. 12

LONGITUDINAL OSCILLATION IN A CLIMB
CONTROLS FIXED
XM-1 ARMAMENT KIT INSTALLED
OH-13H S/N 56-6234
V_C = 45 KTS G.W. = 2710 LBS C.G. = 83.10 IN. (FWD)

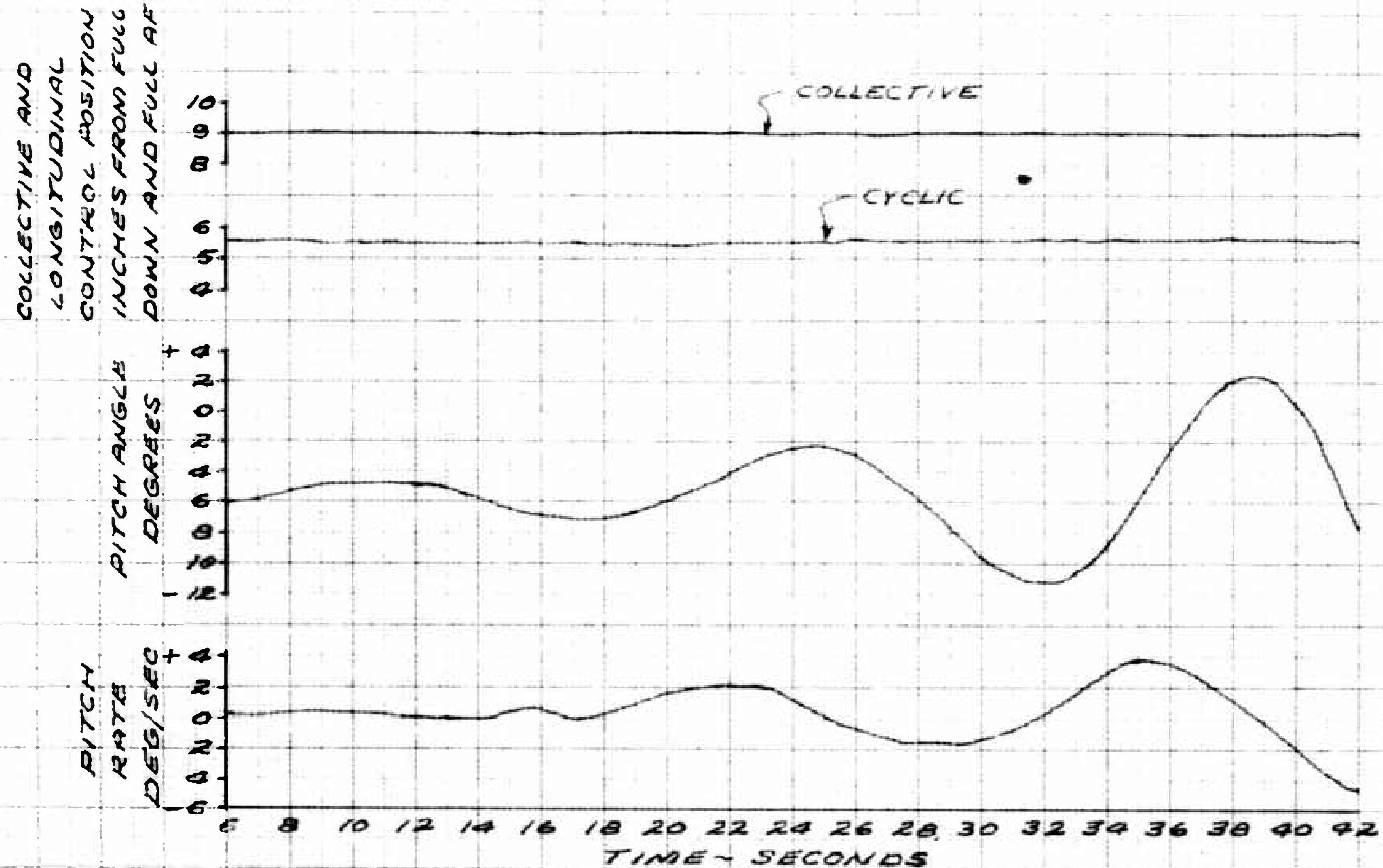

FIG. No. 13

CONTROL POSITIONS DURING GUN FIRING
HOVERING FLIGHT (IGE)

OH-13H S/N 57-6234

V_c - KT	H_p - FT	G.W. - LB	C.G. - IN	RPM
0	3050	2660	84.70 (MID)	365

CONDITION: BOTH GUNS FIRING - ZERO DEG. ELEVATION

PITCH —— ROLL - - - - YAW — - — -

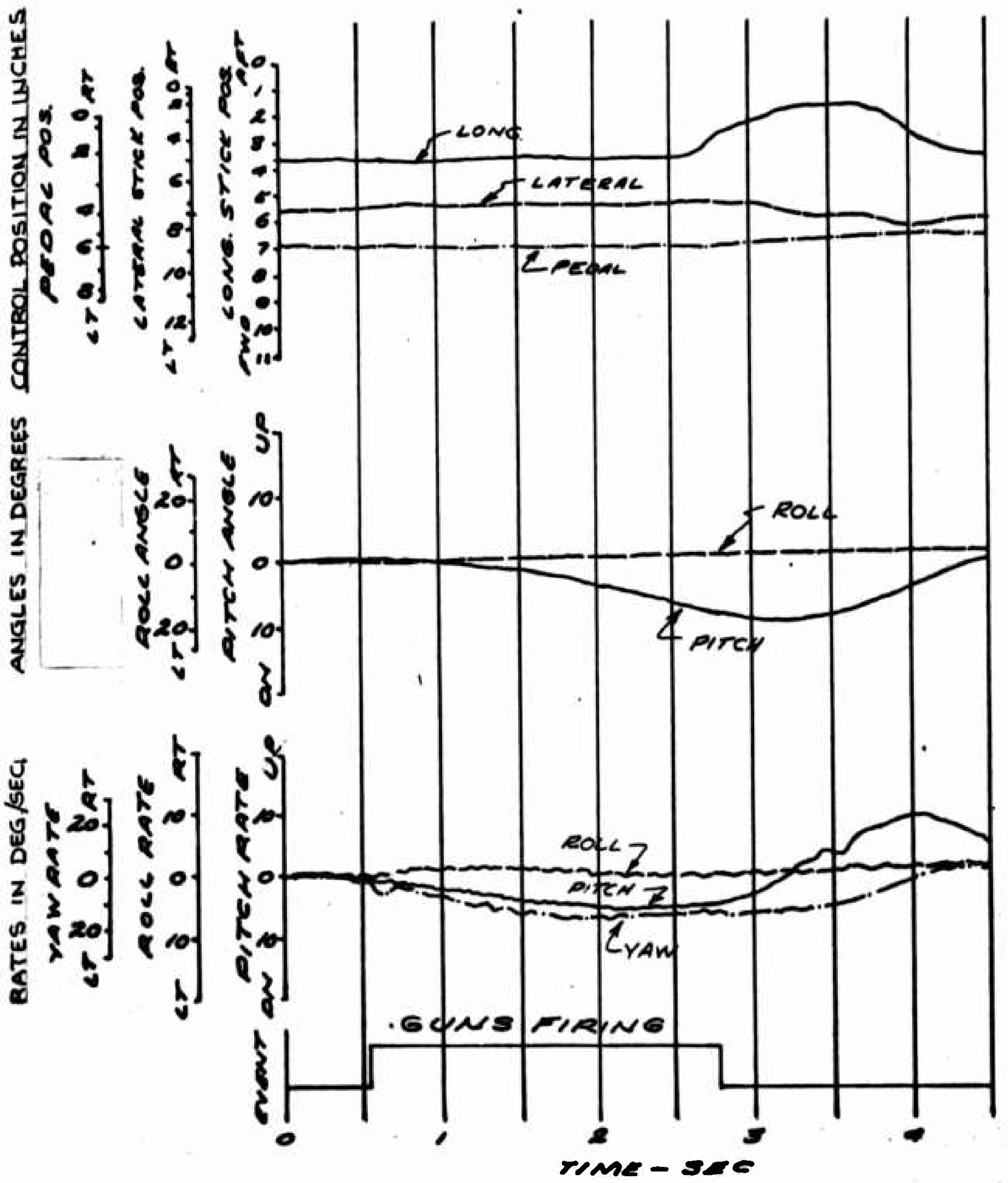

FIG. No. 14
CONTROL POSITIONS DURING GUN FIRING
HOVERING FLIGHT (IGE)

OH-13H S/N 57-6234

Ve - KT	Ho - FT	G.W. - LB	C.G. - IN	RPM
0	3050	2620	89.70 (MID)	355

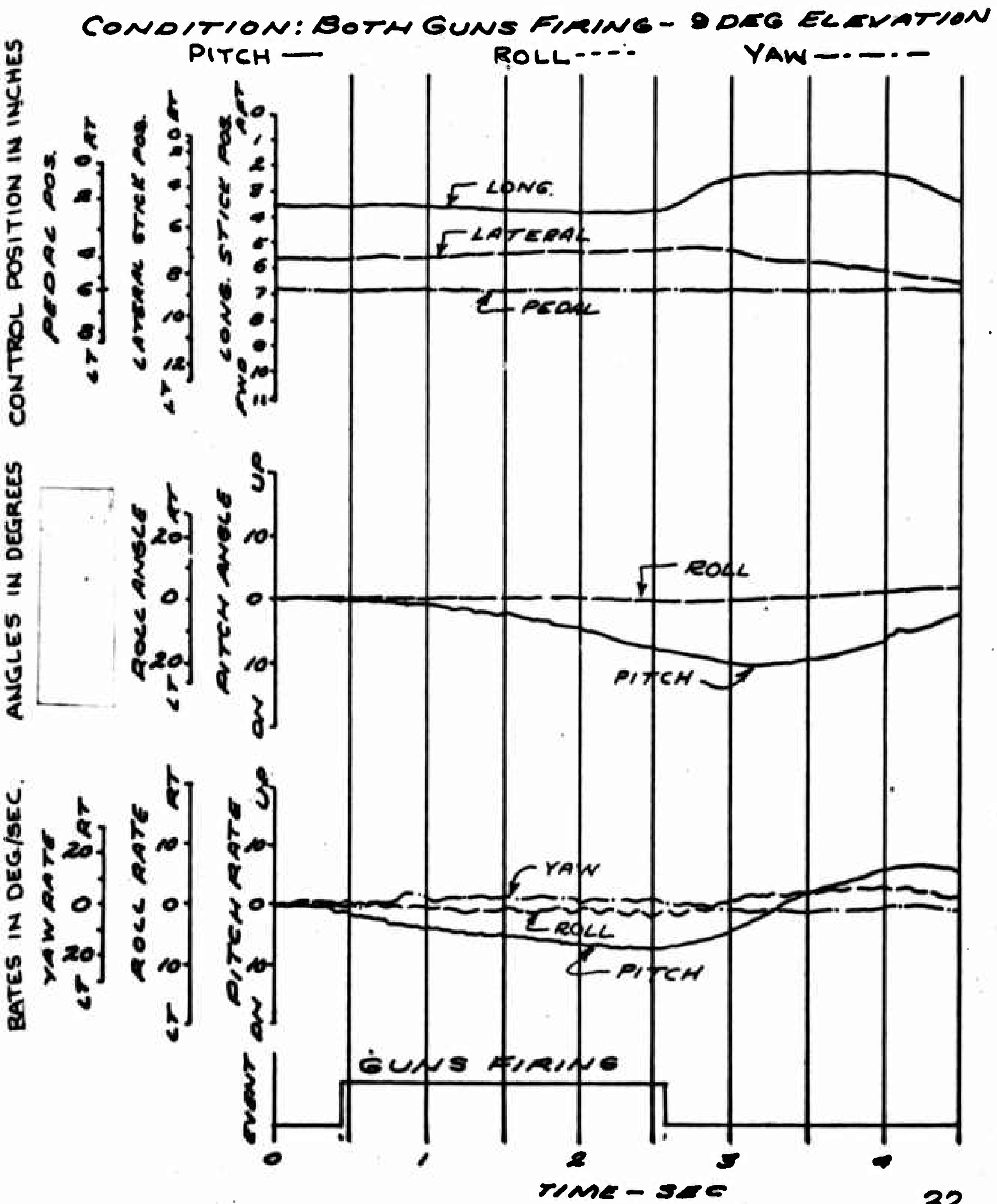

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FIG. NO. 15
CONTROL POSITIONS DURING GUN FIRING
HOVERING FLIGHT (IGE)

OH-13H S/N 67-6234

V_e - KT	H_D - FT	G.W. - LB	C.G. - IN	RPM
0	3050	2660	89.70 (MID)	355

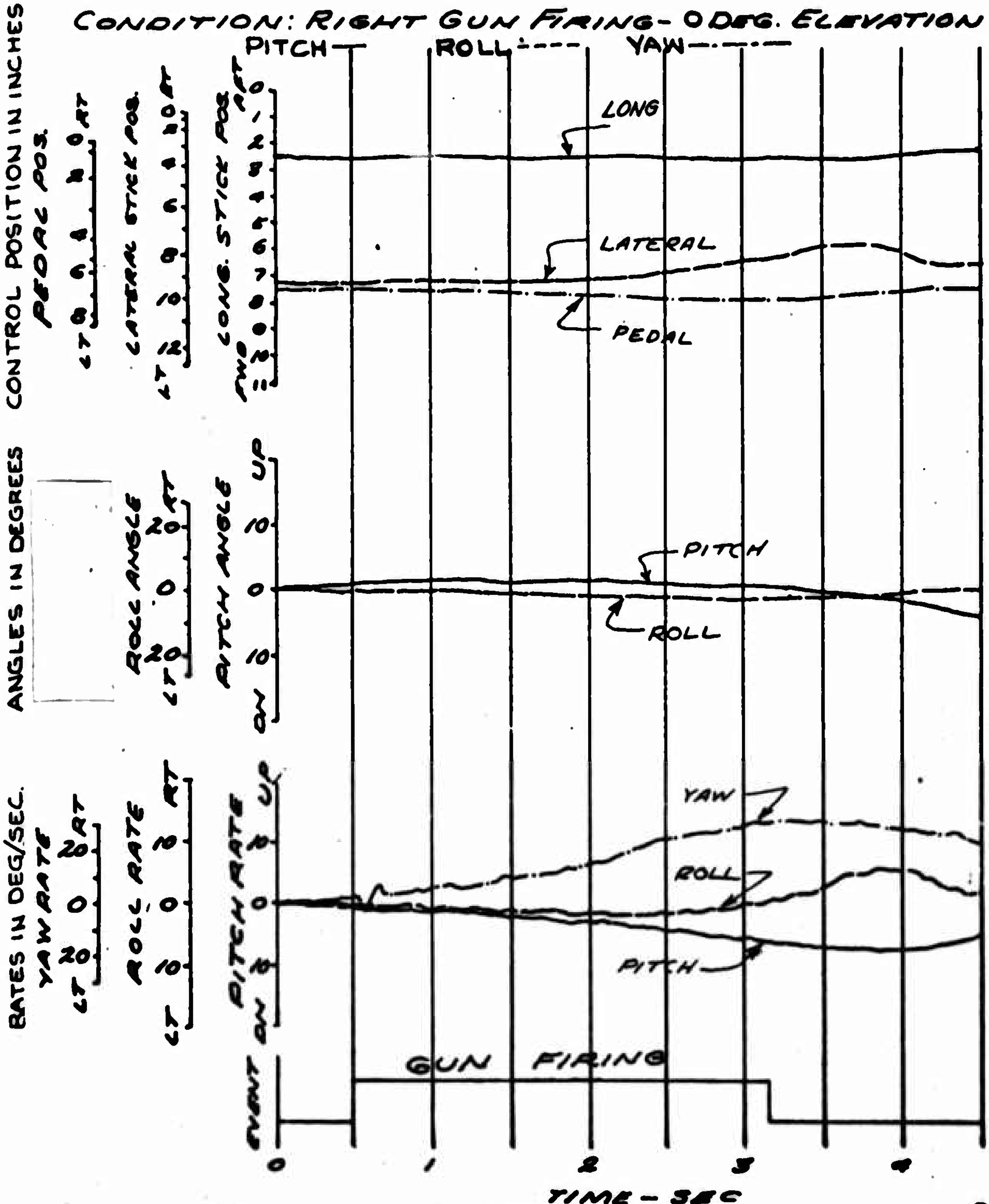

FIG. No. 16
CONTROL POSITIONS DURING GUN FIRING
HOVERING FLIGHT (IGE)

OH-13H S/N 57-6234

Vc-KT	Hp-FT	G.W.-LB	C.G.-IN	RPM
0	3050	2660	84.70 (MID)	355

CONDITION: RIGHT GUN ONLY - 9 DEG ELEVATION

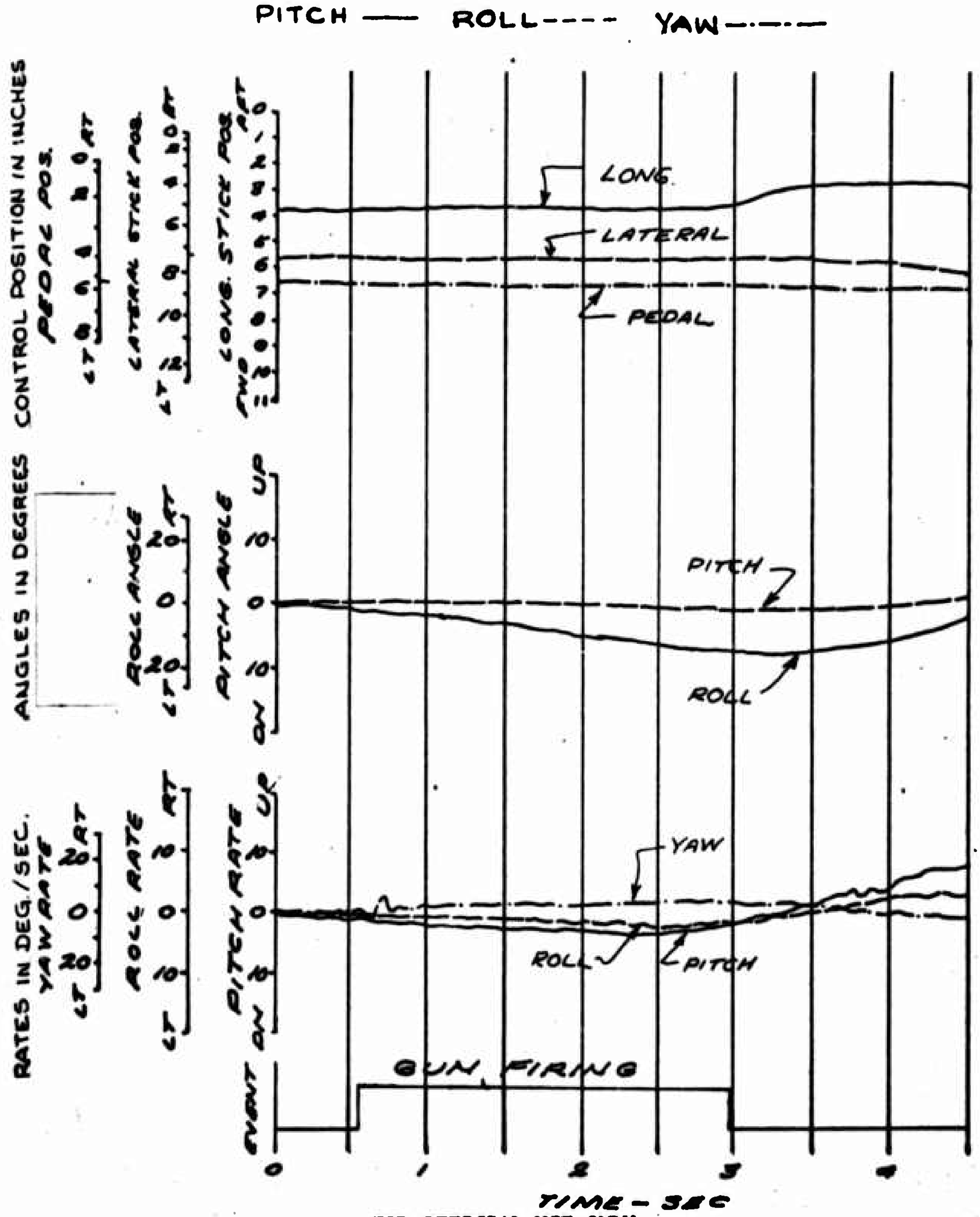

FIG. No. 17
CONTROL POSITIONS DURING GUN FIRING
HOVERING FLIGHT (IGE)

OH-13H S/N 67-6234

V_c - KT	H_p - FT	G.W. - LB	C.G. - IN	RPM
0	3050	2660	84.70 (MID)	355

CONDITION: LEFT GUN FIRING - ZERO DEG ELEVATION

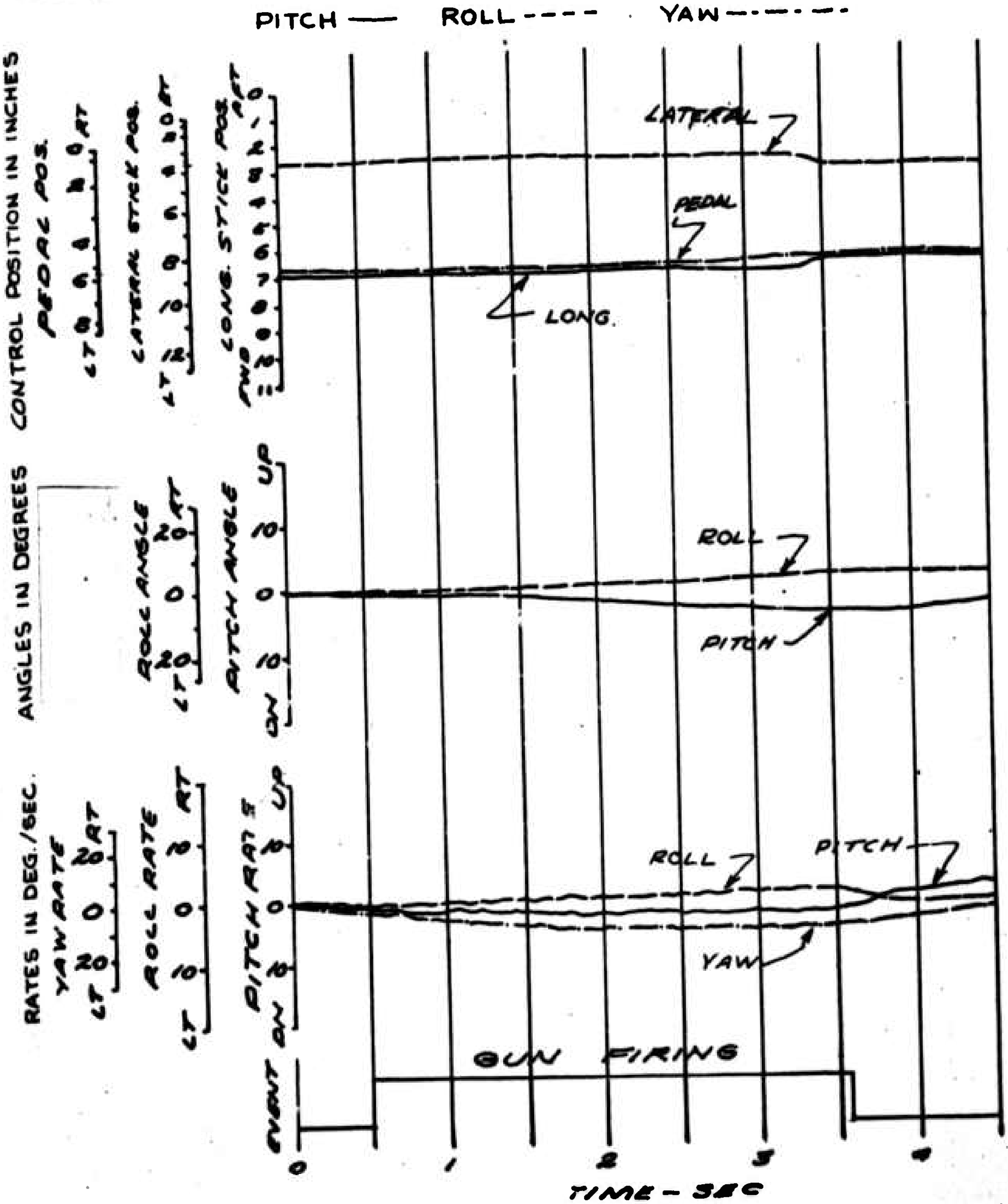

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FIG. No. 18

CONTROL POSITIONS DURING GUN FIRING

HOVERING FLIGHT (IGE)

OH-13H S/N 57-6234

V_c-KT	H_o-FT	G.W.-LB	C.G-IN	RPM
0	3050	2660	89.70 (MID)	355

CONDITION: LEFT GUN FIRING - 0° DEG ELEVATION

PITCH —— ROLL - - - - YAW —·—·—

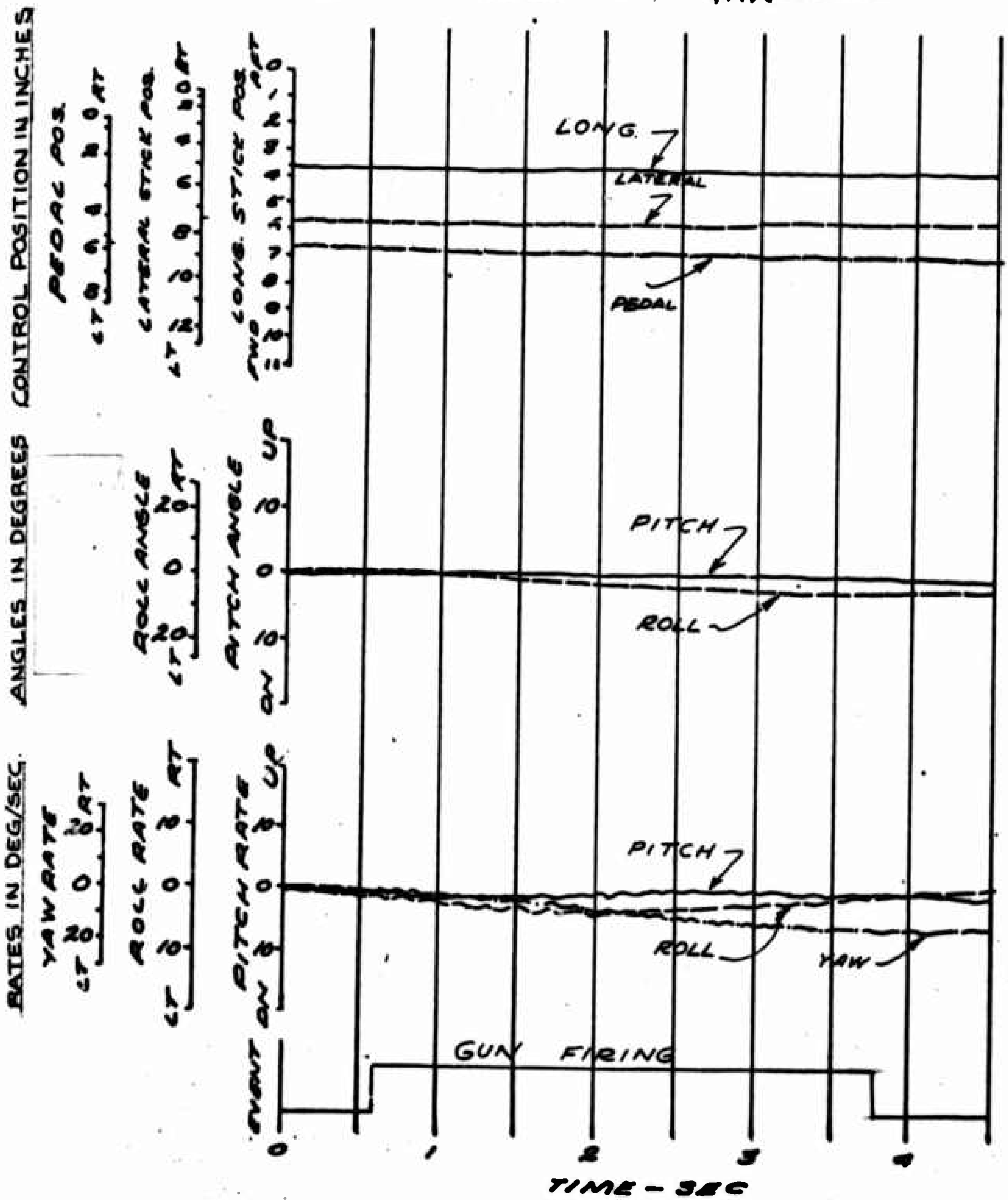

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FIG. NO. 19
CONTROL POSITIONS DURING GUN FIRING
RIGHT SIDEWARD FLIGHT (IGE)

OH-13H S/N57-6234

Vc-KT	Hp-FT	G.W.-LB	C.G.-IN	RPM
5 (EST.)	3050	2660	89.70 (MID)	344

CONDITION: BOTH GUNS FIRING - ZERO DEG. ELEVATION

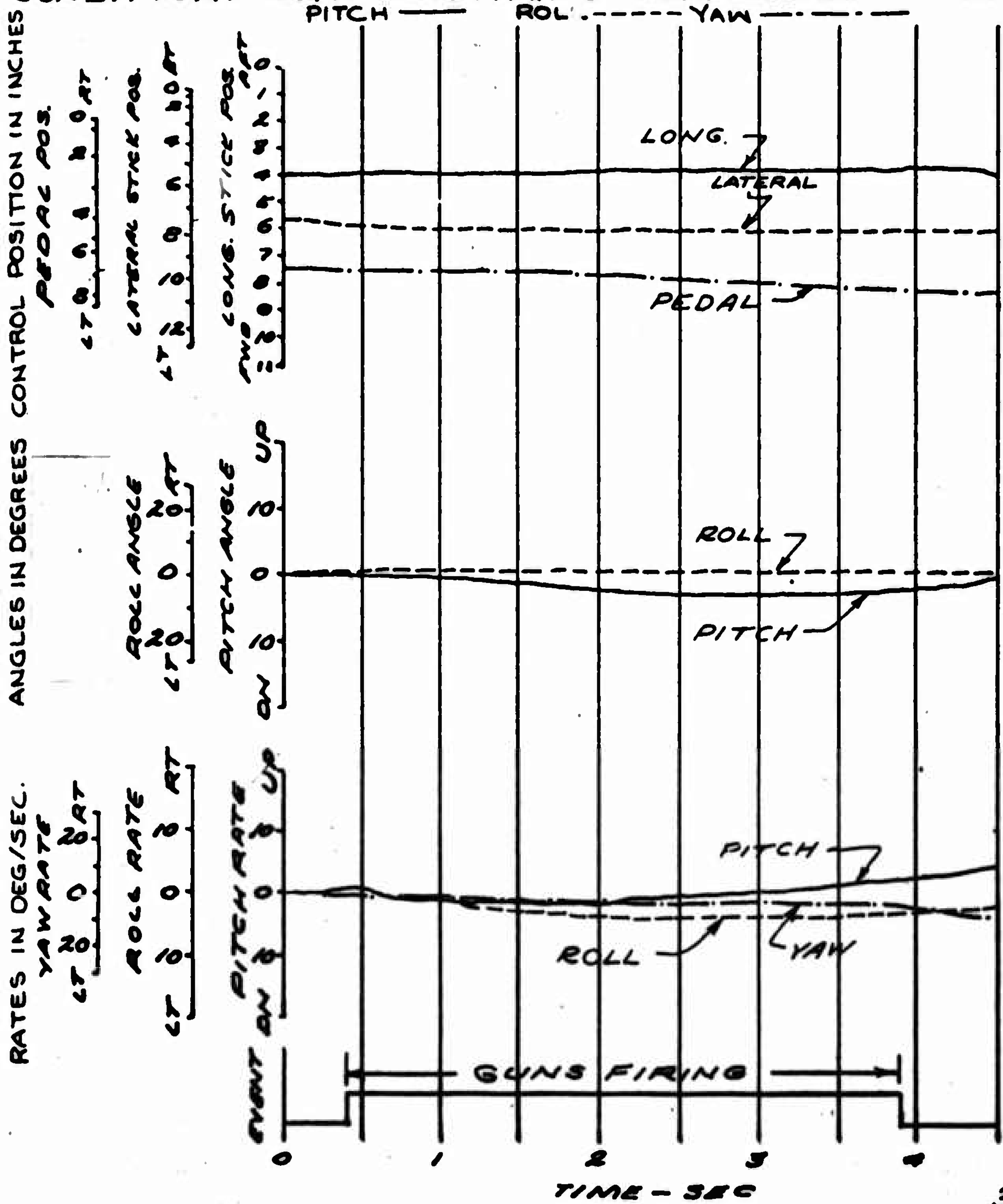

FIG. No. 20
CONTROL POSITIONS DURING GUN FIRING
RIGHT SIDEWARD FLIGHT (IGE)

OH-13H S/N 57-6234

Vc-KT	Hp-FT	G.W.-LB	C.G-IN	RPM
5	3050	2660	94.70 (MID)	344

CONDITION: BOTH GUNS FIRING - 9 DEG ELEVATION

PITCH —— ROLL ----- YAW —-—-—

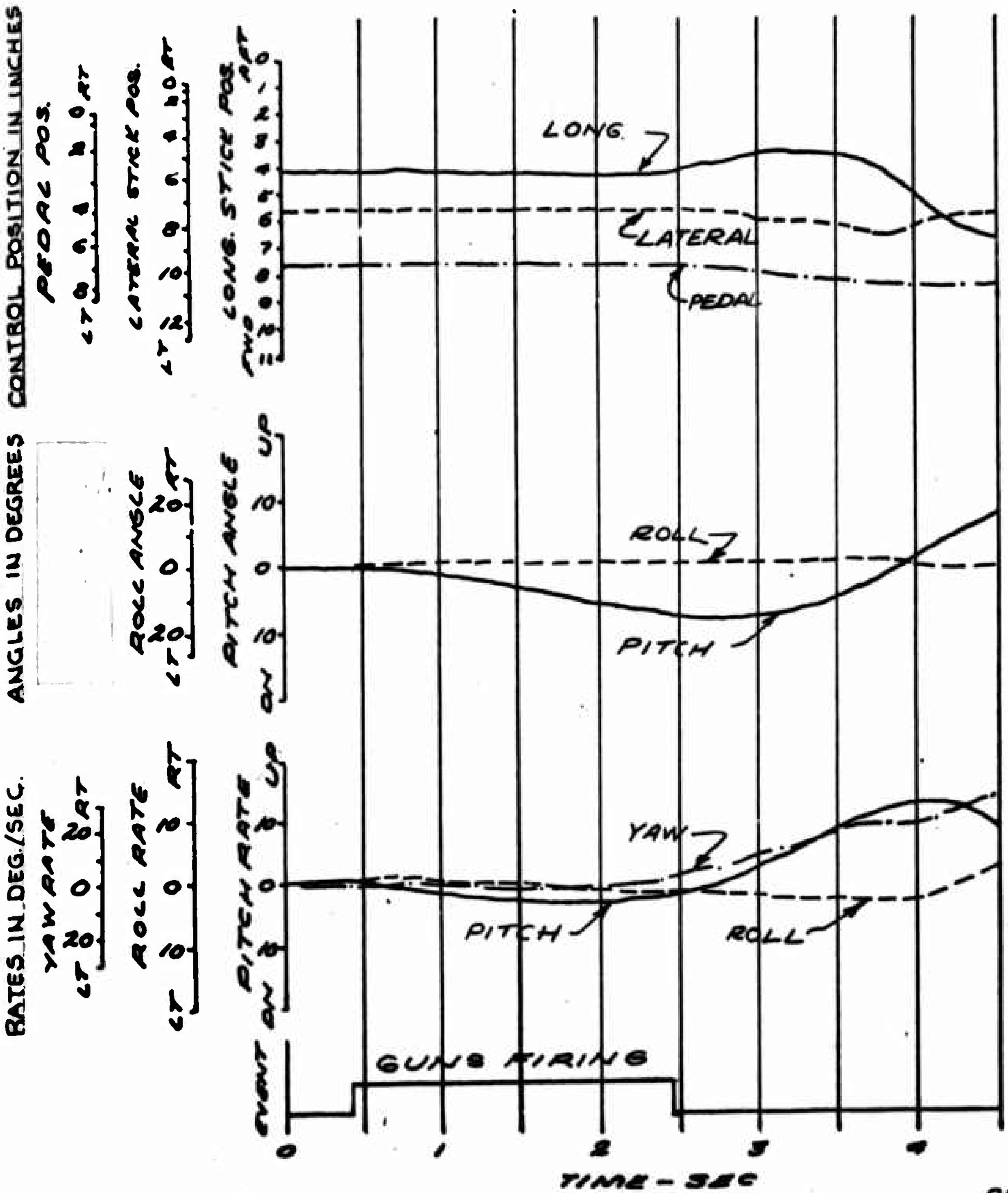

FIG. No. 21
CONTROL POSITIONS DURING GUN FIRING
LEFT SIDEWARD FLIGHT (IGE)

OH-13H S/N 67-6234

Vc-KT	Ho-FT	G.W.-LB	C.G-IN	RPM
5 (EST)	3050	2660	84.70 (MID)	394

CONDITION: BOTH GUNS FIRING - ZERO DEG. ELEVATION

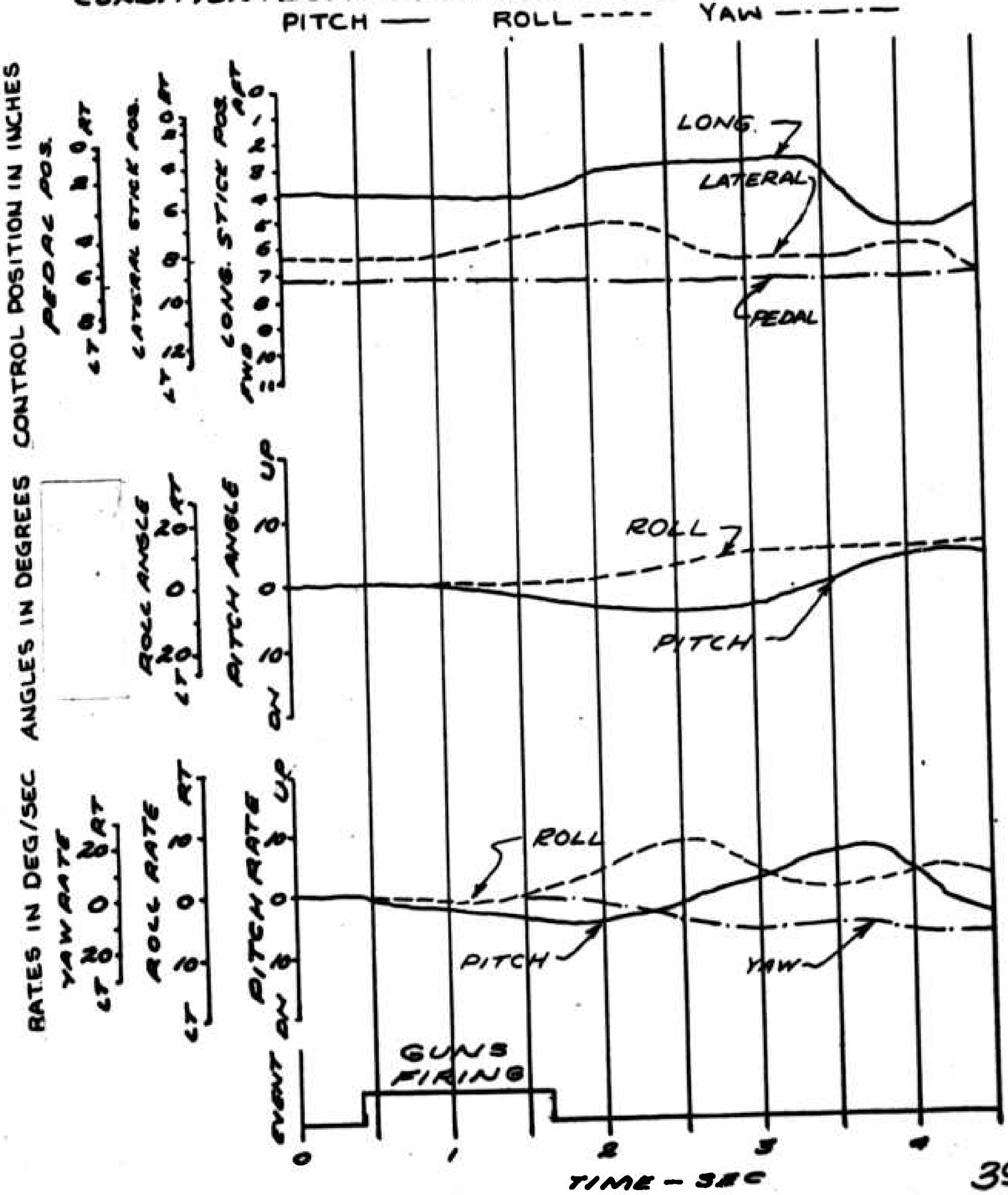

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FIG. No. 22

CONTROL POSITIONS DURING GUN FIRING
LEFT SIDEWARD FLIGHT (IGE)

OH-13H S/N 67-6234

Ve-KT	Ho-FT	G.W.-LB	C.G-IN	RPM
5	3050	2660	84.70(MID)	344

CONDITION: BOTH GUNS FIRING - 9 DEG. ELEVATION

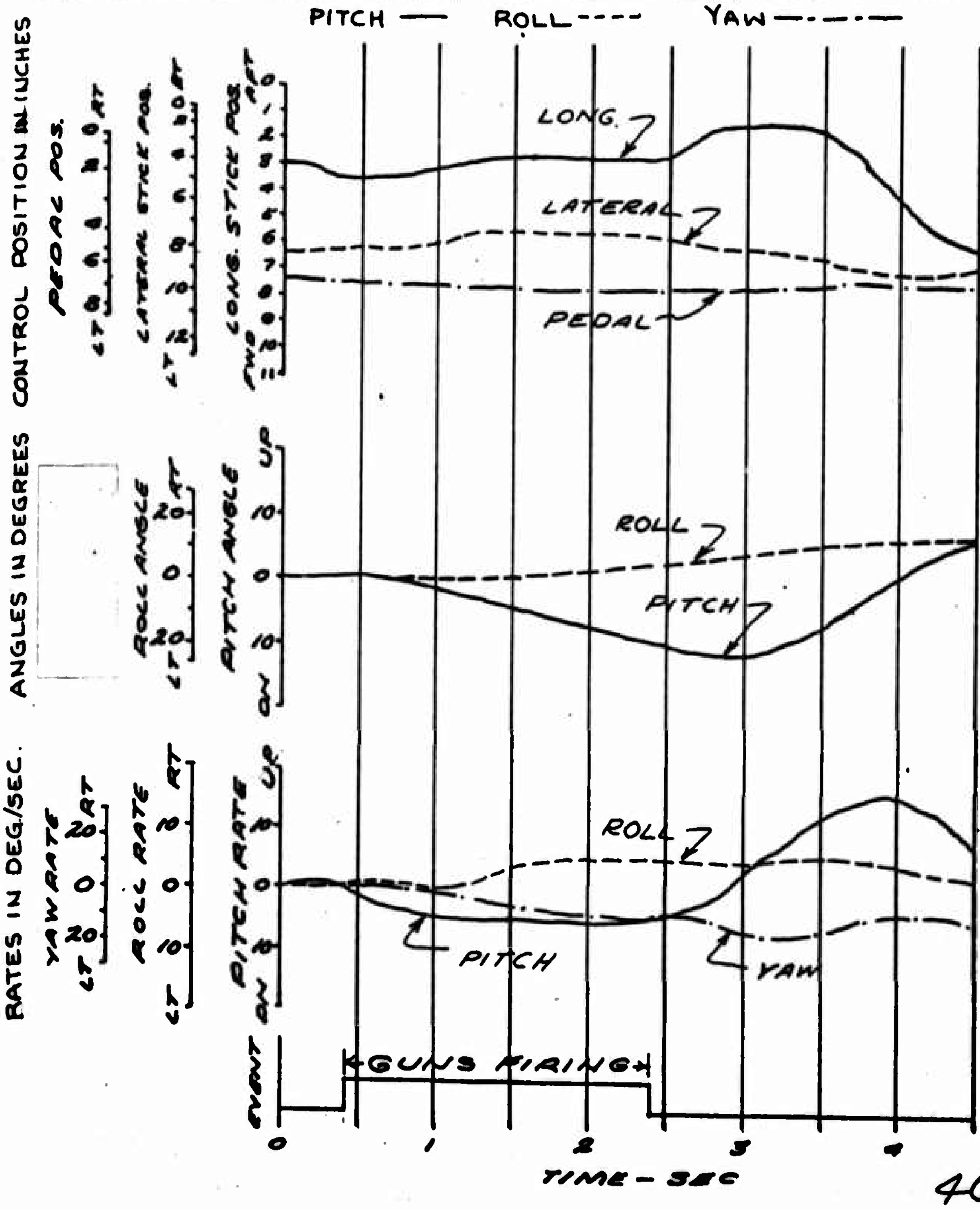

FIG. No. 23

CONTROL POSITIONS DURING GUN FIRING

TAKE-OFF (AT POINT OF TRANSITION)

OH-13H S/N 57-6234

Vc-KT	Hp-FT	G.W.-LB	C.G-IN	RPM
10-15 (EST)	3050	2660	84.70 (MID)	344

CONDITION: BOTH GUNS FIRING - 9 DEG ELEVATION

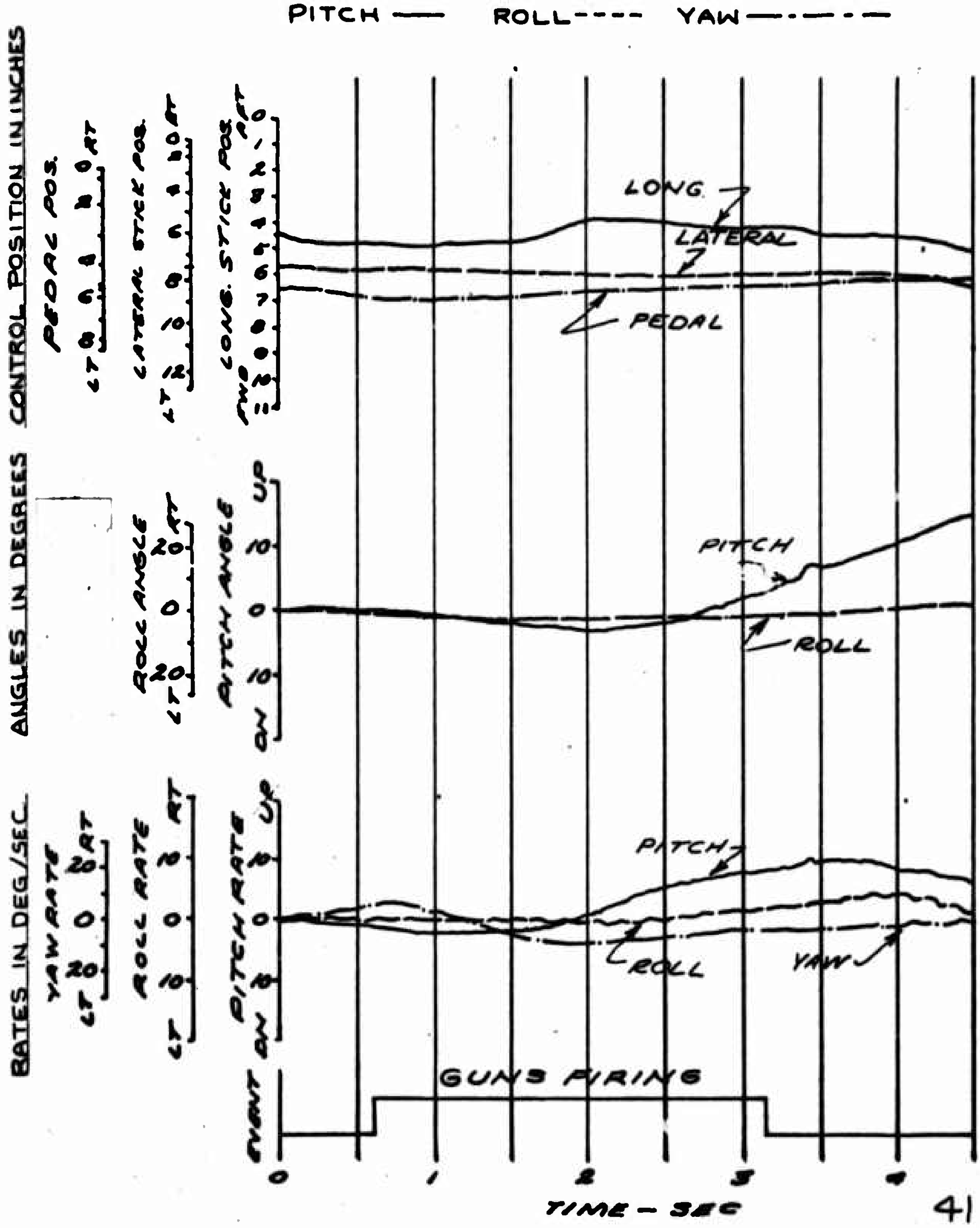

FIG. No. 24
CONTROL POSITIONS DURING GUN FIRING
FORWARD FLIGHT

OH-13H S/N 57-6234

V_c - KT	H_p - FT	G.W. - LB	C.G - IN	RPM
35	3050	2660	84.70 (MID)	344

CONDITION: BOTH GUNS FIRING - ZERO DEG ELEVATION

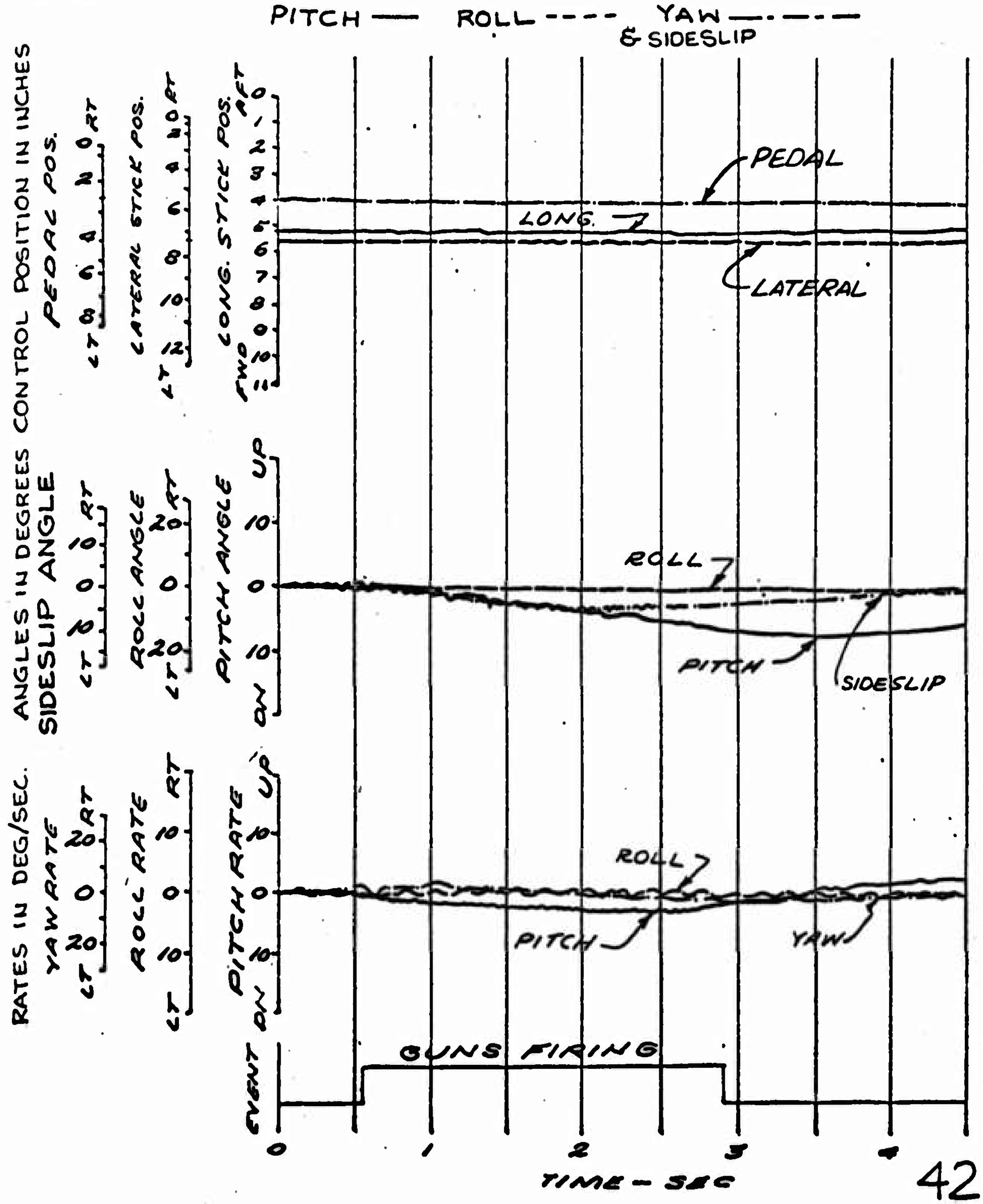

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FIG. No. 25
CONTROL POSITIONS DURING GUN FIRING
FORWARD FLIGHT

OH-13H S/N 57-6234

V_c - KT	H_o - FT	G.W. - LB	C.G. - IN	RPM
50	3050	2660	84.70 (MID)	344

CONDITION: BOTH GUNS FIRING - ZERO DEG. ELEVATION

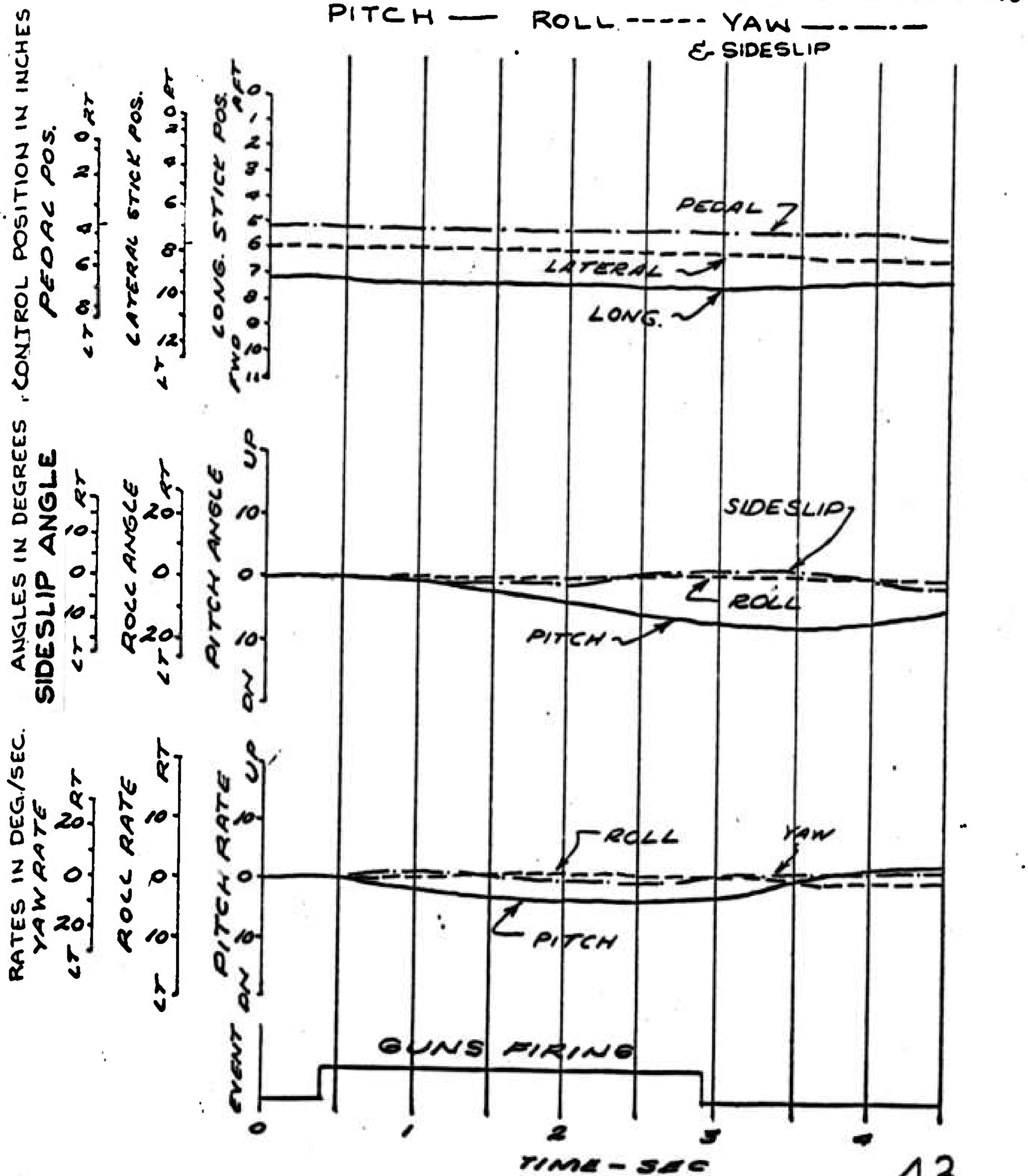

FIG. No. 26
CONTROL POSITIONS DURING GUN FIRING
FORWARD FLIGHT

OH-13H			S/N 57-6234	
V_e-KT	H_p-FT	G.W.-LB	C.G-IN	RPM
65	3050	2660	89.70 (MID)	344

CONDITION: BOTH GUNS FIRING - ZERO DEG. ELEVATION

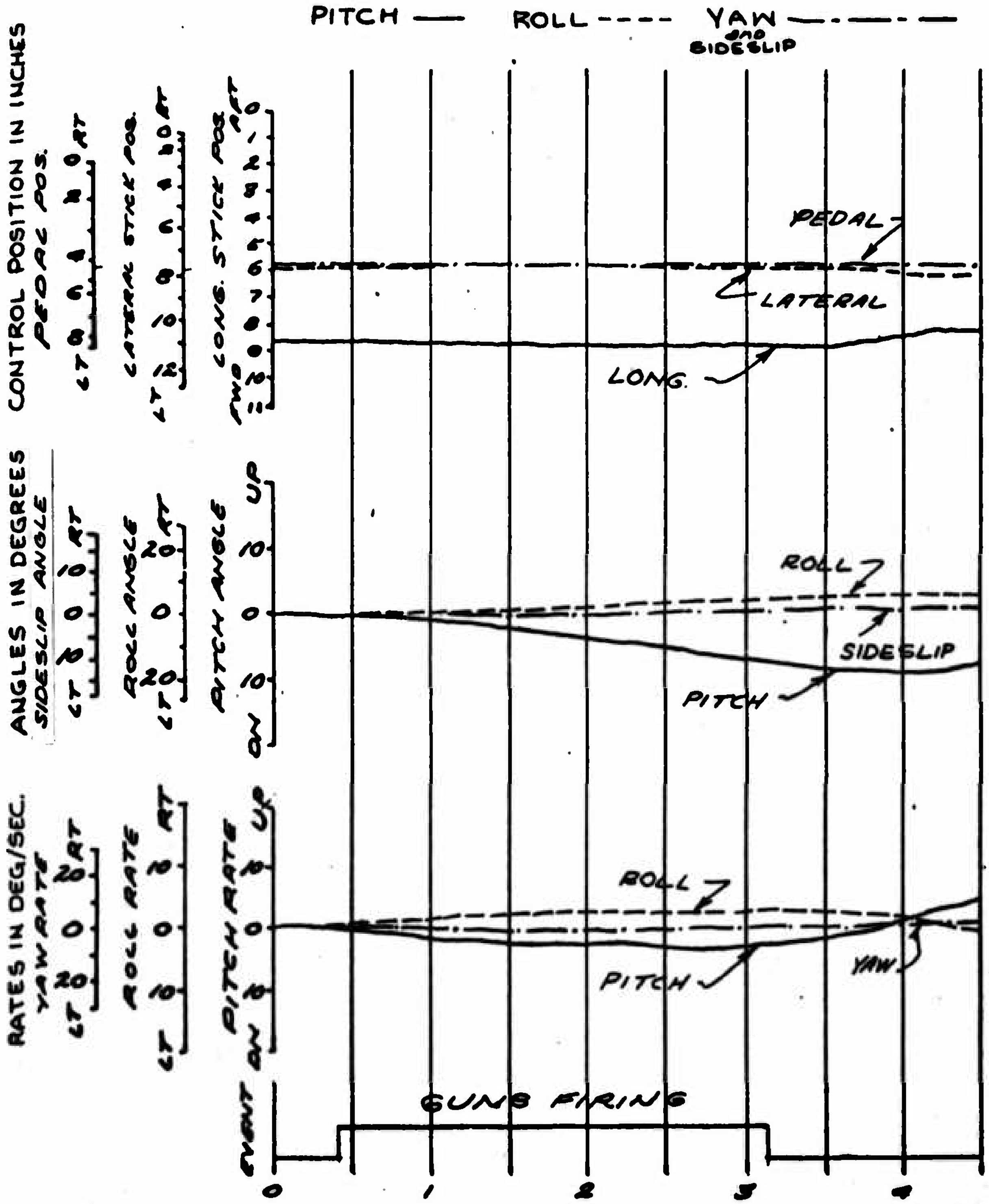

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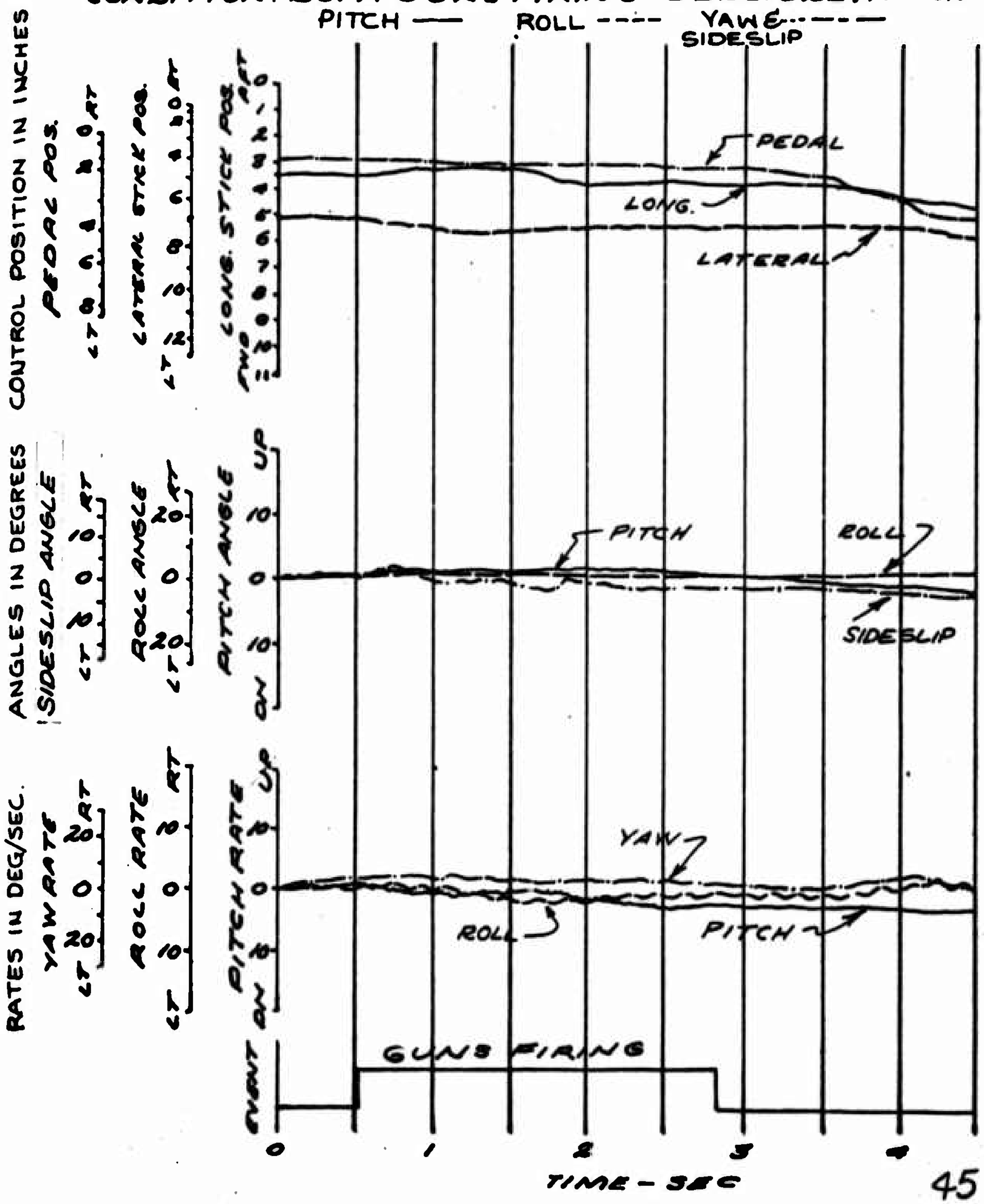
FIG. No. 27
CONTROL POSITIONS DURING GUN FIRING

LANDING APPROACH

OH-13H S/N 57-6234

Ve-KT	Ho-FT	G.W.-LB	C.G.-IN	RPM
20 (EST)	3050	2620	84.70 (MID)	344

CONDITION: BOTH GUNS FIRING - 8 DEG. ELEVATION



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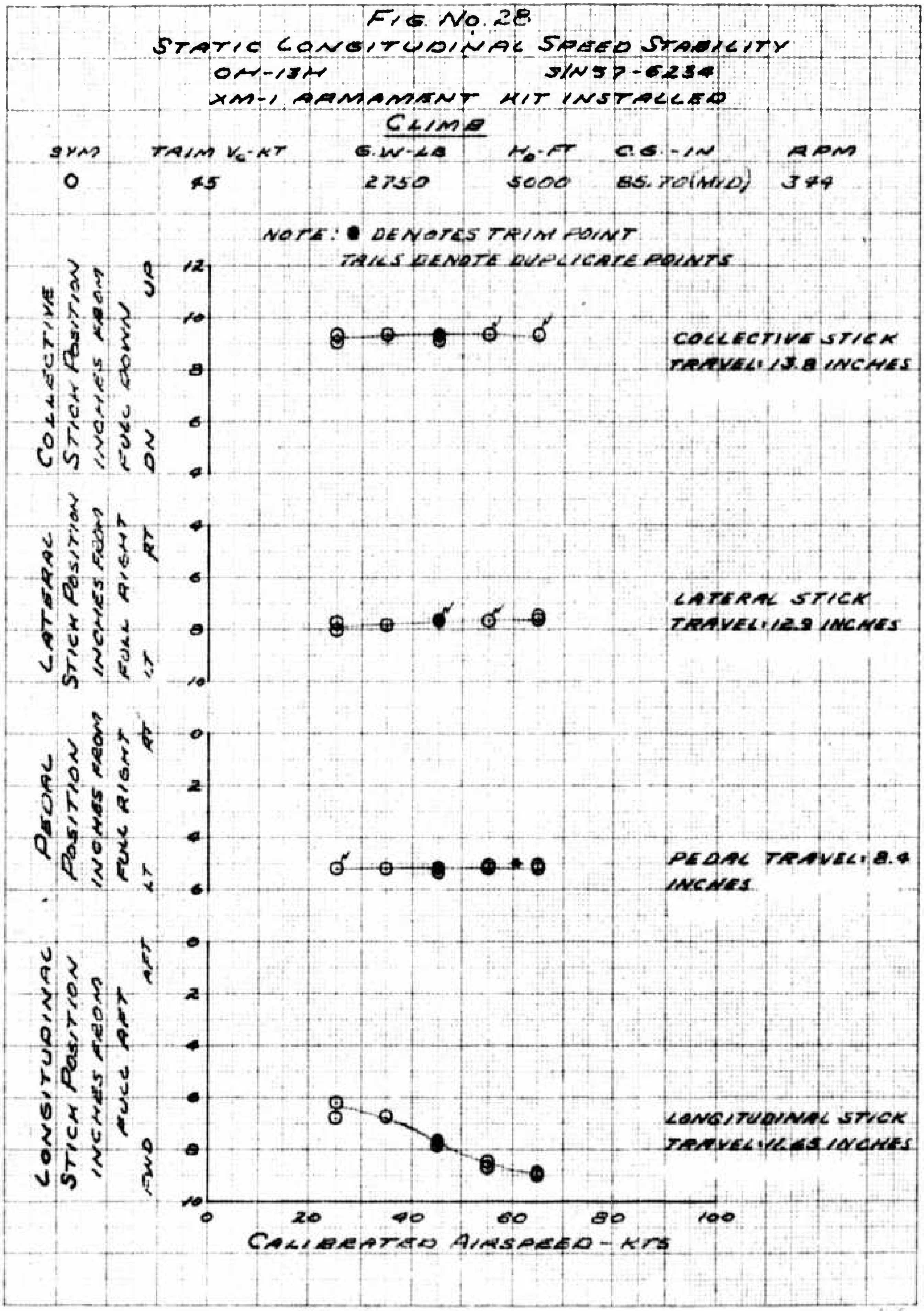
FIG. NO. 28
STATIC LONGITUDINAL SPEED STABILITY
OH-13H S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED
CLIMB
SYM TRIM Vc-KT G.W-LB Hp-FT C.G.-IN RPM
O 45 2750 5000 85.70(MID) 344
NOTE: ● DENOTES TRIM POINT
TAILS DENOTE DUPLICATE POINTS
COLLECTIVE STICK POSITION INCHES FROM FULL DOWN
DN UP
COLLECTIVE STICK TRAVEL: 13.8 INCHES
LATERAL STICK POSITION INCHES FROM FULL RIGHT
LT RT
LATERAL STICK TRAVEL: 12.9 INCHES
PEDAL POSITION INCHES FROM FULL RIGHT
LT RT
PEDAL TRAVEL: 8.4 INCHES
LONGITUDINAL STICK POSITION INCHES FROM FULL AFT
FWD AFT
LONGITUDINAL STICK TRAVEL: 11.65 INCHES
CALIBRATED AIRSPEED - KTS
0 20 40 60 80 100

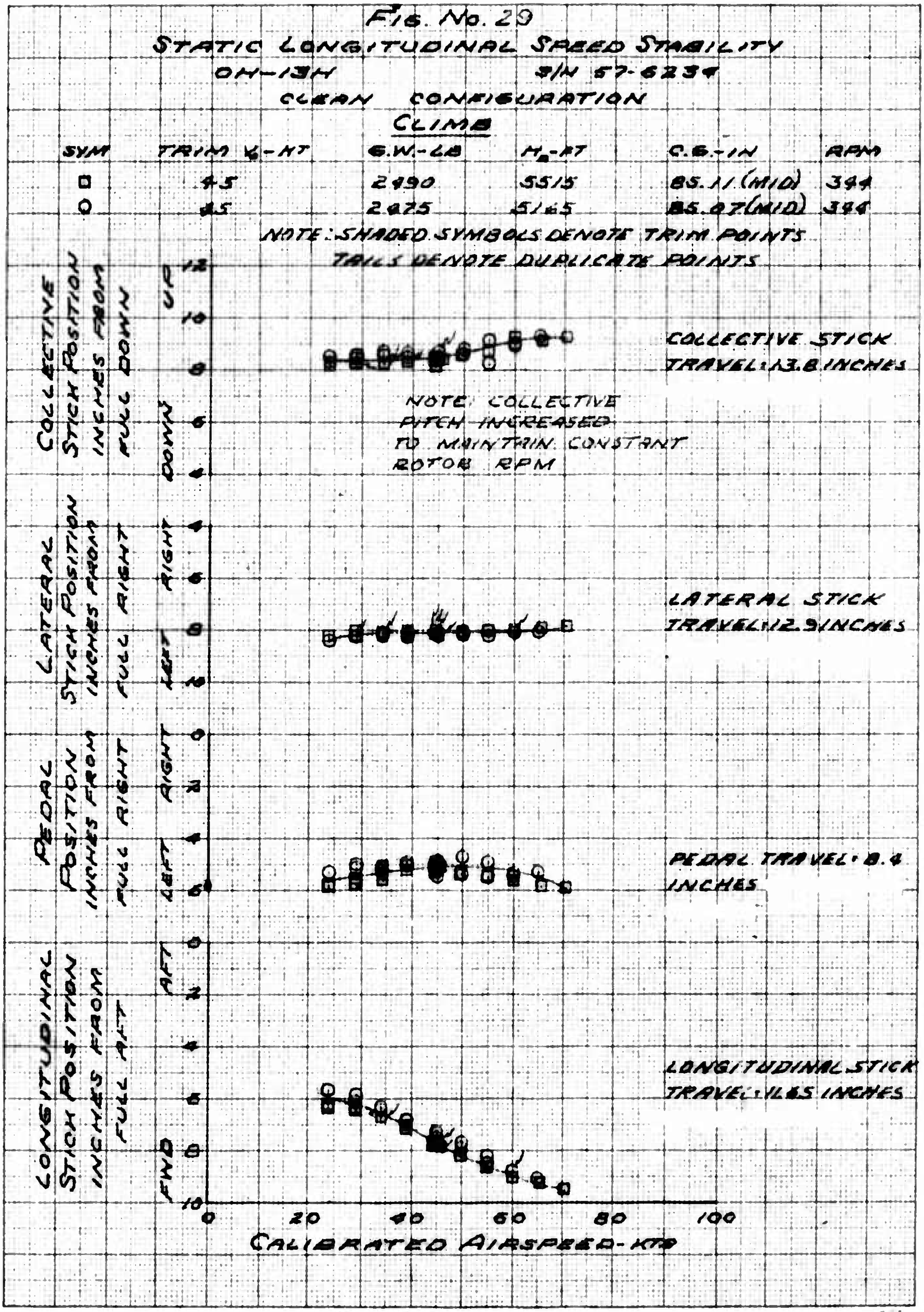

FIG. No. 29
STATIC LONGITUDINAL SPEED STABILITY
OH-13H S/N 57-6234
CLEAN CONFIGURATION
CLIMB
SYM TRIM V_c-KT G.W.-LB H_D-FT C.G.-IN RPM
□ 45 2490 5515 85.11 (MID) 344
○ 45 2475 5165 85.07 (MID) 344
NOTE: SHADED SYMBOLS DENOTE TRIM POINTS
TAILS DENOTE DUPLICATE POINTS
COLLECTIVE STICK POSITION INCHES FROM FULL DOWN
UP
DOWN
COLLECTIVE STICK TRAVEL: 13.8 INCHES
NOTE: COLLECTIVE PITCH INCREASED TO MAINTAIN CONSTANT ROTOR RPM
LATERAL STICK POSITION INCHES FROM FULL RIGHT
RIGHT
LEFT
LATERAL STICK TRAVEL: 12.9 INCHES
PEDAL POSITION INCHES FROM FULL RIGHT
RIGHT
LEFT
PEDAL TRAVEL: 8.4 INCHES
LONGITUDINAL STICK POSITION INCHES FROM FULL AFT
AFT
FWD
LONGITUDINAL STICK TRAVEL: 11.65 INCHES
0
20
40
60
80
100
CALIBRATED AIRSPEED-KTS

FIG No 30

STATIC LONGITUDINAL SPEED STABILITY

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

LEVEL FLIGHT

SYM	TRIM V_c-KT	G.W. -LB	H_D- FT	C.G-IN.	RPM
O	35	2750	5000	85.70 (MID)	344

NOTE: ● DENOTES TRIM POINT
O' DENOTES DUPLICATE POINTS

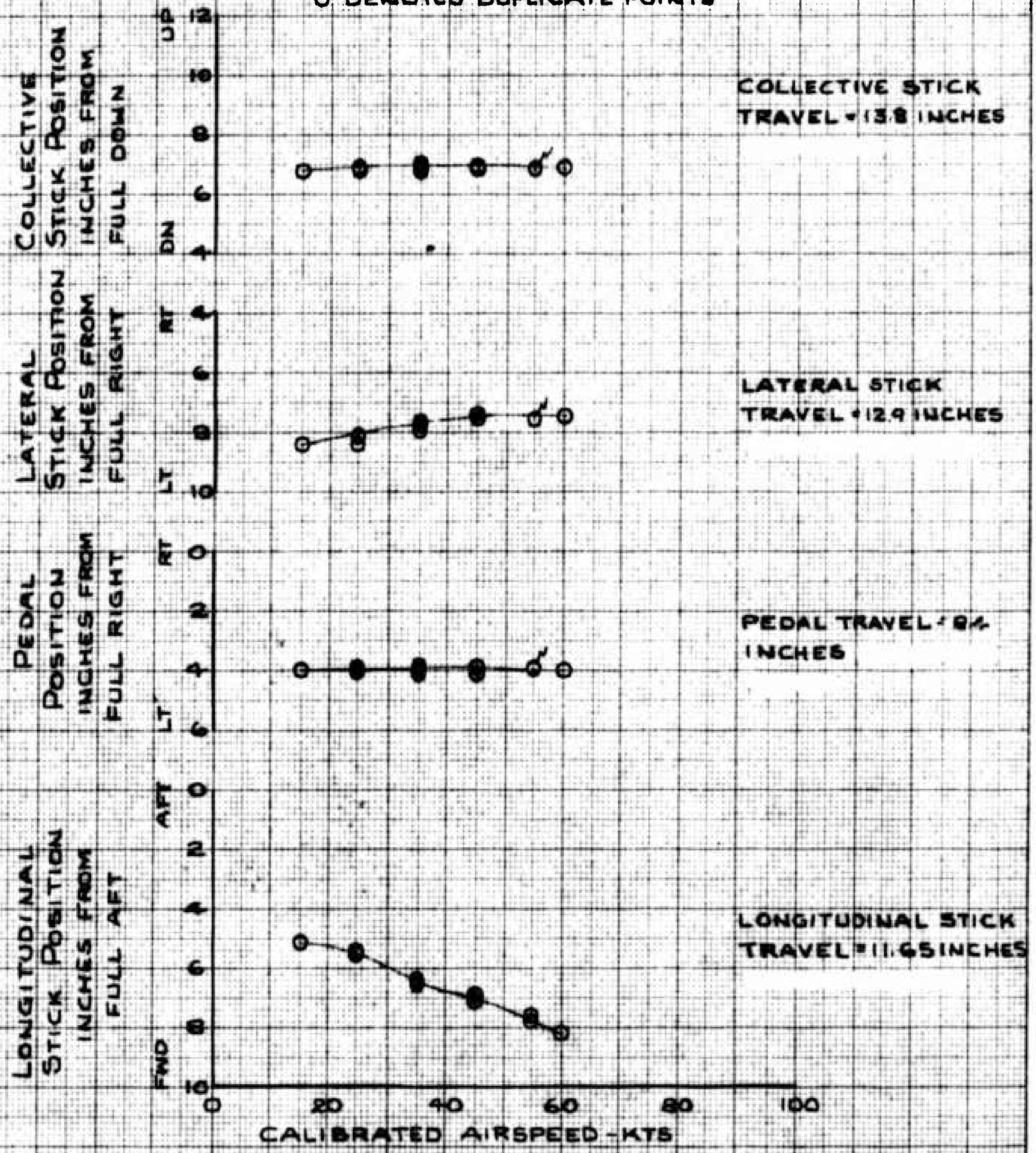

FIG. NO. 31

STATIC LONGITUDINAL SPEED STABILITY

OH-13H S/N 57-6234

CLEAN CONFIGURATION

LEVEL FLIGHT

SYM	TRIM V_c-KT	G.W-LB	H_p-FT	C.G-IN	RPM
○	34	2490	5200	85.11 (MID)	344
□	34	2475	4950	85.07 (MID)	344

NOTE: SHADED SYMBOLS DENOTE TRIM POINTS
TAILS DENOTE DUPLICATE POINTS

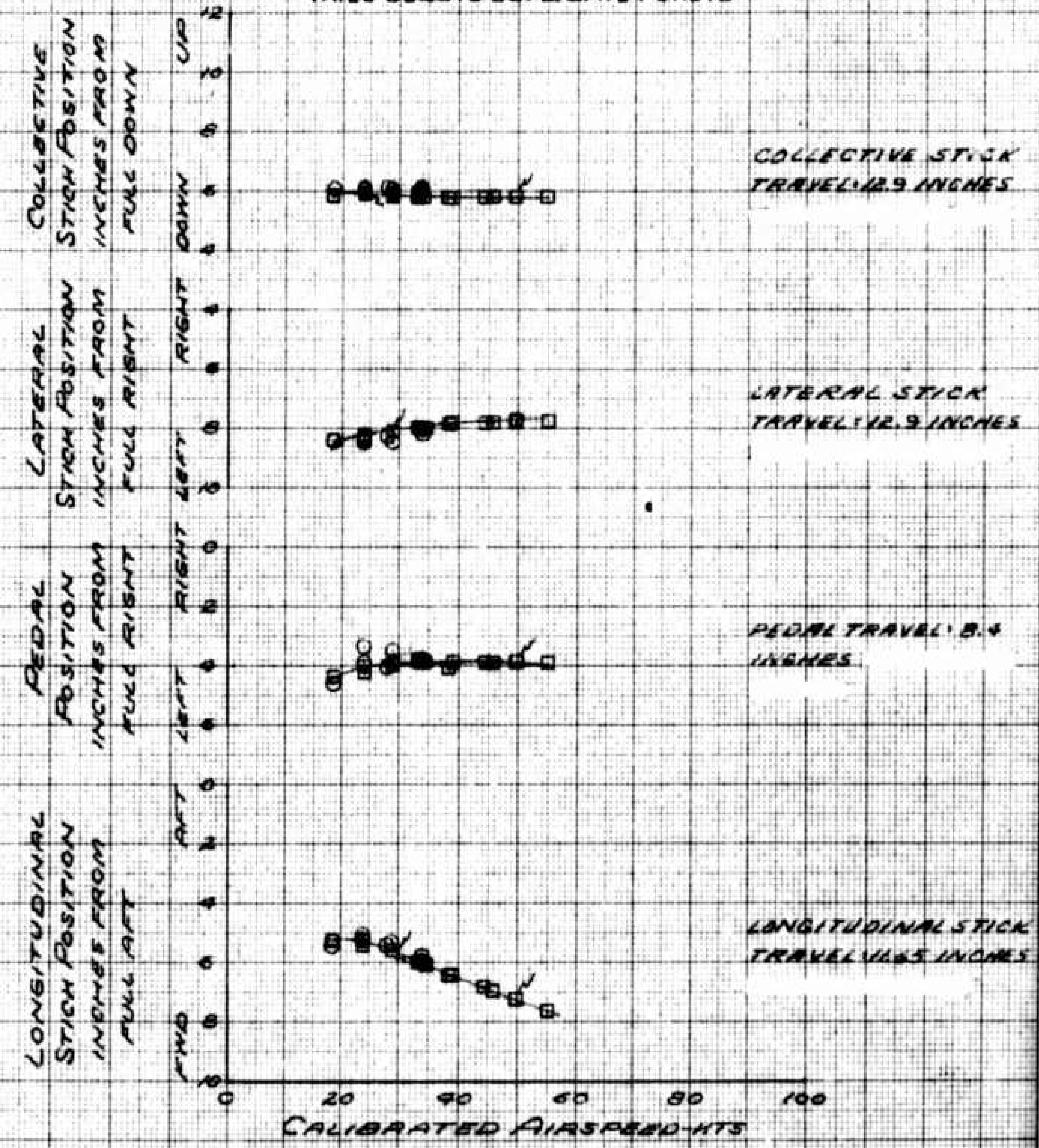

FIG. NO. 32

STATIC LONGITUDINAL SPEED STABILITY

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

LEVEL FLIGHT

SYM	TRIM V_c-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
O	65	2750	5000	85.7 (MID)	344

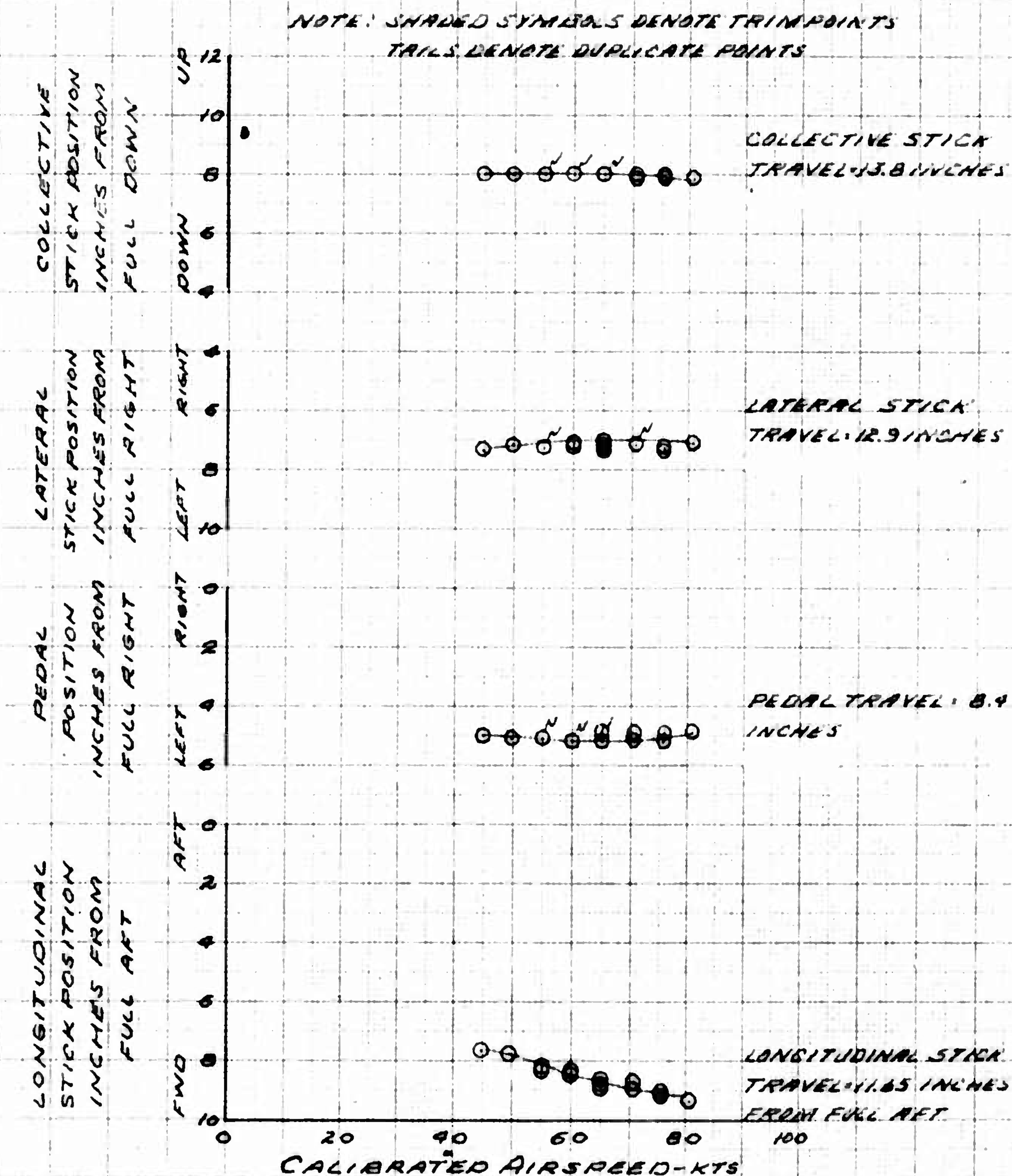

Fig No 33

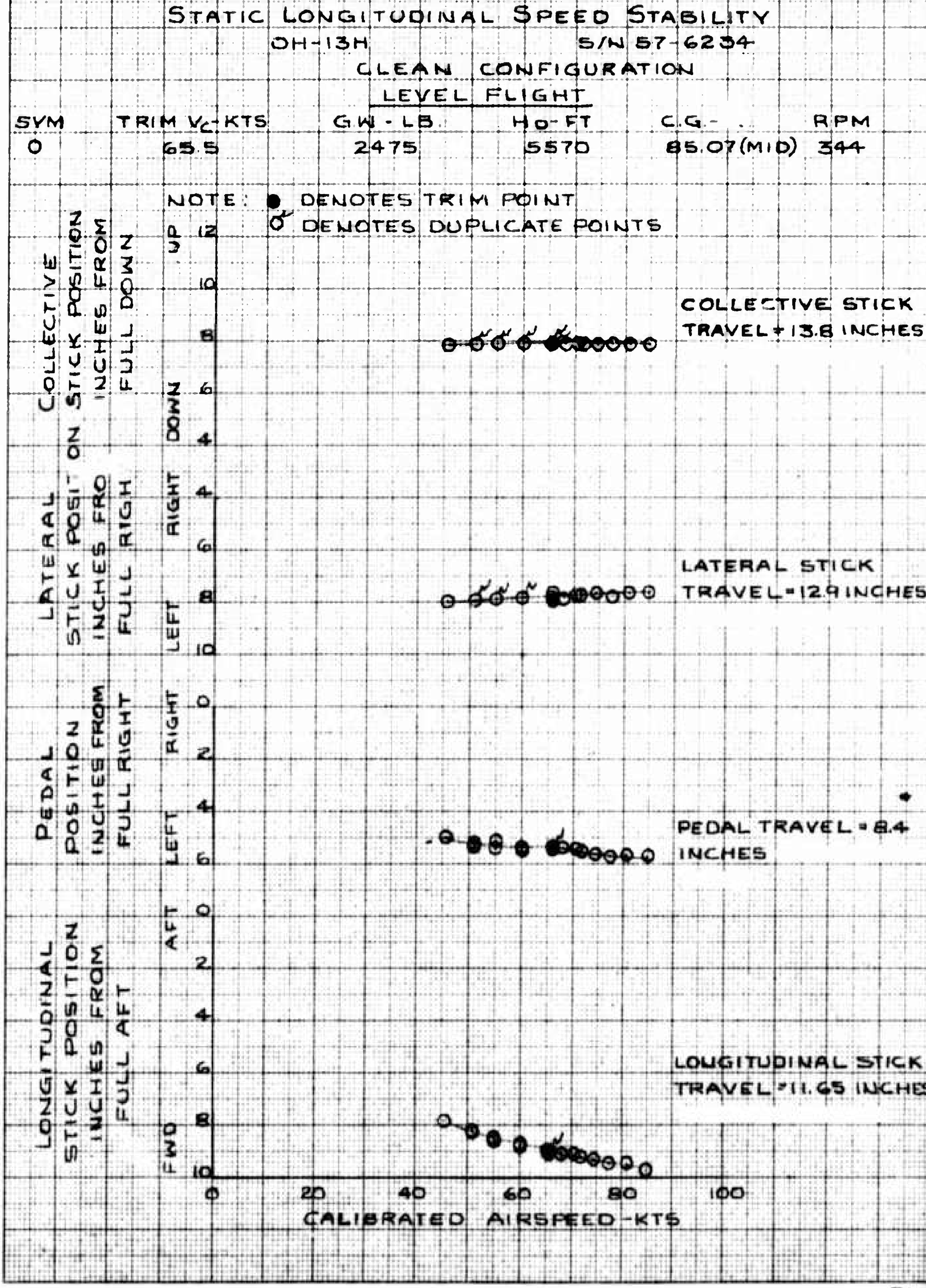

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FIG. No. 34

STATIC LONGITUDINAL SPEED STABILITY

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

AUTOROTATION

SYM	TRIM V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
○	55	2750	5000	85.7(MID)	344

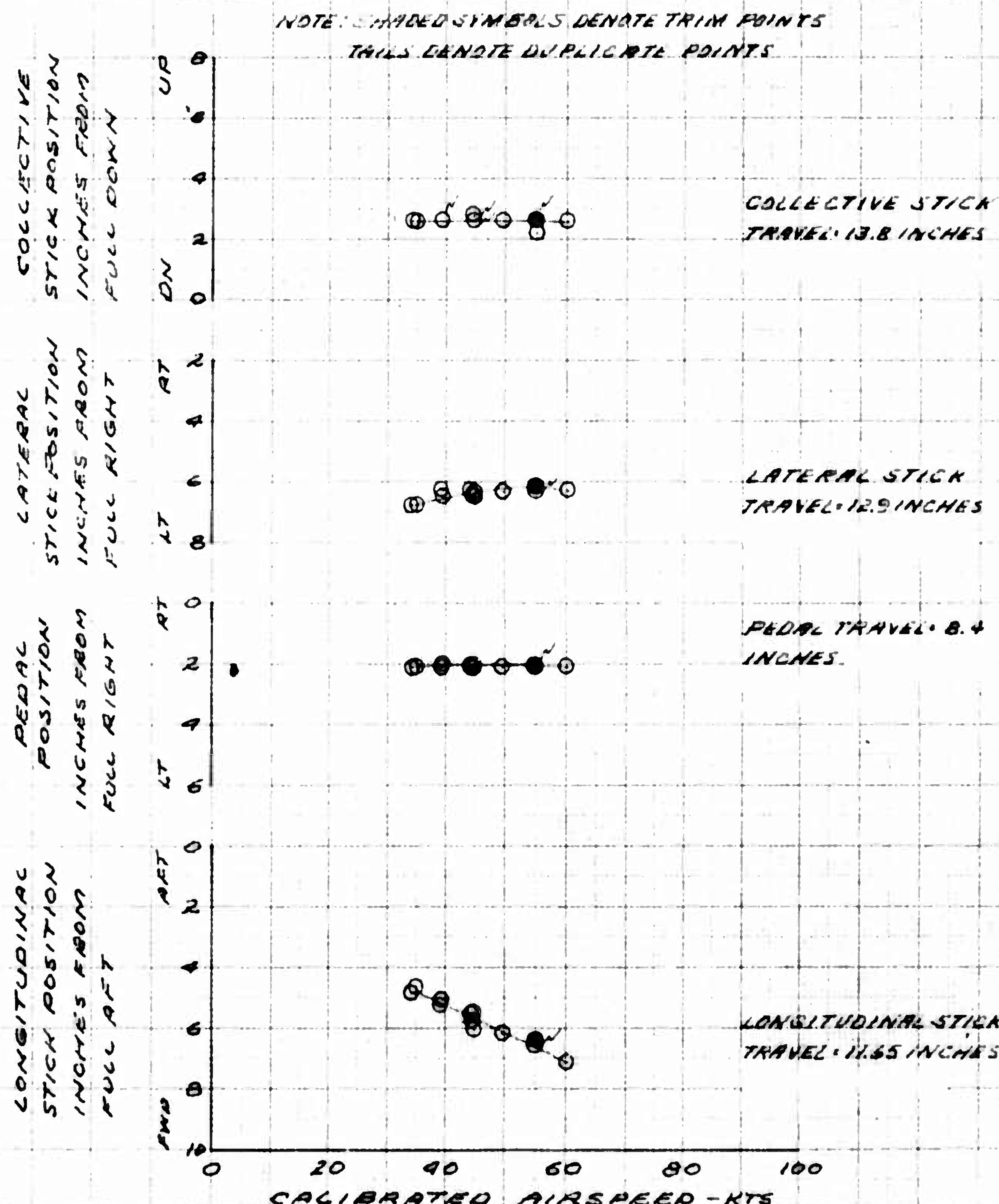

FIG. NO 35

STATIC LONGITUDINAL SPEED STABILITY

OH-13H S/N 57-6234

CLEAN CONFIGURATION

AUTOROTATION

SYM	TRIM V_c-K	G.W-LB	H_D-FT	CG-IN	RPM
○	54	2490	4440	85.11(MID)	344
□	54	2475	5100	85.07(MID)	344

NOTE: TAILS DENOTE DUPLICATE POINTS
SHADED SYMBOLS DENOTE TRIM POINTS

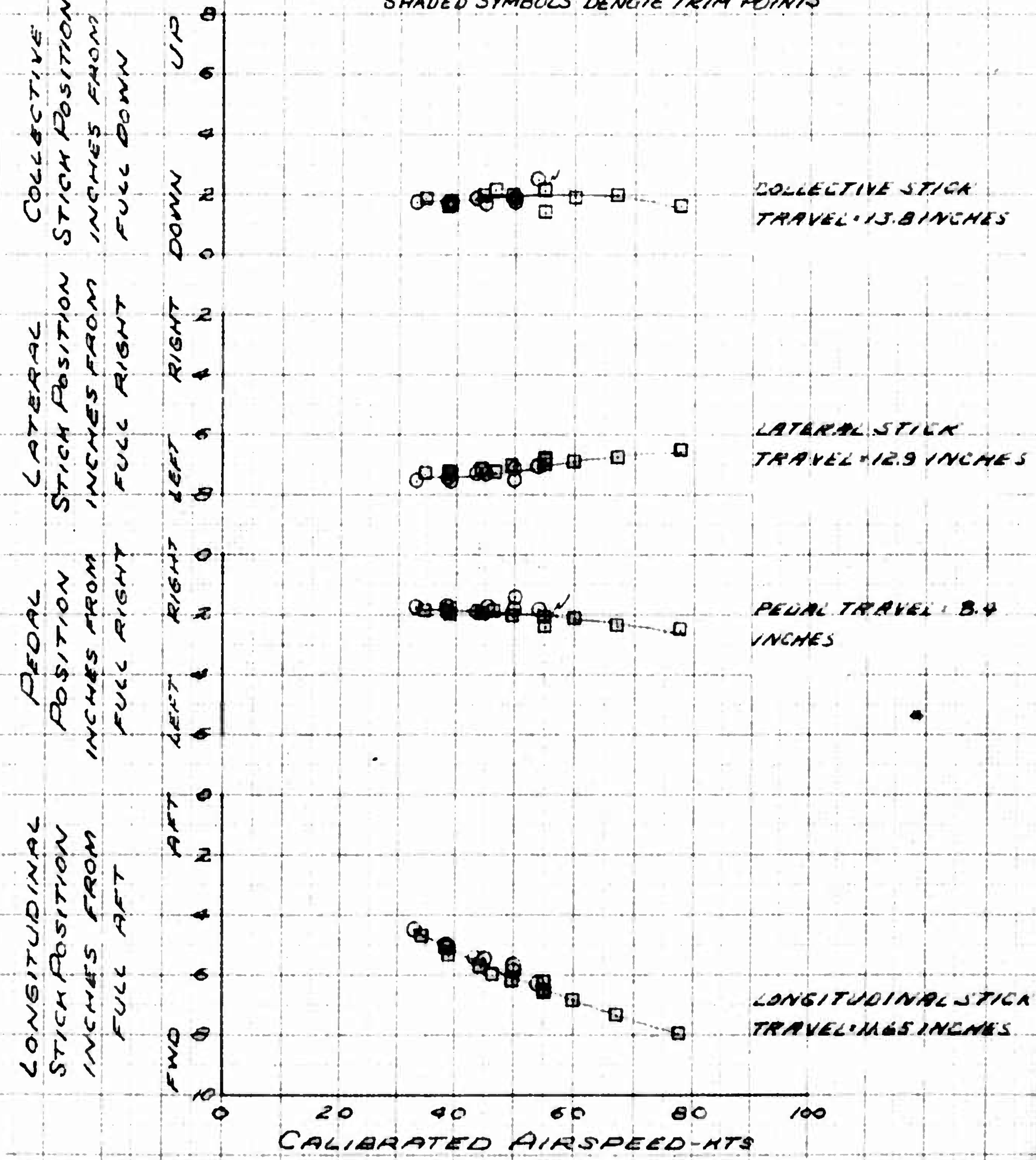

FIG. No. 36
RESPONSE TO AN AFT LONGITUDINAL PULSE IN CLIMB
OH-13H S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
45	5075	2745	85.65(MID)	344

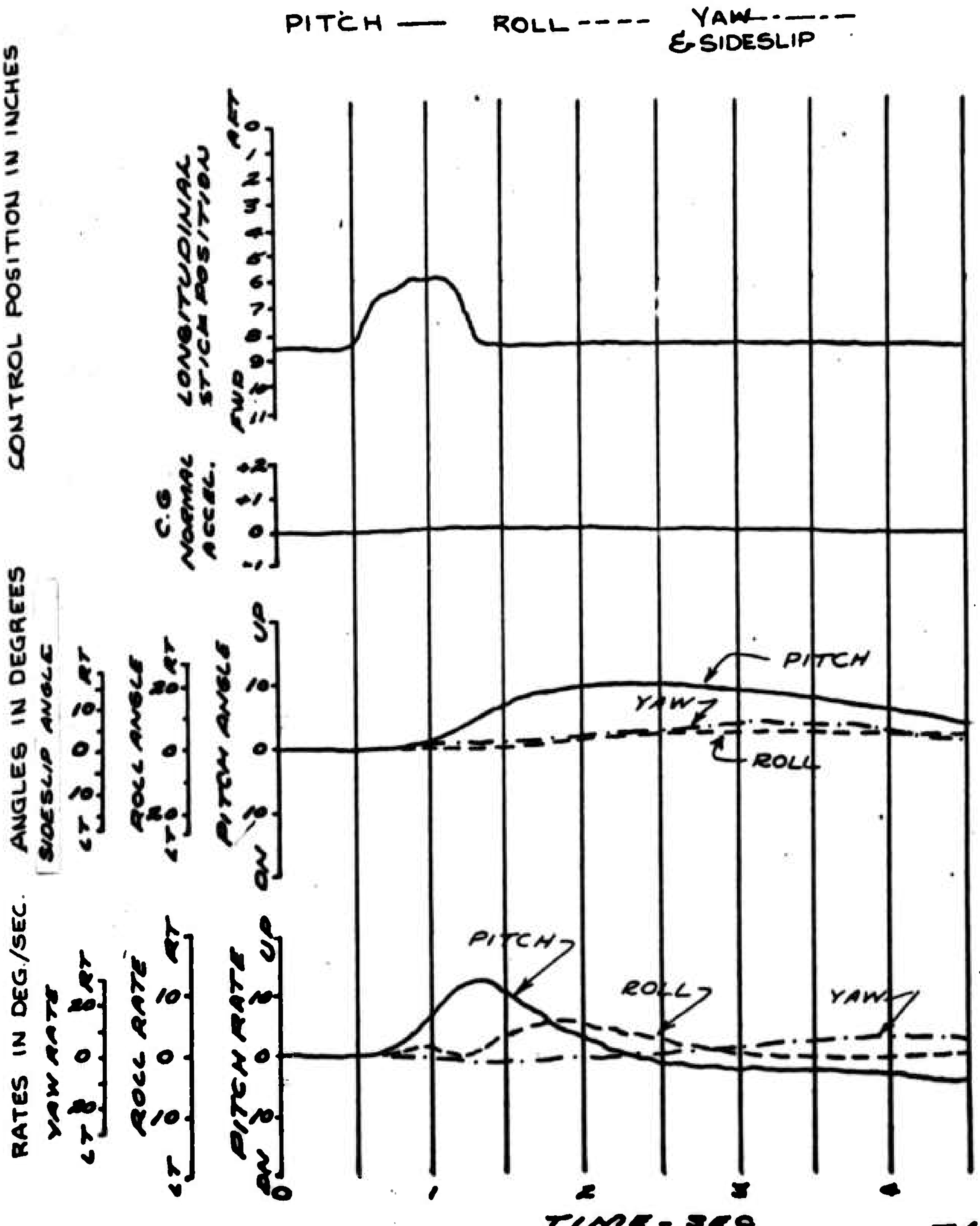

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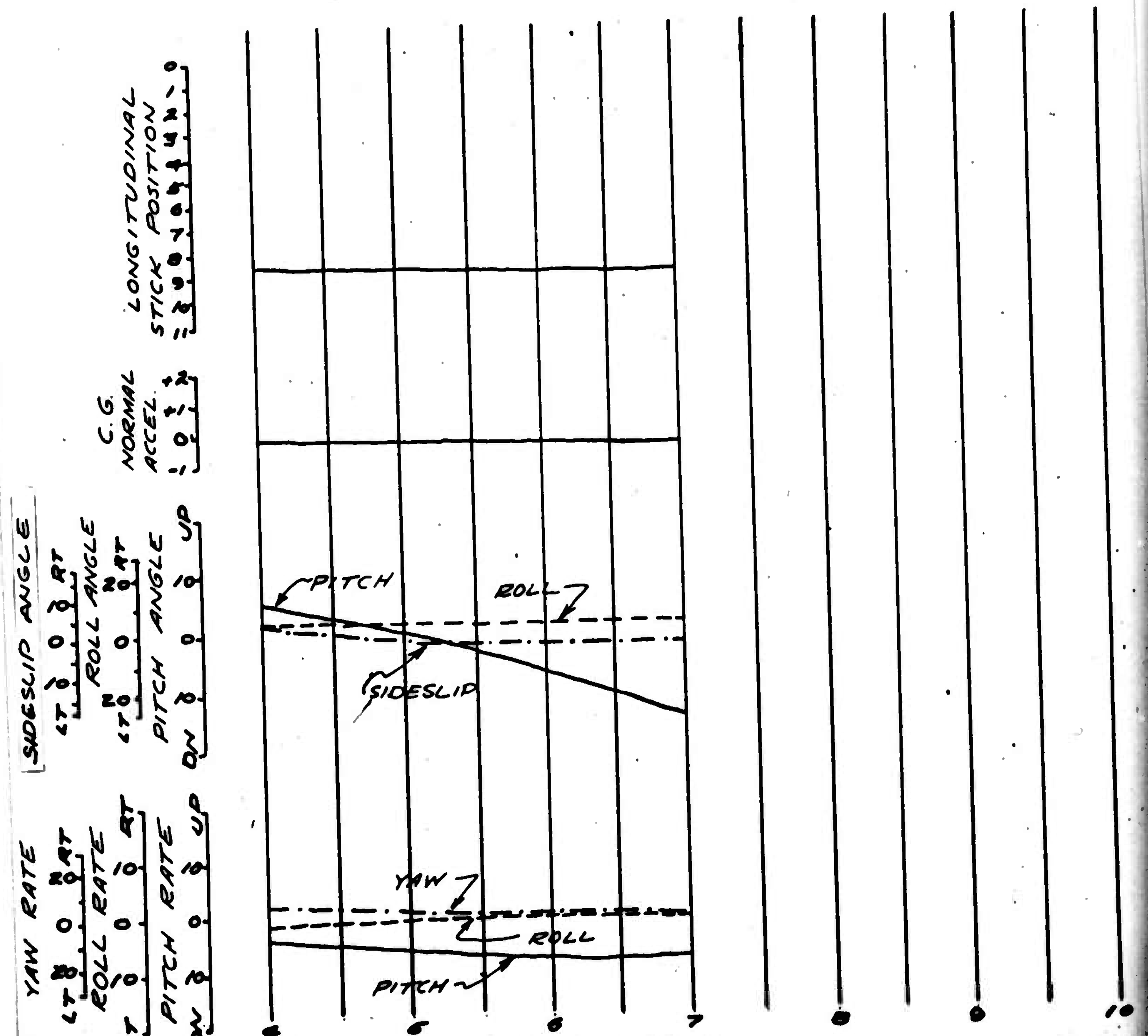
FIG. No. 36 (CONT.)



FLT 9
002

FIG. No. 37

RESPONSE TO AN AFT LONGITUDINAL PULSE IN CLIMB

OH-13H S/N 57-6234

CLEAN CONFIGURATION

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
45	5000	2490	85.05 (MID)	344

PITCH —— ROLL ---- YAW & SIDESLIP —·—·—

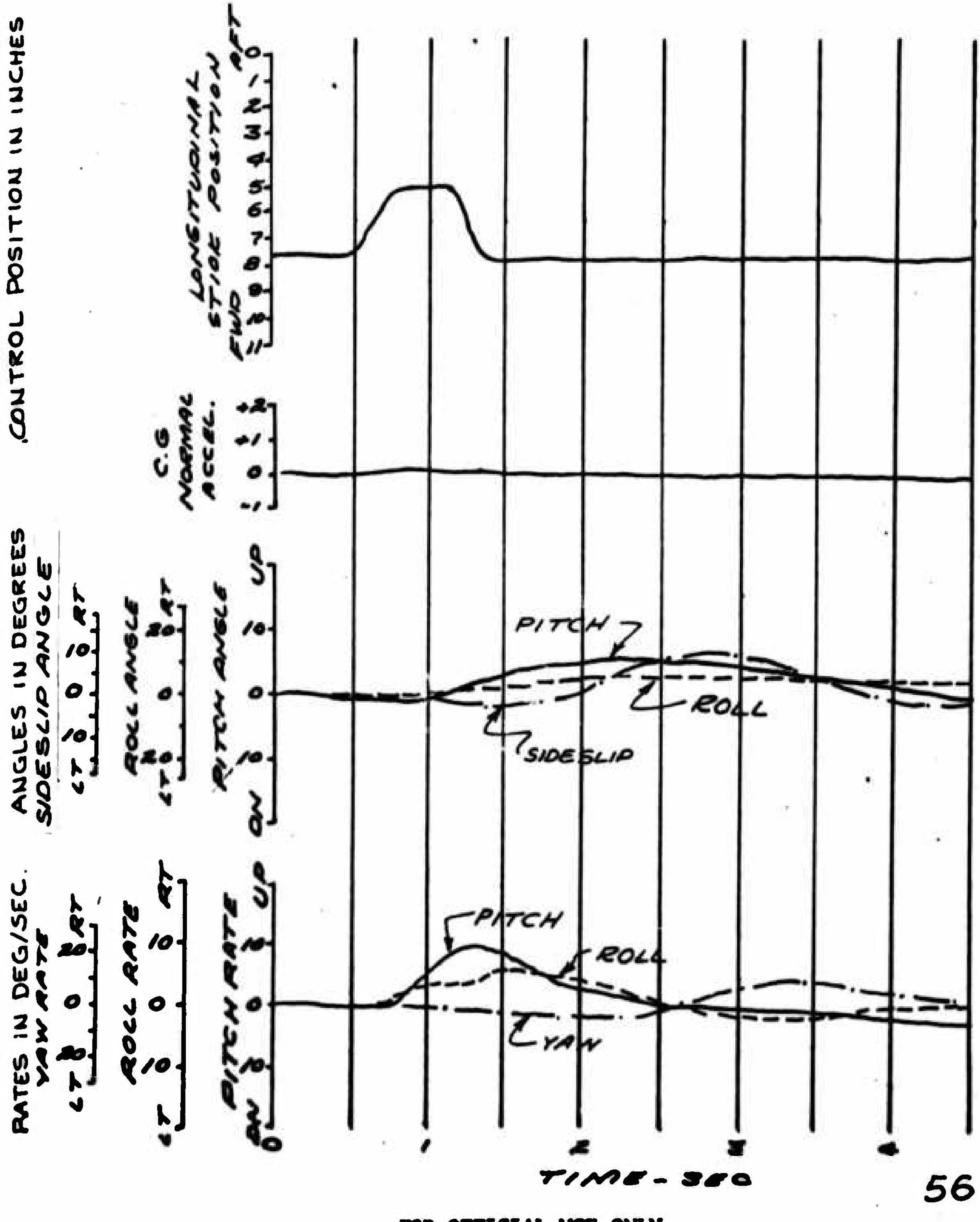


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FIG. No. 37 (CONT.)

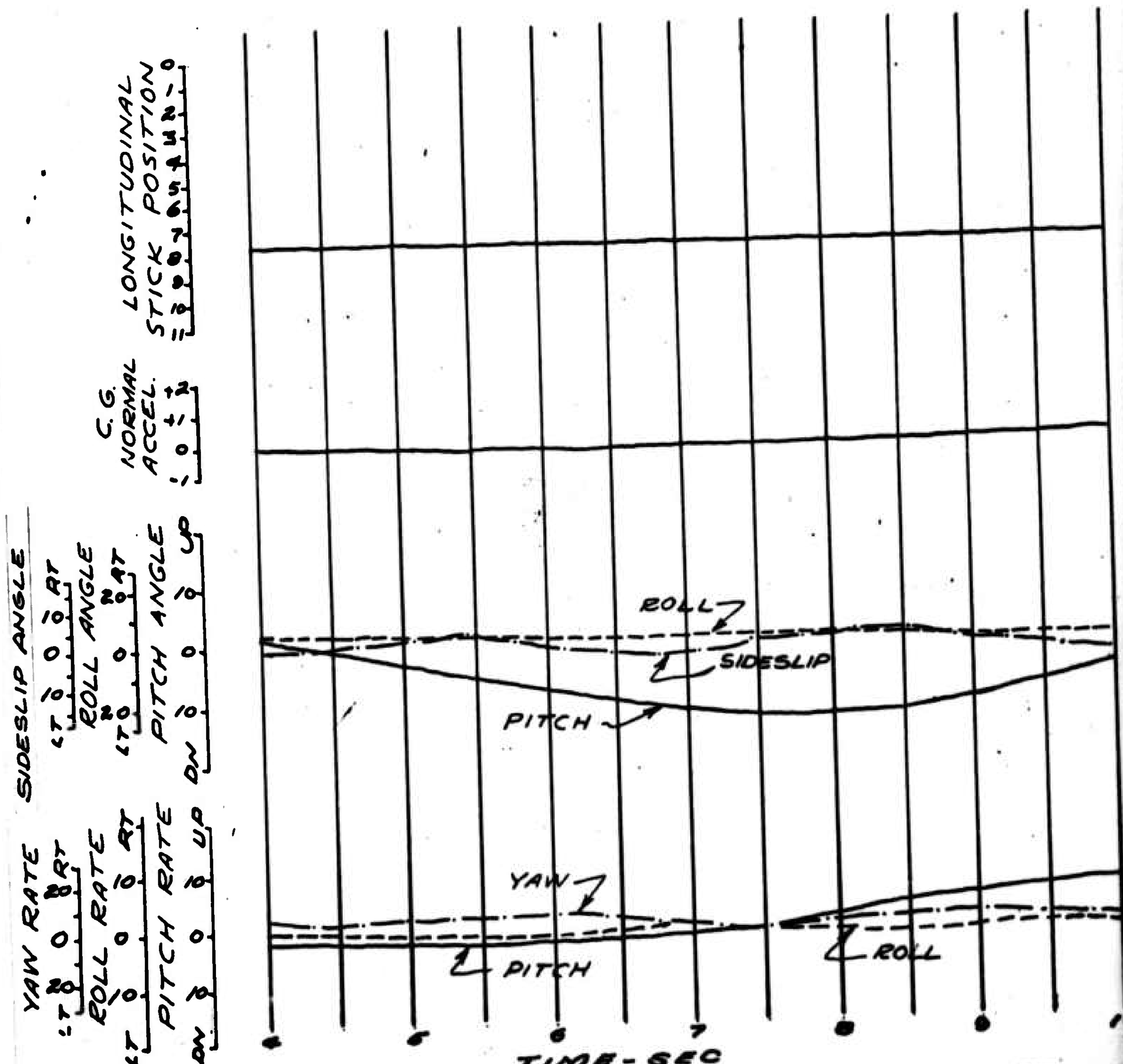

FIG. No. 38

RESPONSE TO A FORWARD LONGITUDINAL PULSE IN CLIMB

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_o-FT	G.W.-LB	C.G-IN.	RPM
45	5000	2745	95.65 (MID)	344

PITCH —— ROLL ---- YAW & SIDESLIP —·—·—

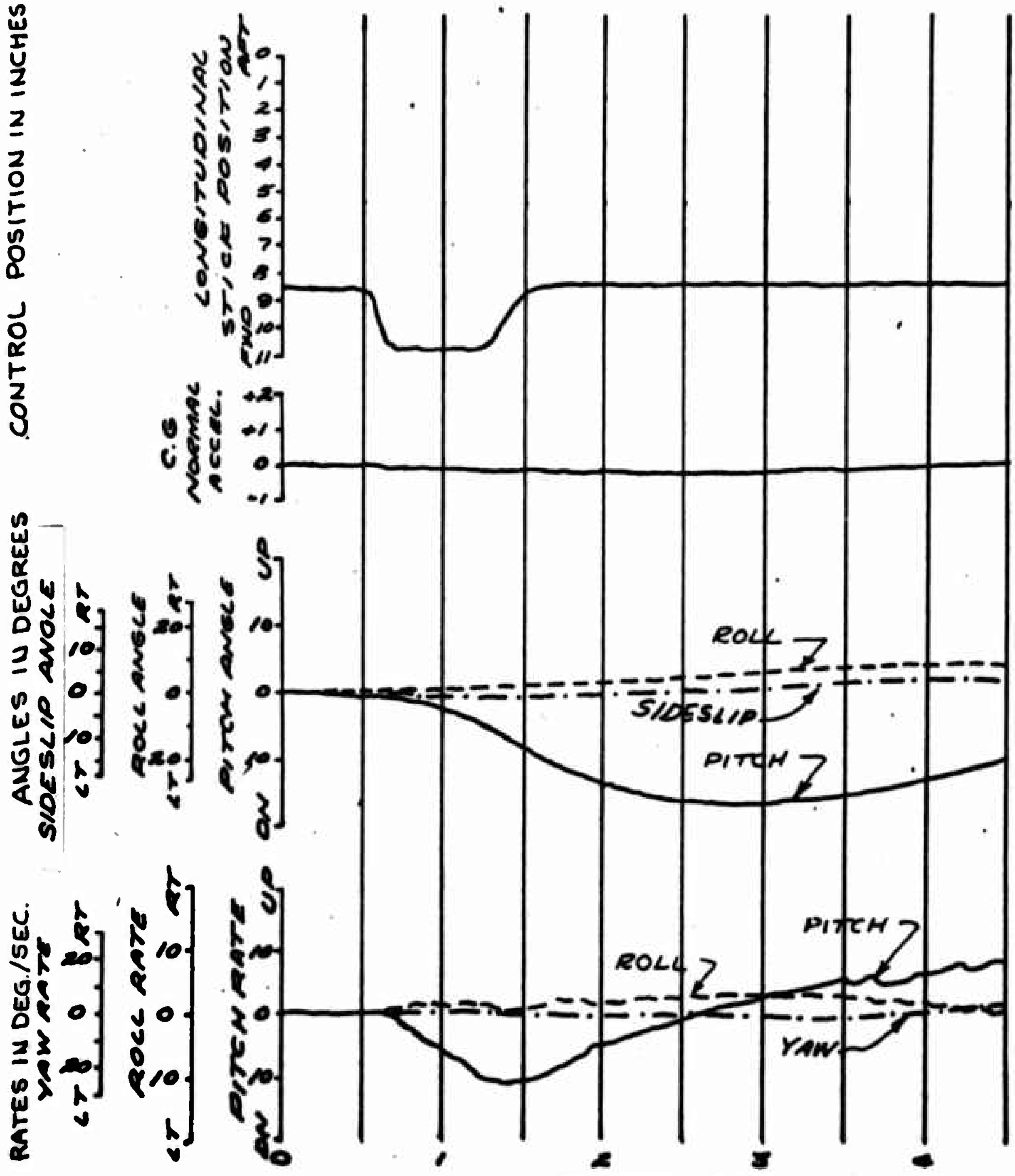

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FIG. No. 38 (CONT.)

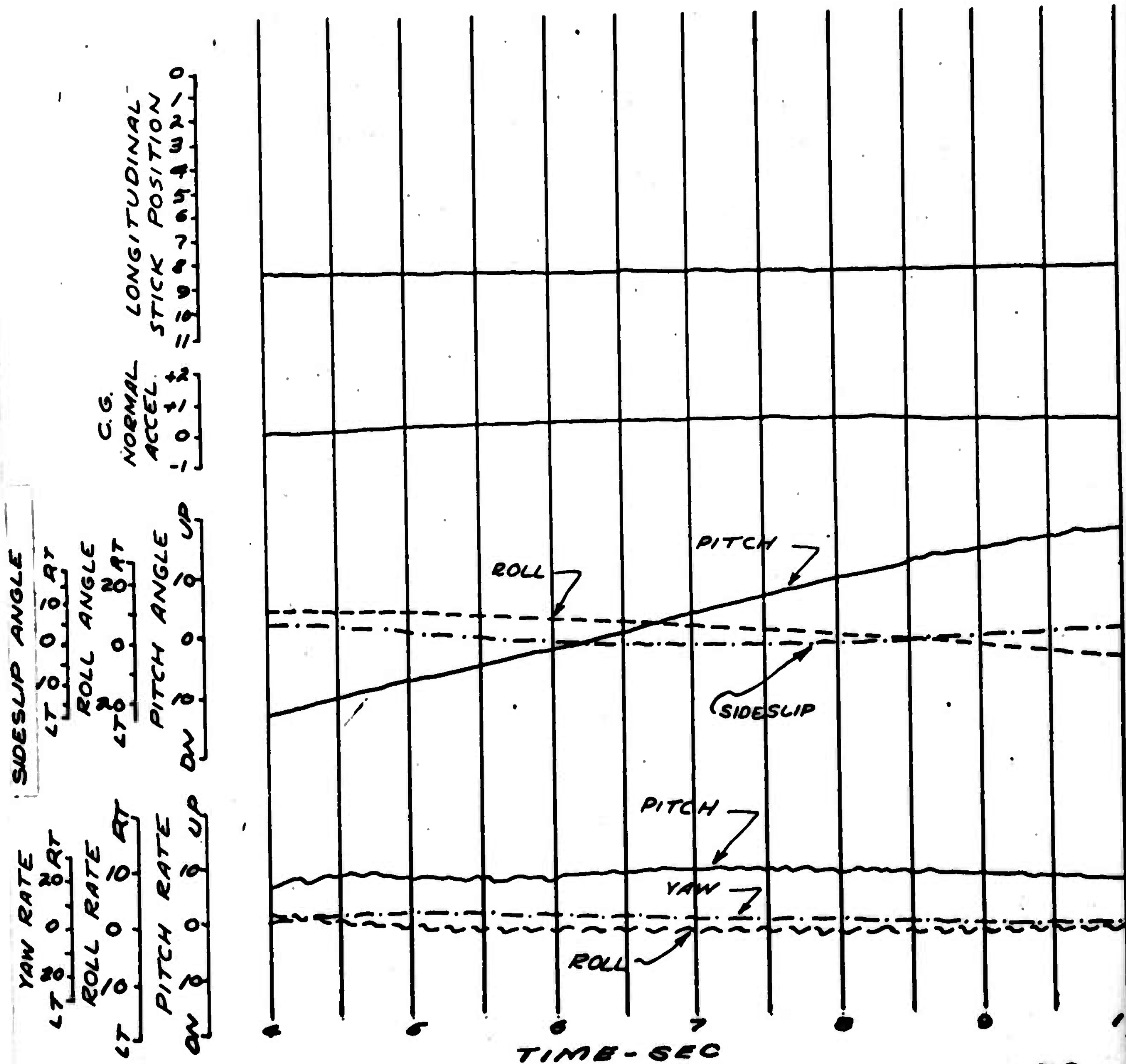

FIG. No. 39

RESPONSE TO A FORWARD LONGITUDINAL PULSE IN CLIMB

OH-13H S/N 57-6284

CLEAN CONFIGURATION

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
45	6000	2490	88.05 (MID)	344

PITCH —— ROLL - - - YAW —-—-— & SIDESLIP

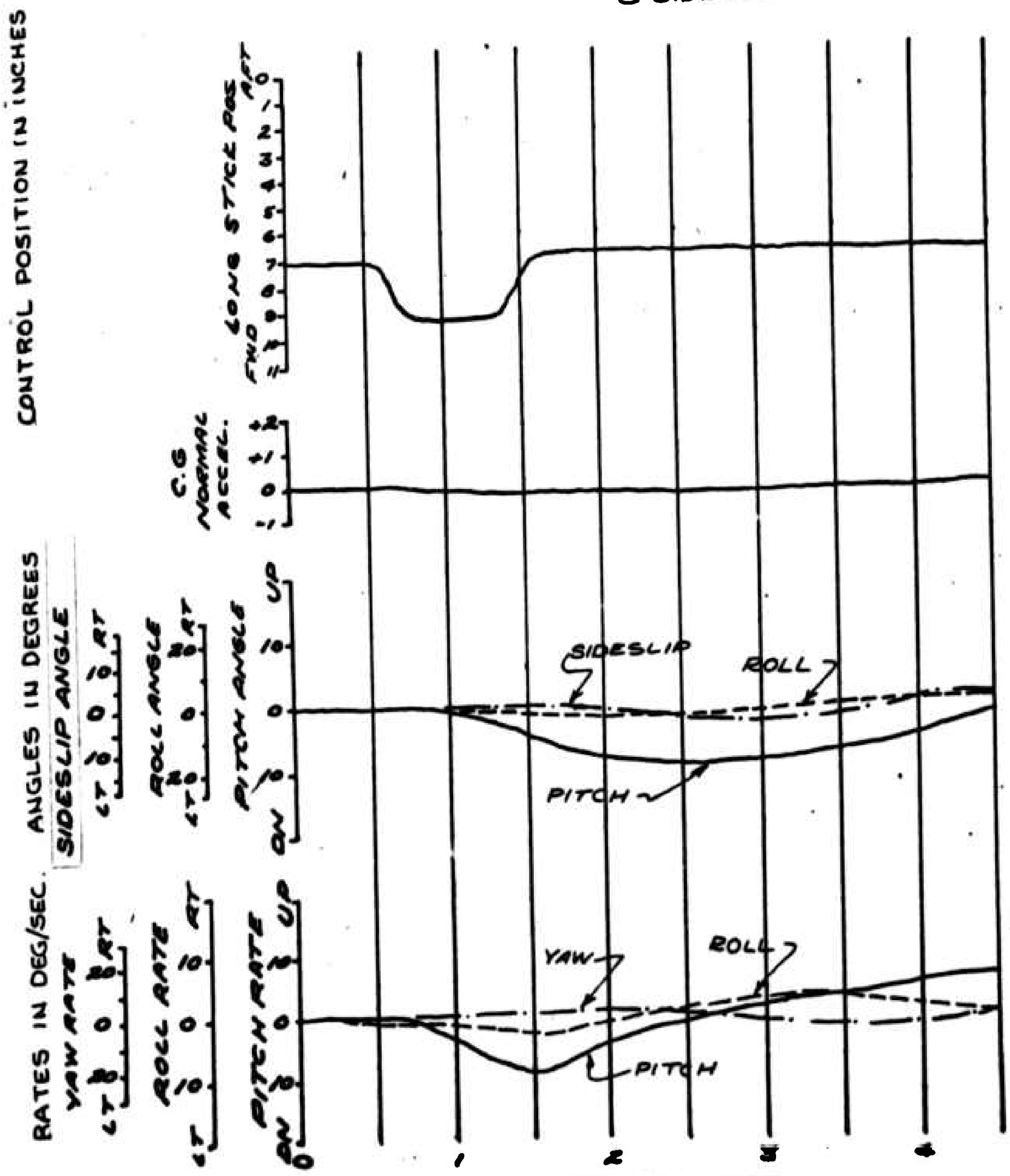

FIG. No. 39 (CONT.)

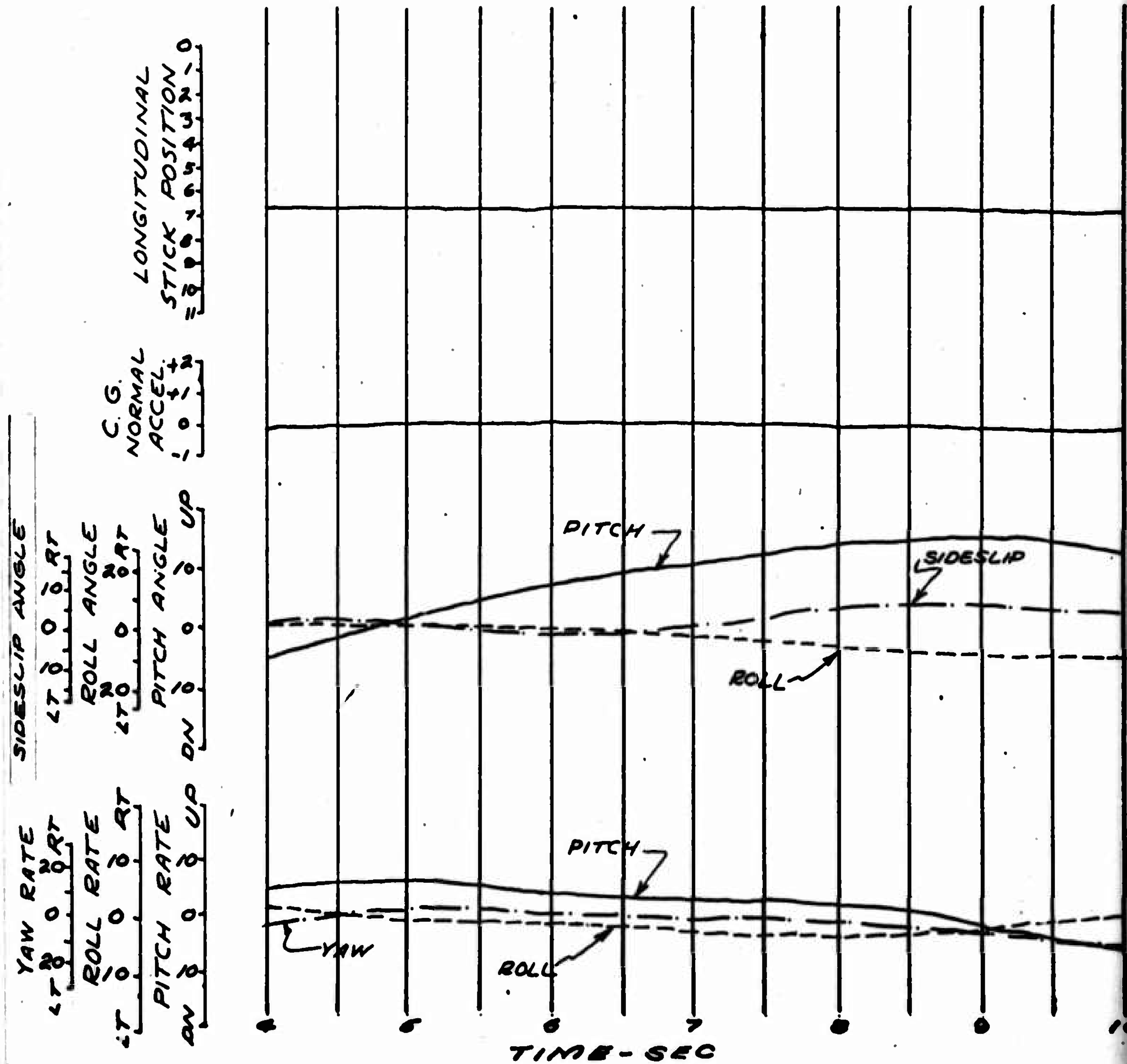

FIG. No. 40

RESPONSE TO AN AFT LONGITUDINAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
65	5400	2745	85.65 (MID)	344

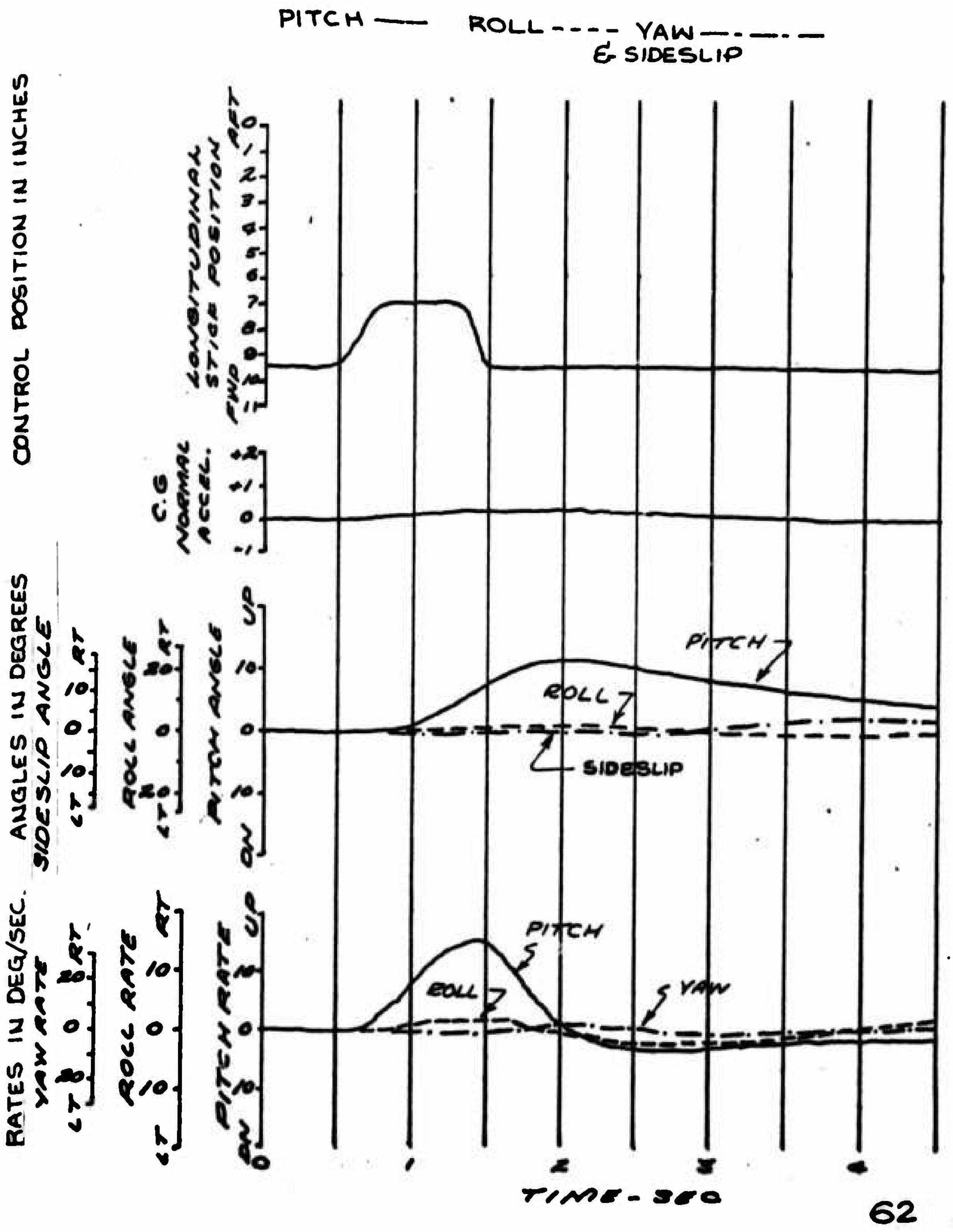

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FIG. No. 40 (CONT.)

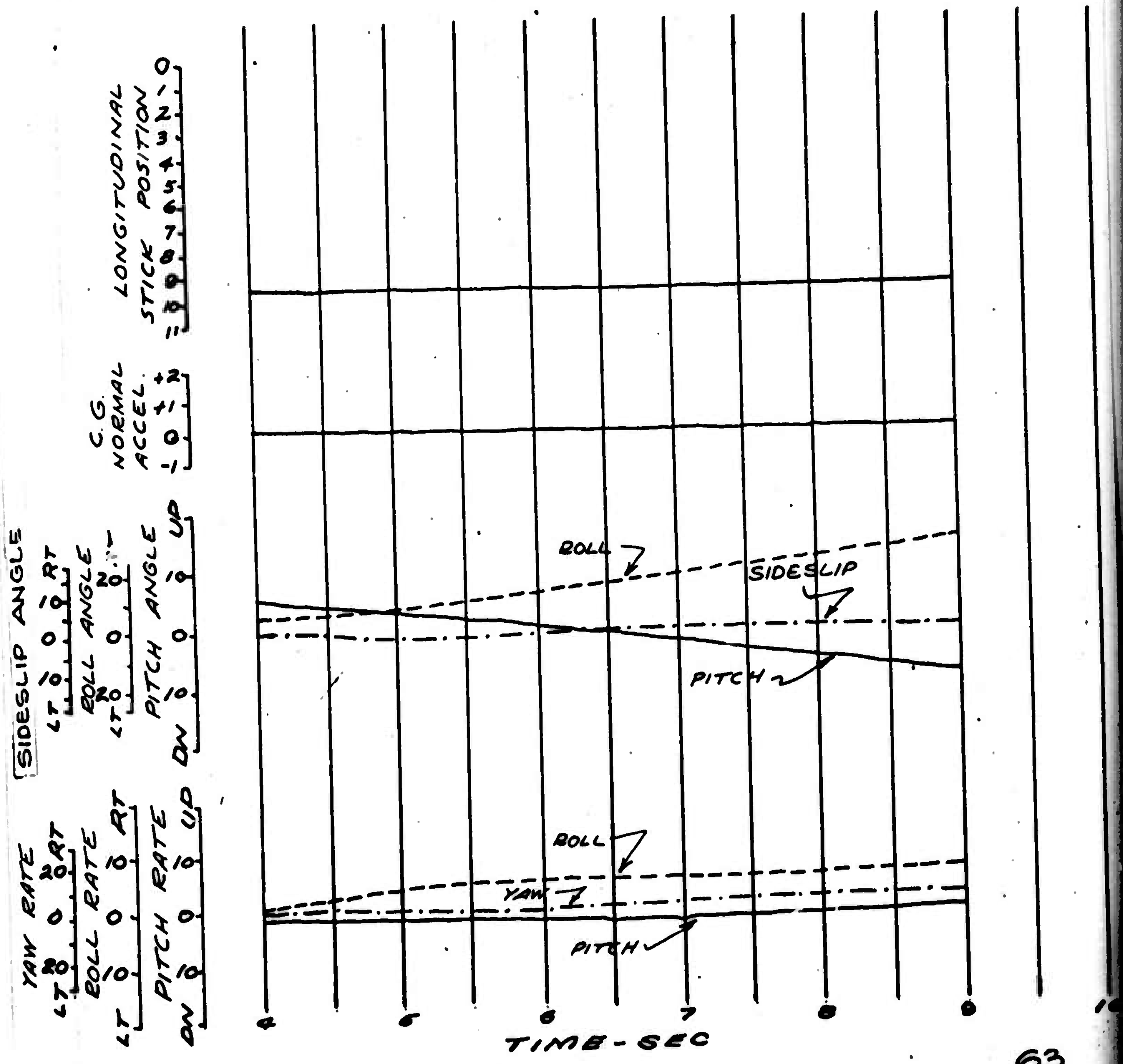

FIG. No. 41

RESPONSE TO A FORWARD LONGITUDINAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
65	5400	2745	88.65 (MID)	344

PITCH —— ROLL ---- YAW & SIDESLIP —·—·—

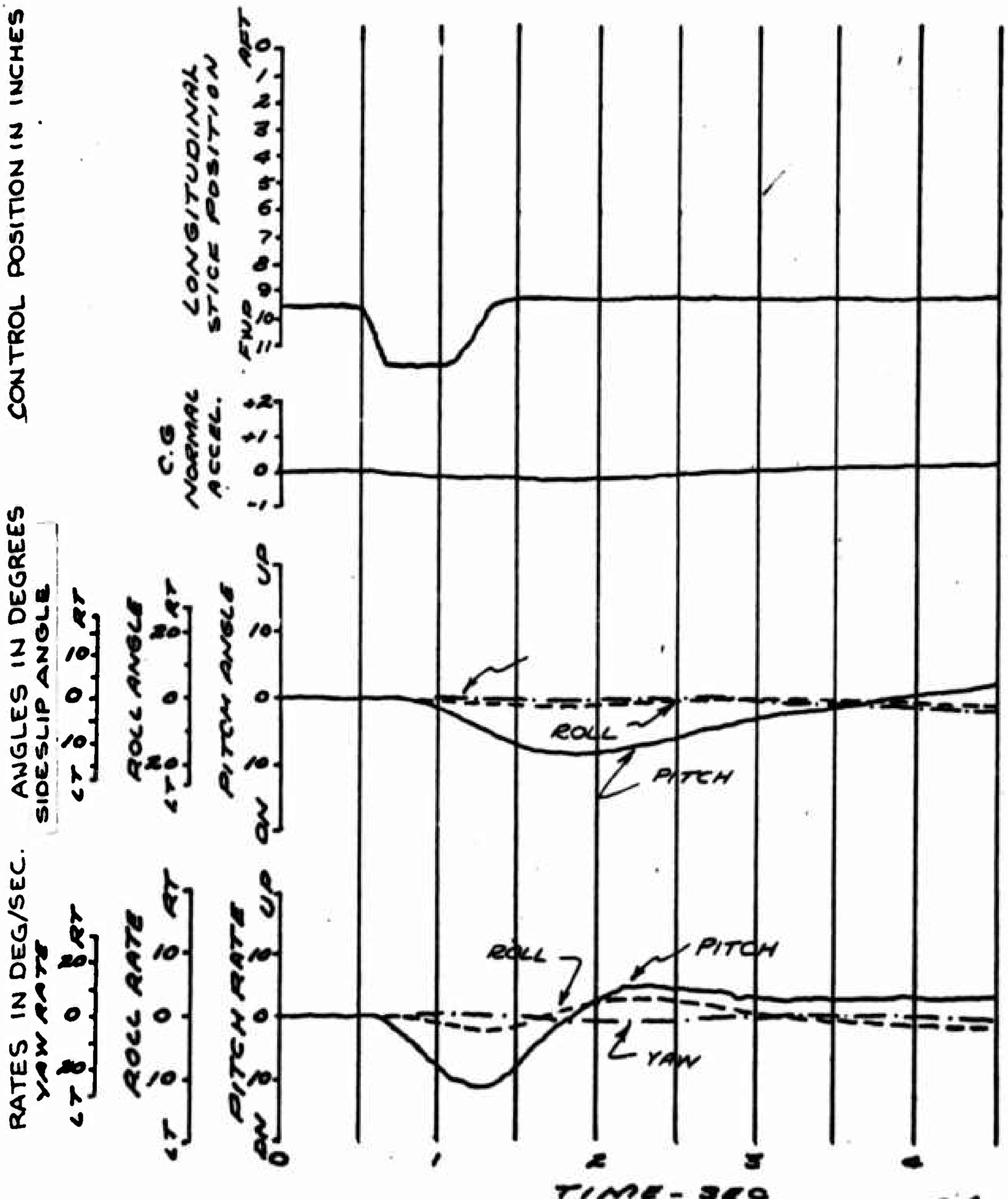

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FIG. NO. 41 (CONT.)

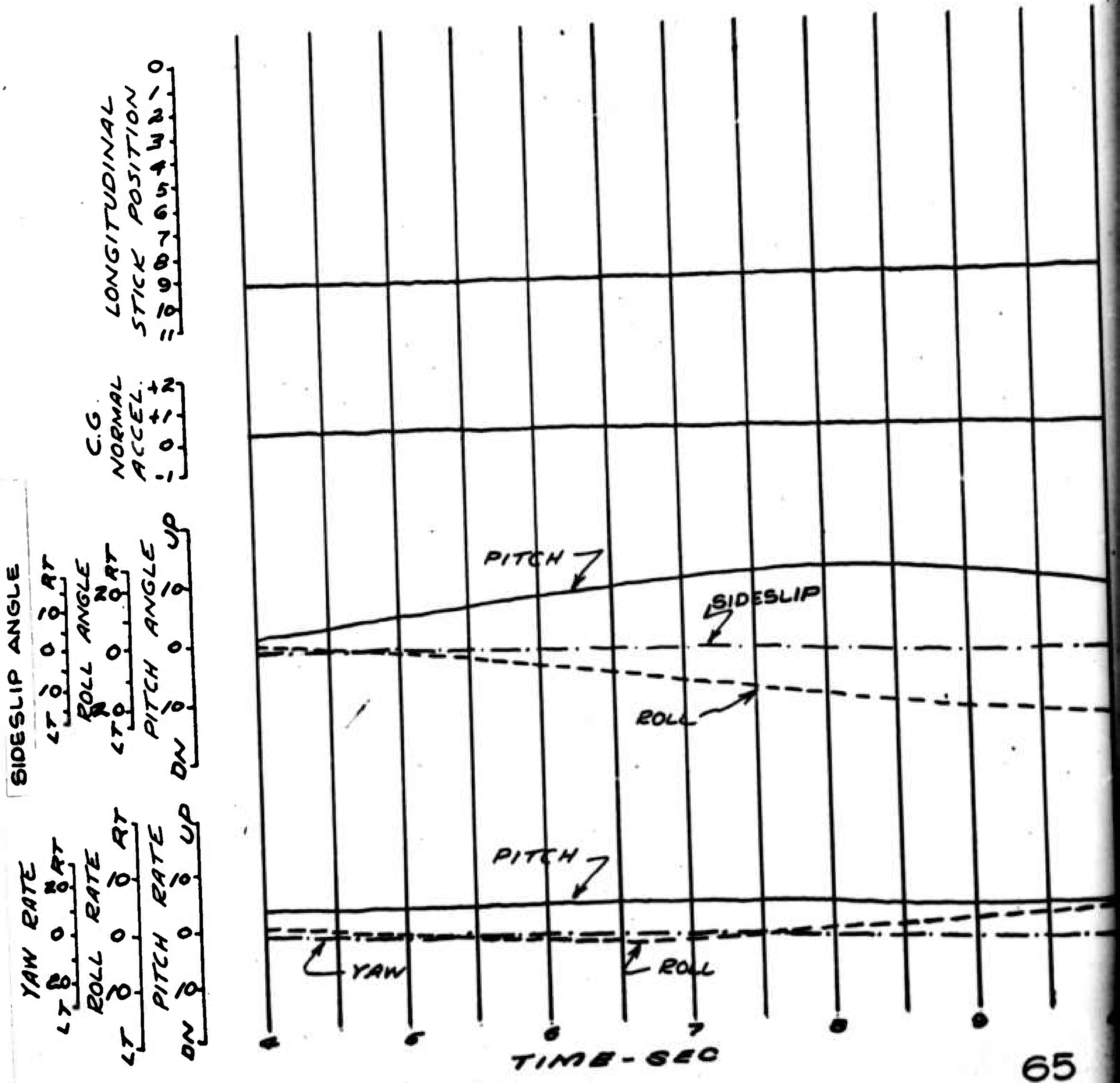


FIG. No. 42

RESPONSE TO AN AFT LONGITUDINAL PULSE IN AUTOROTATION

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_o-FT	G.W.-LB	C.G-IN.	RPM
45	5000	2745	85.65 (MID)	344

PITCH —— ROLL ---- YAW —·—·— & SIDESLIP

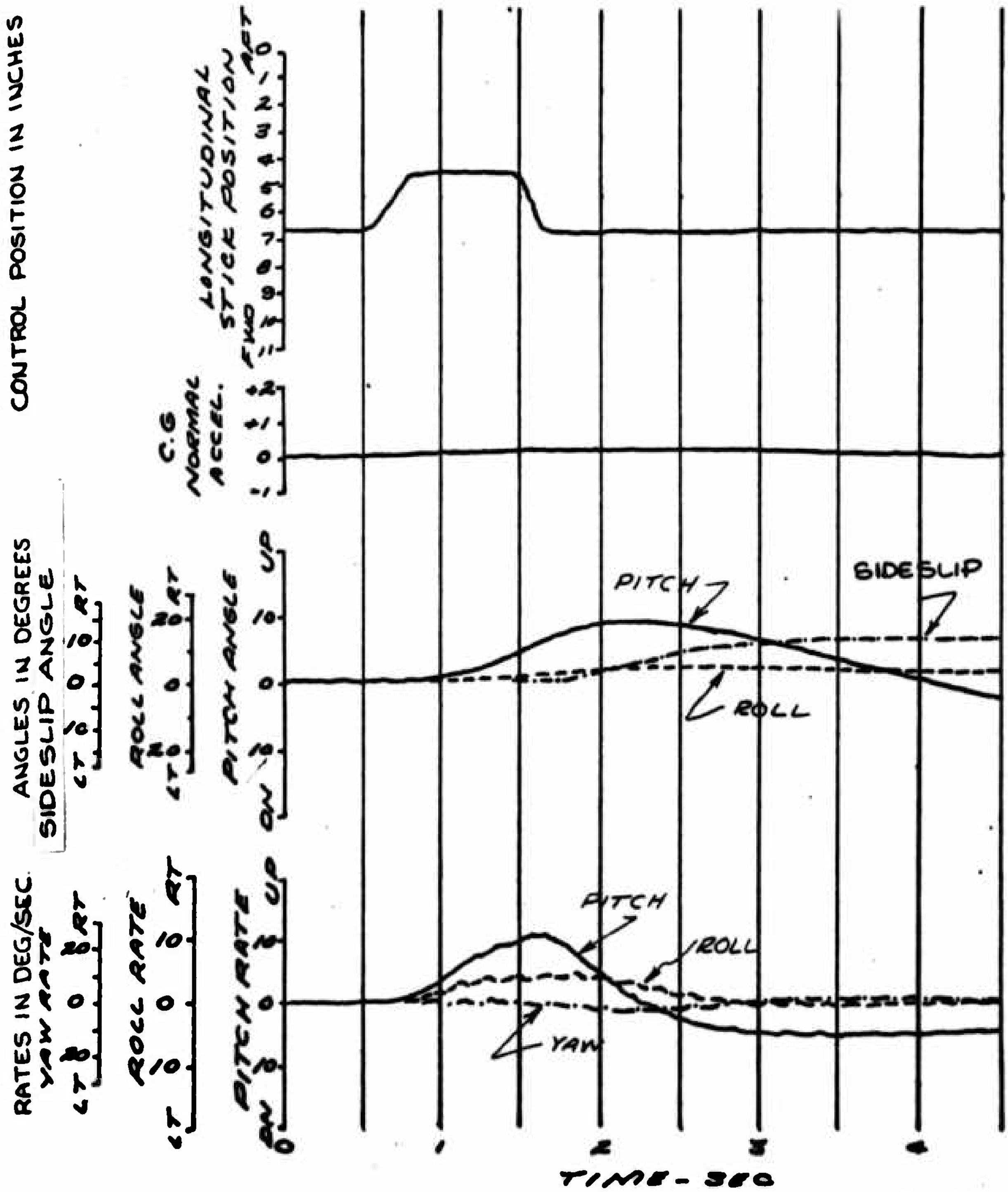


FIG. No. 42 (CONT.)

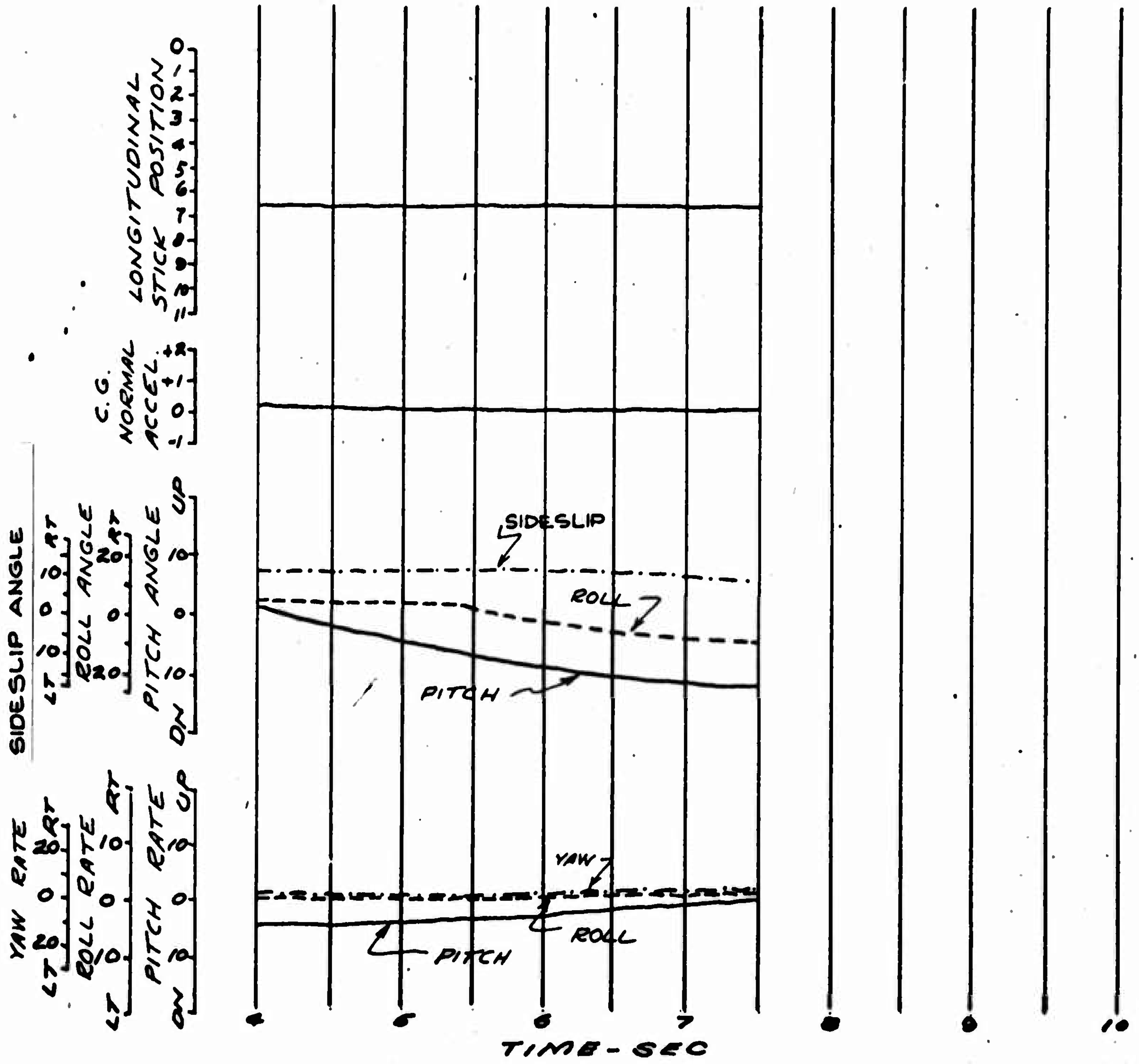


FIG. No. 43

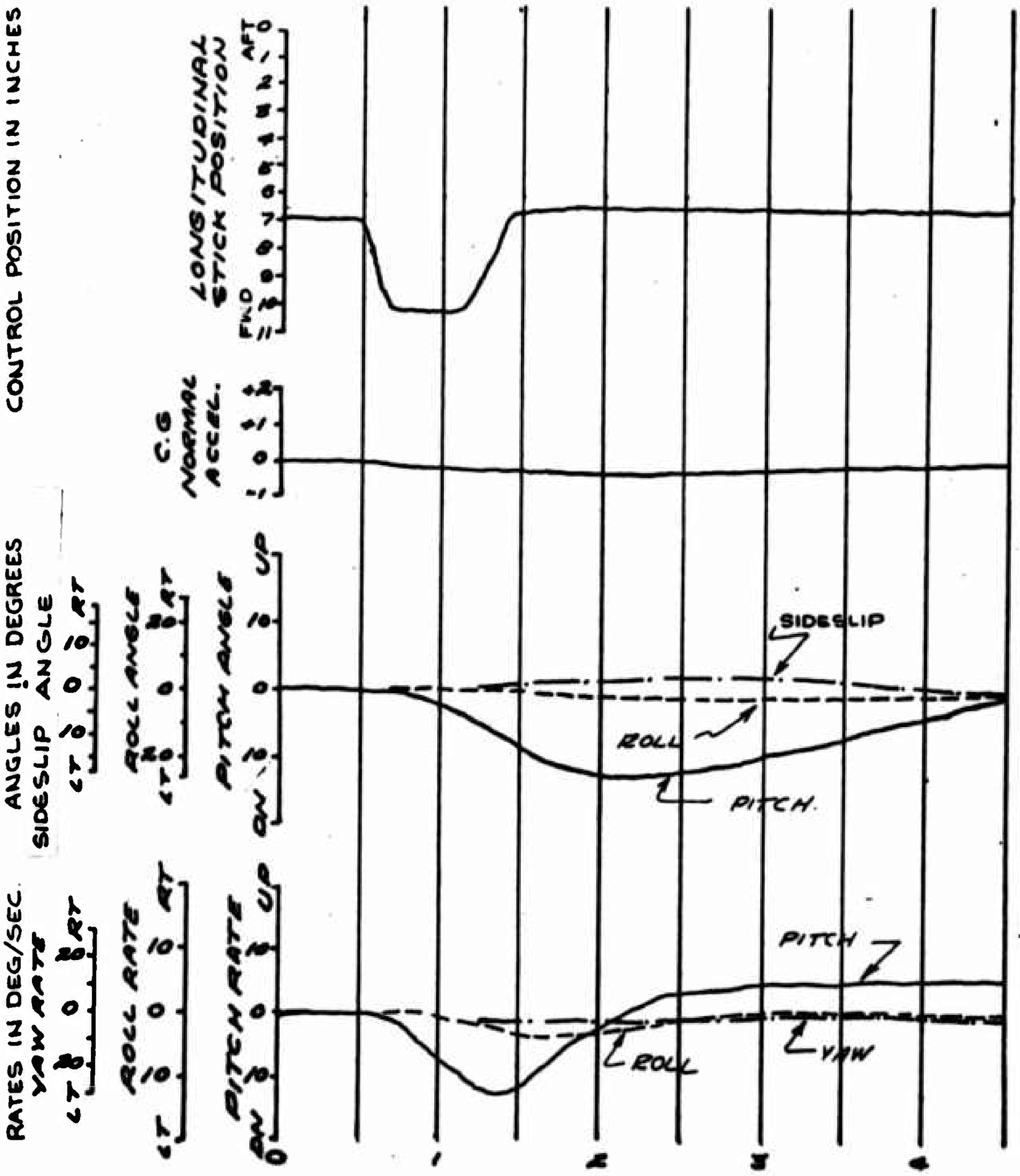
RESPONSE TO A FWD LONGITUDINAL PULSE IN AUTOROTATION

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
45	5260	2745	85.65 (MID)	344

PITCH —— ROLL - - - - YAW & SIDESLIP — - — - —



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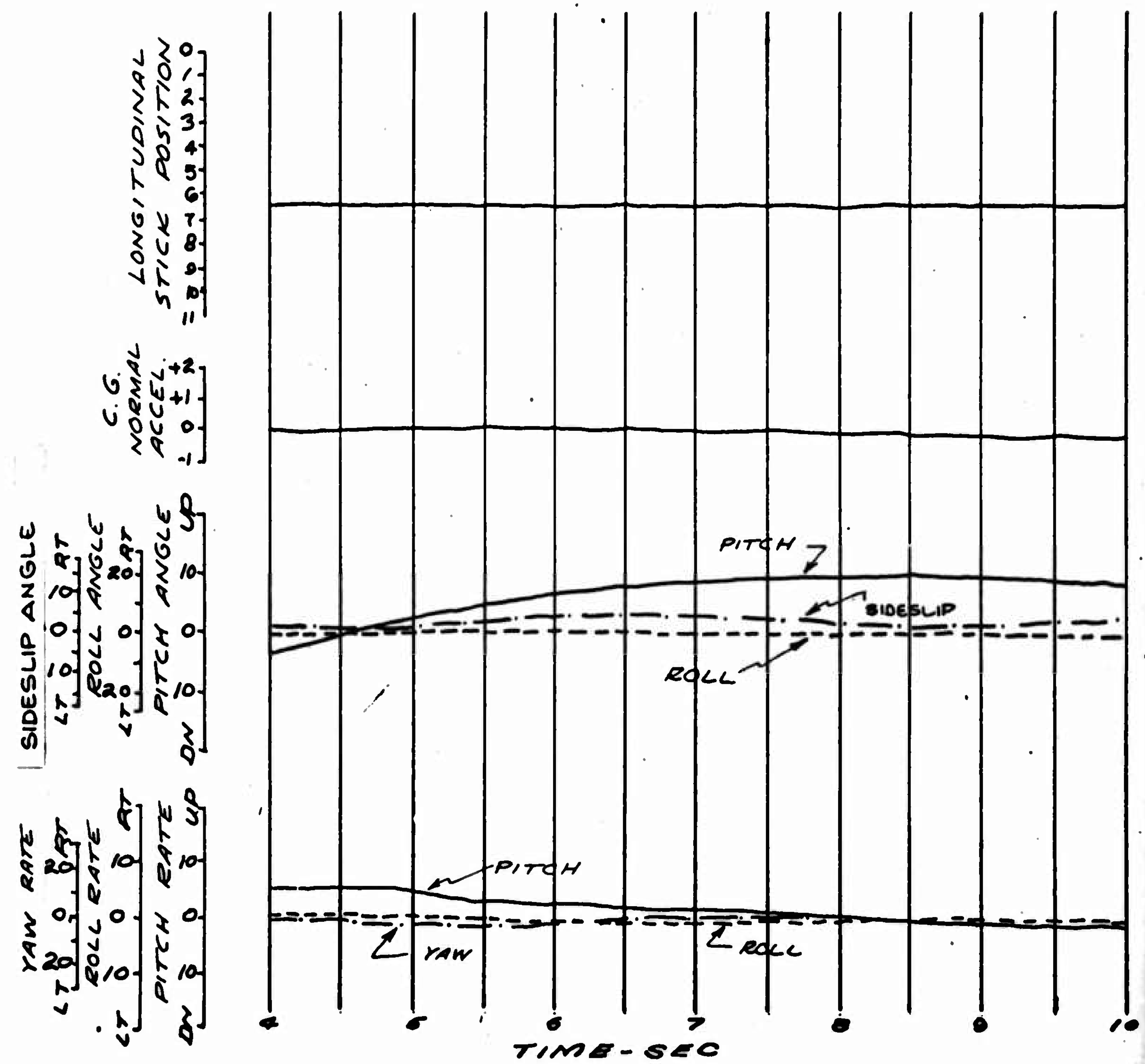
LONGITUDINAL STICK POSITION
C.G. NORMAL ACCEL.
SIDESLIP ANGLE
ROLL ANGLE
PITCH ANGLE
PITCH
SIDESLIP
ROLL
YAW RATE
ROLL RATE
PITCH RATE
PITCH
YAW
ROLL
TIME - SEC

FIG. No. 44

RESPONSE TO AN AFT LONGITUDINAL PULSE IN A HOVER

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_o-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	84.03 (MID)	355

PITCH —— ROLL - - - - YAW — · — · —

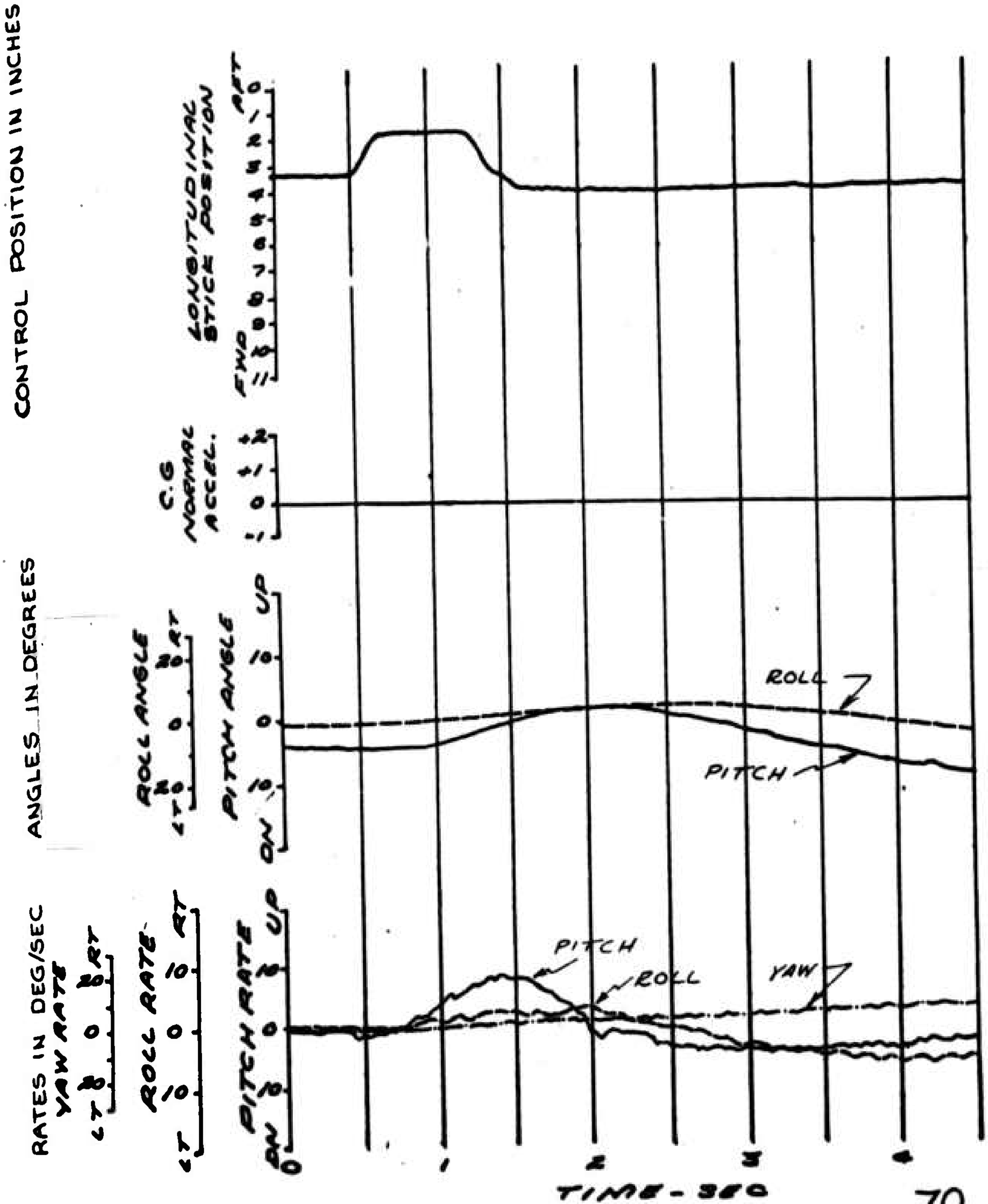

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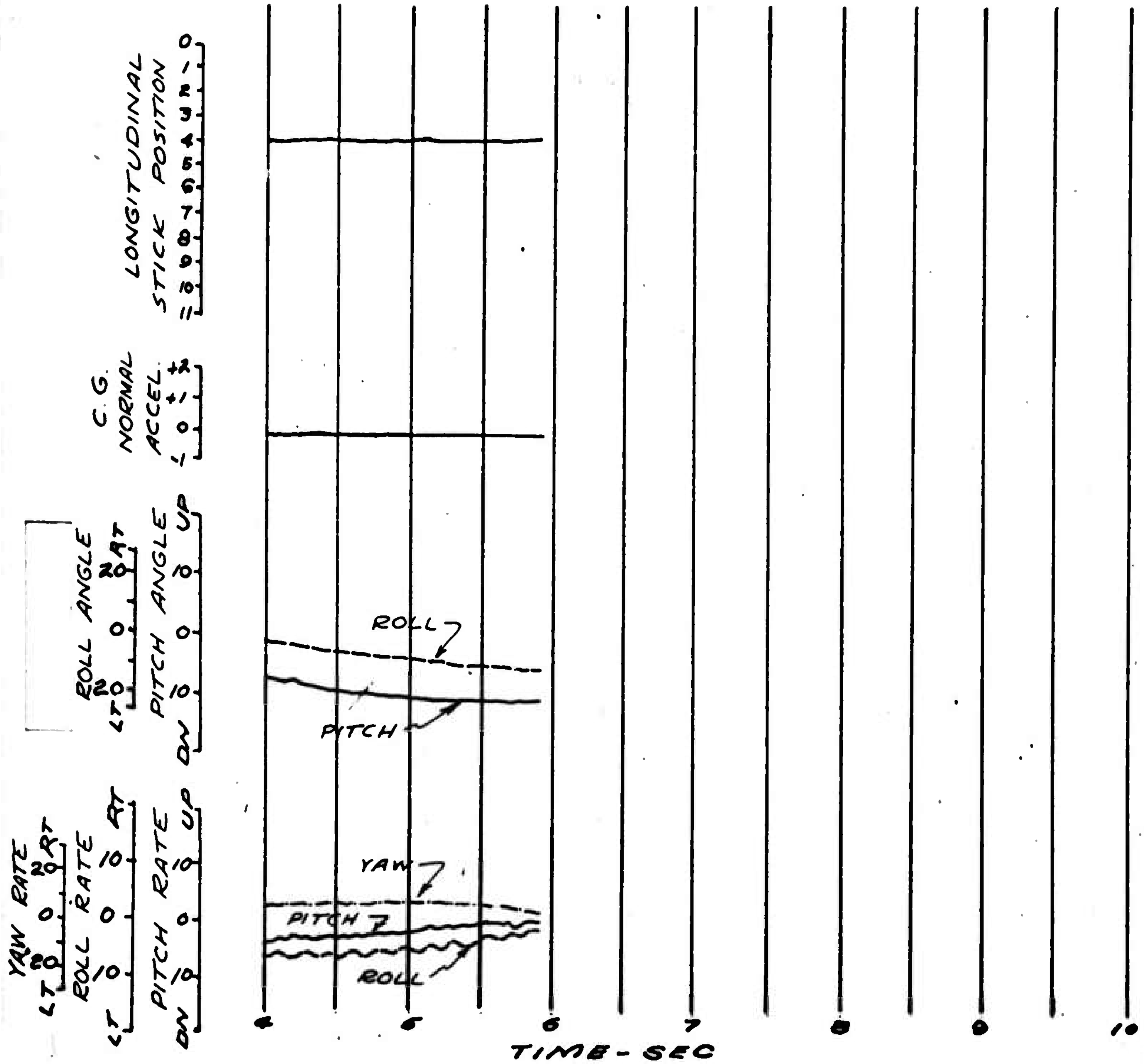
FIG. No. 44 (CONT.)



FLT 10
012

FIG. No. 45

RESPONSE TO A FORWARD LONGITUDINAL PULSE IN A HOVER

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_o-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	90.43 (MID)	355

PITCH —— ROLL ---- YAW —·—·—

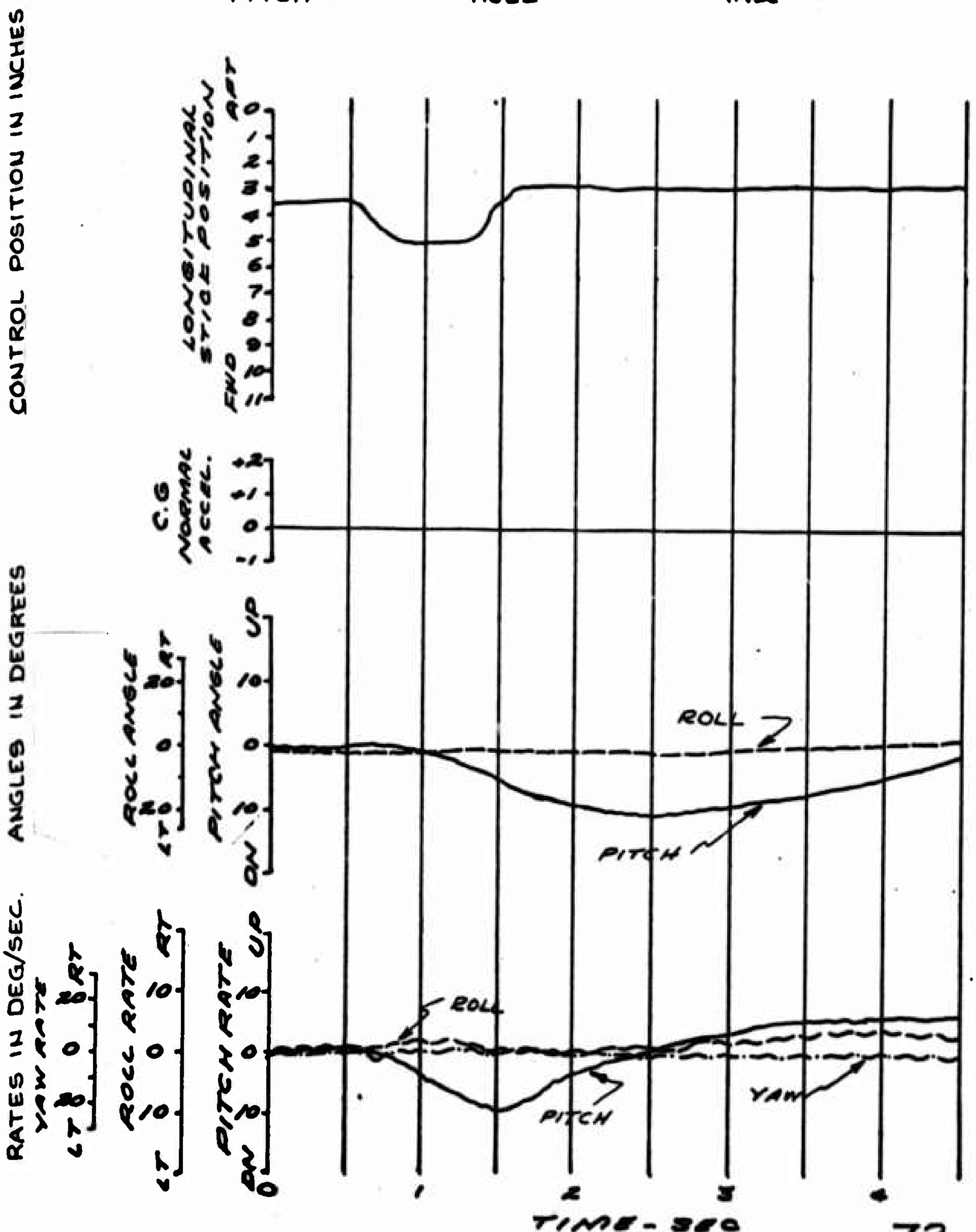


FIG. No. 45 (CONT.)

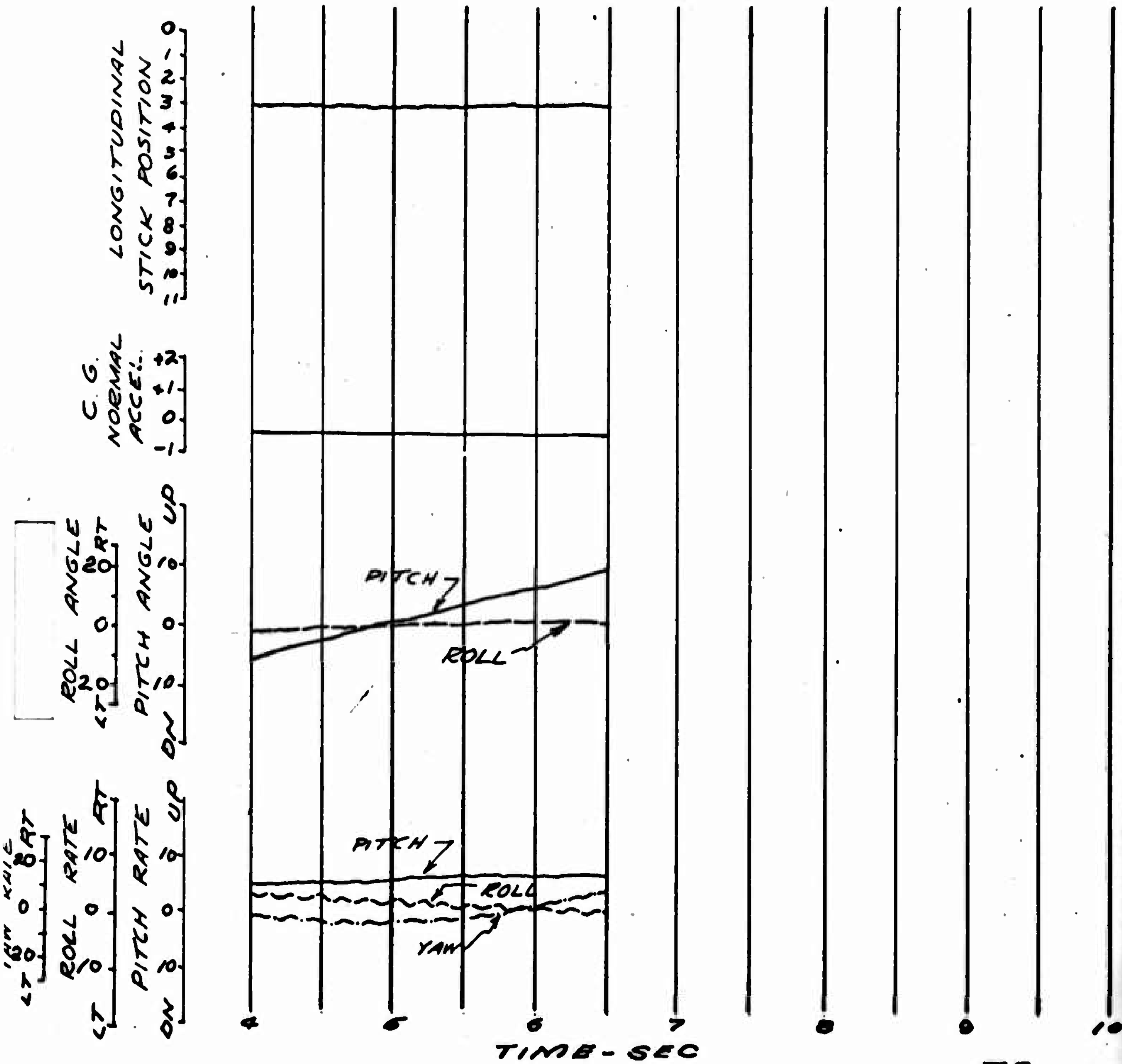


FIG. NO. 46

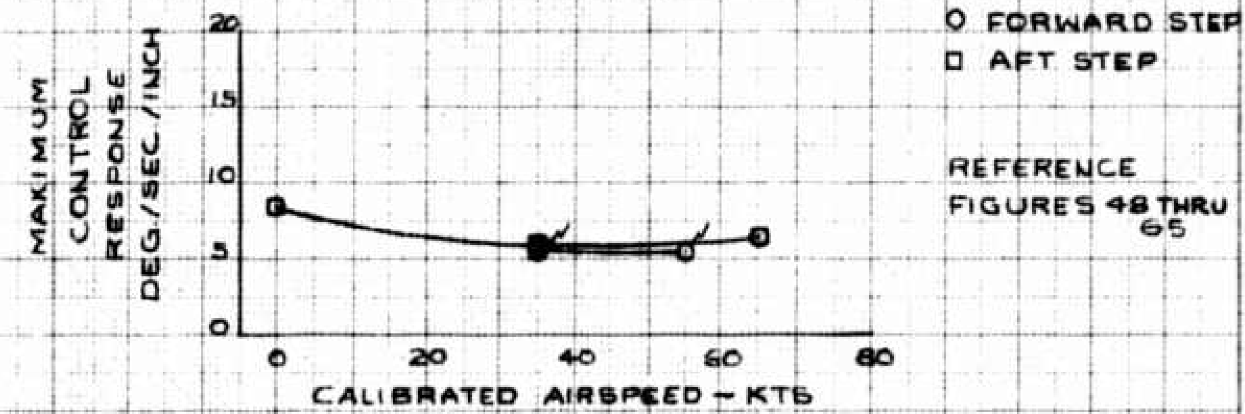
SUMMARY LONGITUDINAL CONTROL RESPONSE

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_C-KT	AVG. G.W.-LB.	AVG. H_D-FT	AVG. C.G.-IN.	RPM
0	2720	1000	84.43(MID)	355
35	2760	4700	85.75(MID)	344
65	2760	4700	85.75(MID)	344
35	2750	9000	85.70(MID)	344
55	2750	9000	85.70(MID)	344

TAILS DENOTE 9000 FT



CLEAN CONFIGURATION

V_C-KT	AVG. G.W.-LB.	AVG. H_D-FT	AVG. C.G.-IN.	RPM
0	2475	2500	85.02(MID)	355
35	2480	5000	85.05(MID)	344
65	2480	5000	85.05(MID)	344
35	2475	9000	85.02(MID)	344
62	2475	9000	85.02(MID)	344

TAILS DENOTE 9000 FT

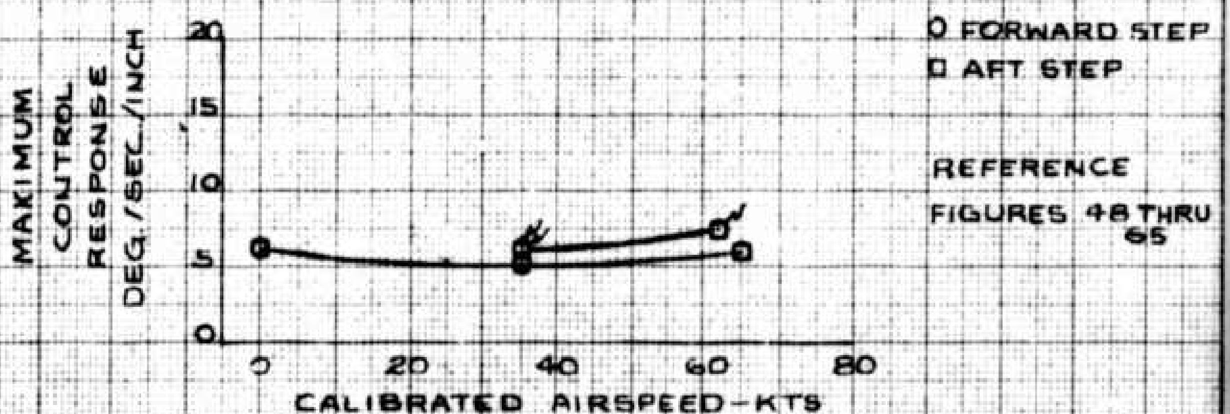


Fig No. 47

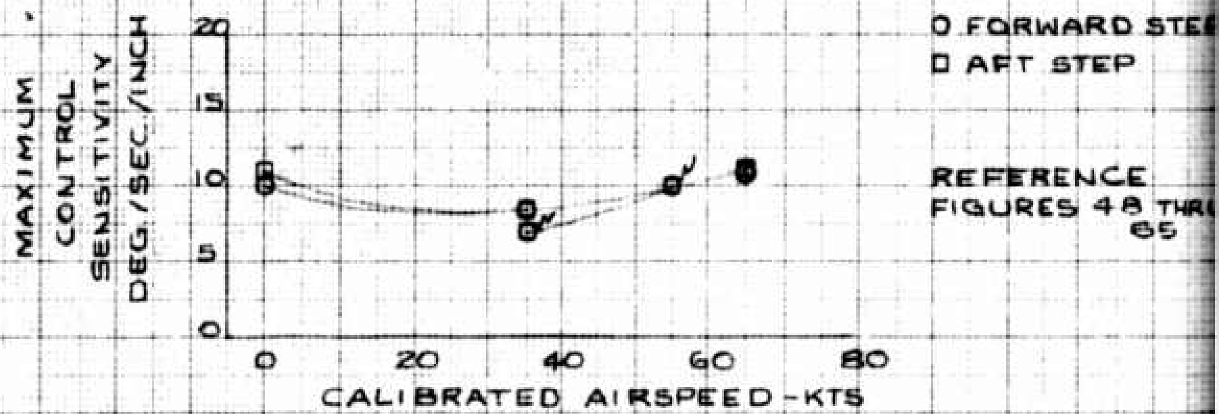
Summary Longitudinal Control Sensitivity

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_C-KT	AVG G.W.-LB	AVG H_D-FT	AVG C.G.-IN.	RPM
0	2720	1000	84.43 (MID)	355
35	2760	4700	85.75 (MID)	344
65	2760	4700	85.75 (MID)	344
35	2750	9000	85.70 (MID)	344
55	2750	9000	85.70 (MID)	344

TAILS DENOTE 9000 FT.



CLEAN CONFIGURATION

V_C-KT	AVG G.W.-LB	AVG H_D-FT	AVG C.G.-IN	RPM
0	2475	2500	85.02 (MID)	355
35	2480	5000	85.05 (MID)	344
65	2480	5000	85.05 (MID)	344
35	2475	9000	85.02 (MID)	344
62	2475	9000	85.02 (MID)	344

TAILS DENOTE 9000 FT.

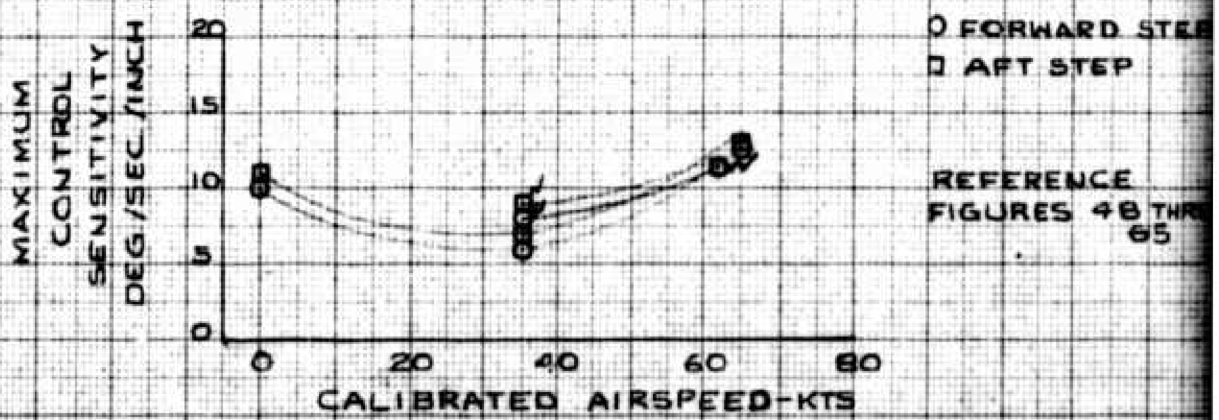


FIG. NO. 48

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
○	35	2760	4740	85.75 (MID)	344
◇	65	2760	4700	85.75 (MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 7.20 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 9.60 INCHES AT 65 KNOTS

NOTE 3: MAXIMUM PITCH RATE REACHED APPROX. 1.63 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.05 SECONDS AT 65 KNOTS

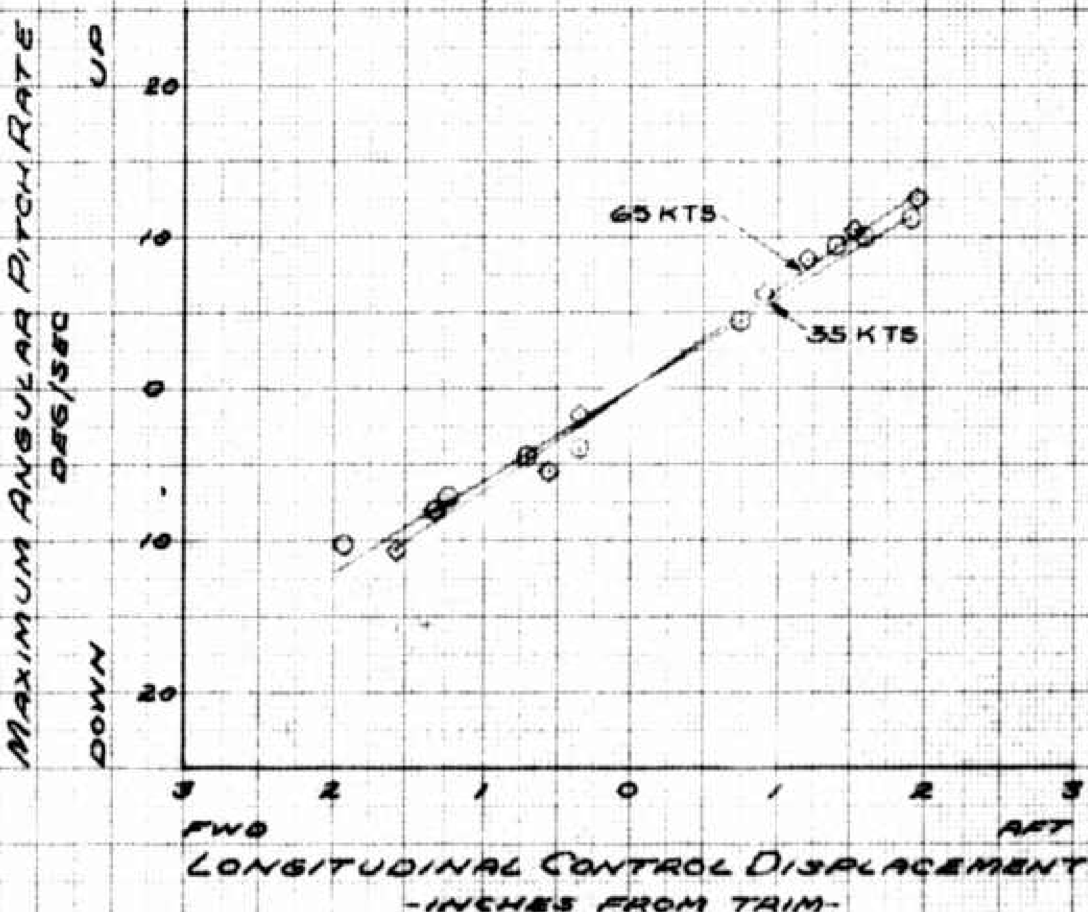


FIG. NO. 49

LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
O	35	2760	4740	85.75 (MID)	344
◇	65	2760	4700	85.75 (MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 7.20 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 9.60 INCHES AT 65 KNOTS.

NOTE 3: MAX. ANGULAR PITCH ACCELERATION REACHED APPROX. 0.46 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND APPROX. 0.37 SECONDS AT 65 KNOTS

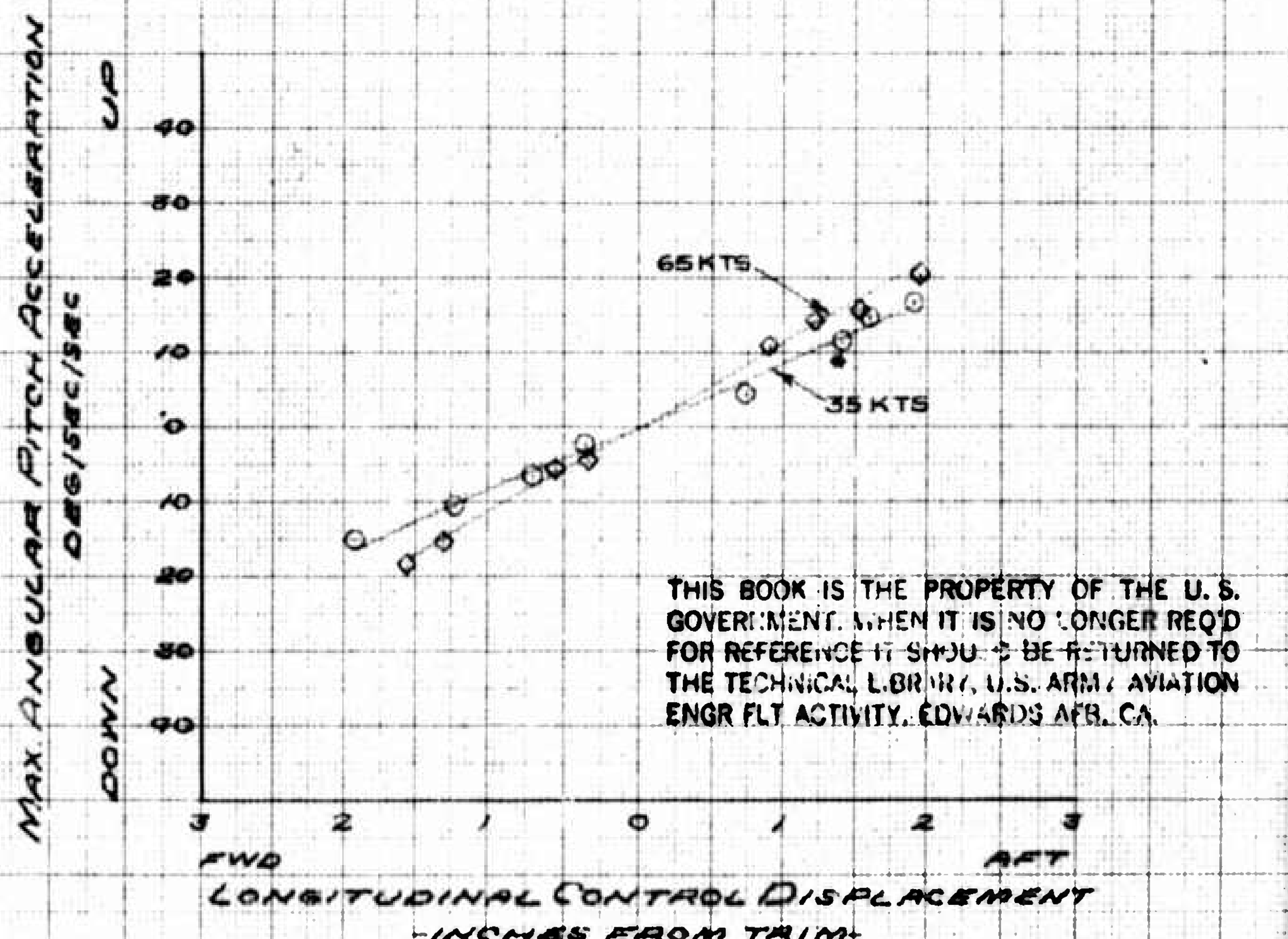


FIG. NO. 50

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c - KT	G.W. - LB	H_D - FT	C.G. - IN	RPM
O	35	2480	5000	85.05 (MID.)	344
◇	65	2480	5140	85.05 (MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 6.0 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 8.9 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR PITCH REACHED APPROX. 1.61 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.11 SECONDS AT 65 KNOTS.

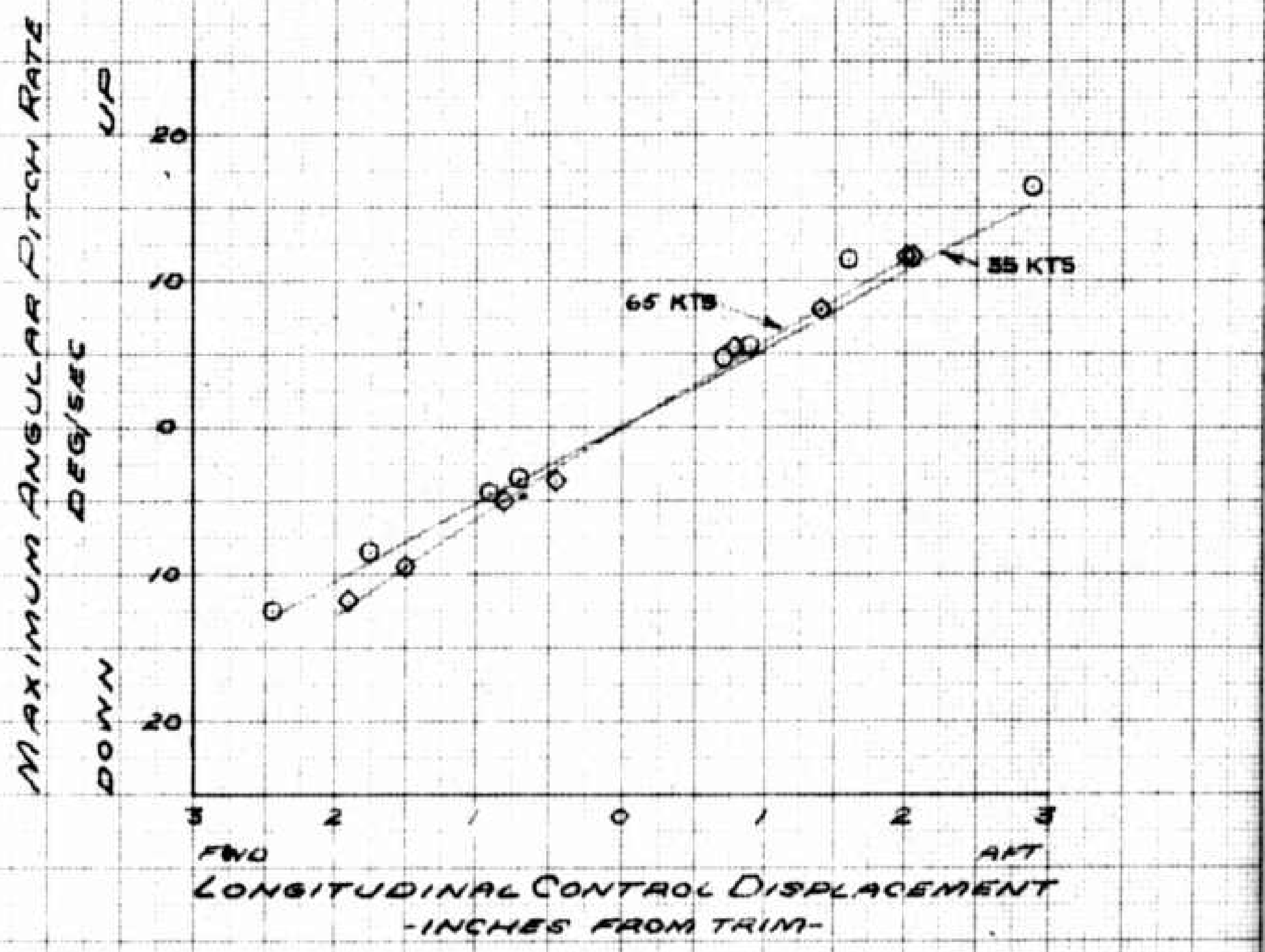


FIG No. 51

LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N57-6234

CLEAN CONFIGURATION

SYM	V_C-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
○	35	2480	5000	85.05(MID)	344
◇	65	2480	5140	85.05(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 6.0 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 8.9 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR ACCELERATION REACHED APPROX 0.48 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 0.42 SECONDS AT 65 KNOTS.

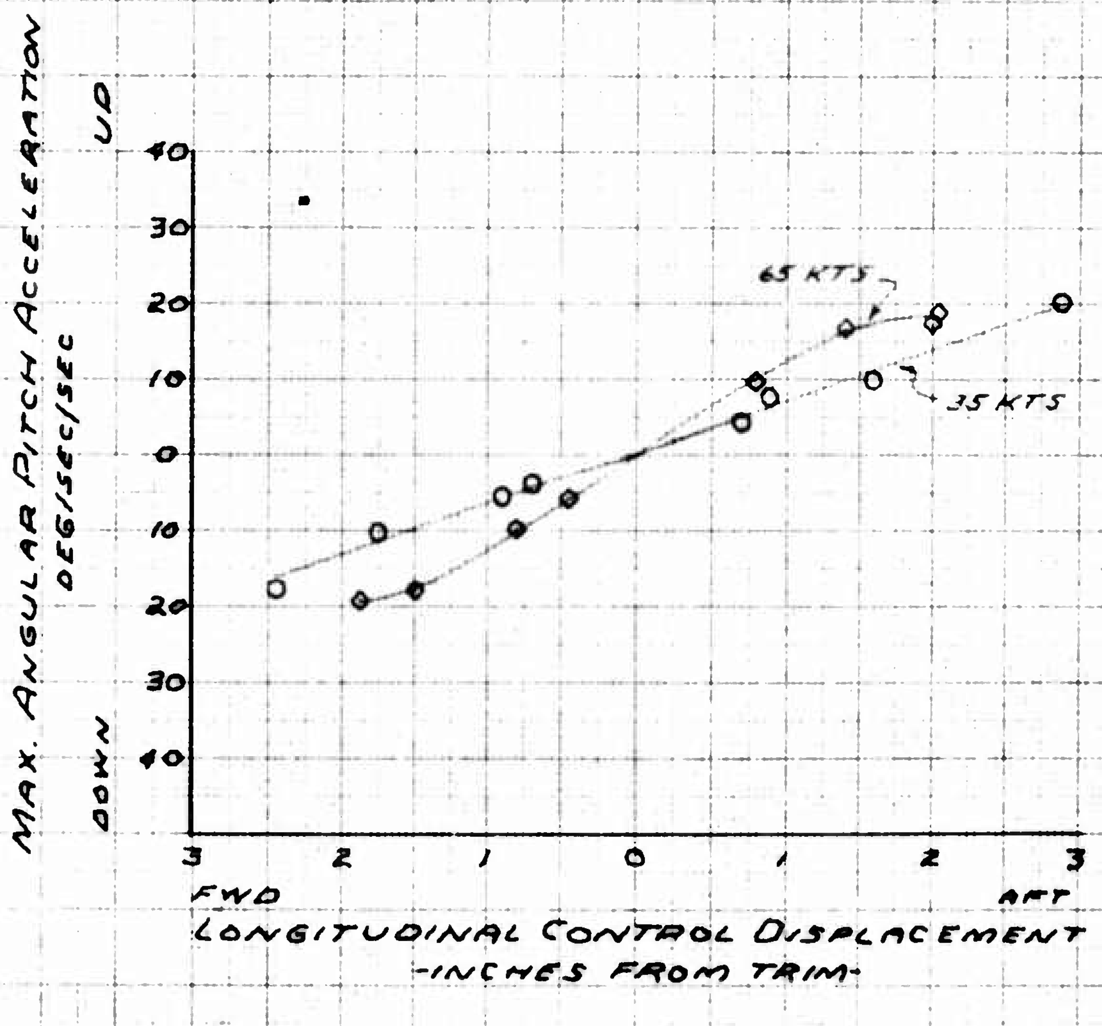


FIG. NO. 52

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
△	65	2710	5000	83.10 (FWD)	344
□	65	2720	5000	85.05 (MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION = 8.1 INCHES FROM FULL AFT WITH FORWARD C.G. AND 9.4 INCHES WITH MID C.G.

NOTE 3: MAXIMUM PITCH RATE REACHED APPROX. 1.20 SECONDS AFTER CONTROL DISPLACEMENT.

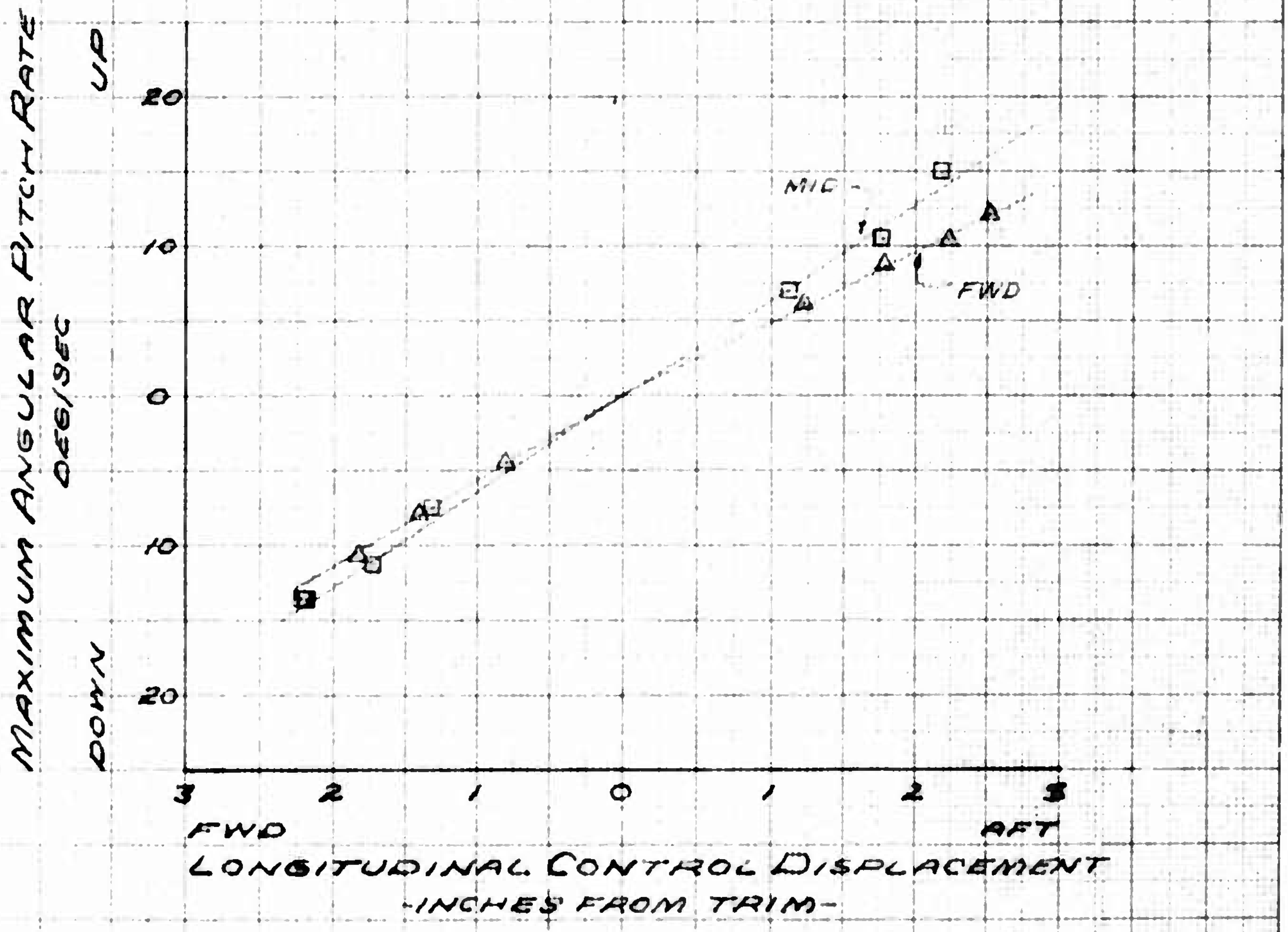


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FIG. NO. 53
LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT
OH-13H S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED

SYM	V_e-KT	G.W.-LB	H_e-FT	C.G.-IN	RPM
Δ	65	2710	5000	83.10(FWD)	344
□	65	2720	5000	85.05(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL=11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 8.1 INCHES FROM FULL AFT WITH FORWARD C.G. AND 9.4 INCHES WITH MID C.G.

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX 0.40 SECONDS AFTER CONTROL DISPLACEMENT.

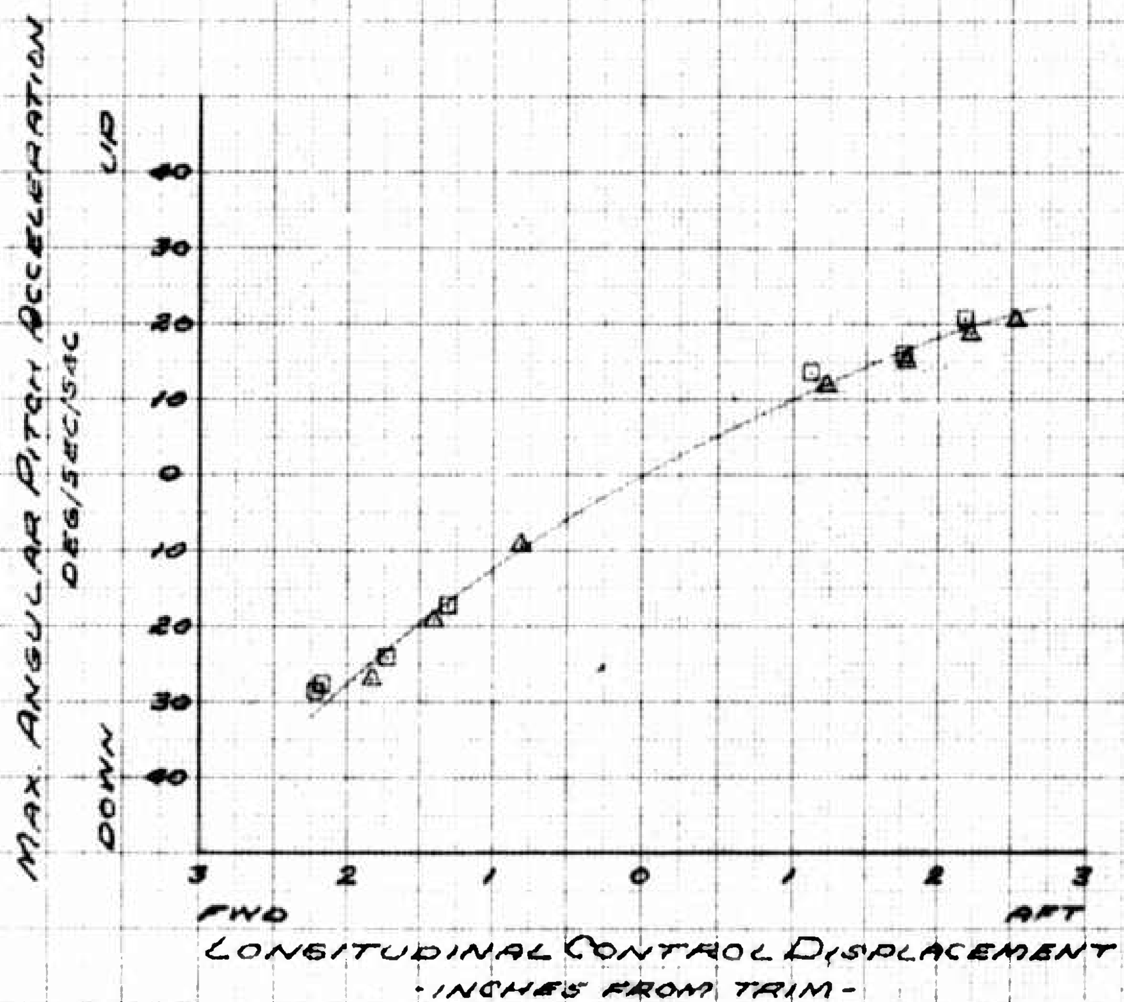

FIG. NO. 54

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 67-6239

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_d-FT	C.G.-IN	RPM
△	65	2465	4720	82.37(FWD)	344
□	65	2485	4800	84.65(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 7.51 INCHES FROM FULL AFT WITH FWD C.G. AND APPROX. 8.8 INCHES WITH MID C.G.

NOTE 3: MAXIMUM ANGULAR PITCH RATE REACHED APPROX. 1.0 SECONDS AFTER CONTROL DISPLACEMENT

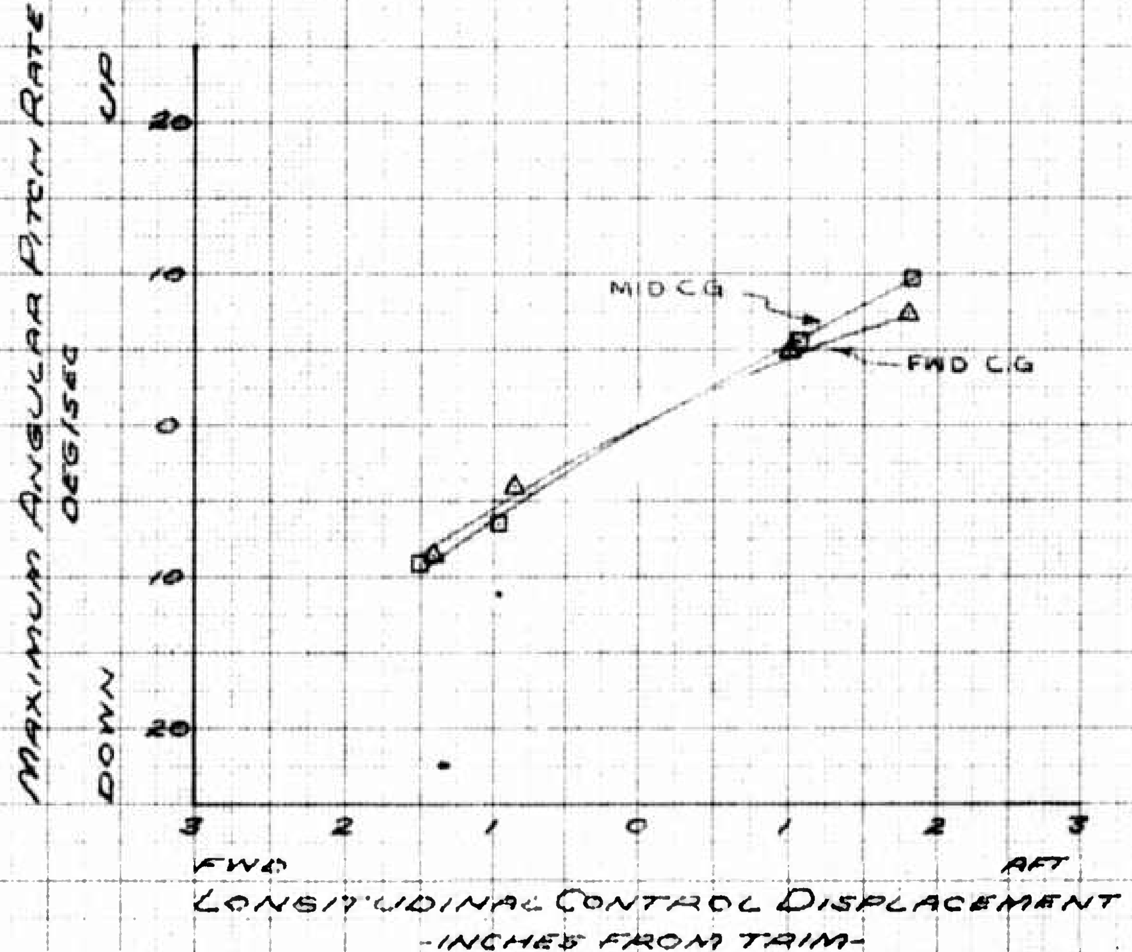

FIG. NO. 55

LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_C-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
△	65	2465	4720	82.37(FWD)	344
□	65	2485	4800	84.65(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX 7.51 INCHES FROM FULL AFT WITH FWD C.G. AND APPROX 8.8 INCHES WITH MID C.G.

NOTE 3: MAX. ANGULAR PITCH ACCELERATION REACHED APPROX. 0.38 SECONDS AFTER CONTROL DISPLACEMENT.

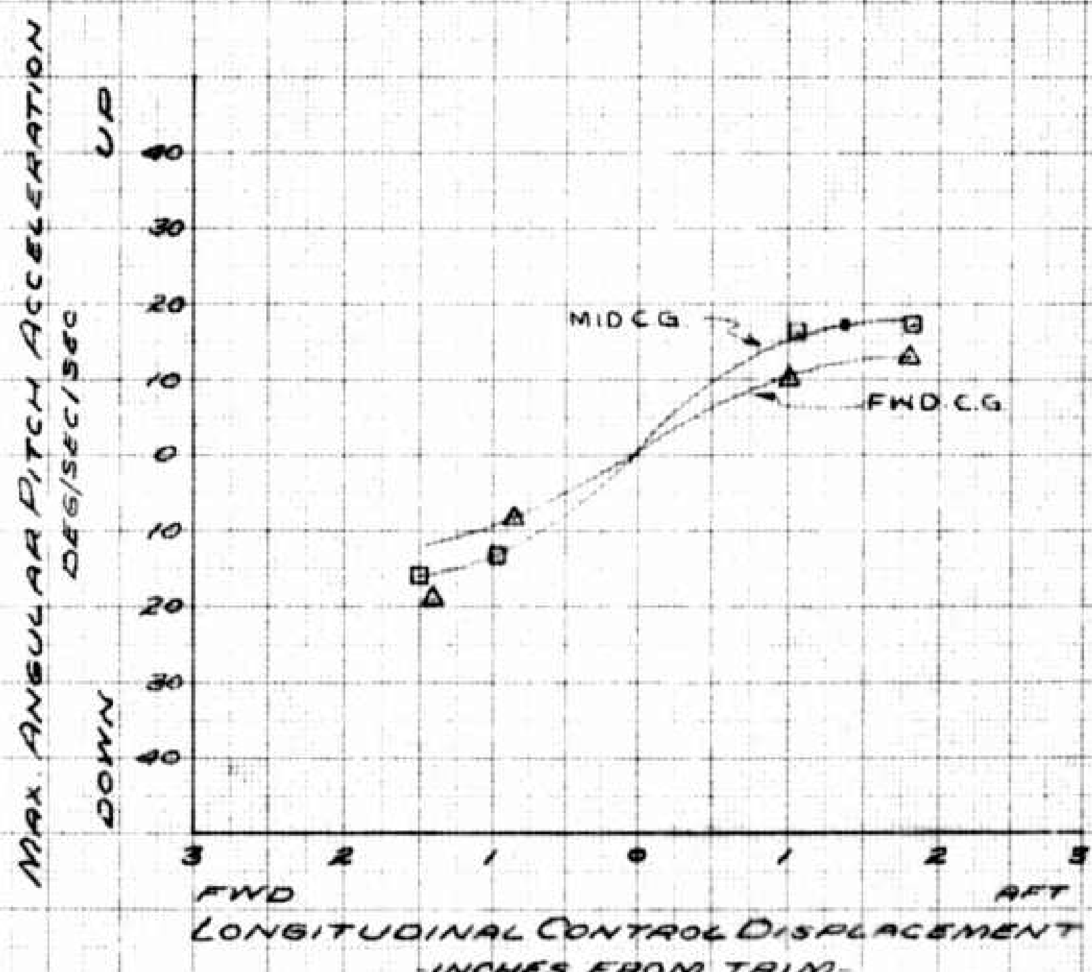

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FIG. NO 56

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2750	9000	85.70 (MID)	344
▽	55	2750	9000	85.70 (MID)	344

NOTE 1 FULL LONGITUDINAL CONTROL TRAVEL= 11.65 INCHES

NOTE 2 LONGITUDINAL CONTROL TRIM POSITION APPROX 7.4 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 9.3 INCHES AT 55 KNOTS.

NOTE 3 MAXIMUM ANGULAR PITCH RATE REACHED APPROX 1.35 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.25 SECONDS AT 55 KNOTS

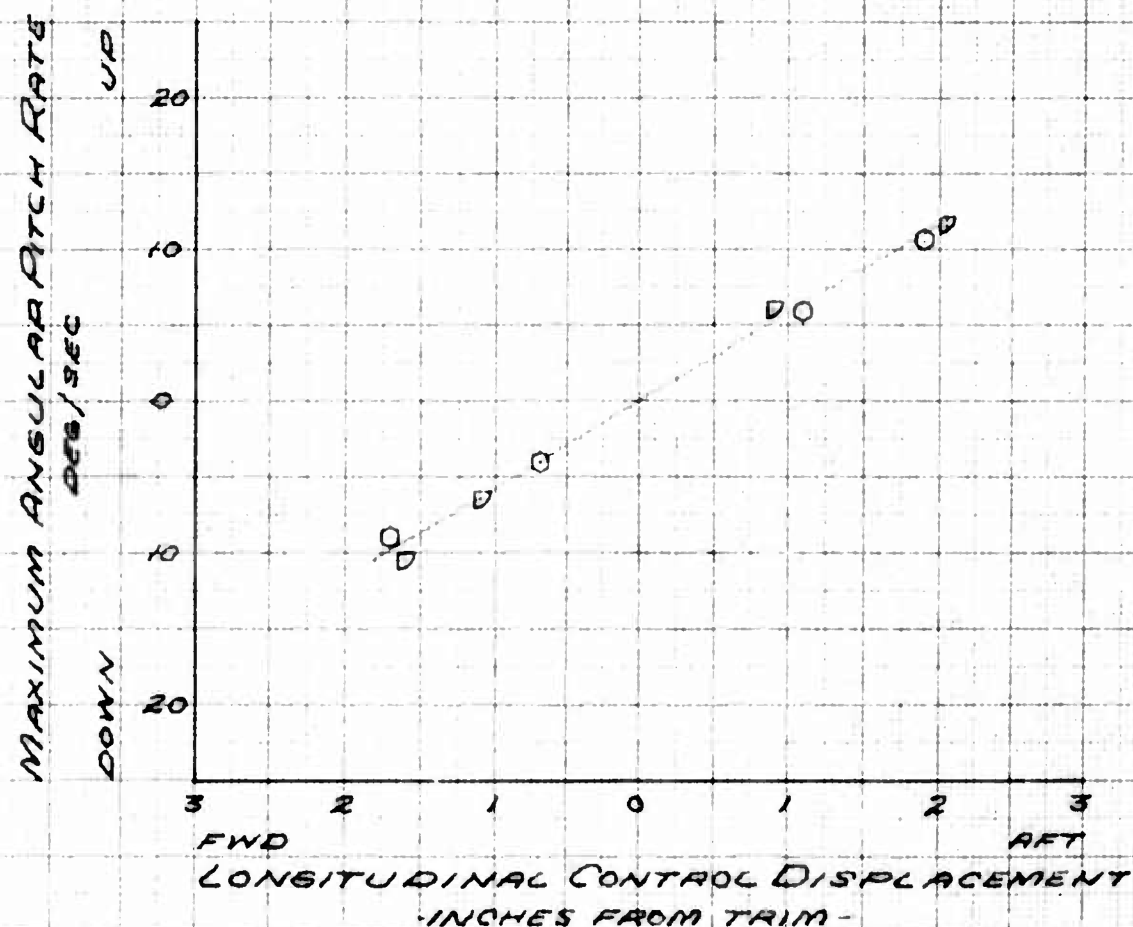

FIG. NO 57

LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 576234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c - KT	G.W. - LB	H_p - FT	C.G. - IN	RPM
O	35	2750	9000	85.70(MID)	344
D	55	2750	9000	85.70(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 7.4 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX. 9.3 INCHES AT 55 KNOTS

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX. 0.47 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 0.55 SECONDS AT 55 KNOTS.

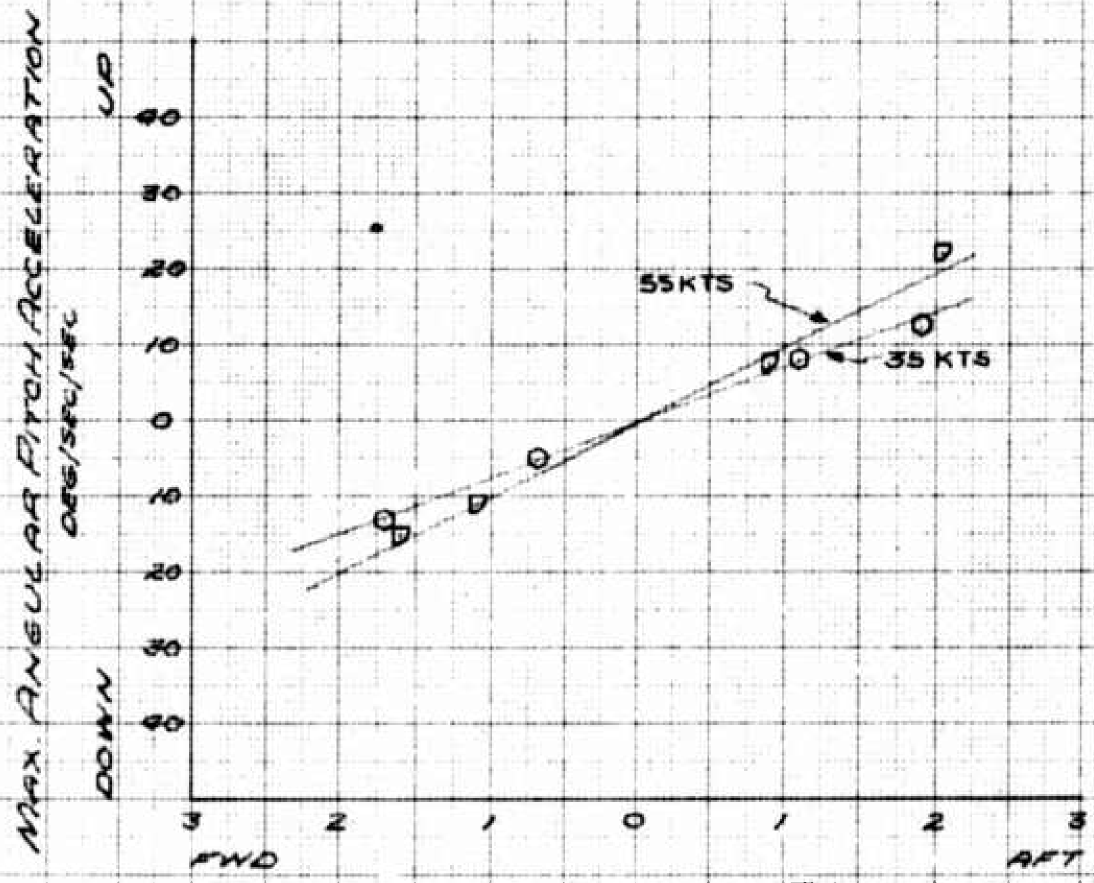

FIG. No 58

LONGITUDINAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
○	35	2475	9000	85.02(MID)	344
▽	62	2475	9000	85.02(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 6.2 INCHES FROM FULL AFT AT 35 KNOTS AND APPROX 6.8 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR PITCH RATE REACHED APPROX. 1.58 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.25 SECONDS AT 62 KNOTS.

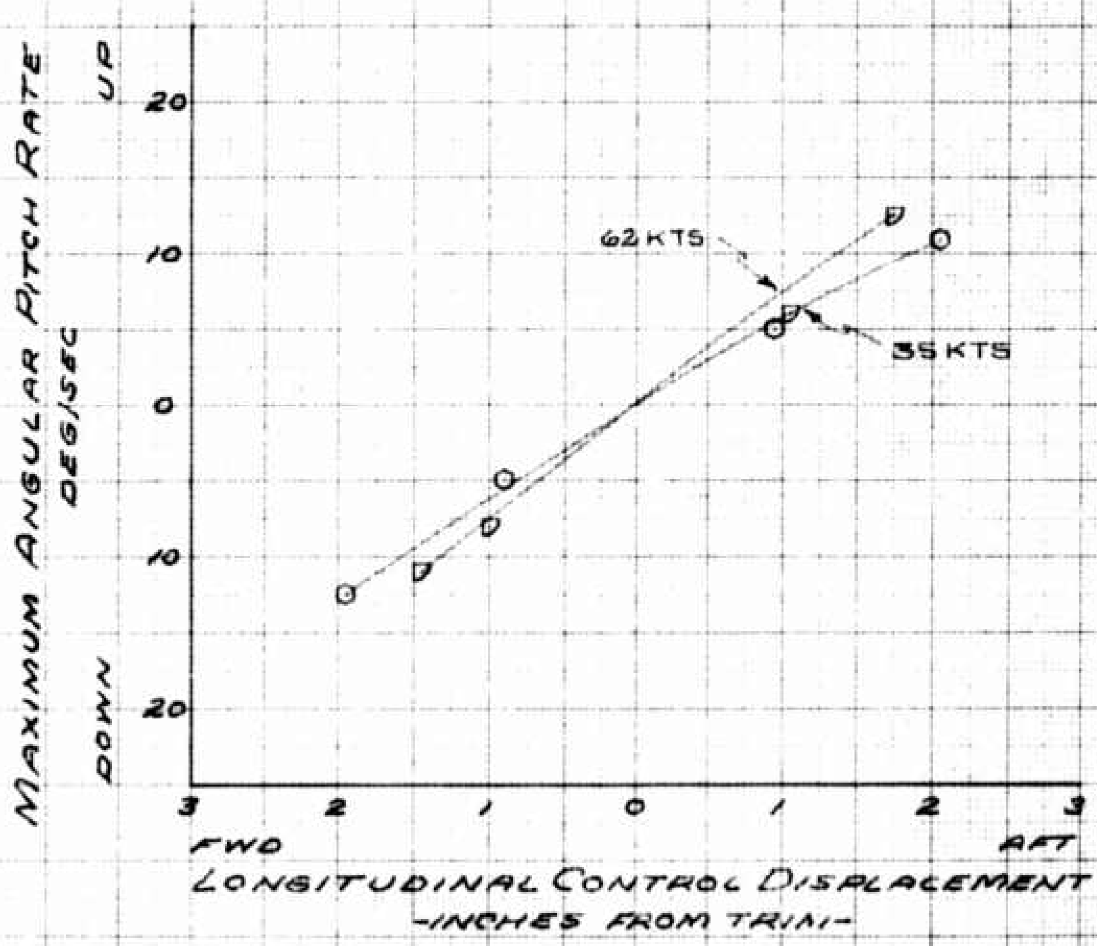

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FIG. No. 59

LONGITUDINAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_d-FT	C.G.-IN	RPM
O	35	2475	9000	85.02(MID)	344
▽	62	2475	9000	85.02(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX 6.2 INCHES FROM FULL AFT AT 35KNOTS AND APPROX 8.8 INCHES AT 65KNOTS.

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX. 0.48 SECONDS AFTER CONTROL DISPLACEMENT

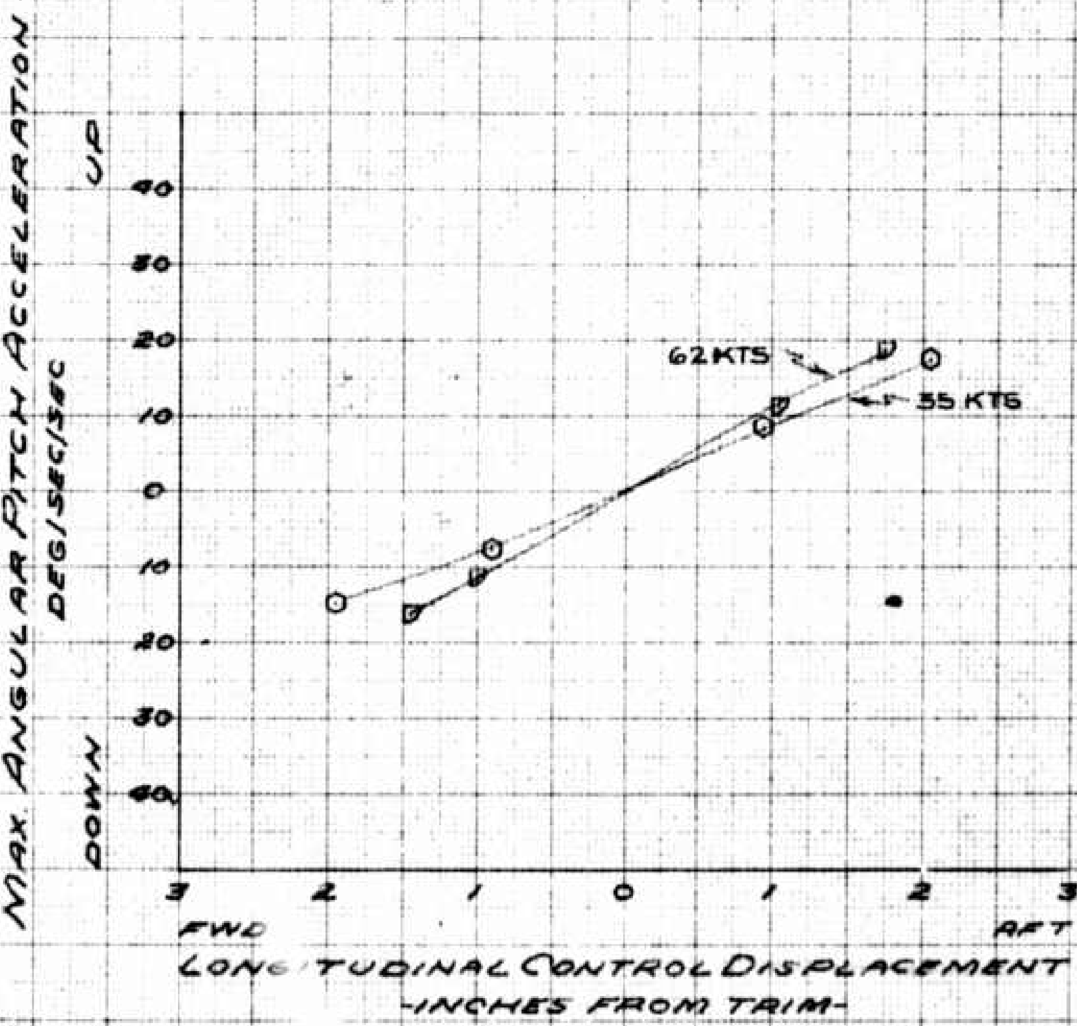

FIG. No. 60

LONGITUDINAL CONTROL RESPONSE IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	V_e - KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
○	CLIMB	45	2760	5660	85.75 (MID)	344
□	AUTOROTATION	45	2760	4975	85.75 (MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2 LONGITUDINAL CONTROL TRIM POSITION APPROX 8.5 INCHES FROM FULL AFT IN CLIMB AND 7.0 INCHES IN AUTOROTATION

NOTE 3 MAXIMUM ANGULAR PITCH RATE REACHED APPROX. 1.70 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 1.27 SECONDS IN AUTOROTATION

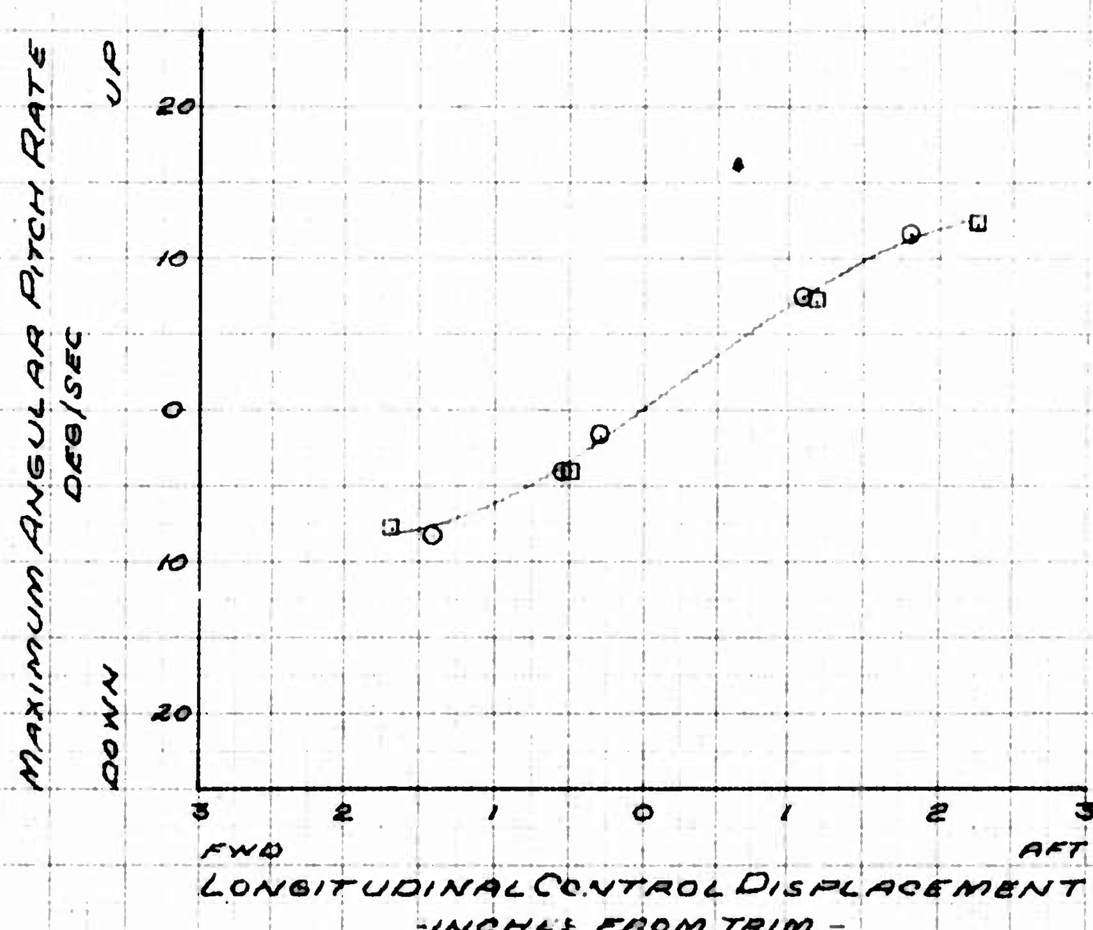

FIG. No. 61

LONGITUDINAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	V_c-KT	G.W-LB	H_p-FT	C.G-IN	RPM
○	CLIMB	45	2760	5660	85.75(MID)	344
□	AUTOROTATION	45	2760	4975	85.75(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 8.5 INCHES FROM FULL AFT IN CLIMB AND 7.0 INCHES IN AUTOROTATION

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX. 0.40 TO 0.50 SECONDS AFTER CONTROL DISPLACEMENT

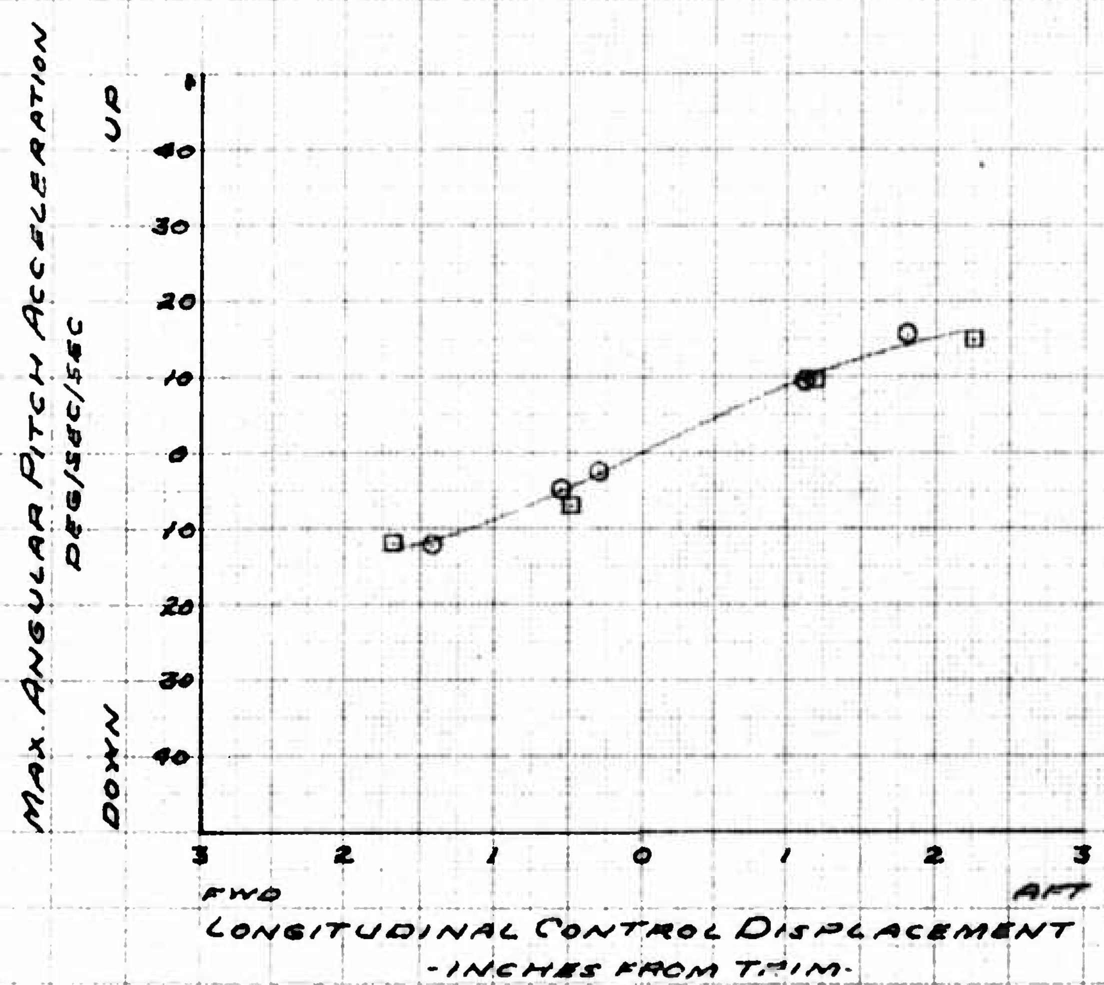

FIG NO 62

LONGITUDINAL CONTROL RESPONSE IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	FLT CONDITION	V_C-KT	GW-LB	H_D-FT	CG-IN	RPM
O	CLIMB	45	2480	4360	85.05(MID)	344
□	AUTOROTATION	45	2480	4125	85.05(MID)	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 7.6 INCHES FROM FULL AFT IN CLIMB AND APPROX 5.4 INCHES IN AUTOROTATION

NOTE 3: MAXIMUM ANGULAR PITCH RATE REACHED APPROX 1.90 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 1.43 SECONDS IN AUTOROTATION.

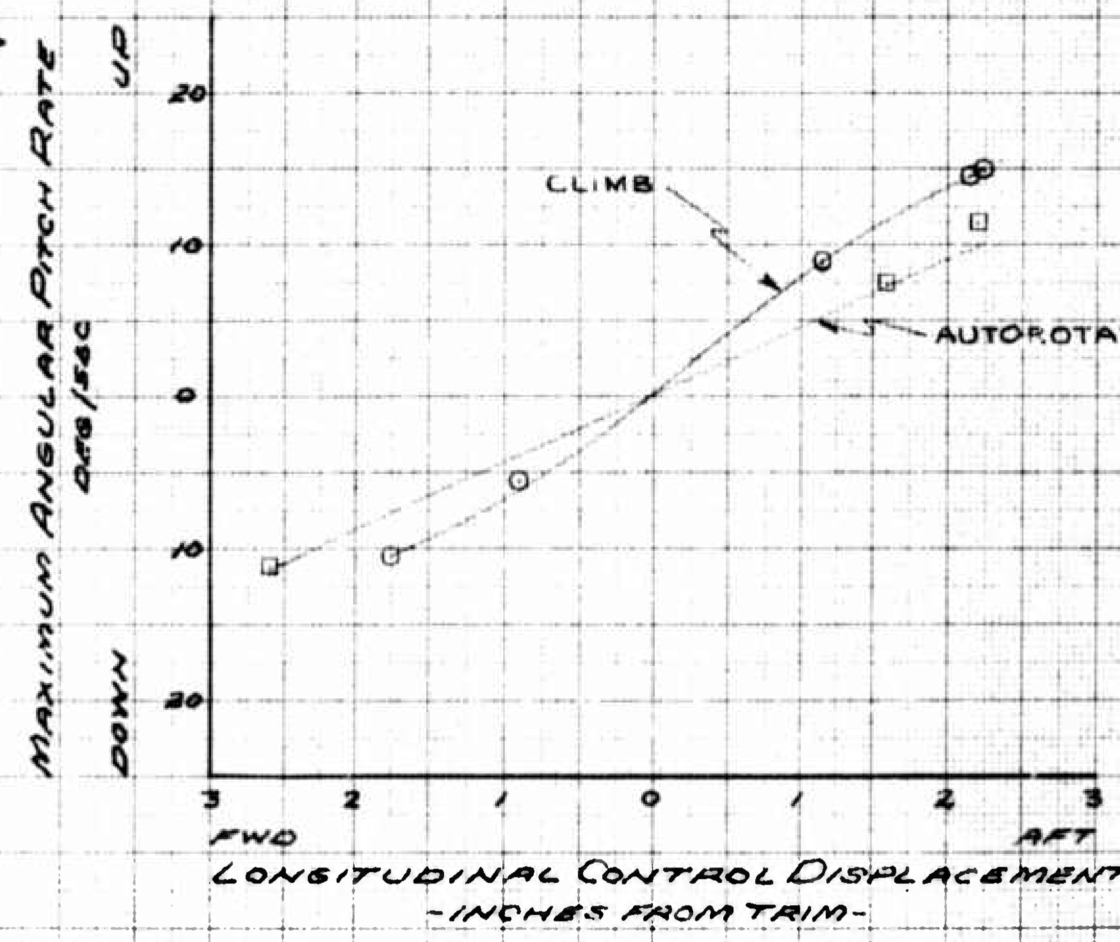

FIG. No 63

LONGITUDINAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6239

CLEAN CONFIGURATION

SYM	FLT CONDITION	V_c-KT	G.W.-LB	H_D-FT	C.G-IN	RPM
○	CLIMB	45	2480	4360	85.05	344
□	AUTOROTATION	45	2480	4125	85.05	344

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX 7.6 INCHES FROM FULL AFT IN CLIMB AND APPROX. 5.4 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX. 0.48 SECONDS AFTER CONTROL DISPLACEMENT.

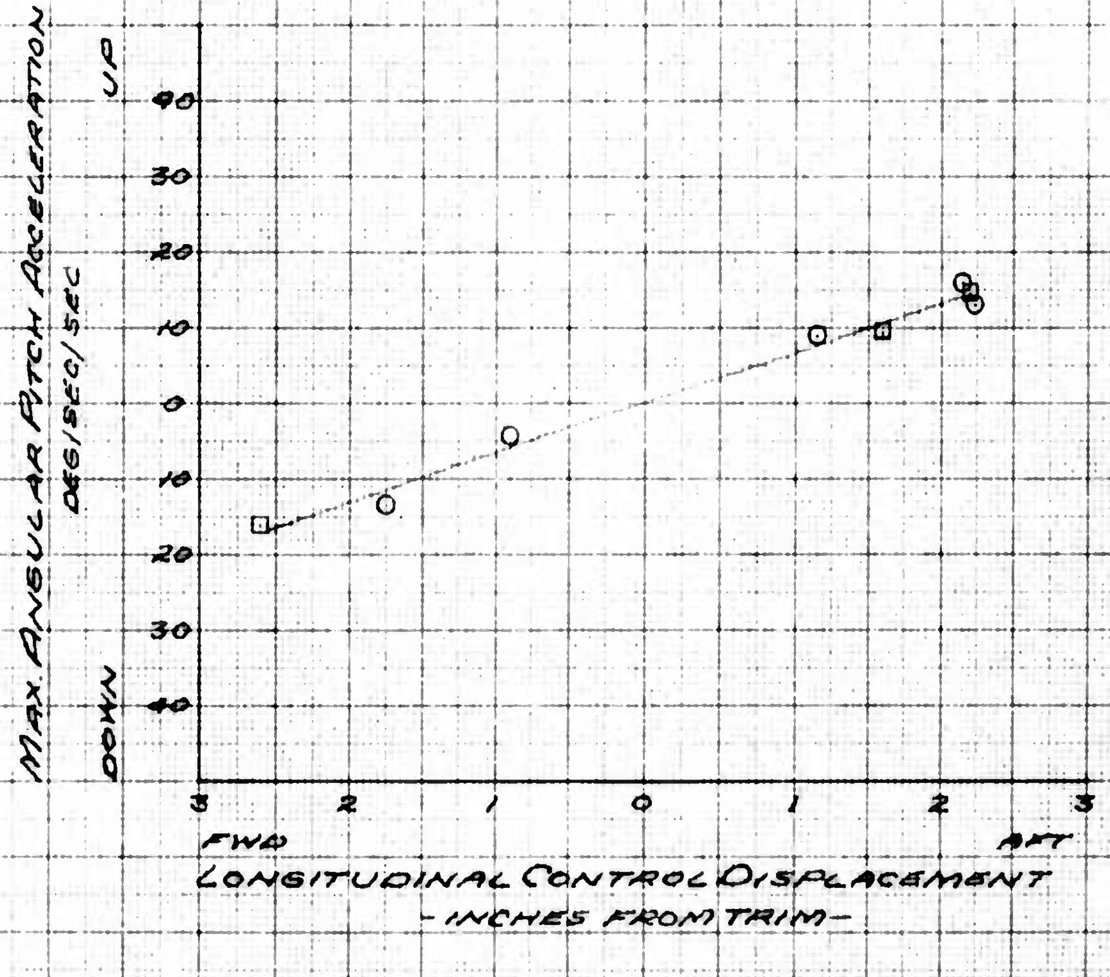

FIG. NO. 64

LONGITUDINAL CONTROL RESPONSE IN HOVER

OH-13H S/N 57-6234

SYM	CONFIGURATION	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	CLEAN	2475	2500	85.02	355
Δ	XM-1 KIT INSTALLED	2720	1000	84.43	355

NOTE 1: FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 2.8 INCHES FROM FULL AFT WITH THE 84.43 C.G. LOCATION AND 4.3 INCHES WITH THE 85.02 C.G. LOCATION.

NOTE 3: MAXIMUM ANGULAR PITCH RATE REACHED APPROX. 1.96 SECONDS AFTER CONTROL DISPLACEMENT.

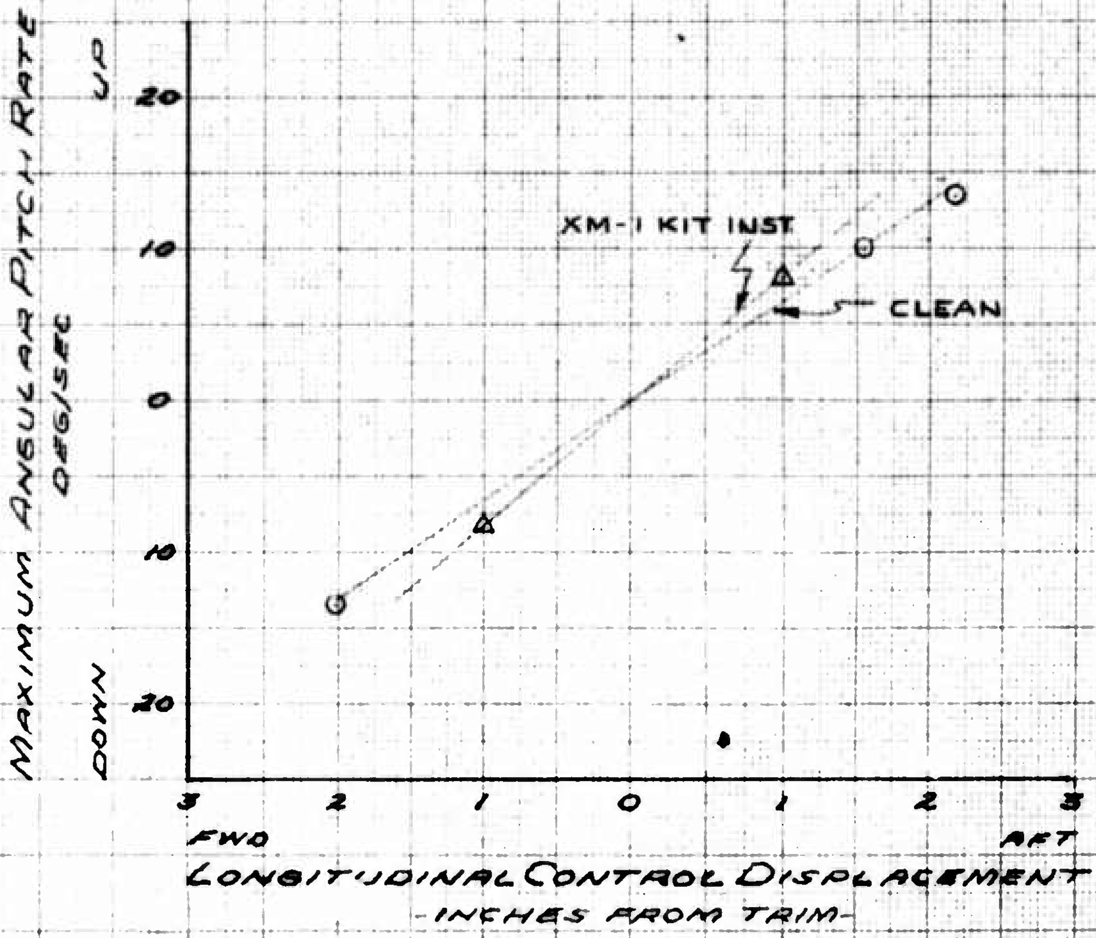

FIG. No. 65

LONGITUDINAL CONTROL SENSITIVITY IN HOVER

OH-13H S/N 57-6239

SYM	CONFIGURATION	G.W.-LB	H_D-FT	C.G.-IN	RPM
O	CLEAN	2475	2500	85.02(MID)	355
Δ	XM-1 KIT INSTALLED	2720	1000	84.43(MID)	355

NOTE 1 FULL LONGITUDINAL CONTROL TRAVEL = 11.65 INCHES

NOTE 2: LONGITUDINAL CONTROL TRIM POSITION APPROX. 2.8 INCHES FROM FULL AFT WITH THE 84.43 C.G. LOCATION AND 4.3 INCHES WITH THE 85.02 C.G. LOCATION.

NOTE 3: MAXIMUM ANGULAR PITCH ACCELERATION REACHED APPROX. 0.43 SECONDS AFTER CONTROL DISPLACEMENT.

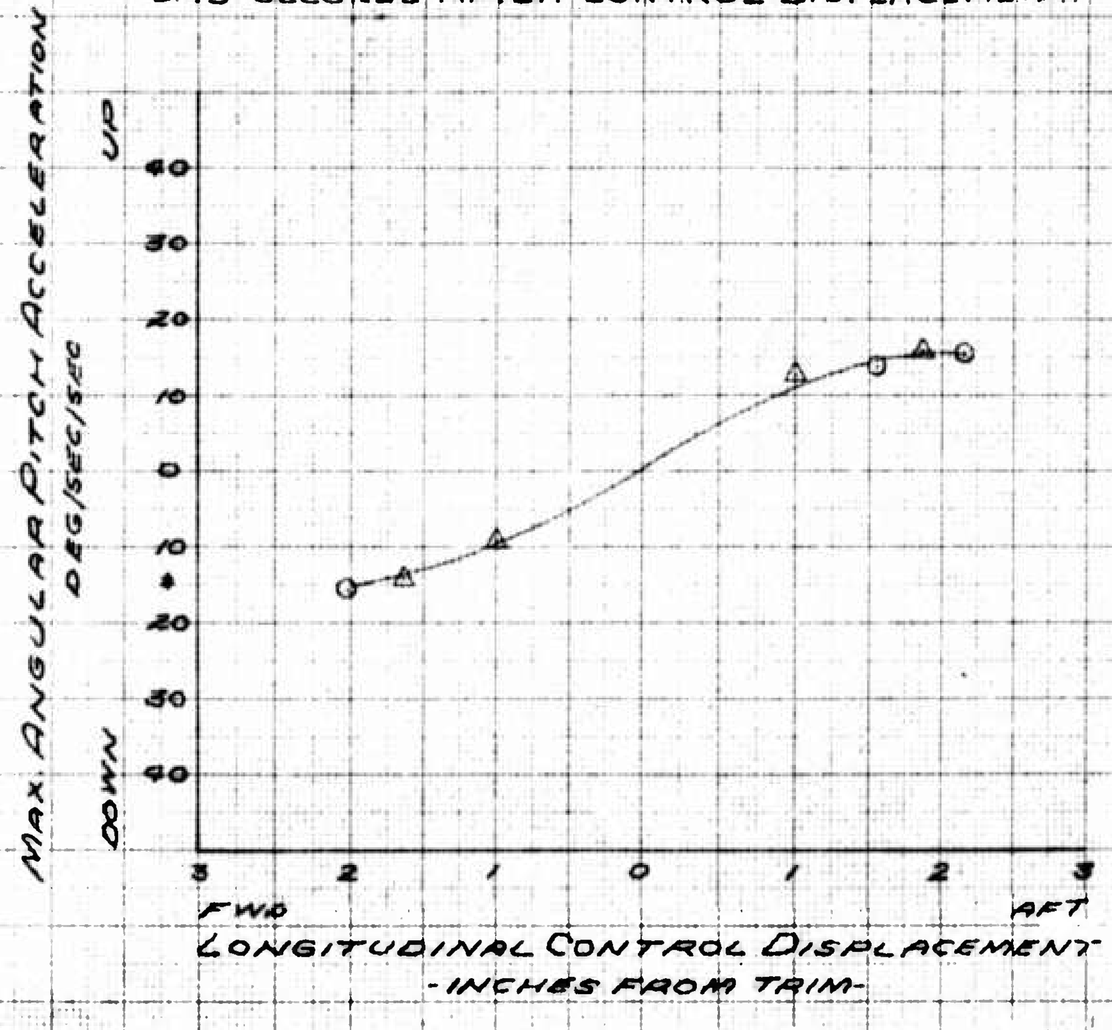

FIG. No. 66

RESPONSE TO A RIGHT LATERAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
65	5400	2745	85.65 (MID)	344

PITCH —— ROLL ---- YAW & SIDESLIP —-—-—

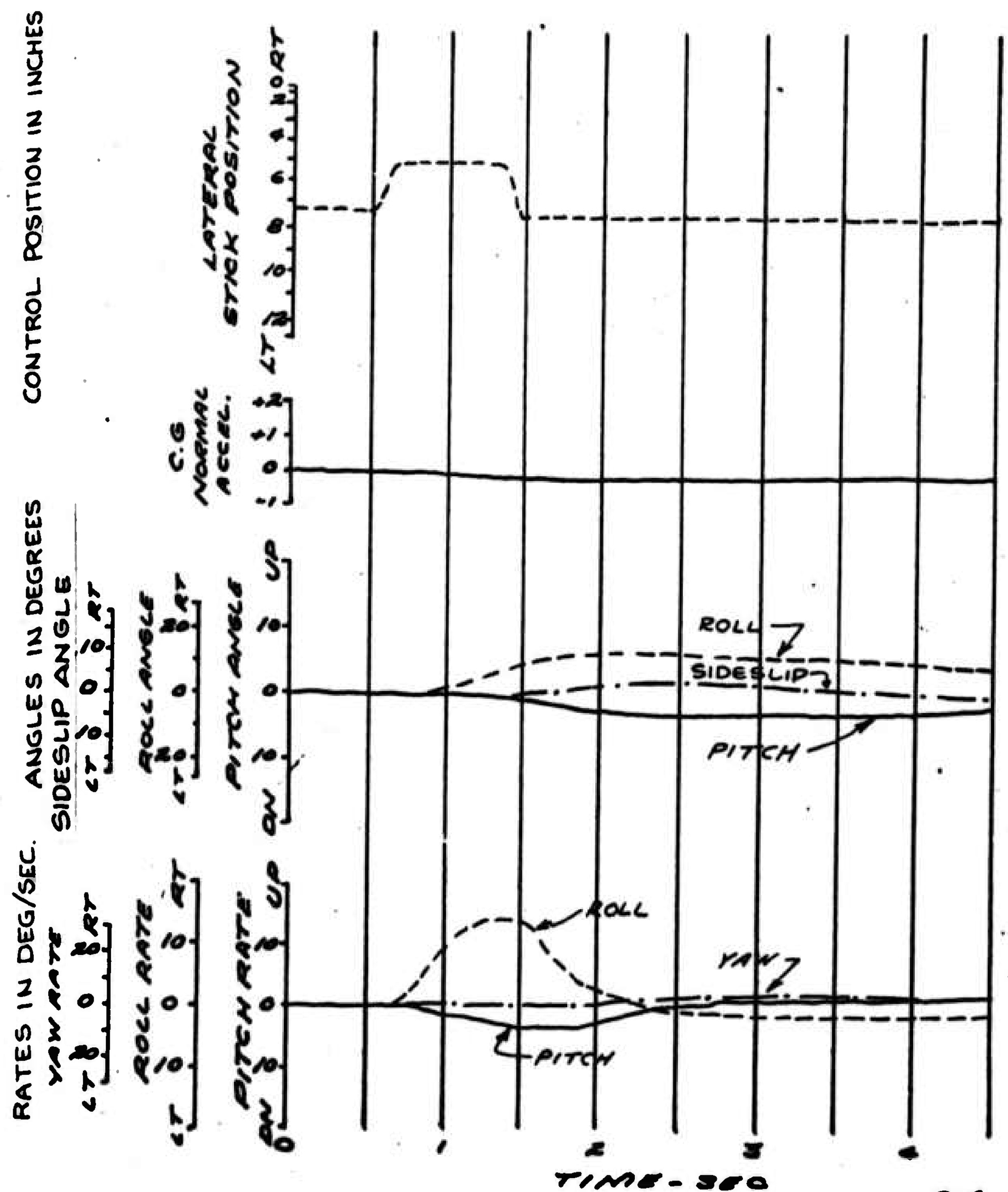

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FIG. No. 67

RESPONSE TO A LEFT LATERAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
65	5400	2745	85.65 (MID)	344

PITCH —— ROLL ---- YAW —·—·— & SIDESLIP

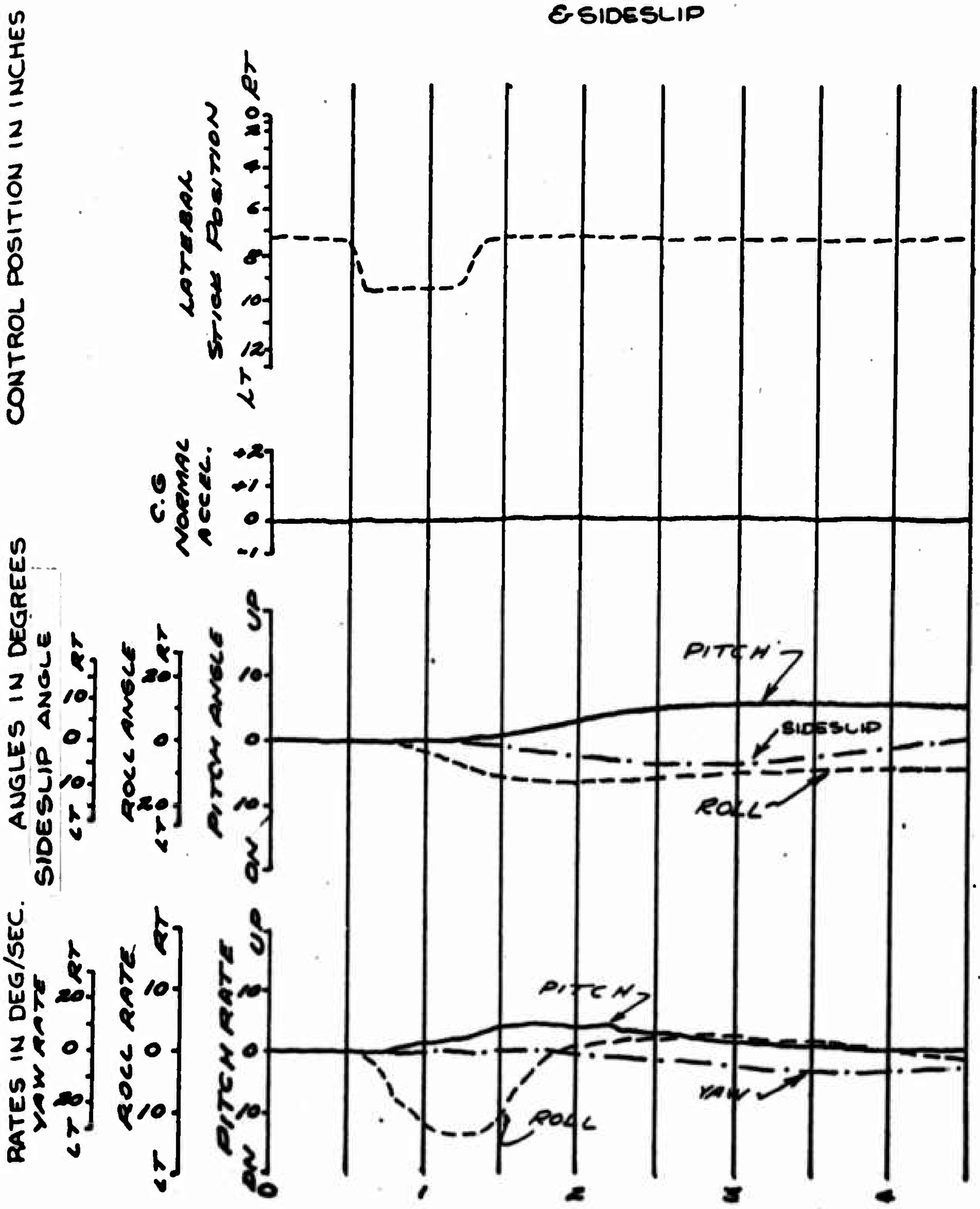

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FIG. No. 67 (CONT.)

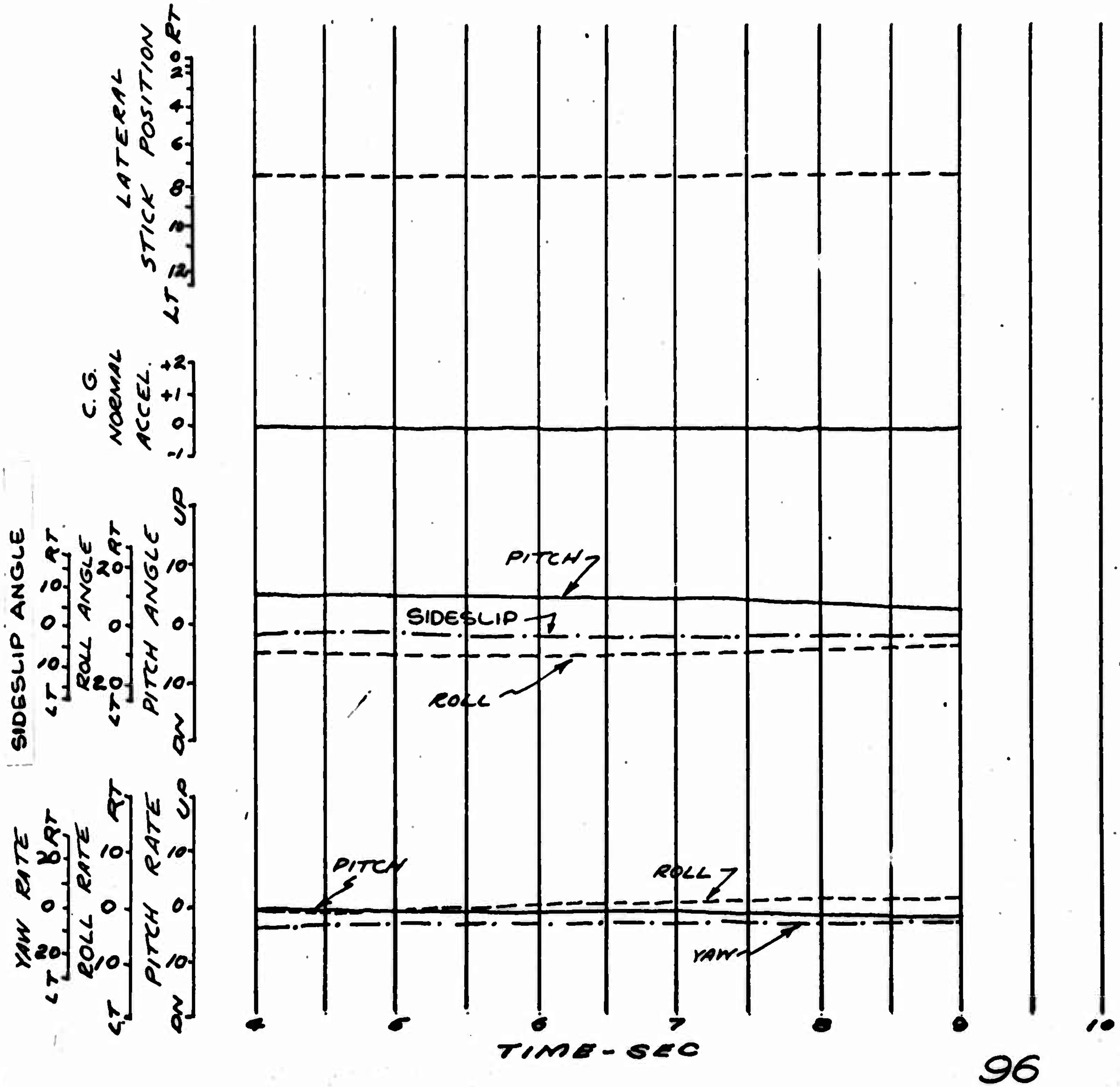

FIG. No. 68

RESPONSE TO A RIGHT LATERAL PULSE IN A HOVER

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	84.43 (MID)	355

PITCH ——— ROLL - - - - YAW —-—-—

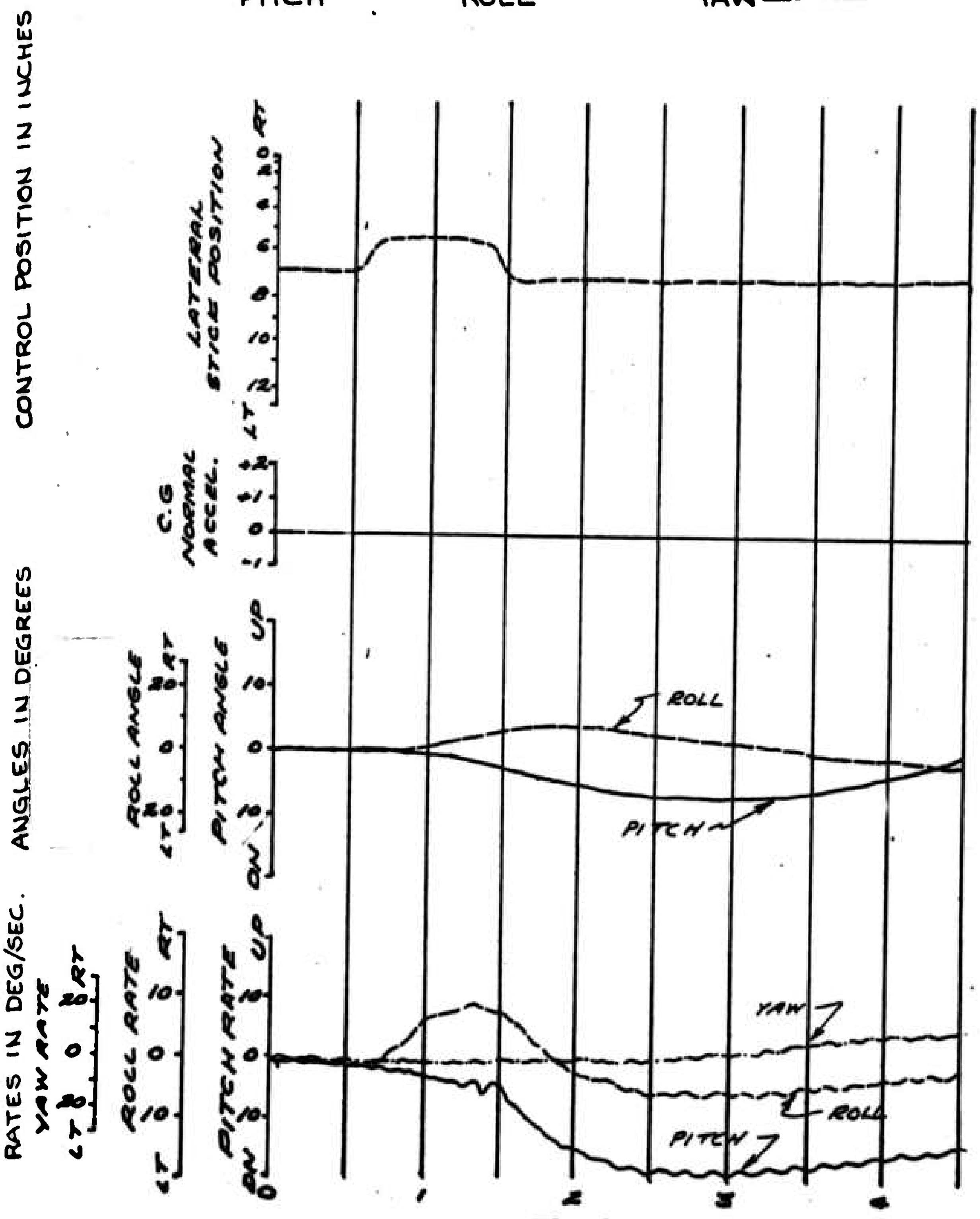

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FIG. No. 68 (CONT.)

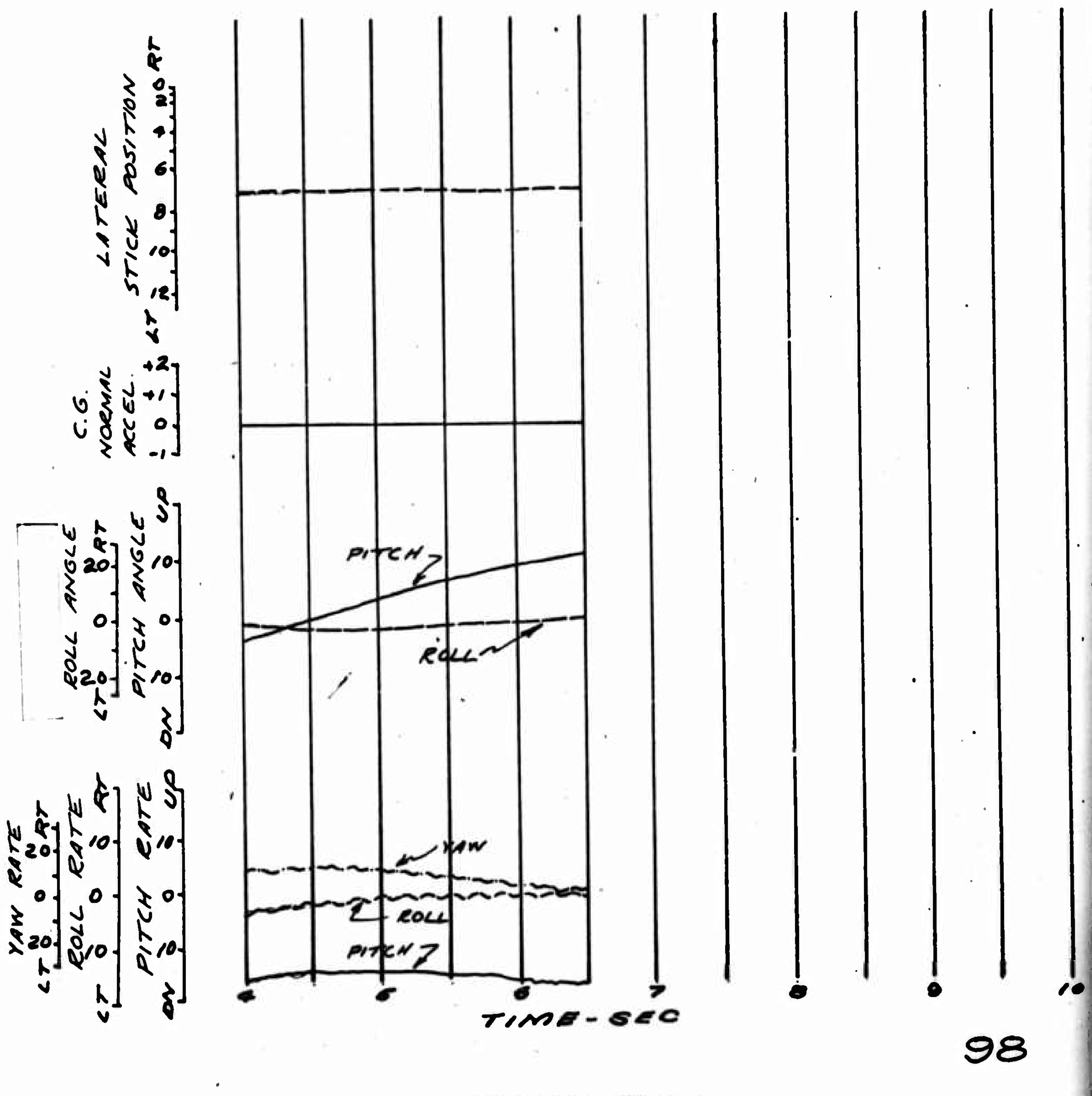

FIG. No. 69

RESPONSE TO A LEFT LATERAL PULSE IN A HOVER

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	84.43(MID)	355

PITCH —— ROLL - - - - YAW —-—-—

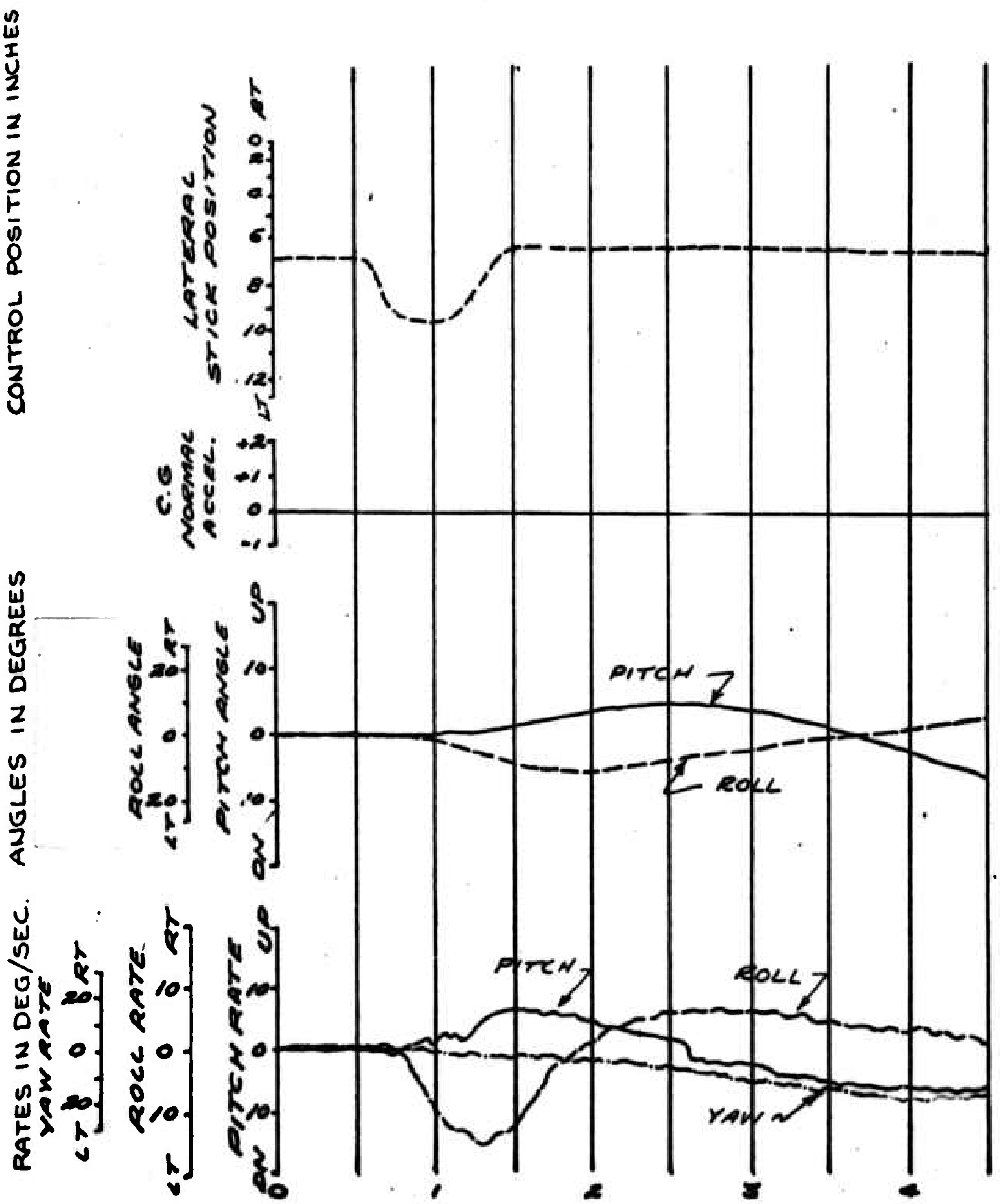

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FIG. No. 69 (CONT.)

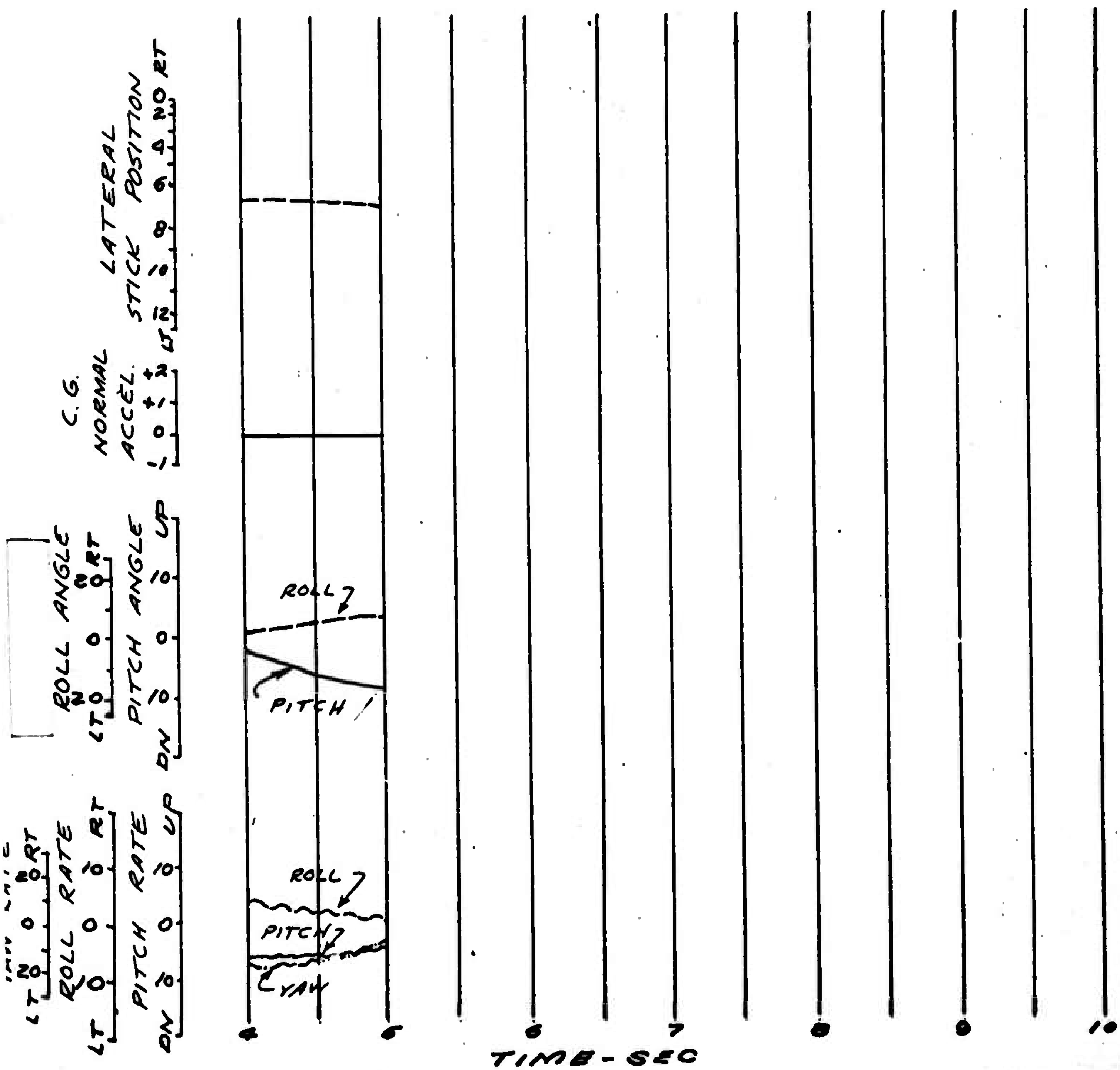


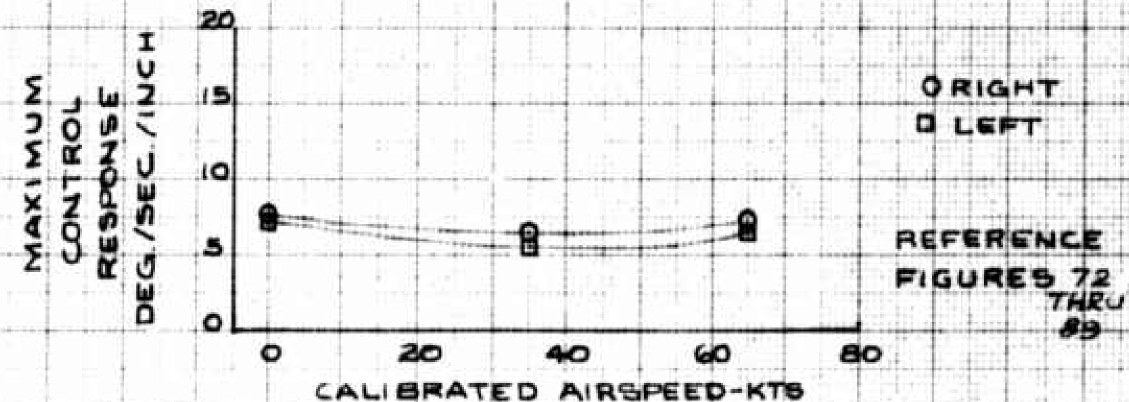
FIG. No. 70

SUMMARY LATERAL CONTROL RESPONSE

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_C-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
0	2720	1000	84.43 (MID)	355
35	2760	4470	85.65 (MID)	344
65	2760	4485	85.65 (MID)	344



V_C-KTS	G.W.-LB	H_D-FT.	C.G.-IN.	RPM
0	2475	2500	85.02 (MID)	355
35	2475	5000	85.10 (MID)	344
65	2475	5000	85.10 (MID)	344

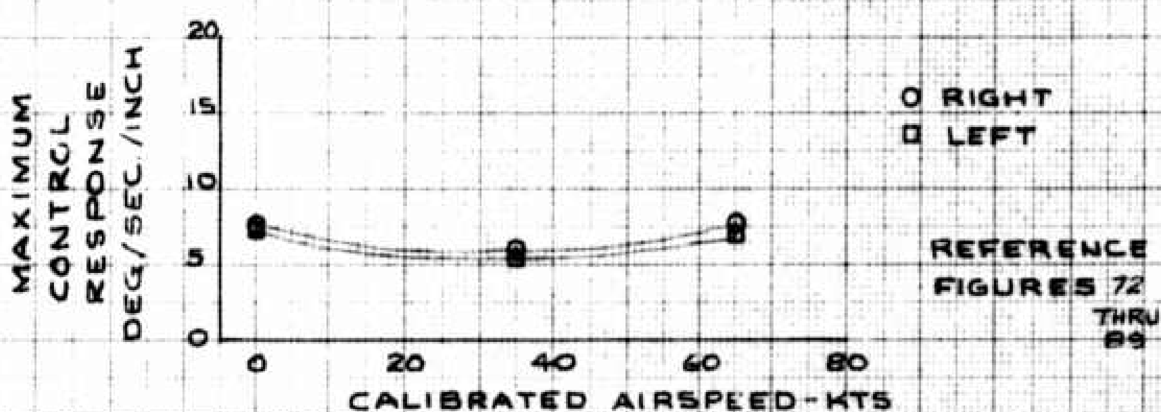
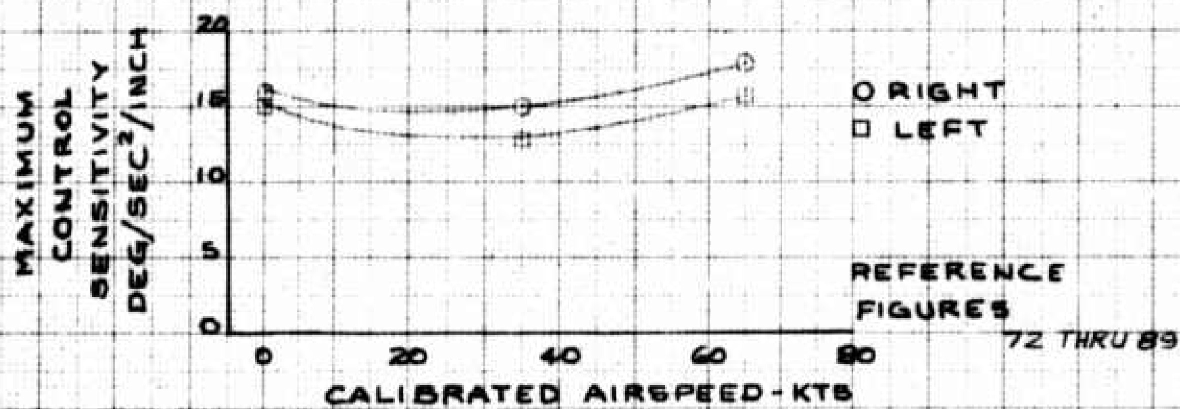


Fig. No. 71
Summary Lateral Control Sensitivity

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KTS	G.W.-LB	H_D-FT.	C.G.-IN.	RPM
0	2720	1000	84.43	335
35	2760	4470	85.65	344
65	2760	4485	85.65	344



CLEAN CONFIGURATION

V_c-KTS	G.W.-LB	H_D-FT	C.G.-IN.	RPM
0	2475	2500	85.02 (MID)	355
35	2475	5000	85.10 (MID)	344
65	2475	5000	85.10 (MID)	344

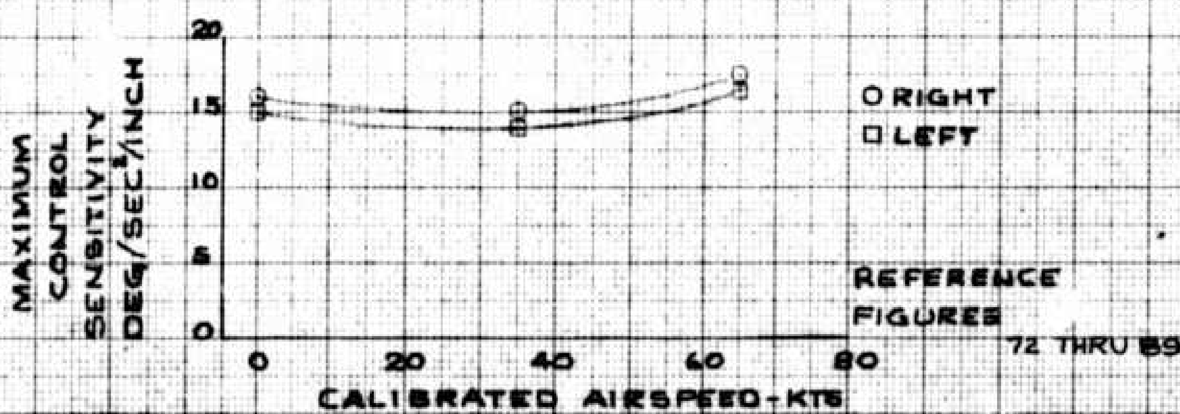


FIG. No. 72

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_d-FT	C.G.-IN	RPM
O	35	2760	4470	85.65 (MID)	344
◇	65	2760	4485	85.65 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL - 12.9 INCHES FROM

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX 7.4 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.1 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 0.98 SECONDS AFTER CONTROL DISPLACEMENT.

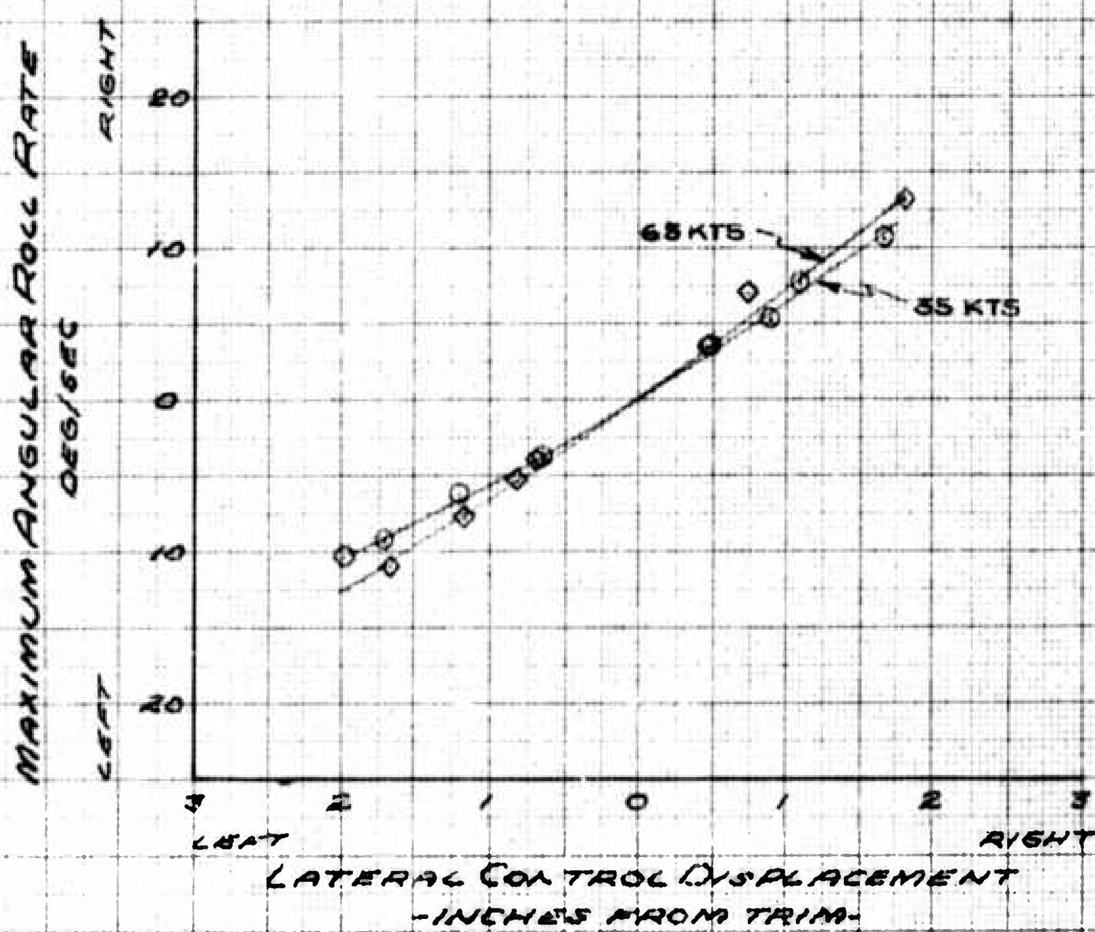


FIG. NO. 73

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N57-6239

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_c-FT	C.G.-IN	RPM
O	35	2760	4470	85.65 (MID)	344
◇	65	2760	4485	85.65 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.4 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.1 INCHES AT 65 KNOTS

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.36 SECONDS AFTER CONTROL DISPLACEMENT.

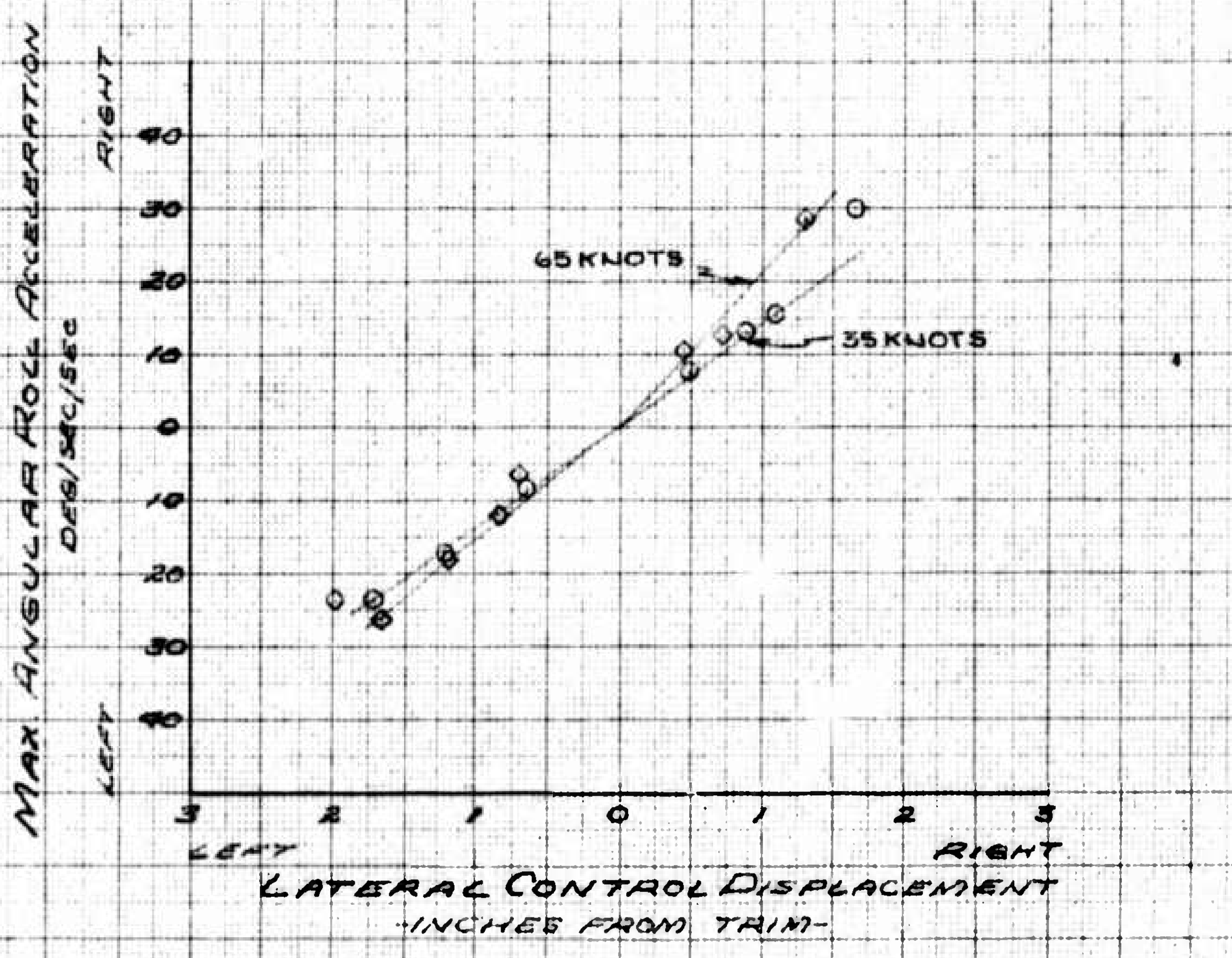


FIG. NO. 74

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2475	5000	85.10(MID)	344
□	65	2475	5000	85.10(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.5 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.1 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ROLL RATE REACHED APPROX. 0.95 SECONDS AFTER CONTROL DISPLACEMENT.

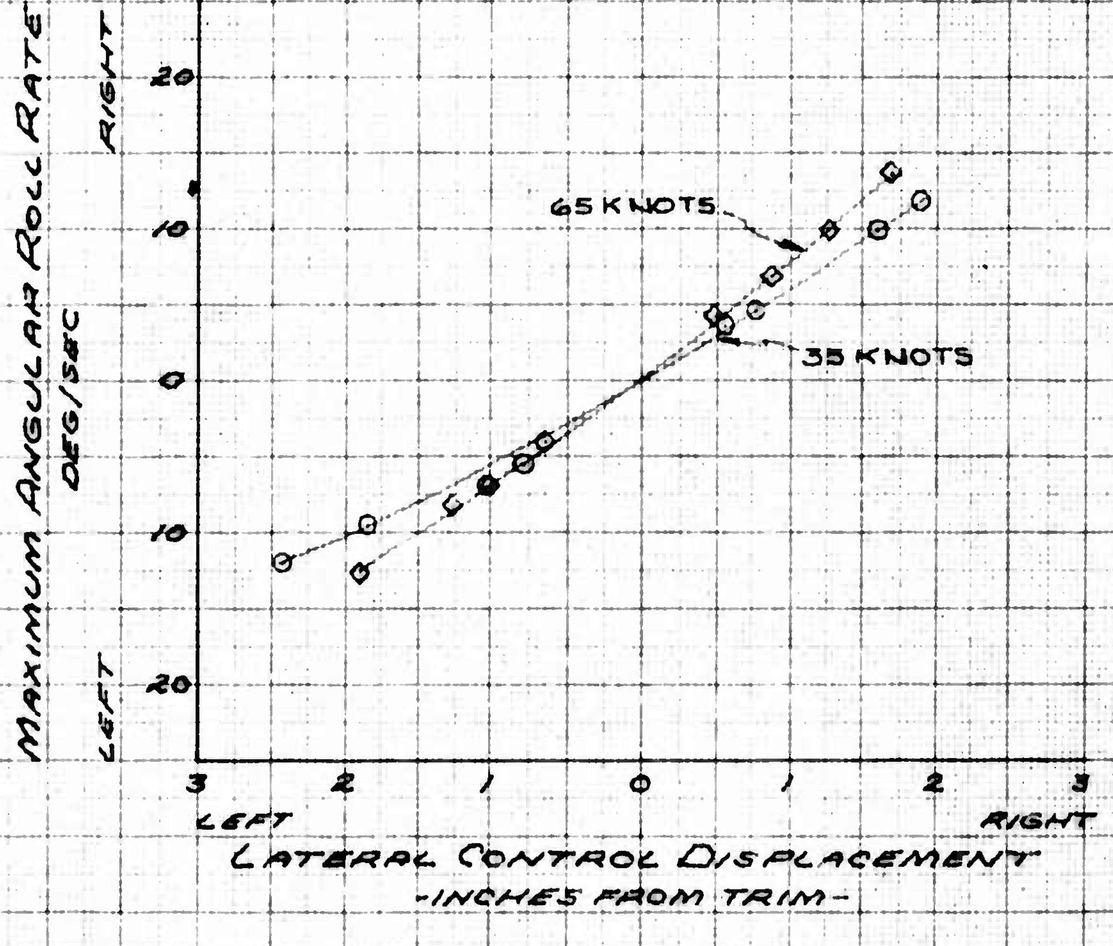


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FIG. NO. 75

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
○	35	2475	5000	85.10 (MID)	344
◇	65	2475	5000	85.10 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.5 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.1 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.36 SECONDS AFTER CONTROL DISPLACEMENT

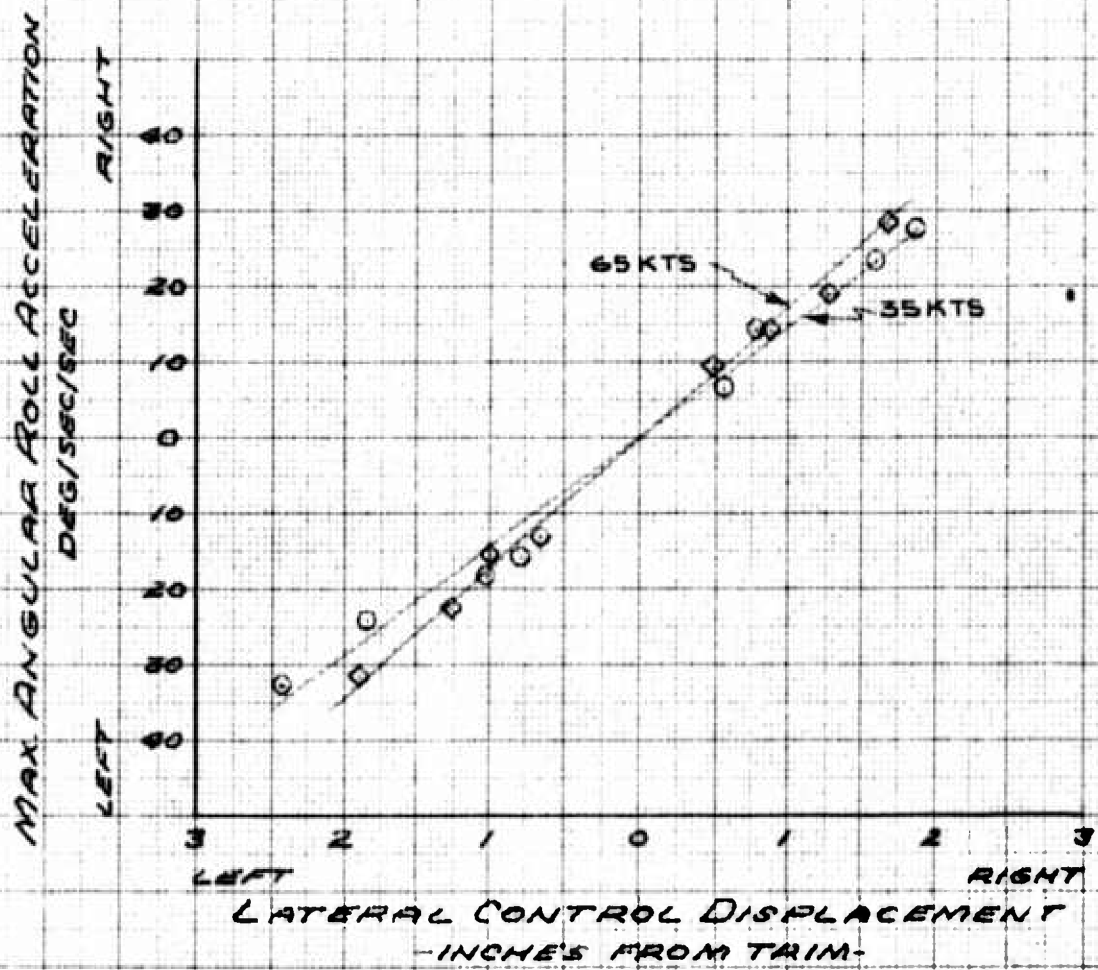

FIG. NO. 7E

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G-IN	RPM
△	65	2710	5100	85.10 (FWD)	344
□	65	2720	5000	85.05 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.3 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.10 SECONDS AFTER CONTROL DISPLACEMENT.

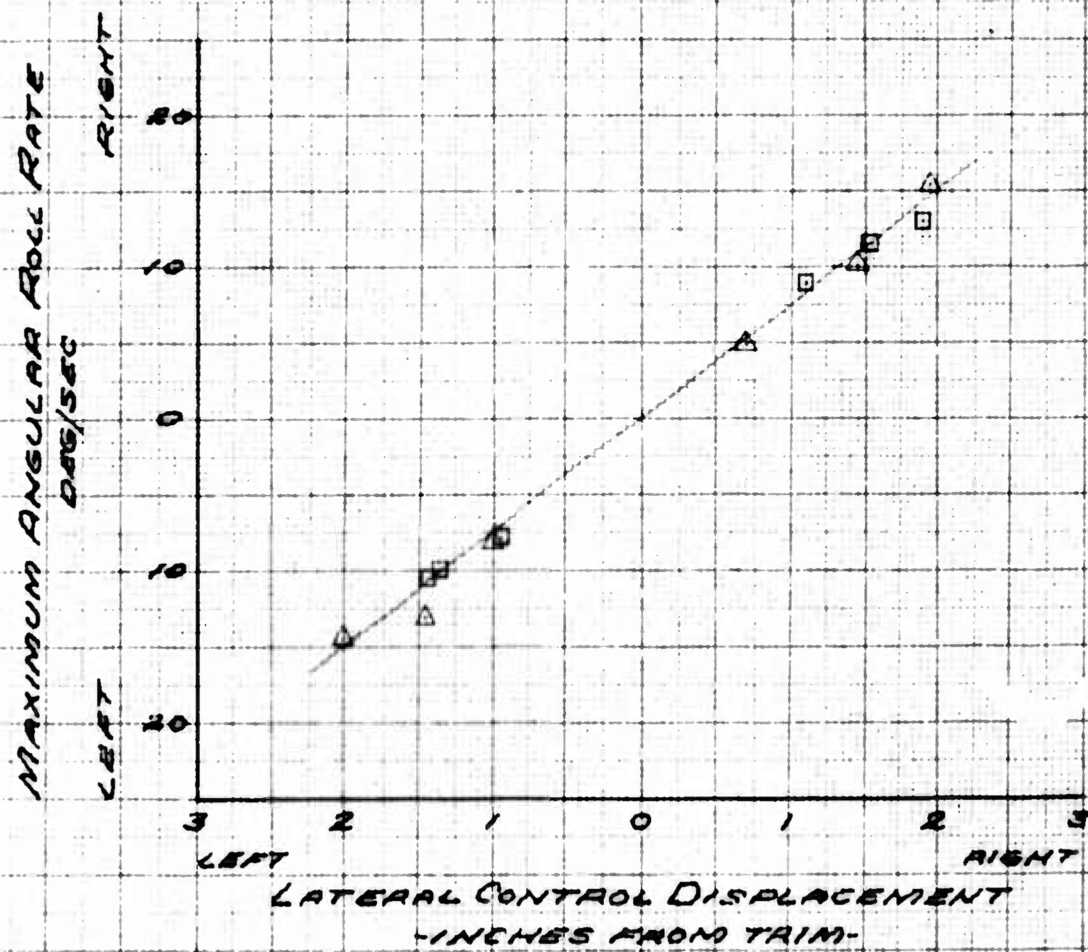

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FIG. No. 77

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB.	H_p-FT	C.G.-IN	RPM
△	65	2710	5100	83.10(FWD)	344
□	65	2720	5000	85.05(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.3 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.32 SECONDS AFTER CONTROL DISPLACEMENT.

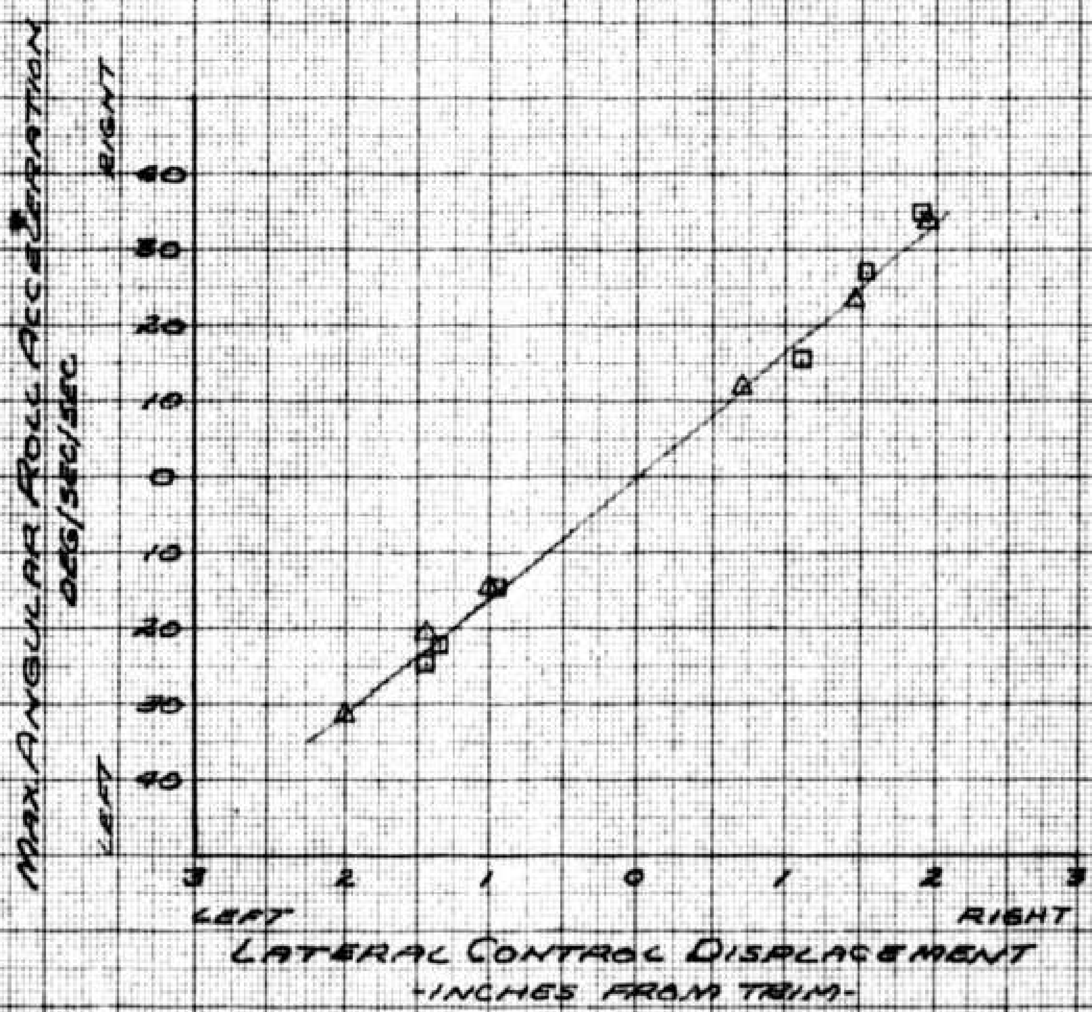

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FIG No 78

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN.	RPM
△	65	2465	4700	82.37(FWD)	344
□	65	2485	4800	84.65(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.3 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.30 SECOND AFTER CONTROL DISPLACEMENT.

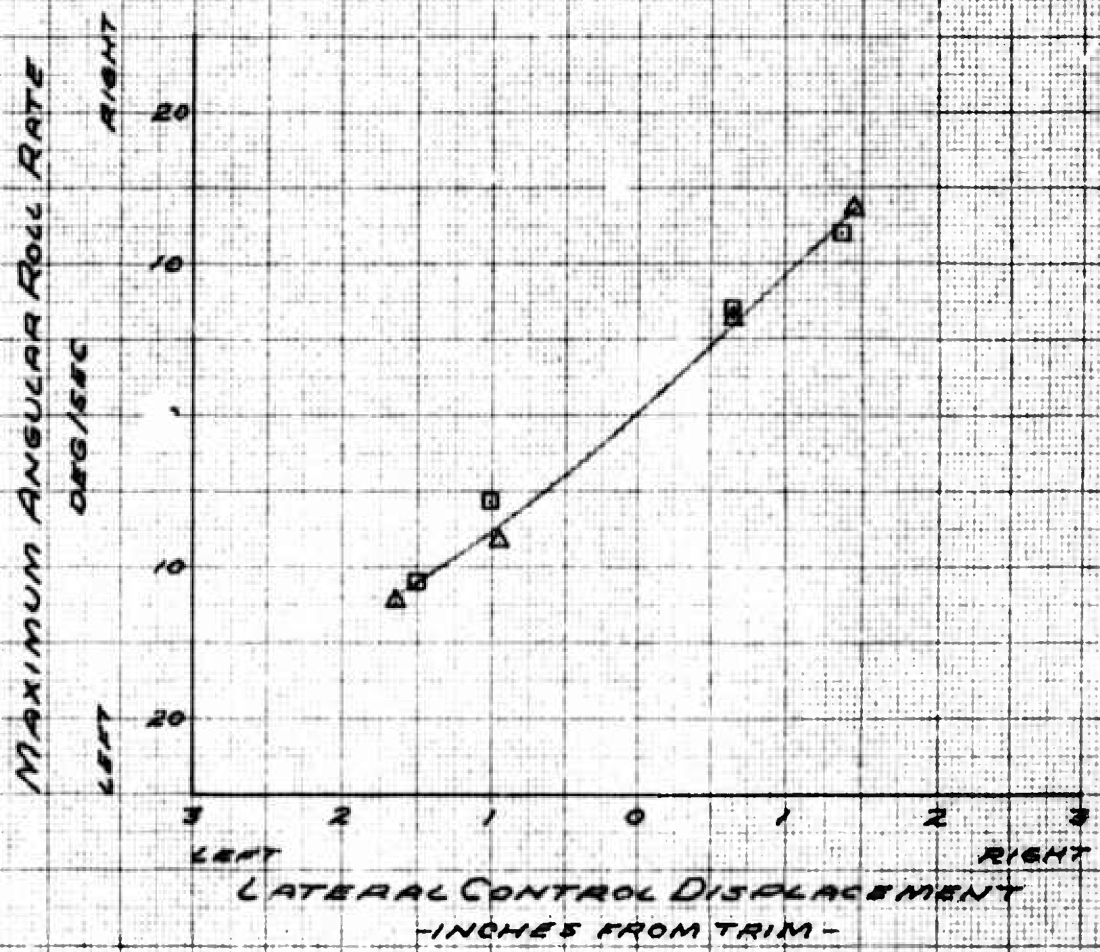

FIG NO. 79

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN.	RPM
△	65	2465	4700	82.37(FWD)	344
□	65	2465	4800	84.65(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX 7.5 INCHES FROM FULL RIGHT

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX 0.36 SECONDS AFTER CONTROL DISPLACEMENT

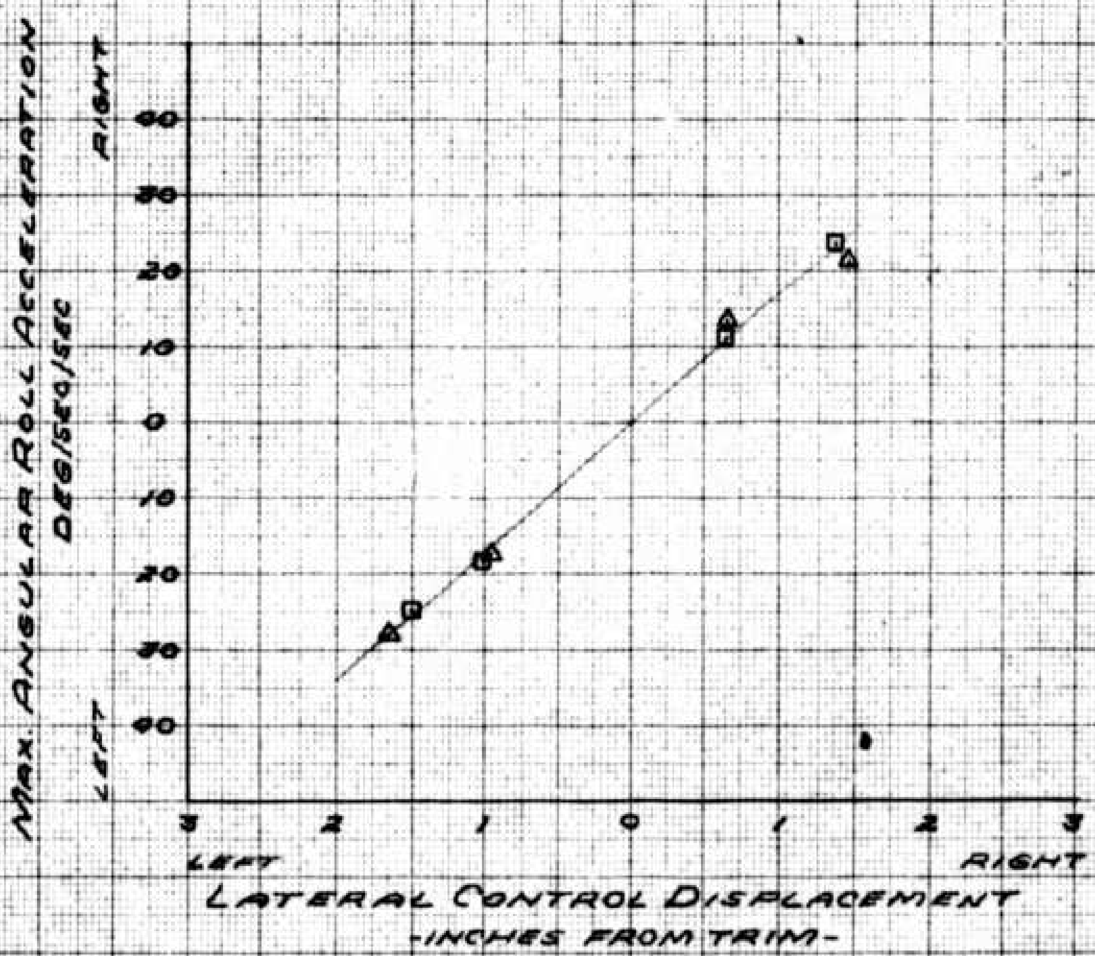

FIG. No 80

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
○	35	2750	9000	85.70 (MID)	344
▽	65	2750	9000	85.70 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.6 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.3 INCHES AT 65 KNOTS

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.00 SECONDS AFTER CONTROL DISPLACEMENT.

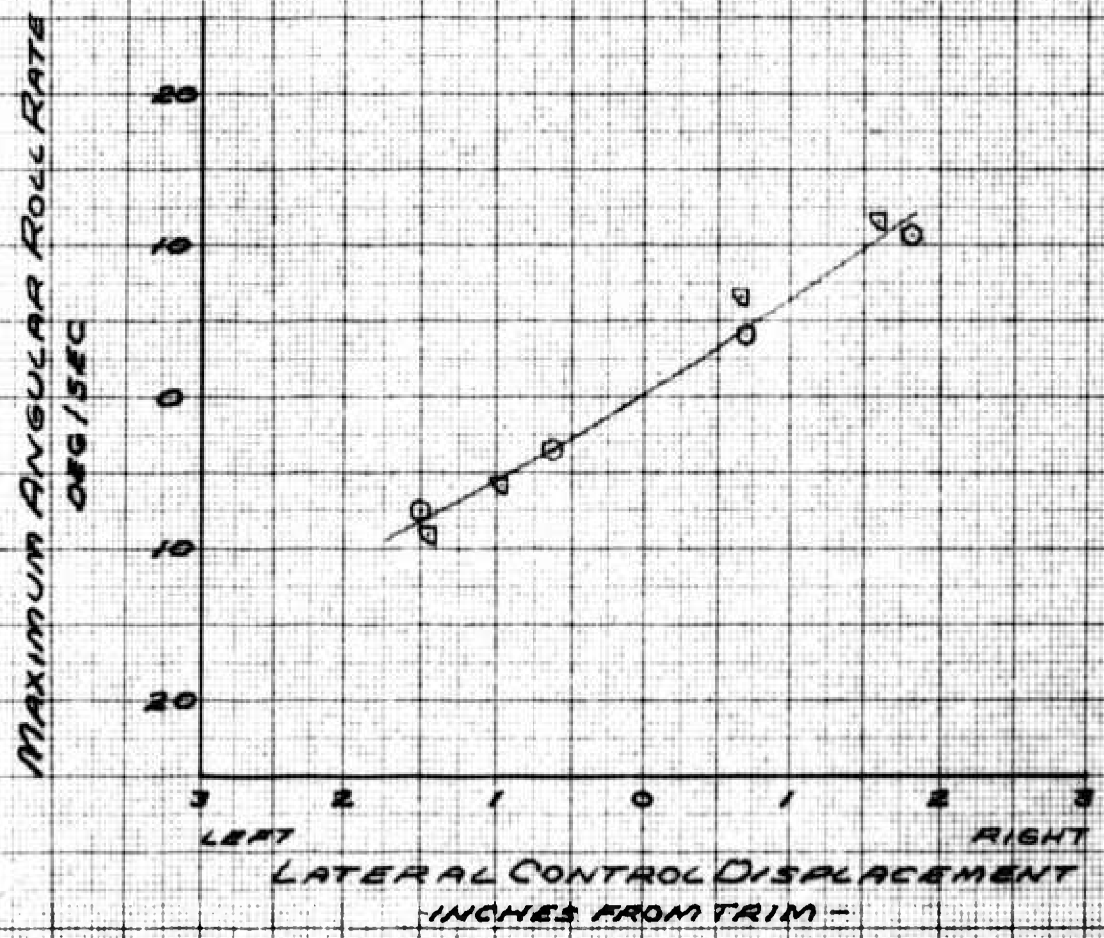

FIG. NO. 81

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_C-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
○	35	2750	9000	85.70 (MID)	344
▽	63	2750	9000	85.70 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.6 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.3 INCHES AT 65 KNOTS

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.42 SECONDS AFTER CONTROL DISPLACEMENT.

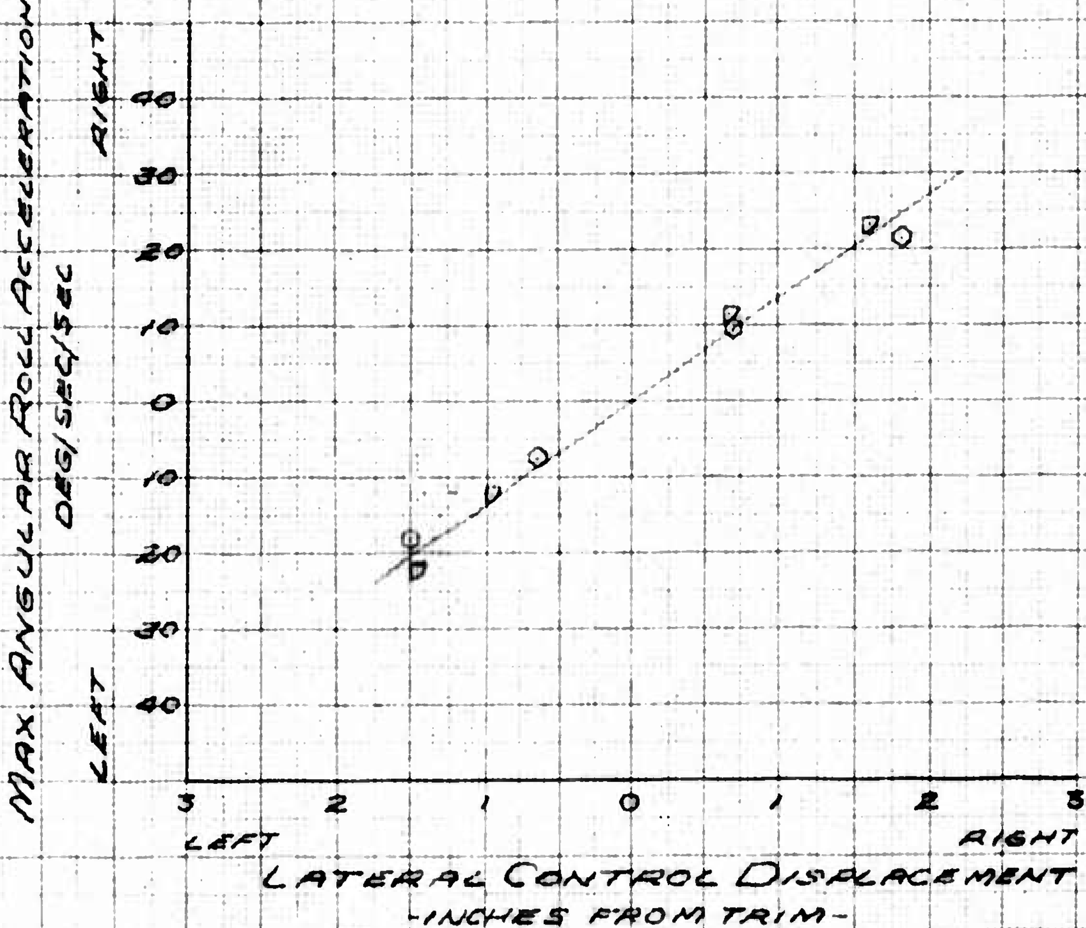

FIG. No. 82

LATERAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
O	35	2475	9000	85.02 (MID)	344
▽	62	2475	9000	85.02 (MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.8 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.5 INCHES AT 62 KNOTS.

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.00 SECOND AFTER CONTROL DISPLACEMENT.

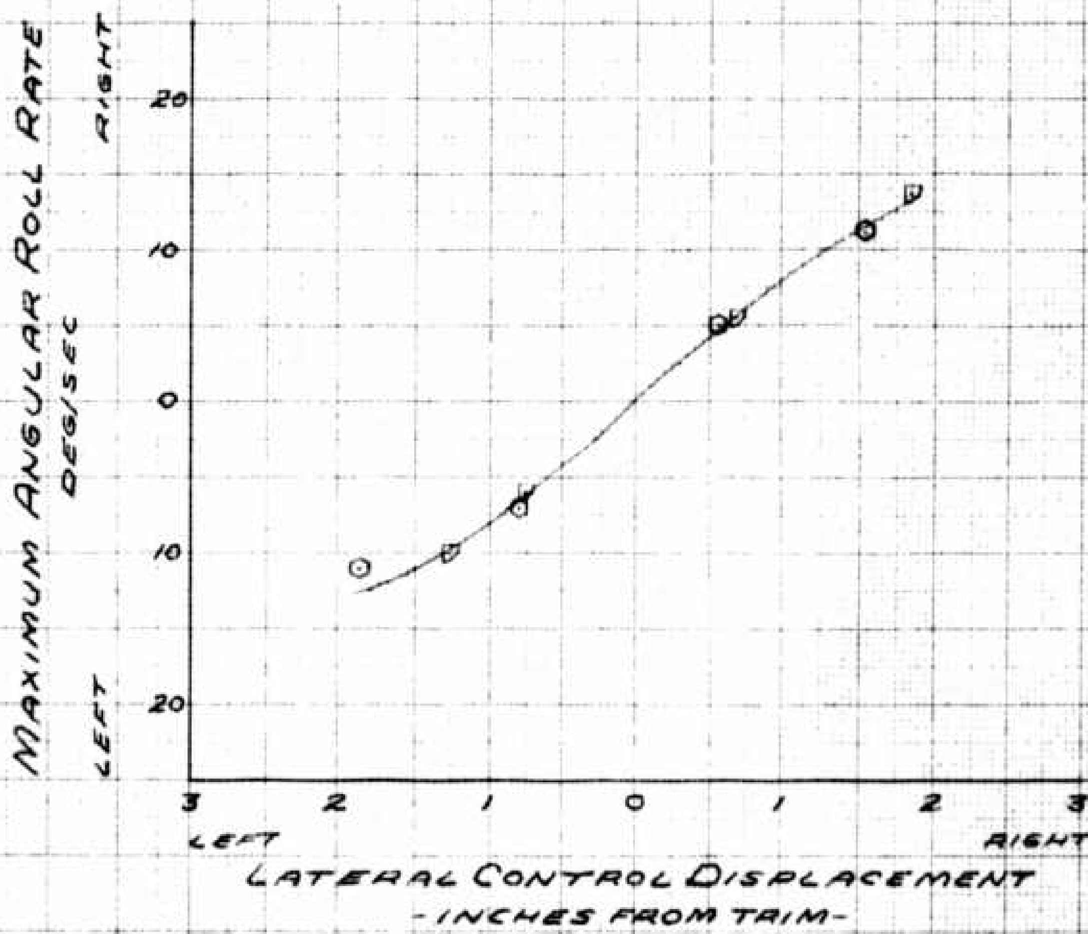

FIG. No. 83

LATERAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_C-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2475	9000	85.02(MID)	344
□	62	2475	9000	85.02(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.8 INCHES FROM FULL RIGHT AT 35 KNOTS AND 7.5 INCHES AT 62 KNOTS

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.37 SECONDS AFTER CONTROL DISPLACEMENT

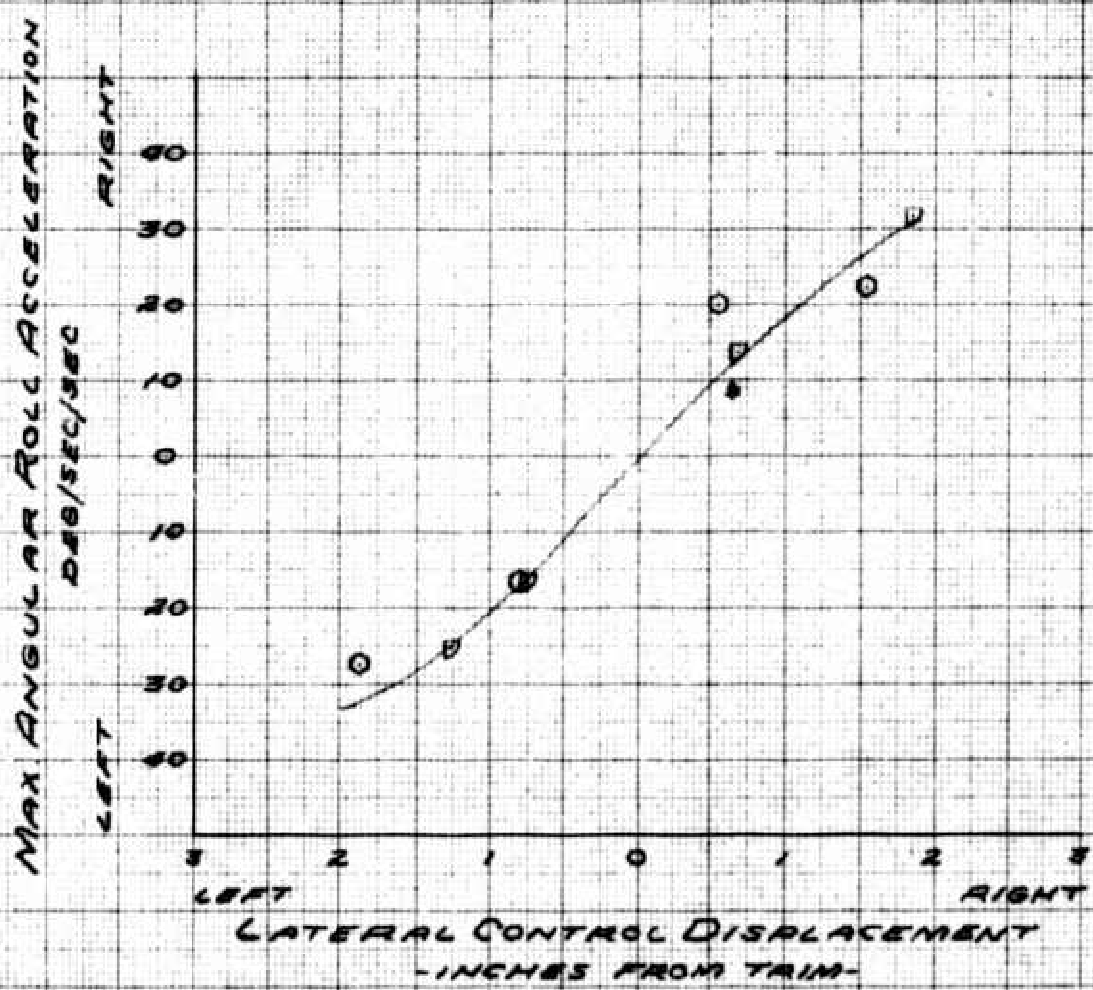

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FIG. NO. 84
LATERAL CONTROL RESPONSE IN CLIMB & AUTOROTATION
OH-13H S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	V_C-KT	G.W.-LB	H_D-FT	C.G.-IN	RPM
O	CLIMB	45	2760	4725	85.65(MID)	344
□	AUTOROTATION	45	2760	5250	85.65(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.5 INCHES FROM FULL RIGHT IN CLIMB AND APPROX 6.1 INCHES IN AUTO-ROTATION

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.15 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 0.80 SECONDS IN AUTOROTATION.

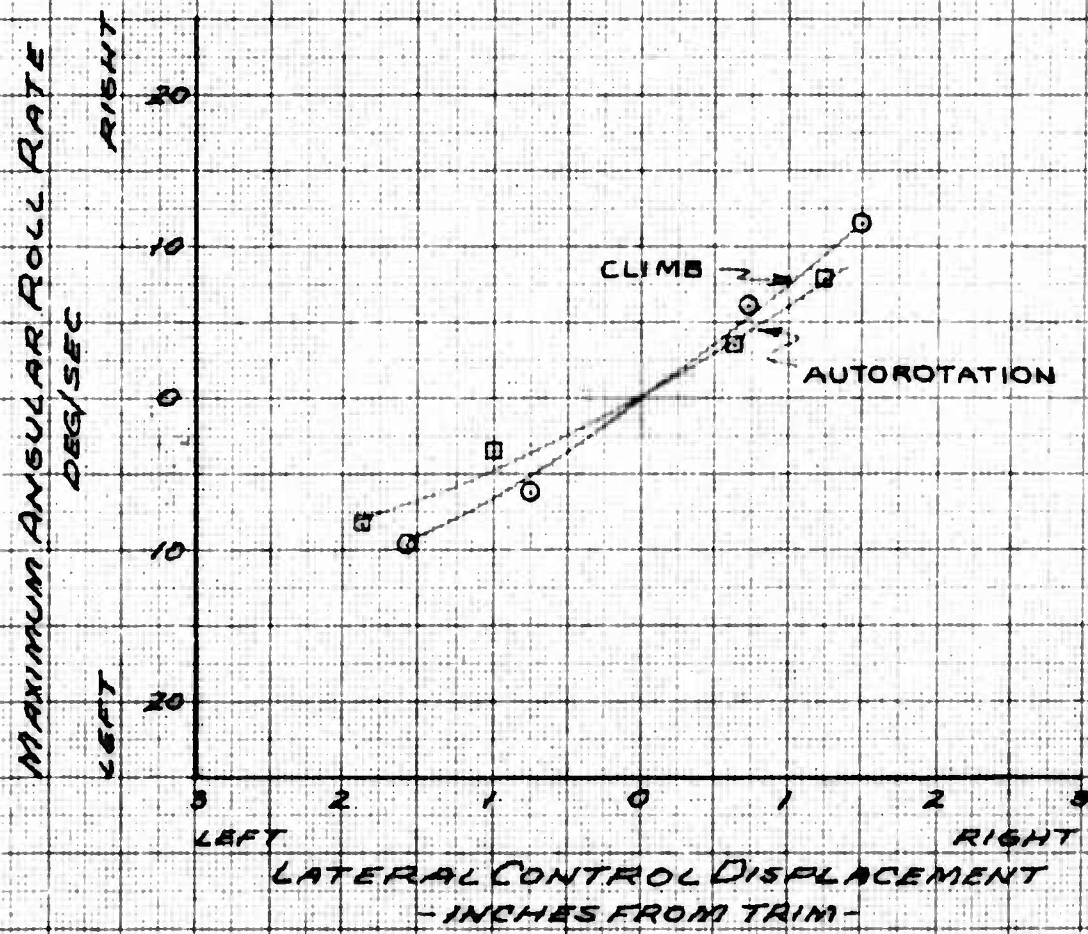

FIG. No. 85

LATERAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	CLIMB	45	2760	4725	85.65(MID)	344
□	AUTOROTATION	45	2760	5250	85.65(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.5 INCHES FROM FULL RIGHT IN CLIMB AND 6.1 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.38 SECONDS AFTER CONTROL DISPLACEMENT.

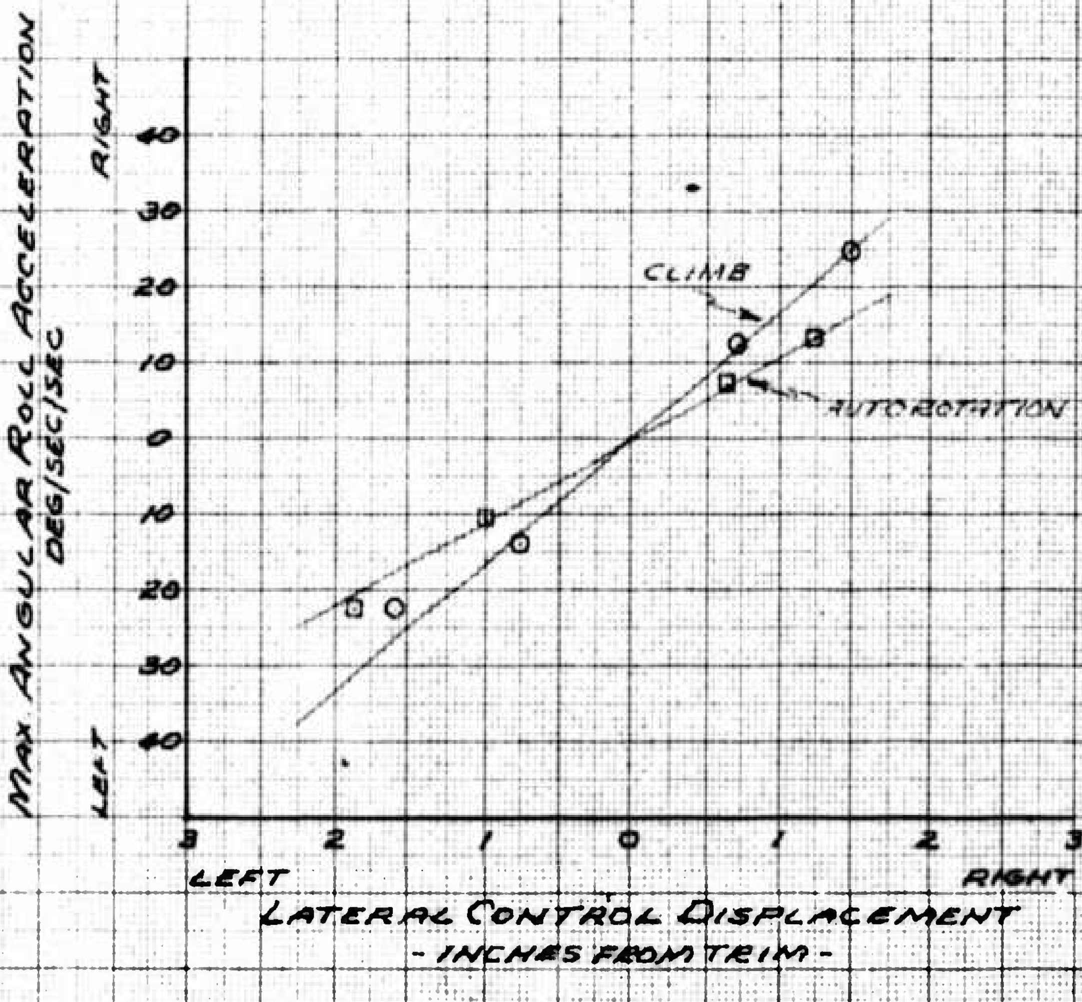

FIG. NO. 8F

LATERAL CONTROL RESPONSE IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	FLT CONDITION	V_c-KT	G.W.-LB	H_d-FT	C.G.-IN	RPM
O	CLIMB	45	2475	4425	85.10(MID)	344
□	AUTOROTATION	45	2475	4700	85.10(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES RIGHT

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.6 INCHES FROM FULL RIGHT IN CLIMB AND 6.4 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX. 1.07 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 0.82 SEC--ONDS IN AUTOROTATION.

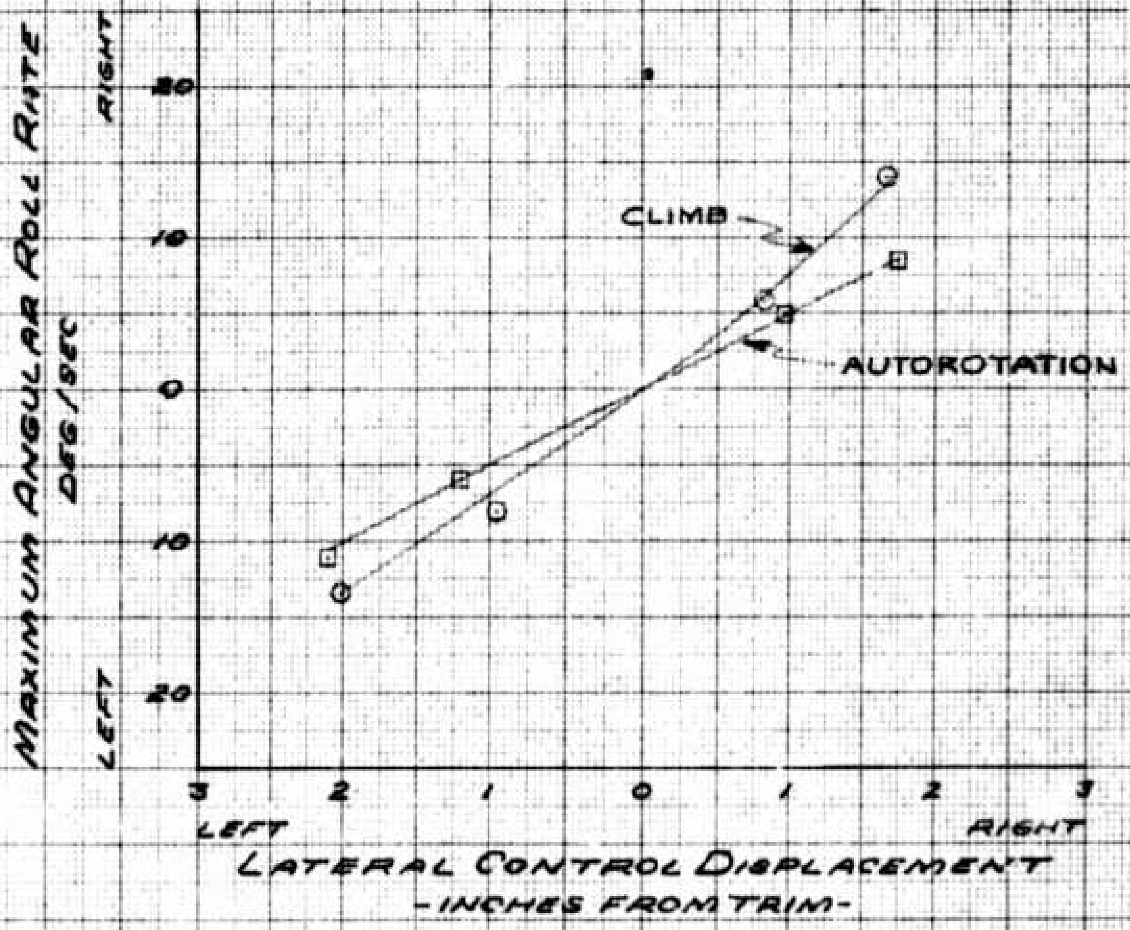

FIG. NO. 87

LATERAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	FLT CONDITION	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	CLIMB	45	2475	4425	85.10(MID)	344
□	AUTOROTATION	45	2475	4700	85.10(MID)	344

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX. 7.6 INCHES FROM FULL RIGHT IN CLIMB AND 6.4 INCHES IN AUTO-ROTATION.

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX 0.38 SECONDS AFTER CONTROL DISPLACEMENT.

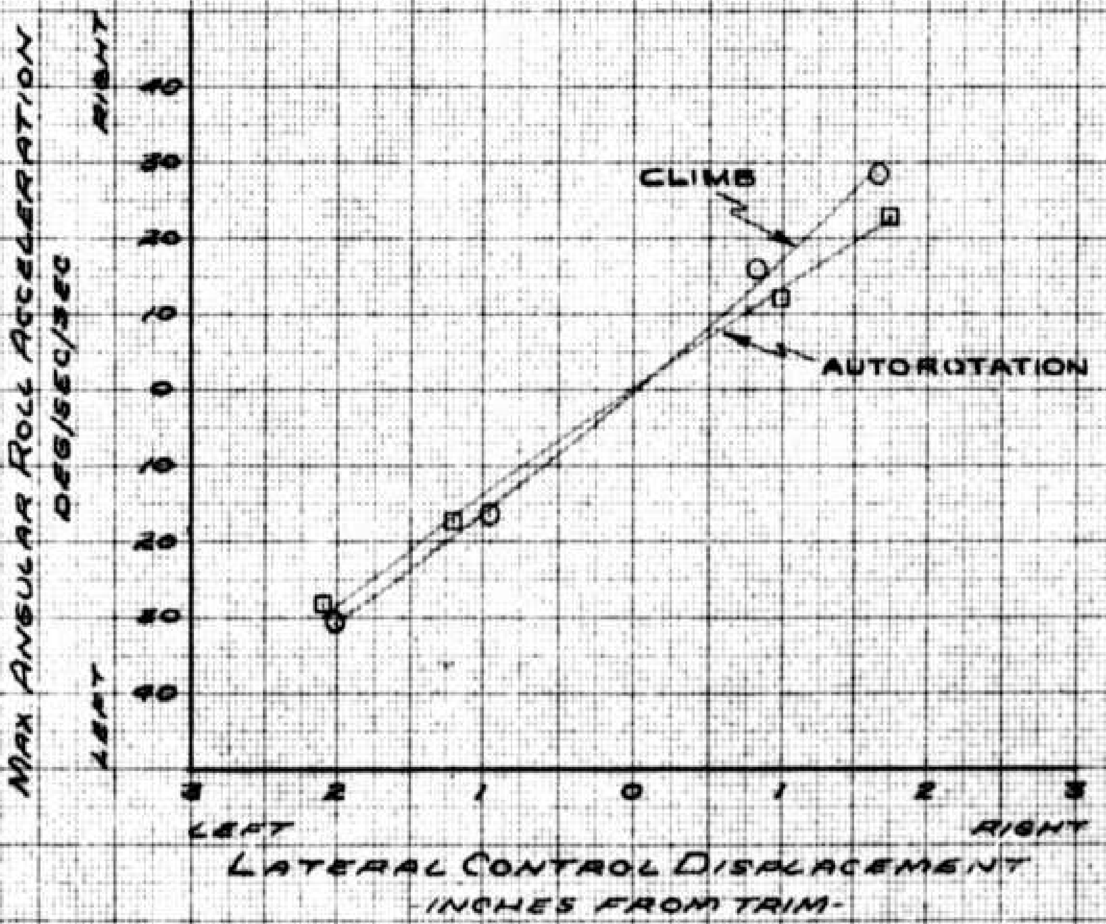

FIG. NO. 88

LATERAL CONTROL RESPONSE IN HOVER

OH-13H 57-6234

SYM	CONFIGURATION	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	CLEAN	2475	2500	85.02(MID)	355
Δ	XM-I KIT INSTALLED	2720	1000	84.43(MID)	355

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX 7.2 INCHES FROM FULL RIGHT AT THE CLEAN CONFIGURATION AND 7.8 INCHES WITH THE XM-I KIT INSTALLED

NOTE 3: MAXIMUM ANGULAR ROLL RATE REACHED APPROX 0.86 SECONDS AFTER CONTROL DISPLACEMENT.

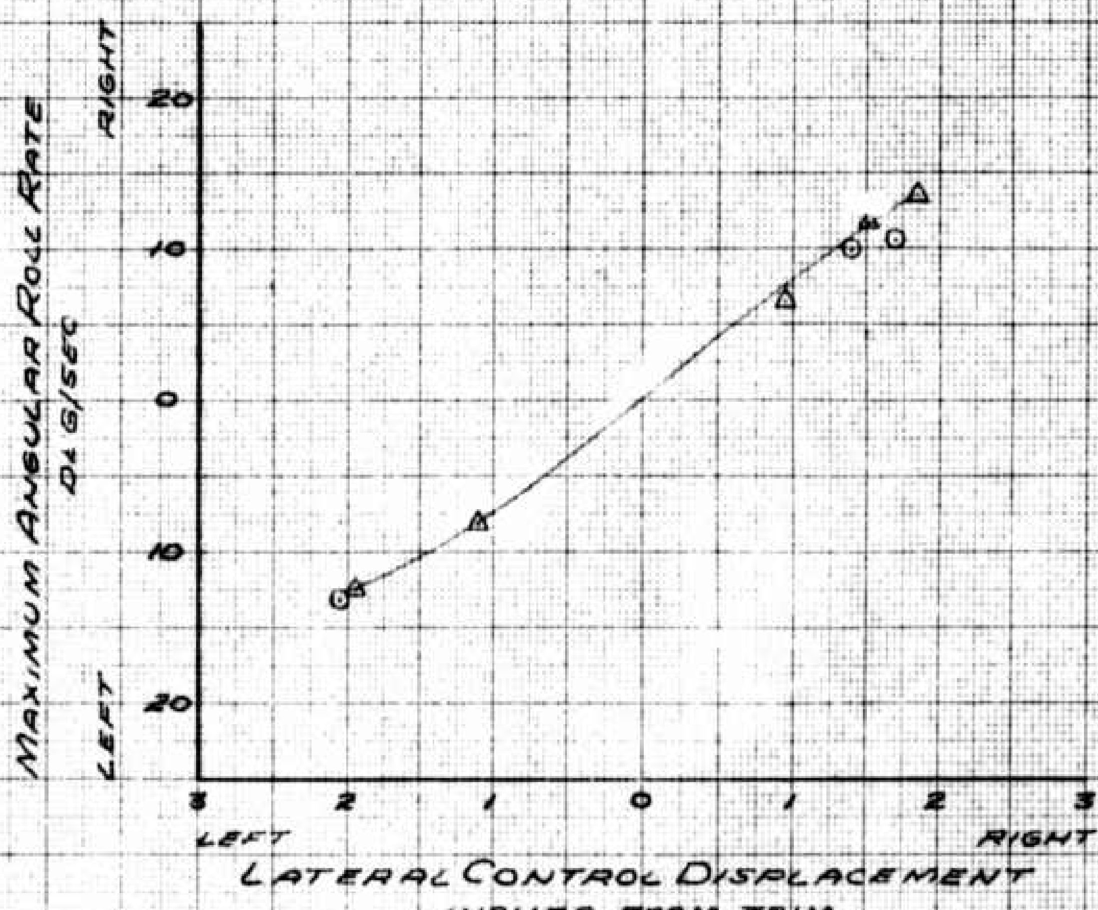

Fig No 89

Lateral Control Sensitivity in Hover

OH-13H S/N 57-6254

SYM	CONFIGURATION	G.W.-LB	H_D-FT	C.G.-IN.	RPM
O	CLEAN	2475	2500	85.02 (MID)	355
Δ	XM-1 KIT INSTALLED	2720	1000	84.43 (MID)	355

NOTE 1: FULL LATERAL CONTROL TRAVEL = 12.9 INCHES

NOTE 2: LATERAL CONTROL TRIM POSITION APPROX 7.2 INCHES FROM FULL RIGHT WITH CLEAN COFIGURATION AND 7.8 INCHES WITH XM-1 KIT INSTALLED.

NOTE 3: MAXIMUM ANGULAR ROLL ACCELERATION REACHED APPROX. 0.33 SECONDS AFTER CONTROL DISPLACEMENT.

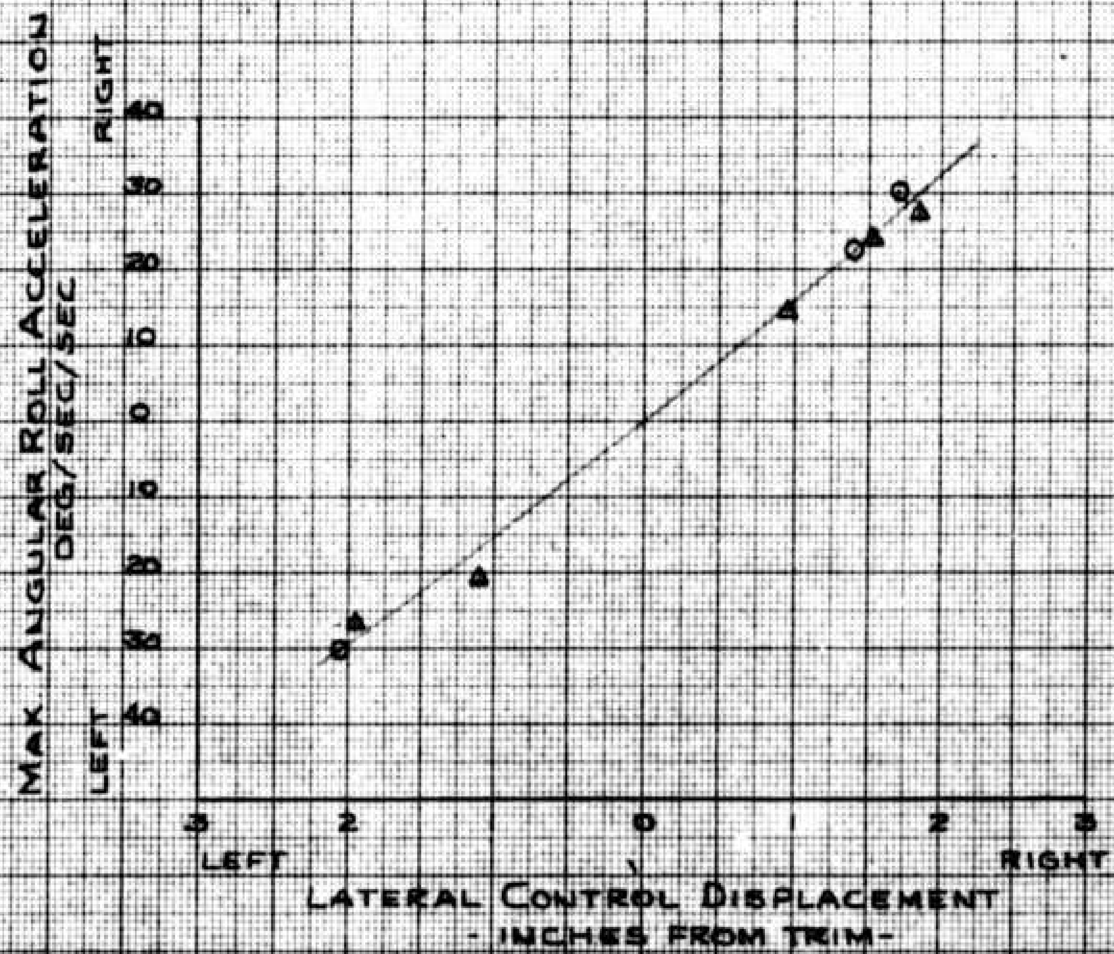

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FIG. No. 90

STATIC DIRECTIONAL STABILITY

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

CLIMB

SYM	V_c-KT	G.W.-LB	H_c-FT	C.G.-IN	RPM
O	45	2720	4830	85.10(MID)	344

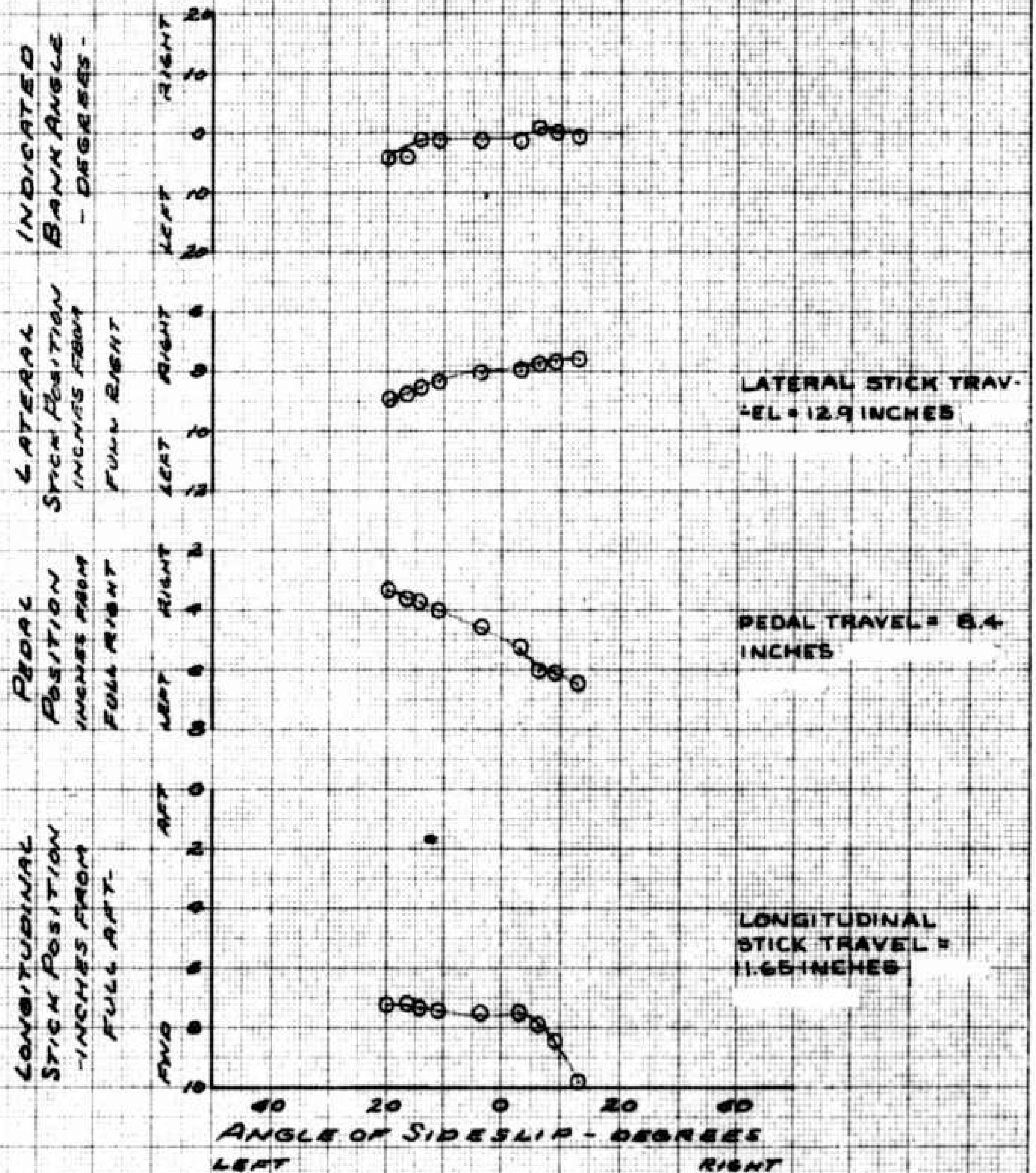

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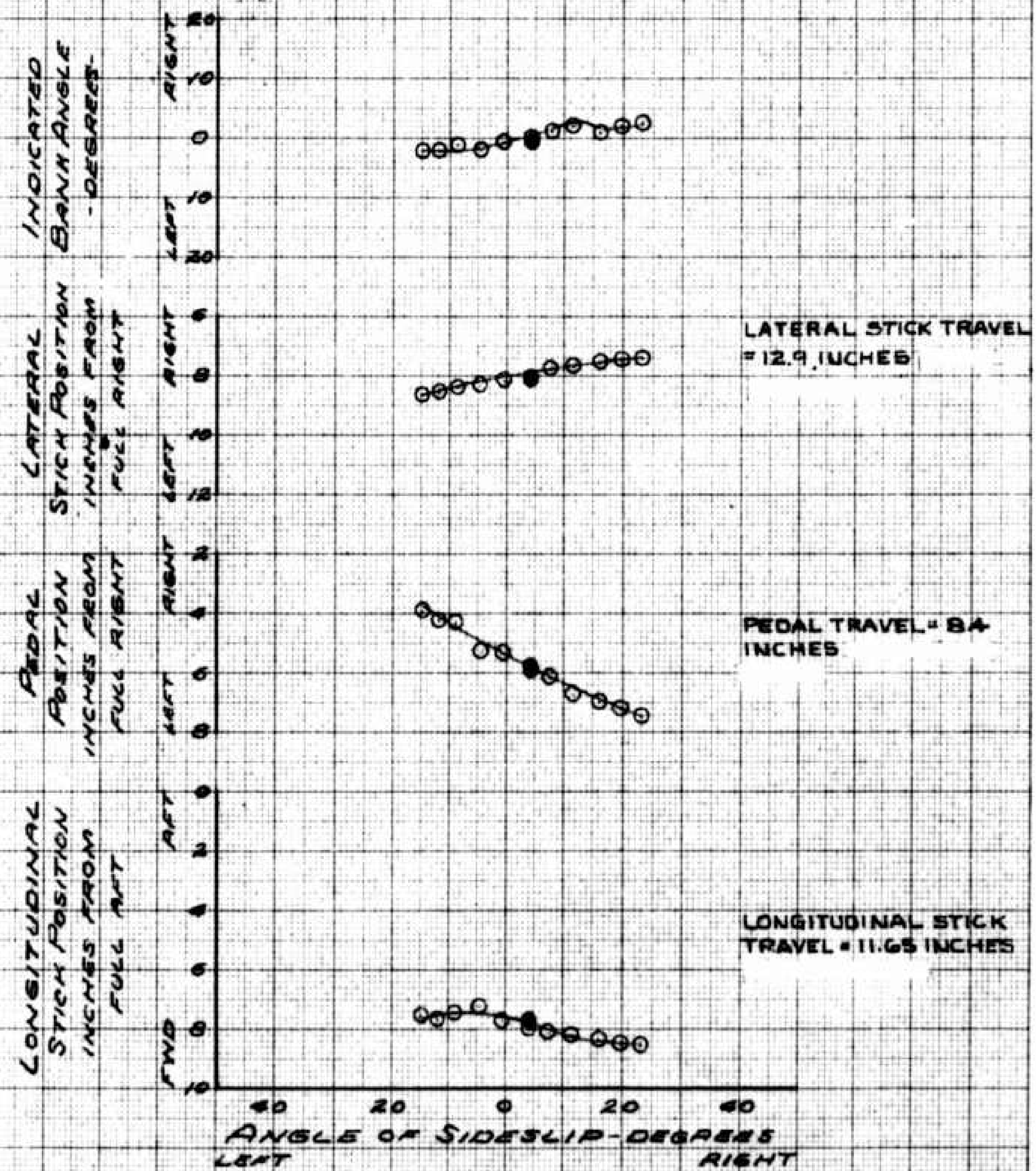
FIG. No. 31
STATIC DIRECTIONAL STABILITY
OH-13H S/N 57-6234
CLEAN CONFIGURATION
CLIMB

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	45	2490	4760	84.70(MID)	344

NOTE: ● DENOTES TRIM POINT



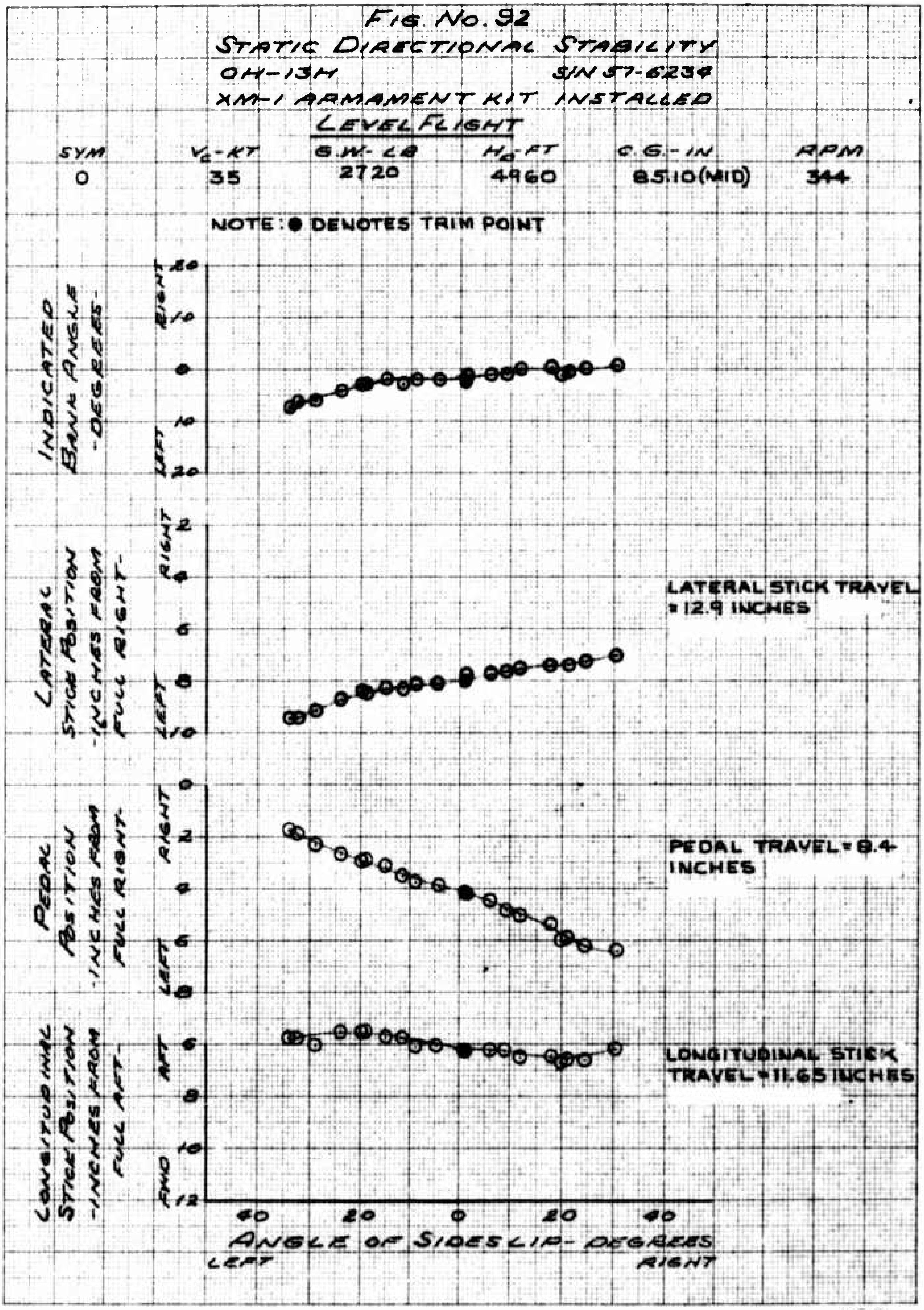


FIG. NO. 92
STATIC DIRECTIONAL STABILITY
OH-13H
S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED
LEVEL FLIGHT
SYM
VC-KT
G.W.-LB
HD-FT
C.G.-IN
RPM
O
35
2720
4960
85.10(MID)
344
NOTE: ● DENOTES TRIM POINT
INDICATED BANK ANGLE -DEGREES-
LATERAL STICK POSITION -INCHES FROM FULL RIGHT-
PEDAL POSITION -INCHES FROM FULL RIGHT-
LONGITUDINAL STICK POSITION -INCHES FROM FULL AFT-
LATERAL STICK TRAVEL = 12.9 INCHES
PEDAL TRAVEL = 8.4 INCHES
LONGITUDINAL STICK TRAVEL = 11.65 INCHES
ANGLE OF SIDESLIP - DEGREES
LEFT
RIGHT

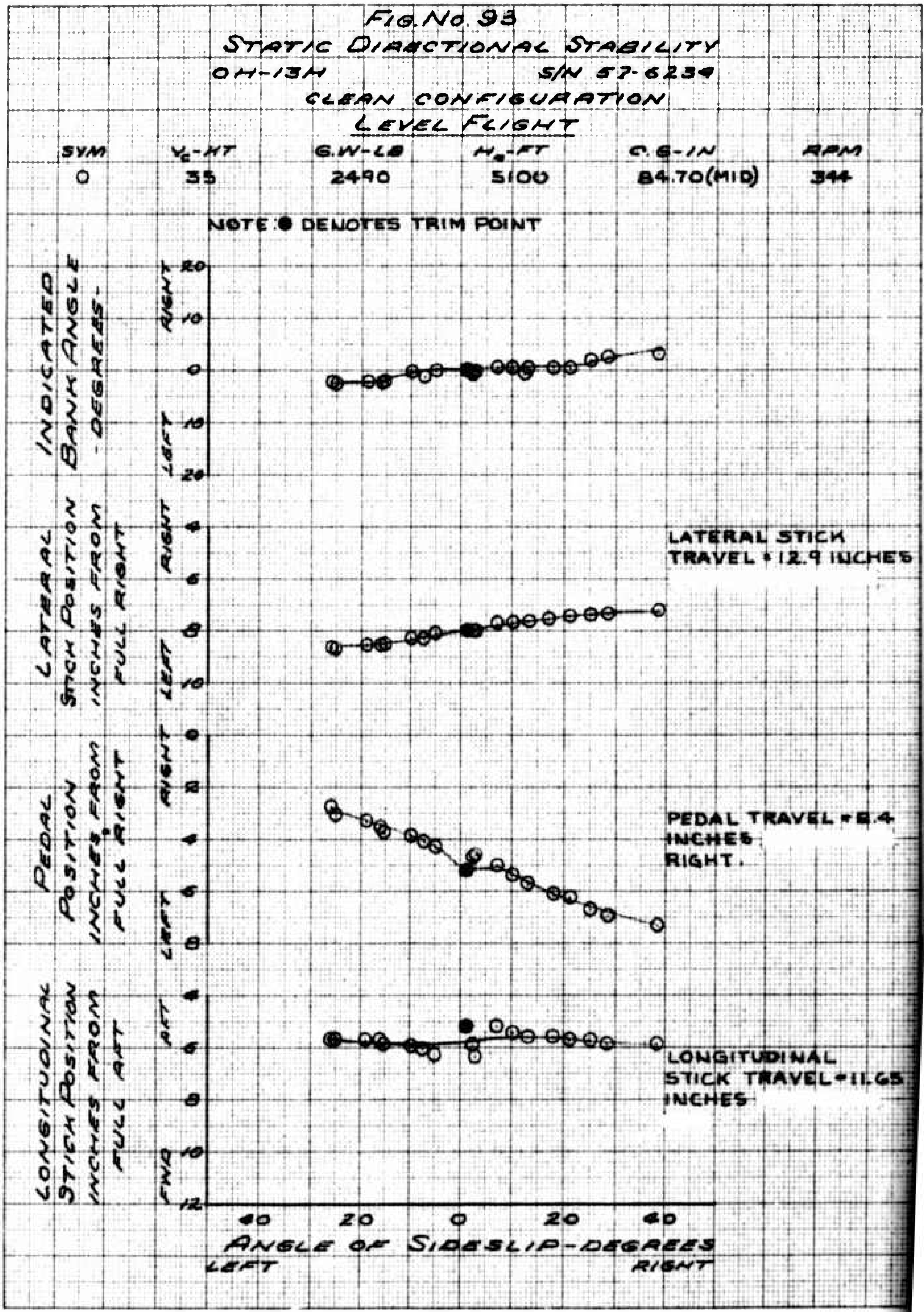


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FIG. NO. 94
STATIC DIRECTIONAL STABILITY
OH-13H S/N 57-6234
XM-1 ARMAMENT KIT INSTALLED
LEVEL FLIGHT

SYM	V_c-KT	G W-LB	H_p-FT	C.G.-IN	RPM
O	65	2720	4960	85.10(MID)	344

NOTE: ● DENOTES TRIM POINT

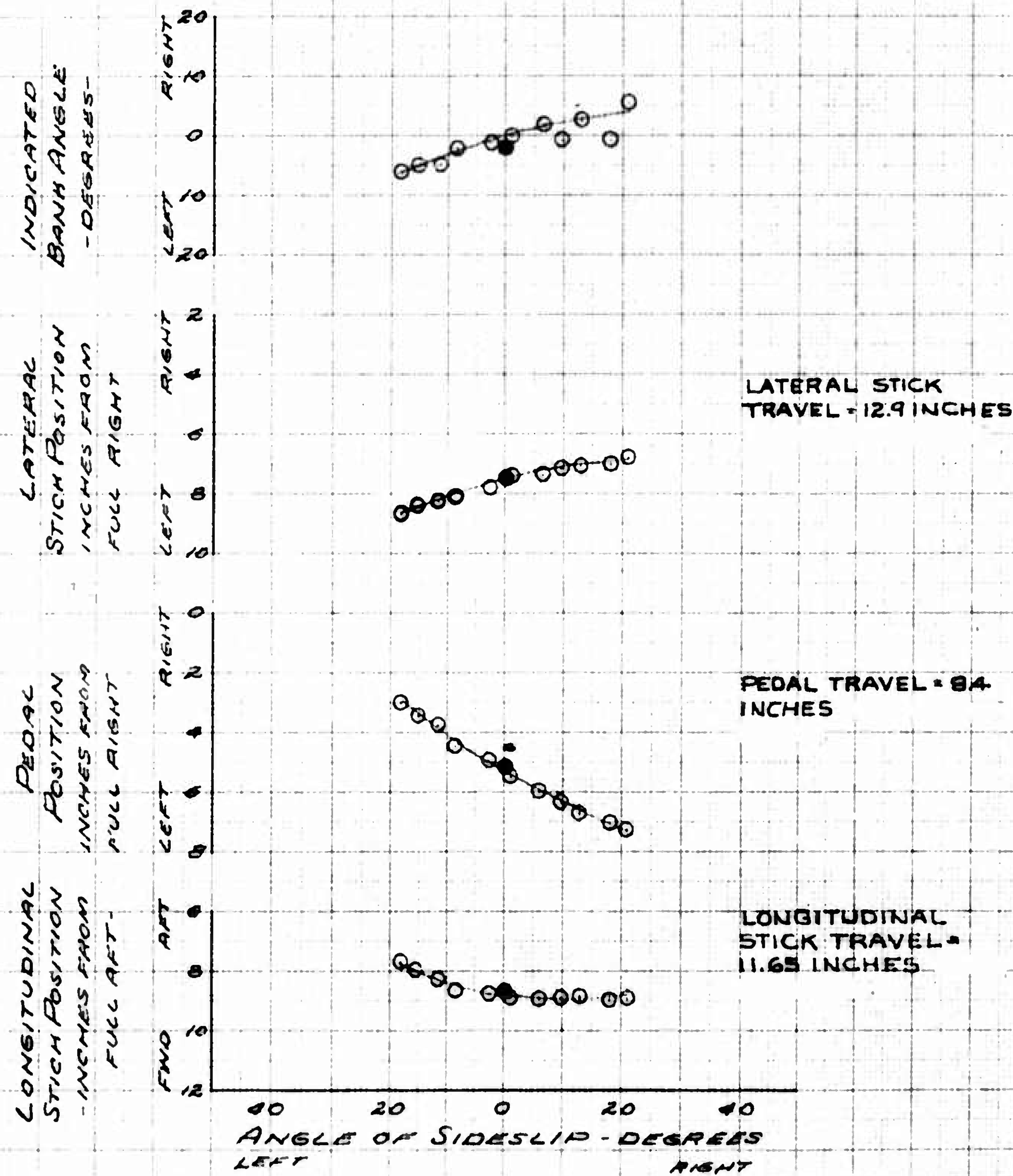

FIG NO. 95

STATIC DIRECTIONAL STABILITY

OH-13H S/N 57-6234

CLEAN CONFIGURATION

LEVEL FLIGHT

SYM	V_C-KT	G.W.-LB.	H_D-FT	C.G.-IN.	RPM
O	65	2490	5040	84.70(MID)	344

NOTE: ● DENOTES TRIM POINT

O' DENOTES DUPLICATE POINTS

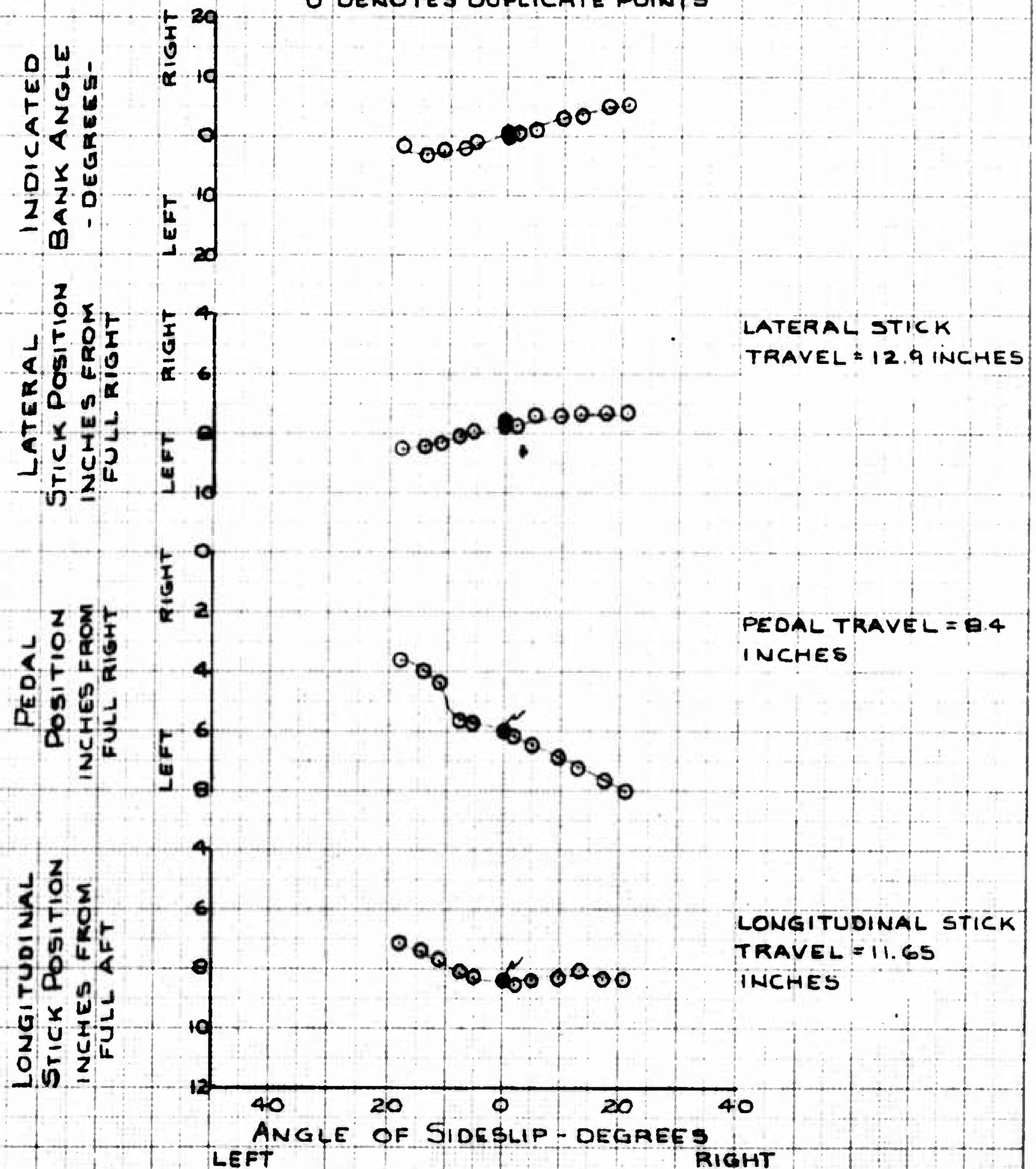

FIG. NO. 96

STATIC DIRECTIONAL STABILITY

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

AUTOROTATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	45	2720	4440	85.10 (MID)	344

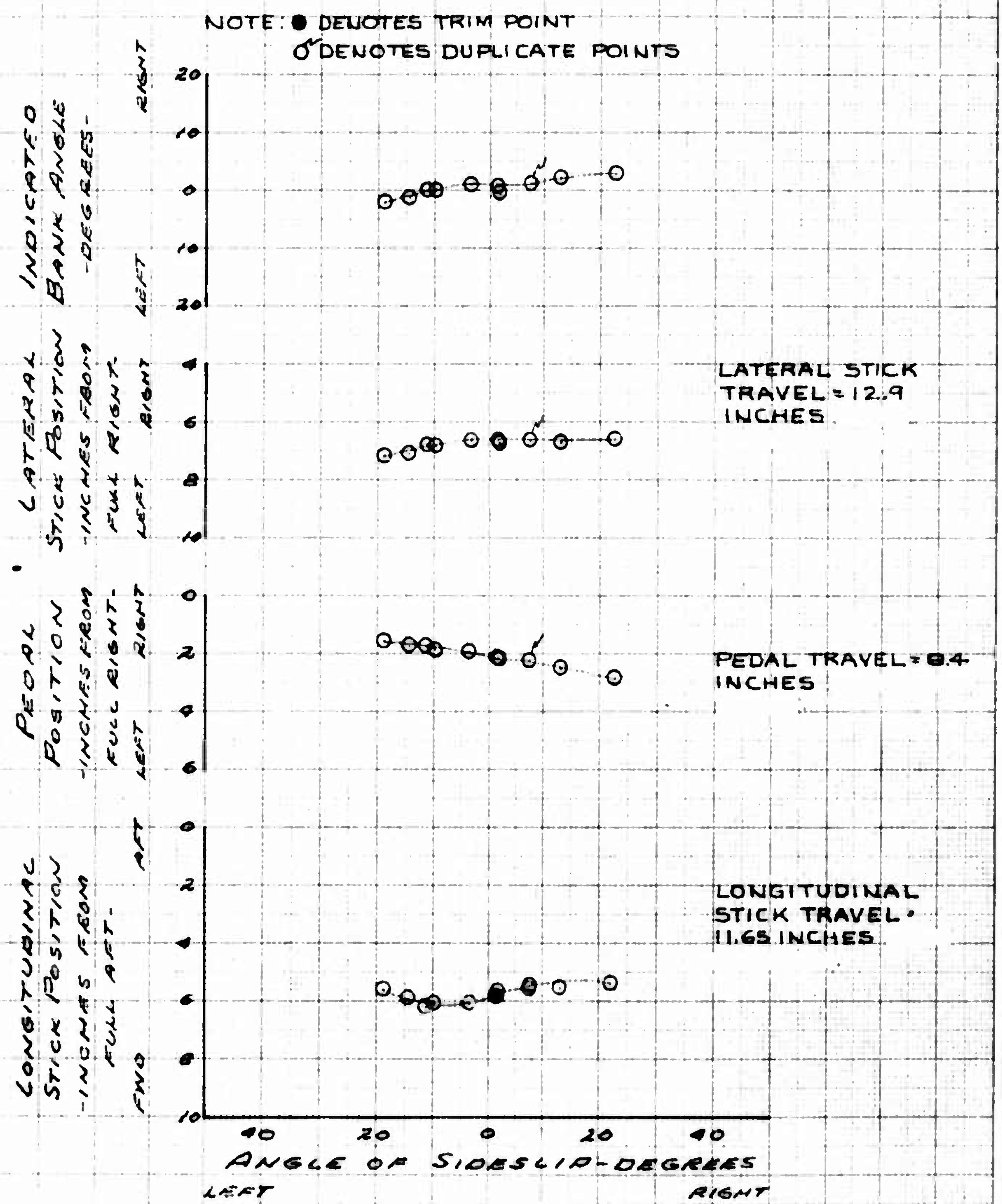

FIG. NO. 97

STATIC DIRECTIONAL STABILITY

OH-13H — S/N 57-6234

CLEAN CONFIGURATION

AUTOROTATION

SYM	V_c-KT	G.W.-LB	H_D-FT	CG-IN	RPM
O	45	2490	3285	84.70(MID)	344

NOTE: ● DENOTES TRIM POINT

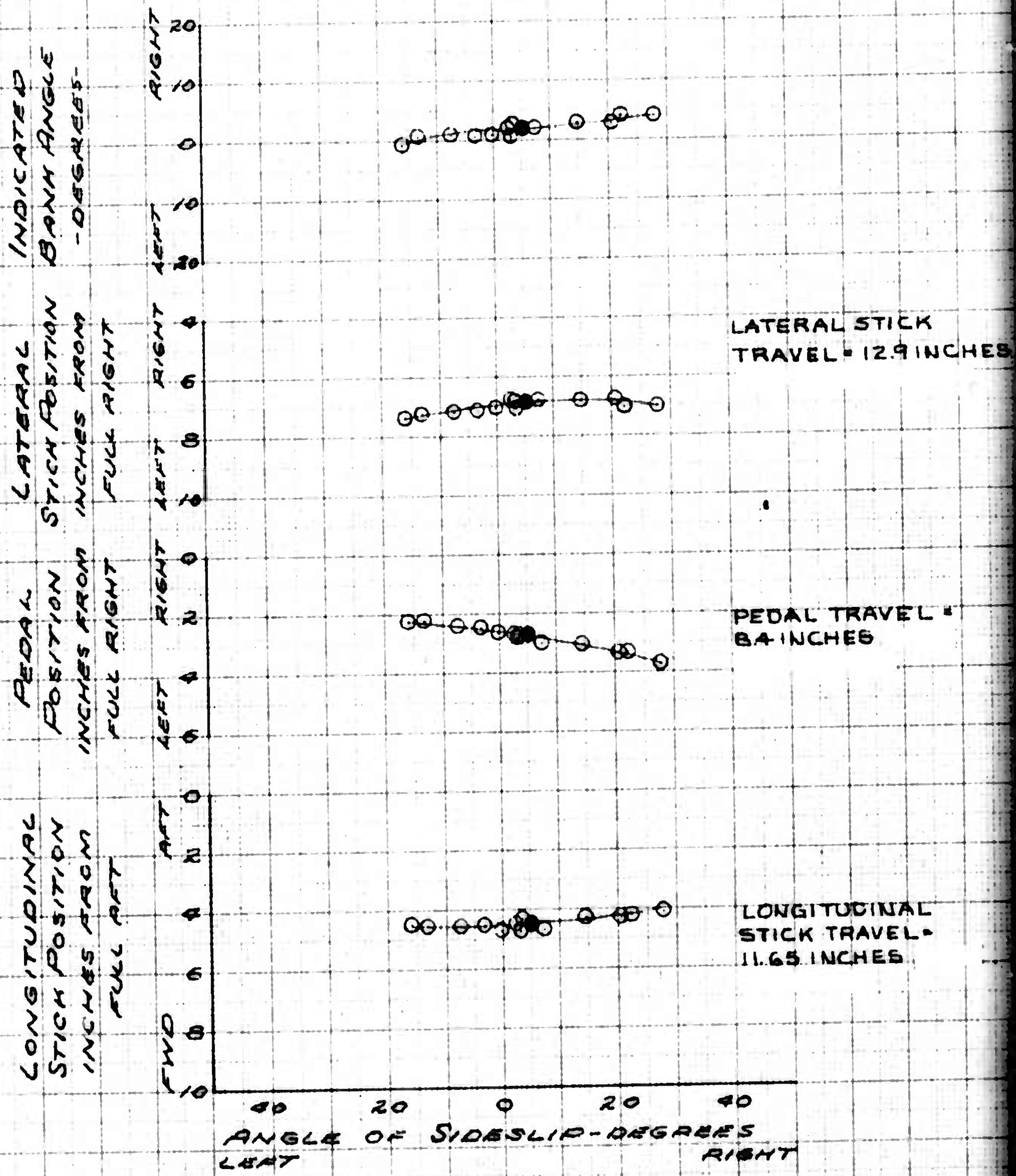

FIG. No. 98

RESPONSE TO A RIGHT DIRECTIONAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G.-IN.	RPM
65	5400	2745	85.65(MID)	344

PITCH —— ROLL - - - - YAW —·—·— & SIDESLIP

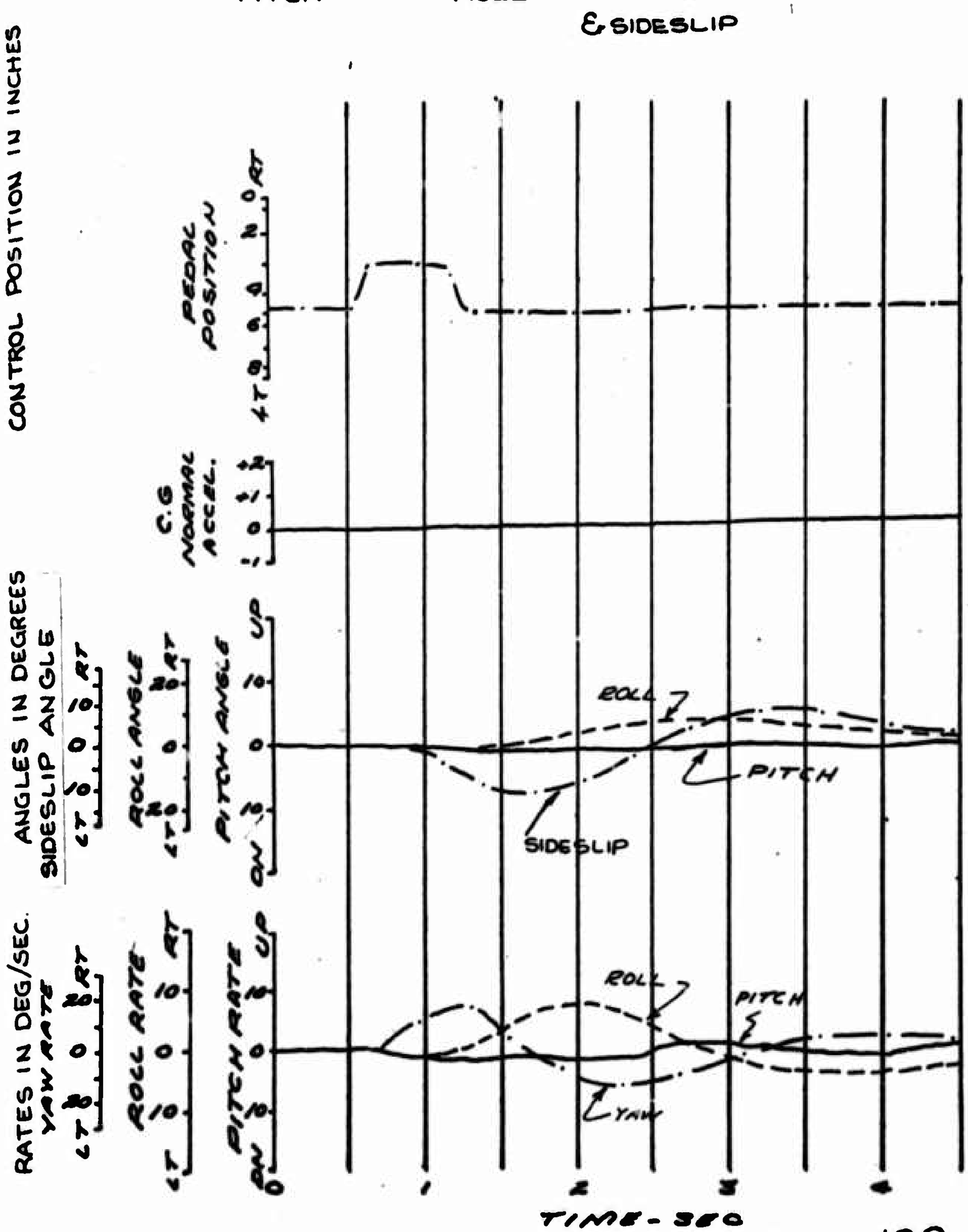

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FIG. No. 98 (CONT.)

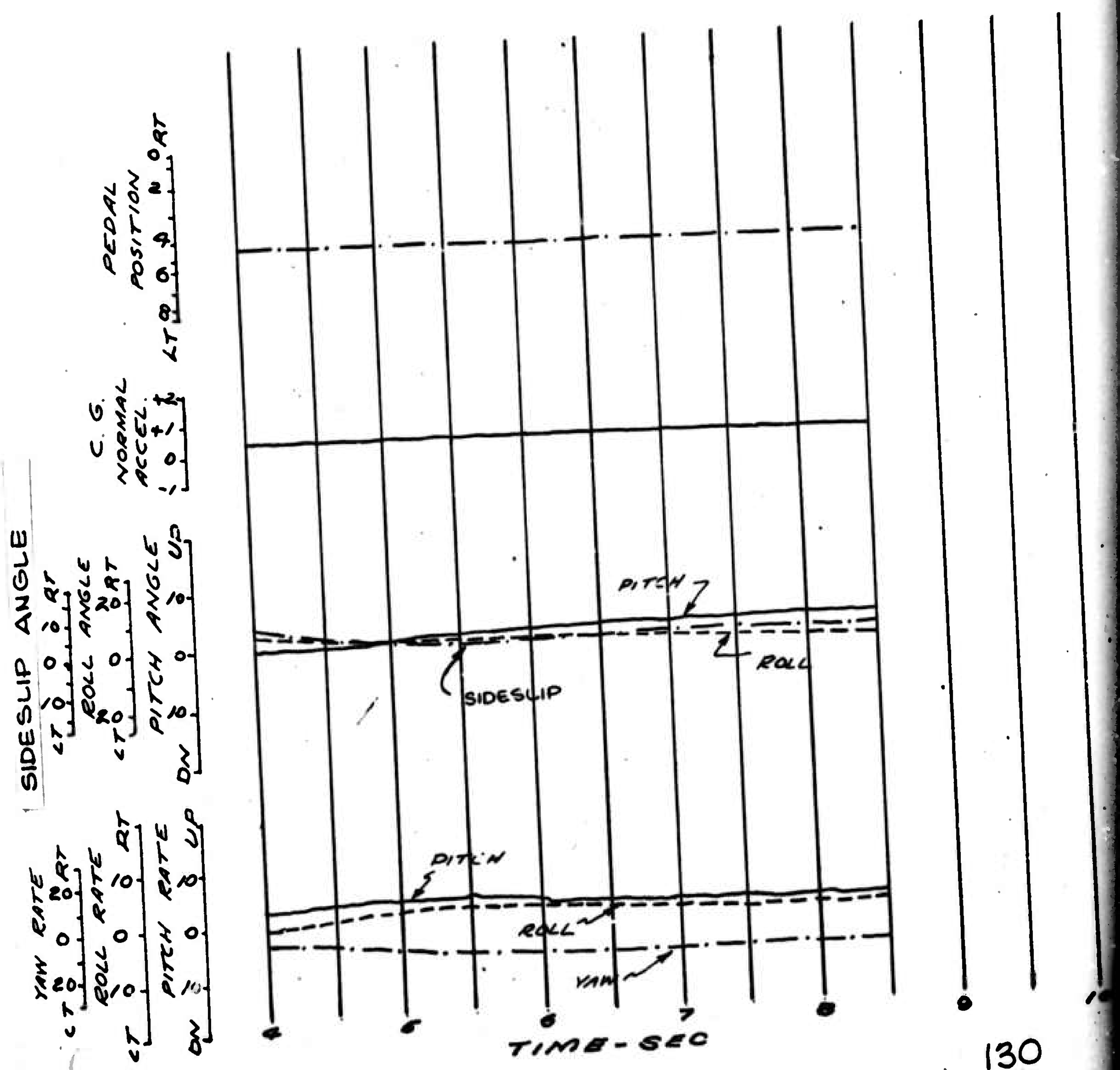

FIG. No. 99

RESPONSE TO A LEFT DIRECTIONAL PULSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
65	5400	2745	85.65 (MID)	344

PITCH —— ROLL - - - - YAW & SIDESLIP —·—·—

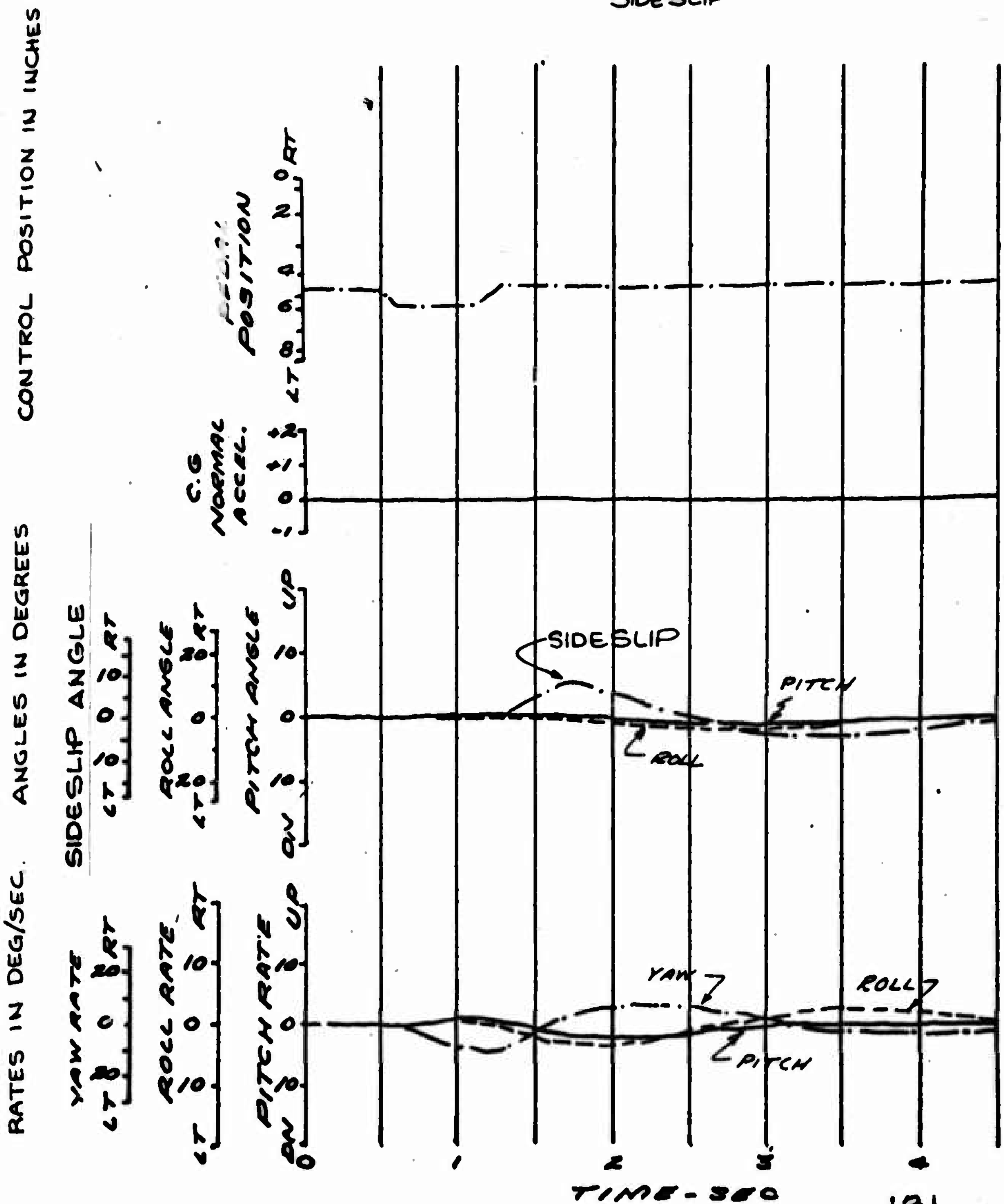

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FIG. No. 99 (CONT.)

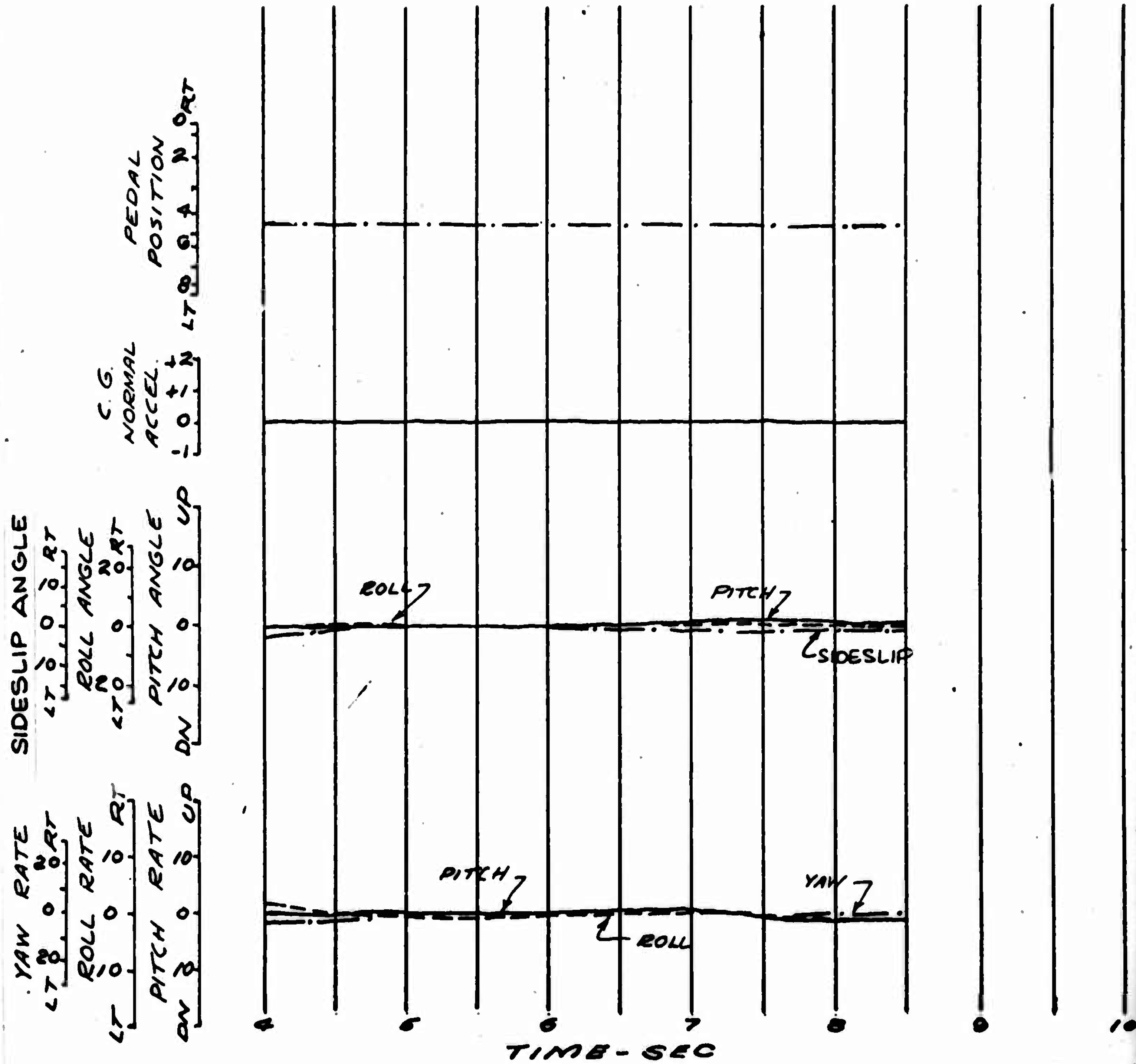


FIG. No. 100

RESPONSE TO A RIGHT DIRECTIONAL PULSE IN A HOVER

OH-13H S/N 57-6284

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_p-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	84.43 (MID)	355

PITCH ——— ROLL - - - - YAW —-—-—

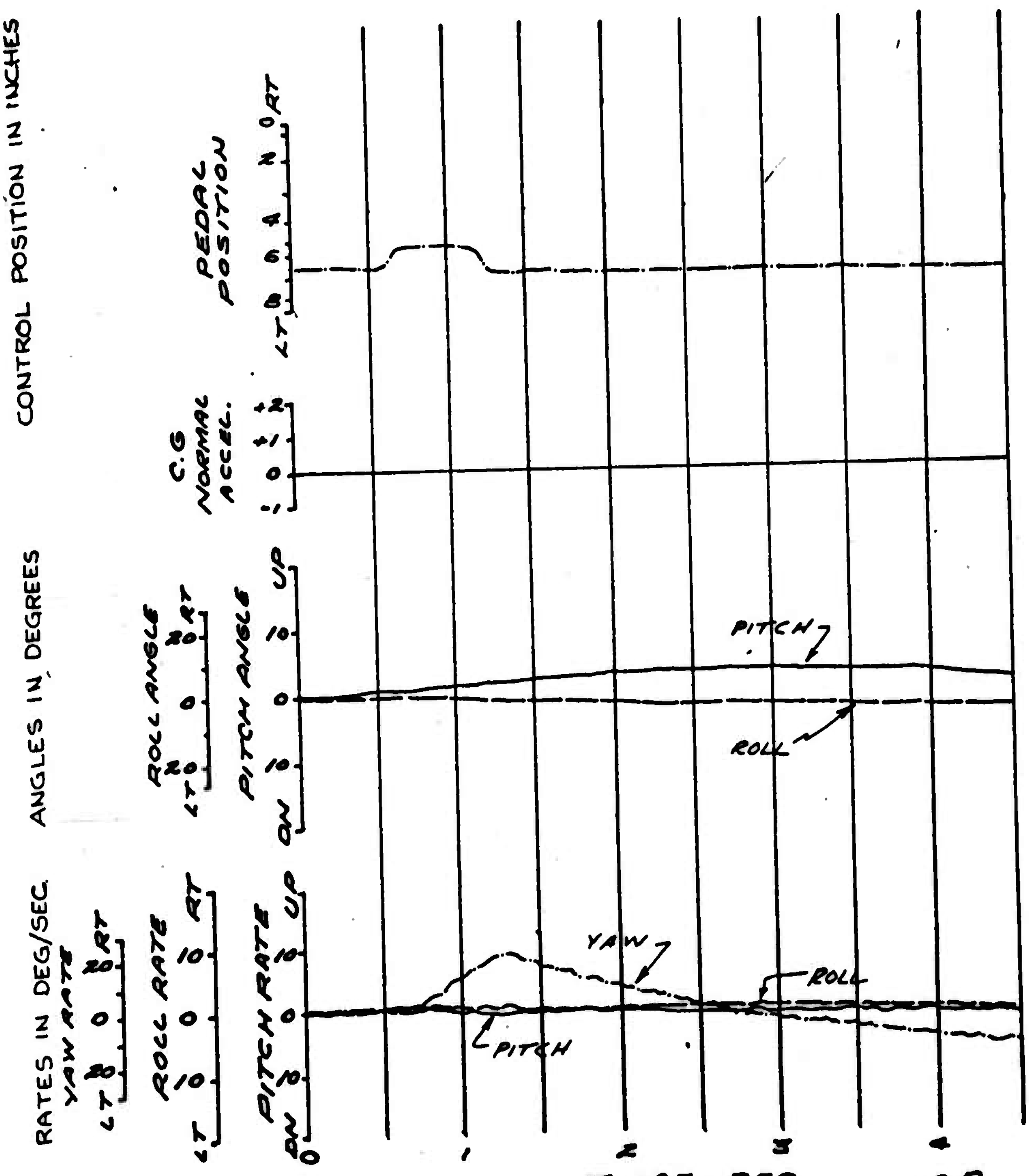


FIG. No. 100 (CONT.)

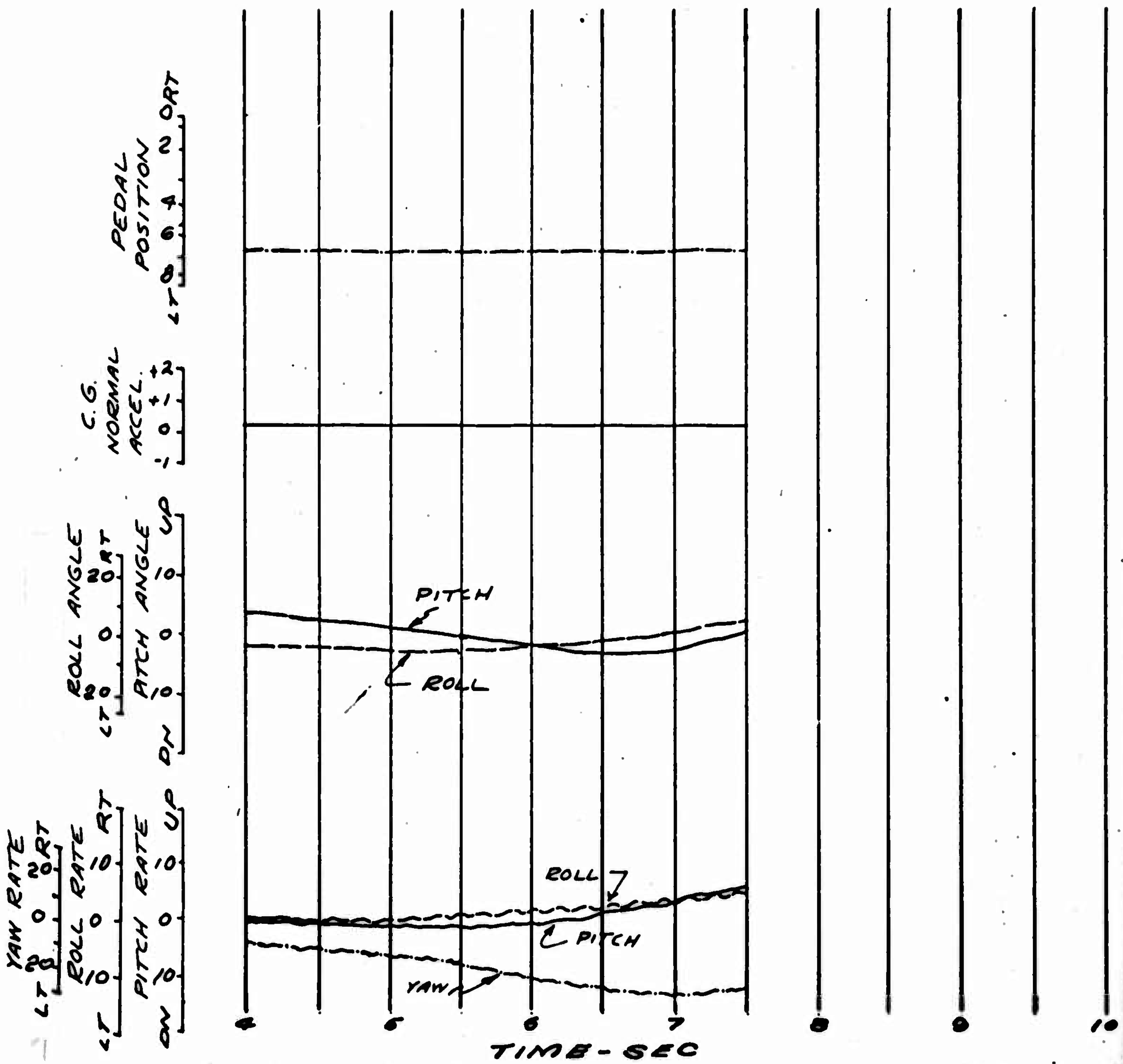


FIG. No. 101

RESPONSE TO A LEFT DIRECTIONAL PULSE IN A HOVER

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	H_o-FT	G.W.-LB	C.G-IN.	RPM
0	1000	2720	84.43(MID)	355

PITCH —— ROLL - - - - YAW —·—·—

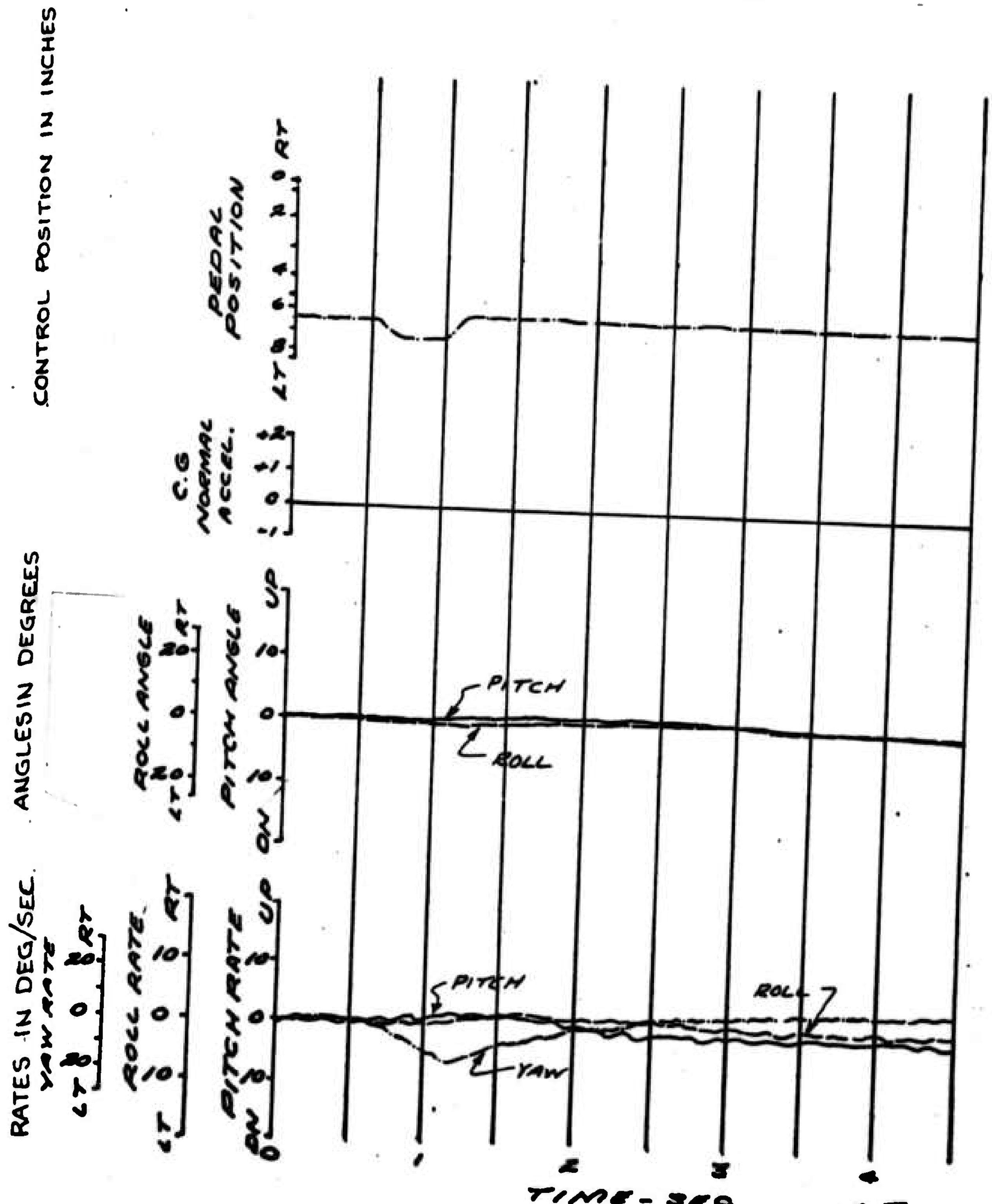


FIG. No. 101 (CONT.)

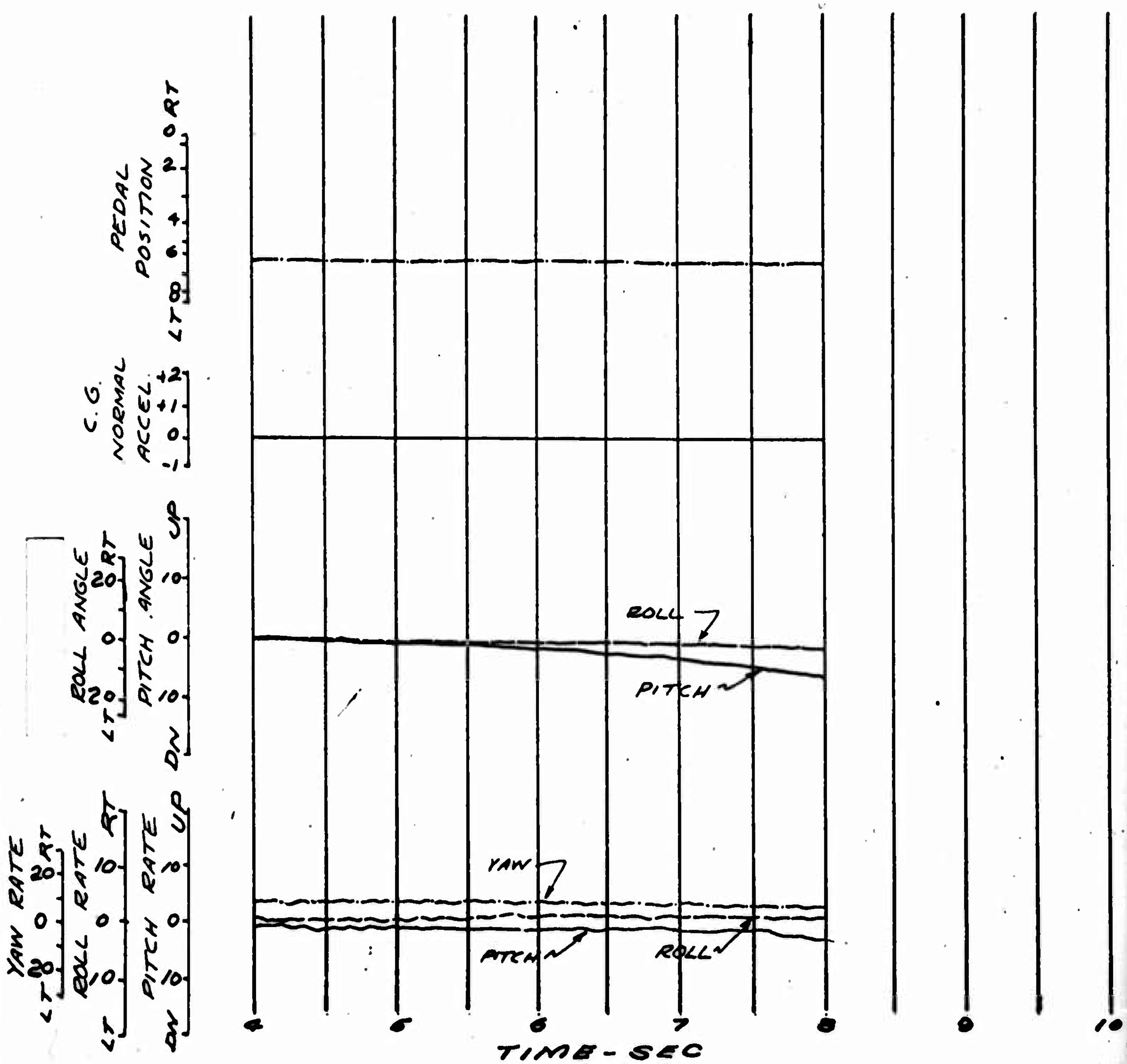
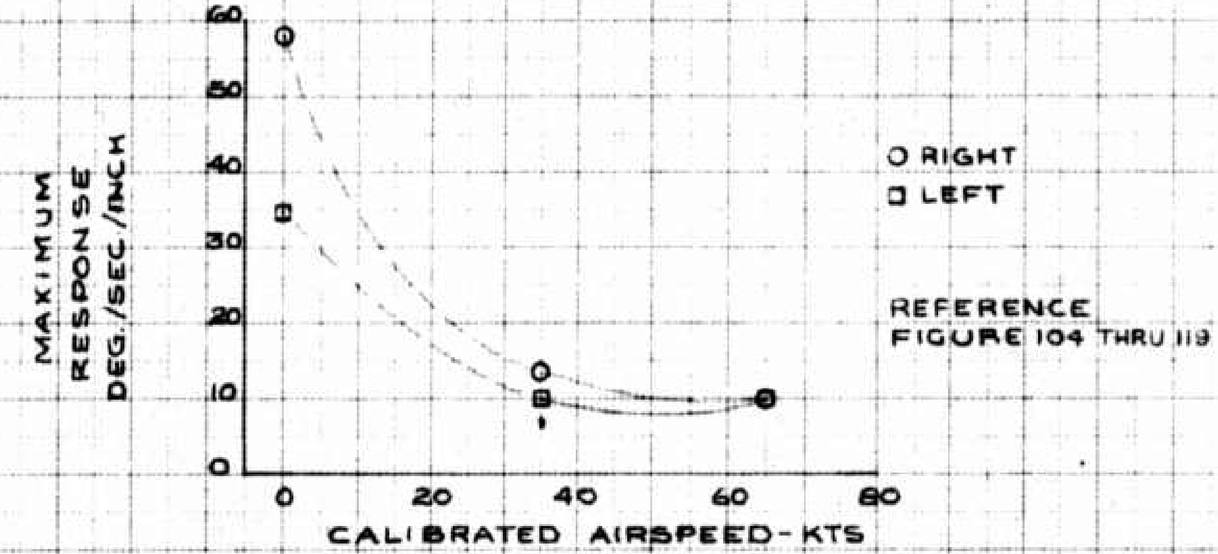


FIG. No 102
SUMMARY DIRECTIONAL CONTROL RESPONSE
OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_c-KT	G.W.-LB.	H_D-FT	C.G.-IN.	RPM
0	2720	1000	84.43(MID)	355
35	2750	5200	85.75(MID)	344
65	2750	5200	85.75(MID)	344



CLEAN CONFIGURATION

V_c-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
0	2475	2500	85.02(MID)	355
35	2480	5130	85.02(MID)	344
65	2480	5130	85.05(MID)	344

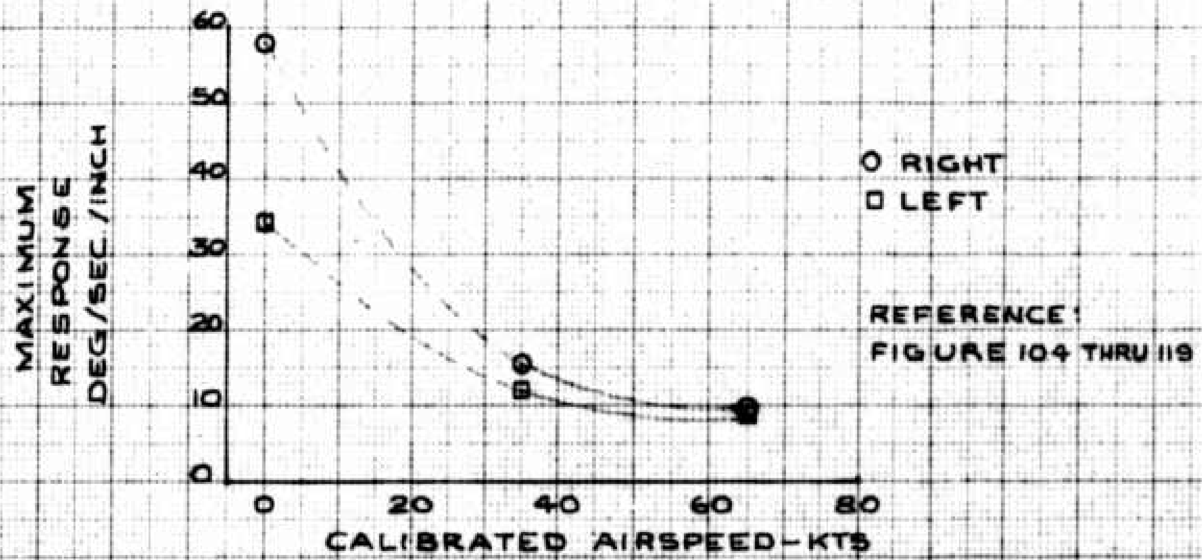
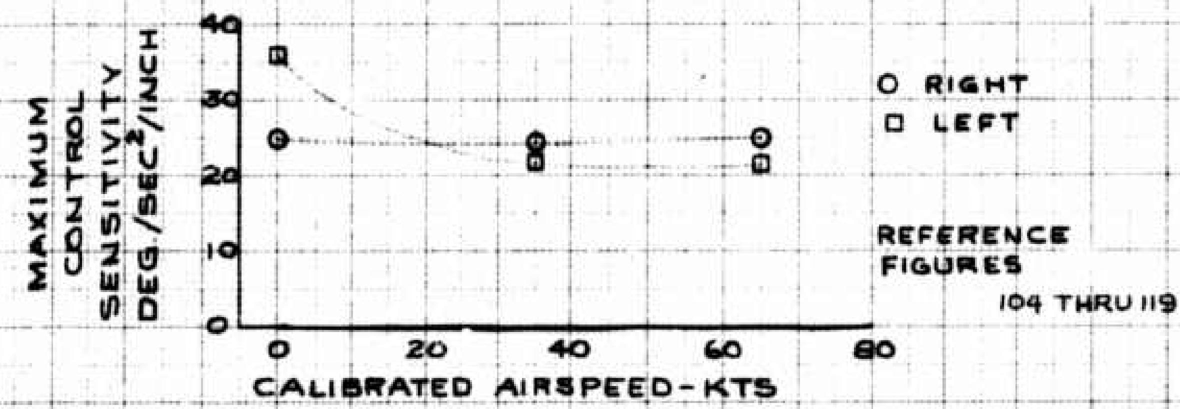


Fig No 103
Summary Directional Control Sensitivity
OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

V_C-KT	G.W.-LB.	H_D-FT.	C.G.-INCHES	RPM
0	2720	1000	84.43 (MID)	355
35	2750	5200	85.75 (MID)	344
65	2750	5200	85.75 (MID)	344



CLEAN CONFIGURATION

V_C-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
0	2475	2500	85.02 (MID)	355
35	2480	5130	85.02 (MID)	344
65	2480	5130	85.05 (MID)	344

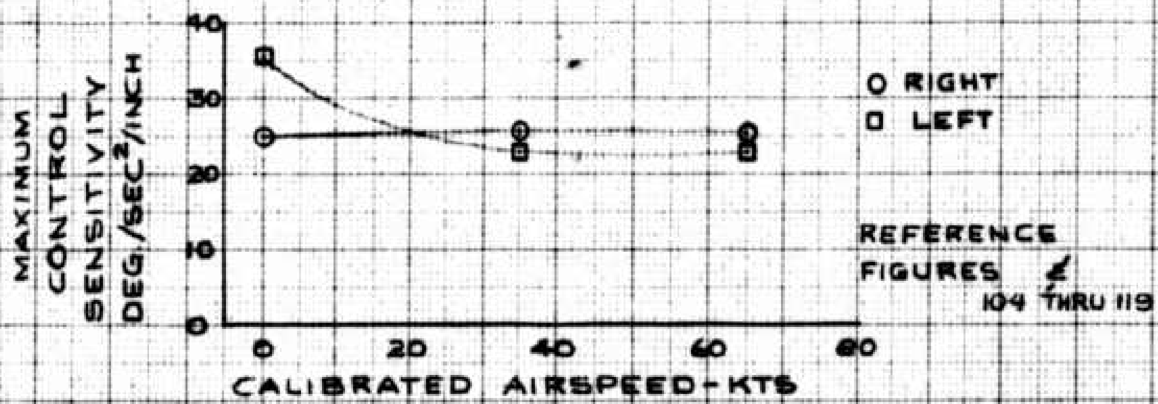


FIG. No. 104

DIRECTIONAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2750	5200	85.75 (MID)	344
◇	65	2750	5200	85.75 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: MAXIMUM YAW RATE REACHED APPROX. 1.15 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.08 SECONDS AT 65 KNOTS.

NOTE 3: DIRECTIONAL CONTROL TRIM POSITION APPROX. 3.9 INCHES FROM FULL RIGHT AT 35 KNOTS AND 5.3 INCHES AT 65 KNOTS.

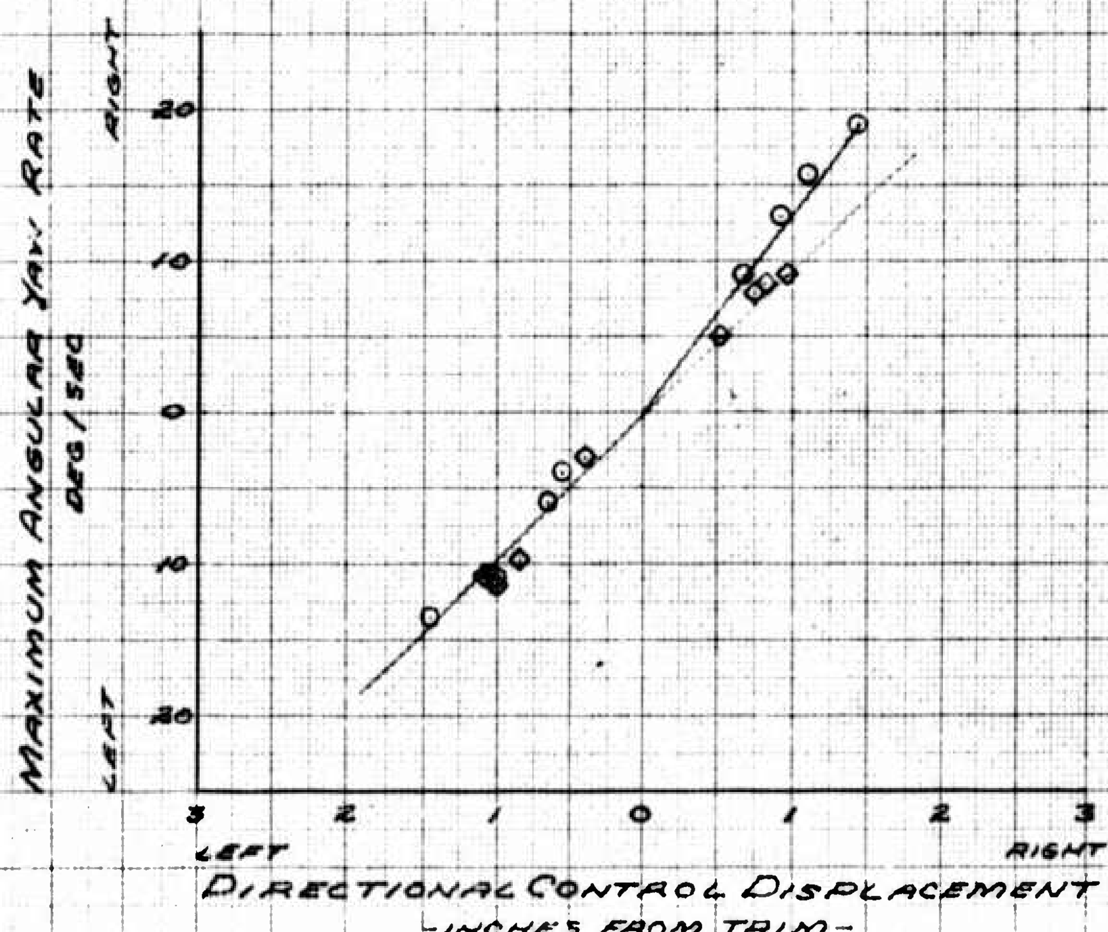


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FIG. No 105

DIRECTIONAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2750	5200	85.75(MID)	344
◇	65	2750	5200	85.75(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX 3.9 INCHES FROM FULL RIGHT AT 35 KNOTS AND 5.3 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM YAW RATE REACHED APPROX. 3.9 INCHES FROM FULL RIGHT AT 35 KNOTS AND 5.3 INCHES AT 65 KNOTS

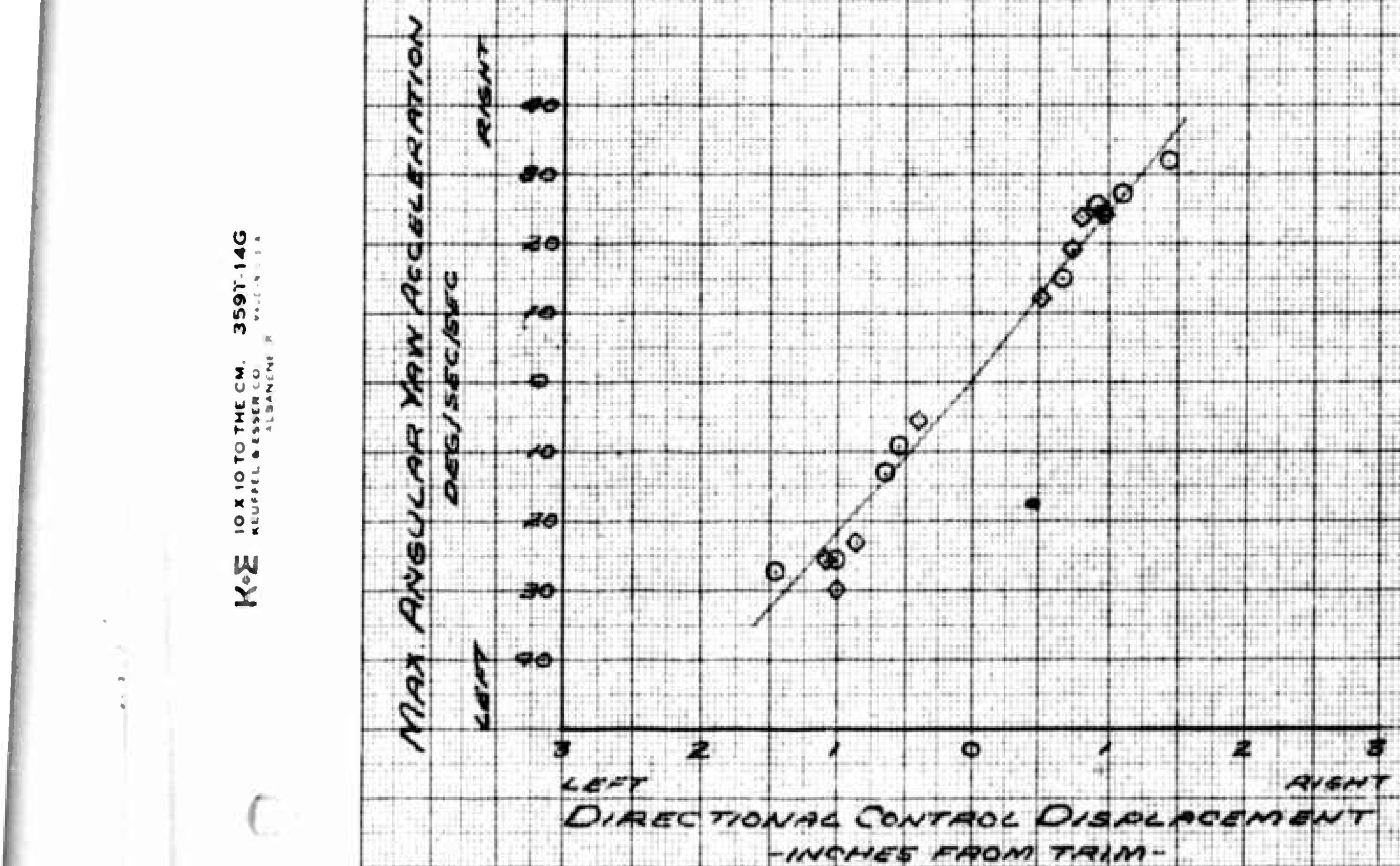

FIG. NO. 106

DIRECTIONAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_d-FT	C.G.-IN	RPM
○	35	2480	5130	85.05(MID)	344
◇	65	2480	5130	85.05(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POINT APPROX. 2.95 INCHES FROM FULL RIGHT AT 35 KNOTS AND 4.20 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR YAW RATE REACHED APPROX. 1.1 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 0.87 SECONDS AT 65 KNOTS.

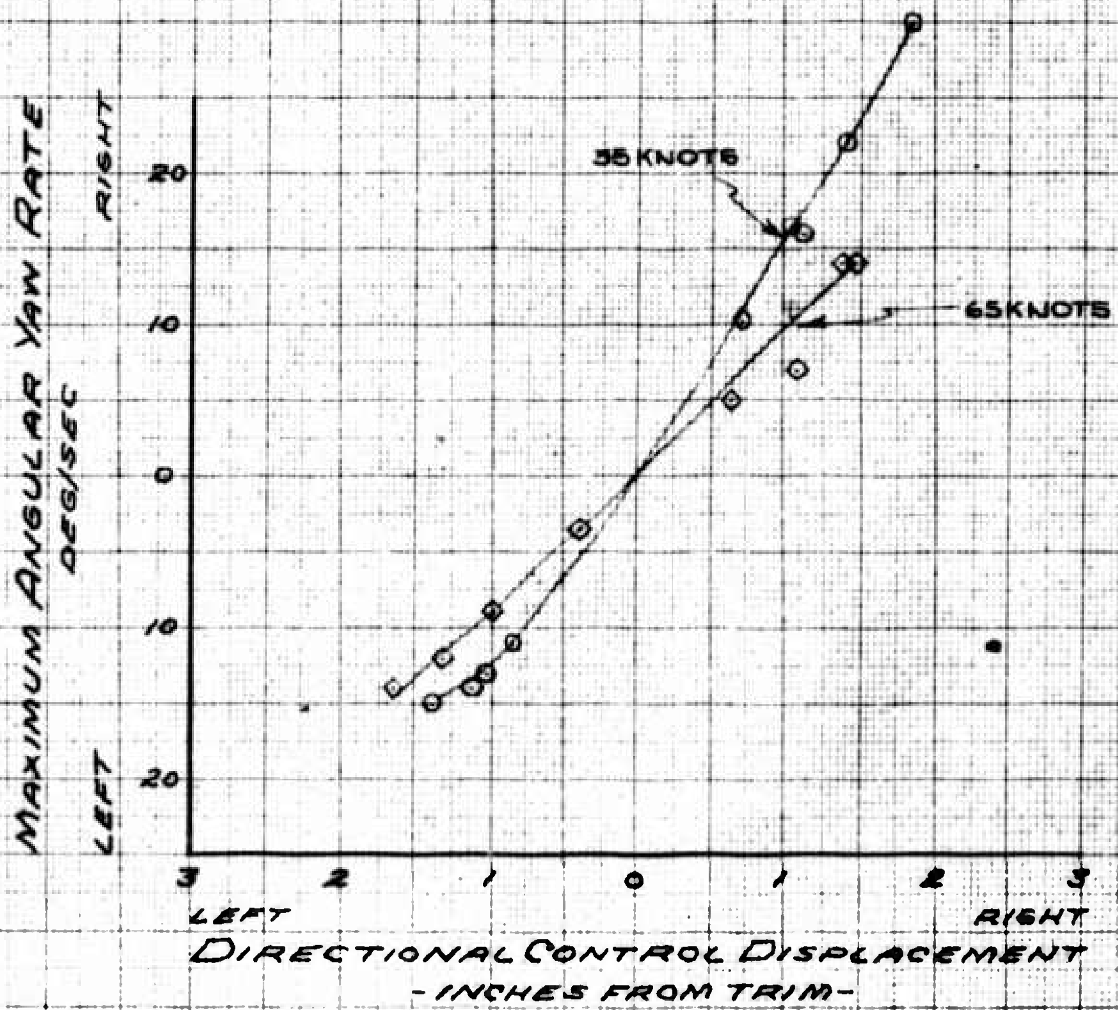

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FIG. No. 107

DIRECTIONAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6239

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
○	35	2480	5130	85.05(MID)	344
◇	65	2480	5130	85.05(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 2.95 INCHES FROM FULL RIGHT AT 35 KNOTS AND 4.20 INCHES AT 65 KNOTS.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX. 0.41 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 0.35 SECONDS AT 65 KNOTS.

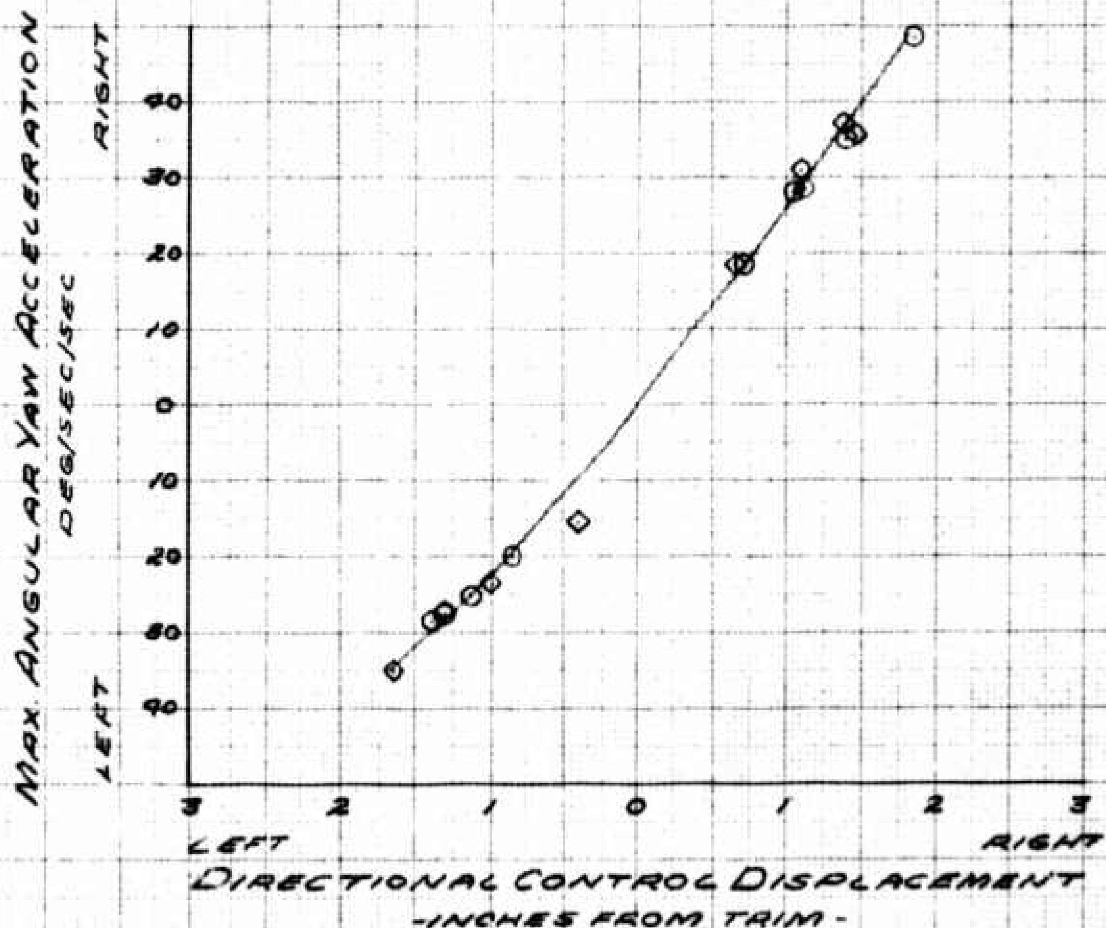

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FIG. No. 108

DIRECTIONAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
△	65	2710	5100	83.10 (FWD)	344
□	65	2720	5100	85.05 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 6.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.85 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR YAW RATE REACHED APPROX. 0.84 SECONDS AFTER CONTROL DISPLACEMENT.

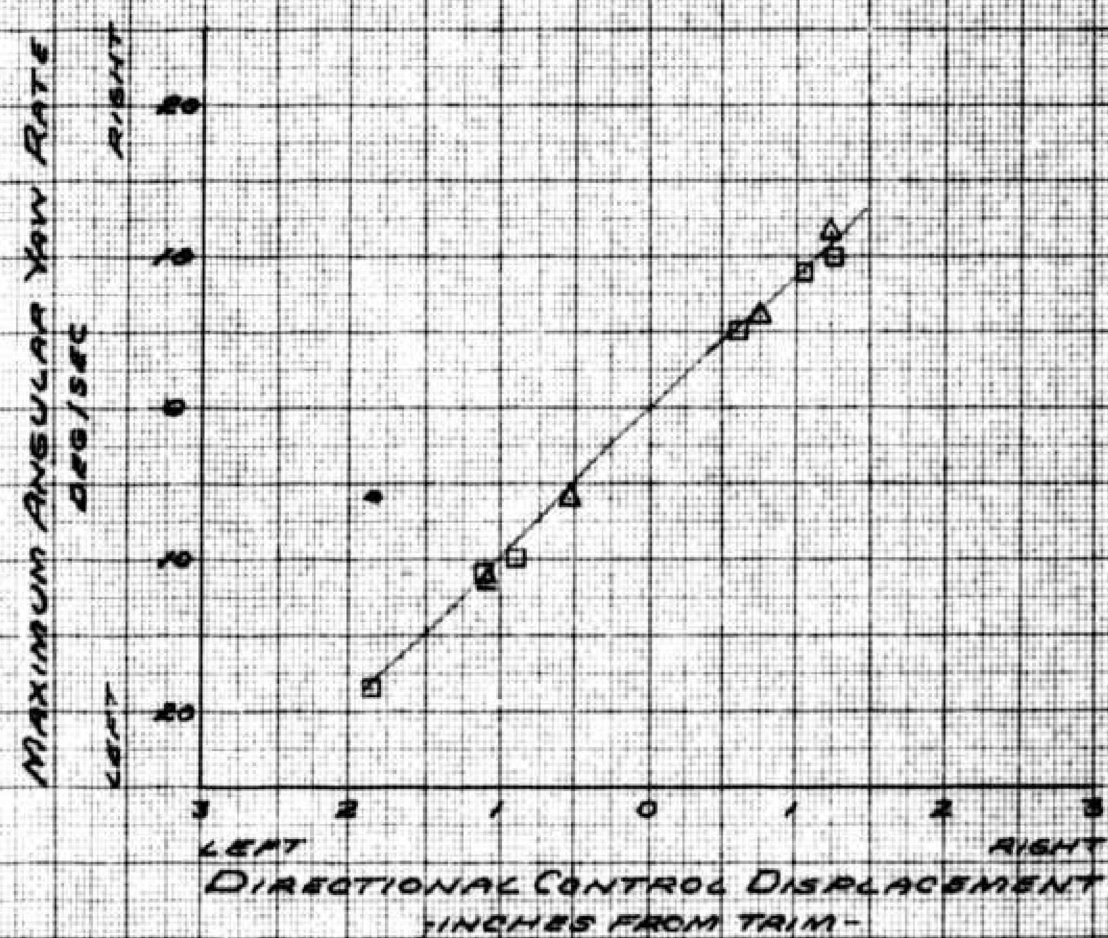

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FIG. NO. 109

DIRECTIONAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
△	65	2710	5100	83.10(FWD)	344
□	65	2720	5100	85.05(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.85 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX. 0.36 SECONDS AFTER CONTROL DISPLACEMENT.

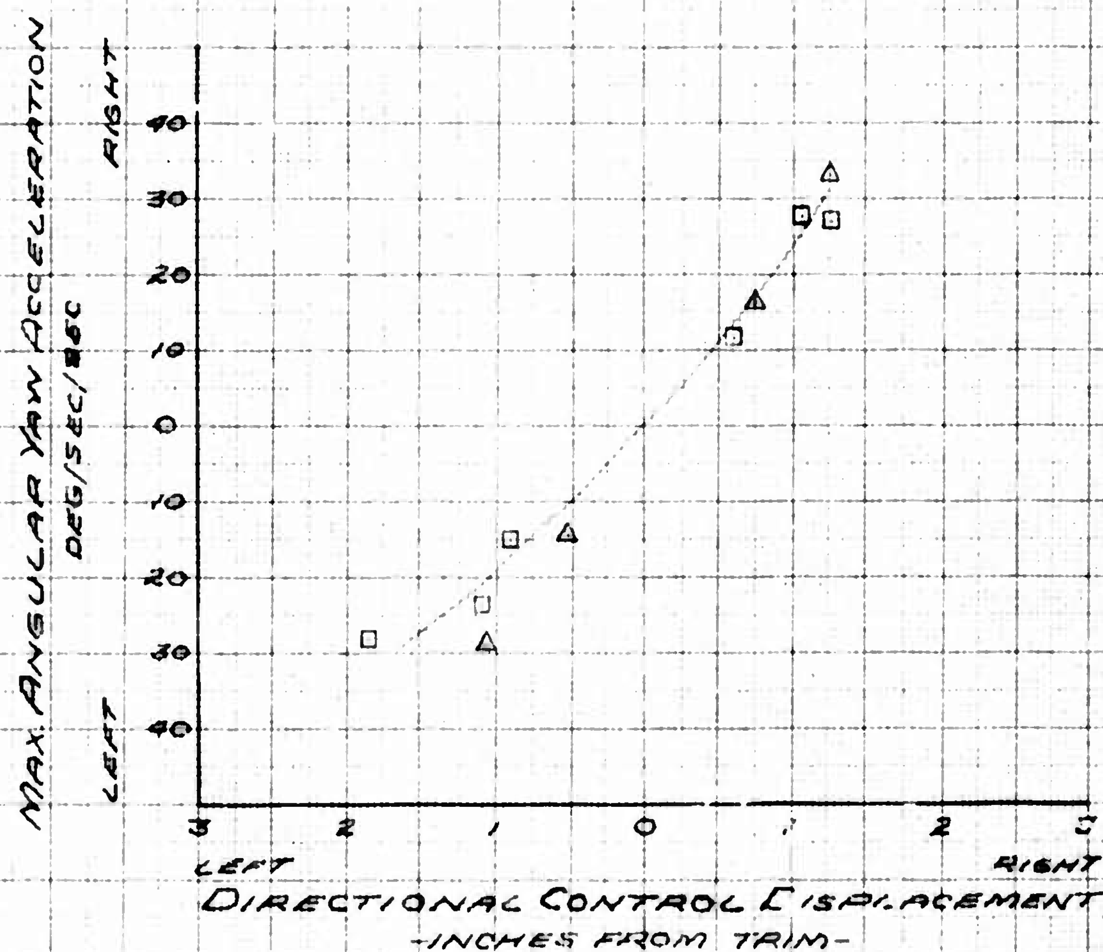

FIG. No 110
DIRECTIONAL CONTROL RESPONSE IN LEVEL FLIGHT
CH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
△	65	2465	4700	82.57	344
□	65	2485	4800	84.65	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.55 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR YAW RATE REACHED APPROX 0.78 SECONDS AFTER CONTROL DISPLACEMENT.

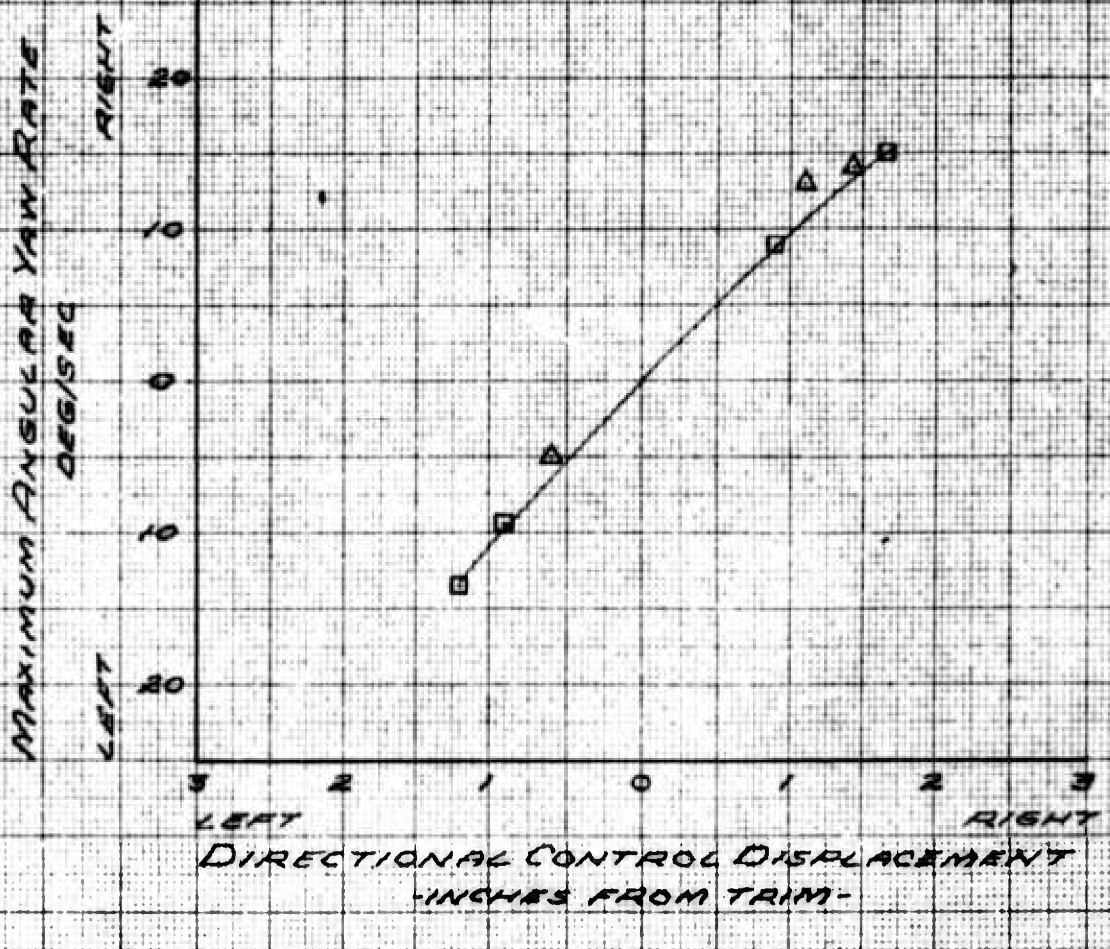

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Fig. No. 111

Directional Control Sensitivity in Level Flight

OH-13H S/N 57-6234

Clean Configuration

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
△	65	2465	4700	82.37 (FWD)	344
□	65	2485	4800	84.65 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.55 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX. 0.28 SECONDS AFTER CONTROL DISPLACEMENT.

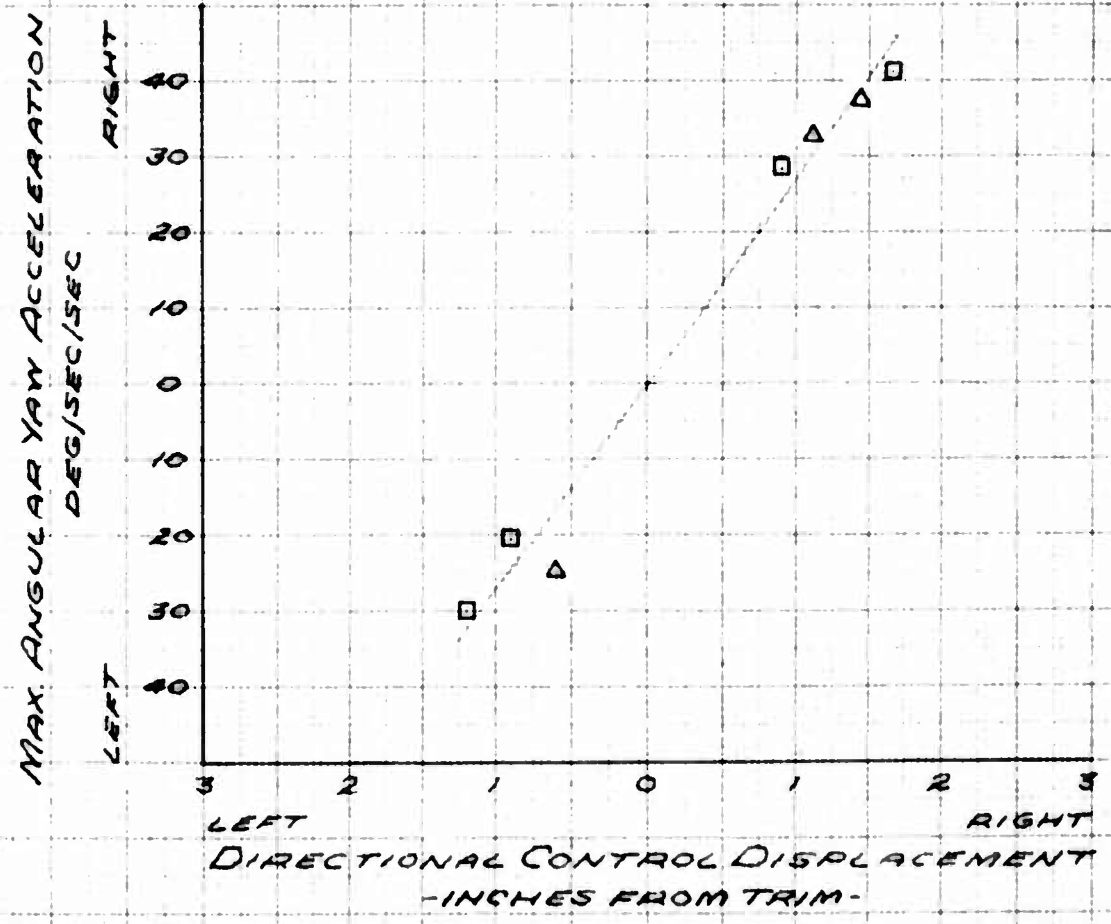

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FIG. NO 112

DIRECTIONAL CONTROL RESPONSE IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
O	35	2475	9000	85.02 (MID)	344
▽	62	2475	9000	85.02 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.18 INCHES FROM FULL RIGHT AT 35 KNOTS AND 5.45 INCHES AT 62 KNOTS.

NOTE 3: MAXIMUM ANGULAR YAW RATE REACHED APPROX. 1.02 SECONDS AFTER CONTROL DISPLACEMENT AT 35 KNOTS AND 1.20 SECONDS AT 62 KNOTS.

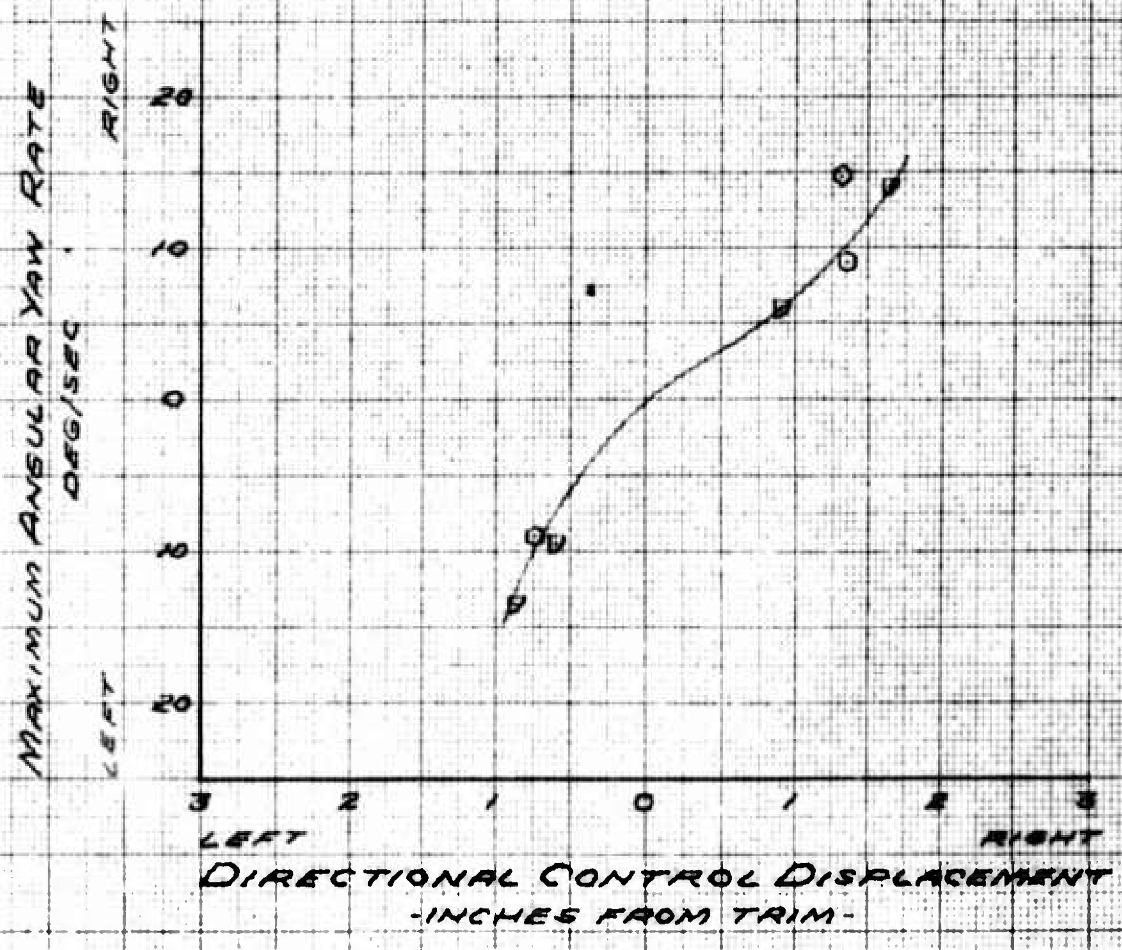

FIG. NO. 113

DIRECTIONAL CONTROL SENSITIVITY IN LEVEL FLIGHT

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W-LB	H_p-FT	C.G.-IN	RPM
O	35	2475	9000	85.02(MID)	344
◊	62	2475	9000	85.02(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.18 INCHES FROM FULL RIGHT AT 35 KNOTS AND 5.45 INCHES AT 62 KNOTS.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX 0.36 SECONDS AFTER CONTROL DISPLACEMENT

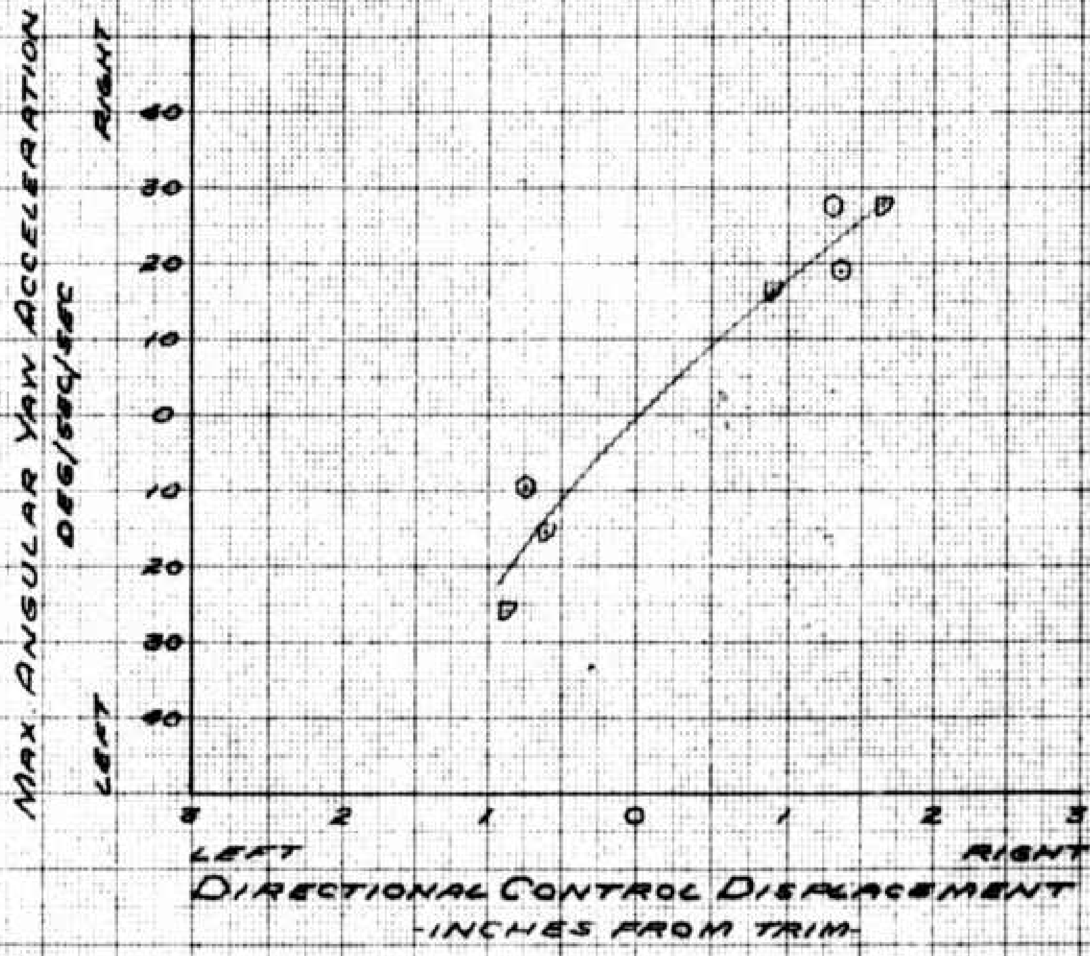

Fig No. 34

Directional Control Response in Climb & Autorotation

OH-13H S/N 57-6254

XM-1 Armament Kit Installed

SYM	FLT CONDITION	V_C-KT	G.W.-LB	H_D-FT	C.G.-IN.	RPM
○	CLIMB	45	2750	4225	95.75 (MID)	344
□	AUTOROTATION	45	2750	5185	95.75 (MID)	344

NOTE 1. FULL DIRECTIONAL CONTROL TRAVEL = 5.4 INCHES

NOTE 2. DIRECTIONAL CONTROL TRIM POSITION APPROX 4.72 INCHES FROM FULL RIGHT IN CLIMB AND .96 INCHES IN AUTO-ROTATION.

NOTE 3. MAXIMUM ANGULAR YAW RATE REACHED APPROX. 0.90 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 1.08 SECONDS IN AUTOROTATION.

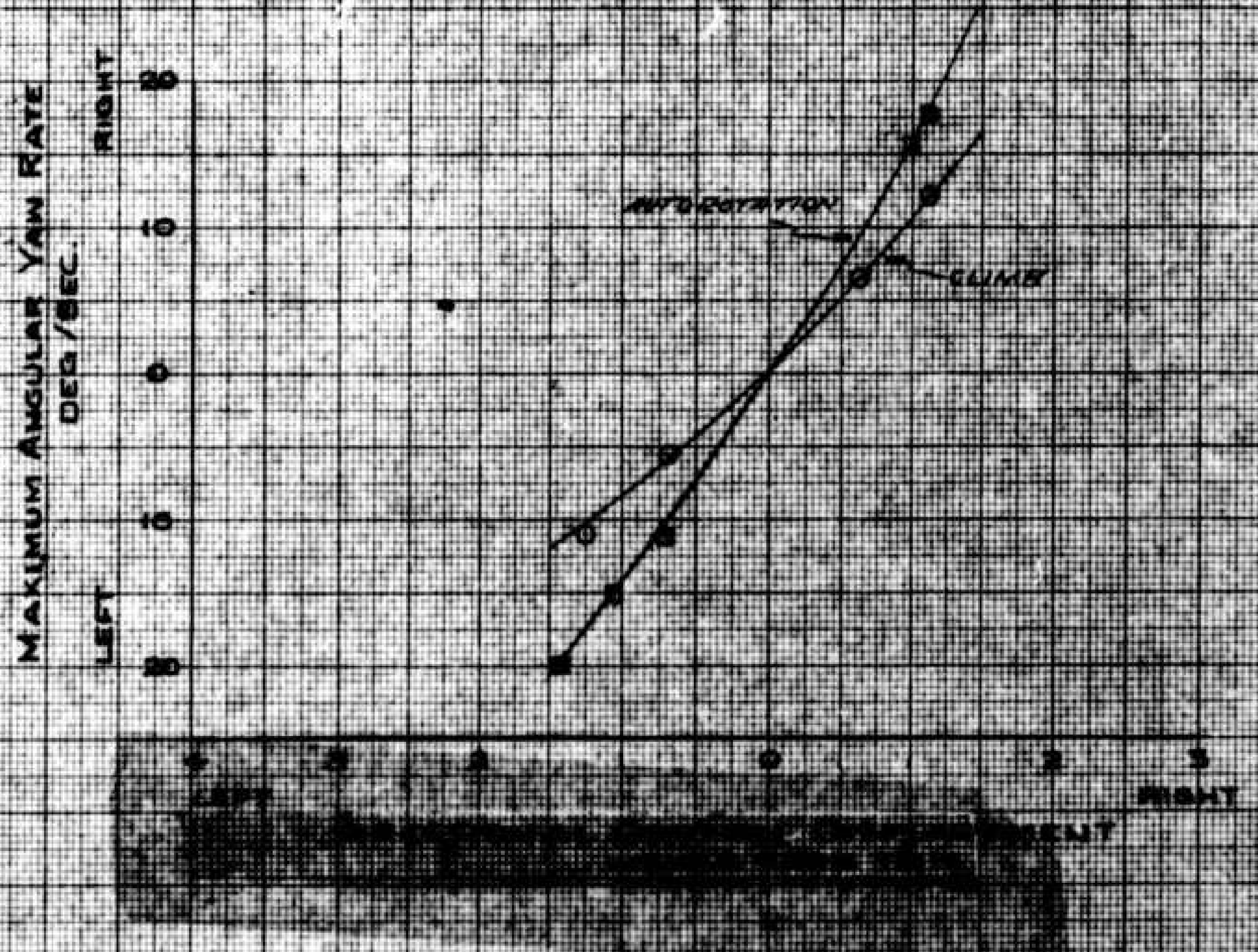

FIG. No. 115

DIRECTIONAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

XM-1 ARMAMENT KIT INSTALLED

SYM	FLT CONDITION	V_c-KT	G.W.-IN	H_p-FT	C.G.-IN	RPM
O	CLIMB	45	2750	4225	85.75(MID)	344
□	AUTOROTATION	45	2750	5185	85.75(MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.72 INCHES FROM FULL RIGHT IN CLIMB AND [illegible]76 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX. 0.35 SECONDS AFTER CONTROL DISPLACEMENT IN CLIMB AND 0.40 SECONDS IN AUTOROTATION

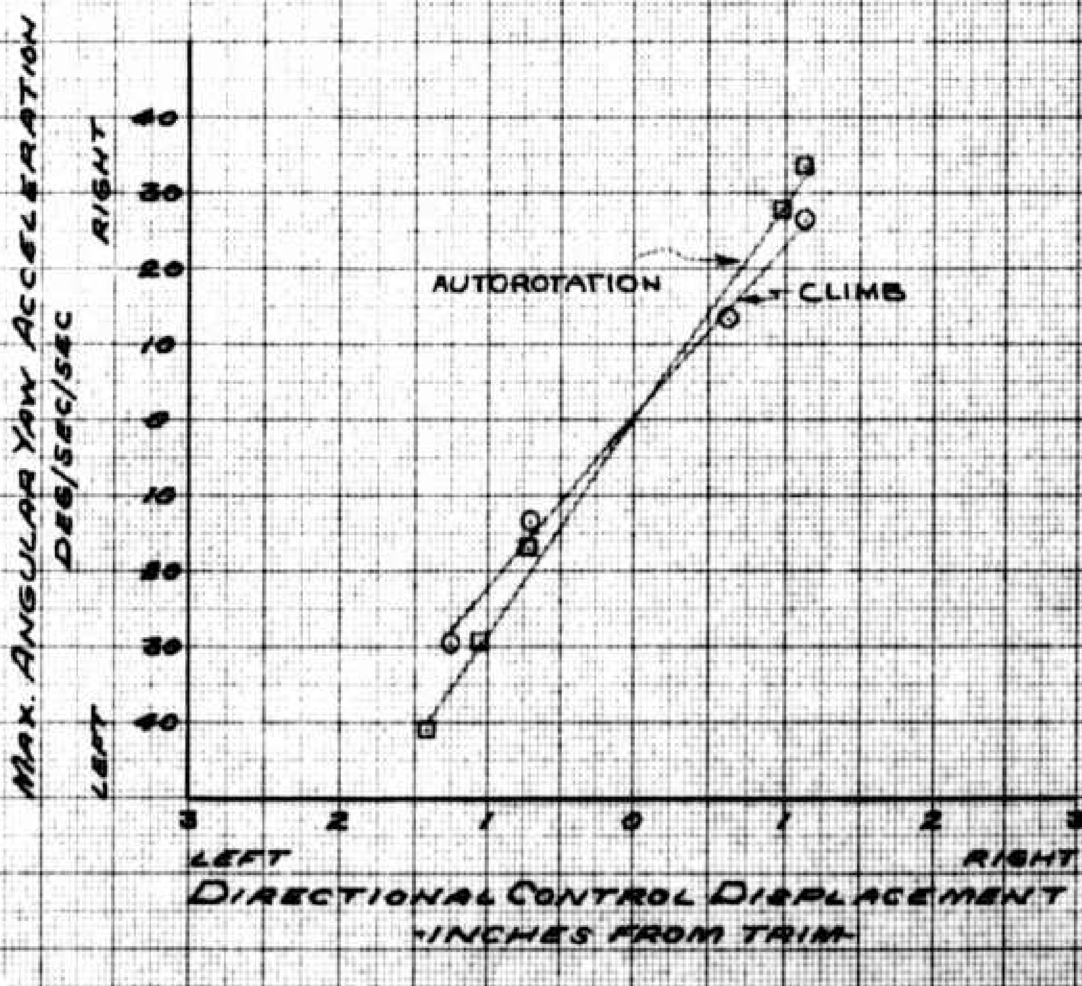

Fig. No. 116

Directional Control Response in Climb & Autorotation

OH-13H S/N 57-6234

Clean Configuration

SYM	V_c-KT	G.W.-LB	H_p-FT	C.G.-IN	RPM
○	45	2480	4850	85.05(MID)	344
□	45	2480	5000	85.05 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES.

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.0 INCHES FROM FULL RIGHT IN CLIMB AND 1.80 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR YAW RATE REACHED APPROX. 0.92 SECONDS AFTER CONTROL DISPLACEMENT AND 1.12 SECONDS IN AUTOROTATION.

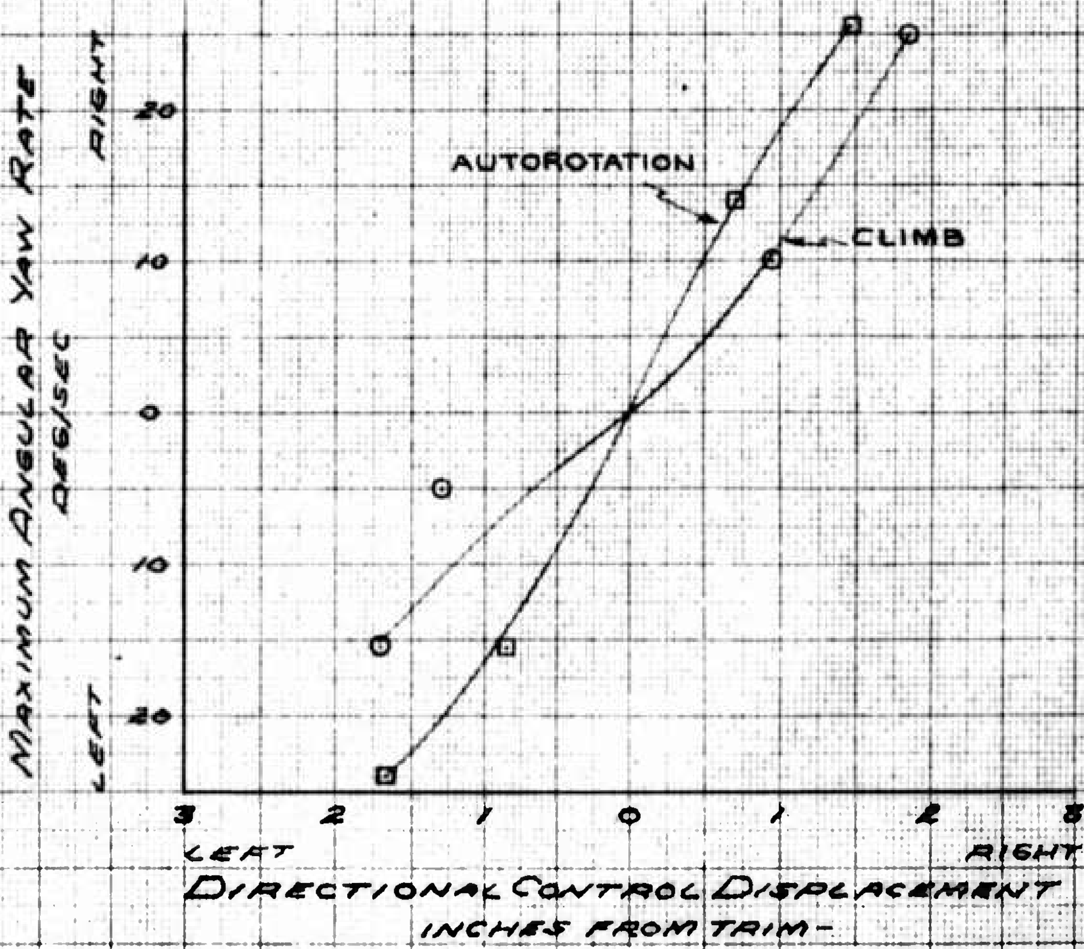

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FIG. NO. 117

DIRECTIONAL CONTROL SENSITIVITY IN CLIMB & AUTOROTATION

OH-13H S/N 57-6234

CLEAN CONFIGURATION

SYM	V_c-KT	G.W-LB	H_p-FT	C.G.-IN	RPM
O	45	2480	4850	85.05 (MID)	344
□	45	2480	5000	85.05 (MID)	344

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 4.0 INCHES FROM FULL RIGHT IN CLIMB AND 1.80 INCHES IN AUTOROTATION.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX. 0.37 SECONDS IN CLIMB AND 0.41 SECONDS IN AUTOROTATION

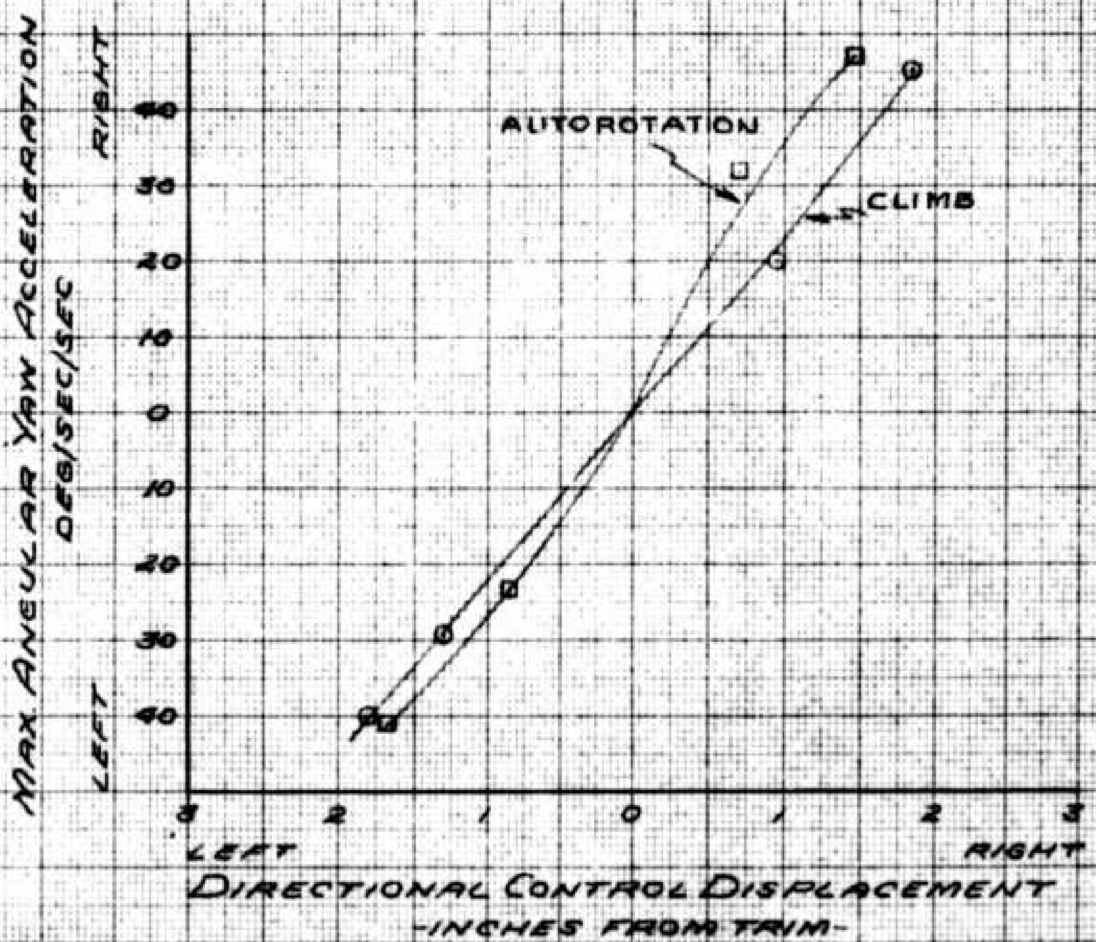

FIG. No. 118
DIRECTIONAL CONTROL RESPONSE IN HOVER
OH-13H S/N 57-6239

SYM	CONFIGURATION	G.W.-LB	H_d-FT	C.G.-IN	RPM
○	CLEAN	2475	2500	85.02(MID)	355
△	XM-1 KIT INSTALLED	2720	1000	84.43(MID)	355

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 6.3 INCHES FROM FULL RIGHT

NOTE 3: MAXIMUM ANGULAR RATE REACHED APPROX. 3.0 SECONDS AFTER CONTROL DISPLACEMENT

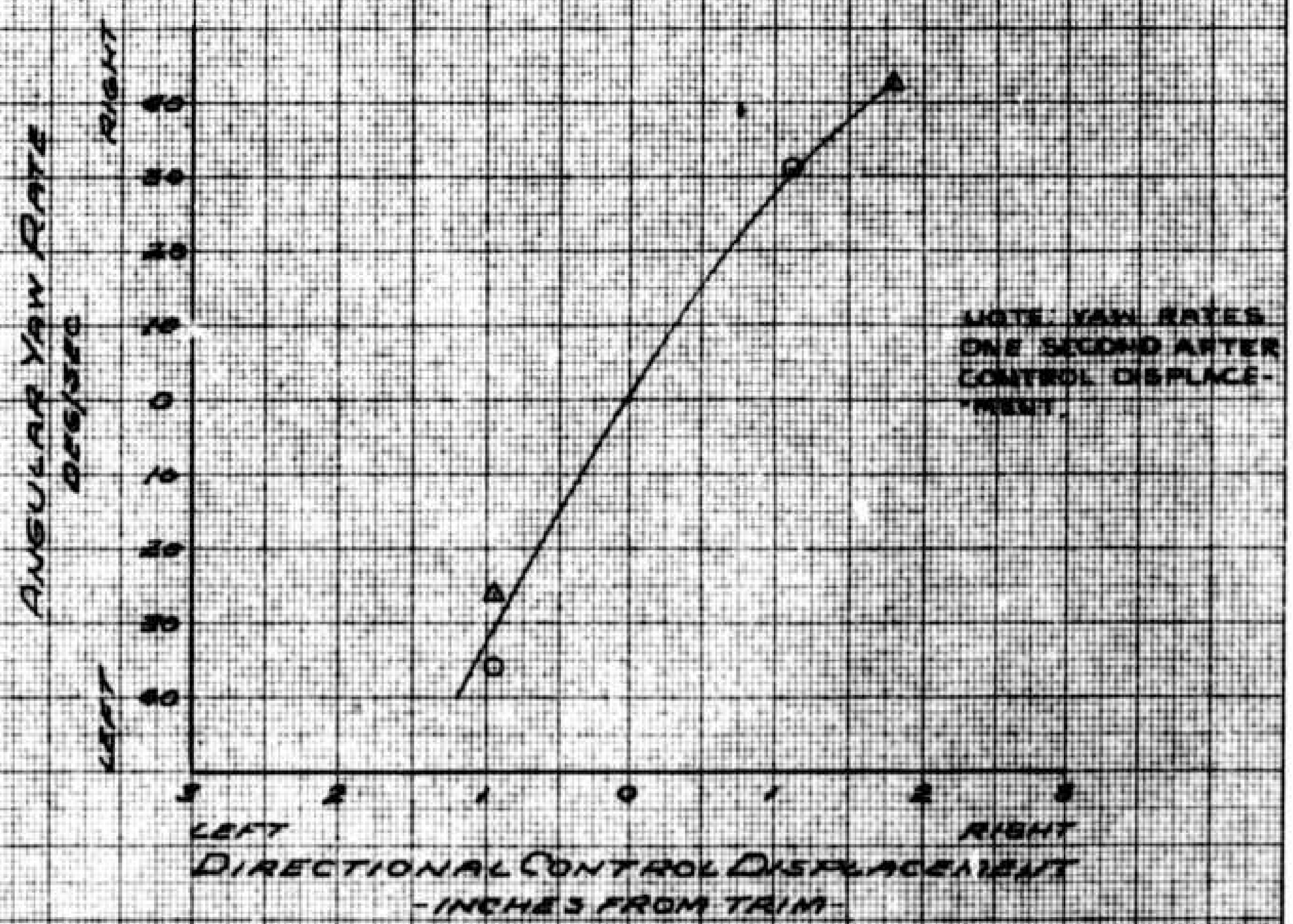

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FIG. No. 119

DIRECTIONAL CONTROL SENSITIVITY IN HOVER

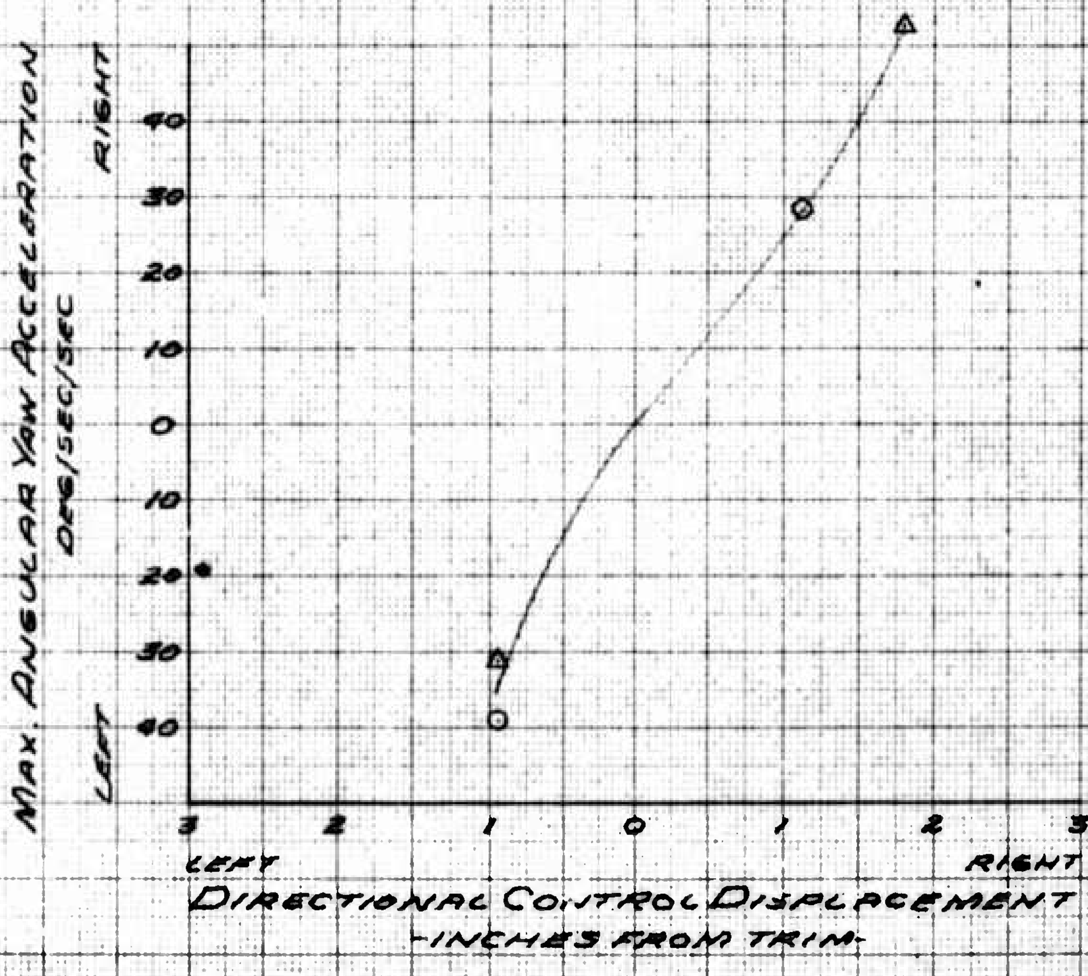
OH-13H S/N 57-6234

SYM	CONFIGURATION	G.W.-LB	H_D-FT	C.G.-IN	RPM
O	CLEAN	2475	2500	85.02 (MID)	355
Δ	XM-1 KIT INSTALLED	2720	1000	84.43 (MID)	355

NOTE 1: FULL DIRECTIONAL CONTROL TRAVEL = 8.4 INCHES

NOTE 2: DIRECTIONAL CONTROL TRIM POSITION APPROX. 6.3 INCHES FROM FULL RIGHT.

NOTE 3: MAXIMUM ANGULAR YAW ACCELERATION REACHED APPROX 0.47 SECONDS AFTER CONTROL DISPLACEMENT.



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PART III - ANNEXES

ANNEX A

REFERENCES

1. Manual No. TM 55-1520-204-10, "H-13 __ Helicopter Operator's Manual," revised September 1960.

2. Military Specification, MIL-H-8501A, "General Specification for Helicopter Flying and Ground Handling Qualities," 5 November 1952.

3. AFFTC-TN-59-21, "AFFTC Stability and Control Techniques," by Major Nelson D. Flack, USAF.

4. Air Force Technical Report No. 6273, "Flight Test Engineering Manual," by Major R. M. Herrington and Captain P. E. Shoemacher, May 1951, revised January 1953.

5. AFFTC-TR-57-12, "H-13H Phase IV Performance Test."

6. "Final Report of Test, Project Nr. Avn 1457, Evaluation of the Relocated Ground-Handling Wheels on the H-13-type Helicopter," DDC No. 209-733.

7. Technical Bulletin 55-1520-204-10/1, "Armament Data for H-13E, H-13G and H-13H Helicopters," 12 July 1962.

8. "Introduction to Rotary Wing Stability and Control," by W. A. Swope, U. S. Army Aviation Test Office.

9. Bell Helicopter Report No. 57-030-102.

10. ATA-TR-63-1 "OH-13H Gross Weight Increase/XM-1 Armament Kit Performance Test."

ANNEX B

TEST INSTRUMENTATION

The test instrumentation was installed and maintained by the Instrumentation Branch of the U. S. Army Aviation Test Activity. This instrumentation was calibrated by the Instrumentation Branch of the U. S. Air Force Flight Test Center, Edwards Air Force Base, California. A swivel-type pitot-static head was installed on a boom located on the right side of the helicopter.

The following sensitive instruments were installed in the instrument panel:

a. Airspeed Indicator (Boom System)

b. Altimeter (Boom System)

c. Rotor Tachometer

d. Manifold Pressure

e. Free Air Temperature

f. Carbruetor Air Temperature

g. Fuel Totalizer

The following parameters were recorded on a CEC 14-channel oscillograph:

a. Collective Stick Position

b. C.G. Normal Acceleration

c. Angle of Sideslip

d. Yaw Rate

e. Roll Rate

f. Roll Angle

g. Pitch Rate

h. Pitch Angle

i. Pedal Position

j. Longitudinal Cyclic Stick Position

k. Lateral Cyclic Stick Position

l. Battery Monitor and Engineer's Event Mark

m. Pilot's Event Mark

ANNEX C

WEIGHT AND BALANCE

The test aircraft was weighed prior to initial test flight.

Basic Test Weight (Includes instrumentation, ground handling wheels, full oil and trapped fuel)	1948 lb

Maximum Overload Gross Weight at Takeoff, Mid C.G., (STA 85.7):

Basic Test Weight	1948 lb
Guns	114
Crew (2) with chutes	400
Ballast @ STA 113.0	150
Ballast @ STA 152.0	50
Fuel, 20 Gal @ 6.0 lb/gal	120
	2782 lb

Maximum Overload Gross Weight at Takeoff, Fwd C.G., (STA 83.1):

Basic Test Weight	1948 lb
Guns	114
Crew (2) with chutes	400
Ballast @ STA 69.4	50
Fuel, 41 Gal @ 6.0 lb/gal	246
	2758 lb

Design Gross Weight at Takeoff, Mid C.G., (STA 84.7):

Basic Test Weight	1948 lb
Crew (2) with chutes	400
Ballast @ STA 152.0	50
Ballast @ STA 285.0	5
Fuel, 18 Gal @ 6.0 lb/gal	108
	2511 lb
Wheels Removed	- 22
	2489 lb

Design Gross Weight at Takeoff, Fwd C.G., (STA 82.4):

Basic Test Weight	1948 lb
Crew (2) with chutes	400
Ballast @ STA 50	15
Fuel, 21 Gal @ 6.0 lb/gal	126
	2489 lb

ANNEX D

AIRCRAFT DIMENSIONS AND DESIGN DATA

These descriptive data and design information were obtained from the Model H-13H "Detail Specification for Three Place, Single Engine, Two-Bladed Helicopter," Bell Helicopter Report No. 47-947-036, dated 1 March 1955.

Fuselage Group:

Fuselage Length to Tail Rotor Hub	27 ft 4 in
Fuselage Width (Tread)	7 ft 6 in
Height (To Rotor Hub)	9 ft 3-5/16 in
Length (Blades Turning)	41 ft 4-3/4 in
Design Gross Weight	2350 lb
Maximum Overload Gross Weight	2750 lb

Main Rotor Group:

Airfoil Root and Tip	NACA 0015
Chord Root and Tip	11 in
Rotor Diameter	35 ft 1-1/2 in
Blade Area	32.2 sq ft
Disc Area	968.5 sq ft
Vertical Distance from Rotor Head to Bottom of Skid Tube	8 ft 3-5/32 in

Tail Rotor Group:

Airfoil, Root	NACA 23018
Tip	NACA 23011
Chord, Root	STA 12.5, 5.375 in
Tip	STA 34.0, 4.125 in
Rotor Diameter	5 ft 8-1/2 in
Disc Area	25.58 sq ft

Transmission Ratios:

Engine to Main Rotor	9:1
Engine to Tail Rotor	.833:1

Aircraft Flight Limits:

Rotor Speed (RPM)	
Power ON	
Maximum Continuous	322-344
Takeoff (5 minutes)	344-355
Power OFF	310-370 (Recommended)
Limit Flight Load Factor @ 2350 lb	
Positive	2.5
Negative	.5
Landing	3.75

Center of Gravity Limit:

Forward	STA 82
Aft	STA 89
Center of Main Rotor Mast	STA 87

$V_{never\ exceed}$	87 kt from S.L. to 1400 ft. Decrease 3.0 kt per 1000 ft after 1400 ft.

Engine Limits in Flight:

1. Maximum Carburetor Air Temp	40°C
2. Oil Pressure	40-60 psi
3. Engine Oil Temp	40-110°C
4. Cylinder Head Temp	100-224°C
5. Transmission Oil Temp	40-130°C

Miscellaneous Information:

Fuel	115/145
Fuel Capacity	43 gal
Fuel Usable	41.6 gal
Oil Capacity	8.0 qt

ANNEX E

XM-1 ARMAMENT KIT

1. Description

The XM-1 armament kit is designed for use on the OH-13F, OH-13G and OH-13H U. S. Army helicopters. It consists of two 30-caliber machine guns, machine gun mounts, sight assembly, pneumatic charger assemblies and armament controls.

The machine guns are interchangeable and can be quickly detatched from the mounts. The pneumatic charger assemblies control the charging and safetying operation and solenoids are utilized to actuate the triggers. Each mount assembly contains a buffer assembly to reduce recoil and counter-recoil. Gun elevation is controlled by electrically operated elevating mechanisms and elevating limit switches contained in the mount. The ammunition box is also attached to the mount.

2. Operation

The preflight inspection by the pilot consists of a visual check of the weapon system preparatory to firing, as prescribed in a. and b. below:

a. Exterior Cabin

(1) Make sure that mounting pins of both guns and mount assemblies are properly installed.

(2) Observe that electrical connectors are connected to mating receptacies.

(3) Make sure air hoses of chargers are connected to air bottles.

(4) Be sure pneumatic valves on air bottles are open, bolts are held to the rear by the chargers, and red indicators on bottles are not visible, indicating sufficient air pressure.

(5) Check ammunition for full load and proper type.

(6) Insure that the "F" position on the gun trigger safety is visible.

b. Cockpit

(1) Make sure that the arm/safe switch is in the "OFF" position and that both indicator lights on the console are off.

(2) Note that sight frame is adjusted to eye level height. If not properly adjusted, slide sight frame vertically until axis zero degree tube is at eye level when seated in normal operating position.

3. In-flight Operation

a. Firing the Machine Guns

(1) Move the arm/safe switch of the collective pitch control to the "SAFE" position. This will permit elevation/depression of the guns through the activation of the elevation/depression switch located on the cyclic control handgrip and also illuminated the green "SAFE" light on the left side of the control console.

(2) Place the arm/safe switch in the "ARM" position. The chargers will permit the bolts to go forward, chambering a round in the guns. The green "SAFE" light will go out, and the red "ARM" light will illuminate.

(3) Locate target through the sight assembly, noting degree of frame in which it appears.

(4) Operate elevation/depression switch until elevation indicator on the guns corresponds with the degree of frame noted in (3) above.

(5) Depress the gun trigger switch to fire the guns.

WARNING: Prior to operating machine guns (firing and/or changing elevation), turn off muff heater blowers to prevent possible electrical overload. After gun operation, turn heater blowers on.

b. Safetying the Machine Guns

(1) Switch the arm/safe switch to the "SAFE" position. "SAFE" indicator light will illuminate green. Elevation or depression may be accomplished with switch in the "SAFE" position.

(2) Switch arm/safe switch to the "OFF" position. Indicator lights will go off.

(3) Before landing or leaving the helicopter, visually check to insure that gun bolts are in the retracted (rearward) position.

WARNING: If arm/safe switch is in the "SAFE" position and the gun bolts are in the forward (firing) position due to insufficient pressure in the charger system, exercise extreme caution in leaving the helicopter, as the weapon may be armed. Keep weapon directed away from personnel and notify organizational maintenance to take necessary corrective action.

If a gun stoppage occurs during firing, move the arm/safe switch to the "OFF" position, then back to "ARM" position. This action will chamber a new cartridge in both guns. Depress gun trigger switch. If gun(s) still fail to fire, place arm/safe switch in "OFF" position.

ANNEX F

RELOCATION OF GROUND HANDLING WHEELS

The OH-13H helicopter rocks forward on the skid tubes following a hard landing with forward velocity. Controllability of this action requires aft displacement of the cyclic stick. Rapid or excessive aft movement of the cyclic control may cause the following one of two problems or possibly both: (a) The rotor blades may strike the tail section; (b) The dynamic stops in the main rotor may be snapped. To aid in alleviating this characteristic, the original OH-13H wheel brackets were used. These brackets enable the mounting of the ground handling wheels on the forward end of the skid tubes. The brackets were mounted as outlined in AFFTC-TR-57-12, Page 7. This unique installation is mandatory at the higher maximum gross weight (2750 pounds). It aids pilots in three phases of flying: Landing, takeoff and taxiing. This forward wheel mounting becomes particularly useful where maximum power is required for taxiing. This feature also enables a pilot to make a ground running takeoff.