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SLED TEST OF GYRO CONTROLLED VEHICLE 4 (U)

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CENTRAL TECH FILE

Organization 7300 Environmental Test Report

D. L. Preston, 7344

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CENTRAL TECHNICAL FILE
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SLED TEST OF GYRO CONTROLLED VEHICLE 4 (U)

Introduction

The object of this test was to provide functional flight testing of the GCV-4 by ejecting and retrofiring it from an ejector sled on the Area III 5000-foot track. The unit was to be ejected at 20 fps, ignite, pitch up, negotiate the zero velocity transition, and fly back downrange. At unit ejection, the sled velocity was to be 410 fps. Ejection apogee was theoretically six feet and the thrusting apogee was to be about 43 feet.

This test was requested by D. D. Frasier, 1543, on June 29, 1967. J. M. Carmichael, 7331, was Test Coordinator. The test item was received August 25, 1967, and the test was completed August 26, 1967.

Summary

On Saturday, August 26, 1967, a GCV-4 sled test was conducted on the 5000-foot test track in Area III. The unit was mounted atop an ejector sled, the electrical circuits checked, the hydraulic control system pressurized, and the sled launched at 10:26 a.m. The sled, on its way to a 400 foot-a-second (fps) velocity at ejection, passed through two screen box systems. These systems performed the necessary switching and initiating functions inside the unit through two electrical cords; subsequently removed those cords and ejected the unit upward at 20 fps using a maximum acceleration of less than 15 g's. At unit-sled separation, the unit rocket motor, carried in the retrofire position, ignited; the control system functioned and the unit negotiated the zero velocity transition. The GCV flight was an excellent one. First impact occurred 2615 feet south of the track and 15 feet west of the track centerline. The unit broke into three main sections before coming to rest. The sections were the jet vane control system, the rocket motor, and the remaining forward section.

Procedure and Results

The GCV-4 was mounted, in the retrofire position, on the 22-inch ejector sled (for operation on the 5000 ft. track) by containing its two lugs in special pneumatically operated latches. Two military ejection rack sway braces were then positioned against the unit and the ejection pad (saddle) located underneath the unit center of gravity. The lugs and sway braces were located as follows:

Unit Front Sway Brace	Unit Station 20.50
Unit Front Lug	Unit Station 25.12
Unit Rear Lug	Unit Station 56.19
Unit Rear Sway Brace	Unit Station 59.80

The unit remained electrically accessible until just prior to ejection by two connectors attached to the unit aft end (sled forward end). The electrical cords were attached to two sled mounted, squib operated, connector extractors for quick removal immediately before ejection. Two external power supplies were available to the unit prior to ejection. Before sled launch, a battery placed on the ground was connected through a launch pull-out connector. This battery provided external telemetry and gyro power. At sled launch, this battery was disconnected; the TM placed on internal power, and the gyros allowed to spin down throughout the remainder of the test. During the sled run and prior to unit ejection, all external unit power was obtained from a sled mounted battery. Figure 1 depicts GCV-4 prior to testing.

Sled rocket power consisted of five HVAR rocket motors. Ejection pressure was 230 psi while the cushion pressure used to retain the ejection piston was 120 psi. Only two-thirds of the available cushion volume was used in order to shorten the ejection stroke and provide a cleaner unit-sled separation.

The sled was launched northward from Station 10. Two seconds before sled launch, a 28-volt battery was connected to the gyro uncage cable in the unit. This signal was disconnected as the sled left the launch station. Normally, the uncage signal would have been given singly by screen box one approximately 100 milliseconds before the ejection signal, but the results of the captive GCV-4 test (T-12463) indicated a sluggish uncage of the pitch-yaw gyro. The premature uncage signal was given as a precautionary measure. At track Station 254, 1.01 seconds from sled launch, the sled contacted screen box one which gave the back up uncage signal; the switching however, was accomplished by the -2 second signal.

The next event was screen box two located at Station 310. This signal, occuring 1.14 seconds from sled launch, initiated the two plug extractors removing the electrical connections from the unit, and fired an explosive valve opening the pneumatic latches and ejecting the unit. The unit separated from the saddle and ignited at Station 400, 1.36 seconds from launch, with the sled traveling 400 fps. At separation, the unit was traveling upward at 20 fps after withstanding a maximum vertical acceleration of less than 15 g's.

First impact occurred 2615 feet south of the track and 15 feet west of the track centerline. At impact, the jet vanes shattered and spewed from the unit. The unit was ultimately broken into three main sections including the jet vane control section, the rocket motor, and the remaining forward section. Figures 2 through 6 show the various pieces of tested hardware. More information regarding the unit flight may be obtained from Organization 5613.

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A further listing of times and events as taken from the August Beckett Status Report is as follows:

T + 1.56 seconds	Unit has pitched up to 12 degrees and stabilized.
T + 2.16 seconds	Zero velocity point. Unit is at track Station 610, 20 feet above the ground at 12 degrees pitch angle.
T + 2.36 seconds	Unit begins to pitch down.
T + 2.56 seconds	Unit has pitched down to zero degrees and stabilized.
T + 4.03 seconds	GCV rocket motor burnout (thrust is 75% of peak thrust).
T + 4.16 seconds	End of controlled flight. Unit is at track Station -300, 40 ft. above the ground at 0 pitch angle.

Instrumentation for the test consisted of photometric coverage and internal unit information related by a telemetry system. Reduced photometric information, not available at this writing, should yield the following:

1. Plot of apparent pitch angle.
2. Plot of altitude versus distance from GCV launch.
3. Plot of lateral displacement from track centerline.
4. Time elapsed from GCV launch to zero range velocity.
5. Unit roll versus time.
6. Smoothed trajectory data listing including VAX, VAY, VZ, M, TA, and apparent Q.

Some of the major events monitored by the TM system included:

1. Gyro uncage signal.
2. Rocket Motor Ignition.
3. Vane Position.
4. Servo valve position.
5. Gyro outputs.
6. Three accelerometers in the unit nose.

Telemetry results are available from Organization 5613.

Meterological data for the track at the time of testing is included in Table I.

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TABLE I

Sheet 1 of 1

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METEOROLOGICAL DATA

GCV-4

ATMOSPHERIC PRESSURE 870.0 MILLIBARS

ALTITUDE (FT)	WIND DIRECTION (DEGREES)	VELOCITY (KNOTS)	TEMP (°F)	RELATIVE HUM (%)	
12	105	11	81	21	
100	89	12	79	29	

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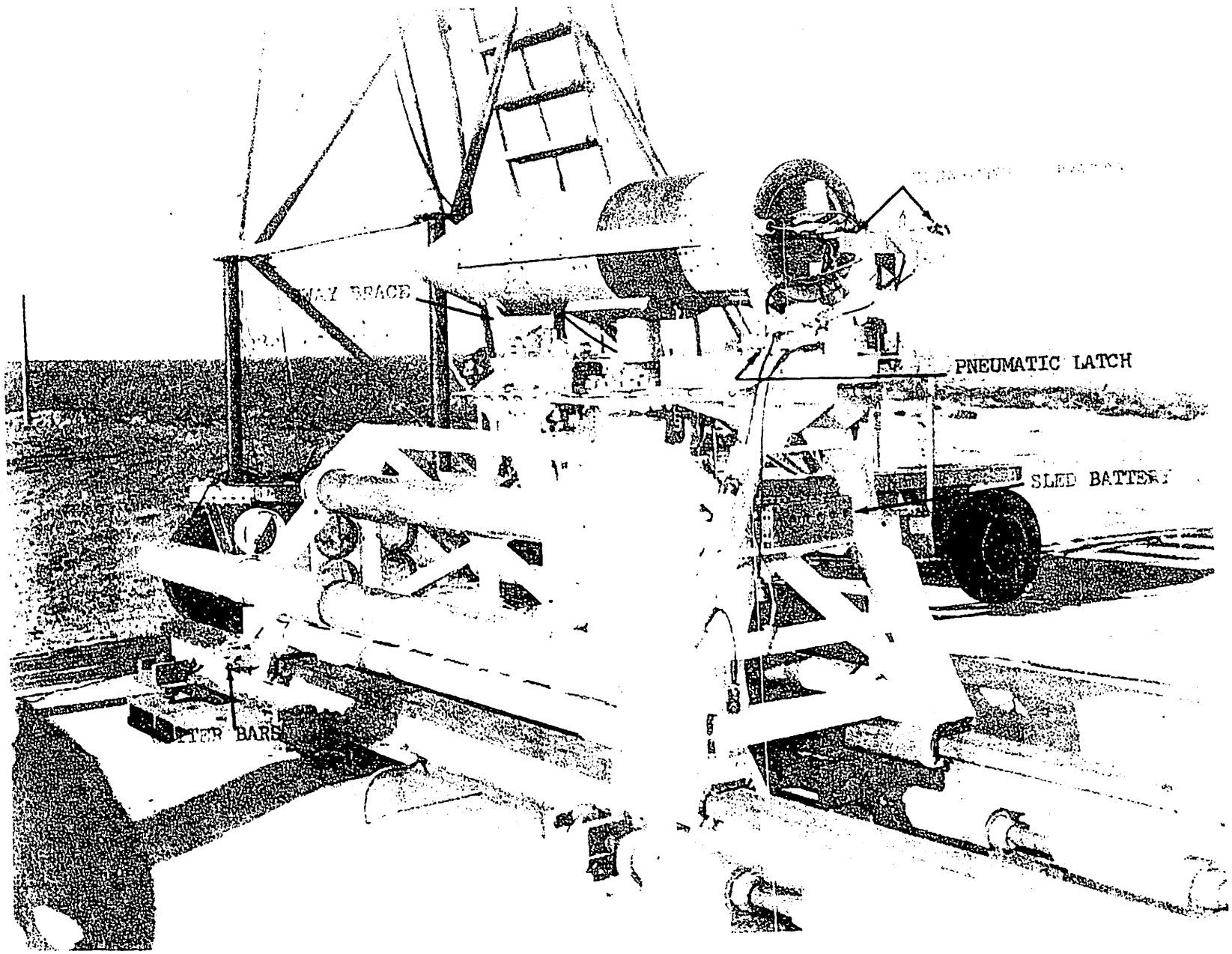
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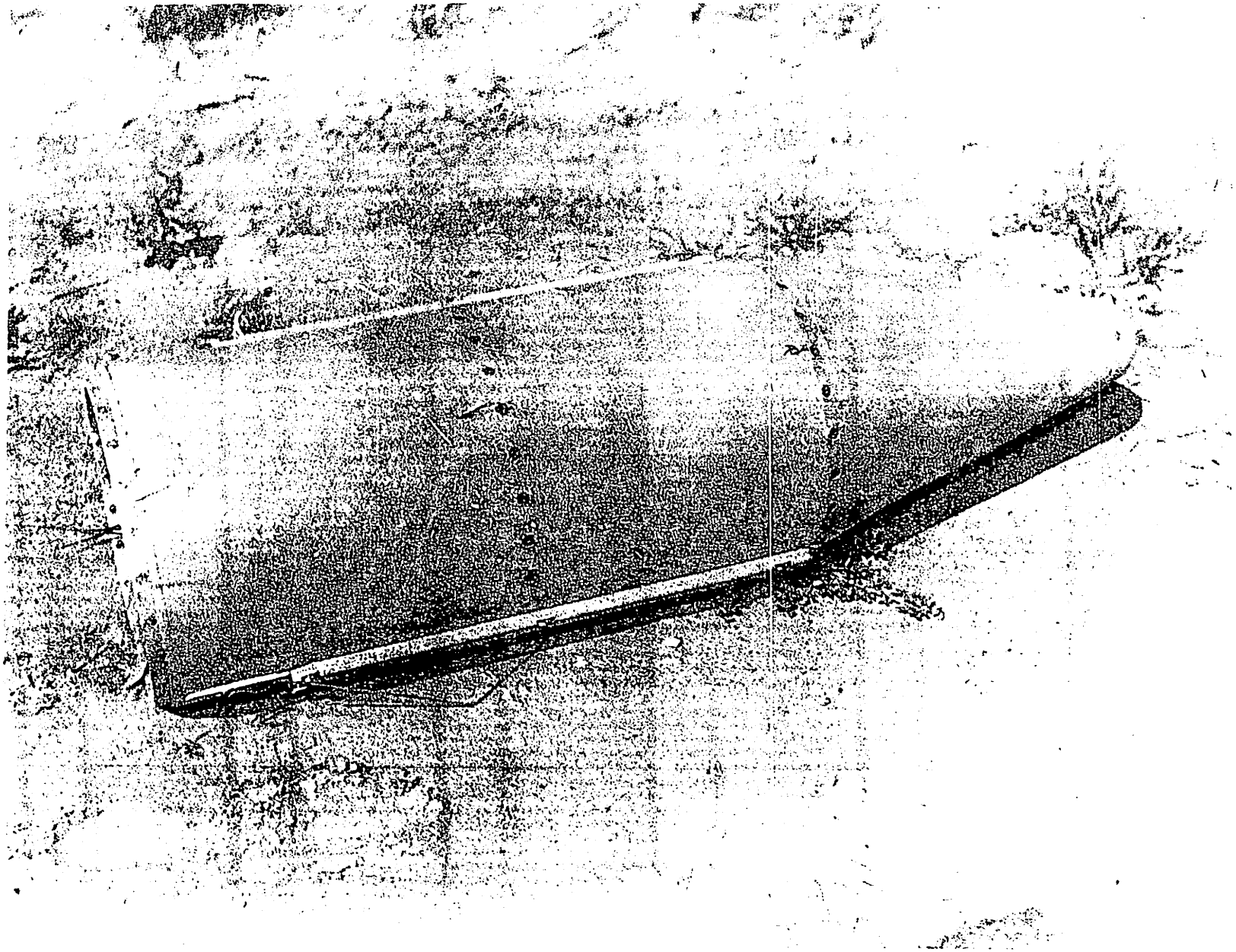
SLED BATTERY

16689-49 #2



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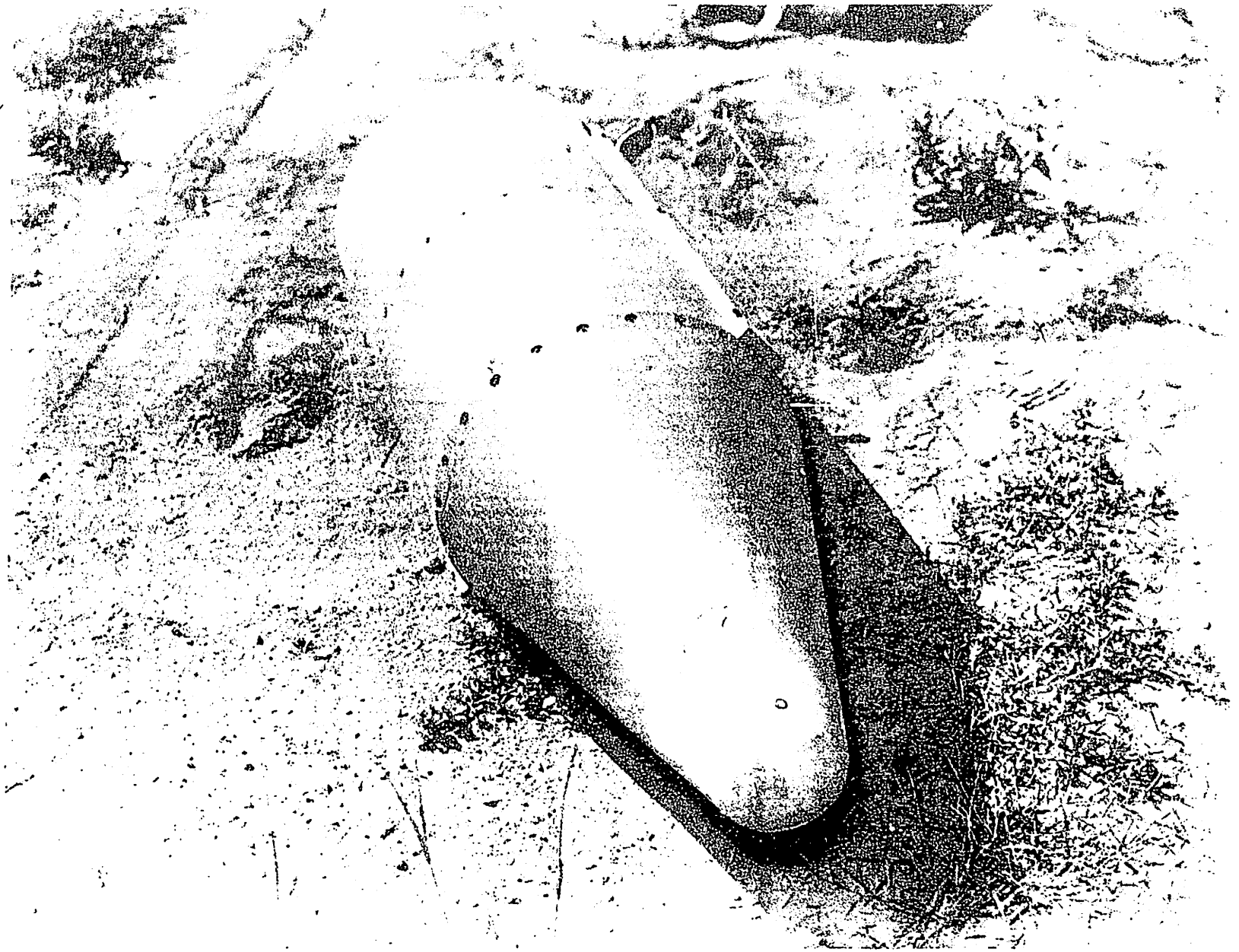

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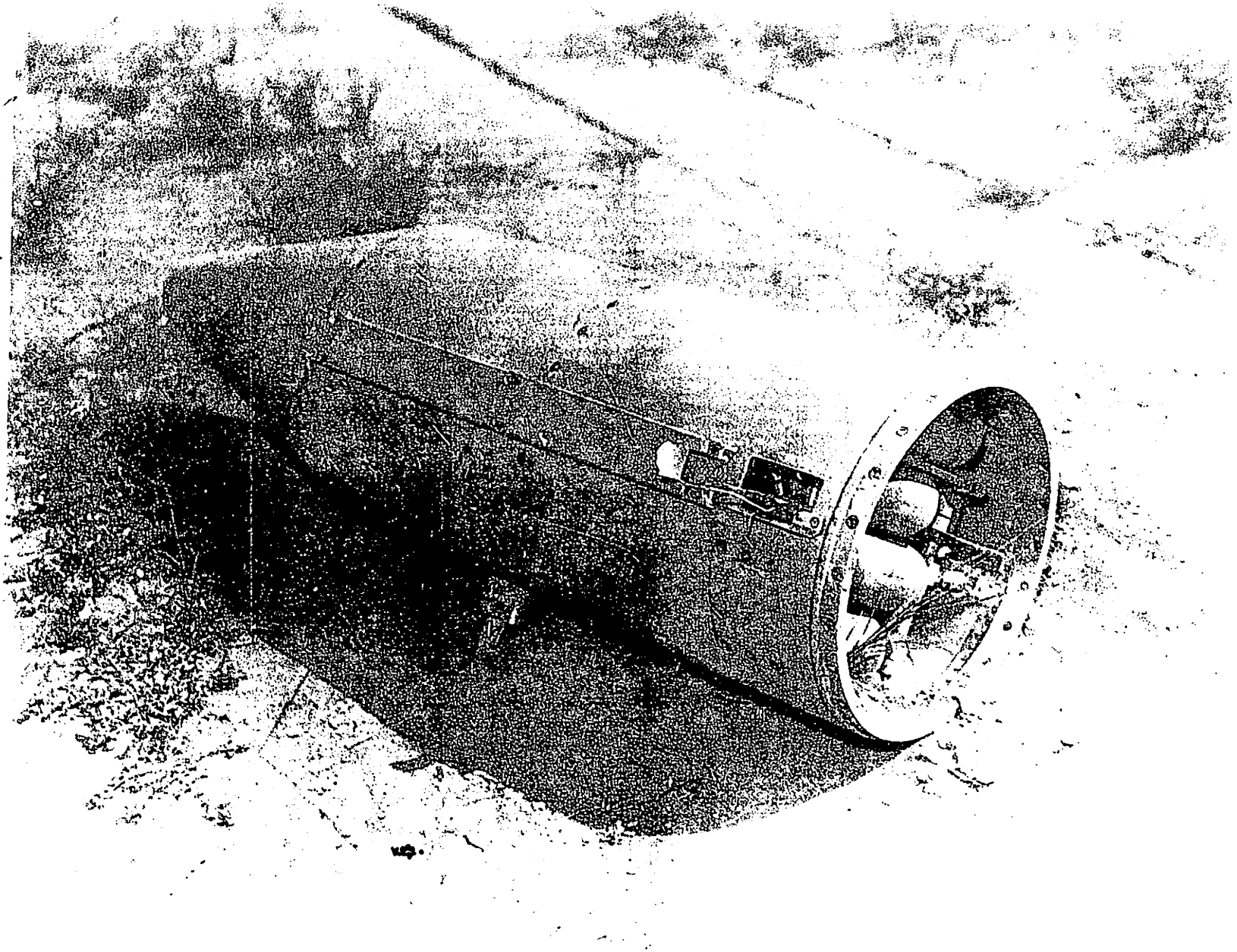

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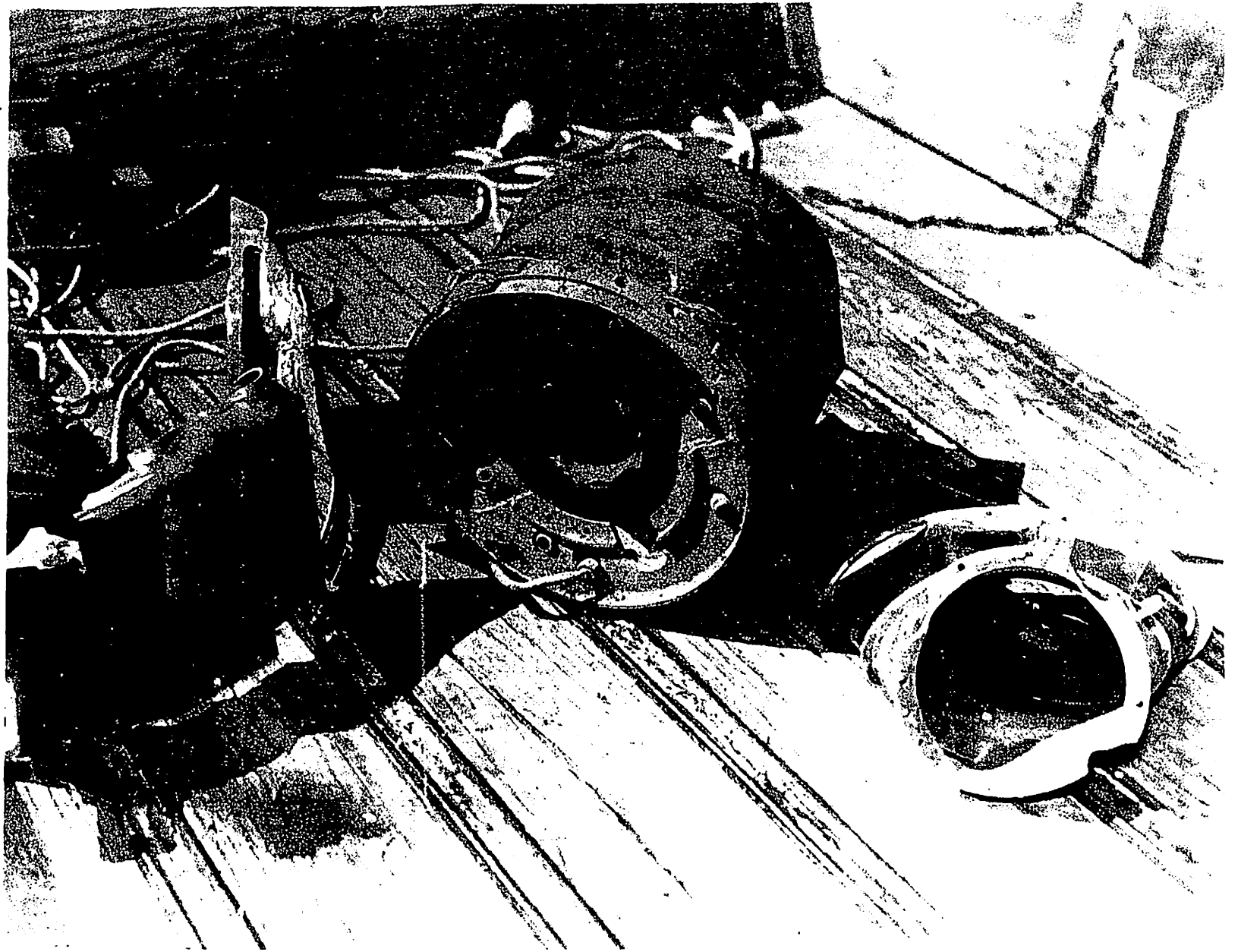

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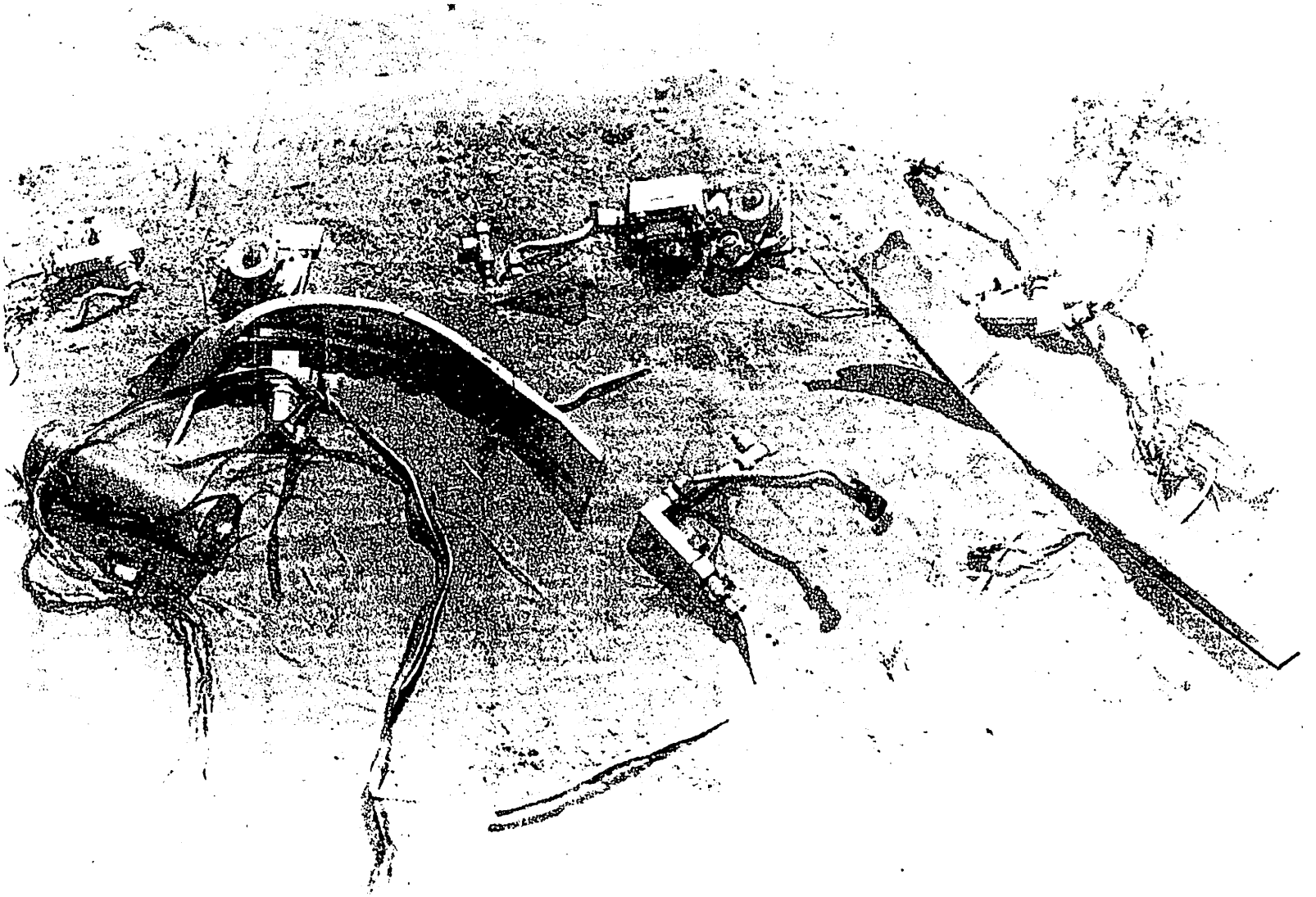
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