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TECHNICAL REPORT NO. 74-40

ANCHOR CAPSTAN KITS
FOR
WHEELED VEHICLES

by

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Mobility Branch

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Final Report

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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Vehicle Recovery Vehicle Capstan Kits Capstan Kits Winches | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Self-recovery anchor capstan kits were developed for the M151 and M35 military tactical wheeled vehicles. The kits consist of wheel-adaptors, wheel capstans, plastic fiber rope, and earth anchor. The kits are employed, in lieu of conventional vehicle winches, to recover the immobilized vehicle. The kits have these advantages: they are simple and thus likely to be available in working condition when needed; application of towing forces is lower and will usually have an upward component which lifts the vehicle; and a Continued on Reverse | | |

BLOCK 20. ABSTRACT CON'T

self-emplacing anchor is included.

The kits were found to be effective. A kit for each vehicle has been furnished to a military advisory unit in Thailand for evaluation; the results were not available for inclusion in this report.

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INTRODUCTION

Problem

Only a proportion of military wheeled vehicles are procured with winches. Even with a winch, the lack of a convenient tree results in the need for a second vehicle or construction of an expedient earth anchor.

Background

The US Army Land Warfare Laboratory developed an anchor capstan kit for the M113 Armored Personnel Carrier in response to mobility problems encountered in South Vietnam. Approximately 800 of these kits were furnished to field units. The kits provided a simple and effective self-recovery capability, and enabled the equipped vehicles to cross all of the canal banks encountered in the delta of South Vietnam. This kit is described in Field Manual 20-22.¹ A similar kit for wheeled vehicles would give field units the option of having a self-recovery capability for any vehicle to be installed only when required by the tactical situation.

¹Field Manual 20-22, Vehicle Recovery Operations, July 1970

DESCRIPTION

The anchor capstan kits consist of the following items, as shown in Figures 1 and 2:

M35, 2 1/2-ton Truck

| | |
|---|----------|
| Wheel Adaptors, front | 2 each |
| Wheel Adaptors, rear | 2 each |
| Wheel Capstans, with bolt | 2 each |
| Recovery Rope, 5/8-inch diameter, Double Braided Polyester | 150 feet |
| Anchor, 60-lb., Danforth 60-HM (modified) | 1 each |
| Extraction Rope, 5/8-inch diameter, Double Braided Polyester | 25 feet |
| Pulley | 1 each |
| Shackle | 1 each |

M151, 1/4-ton Truck

| | |
|---|----------|
| Wheel Adaptors, front or rear | 4 each |
| Wheel Capstans, with bolt | 2 each |
| Recovery Rope, 5/8-inch diameter, Double Braided Polyester | 150 feet |
| Anchor, 7 1/2-lb., Viking No. 30 | 1 each |
| Extraction Rope, 5/8-inch diameter, Double Braided Polyester | 25 feet |
| Pulley | 1 each |
| Chain (not shown) | 2 each |
| Shackle | 1 each |

The wheel adaptors are attached by the field unit, and remain attached as long as the vehicle is employed in a situation which may require self-recovery. The adaptors are bolted to the wheel by the wheel lug bolts, but do not engage all of the lug bolts. This permits installation without removing the wheels. (See Figure 3.) The adaptors do not extend beyond the vehicle width.

The capstans are installed after the vehicle has become immobilized, and are removed and stowed afterwards. They are installed on the front or rear adaptors depending on which direction of recovery is required. They are attached by a single bolt, as shown in Figure 4, and engage the wheel adaptor by means of two lugs as shown in Figure 3.

The recovery rope is knotted to the slot in one capstan, Figure 5; passes through the pulley attached to the anchor, Figure 6; and then passes around the other capstan and is controlled by hand as shown in Figure 7, or if an assistant is not available, it also can be knotted.

Two lengths of chain are furnished with the M151 kit to enable the recovery rope to be fastened to a tree or other anchor point.

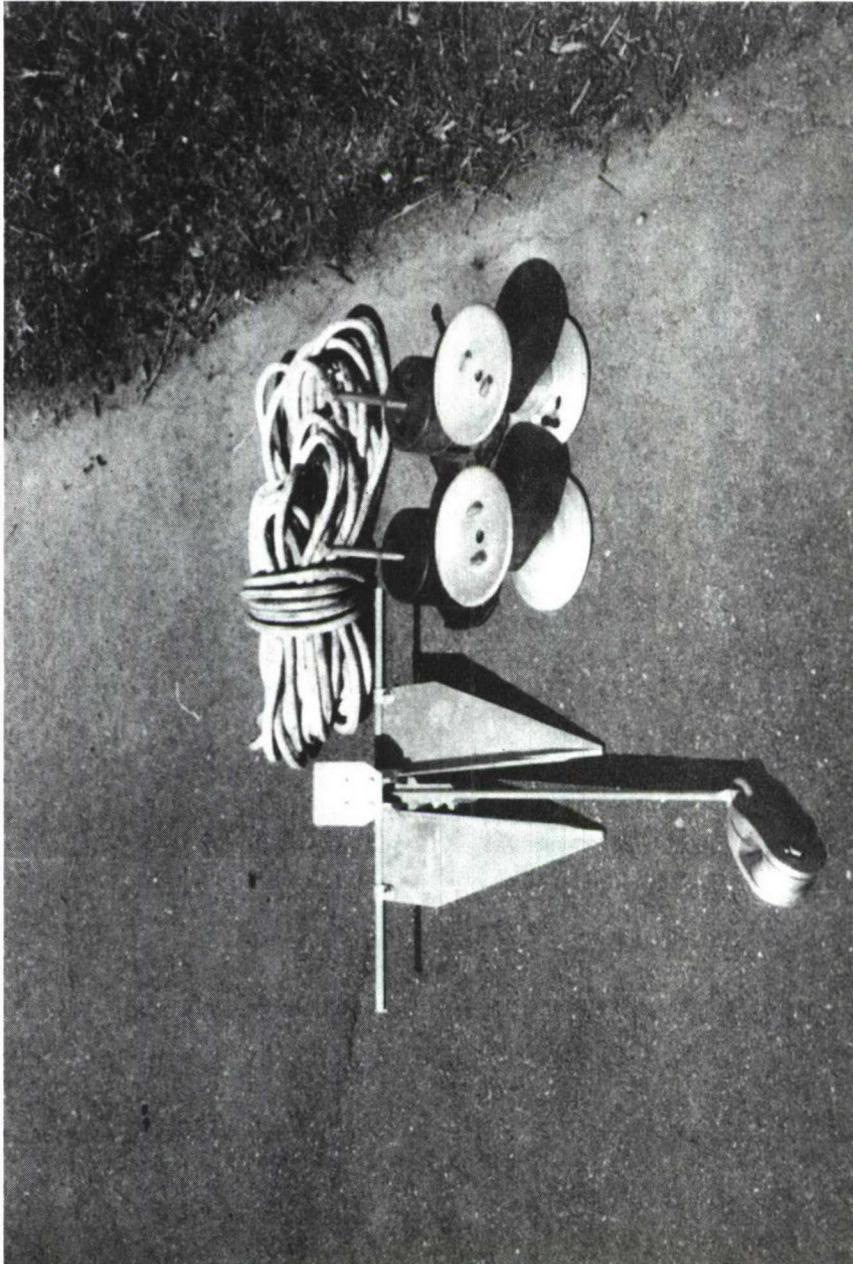


Figure 1. Anchor Capstan Kit for M151 (four wheel adaptors are furnished)

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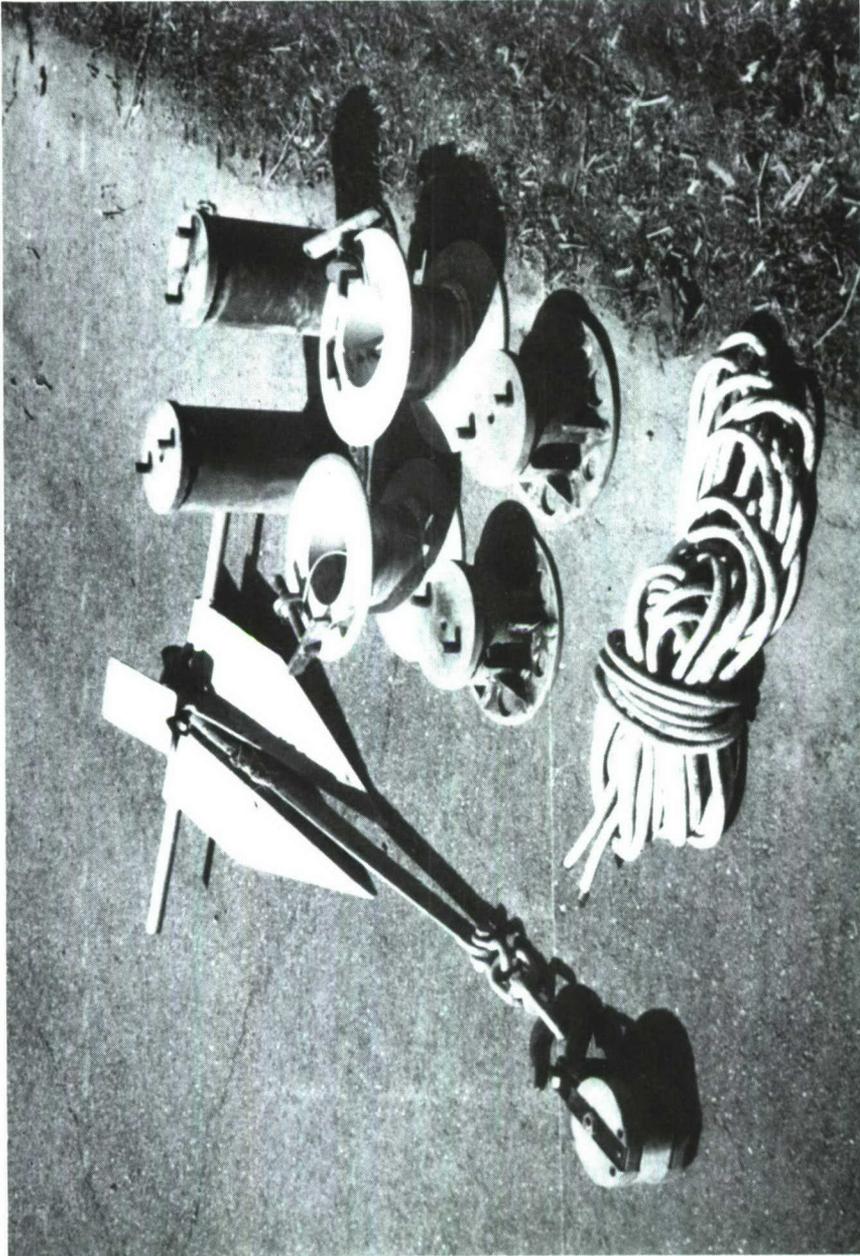


Figure 2. Anchor Capstan Kit for M35



Figure 3. Wheel Adaptor (front) and Capstan for M35 Truck



Figure 4. Installing Capstan on M35.



Figure 5. Recovery Rope Attached to Capstan, M35



Figure 6. Holding Anchor In Position for Embedding



Figure 7. Manual Control of Capstan

The extraction rope is attached to the base of the anchor before the recovery operation, Figure 8. The anchor can be easily removed from the ground by pulling it out with the recovered vehicle in the reverse direction.

A plastic coated cloth bag is furnished for stowage of the rope. A heavy web netting is furnished for stowage of the entire M151 kit underneath the rear seat, as shown in Figure 9. The rope and capstans for the M35 truck are stowed in a similar bag under the assisant operator's seat. The anchor for the 2 1/2-ton truck may be stowed in several locations by means of a webbing assembly furnished, as shown in Figures 10 and 11.

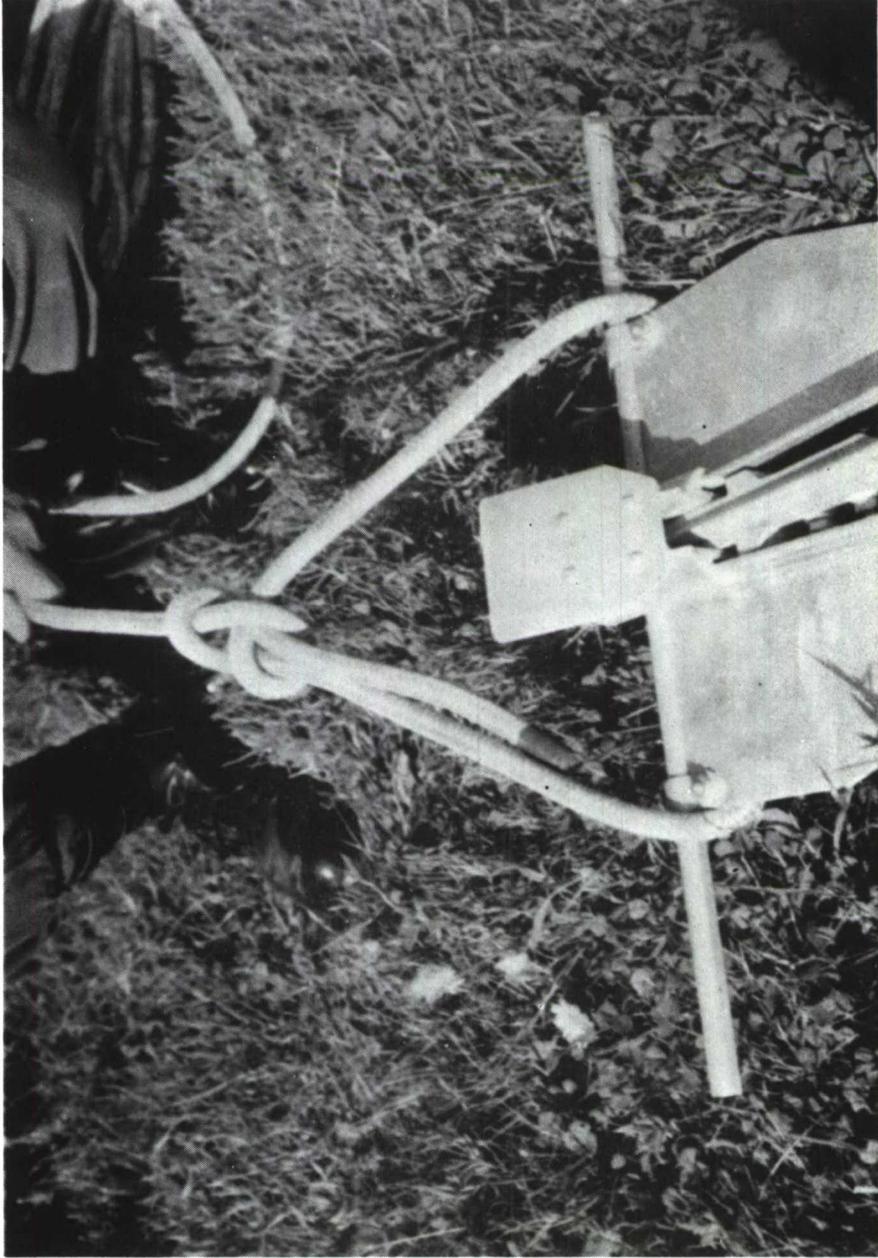


Figure 8. Extraction Rope Attached for Recovery of Anchor

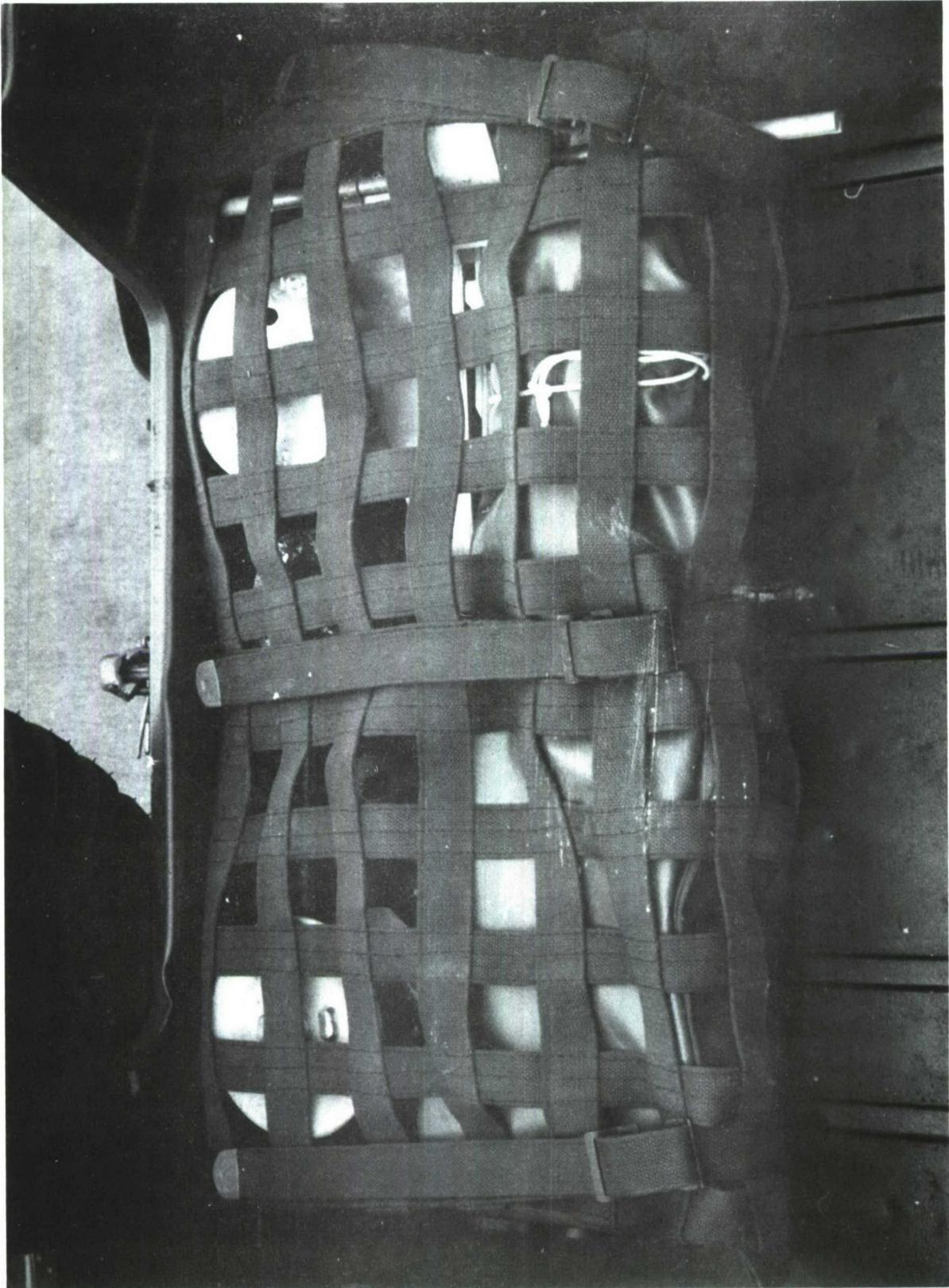


Figure 9. Kit Stowage Under Rear Seat of M151

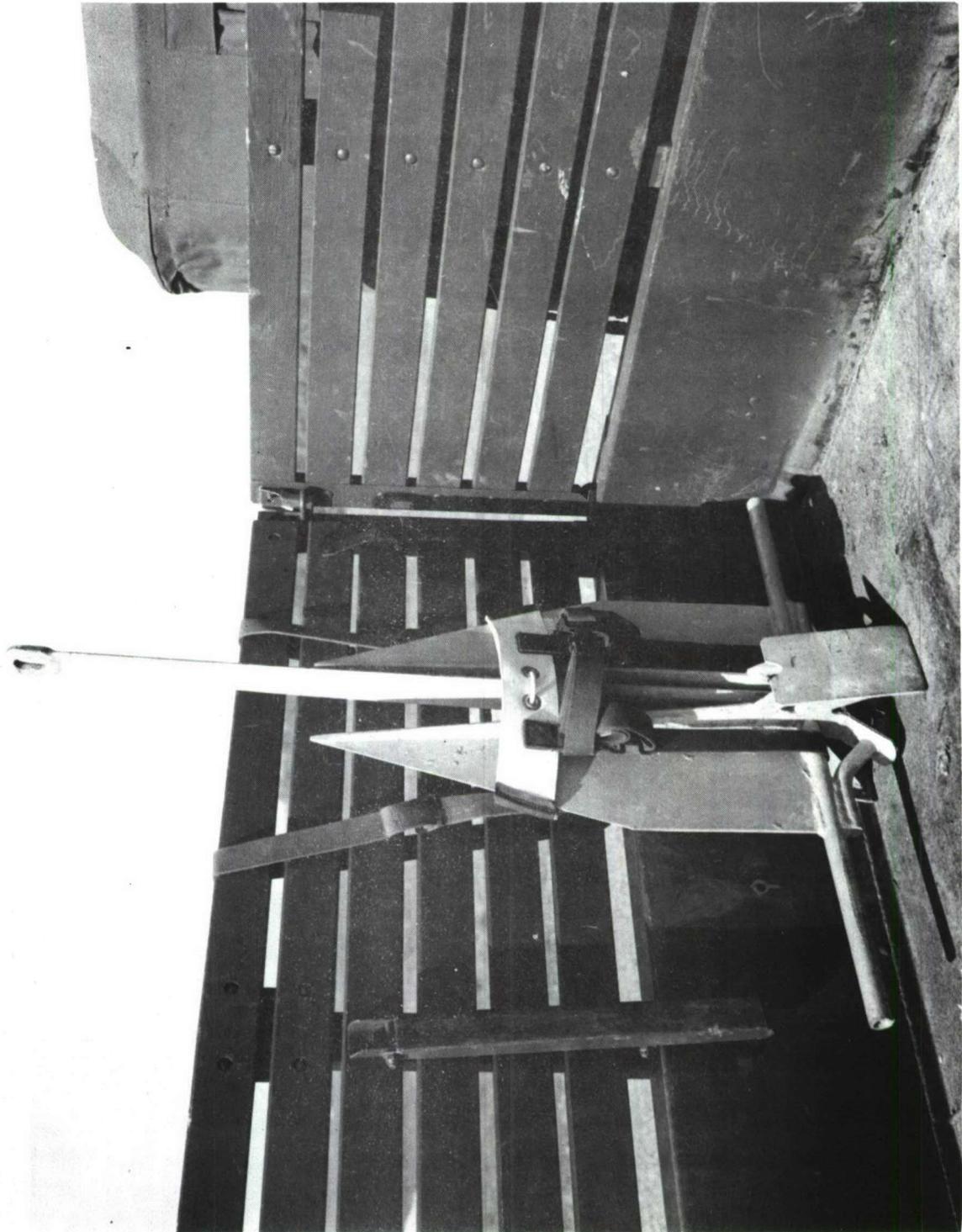


Figure 10. Stowage of Anchor Inside M35 Cargo Bed

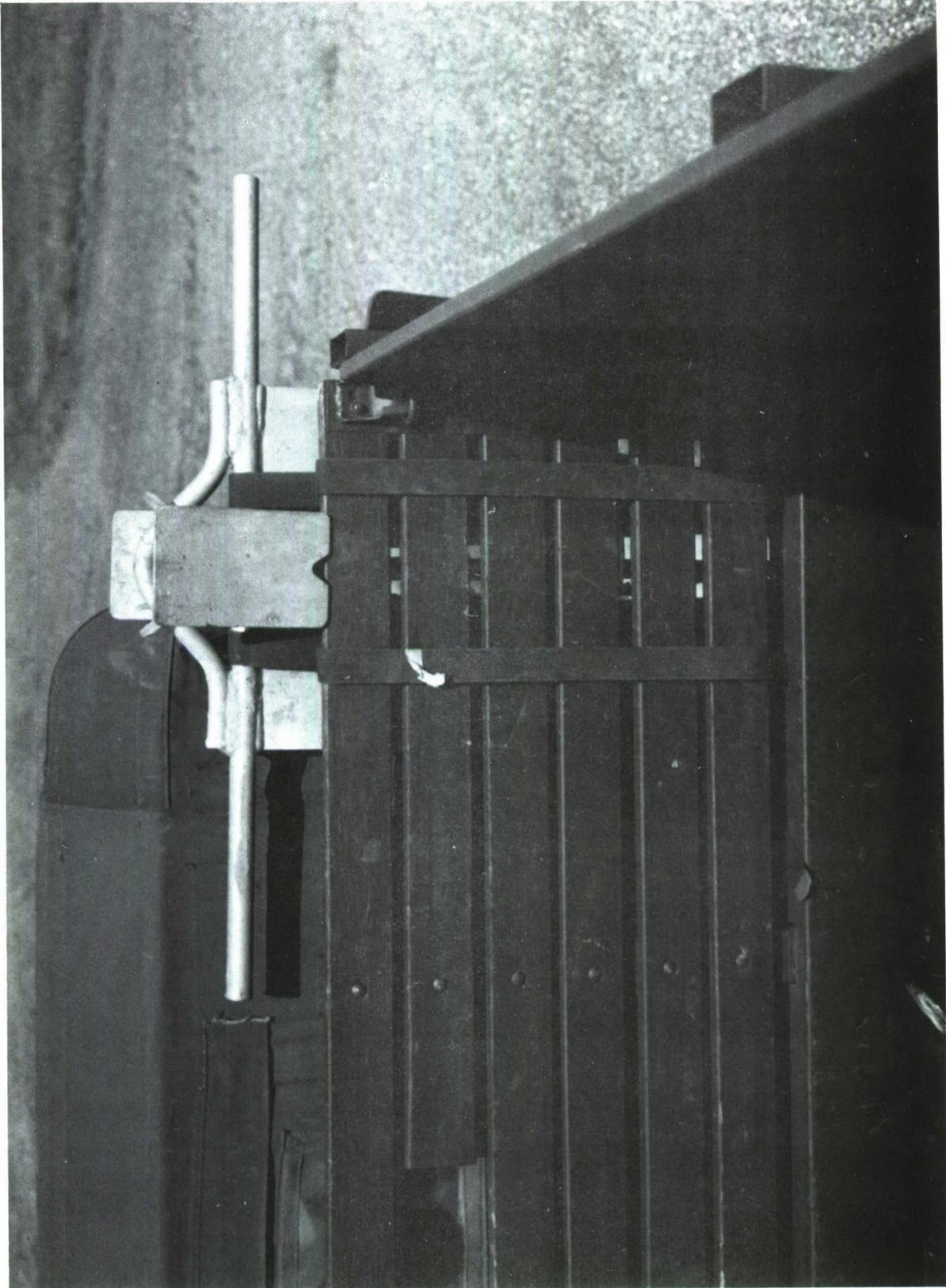


Figure 11. Storage of Anchor Outside of M35 Cargo Bed

DEVELOPMENT AND TEST

The wheel adaptors and capstans for the 1/4-ton truck were commercially available from the McCain Hub Winch Co. For the 2 1/2-ton truck these items were specially designed and fabricated. The front and rear adaptors are identical for the 1/4-ton vehicle; for the 2 1/2-ton vehicle they are different because of the dual rear and single front wheels.

The double braided polyester rope was chosen because it will not cut hands or rust as will steel cable, and it is easier to stow. The polyester rope also has the least stretch of commonly available synthetic fiber ropes. The 5/8-inch diameter rope has an average breaking strength of 13,000 pounds, which in the two strand application to the anchor provides ample strength for recovering either vehicle.

The Danforth-type anchor was chosen because it has good holding power for its weight, and has a self-emplacing characteristic. If the anchor is merely held in position as shown in Figure 6, the pulling force of the vehicle will imbed it; it will usually bury itself completely. Since some structural failures of the anchor occurred in recovery operations of the M35, the 60-pound anchor was reinforced by welding a 1-inch bar across the base of the anchor, as shown in Figure 11.

For tests both vehicles were purposely immobilized in difficult terrain conditions and successfully recovered, as shown in Figures 12 and 13. The capstans were attached in a few minutes, and recoveries were made in 5 to 10 minutes. All recoveries were successful in a variety of conditions and in all cases the anchor was easily retrieved by pulling it out with the vehicle and the extraction rope.

At their request, one kit for each vehicle has been furnished to a military advisory unit in Thailand (MACTRD) for evaluation; the results were not available for inclusion in this report. One of each kit has been furnished to the US Army Tank-Automotive Command, Warren, MI.

CONCLUSION

The Anchor Capstan Kits provide an effective self-recovery capability for the M35 2 1/2-ton Truck and the M151 1/4-ton Truck.



Figure 12. Recovery Operation of M35

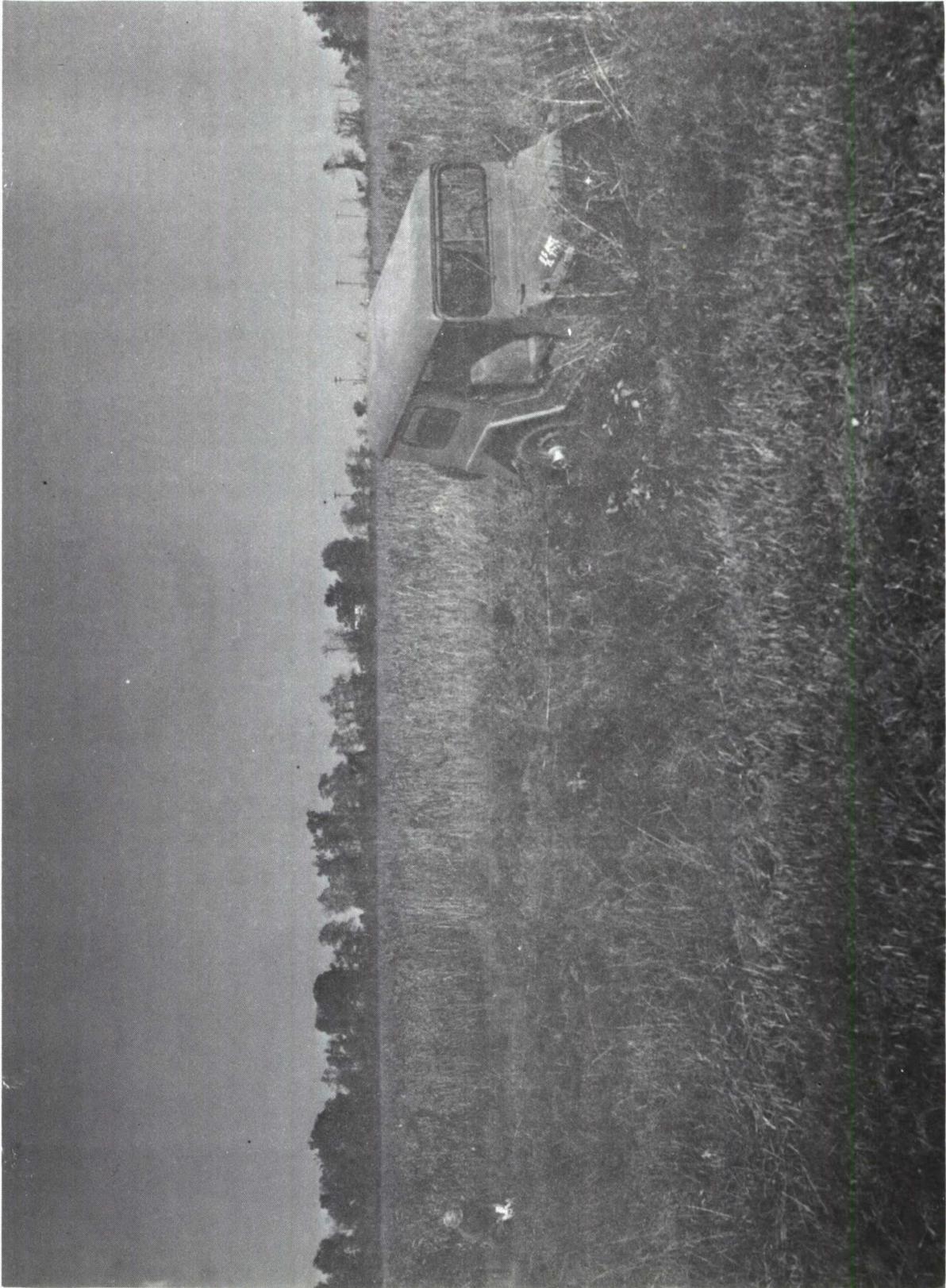


Figure 13. Recovery Operation of M151

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