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JUN 6 1957

Case No. 433.00
Ref. Sym: 1612 (506)
Project No. TM-566
File: H-423, 3-2

MR. L. A. DUNN - 1284 TCG-NNT-1

Re: Railroad Switching Test of the H-423 Redesigned Shear Pin

COL No. H-423 3-2

Summary of Results

Railroad switching tests were conducted under one switching condition at impact velocities up to approximately 12 mph with a TX-21-X1 mounted on an H-423 to determine the suitability of three different shear pin designs. The shear pins tested were as follows:

1. Solid shear pin, bolted into the H-423.
2. Solid shear pin, spring loaded in the H-423.
3. Circular grooved shear pin, spring loaded in the H-423.

The three shear pins tested were visually inspected and found to be undamaged at completion of the tests. The TX-21-X1 and the H-423 showed no damage. They were visually inspected only.

Maximum measured faired longitudinal accelerations recorded on the TX-21-X1 during the tests were: 6.9 g using the solid shear pin bolted in the H-423; 7.6 g using the solid spring-loaded shear pin; and 6.9 g using the circular grooved spring-loaded shear pin. Accelerations apparently depended only upon the impact velocity, and were independent of the type of shear pin used.

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MAR 2 1959
BY DRG. 4043

INVENTORIED
AUG 6 1964
3427-1

INVENTORIED
SEP 14 '65
3428-3

Object of Test

The object of this test was to determine the type of shear pin most suitable for use in the H-423 when subjected to rail shipping. Three different shear pins were to be tested to railroad switching impact velocities up to 12 mph.

Reason for Test

This test was requested in a Request for Materials Laboratory Investigation from L. A. Dunn, 1284, to P. H. Adams, 1612, dated March 29, 1957.

Function of Object Tested

The shear pins tested in the H-423 are used to prevent longitudinal movement of the TX-21 bomb in the H-423 bolster.

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Summary of Past Tests

A test of the original H-423, entitled Railroad Switching Test of the H-423, TM-256, was reported in a memorandum to Mr. N. E. Hill and Mr. R. J. Kindley, 1284-2, from W. H. Cross, 1612-1, dated May 27, 1955. Switching tests were conducted at velocities from 5.7 to 12.41 mph. During the tests, the tiedown straps holding the TX-21 failed in tension. The H-423 was undamaged.

Another test, Railroad Switching Test of the TX-21-X1, TM-350, was reported in a memorandum to Mr. A. F. Howard, 1243-2, from W. H. Cross, 1612-1, dated April 17, 1956. A TX-21-X1 mounted on an H-423 bolster attached to an H-504 shipping platform was tested at impact velocities from 7.74 to 10.84 mph. The H-423 was undamaged during the tests.

A test, Railroad Humping Test of the Redesigned H-423, TM-486, was reported in a memorandum to Mr. L. A. Dunn, 1284, from G. M. Willson, 1612-1, dated April 25, 1957.

In this test, a TX-21-X1 in a redesigned H-423 using a spring-loaded, circular grooved shear pin with tapered edges was subjected to switching impacts from 4.94 to 12.2 mph under three switching conditions. The spring-loaded shear pin failed during the tests, allowing the TX-21 to slide longitudinally about 1-1/2 inches forward and one inch aft. Failure apparently resulted because the concentric interlocking rings of the shear pin were beveled, allowing the longitudinal force of impact to force the spring-loaded shear pin down into the H-423, thus disengaging it. This occurred progressively throughout the tests. Both upper and lower sections of the shear pin were chipped and cracked.

Setup for Test

The TX-21-X1, on an H-423 bolster secured to an H-504 shipping pallet, was mounted in the rail car with the nose end pointing in the direction of travel.

Figure 1 shows the overall test setup and switching condition.

Table I lists the components tested.

Test equipment used during the tests was:

William Miller oscillograph, Model J, Serial No. 99.
William Miller amplifiers, Type C-3, Model CA-12, Serial No. 3.
Instrumented rail car, Santa Fe Serial No. 74,303, capacity 133,000 pounds, spring travel 3-11/16 inches.

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Hammer rail car, Santa Fe Serial No. 183607, capacity 140,000 pounds.

Ballast rail cars, Santa Fe Serial No. 184371, capacity 140,000 pounds; Santa Fe Serial No. 184263, capacity 140,000 pounds; and Santa Fe Serial No. 183111, capacity 140,000 pounds.

A scratch type displacement gage was mounted on the TX-21 as shown in Fig. 2 to determine the relative displacement between the TX-21 and the H-423.

Accelerometers used during the tests are listed in Table II and shown in Figs. 2 through 5.

Procedure

The TX-21-X1 was mounted with the nose end forward (in direction of travel) on the H-423 bolster attached to an H-504 shipping pallet in the rail car. Accelerometers were mounted as requested. A scratch type displacement gage was fastened as shown in Fig. 2 to detect any relative movement between the TX-21 warhead and the H-423 bolster during the tests.

Tests were run under one switching condition (Fig. 1). The hammer car was coupled behind the instrumented car. Both cars were accelerated by the switch engine, uncoupled, and allowed to roll free into three stationary loaded ballast cars. Impact velocity was measured by means of two copper contacts placed 15 feet apart on the rail and connected by instrument cables to a recording oscillograph. The circuit was completed when the wheels of the rail car passed over the two contacts, thus, recording the time of travel between the contacts on the oscillograph record.

Three type shear pins were tested in the H-423 in the order mentioned:

1. A solid shear pin, bolted in the H-423 (Fig. 6).

2. A circular grooved shear pin, spring loaded in the H-423 (Fig. 7).

3. A solid shear pin, spring loaded in the H-423 (Fig. 8). (Same shear pin as No. 1, except spring loaded in the H-423.)

Impact velocities were run to approximately 12 mph using each shear pin.

Results

A visual inspection at the completion of each series of tests showed that the three shear pins tested were undamaged. No damage was done to the H-423 or the contained TX-21.

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During the tests using each shear pin, the TX-21-X1 moved longitudinally forward approximately 3/32-inch with respect to the H-423 bolster.

Accelerations, rise times, and pulse durations recorded during the tests of the three shear pins are listed in Table III.

A typical oscillograph record of switching tests using the circular grooved spring-loaded shear pin is shown in Fig. 9. Oscillograph records of the tests using the other shear pins were very similar and are not shown.

Conclusions

Each of the three different type shear pins is adequately designed to withstand the loads imparted during rail shipment.

The solid shear pin was tested twice; once bolted in the H-423 and once spring-loaded in the H-423. Since the spring loaded shear pin functioned as well as the bolted shear pin and is easier to assemble, the bolts appear to be superfluous.

G. M. WILLSON - 1612-1

J. H. STOEVER - 1612-1

Approved by: P. H. ADAMS - 1612

GMW:1612-1:as

DISTRIBUTION:
1/6A - L. A. Dunn, 1284
2/6A - W. A. Gardner, 1610
3/6A - D. M. Bruce, 1282
4/6A - C. L. Gomel, 5523
5/6A - R. K. Smeltzer, 7221-3
6/6A - Tech. Ref. File, 7221-3

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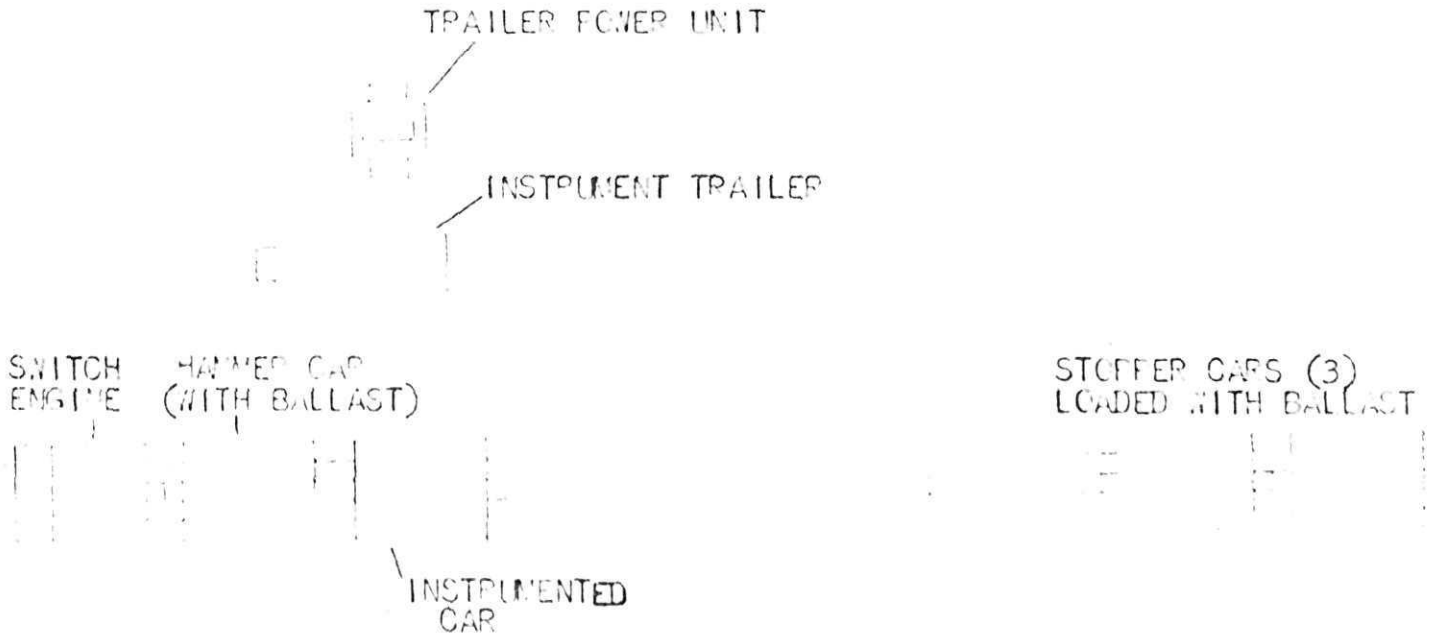

HAMMER CAR AND INSTRUMENTED CAR ACCELERATED, UNCOUPLED AND ALLOWED TO ROLL FREE INTO THE STOPPER CARS

FIG.1 PLAN VIEW OF TEST [illegible] AND SWITCHING [illegible]---RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

REF. SYM. 1612(506)
TM-566

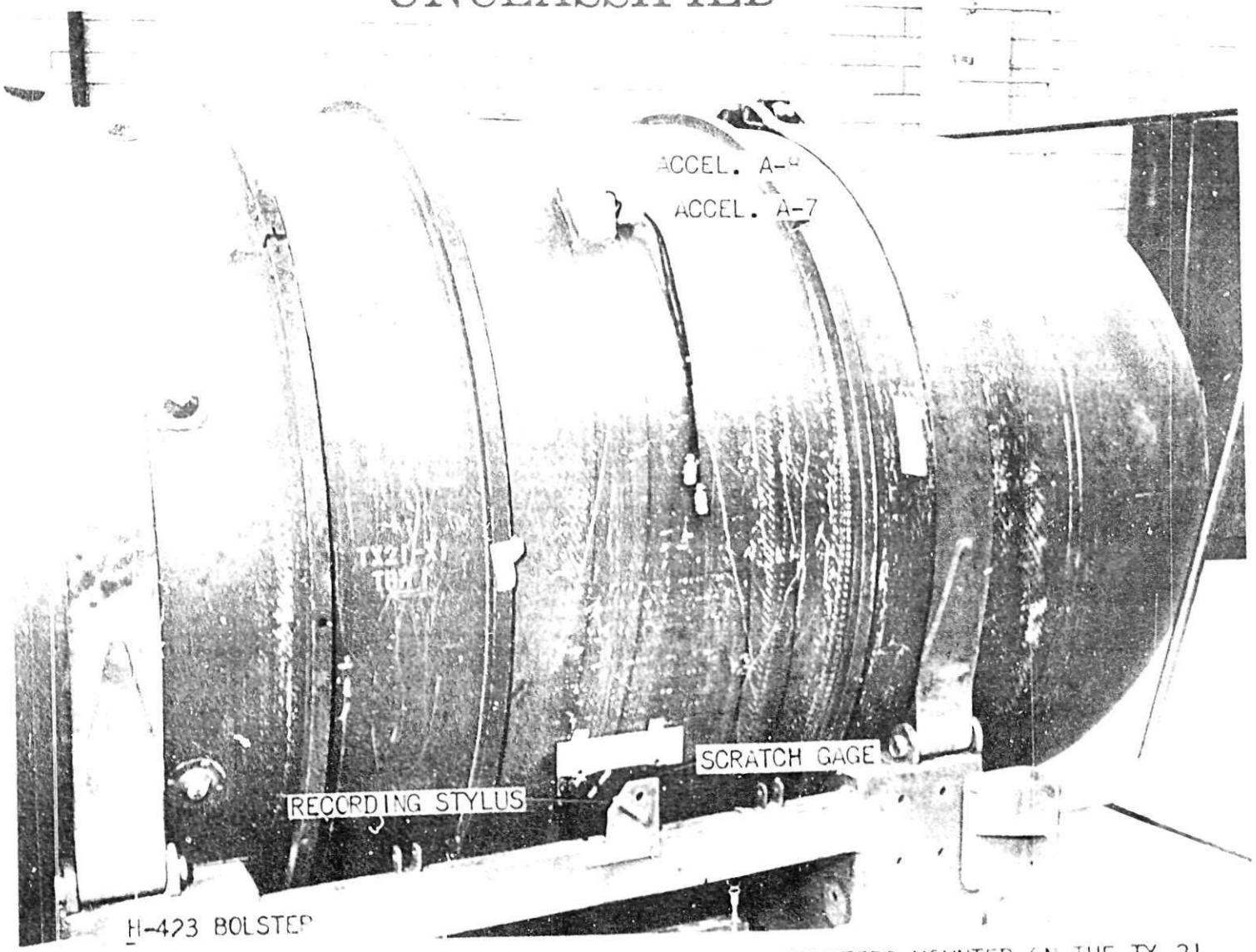

FIG. 2 SCRATCH TYPE DISPLACEMENT GAGE AND ACCELEROMETERS MOUNTED ON THE TX-21 -X1 ---- RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN.

REF. SYM. 1612(506)
PROJECT NO. TM-566

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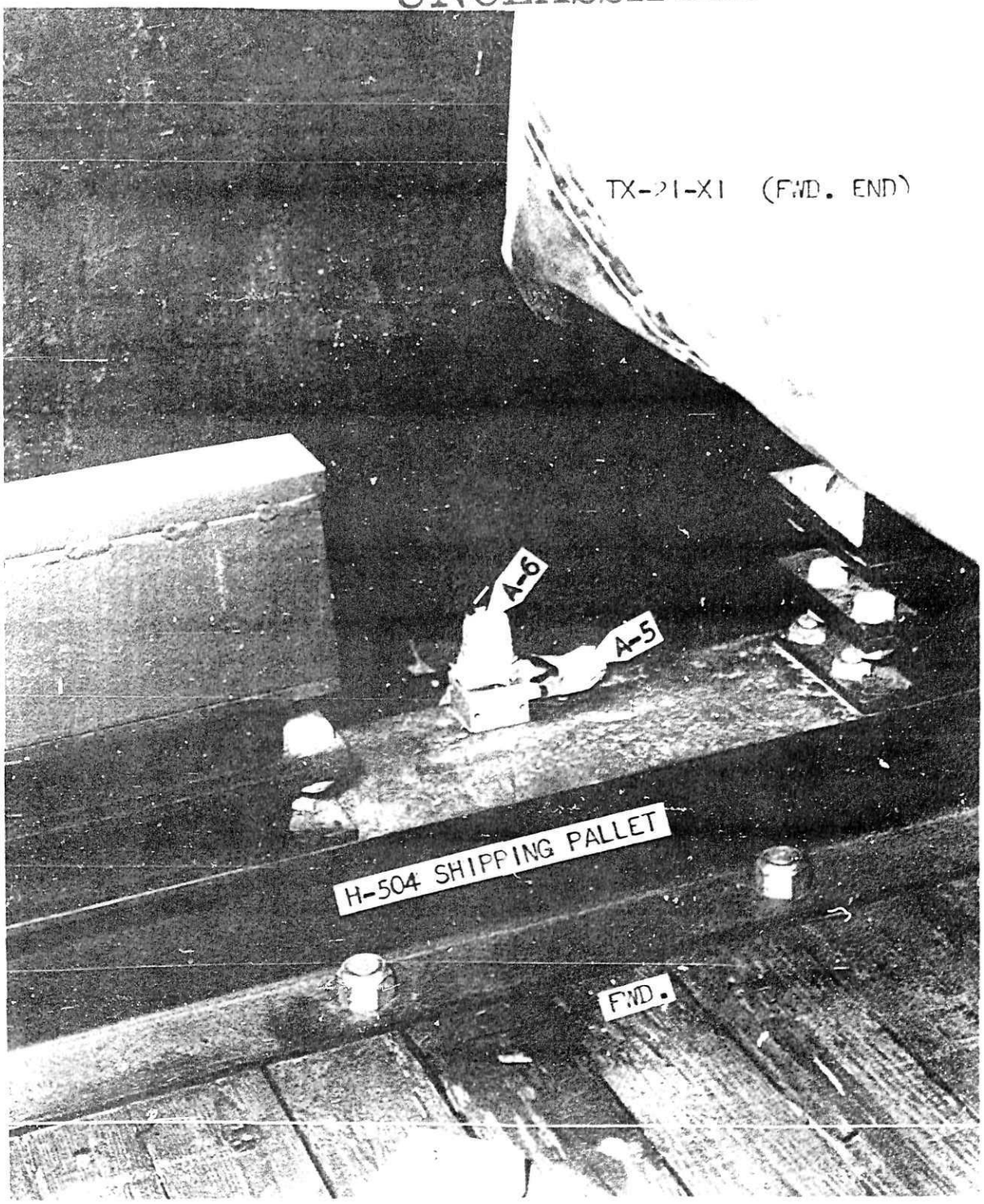

FIG. 3 LOCATION OF ACCELEROMETERS MOUNTED ON THE H-504 SHIPPING PALLET---RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

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TM-566

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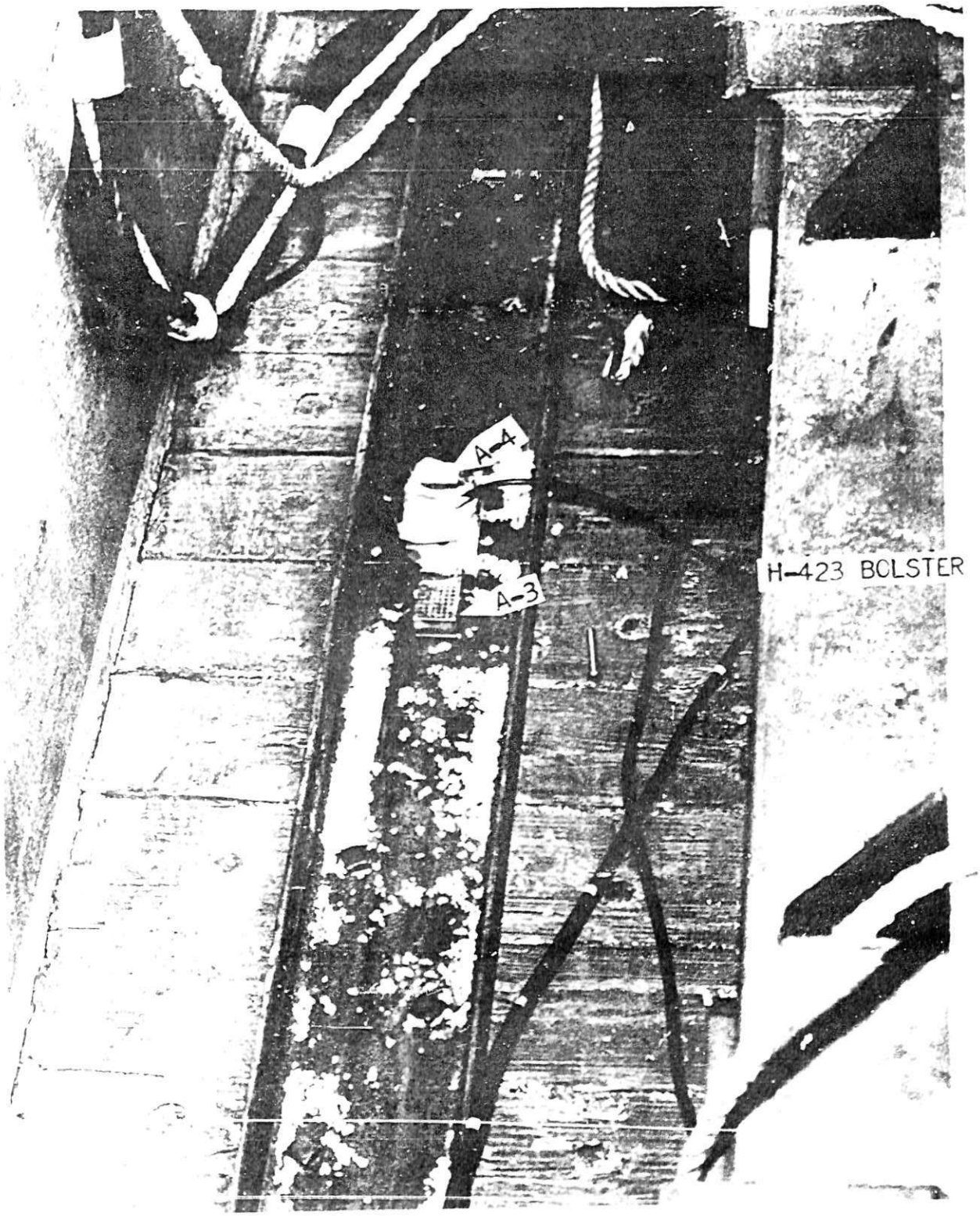

FIG. 4 LOCATION OF ACCELEROMETERS MOUNTED ON THE LEFT AFT SIDE OF THE RAIL CAR FLOOR--- RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

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TM-566

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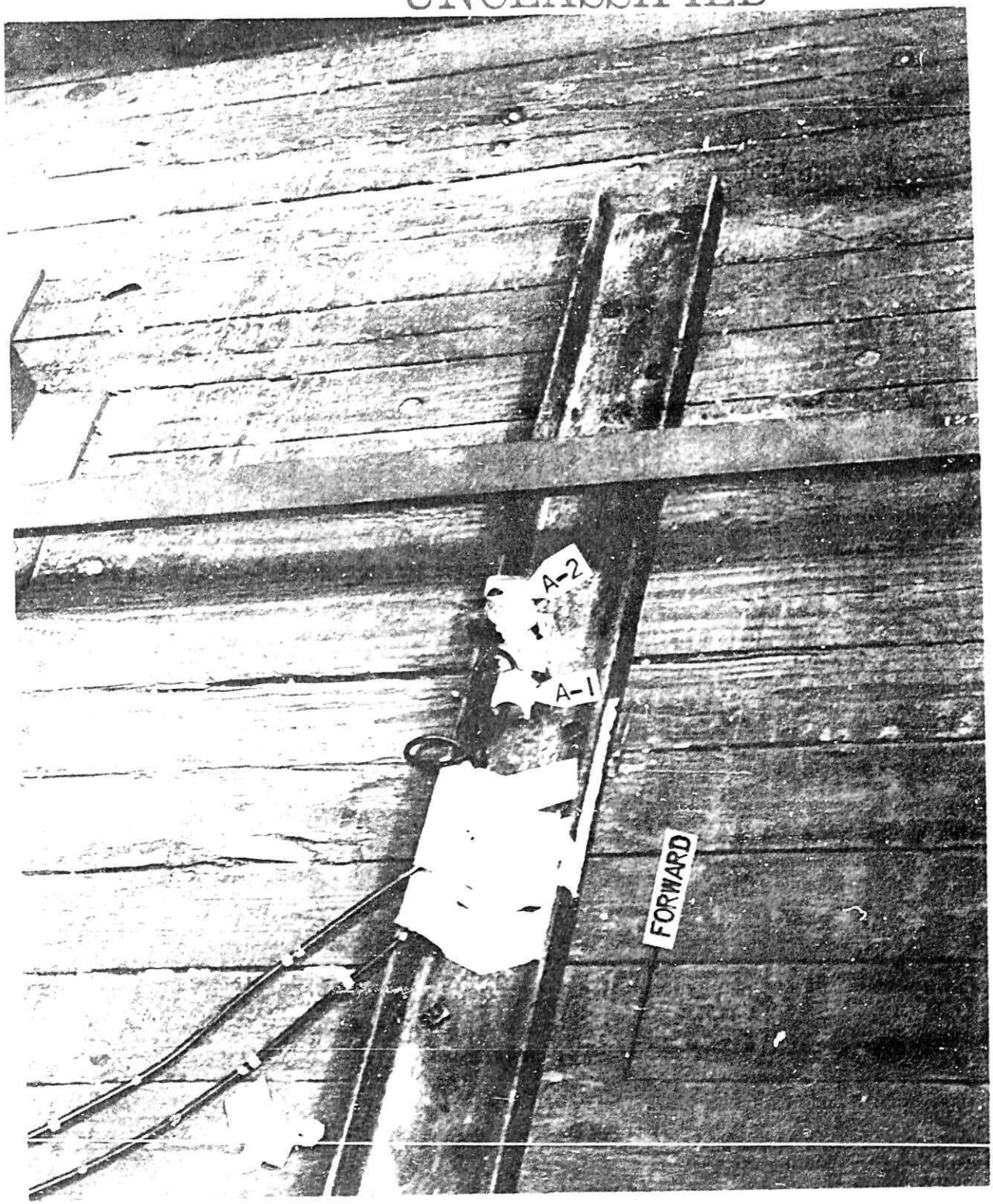

FIG. 5 LOCATION OF ACCELEROMETERS MOUNTED ON THE RAIL CAR FLOOR (FORWARD CENTER)---RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

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FIG. 6 VIEW OF THE SOLID SHEAR PIN BOLTED IN THE H-423 ----RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN.

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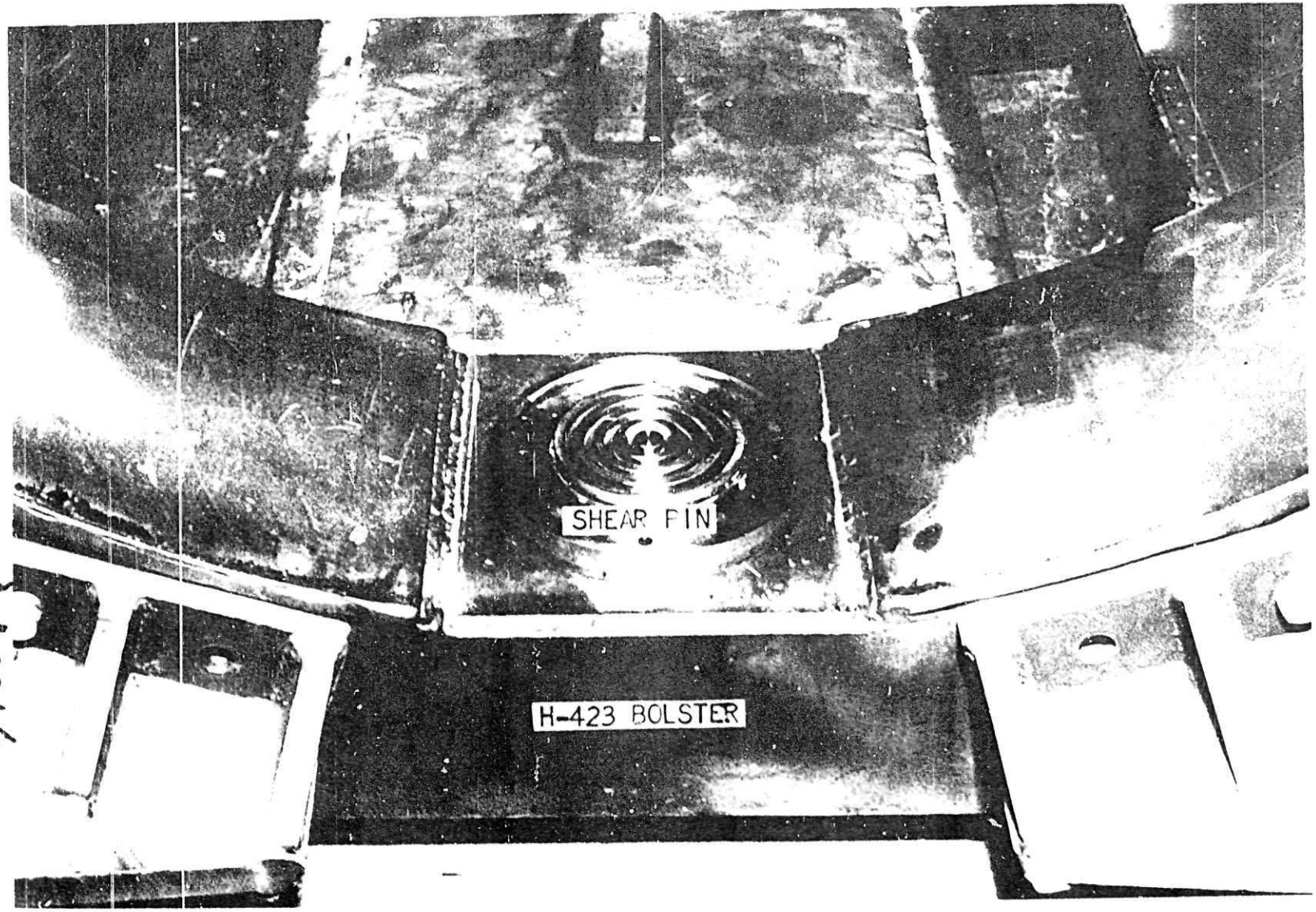

FIG. 7 VIEW OF CIRCULAR GROOVED SHEAR PIN (SPRING-LOADED) IN THE H-423---- RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN.

REF. SYM. 1612(506)
PROJECT NO. TM-566

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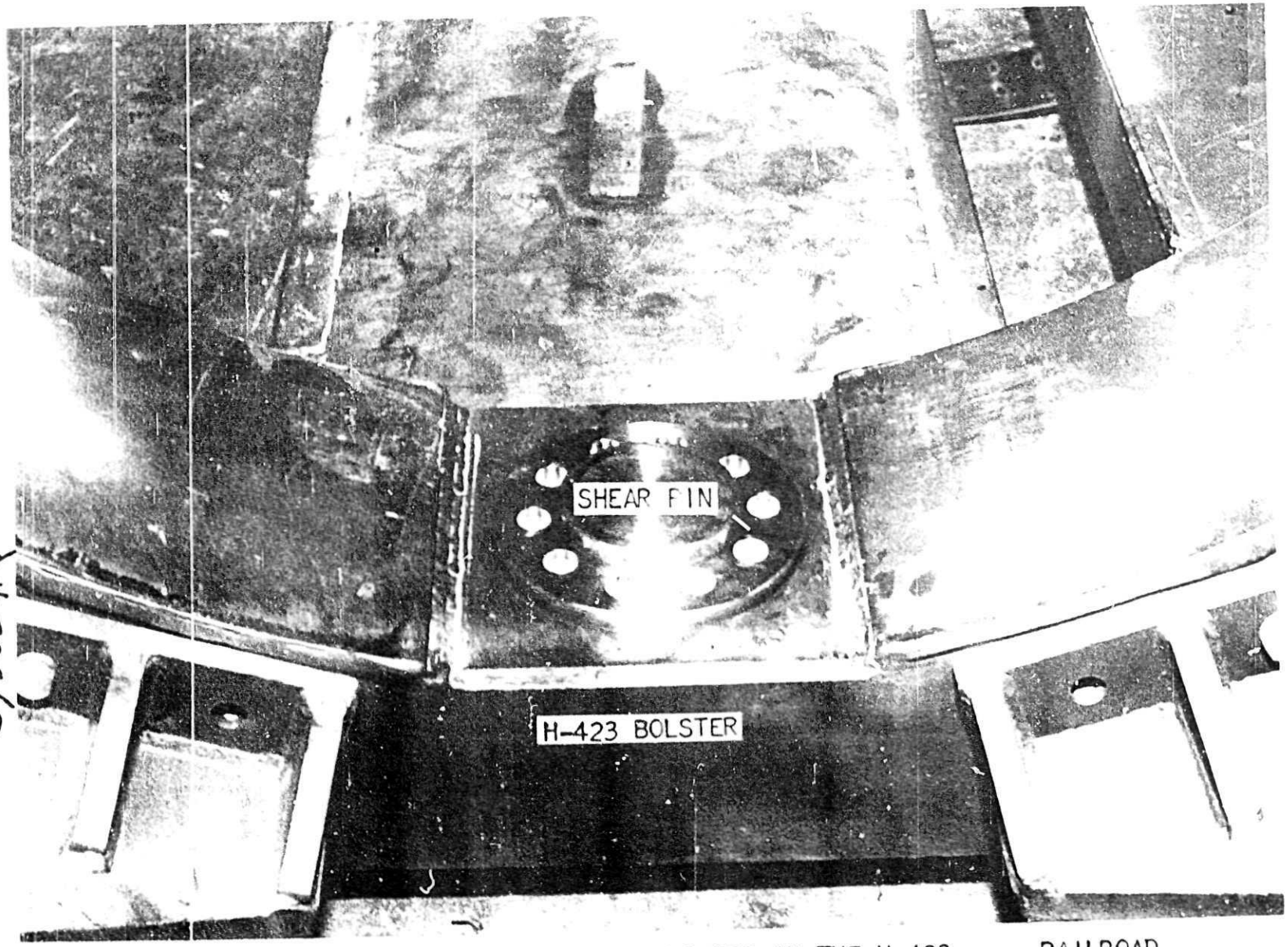

FIG. 8 VIEW OF SOLID SHEAR PIN, SPRING-LOADED IN THE H-423 ---- RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN.

REF.SYM. 1612(506)
PROJECT NO. TM-566

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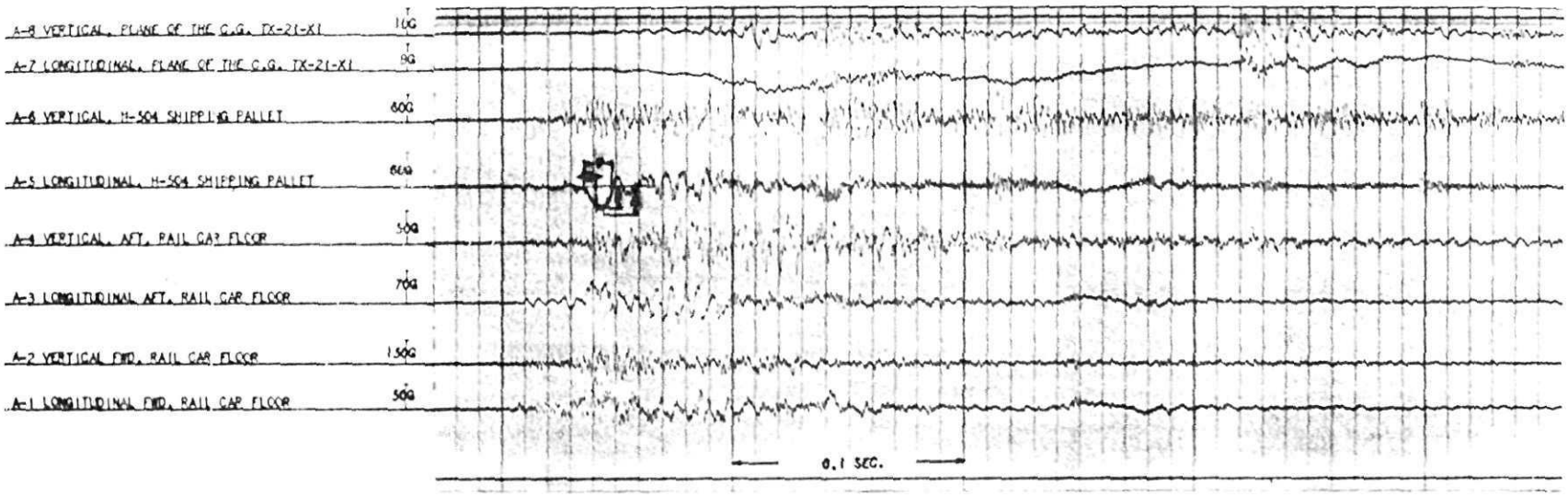

A-MAXIMUM ACCELERATION
F-MAXIMUM FAIRED PULSE
R-RISE TIME(10-90%)
P-PULSE DURATION(10-10%)

FIG. 9 TYPICAL OSCILLOGRAPH RECORD FOR RUN NO. 3, 11.75 MPH., (CIRCULAR GROOVED SPRING-LOADED SHEAR PIN)----RAILROAD SWITCHING TEST OF THE M-423 REDESIGNED SHEAR PIN

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TABLE I

COMPONENTS TESTED DURING RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

Component and MC No.	Drawing No.
TX-21-X1 (TN-1) Dummy Warhead	300260
H-423 Truck, Bolster	320055
H-504 Trestle, Platform, Bomb	321140
Shear Pin, Circular Grooved, Upper	DS(1284)83927
Shear Pin, Circular Grooved, Lower	DS(1284)83928
Shear Pin, Upper	DS(1243)83819
Shear Pin, Lower	DS(1243)83827

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TABLE II

ACCELEROMETERS USED DURING RAILROAD SKIDDING TEST OF THE H-423 REDESIGNED SHEAR PIN

Accel. No.	Location*	Fig. Ref.	Statham Model No.	Serial No.	Range (g)	Natural Freq. (cps)
A-1	Long., Fwd., Rail Car Floor	5	A5Aa-1000-350	5382	±1000	Over 1500
A-2	Vert., Fwd., Rail Car Floor	5	A5Aa-1000-350	5384	±1000	Over 1500
A-3	Long., Aft., Rail Car Floor	4	A5Aa-1000-350	5383	±1000	Over 1500
A-4	Vert., Aft., Rail Car Floor	4	A5Aa-1000-350	5381	±1000	Over 1500
A-5	Long., H-504 Shipping Pallet	3	A5A-500-700	153	±500	1400
A-6	Vert., H-504 Shipping Pallet	3	A5A-500-700	150	±500	1450
A-7	Long., Plane of CG of TX-21-X1	2	A5A-50-240	523	±50	680
A-8	Vert., Plane of CG of TX-21-X1	2	A5A-50-240	521	±50	700

* All directions are with respect to the rail car axes.

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Note!

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TABLE III

ACCELERATIONS, RISE TIMES, AND PULSE DURATIONS RECORDED DURING RAILROAD SWITCHING TEST OF THE H-423 REDESIGNED SHEAR PIN

Solid Shear Pin, Bolted in the H-423

Accel. No.	Location*	Run No. 1, 6.87 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 2, 7.70 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 3, 9.40 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 4, 10.34 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)
A-1	Long., Fwd., Rail Car Floor	20.0	26.9	-15.8	0.007	0.014	37.8	51.5	-21.9	0.008	0.023	32.2	57.5	-15.8	0.015	0.031	29.7	66.3	-25.0	0.005	0.022
A-2	Vert., Fwd., Rail Car Floor	93.5	150.1	--	--	--	78.0	85.3	--	--	--	82.3	134.7	--	--	--	130.3	161.4	--	--	--
A-3	Long., Aft., Rail Car Floor	16.5	26.6	-12.8	0.022	0.039	38.1	38.6	-20.6	0.008	0.023	45.8	35.5	-22.9	0.005	0.018	60.2	49.6	-25.4	0.014	0.029
A-4	Vert., Aft., Rail Car Floor	35.4	29.2	--	--	--	57.8	66.7	--	--	--	52.2	48.1	--	--	--	37.0	56.8	--	--	--
A-5	Long., H-504 Shipping Pallet	14.8	16.4	-14.4	0.014	0.025	25.4	42.1	-14.0	0.014	0.023	28.0	35.5	-25.3	0.006	0.017	23.8	50.5	-31.3	0.008	0.021
A-6	Vert., H-504 Shipping Pallet	25.4	42.5	--	--	--	53.7	35.8	--	--	--	53.8	42.5	--	--	--	55.5	76.9	--	--	--
A-7	Long., Plane of CG of TX-21-X1	3.6	5.1	-3.8	0.063	0.199	3.5	5.5	-4.4	0.048	0.198	3.2	6.2	-4.8	0.050	0.195	4.7	8.8	-5.6	0.042	0.185
A-8	Vert., Plane of CG of TX-21-X1	5.4	5.3	+1.3	0.016	0.054	4.3	7.5	+2.3	0.013	0.033	4.9	5.0	+2.0	0.009	0.031	4.7	9.8	-1.2	0.019	0.051

Accel. No.	Location*	Run No. 5, 11.43 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 6, 11.90 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)
A-1	Long., Fwd., Rail Car Floor	34.6	62.1	-24.0	0.011	0.023	86.1	96.8	-45.2	0.005	0.019
A-2	Vert., Fwd., Rail Car Floor	97.8	124.0	--	--	--	218.7	252.2	--	--	--
A-3	Long., Aft., Rail Car Floor	44.4	48.5	-32.3	0.008	0.020	45.7	72.9	-36.7	0.007	0.022
A-4	Vert., Aft., Rail Car Floor	53.6	44.5	--	--	--	48.4	52.7	--	--	--
A-5	Long., H-504 Shipping Pallet	31.6	48.1	-38.0	0.006	0.015	43.7	56.2	-38.7	0.009	0.019
A-6	Vert., H-504 Shipping Pallet	64.4	65.4	--	--	--	64.5	59.6	--	--	--
A-7	Long., Plane of CG of TX-21-X1	4.5	8.7	-6.5	0.050	0.199	6.5	9.4	-6.9	0.049	0.198
A-8	Vert., Plane of CG of TX-21-X1	9.7	10.7	-1.5	0.029	0.059	6.7	5.6	-1.5	0.027	0.055

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Solid Shear Pin, Spring-Loaded in the H-423

Accel. No.	Location*	Run No. 1, 9.06 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 2, 10.50 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 3, 11.83 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 4, 11.37 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)
A-1	Long., Fwd., Rail Car Floor	28.3	66.6	-28.3	0.016	0.027	46.0	75.0	-26.6	0.011	0.026	67.4	118.1	-29.9	0.006	0.017	37.9	70.5	-29.6	0.006	0.015
A-2	Vert., Fwd., Rail Car Floor	70.4	64.6	--	--	--	174.6	133.1	--	--	--	131.0	142.4	--	--	--	136.9	131.0	--	--	--
A-3	Long., Aft., Rail Car Floor	30.4	44.2	-29.4	0.008	0.020	36.7	38.6	-28.2	0.009	0.022	50.2	57.1	-36.3	0.007	0.020	49.3	48.9	-33.9	0.014	0.026
A-4	Vert., Aft., Rail Car Floor	42.0	47.7	--	--	--	40.6	51.0	--	--	--	43.7	55.8	--	--	--	49.1	49.1	--	--	--
A-5	Long., H-504 Shipping Pallet	26.2	52.5	-32.9	0.007	0.014	47.7	50.0	-31.1	0.007	0.020	46.0	76.2	-37.4	0.011	0.021	34.0	53.0	-40.7	0.008	0.015
A-6	Vert., H-504 Shipping Pallet	55.6	43.3	--	--	--	61.2	62.8	--	--	--	80.8	85.0	--	--	--	53.9	72.3	--	--	--
A-7	Long., Plane of CG of TX-21-X1	3.0	6.5	-4.8	0.047	0.218	6.8	8.9	-7.6	0.056	0.213	8.0	8.5	-6.4	0.058	0.205	9.6	8.1	-5.9	0.051	0.194
A-8	Vert., Plane of CG of TX-21-X1	6.9	10.0	+1.6	0.013	0.027	6.0	7.0	+2.4	0.022	0.045	10.8	13.6	+2.4	0.015	0.045	9.4	16.2	-2.5	0.023	0.060

Circular Grooved Shear Pin, Spring Loaded in the H-423

Accel. No.	Location*	Run No. 1, 8.21 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 2, 10.76 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 3, 11.75 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)	Run No. 4, 12.10 mph Max. Accel. (g) +	Max. Accel. (g) -	Max. Faired Pulse (g)	Rise Time (sec)	Pulse Dur. (sec)
A-1	Long., Fwd., Rail Car Floor	19.1	56.8	-35.8	0.004	0.018	40.3	90.8	-30.6	0.005	0.019	28.1	73.6	-28.1	0.009	0.019	37.4	91.8	-29.8	0.006	0.016
A-2	Vert., Fwd., Rail Car Floor	68.2	95.7	--	--	--	152.2	124.3	--	--	--	117.6	178.0	--	--	--	139.5	145.3	--	--	--
A-3	Long., Aft., Rail Car Floor	36.5	36.5	-23.9	0.004	0.015	41.2	41.2	-35.2	0.006	0.020	46.2	43.0	-34.0	0.004	0.014	53.3	39.5	-29.3	0.007	0.013
A-4	Vert., Aft., Rail Car Floor	40.6	41.4	--	--	--	39.6	50.9	--	--	--	43.9	44.5	--	--	--	50.7	60.2	--	--	--
A-5	Long., H-504 Shipping Pallet	23.6	35.1	-25.2	0.011	0.019	34.9	49.7	-40.4	0.008	0.014	30.4	47.9	-37.5	0.006	0.012	43.6	53.1	-46.1	0.010	0.016
A-6	Vert., H-504 Shipping Pallet	49.7	44.5	--	--	--	64.9	52.2	--	--	--	84.9	63.6	--	--	--	52.2	71.2	--	--	--
A-7	Long., Plane of CG of TX-21-X1	3.0	6.0	-5.4	0.068	0.220	7.0	7.5	-6.3	0.051	0.183	5.9	7.2	-6.9	0.048	0.188	7.5	8.2	-6.5	0.042	0.182
A-8	Vert., Plane of CG of TX-21-X1	5.7	6.2	+2.4	0.011	0.046	10.3	15.4	+2.2	0.013	0.038	8.4	7.0	+1.5	0.019	0.050	9.3	10.6	-3.2	0.032	0.057

* All directions are with respect to the rail car longitudinal axis. NOTE: Plus accelerations are: longitudinal, forward; vertical, down.

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