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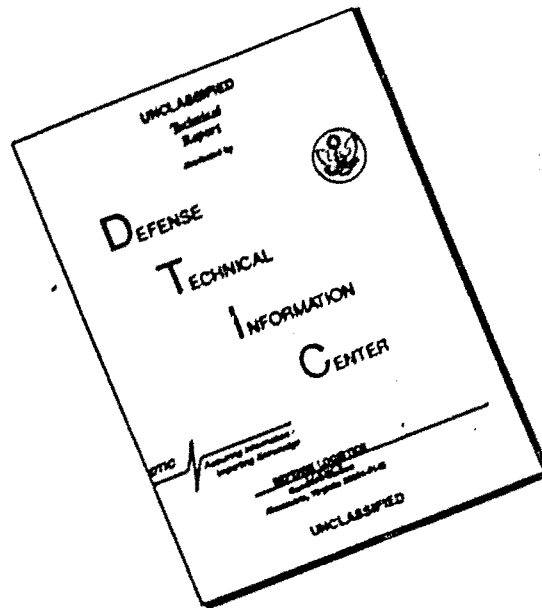
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WADD TECHNICAL REPORT 60-485

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Ultra-Fast Opening Personnel Parachute Type XMP-2

Edward J. Murray, CWO-3, USAF

OPERATIONAL SUPPORT ENGINEERING DIVISION
DIRECTORATE OF SYSTEMS ENGINEERING

APRIL 1961

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AERONAUTICAL SYSTEMS DIVISION

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Ultra-Fast Opening Personnel Parachute Type XMP-2

Edward J. Murray, CWO-3, USAF

Operational Support Engineering Division
Directorate of Systems Engineering

April 1961

Project 8075
Task 60701

Aeronautical Systems Division
Air Force Systems Command
United States Air Force
Wright-Patterson Air Force Base, Ohio

FOREWORD

This report was prepared by the Crew Equipment Branch, Operational Support Engineering Division, Directorate of Systems Engineering, Wright Air Development Division, Wright-Patterson Air Force Base, Ohio, under Task 60701, Project 8075, "Ultra-fast Opening Parachute," with Capt A. N. Abelson as task engineer. The work was accomplished in support of a Department of Army requirement to provide a means of emergency escape for the operators of experimental aerial lift platforms of the ducted fan and underslung rotary wing types. The Department of Army funded the work.

The Oerlikon Tool and Arms Corporation of America, Asheville, North Carolina, under Contract AF33(600)-33249, accomplished the initial work. Under Contract AF33(600)-38893, the Stencil Aero Engineering Corporation was responsible for later improvements. Under Military Interdepartmental Purchase Request, the Frankford Arsenal, U. S. Army Ordnance, Philadelphia, Pennsylvania, evaluated the cartridge-actuated devices. The work presented in this report began in March 1956 and was completed in July 1960.

Personnel who contributed to the overall effort included: CWO E. J. Murray and Mr. C. Graham of Wright Air Development Division and CWO J. A. Ward and Capt A. N. Abelson of the Department of the Army.

ABSTRACT

A personnel parachute, with extremely fast opening characteristics, was designed to support testing of two experimental aerial lift devices known as the Hiller Flying Platform and deLackner Aerocycle. Models were designed to operate at airspeeds of near 0 to 50 miles per hour and at altitudes as low as 25 feet above the terrain. This parachute does not possess the reliability required for a personnel parachute. Under certain conditions, it can be used with the flying platform and aerocycle until a more reliable system is developed. Use of this parachute with other aerial vehicles requires further development to improve its reliability.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:



W.P. SHEPARDSON
Chief, Crew Equipment Branch
Operational Support Engineering Division

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INTRODUCTION

United States Army concepts of mobility in modern warfare include the use of versatile aerial vehicles that can operate at altitudes of less than 500 feet and at relatively low airspeeds to transport personnel and cargo. On 8 February 1956, the Quartermaster Research and Engineering Command, Natick, Massachusetts, submitted a letter to Headquarters Air Research and Development Command establishing the requirement for a parachute to recover personnel engaged in flight testing the Hiller Flying Platform (Figure 1) and the deLackner Aerocycle (Rotocycle) (Figure 2).

Wright Air Development Division evaluated various approaches, basing its evaluation on the device's ability to utilize standard or known parachute components to the maximum practicable degree. The approaches investigated included: improvement of the standard troop-type reserve parachute; forced deployment of the parachute to line stretch; use of a lightweight ejection seat to assist escape; and forced deployment to include forced canopy spreading. Of the three approaches investigated, the one which involved forced deployment and radial spreading of the canopy appeared most feasible. Initial development was concentrated on a parachute assembly that the operator could wear. However, the force required to most effectively deploy this back-style parachute exceeded human tolerance. Therefore, the assembly had to be redesigned so that it could be mounted on the structure of the aerial vehicle.

DESCRIPTION AND OPERATION OF THE XMP-2 PARACHUTE

DESCRIPTION

Back-Style Configuration

The back-style configuration (see Figures 3 and 4) is a free-type parachute; that is, the operator can wear it and can manually use the rip cord, at will, to activate it. A lanyard which connects the rip-cord system to the vehicle structure permits automatic release.

The basic assembly consists of a canopy, harness, projection-frame assembly, pack-projection assembly, and canopy-spreader assembly. The 24-foot diameter parachute canopy is of standard, flat circular construction with folding loops (total of 19) sewed to each radial seam to facilitate packing. (See Detail B, Figure 5.) Metal slugs are permanently attached to each suspension line and are adjacent to the skirt hem. (See Detail A, Figure 3.) A standard troop-type harness was modified to accept a lightweight aluminum frame that was designed for equitable distribution of the reactive force of pack projection. The pack-projection assembly (Figure 6) consists of a steel inner tube, an aluminum outer tube, a combustion chamber, a projection charge and actuator, an inner bag which contains the canopy, and an outer bag which contains and protects the inner-bag assembly. The telescopic arrangement of inner and outer tubes permits acceleration of the projected mass to the design velocity without exceeding human tolerance. The ejection-system (canopy spreader) assembly (Figure 7) consists of a 15-G inertia

actuator, a propelling charge, and a 24-barrel radial ejector gun. The ejector gun contains the 24 slugs that are attached to the canopy suspension lines. A safety pin, connected to the base plate, prevents ejection of the slugs until the assembly has safely cleared the operator. An accessory restraint harness, equipped with a remotely controlled quick release, attaches the parachute harness to the vehicle structure.

The entire assembly and accessories weigh 35 pounds. Detailed maintenance instructions are contained in Handbook of Operating and Service Instructions for Parachute, Personnel, Ultra-fast Opening, Type XMP-2, Back Style, Oerlikon Tool and Arms Corporation of America, dated 24 July 1957, as amended.

Platform-Mounted Configuration

The platform-mounted configuration is similar to the back-style configuration. There are three basic differences in the assembly for the platform-mounted configuration: (1) a mounting plate replaces the aluminum projection frame to permit relocation of the packed parachute on the vehicle structure; (2) powder charge is increased to impart a higher velocity to the projected pack; and (3) harness is modified to accommodate pack relocation.

SEQUENCE OF OPERATION

With the exception of projected pack velocity of the back-style configuration, the operational sequences of the parachutes are similar. See Figure 9.

At onset of emergency, the aerial vehicle operator actuates a remote control switch to release the restraint harness. When the harness separates from the vehicle, a lanyard withdraws the rip-cord wire (manual override option is also available). Movement of the wire releases a precocked firing pin which causes the projection charge to ignite and propel the packed parachute upward. During upward travel of the pack, the suspension lines and four snubber lines are released from storage flutes on the pack. The snubber lines are shorter than the canopy suspension lines. When line stretch occurs, the snubber lines impose pack deceleration in excess of 15 G's which causes the inertia actuator to ignite a charge in the central chamber of the canopy spreader. The 24 slugs are forcefully ejected to extend the skirt into a full-spread condition. Free fall of the operator loads the canopy suspension lines, which results in rapid filling of the positioned canopy.

TEST PROCEDURES

BACK-STYLE PARACHUTE

Ground Tests

The test assembly was attached to an anthropomorphic dummy, and the prepared dummy was placed on cushions for stability (Figure 10). The parachute was activated by pulling a lanyard attached to the rip-cord handle. Projection charges of 3.3 grams and 3.5 grams of Hercules No. 2400 powder were comparatively evaluated. The canopy spreader charge was No. 2 Bulls Eye powder in all tests. The angle-of-pack projection was varied from vertical to 10 degrees off vertical. High-speed motion pictures and 70-mm sequence still pictures were taken of the tests. Six ground tests were accomplished.

Aerial Tests

The test assembly was fitted to an anthropomorphic dummy and dropped from H-19 and H-21 helicopters that operated at indicated airspeeds ranging from near 0 to 70 miles per hour. A specially designed suspension harness that was attached to the dummy was connected to a 300-foot cable and suspended below the helicopter; small drogue chutes, attached to the dummy, controlled attitude in relation to the airstream. An electric impulse released the dummy when desired (see Figure 11). An automatic chest parachute was used to guarantee recovery of the dummy in all tests. Motion picture and 70-mm sequence cameras recorded the tests. The pictures were made from air to air and ground to air. A time and motion picture projector was used to evaluate the test coverage. Twenty-one aerial tests were completed.

PLATFORM-MOUNTED PARACHUTE

A special wooden tower (Figure 12) was used for the tests. For mobility, the tower was mounted on a truck bed. The test parachute assembly, attached to a 240-pound articulated dummy, was dropped from altitudes of 16, 27, and 42 feet at speeds ranging from 10 to 50 miles per hour. Twenty-four tests were conducted. Seven grams of powder were used in all projection tests. Three test procedures were utilized.

Fourteen tests were conducted under Procedure I. Three tests were made from the 16-foot level at speeds from 10 to 35 miles per hour. Dummy attitudes were rotated from sitting to kneeling to standing. Under this procedure, the drag force of the inflated parachute pulled the dummy from the test tower (see Figure 9).

Under Procedure II, eight tests were conducted. This phase was conducted at the 27- and 42-foot levels at speeds ranging from 10 to 50 miles per hour. An ejection seat (Figure 13) was used to propel the dummy to the rear of the tower at the instant of parachute actuation.

Two tests were conducted under Procedure III. Testing was conducted from the 27-foot level at 50 miles per hour. An overhanging trap door (Figure 14) was employed to impart downward motion to the dummy at time of parachute actuation.

Instrumentation included an anemometer, 16-mm motion picture cameras with 128-frames-per-second and 200-frames-per-second capabilities, and a 70-mm still camera.

TEST RESULTS

BACK-STYLE PARACHUTE

The inertia actuator failed in two instances. Both failures were attributed to insufficient G loading during deceleration. The first failure occurred when a 3.3-gram powder charge was used. Increasing the charge to 3.5 grams corrected the condition for all but one of the remaining 24 tests. The second inertia actuator failure occurred at an indicated air-speed of 70 miles per hour. Definite suspension line sail was observed. We concluded that increased deceleration time imposed by line sail reduced loading below the required 15 G's.

Unretarded vertical fall of the dummy was minimal when pack was projected vertically. Full canopy inflation (indicating safe recovery) normally occurred within 11 to 13 feet and at speeds of 46 to 60 miles per hour when pack was projected in an essentially vertical

direction. When the pack was projected horizontally at speeds between 11 and 23 miles per hour, the fall distance increased to 125-145 feet. (Static suspended dummy tests under zero speed conditions showed safe recovery in 8 to 11 feet of vertical fall.) In the horizontal pack-projection tests, partial canopy inflation was followed by considerable slack in line sail until the dummy moved beneath the canopy and descended to line stretch for final canopy inflation.

Observation of the horizontal pack deployment tests indicated that the canopy might envelop the dummy if projection occurred in line with the dummy's trajectory.

Head damage to the dummy indicated that the aluminum frame is a potential source of serious injury. This condition was caused by freedom of the frame to move upward.

PLATFORM-MOUNTED PARACHUTE

Procedure I

Only two of the fourteen tests failed to produce full canopy inflation. Therefore, the angle of oscillation, or dummy inclination, at ground impact was the major factor used to evaluate the degree of recovery. There were no successful recoveries when launch speed exceeded 25 miles per hour. All three of the 16-foot level tests resulted in unsuccessful recovery. Five successful, two marginal, and seven incomplete recoveries were recorded. In the successful recoveries, the canopy was fully inflated and oscillation did not exceed 10 degrees at impact. In the two marginal recovery cases, the canopy was fully inflated and oscillation did not exceed 15 degrees at impact. In the incomplete recoveries, the canopy was not fully inflated and/or oscillation exceeded 15 degrees at impact.

Procedure II

In 87 percent of the tests, full parachute inflation was recorded. The only incomplete recovery occurred on the 27-foot test at a speed of 45 miles per hour. The major cause of marginal recovery was excessive dummy inclination at moment of impact.

Procedure III

Pack projection was vertical and 11 degrees off vertical. Excessive oscillation at ground impact resulted in unsuccessful recovery for both tests.

Summary of Results

A summary of test results of all procedures follows:

1. No successful recoveries were made from the 16-foot level.
2. No successful recoveries were made from the 27-foot level at speeds in excess of 10 miles per hour.
3. Only one of 17 tests from the 42-foot level was successful at speeds in excess of 25 miles per hour.
4. Eight successful tests were made from the 42-foot level at, or below, speeds of 25 miles per hour.

5. On four of the five successful Procedure I tests, the dummy was in a standing position and less force was required to launch the dummy.

CONCLUSIONS

The back-style parachute assembly does not meet the stated requirement and its further use is not recommended. The platform-mounted assembly does not meet the stated requirement but it does possess a degree of performance and reliability superior to the back-style type. The operator of a Hiller Flying Platform or a deLackner Aero-cycle can be recovered successfully with the platform-mounted parachute if escape is initiated above 50 feet altitude and at airspeeds not in excess of 25 miles per hour and if projection of the pack at time of escape is essentially vertical.

The altitude required for successful recovery can be expected to increase proportionately as the angle of the projected pack departs from the vertical.

The characteristics of the aerial vehicles of intended use prohibit utilization of either vehicle as a test bed to determine the separation potential of the aerial vehicle and operator during an in-flight emergency. Flight simulation, using mobile towers, helicopters, and other devices, does not provide sufficient realism to permit accurate determination of the separation potential. Definitive conclusions in this area would require in-flight testing from a multiplace version of the vehicles or development of a method to safely recover the vehicle after departure of the test subject or dummy.

Frankford Arsenal's evaluation of the cartridge actuated devices (CAD) leads to the conclusion that major redesign of the CAD's is required to provide an acceptable level of safety and reliability.

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2. Ultra-Fast Opening Parachute, AF Flight Test Center Technical Report 59-9, AF Flight Test Center, dated June 1959.
3. Ultra-Fast Opening Parachute Assembly XMP-2, Platform Mounted, 6511th Test Group Letter Report 60-100, 6511th Test Group, undated.
4. Evaluation of Ejector for Parachute Ultra-Fast Opening, XMP-2, Back Style, Frankford Arsenal Memorandum Report M59-12-1, Frankford Arsenal, dated January 1959.

APPENDIX
ILLUSTRATIONS



Figure 1. Hiller Flying Platform

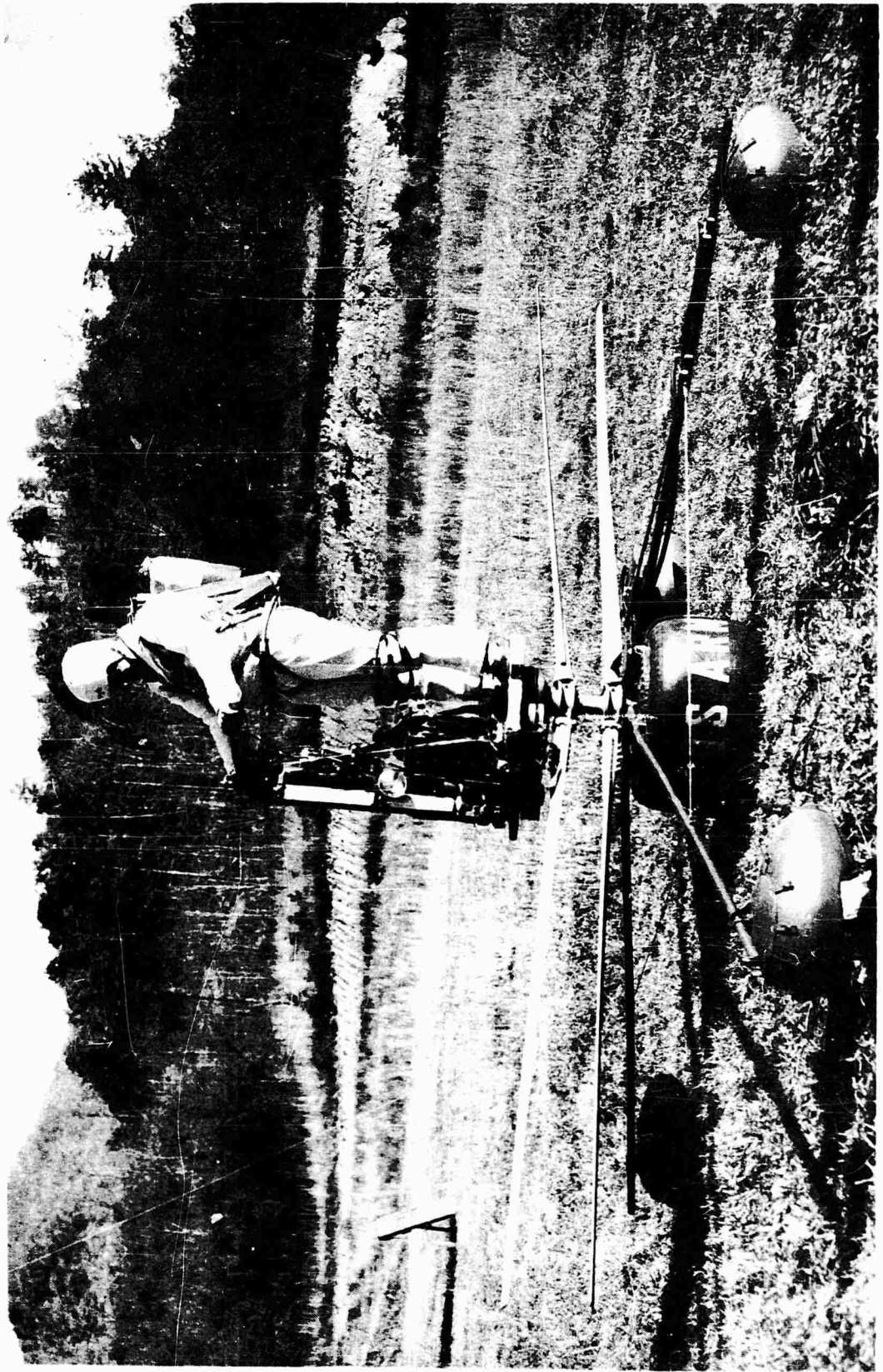


Figure 2. deLackner Aerocycle



Figure 3. Side View of Back-Style Assembly

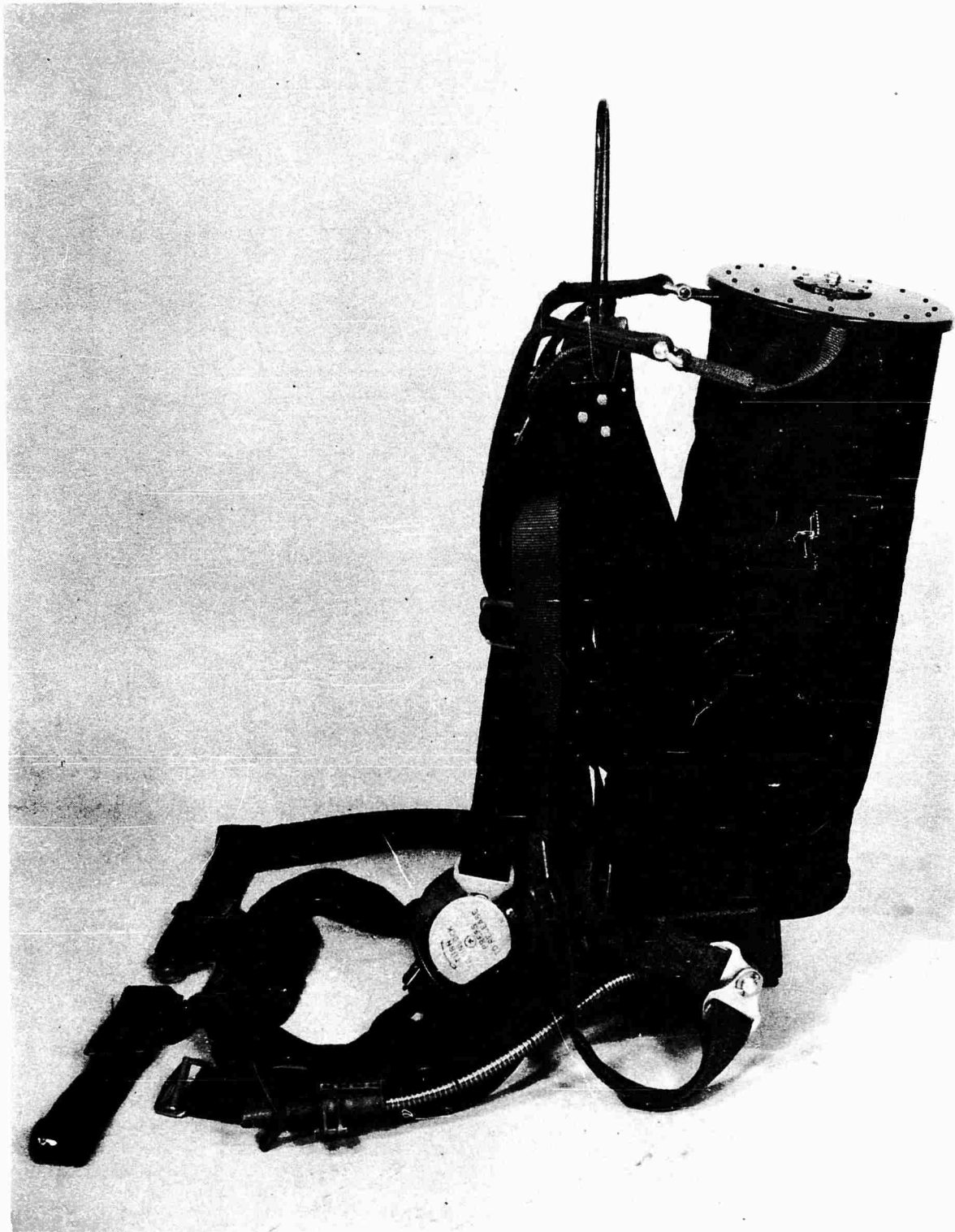


Figure 4. Overall View of Back-Style Assembly

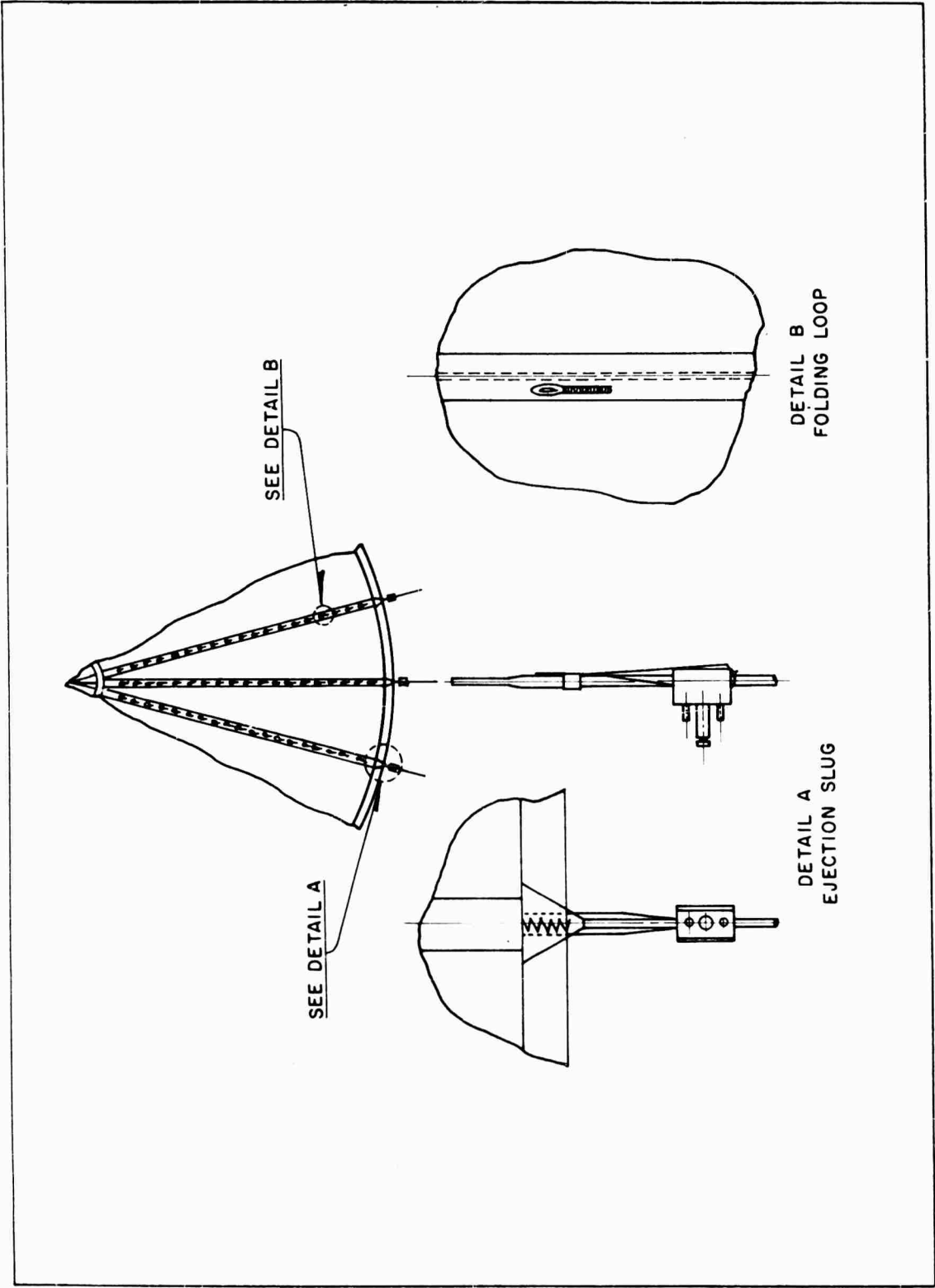


Figure 5. Schematic of Canopy

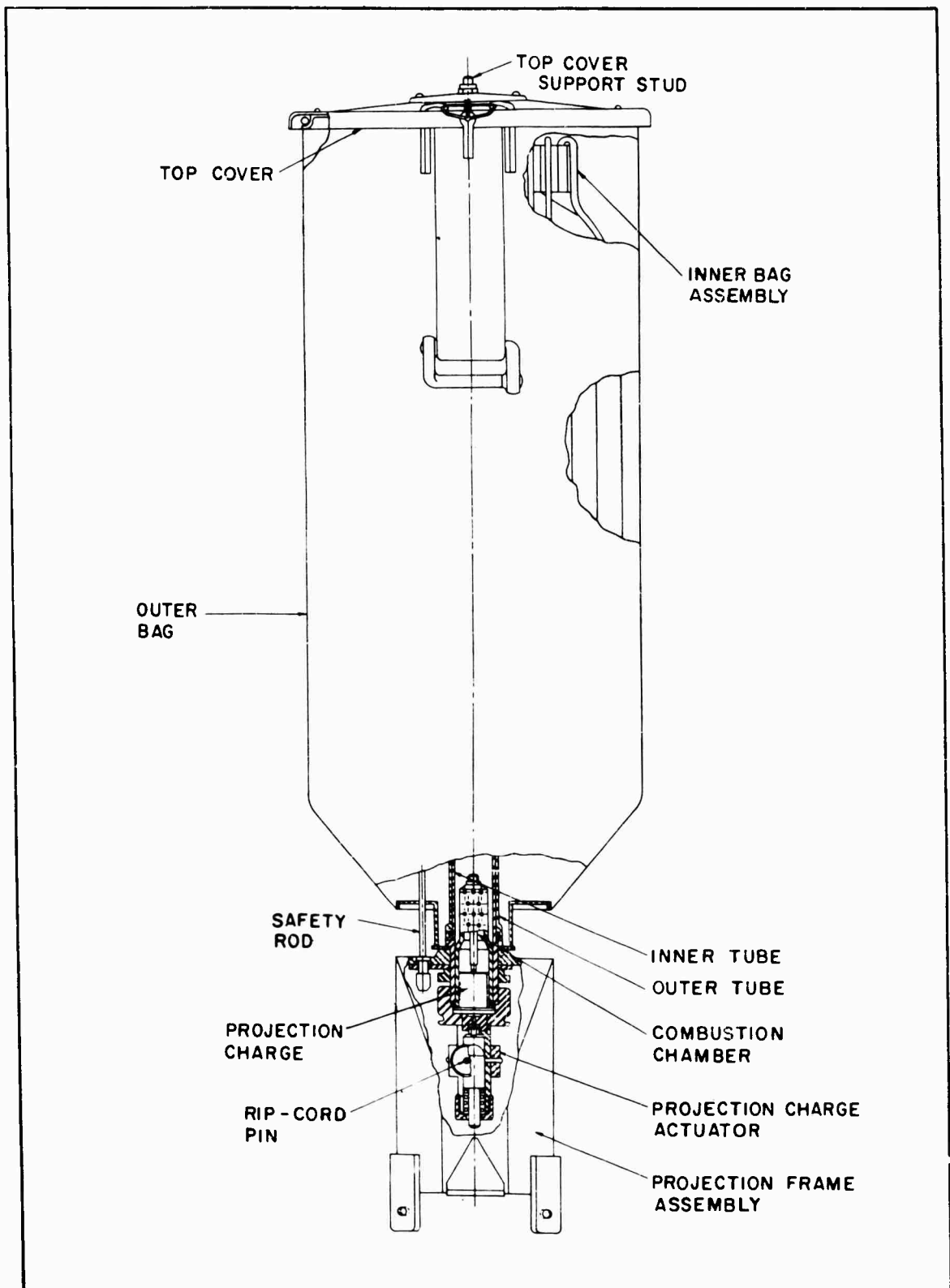


Figure 6. Pack Projection Assembly

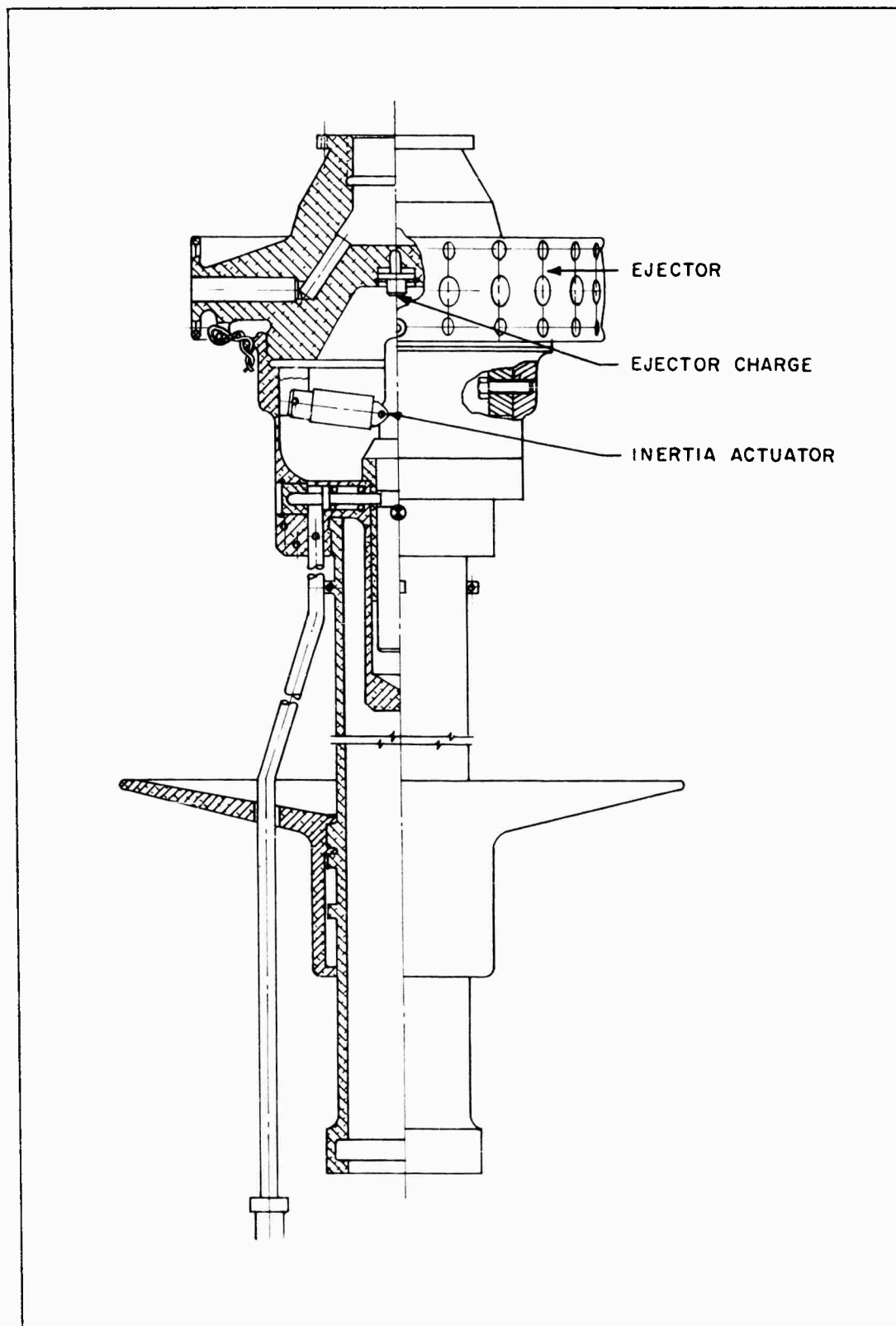
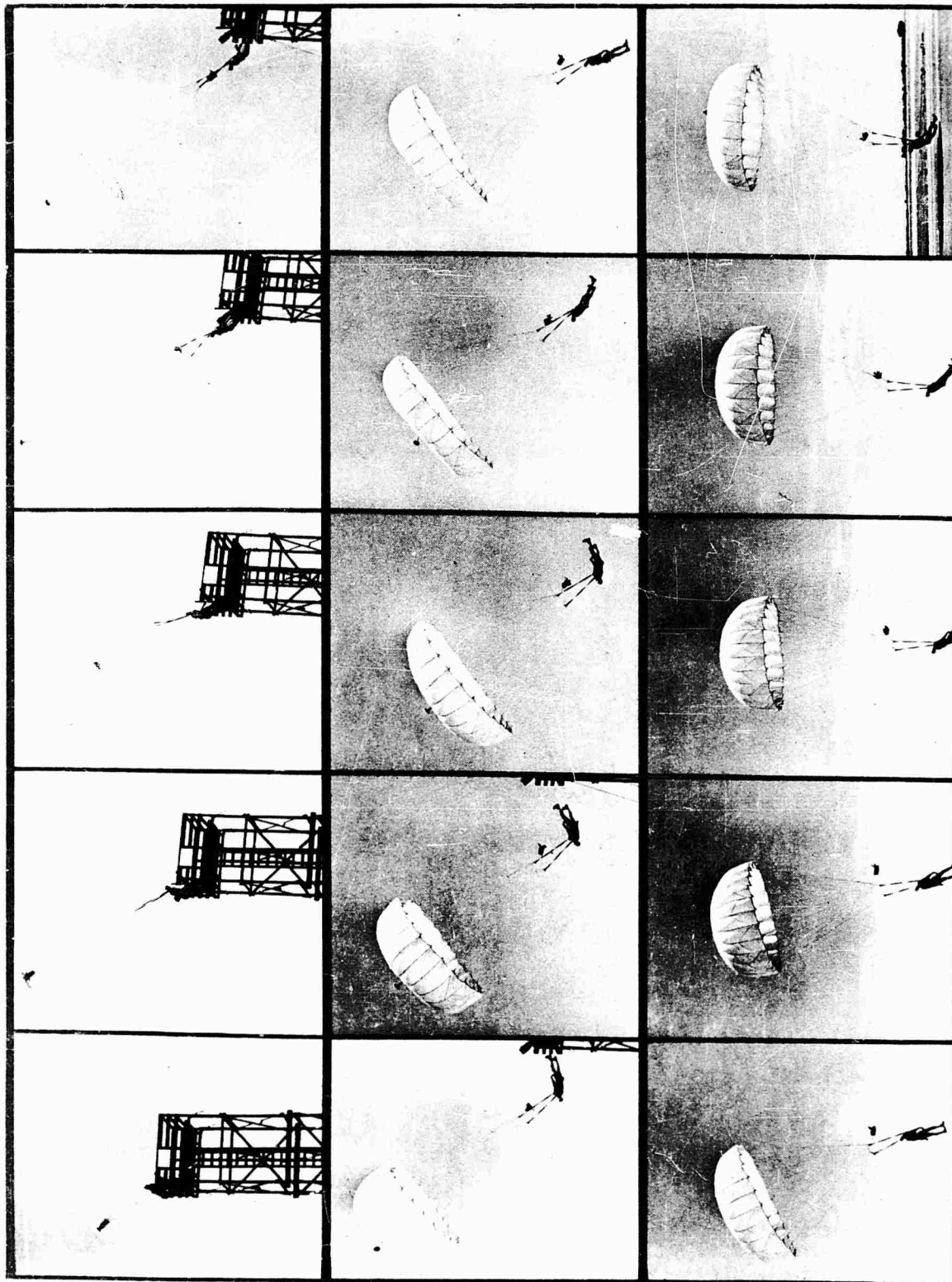


Figure 7. Ejection System Assembly



Figure 8. Platform-Mounted Style Assembly



OPERATIONAL SEQUENCE of TEST NO. 10-DROP NO. EC59-777

Figure 9. Operational Sequence of Back-Style and Platform-Mounted Style Parachutes

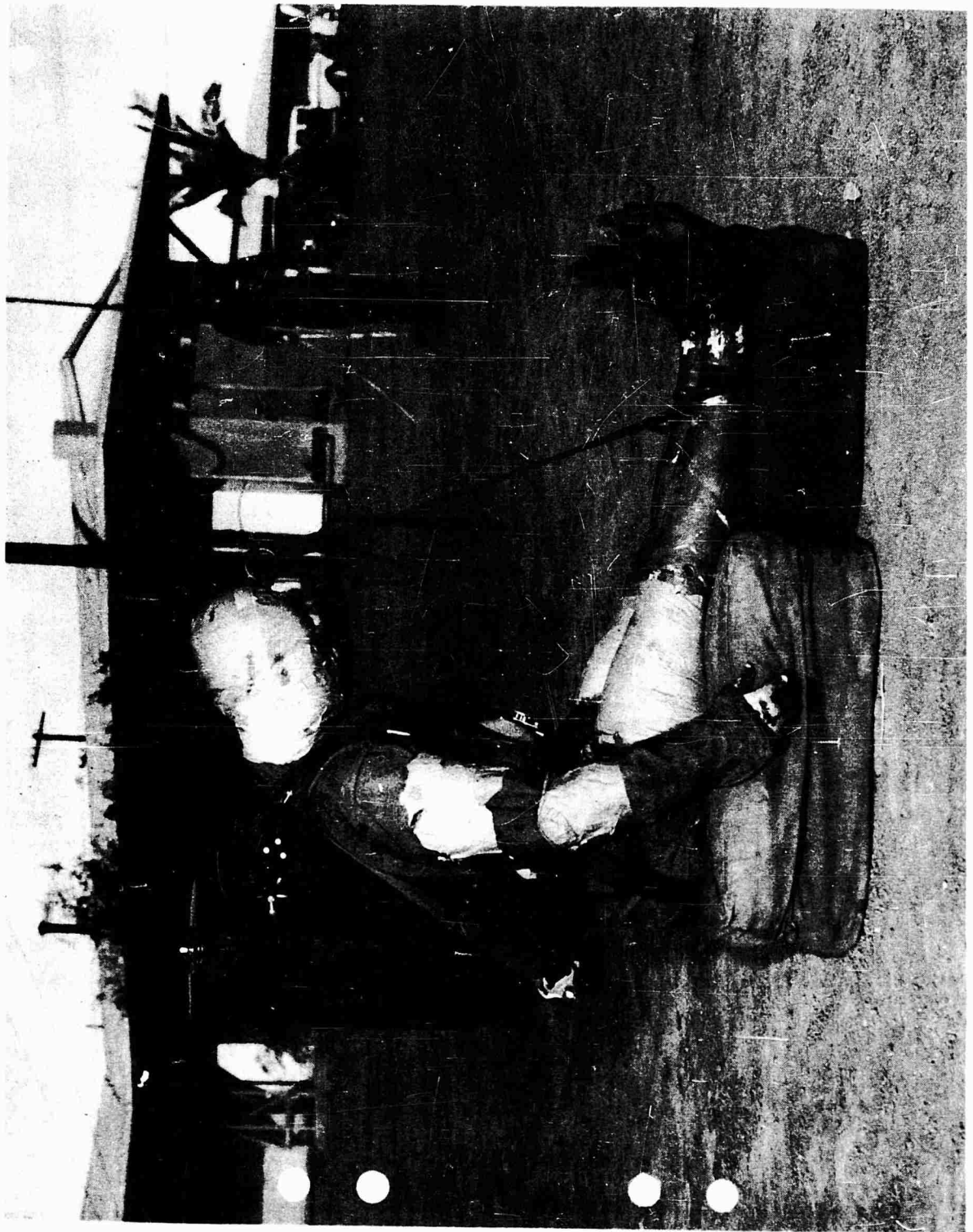


Figure 10. Test Assembly Attached to Anthropomorphic Dummy

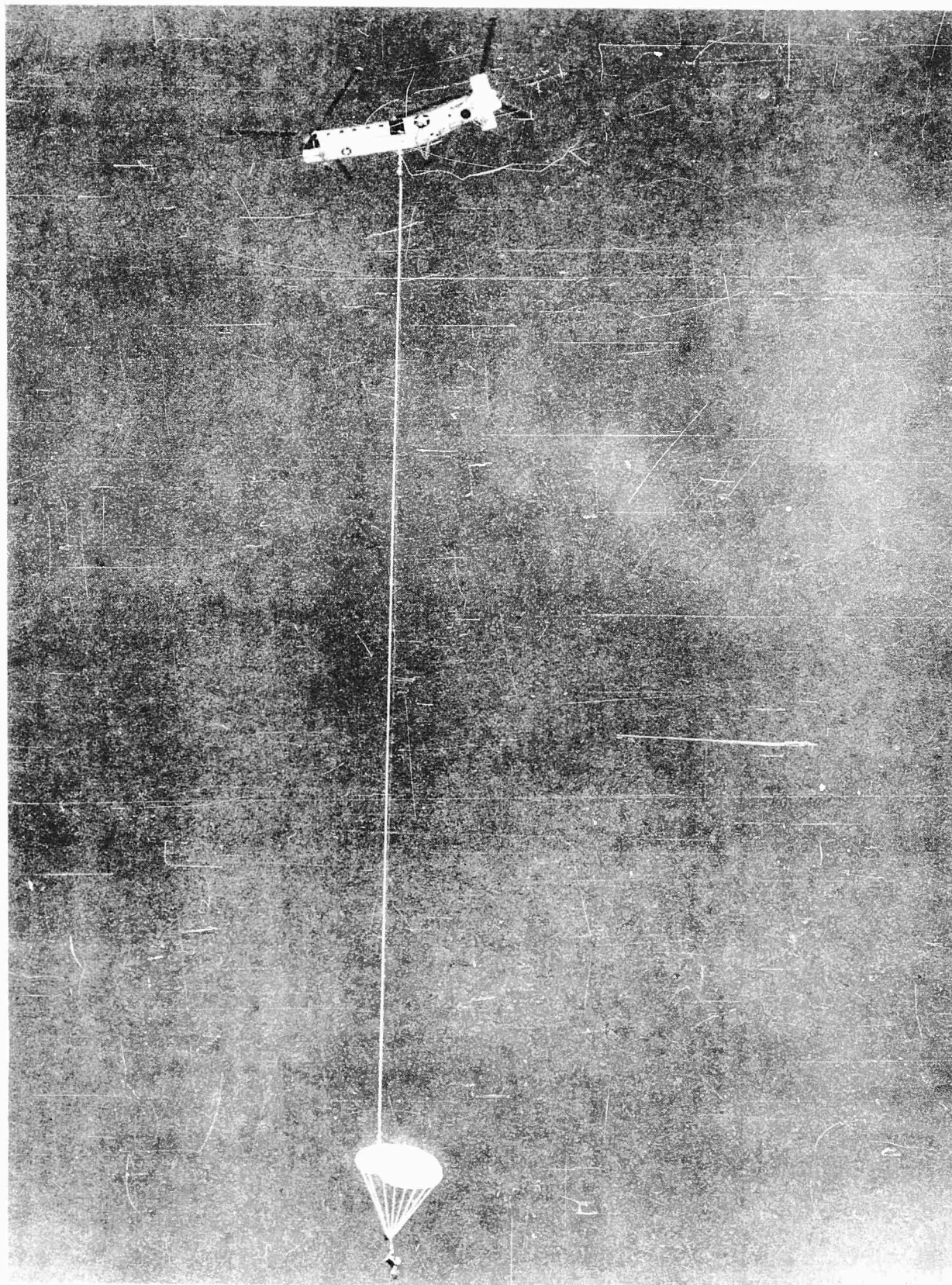


Figure 11. Dummy with Harness Attached and Suspended Below Helicopter

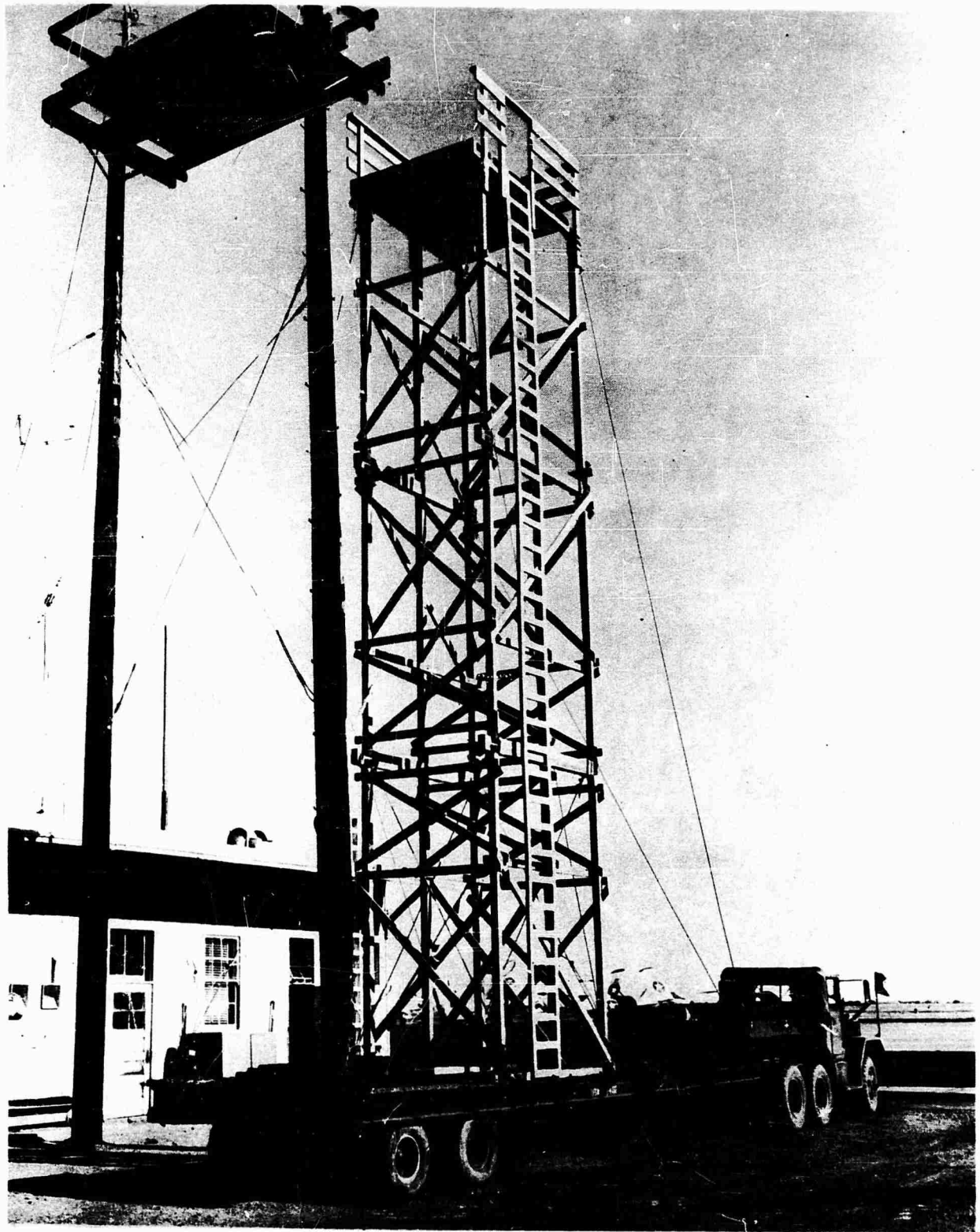


Figure 12. Wooden Tower Mounted on Flat-Bed Truck

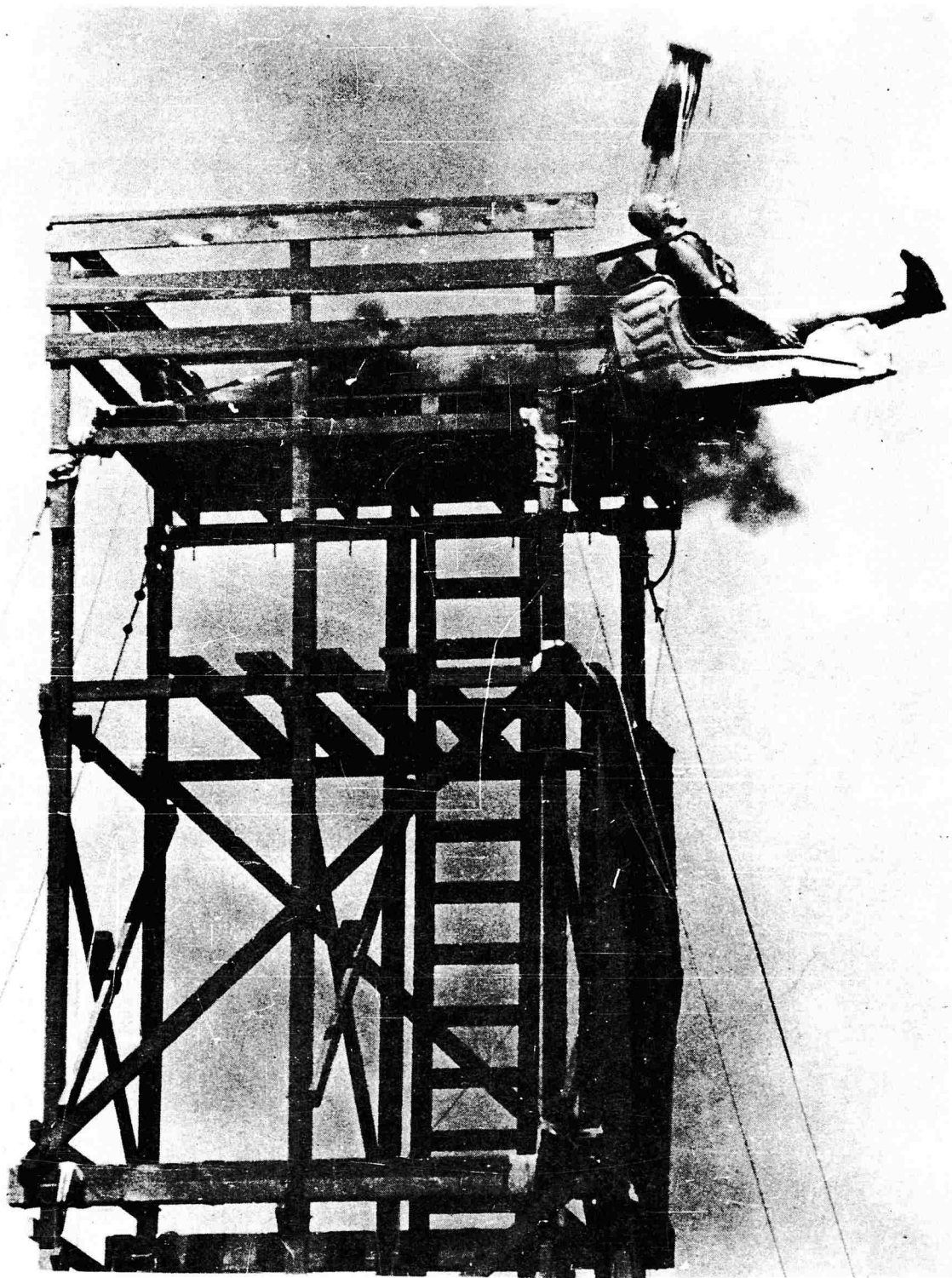


Figure 13. Dummy being Propelled by Ejection Seat

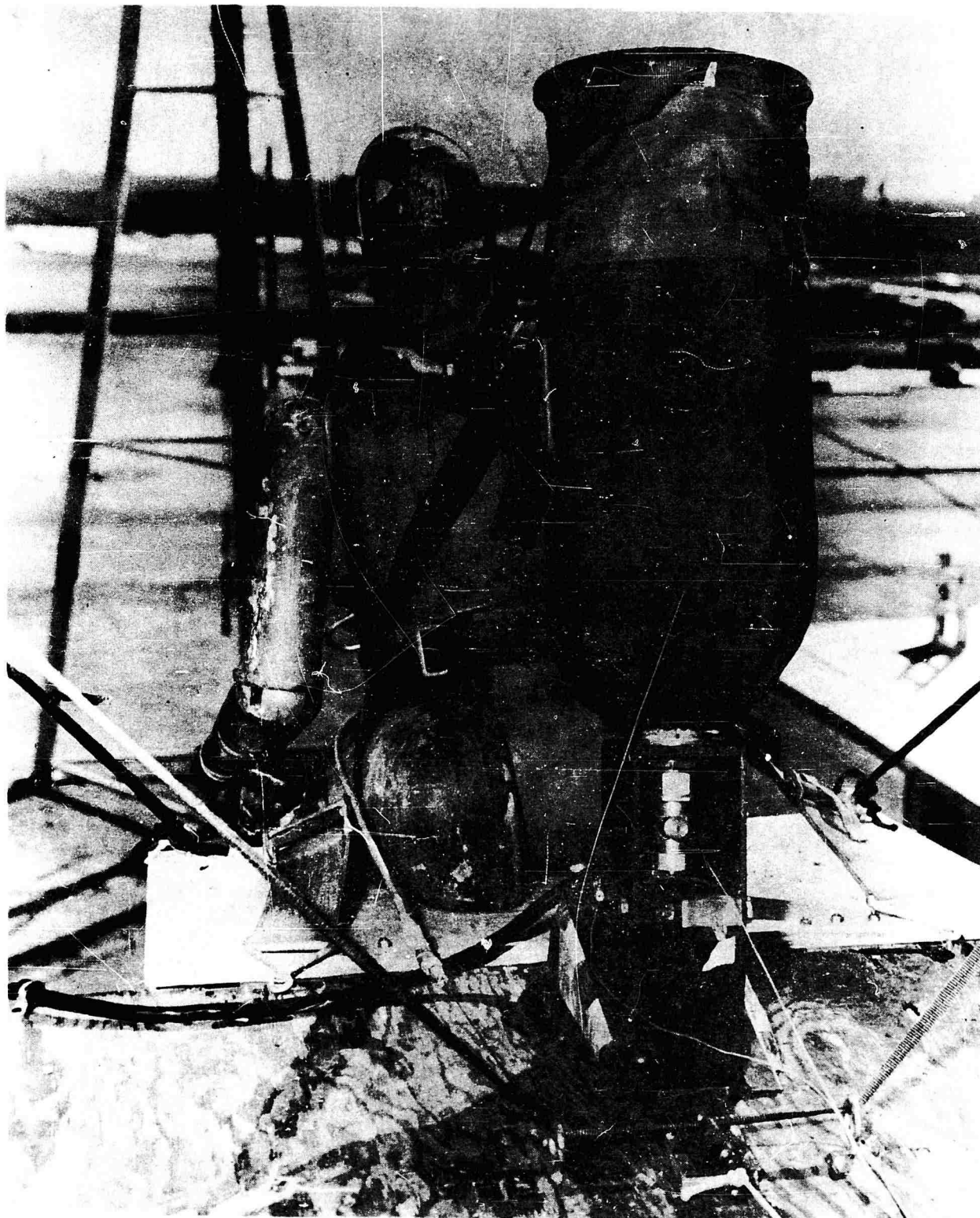


Figure 14. Dummy in Position on Trap Door

Operational Support Engineering Division, Directorate of Systems Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio. ULTRA-FAST OPENING PERSONNEL PARA- CHUTE TYPE XMP-2, by Edward J. Murray, CWO-3, USAF, April 1961. 25 p. incl. illus. (Proj. 8075; Task 60701) (WADD TR 60-485) Unclassified report A personnel parachute, with extremely fast opening characteristics, was designed to support testing of two experimental aerial lift devices known as the Hiller Flying Platform and deLackner Aerocycle. Models were designed to operate at airspeeds of near 0 to 50 miles per hour and at altitudes as low as 25 feet above the (over)	UNCLASSIFIED	Operational Support Engineering Division, Directorate of Systems Engineering, Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio. ULTRA-FAST OPENING PERSONNEL PARA- CHUTE TYPE XMP-2, by Edward J. Murray, CWO-3, USAF, April 1961. 25 p. incl. illus. (Proj. 8075; Task 60701) (WADD TR 60-485) Unclassified report A personnel parachute, with extremely fast opening characteristics, was designed to support testing of two experimental aerial lift devices known as the Hiller Flying Platform and deLackner Aerocycle. Models were designed to operate at airspeeds of near 0 to 50 miles per hour and at altitudes as low as 25 feet above the (over)	UNCLASSIFIED
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