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DESIGN OF A POWERED WHEEL KIT FOR UH/AH HELICOPTERS

TASK 04-M-73

by

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Mobility Branch

COUNTED IN

April 1974

Final Report

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U. S. ARMY LAND WARFARE LABORATORY

Aberdeen Proving Ground, Maryland 21005

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The need to move helicopters from their landing point to a place of concealment or more appropriate parking spot, was first stated by the 4th Armored Division in Europe. Since 1970, the USA Land Warfare Laboratory has been involved in a number of tasks associated with the ground movement of helicopters. These have involved hardware designed and built to demonstrate both the potential and problems of various means of handling skid-mounted helicopters in rough		

BLOCK 20. ABSTRACT CON'T

terrain. The Powered Wheel Kits are but one of the hardware concepts examined.

The Powered Wheel Kit consists of the standard unpowered ground handling wheel set, which has been modified by application of a power package. Each wheel is driven by a two-cycle engine and hydraulic drive unit. The kit was designed and fabricated, but only brief functional check-out tests were conducted. The task has been reassigned to the Aviation Systems Command for further testing.

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INTRODUCTION

The need to move helicopters from their landing point into a place of concealment or to a more appropriate parking spot was first conveyed to USA Land Warfare Laboratory (LWL) in November 1970 by the 4th Armored Division in Europe through an LWL Liaison Team. At that time LWL initiated a study into the feasibility of moving skid-mounted helicopters in rough terrain. The ground rules for the study were stated in the form of in-house generated military characteristics. These appear in this report as an Appendix.

Discussions with numerous military personnel since the initial writing of the military characteristics have indicated that the terrain requirements specified may be too severe. With that in mind, the design of the powered wheel units was undertaken.

An electrically powered wheel unit was developed for the UH-1 helicopter by Aircraft Dynamics, Lima, Ohio in the 1960-61 time frame, and evaluated by the Army at that time. These "Robotow" units were again evaluated by LWL in 1972 as part of a task to examine expedient means for moving helicopters. The units were designed to use the aircraft battery as a power source, which limited their operating time to under five minutes. Due to the danger of a hot start when using a marginal battery, pilots were reluctant to use the "Robotow" units at all. It was suggested that in order to assess the mobility of the helicopter equipped with "Robotow", that they be powered from a generator set. It was found, however, that with a constant voltage and amperage available the electric motors in the "Robotow" would overheat in less than one minute. Consequently, no valid assessment could be made of the mobility aspects of powered wheels.

Still maintaining the objective of assessing the mobility of powered wheels, development work was begun on a gasoline engine-powered unit which could be used in a manner similar to the "Robotow" unit. Two prototype units were fabricated but scheduled in-house tests had to be cancelled due to the programmed disestablishment of LWL on 30 June 1974. Shakedown testing is to be conducted by the Parent Agency, US Army Aviation Systems Command (AVSCOM), and field testing by Modern Army Selected Systems Test Evaluation and Review (MASSTER). The tests at MASSTER will be a part of Test No. FM 161 "Helicopter Ground Movement Systems", and the test results will appear in the final report on that task.

DESIGN

The in-house Military Characteristics (MC's) were used as a basic guide for the design, but no attempt was made to meet the terrain requirements. See Appendix.

The design is based on using the existing standard ground handling wheels. In principal, it is similar to the "Robotow" units in that it provides power to the helicopter wheels through capstans directly engaging the wheel surface. This wheel/capstan engagement occurs through the normal helicopter lifting motion of the ground handling wheel system.

In addition to the basic guidelines spelled out in the MC's, it was considered that provisions should be made to increase helicopter skid clearance, and to provide a variable speed capability in order to effect smooth maneuvering control.

The detail design and fabrication of the power unit portion of the system was accomplished on a contract with the AAI Corporation, Cockeysville, MD. The power unit consists of a six horsepower air-cooled two-stroke cycle engine, driving a hydrostatic transmission, which in turn drives the capstan through limit clutches, and a series of chain reductions. Figure 1 shows the basic power unit. Figure 2 shows the basic power unit and the control handles mounted on the helicopter. Figure 1 shows the latest unit, while Figure 2 is an earlier unit. The differences are due to a series of engineering changes made during initial testing to alleviate vibration problems. During operation the engines are run at a fixed speed and helicopter movement speed and direction controlled through the hydrostatic transmissions. The units are linked together by a flexible push-pull control cable so that both units are controlled at one point. The cross linking between units is shown in Figure 3. The control handle is a proportional unit with large handle displacements for small cable movements near the neutral position, and a decreasing ratio of handle movement to cable movement toward the extremes. This, in combination with the hydrostatic transmission, provides a very smooth and easily controlled transmission of power.

Figure 4 shows the basic power unit from the capstan side. It was originally intended that the basic unit would be tested with three optional configurations. One, a configuration using unmodified standard ground handling wheels; two, a configuration using ground handling wheels modified to provide additional skid ground clearance; and three, a configuration using the capstan to drive a belt track. The second configuration is shown in Figure 4. Experience with "Robotow" units and initial testing with these units indicated that additional ground clearance will increase mobility. The third configuration was not built and tested due to the disestablishment of LWL.

Figure 5 shows the basic unit assembled with a modified wheel set showing the engagement of the capstan with the wheels.

Figure 6 shows a standard ground handling wheel unit in comparison with a modified unit with both units in the lowered position. Figure 7 shows the same two units in the raised position. The increase in skid ground clearance

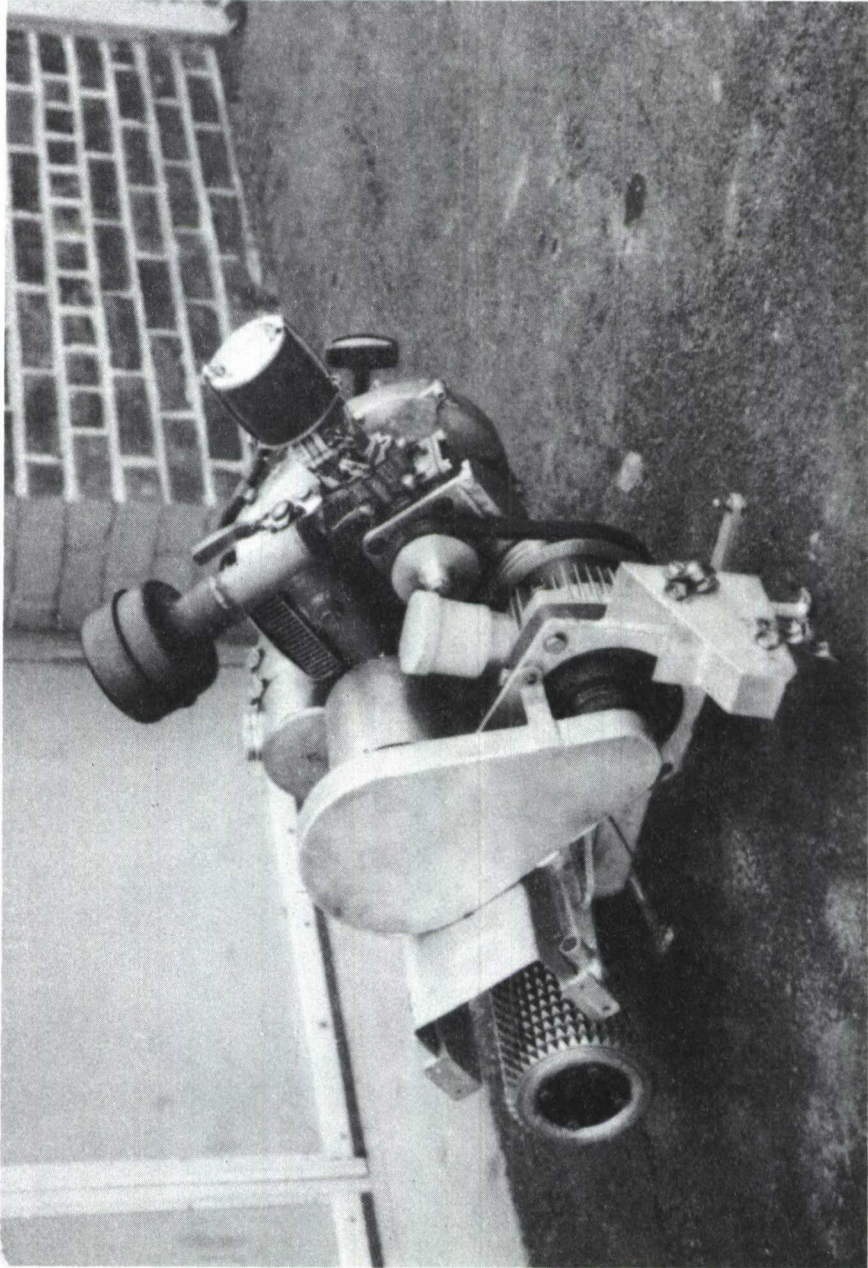


Figure 1. Basic Power Unit

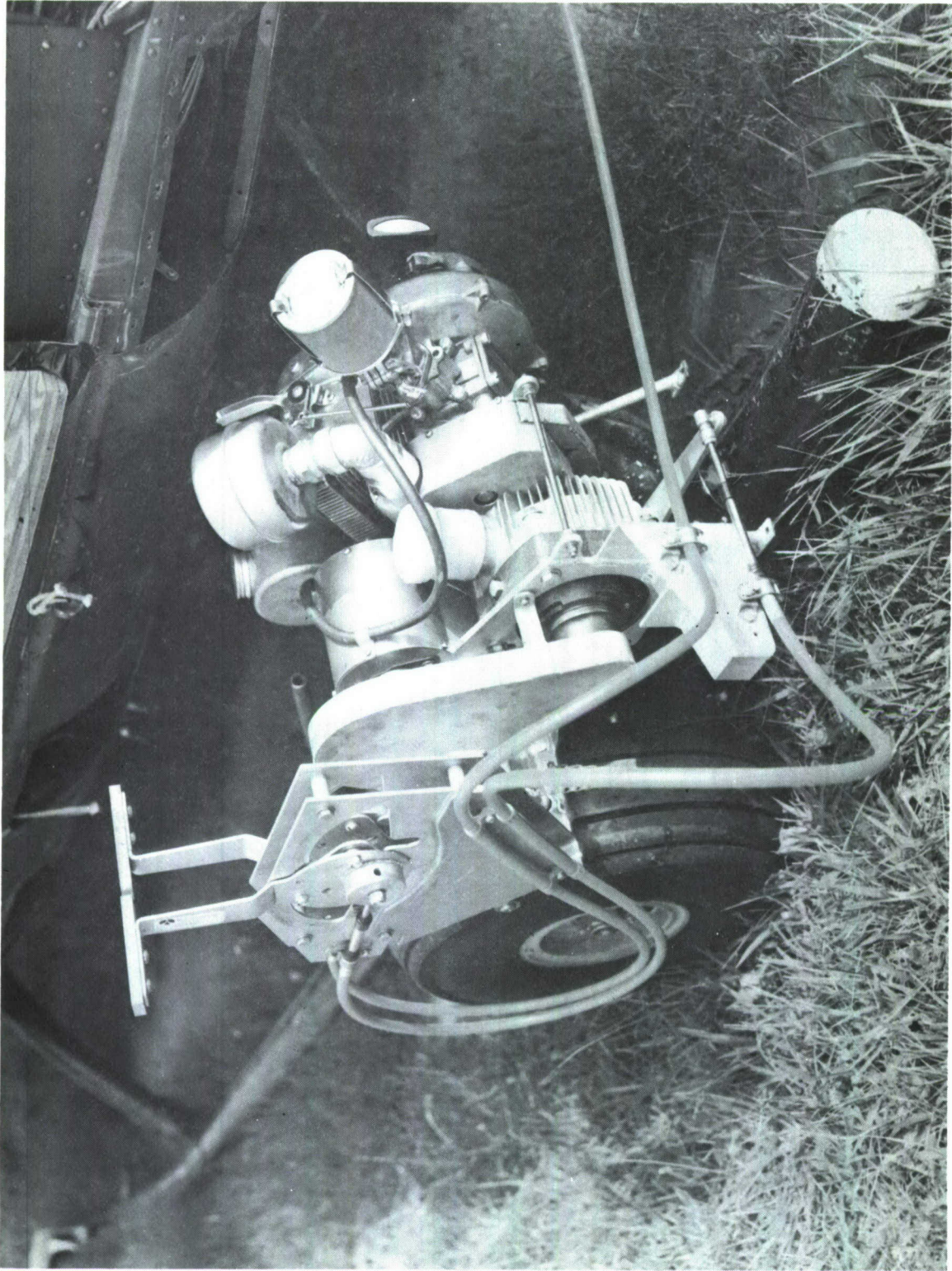


Figure 2. Basic Power Unit Mounted on Helicopter

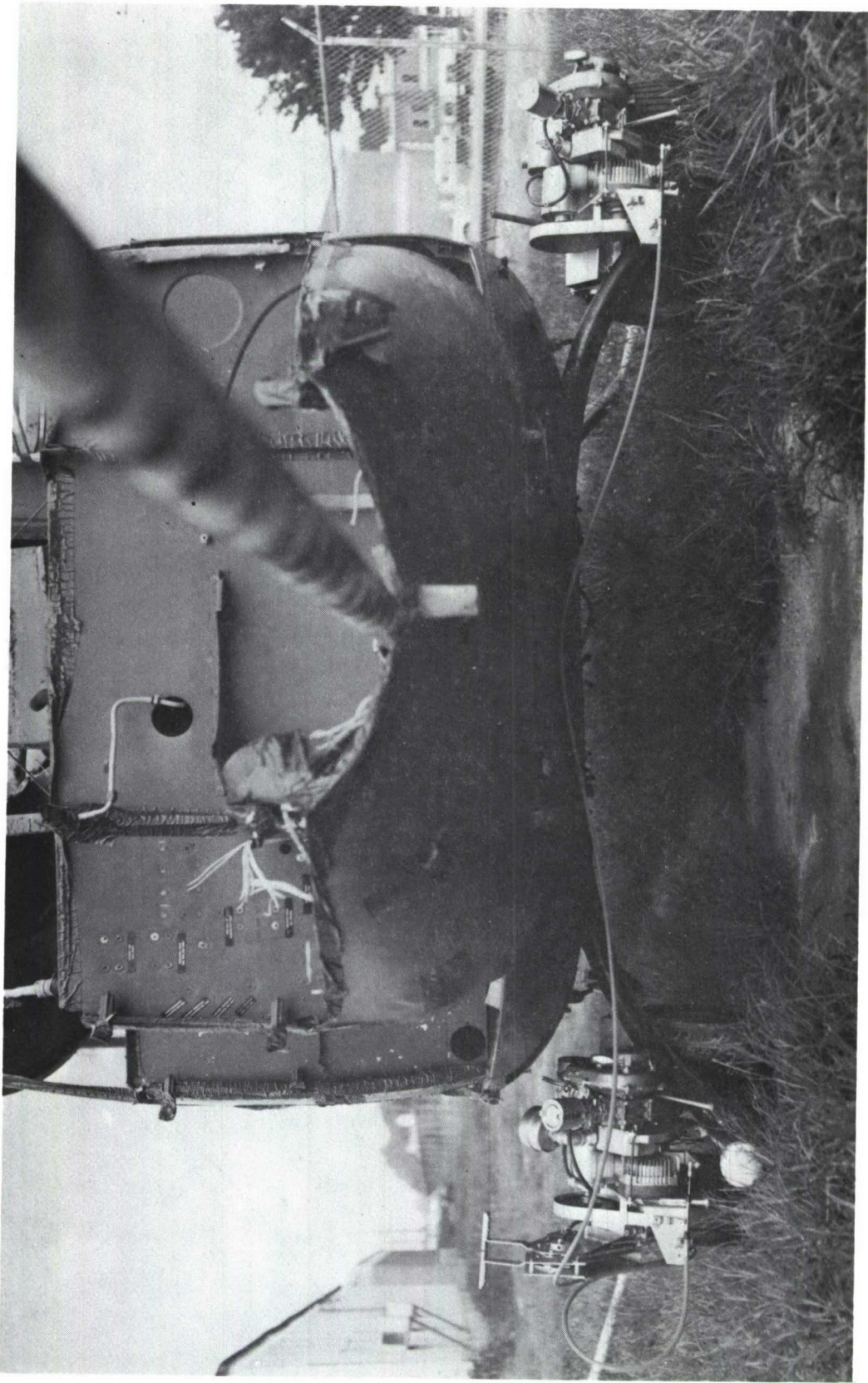


Figure 3. Control Hookup

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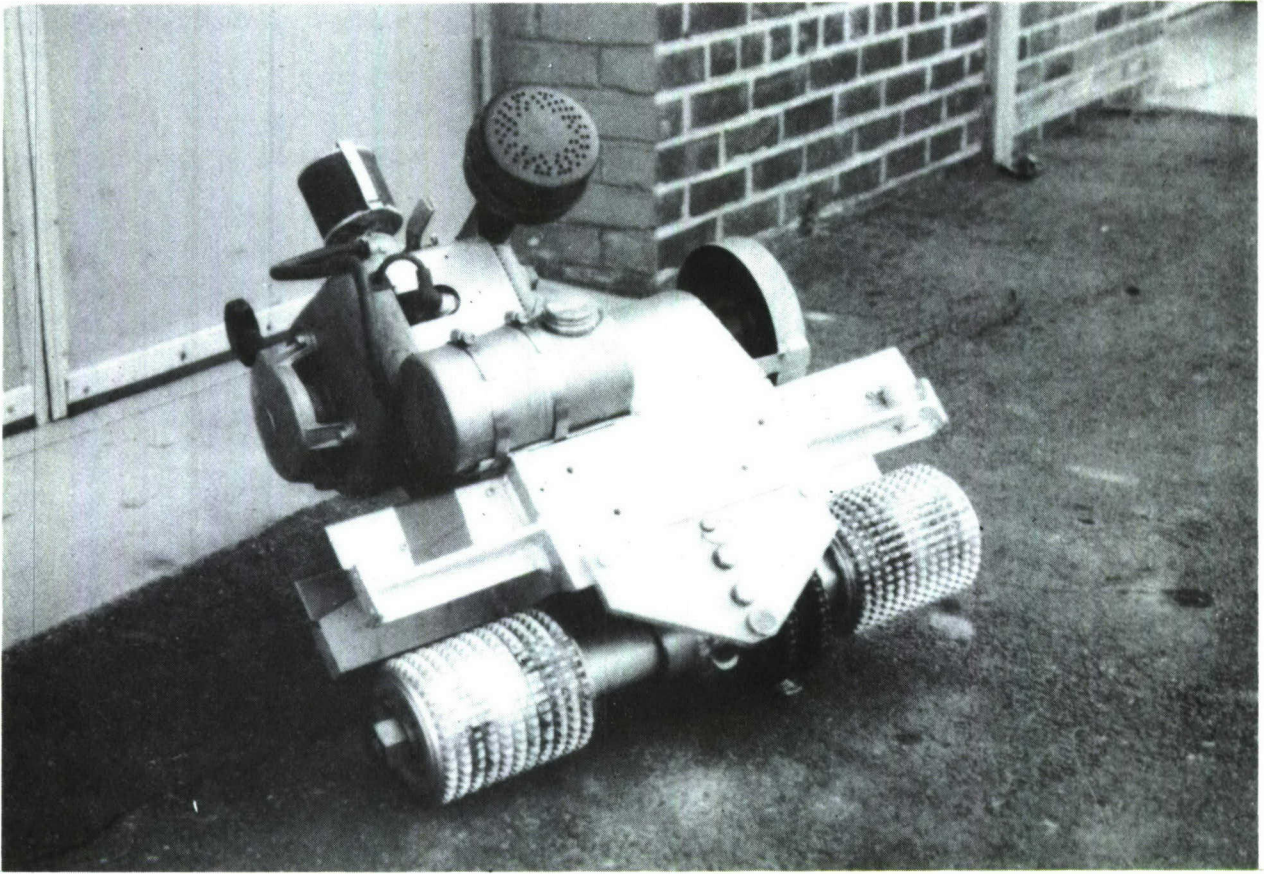


Figure 4. Basic Power Unit-Capstans

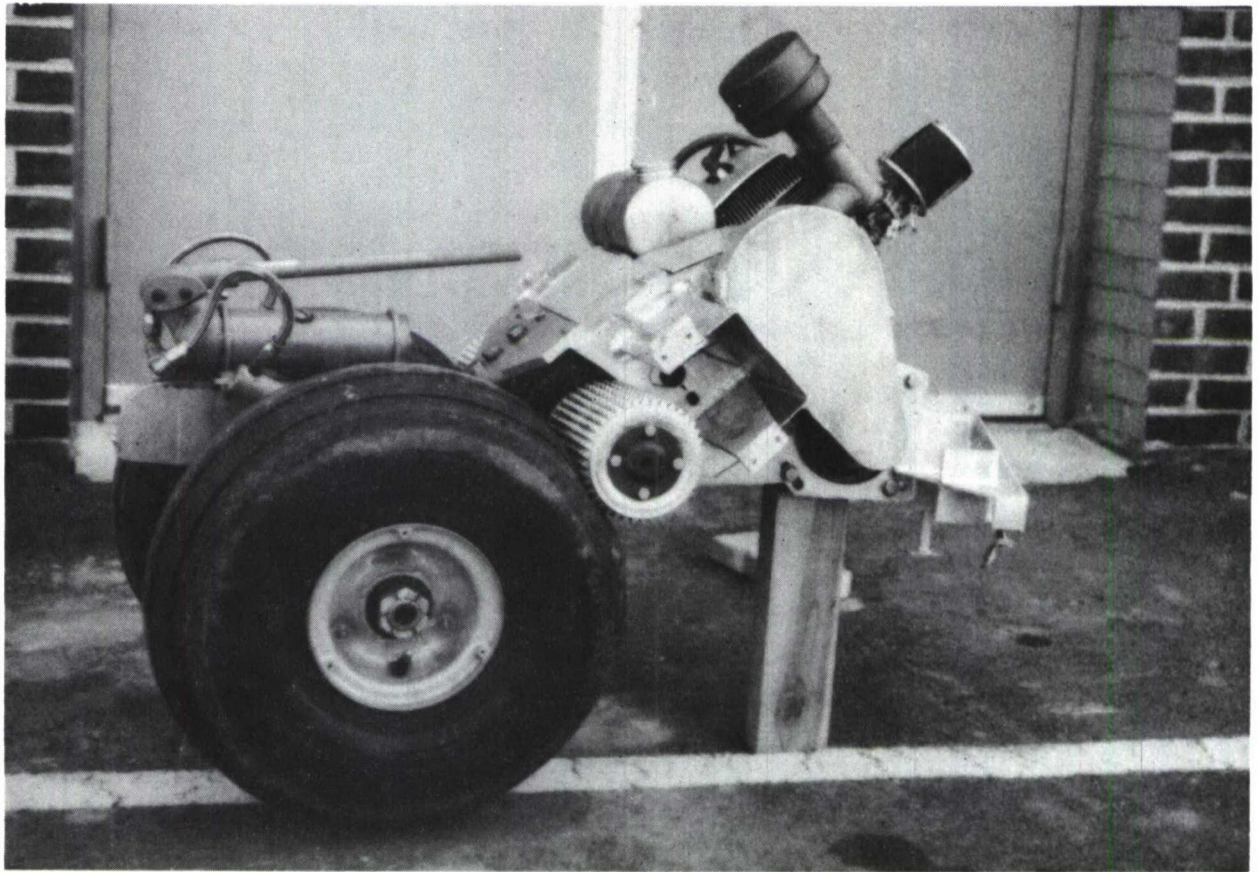


Figure 5. Assembled Unit

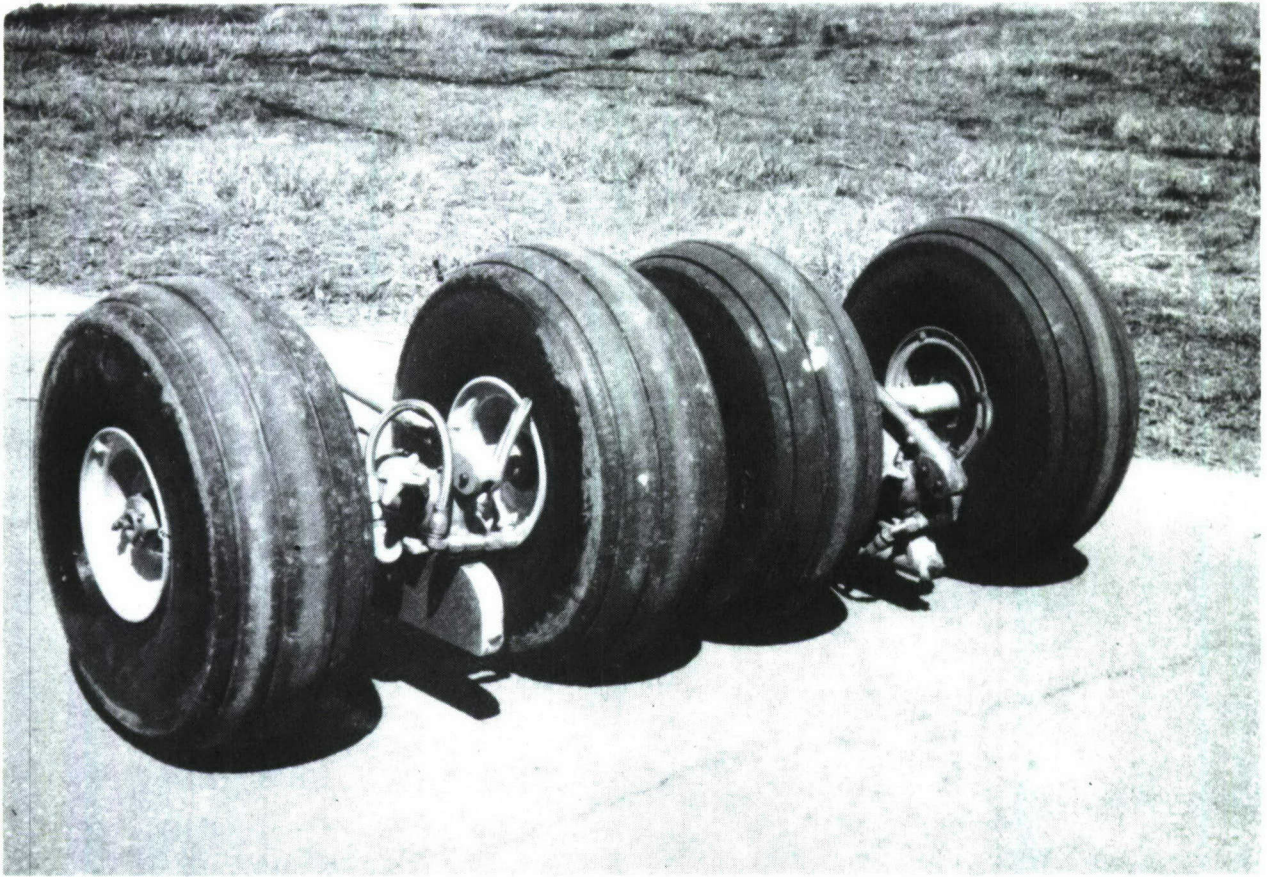


Figure 6. Ground Handling Wheels-Lowered Position

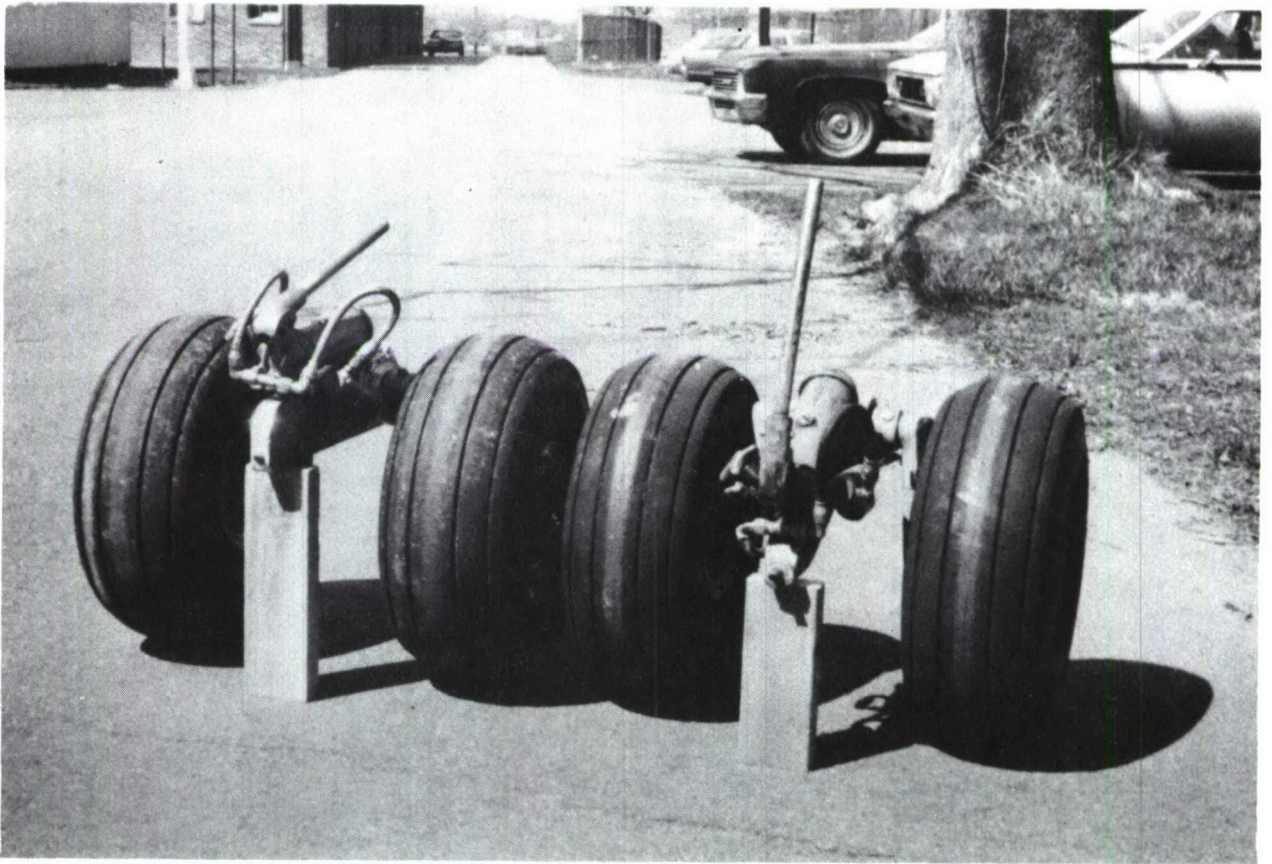


Figure 7. Ground Handling Wheels-Raised Position

of approximately three inches is due to a change in the geometry of the strong-back portion of the wheel unit which effectively lowers the wheel pivot point. All other components of the wheel set are the same. It would be possible to accomplish this same design change on the standard unpowered ground handling wheels to improve off-runway movement.

CONCLUSIONS

The design approach of the Powered Wheel Kit appears to offer a workable means of providing powered ground movement of helicopters.

The Powered Wheel Kit provided increased skid ground clearance. Consideration should be given to incorporating increased skid clearance as a design change in the standard unpowered ground handling wheels.

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APPENDIX

21 December 1970

MILITARY CHARACTERISTICS FOR FEASIBILITY STUDY FOR ROUGH TERRAIN GROUND HANDLING SYSTEM FOR HELICOPTERS

1. REQUIREMENT:

a. Provide U.S. Army units with the capability of pushing or pulling helicopters across rough terrain and maneuvering them rapidly into and out of tree lines so that they could be easily concealed from aerial view and camouflaged.

b. Source of Requirement: USALWL Briefing Team to USAREUR (LTC Romig and Mr. Shira), 4th Armored Division, November 1970.

2. OPERATIONAL & ORGANIZATIONAL CONCEPTS:

a. Operational Concept: Aviation units would use this item as part of their ground support equipment. It would be transported to the site either by vehicle or by aircraft.

b. Organizational Concept: It is envisioned that this item would be available through normal supply channels for the class of supply and would be issued on a basis of one per certain number of aircraft or size of unit.

3. JUSTIFICATION & PRIORITY:

a. Reason for the Requirement: The Ground Handling Kit currently used consists of wheels which raise the skids. The system can only be used with difficulty on rough terrain since there is very little ground clearance and a high ground pressure. A rough terrain system which would permit rapid easy movement of helicopters around on rough terrain and into and out of tree lines does not exist.

b. Priority for Requirement: Priority Grouping III.

4. CHARACTERISTICS:

a. Performance Characteristics:

(1) (Essential) The device should be rugged and capable of moving a helicopter safely over rough terrain to include wet and dry plowed ground and grass grown areas (minimum cone index 40) and to negotiate 15 inch deep ditches or holes without a requirement for digging or disturbing the soil.

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4. CHARACTERISTICS: (Cont'd)

(2) Number of major components: (Desired) 1.

(3) Maximum weight: (Essential) Must be capable of being loaded/off loaded from a vehicle by two to four men by manpower alone.

(4) Maximum Size/Transportability: (Essential) Must require a minimum of space to transport/store and be transportable on a 3/4 ton truck and a UH-1 helicopter as an interior and exterior load. (Desired) Items should have the capability of being nested or stacked when more than one is transported at a time.

(5) Environmental Requirement: (Essential) Climatic Categories 2 thru 7 (AR 70-38).

(6) Paradrop: (Desired) Yes.

(7) Maximum Assemble/Disassemble Time:

(a) Preparation for use from transported mode by two men, (Essential) 15 minutes.

(b) Loading/Unloading helicopter by two men, (Essential) 1 minute; (Desired) ½ minute.

(8) Performance Requirements:

(a) (Essential) Must be capable of moving the following helicopters: UH-1B, UH-1C, UH-1D, UH-1H, OH-58A, OH-6, AH-1G with lateral stability.

(b) (Essential) Require no more than the draw-bar pull of a ½ ton vehicle to move a helicopter with it and be capable of being moved by vehicles up to and including 2½ ton in size; (Desired) 2 men.

(c) (Essential) Not place side loads on the skids of the helicopters being moved.

(d) (Essential) Must be capable of being maneuvered while being moved in order to guide the helicopter between trees and around obstacles.

b. Maintenance Concept: (Essential) Require little or no maintenance.

c. Human Engineering Characteristics: (Essential) Require no special training and be safe in operation in accordance with AR 602-1, dtd 4 March 1968 and AR 385-16, dtd 11 February 1967.

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4. CHARACTERISTICS: (Cont'd)

d. Priority of Characteristics: Performance, size, weight.

5. PERSONNEL CONSIDERATIONS: Introduction of this item into the Army inventory will require no additional spaces in TO&E of tactical units.

DATE 22 Dec 1970

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for 
MIKE ELLIS
LTC, GS
Chief, Military Opns Division

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