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1142

SANDIA SYSTEMATIC DECLASSIFICATION REVIEW	
1st Review Date: 7/20/98	Determination (Circle Numbers):
Authority: ☐ADC ☒ADD	1. Classification Retained
Name: W Layne	2. Classification Changed to U
2nd Review Date: 7/23/98	3. Contains No DOE Classified Information
Authority: ADD	4. Coordinate With:
Name: R B Craner	5. Contains UCAI? NK
	6. Comments: OK for Openmet

NOV 1 0 1954
Case No. 431.00
Ref. Sym: 1612-(114)
Project No. TM-179

UNCLASSIFIED

MR. D. R. COTTER - 1326

Attention: Mr. A. V. Engel - 1326-4

Re: Calibration of Strain Gages on Mk 7 Unit for Measurement of Flight Loads

Summary of Results

The Mk 7 was mounted to simulate an aircraft inatallation. Static loads were then applied to the tail section; these loads established a condition for determination of the magnitude and location of inflight loads by readings taken from strain gage bridges mounted on the outer case of the unit. There was no apparent damage to the unit during the test.

Object of Test

This test was conducted to determine the relationship between the magnitude and location of the load and strain output from SR-4 strain gage bridges mounted on the rear case section of the forward case assembly of a Mk 7 for measurement of air loads during carriage on aircraft in flight.

Reason for Test

This test was requested in a Work Order Authorization from R. A. Bice, 1260, to T. B. Morse, 1610, dated September 14, 1953. A. V. Engel and W. J. Dalby, 1263, were the requestors consultants.

Summary of Past Tests

No previous static calibration tests of this nature have been conducted by Department 1610.

Setup for Test

Figures 1 through 6 are photographs of test setups.

Component	Serial No.	Drawing No. X Ref. G-1
Mk 7	50-X-1	113482 113517

Instrumentation furnished by Section 5224-1 consisted of the following:

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SANDIA SYSTEMATIC DECLASSIFICATION REVIEW DOWNGRADING OR DECLASSIFICATION STAMP	
CLASSIFICATION CHANGED TO: U	AUTHORITY: R.B. Craner
Emilda Selph 7/30/98	RECORD ID: 98SW3069
PERSON CHANGING MARKING & DATE	
W C Layne 7/30/98	DATED: 7/23/98
PERSON VERIFYING MARKING & DATE	

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10

Thirty-two Baldwin A-6 strain gages, resistance 296 ohms, gage factor 2.07, Lot No. 232-11, mounted and connected into six wheatstone bridges (Figs. 7 and 8)

One calibration box, schematic, Fig. 9

Test equipment used consisted of the following:

Seven Baldwin strain indicators

Type	Serial No.
"K"	F-94414
"L"	J-92498
"L"	J-59252
"L"	J-92499
"M"	199375
"M"	175441
"M"	199392

One Baldwin load cell, Serial No. 655, capacity 10,000 pounds

Two Blackhawk hydraulic rams and pumps with capacities of 15,000 pounds and 100,000 pounds

Procedure

The Mk 7 unit was supported in an inverted position in the test jig with two hook suspension and sway braces set at a 35 degree angle to simulate an aircraft carriage installation. The jig was fastened to two fifteen inch I beams, eleven feet long, and then clamped to the floor for stability against the static calibration loads which were applied to the aft end of the Mk 7 unit. The rear case section of the forward case assembly was instrumented by L. Lathrop, Section 5224-1, (Figs. 7, 8 and 9). The calibration box was connected to the SR-4 strain gage bridges through the receptacle on the unit. The output from the SR-4 strain gage bridges was measured by strain indicators connected to the strain gage bridges through the calibrate box.

The calibration resistors serve as a means to convert the records of inflight loading into equivalent static calibration load (pounds). The size of the calibration resistors for each bridge was chosen to give the same strain as was obtained in static load calibration. The maximum calibration load applied to the Mk 7 tail section was equal, approximately, to the maximum expected tail loads in flight.

Static calibration loads of 2500 pounds were applied upward, downward, and laterally to both the right and left sides at station 153, and downward and laterally to the right at station 167.

Static loads to 1500 pounds were applied at the center of pressure on two of the three fins. In each of the load tests, strain readings were recorded at 250 pound increments of applied load.

After flight tests the unit was returned for recalibration and one additional calibration with static load applied to a fin at a point 19 inches from the case. Before the recalibration of the unit, several of the cables from the strain gage bridges were found to be shorted to each other or the cable clamp. The insulation was renewed and the recalibration was made.

Results

The results of the calibration load tests are tabulated in Tables I through X and are plotted in Figs. 10 through 15. The ohmic resistance and amount of induced strain by the calibration resistors are tabulated in Table XI and indicated on the appropriate load strain plot (Figs. 10 through 15) where the strain was maximum for the maximum load.

The recalibration of the various strain gage bridges after the flight test gave essentially the same as the first calibration.

W. J. CRAIG - 1612-2 (by E. White)

H. H. HARTZELL - 1612-2

J. M. MATA - 1612-2

Approved by:

PAUL H. ADAMS - 1612

WJC:1612-2:ach

DISTRIBUTION:
D. R. Cotter - 1326
Attention: A. V. Engel - 1326-4
T. B. Morse - 1610
J. P. Wamser - 1282
W. E. Caldes - 5513
G. M. Byrne - 1922-2
Frances Hale - 1925-2

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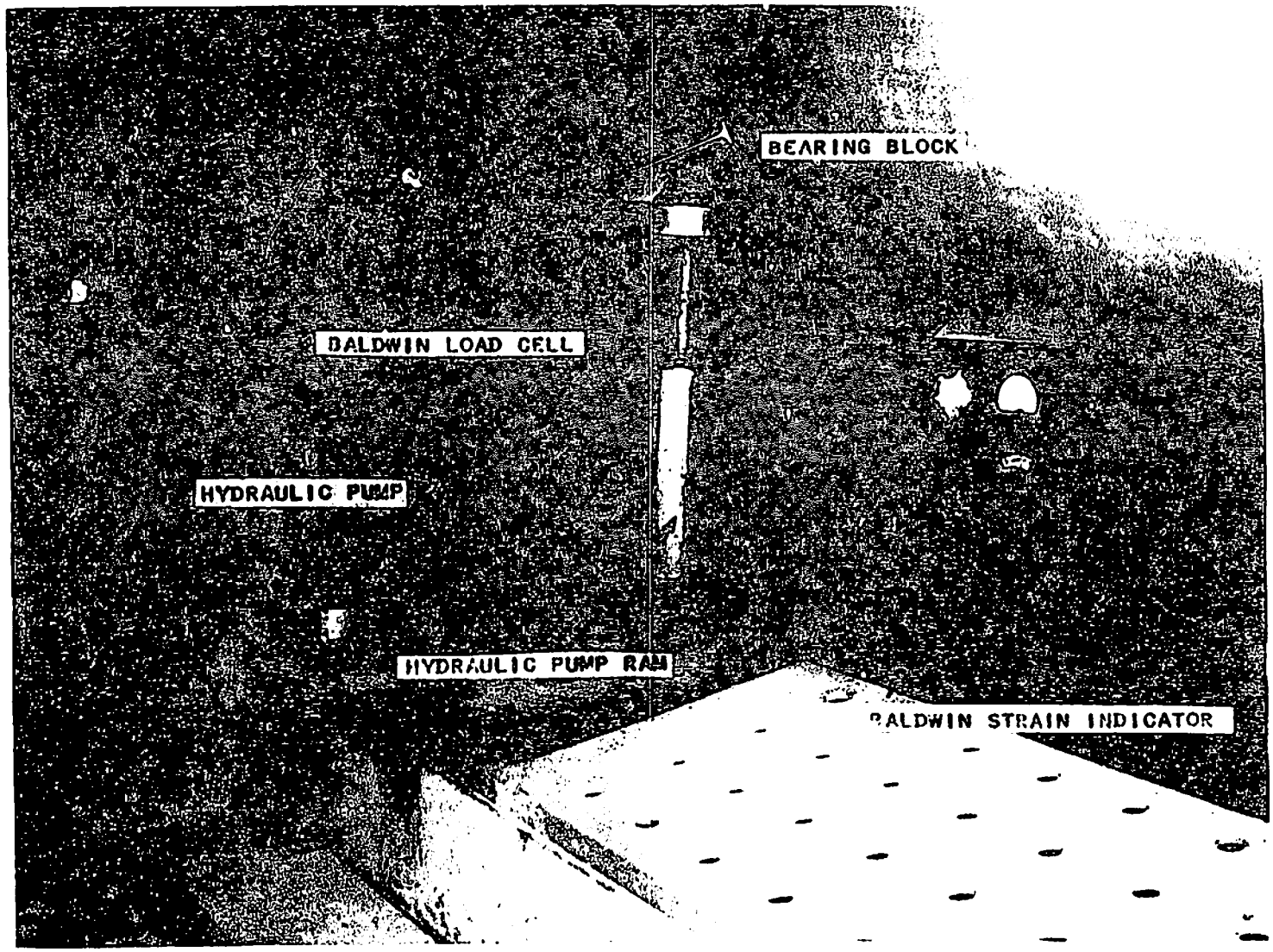

FIG. 1-- TEST SETUP FOR LOAD APPLIED DOWNWARD AT STATION 167 IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS.

TM-179
REF. SYMBOL 1612(114)

D# 53050

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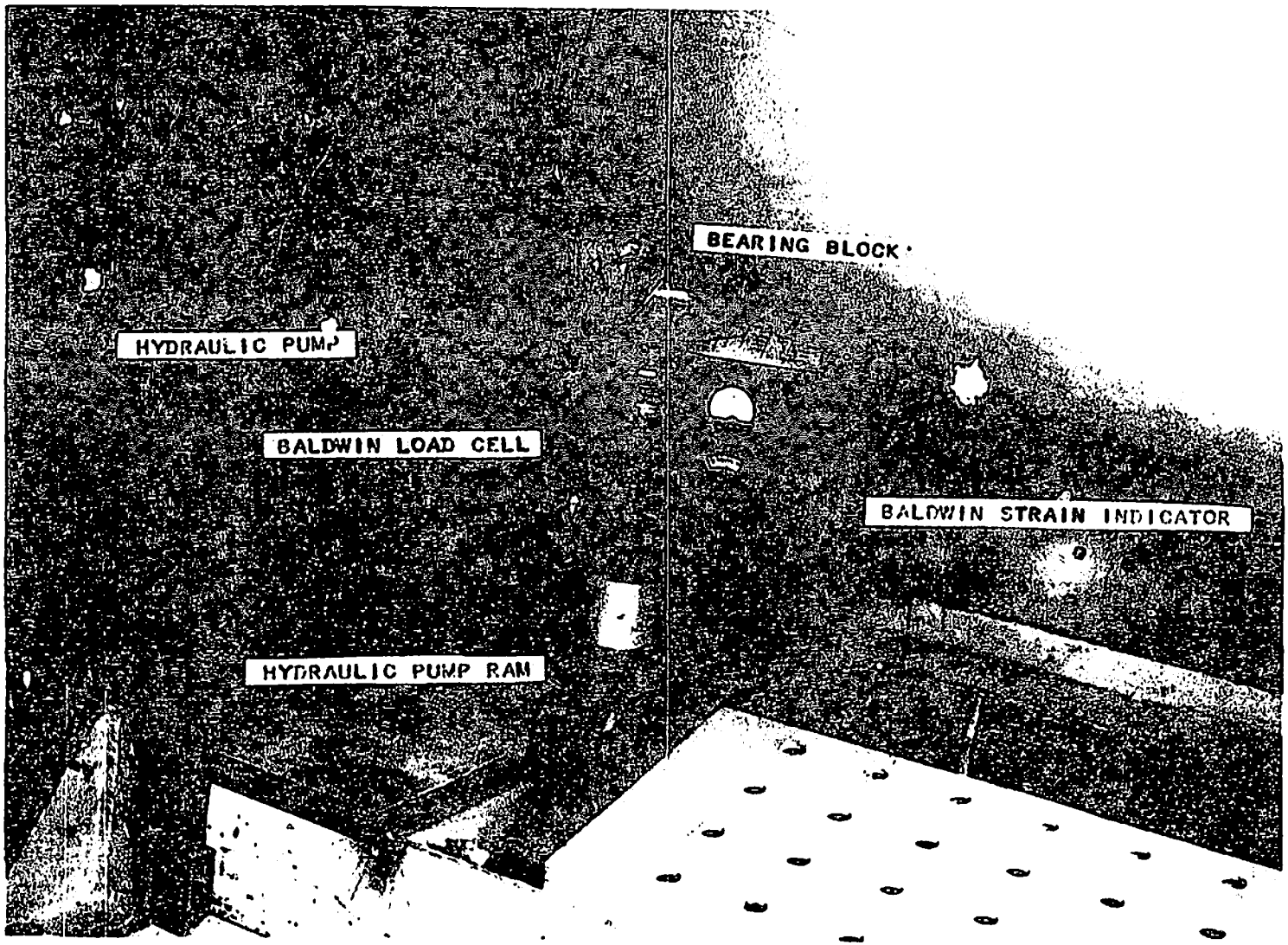

FIG. 2-- TEST SETUP FOR LOAD APPLIED DOWNWARD AT STATION 153 IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS.

TM - 179
REF. [illegible]

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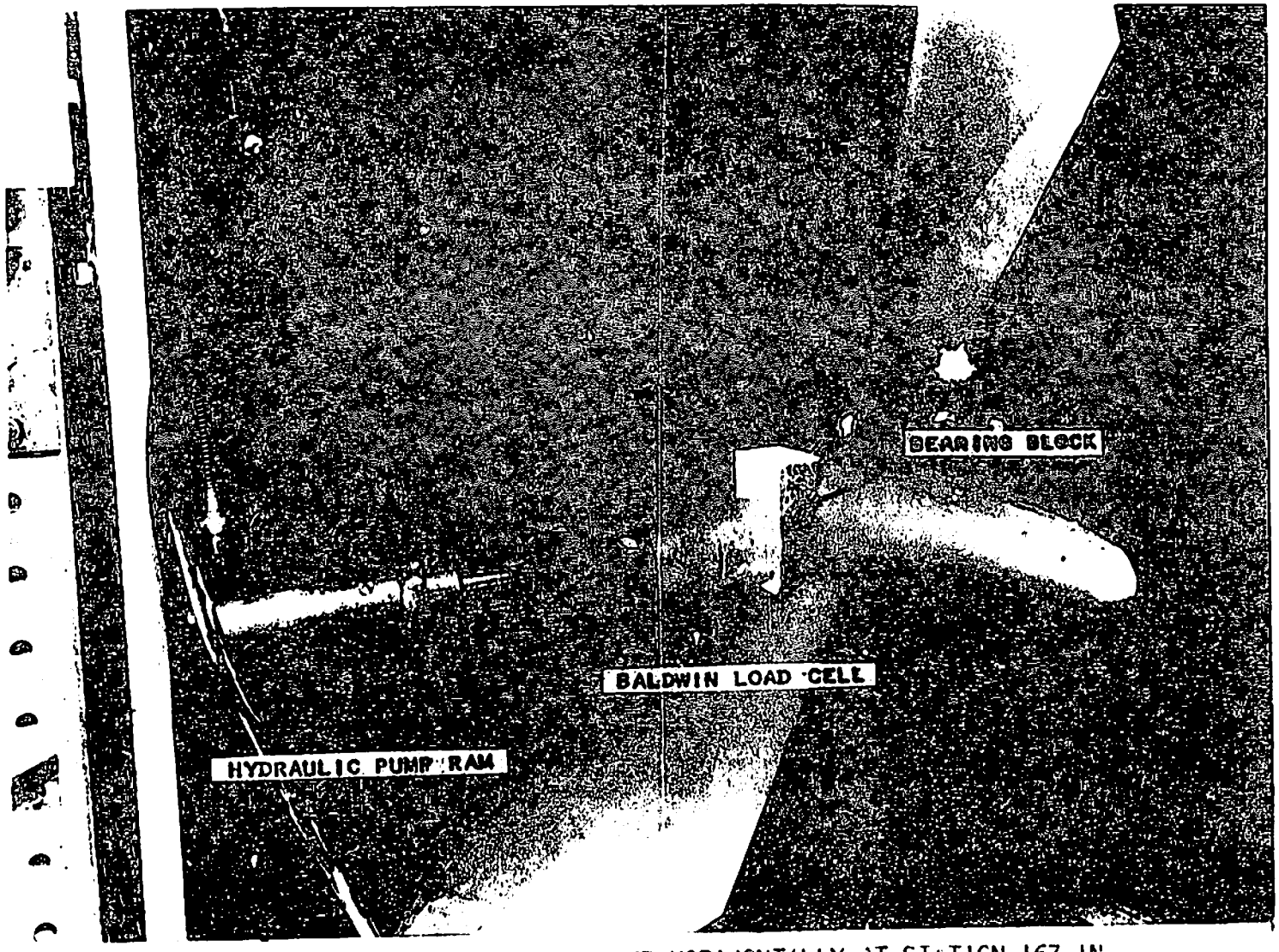

FIG. 3-- TEST SETUP FOR LOAD APPLIED HORIZONTALLY AT STATION 167 IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS.
TM-179
REF. SYMBOL 1612(114)

D# 53052

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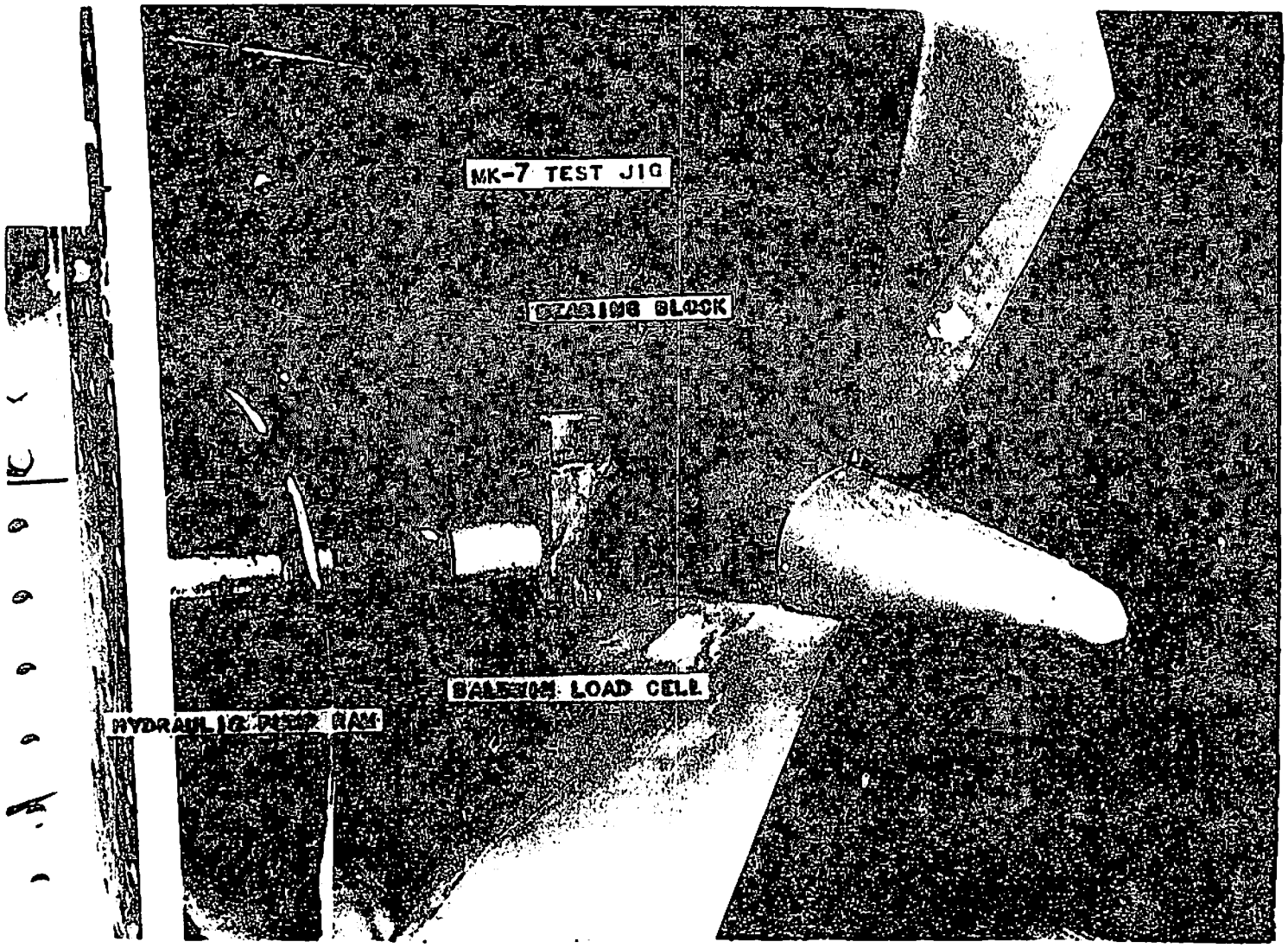

FIG. 4-- TEST SETUP FOR LOAD APPLIED HORIZONTALLY AT STATION 153 IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS.

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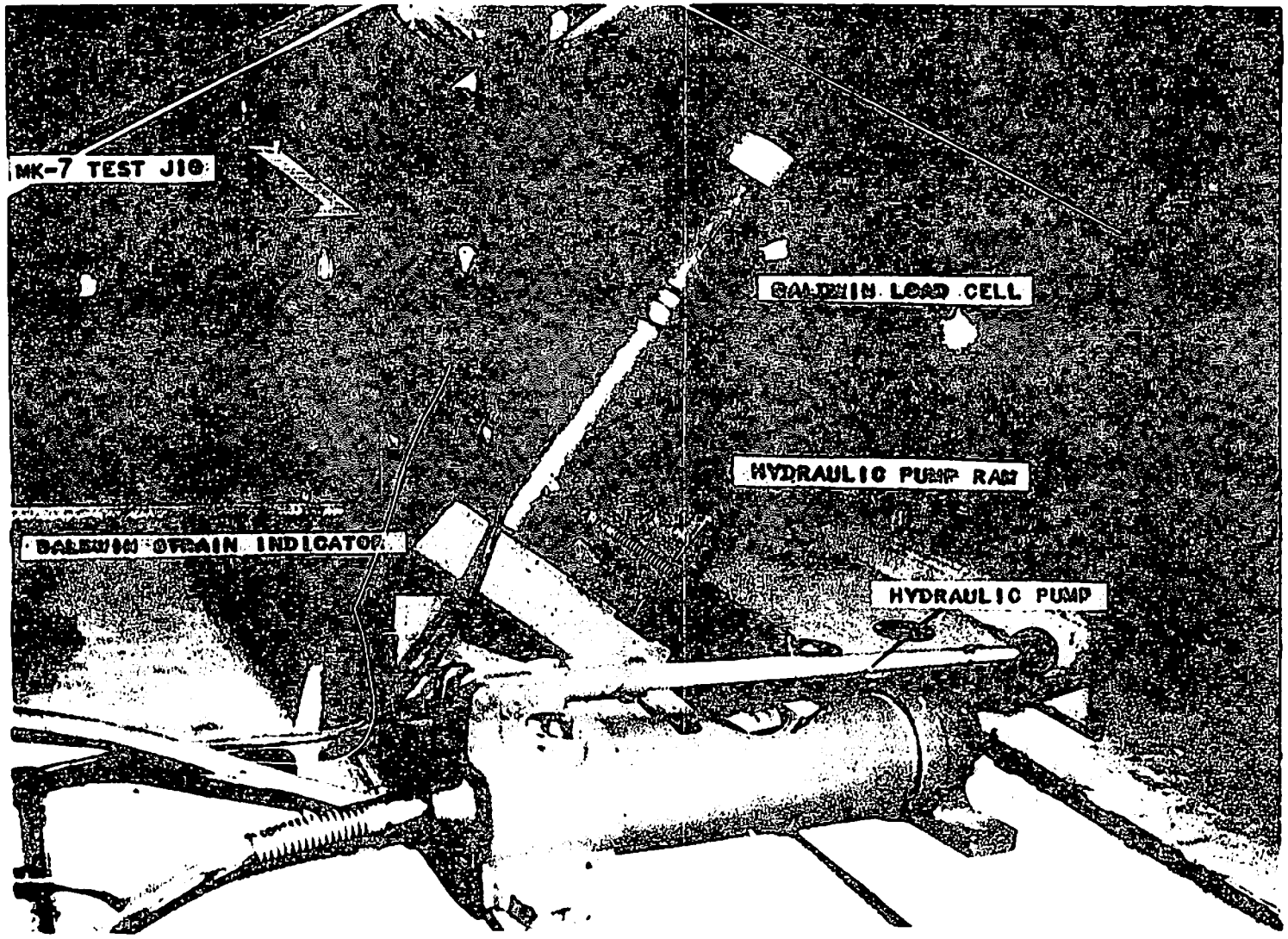

FIG. 5-- TEST SETUP FOR LOAD APPLIED COUNTERCLOCKWISE AT CENTER OF PRESSURE OF FIN IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS TM-179
REF. SYMBOL 1612(114)

D# 53054

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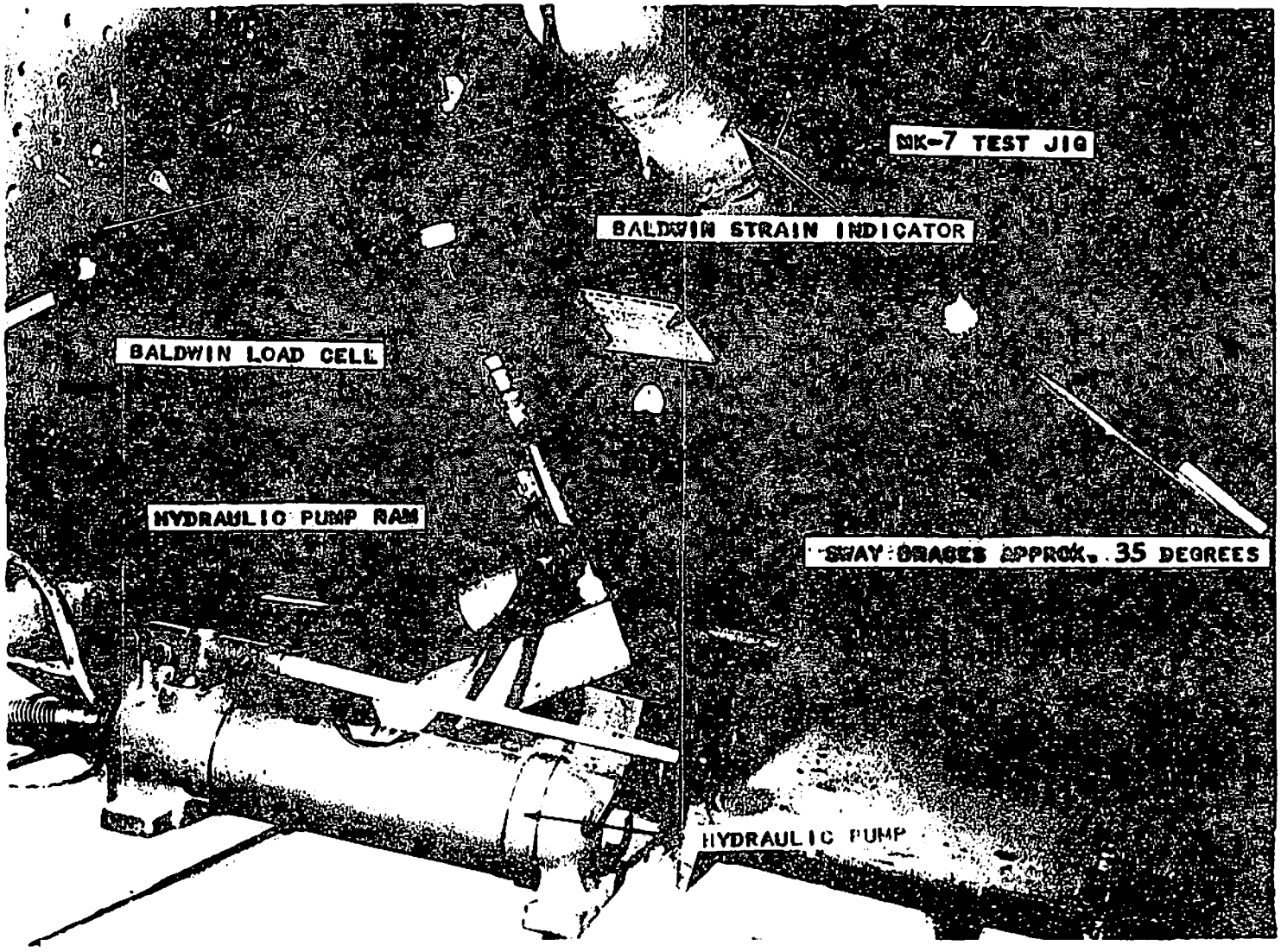

FIG. 6 -- TEST SETUP FOR LOAD APPLIED CLOCKWISE AT CENTER OF PRESSURE OF FIN IN STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS. TM-179
REF. SYMBOL 1612(114)

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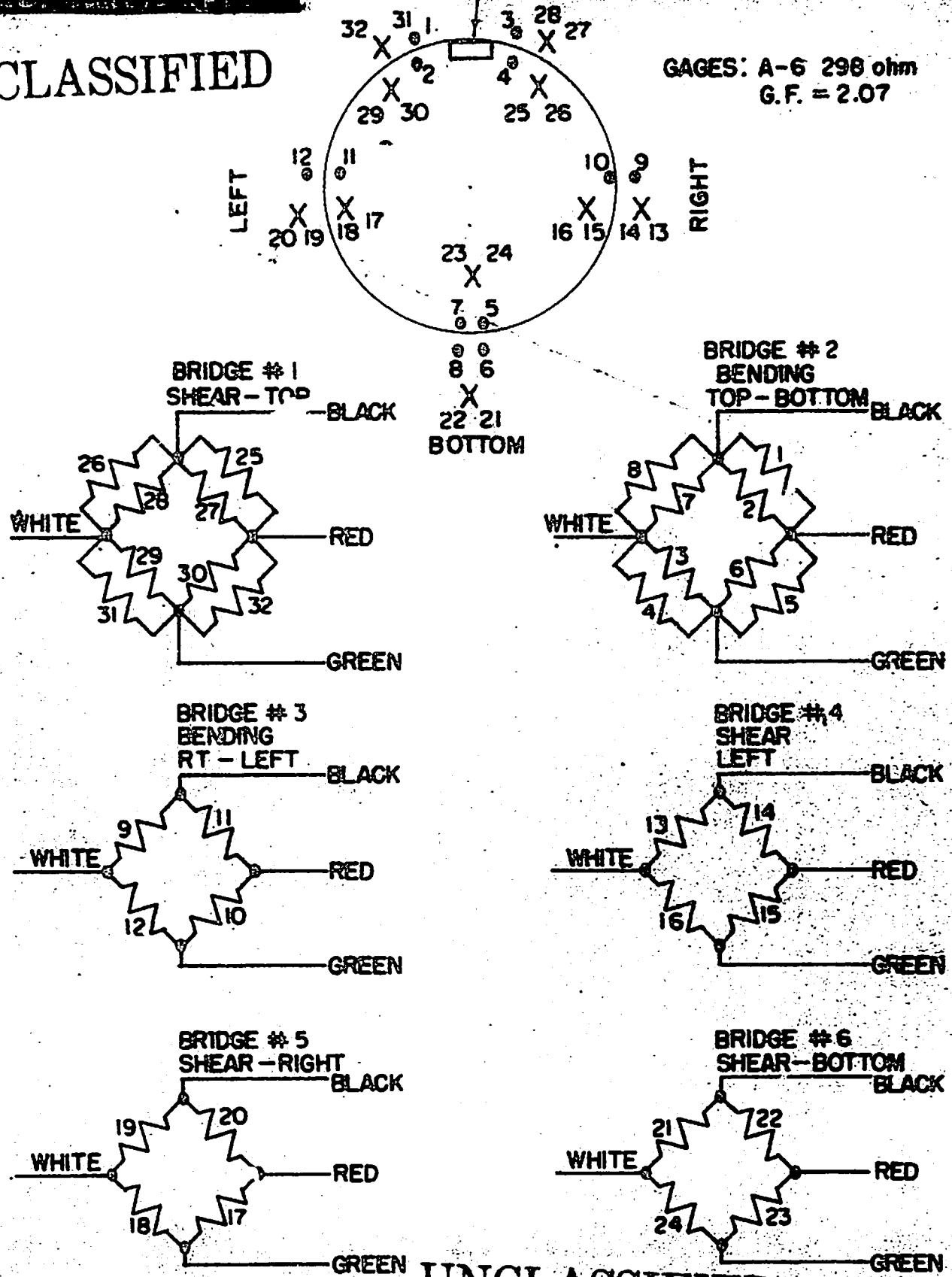

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FIG.7 - INSTRUMENTATION FOR STATIC CALIBRATION OF STRAIN GAGES ON AFT SECTION OF FORWARD CASE ASSEMBLY FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 FOR MEASUREMENT OF FLIGHT LOAD [redacted]

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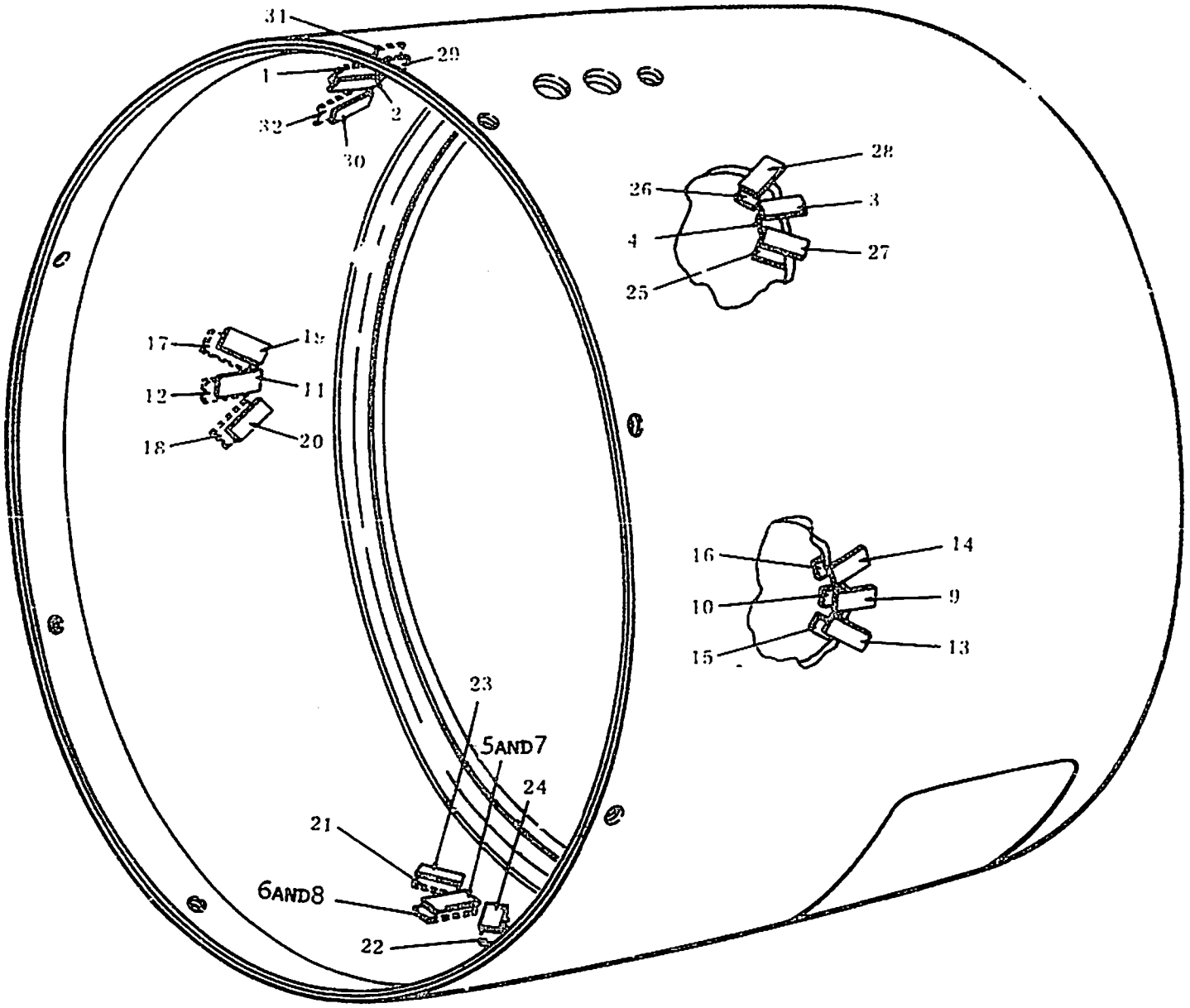

FIG.8- PICTORIAL OF INSTRUMENTED AFT SECTION OF FORWARD CASE ASSEMBLY SHOWING STRAIN GAGE LOCATIONS AS INSTALLED FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

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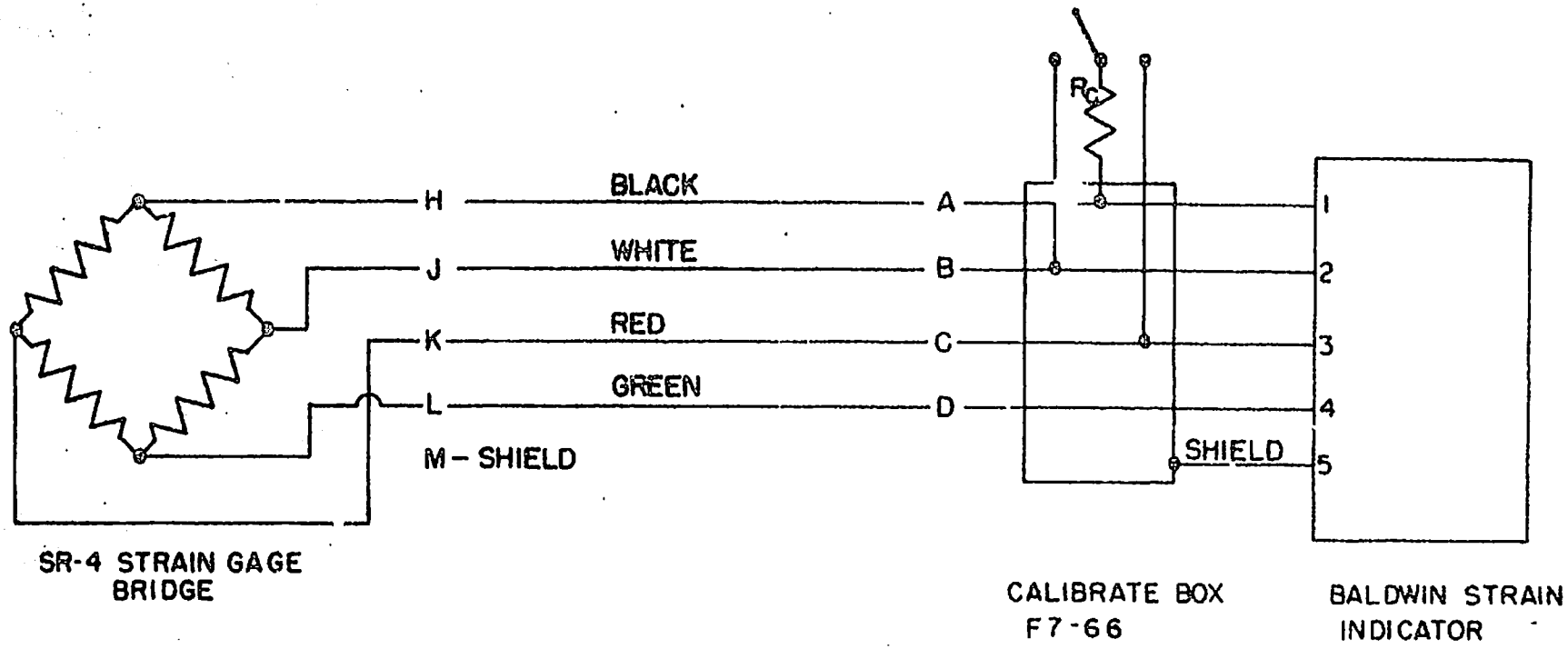

FIG. 9 - TYPICAL HOOKUP OF STRAIN GAGE BRIDGE AND BALDWIN STRAIN INDICATOR IN STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

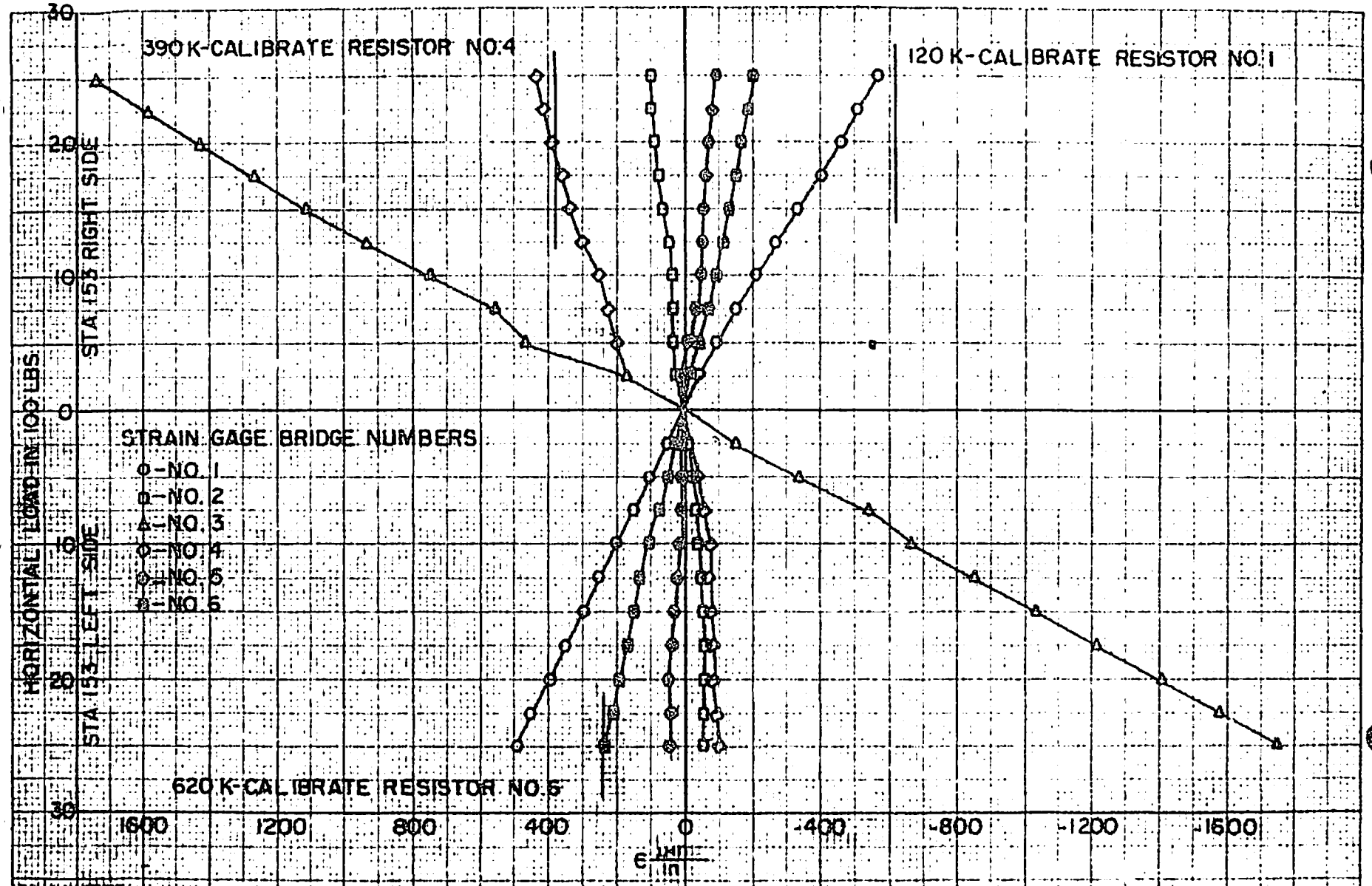

FIG. 10 - LOAD-STRAIN PLOT FOR HORIZONTAL LOADING AT STATION 153 FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

TM-179
REF. SYM. 1612(114)
MSF 9-28-54

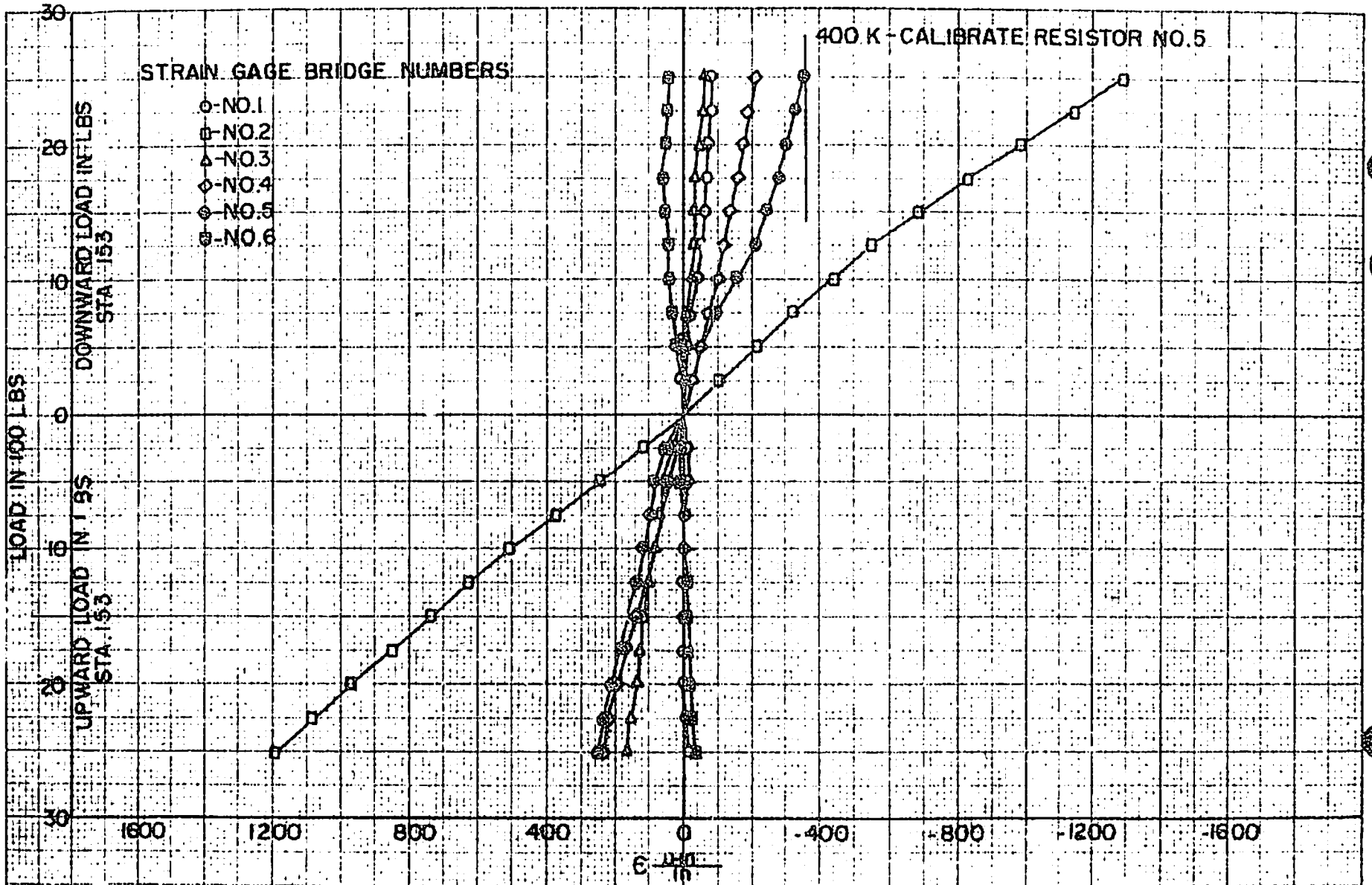

FIG. 11 - LOAD-STRAIN PLOT FOR VERTICAL LOADING AT STATION 153 FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

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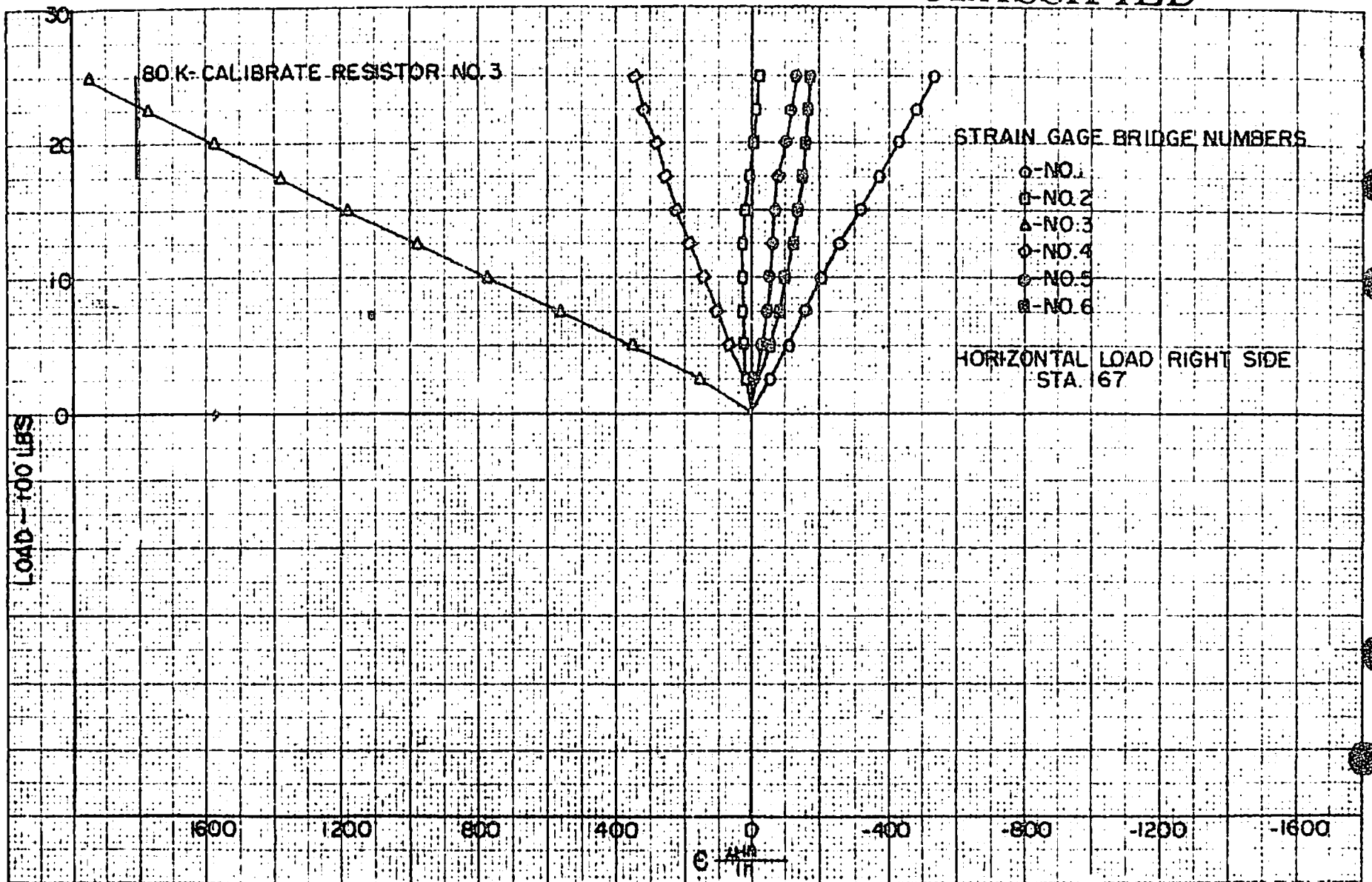

FIG. 12 - LOAD-STRAIN PLOT FOR RIGHT HORIZONTAL LOADING AT STATION 167 FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

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REF. SYM. 1612
MSF 9-30-54

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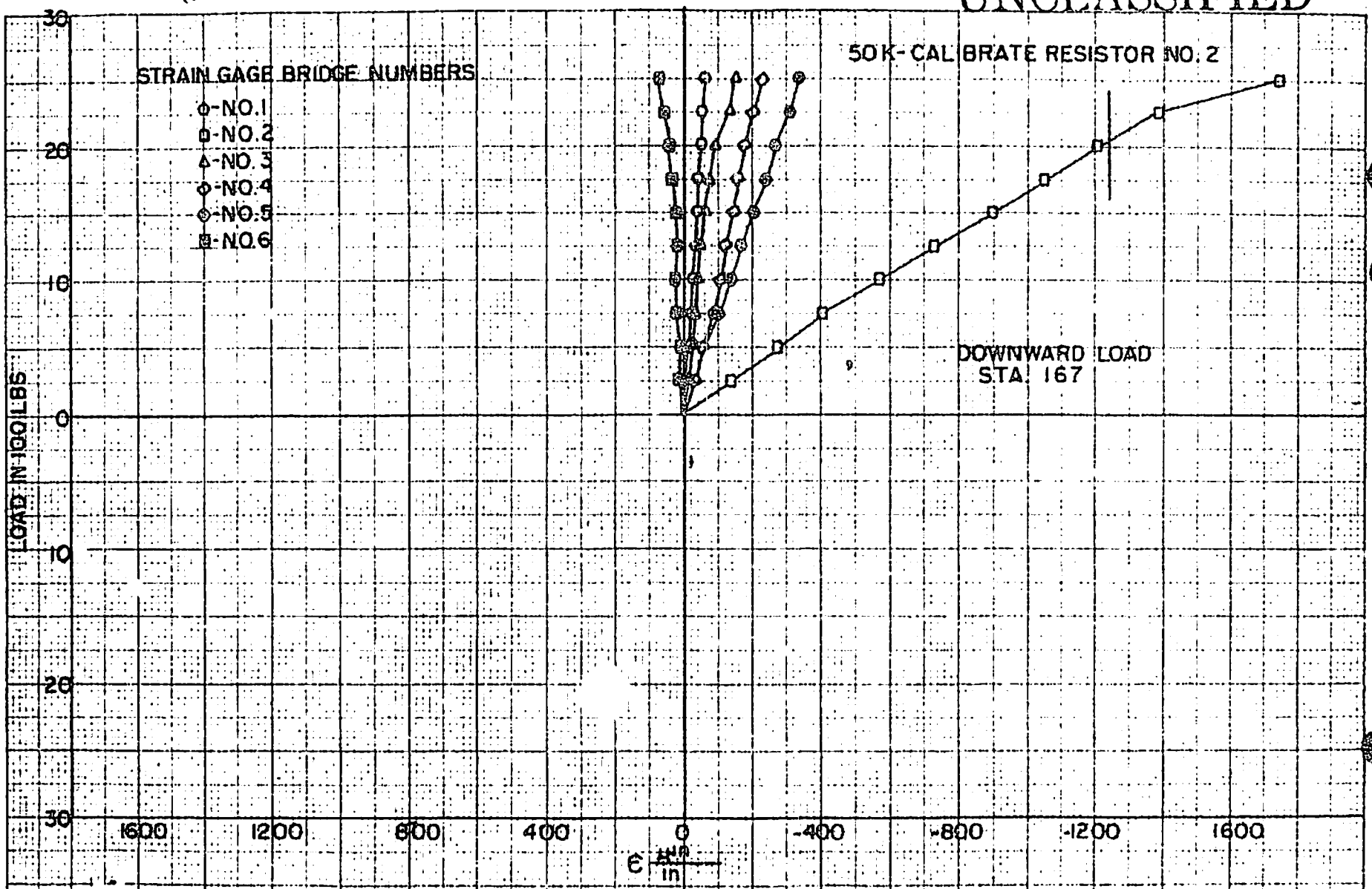

FIG 13-LOAD-STRAIN PLOT FOR DOWNWARD LOADING AT STATION 167 FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

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MSF - 9-30-54

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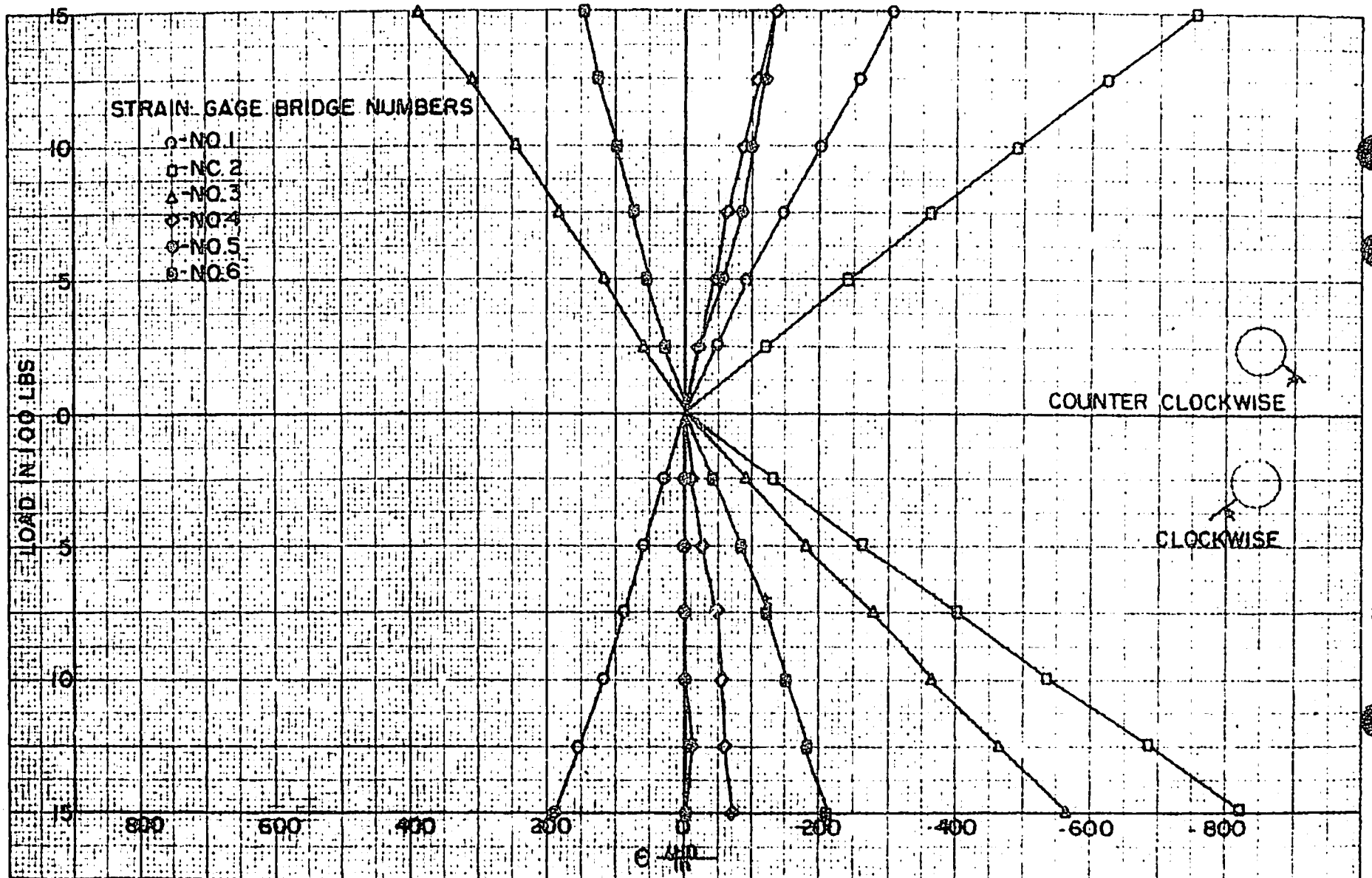

FIG 14-LOAD-STRAIN PLOT FOR ROTATIONAL LOADING OF FINS FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

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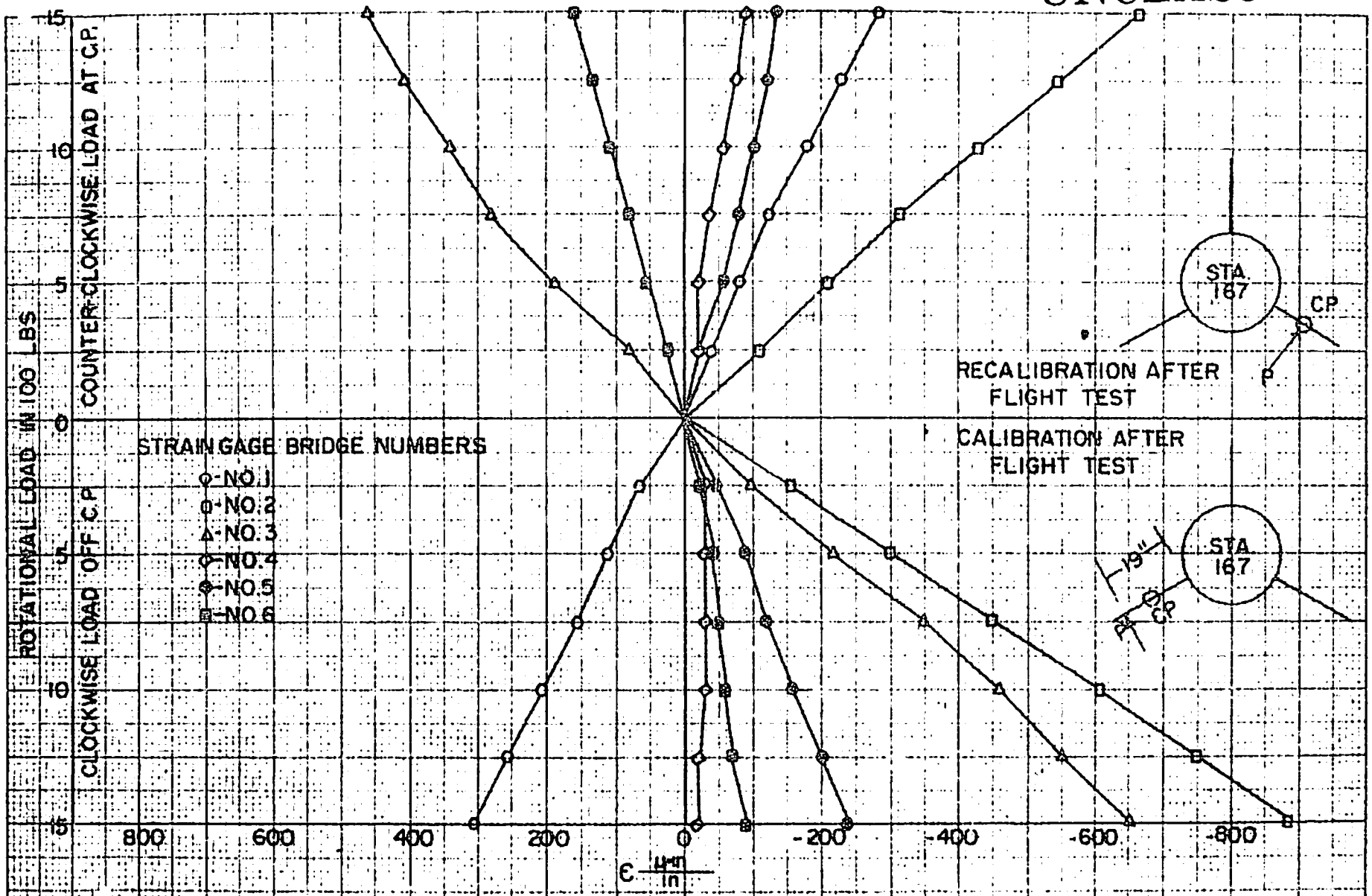

FIG 15 - LOAD-STRAIN PLOT FOR ROTATIONAL LOADING OF FINS FOR STATIC CALIBRATION OF STRAIN GAGES ON MK-7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

TABLE I

TABLE OF LOAD-STRAIN READINGS FOR LEFT HORIZONTAL LOAD APPLIED AT STATION 153, FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	50	-10	- 150	- 15	5	25
500	100	-20	- 330	- 40	10	50
750	150	-30	- 540	- 50	5	75
1000	200	-40	- 660	- 65	10	105
1250	250	-50	- 850	- 70	20	130
1500	300	-50	-1030	- 75	30	150
1750	350	-55	-1210	- 85	40	170
2000	400	-55	-1400	- 85	45	195
2250	445	-55	-1580	- 95	45	215
2500	490	-50	-1745	-100	45	240

TABLE II

TABLE OF LOAD-STRAIN READINGS FOR RIGHT HORIZONTAL LOAD APPLIED AT STATION 153, FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	- 40	25	175	170	+15	- 10
500	- 90	35	465	200	- 5	- 40
750	-150	35	555	225	-35	- 65
1000	-210	35	750	250	-45	- 90
1250	-270	45	935	300	-45	-110
1500	-335	65	1110	336	-55	-130
1750	-400	80	1265	360	-60	-150
2000	-460	85	1425	390	-70	-165
2250	-510	95	1585	415	-80	-185
2500	-565	100	1740	435	-95	-200

TABLE III

TABLE OF LOAD-STRAIN READINGS FOR UPWARD LOAD APPLIED AT STATION 153,
FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	+15	120	40	35	60	- 5
500	+10	250	55	45	85	- 5
750	0	380	75	75	100	0
1000	0	510	90	95	115	0
1250	0	630	105	115	135	- 5
1500	0	740	120	140	155	- 5
1750	0	855	130	170	185	- 5
2000	0	970	140	200	210	-15
2250	-10	1085	160	225	235	-20
2500	-20	1195	170	240	255	-25

TABLE IV

TABLE OF LOAD-STRAIN READINGS FOR DOWNWARD LOAD APPLIED AT STATION 153, FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	+ 5	- 100	0	- 25	- 25	10
500	+ 5	- 210	-10	- 50	- 55	20
750	-20	- 320	-15	- 70	- 95	35
1000	-40	- 440	-25	- 95	-135	45
1250	-50	- 550	-30	-115	-205	45
1500	-60	- 685	-30	-130	-240	55
1750	-65	- 825	-30	-155	-275	65
2000	-70	- 980	-45	-170	-300	55
2250	-75	-1140	-55	-185	-325	50
2500	-75	-1285	-65	-205	-355	45

TABLE V

TABLE OF LOAD-STRAIN READINGS FOR RIGHT HORIZONTAL LOAD APPLIED AT STATION 167, FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	- 60	15	150	25	- 15	- 35
500	-105	20	350	60	- 35	- 55
750	-150	25	560	100	- 45	- 85
1000	-205	25	770	140	- 55	-105
1250	-260	25	980	180	- 65	-125
1500	-320	15	1180	220	- 75	-140
1750	-375	5	1375	255	- 85	-155
2000	-430	- 5	1570	275	-105	-155
2250	-485	-15	1775	320	-125	-175
2500	-540	-25	1970	340	-140	-185

TABLE VI

TABLE OF LOAD-STRAIN READINGS FOR DOWNWARD LOAD APPLIED AT STATION 137, FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	0	- 140	- 10	- 35	- 25	10
500	-10	- 275	- 20	- 65	- 60	10
750	-20	- 410	- 25	- 90	-110	20
1000	-25	- 570	- 35	-110	-140	25
1250	-30	- 730	- 50	-125	-170	20
1500	-35	- 900	- 65	-145	-200	25
1750	-40	-1050	- 75	-165	-240	30
2000	-50	-1210	- 90	-180	-270	40
2250	-50	-1390	-135	-205	-310	60
2500	-55	-1745	-150	-225	-340	70

TABLE VII

TABLE OF LOAD-STRAIN READINGS FOR COUNTERCLOCKWISE LOAD AT CENTER OF PRESSURE OF FIN FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	- 55	-120	60	- 20	- 20	30
500	- 90	-240	120	- 45	- 55	55
750	-145	-360	185	- 65	- 85	75
1000	-200	-490	245	- 90	-100	100
1250	-255	-620	310	-110	-120	125
1500	-305	-755	390	-135	-135	145
0						

TABLE VIII

TABLE OF LOAD-STRAIN READINGS FOR CLOCKWISE LOAD AT CENTER OF PRESSURE OF FIN FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Load lbs	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	30	-130	- 90	-10	- 40	0
500	60	-260	-180	-25	- 80	5
750	90	-400	-275	-45	-120	5
1000	120	-535	-360	-55	-150	0
1250	155	-685	-460	-60	-180	-10
1500	190	-820	-560	-70	-210	0

TABLE IX

TABLE OF LOAD-STRAIN READINGS FOR COUNTERCLOCKWISE LOAD AT CENTER OF PRESSURE OF FIN FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

RECALIBRATION AFTER FLIGHT TEST

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	-40	-110	+30	-20	-20	+25
500	-80	-210	+190	-20	-55	+55
750	-125	-315	+280	-35	-80	+80
1000	-180	-430	+340	-55	-100	+110
1250	-230	-545	+405	-75	-120	+135
1500	-285	-665	+460	-90	-135	+160
0						

TABLE X

TABLE OF LOAD STRAIN READINGS FOR CLOCKWISE LOAD AT A POINT 19 INCHES FROM CASE AT STATION 167 FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

CALIBRATION AFTER FLIGHT TEST

Load lbs.	Strain Increments for the Following Bridge Nos. (microinches/in.)					
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
0	0	0	0	0	0	0
250	+ 70	-155	-100	-30	- 50	-25
500	+115	-300	-220	-30	- 90	-40
750	+160	-450	-350	-30	-120	-50
1000	+210	-605	-460	-30	-160	-60
1250	+260	-750	-550	-20	-200	-70
1500	+310	-890	-655	-20	-240	-90
0						

TABLE XI

CALIBRATION RESISTORS, CORRESPONDING STRAINS AND EQUIVALENT LOAD IN POUNDS OF EACH OF THE STRAIN GAGE BRIDGES FOR STATIC CALIBRATION OF STRAIN GAGES ON MK 7 UNIT FOR MEASUREMENT OF FLIGHT LOADS

Bridge Numbers	Calibration Resistors ohms	Position #1 Compression microinches/in.	Position #2 Tension microinches/in.	Equivalent Load Pounds (direction location)
1	120 K	- 619	613	2650 (Horiz. Right at Sta. 153)
2	50 K	-1448	1437	2300 (Downward at Sta. 167)
3	80 K	-1808	1798	2300 (Horiz. Right at Sta. 167)
4	390 K	- 383	382	1950 (Horiz. Right at Sta. 153)
5	400 K	- 366	362	2550 (Downward at Sta. 153)
6	620 K	- 240	242	2500 (Horiz. Left at Sta. 153)