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Report 2020

EXPENDABLE, MINE-CLEARING ROLLER

(ENSURE 202.1)

by

David C. Edwards

January 1972

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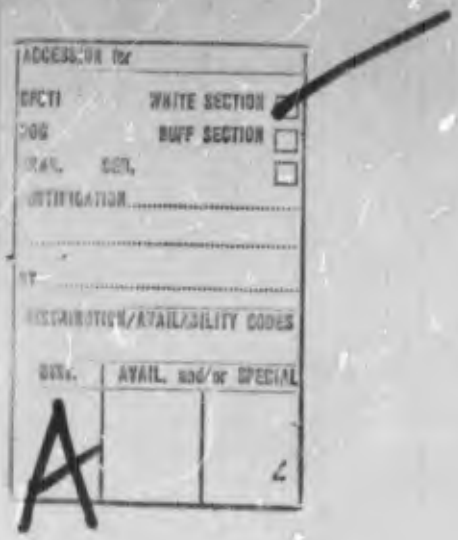
U. S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT CENTER
FORT BELVOIR, VIRGINIA



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13. ABSTRACT

~~This~~ The report covers the development, testing, and field use in South Viet Nam of the Expendable, Mine-Clearing Roller. The data developed and the present status of the roller regarding type classification are also discussed.

The period of time actually covered by this report is from September 1969 through August 1971 and, most specifically, is related to ENSURE 202.1. Appendices include an installation, operation, and maintenance manual prepared by the contractor; the report of the contractor's field engineer while serving as part of the NET team; and a statement of the operational suitability message from USARV. A Final Evaluation Report dated 26 July 1971 is also included. The experience gained from this effort should be categorized as "lessons learned" and be used in the development of more advanced rollers such as the "nonexpendable" type.

Conclusions are that the roller did meet original requirements when operated and maintained as specified but that occasionally the user did change the mission and failed to maintain the equipment as required.

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Report 2020

EXPENDABLE, MINE-CLEARING ROLLER

(ENSURE 202.1)

ACTIV Project No. ACR-202.1E/71

January 1972

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The Commanding Officer
U. S. Army Mobility Equipment Research and Development Center

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SUMMARY

This report covers the development, testing, and field use in South Viet Nam of the Expendable, Mine-Clearing Roller. The data developed and the present status of the roller regarding type classification are also discussed.

The period of time covered by this report is September 1969 through July 1971 and most specifically is related to the Emergency Non-Standard Urgent Requirement for Equipment program (ENSURE 202.1).

Appendices include an Installation, Operation, and Maintenance Manual prepared by the Contractor; the Report of the Contractor's field Engineer while he served as part of the New Equipment Training (NET) team; and a statement of operational suitability message from United States Army, Viet Nam (USARV). A Final Evaluation Report, dated 26 July 1971, is also included as an appendix.

The experience gained from this effort should be categorized as "lessons learned" and should be used in the development of more advanced rollers such as the "nonexpendable" type.

The report concludes that the expendable, mine-clearing roller performed its intended design function of detonating land mines buried in roads, thus destroying the expendable portion of the roller but protecting the propelling vehicle from damage.

FOREWORD

This report is a record of efforts by the U. S. Army Mobility Equipment Research and Development Center (MERDC) in response to ENSURE 202.1. Authority is DA Message 914617, ACSFOR OS CSS, dated 272309Z June 69, Subject: M48 Tank Mounted Mine Clearing Roller (ENSURE 202) (U).

Testing was conducted at the Engineer Proving Ground (EPG), MERDC, and at the Contractor's plant in Hartville, Ohio, during the period December 1969 through February 1970. The NET team installed the roller on vehicles attached to USARV during February through June 1970.

The NET team was composed of David C. Edwards, Military Engineering Division, formerly Engineering Department, Joseph E. Smith, Barrier and Countersurveillance Division, Military Technology Department, and Donald C. Price, Teledyne Monarch Rubber Co., Inc.

In-country assistance was rendered by Vernon W. Urie, MERDC, serving as USAMECOMS Viet Nam Laboratory Assistance Program Army (VLAPA) representative with the Army Concept Team in Viet Nam (ACTIV).

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SEQUENCE OF SIGNIFICANT EVENTS

Date	Event
May 1967	USARV requirement stated (ENSURE 202)
Sep 1968	MERDC satisfies above requirement by shipping rollers under ENSURE 202
May 1969	ACTIV Evaluation of ENSURE 202 & ENSURE 202.1 initiated
8 Dec 1969	Contract DAAK02-70-C-0186 awarded to Teledyne Monarch Rubber Co.
Dec 1969–Feb 1970	Preproduction testing @ Engineer Proving Ground (EPG)
8 Mar 1970	First roller delivered to combat unit: 11th Armed Cavalry Regiment (ACR) in RVN
Feb–Jun 1970	NET team deployment in Republic of South Viet Nam (RVN)
Jan 1971	ACTIV Statement of Operational suitability for the M48 Tank-Mounted, Mine-Clearing Roller (ENSURE 202.1)
Jul 1971	Final Evaluation Report on the M48 Tank-Mounted, Mine-Clearing Roller (ENSURE 202.1) from USARV

EXPENDABLE, MINE-CLEARING ROLLER

(ENSURE 202.1)

I. INTRODUCTION

1. **Background.** Considerable effort was expended by MERDC (then Engineer Research and Development Laboratories) in the period April 1953 through October 1957 on mine-clearing rollers both expendable and nonexpendable. This work is recapitulated in ERDL Technical Report 1632. Additional background information on mine-clearing devices is included in MERDC Report 1924 dated March 1968.

In 1967, USARV sought aid from MERDC to provide some suitable device that was abreast of the state-of-the-art and that would provide a means to detonate or disable antivehicular mines placed in or on major routes of supply. Under a limited-warfare situation such as in Viet Nam with no real fronts and an opponent who relies heavily on guerilla tactics, the U. S. Army continually encounters harrassment-type, mine-warfare situations. The mining done by V. C. type opponents consists primarily of low-density emplacements as opposed to the more classical mine field. Most mining is done on or near supply and access roads of strategic or tactical importance to allied forces.

In order to clear long strips of road by conventional methods of detection, considerable time is needed and specially trained troops are required to operate and appreciate this equipment and to deactivate mines which are encountered.

The Army, therefore, had a need for a device which could be used to detect or destroy low-density mines on roads at a greater rate of speed than was possible at that time.

MERDC's approach to this problem was to destroy mines with an activation signature produced by a device mounted on a prime convoy escort vehicle–the M48 tank. The signature-simulating device was nothing more than a load-producing mechanism pushed in front of the tank.

Since mobility requirements dictate a device which does not encumber the prime mover, a lightweight system capable of transmitting a large load to the ground was desired. These seemingly self-exclusive ends were brought together by coupling a torsio-elastic, weight-transfer device to a relatively light and inexpensive roller which precedes the tank. The weight-transfer device, in effect, lifts the front end of the tank and transfers the load through roller wheels to the ground in front of the tank.

Because the device is necessarily lightweight, it could not be designed, as older mine rollers were, to withstand repeated mine detonations without damage. The MERDC solution to this problem was to design the roller so that only specific sections would be destroyed when mines were activated. Thus, the name, expendable, mine-clearing roller.

II. INVESTIGATION

2. **Tests.** The following tests were performed.

a. **Field.** The original expendable, mine-clearing roller (Model I) utilized a drum-type roller (Fig. 1). On field testing, these rollers were found to have a too-limited sweep path and also were found to "bridge" or span over potholes and irregularities in the terrain. A new alternative was devised whereby six tank road wheels are mounted on a central axle (Fig. 2). Each wheel is individually capable of vertical articulation. Also, the wheels are linked by a cable system which distributes the load equally under each wheel regardless of its relative vertical position (Model Ia).

The concept of Model Ia was demonstrated by testing at the Engineer Proving Ground (EPG) and by operational tests in Viet Nam.

Several structural shortcomings were noted during these tests, and a re-designed model (Model Ib) was generated.

This new model encompasses stronger materials and redesigning at weak points as well as a more responsive weight-distribution system.

All the changes made to Model Ia to convert it to Model Ib were contained in the expendable portion so no modifications would be necessary on units presently in the field. Model Ib replacement rollers can be installed in less than 1/2 hour.

Prototypes of Model Ib were tested at EPG, and a production lot of six of the rollers was made. The shipping date for these items was September 1968. This production was known as ENSURE 202. The six rollers were used by various units in Viet Nam, and an ACTIV evaluation resulted in an add-on to ENSURE 202 (which became known as ENSURE 202.1) for a quantity of 21 rollers with replacement, expendable parts to last for a minimum of 6 months. A contract for these 21 units plus 180 sets of spare or expendable parts was awarded to Teledyne Monarch Rubber Company of Hartville, Ohio, in October 1969 (Appendix A).

C1706

Fig. 1. The original expendable, mine-clearing roller (Model I).

F10358

Fig. 2. The Model Ia roller in which six tank road wheels are mounted on a central axle.

The first model under this contract (DAAK02-70-C-0186) was delivered to Fort Belvoir in the first week of December 1969. This model had incorporated within it certain recommended changes as a result of use in Viet Nam.

Some of these changes were the replacement of "needle" type bearings in the bogie wheel hubs with self-lubricating bushings and an improved cable-pulley arrangement. Testing of the first production model under Contract DAAK02-70-C-0186 was conducted at EPG in December 1969 and January 1970.

ACTIV had recommended a minimal pre-production acceptance test of 50 miles of high-speed running on the gravel loop and 50 miles of slow speed over the "torture course." These two different test conditions would adequately check out the endurance of the new type wheel bushing and the articulation capability of the wheel yoke assembly.

After mounting on the test vehicle, the entire roller assembly was checked out and adjusted and lubricated. The first test was the 50-mile, high-speed run on the gravel loop at EPG.

At the completion of the 50-mile run at approximately 25 mph, 3 of the 12 wheel bushings were found to be extremely hot. Upon disassembly, it was discovered that the thrust washer which also served as a grease seal had cupped and the grease had burned out. After examination and replacement of the 3 wheel-arm assemblies, it was decided that the problem had probably been due to overtorquing the wheel nut during assembly. A torque limit was established for assembly, and no further problem was encountered with this configuration.

The second major difficulty encountered in the endurance tests was at the attachment points on the test vehicle. The pins which married the frame of the roller to the hull of the tank were retained with a washer and cotter key. While the test vehicle was negotiating the torture course, the frame would rack and the cotter key would shear off and after a very short distance the entire pin might work out and be lost. This problem was solved by redesigning the pin retainer. This was done by substituting a retaining plate in lieu of the cotter key. No additional pins were lost.

Weld failures occurred at two similar locations (at the extremity of each of the extension arms), and this proved to be a design deficiency (Fig. 3). This deficiency was corrected by instructing the fabricator to increase the size of the weld in the critical areas and to supplement the weld with internal gusset plates.

The shear bolts failed in tension at one point, and it was decided that the shear plates should be thickened and milled to insure at least 80 percent contact.

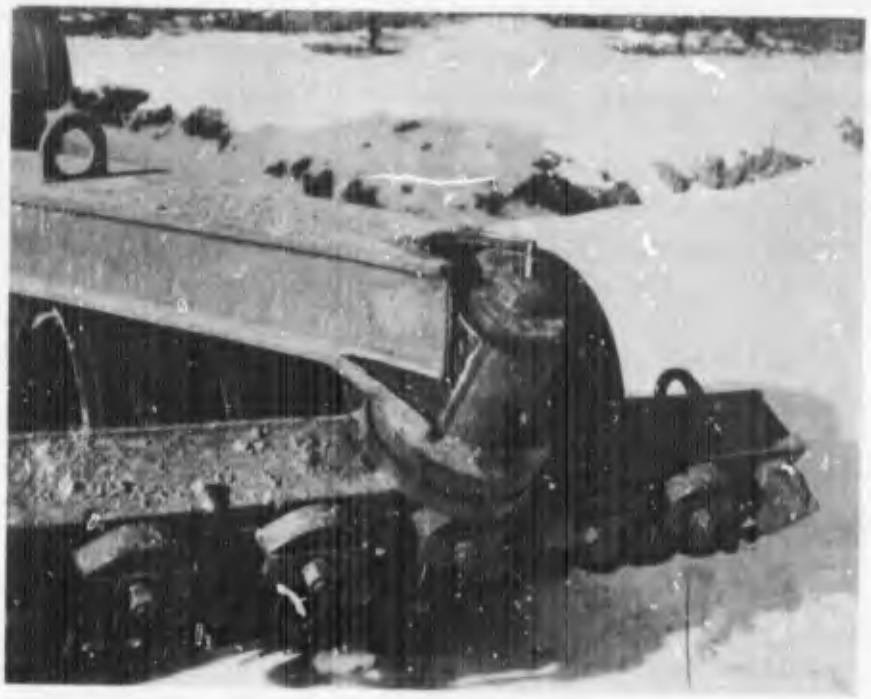

Fig. 3. Weld failure at the extremity of the extension arm.

This would then control the method by which the shear bolts would fail. (All subsequent instances of bolt failure were definitely caused by shear rather than tension.)

The tests led to the discovery of another phenomenon which may be construed as a failure. Ambient temperatures in the vicinity of 0^{o} F were encountered. The material of which the weight-transfer mechanism of the roller is made assumed a "cold weather set," and the roller would no longer produce the signature pressure desired. This elastomer compound had been designed for an operating ambient temperature of 70^{o} F or above which would normally be expected in Southeast Asia (SEA). Although this cold-temperature problem cannot be anticipated in SEA, it could well be very detrimental to the roller mission if the roller were deployed to less temperate climatic areas. Separate work has been undertaken to provide either a compound that has a wider latitude of temperature operating ranges or a separate, special, cold-temperature compound.

Since the majority of failures were of a design nature and not operational, it was decided that the first production model would be returned to the contractor for refurbishing and subsequent delivery to SEA with one stipulation: that one complete yoke assembly be tested by MERDC for a minimum of 500 miles with lubrication

not to exceed once in every 30 miles. The contractor refurbished the first production model; and, in addition, the contractor was required to put a random sample wheel on a Bureau of Standards test wheel for an endurance run of 500 miles. During the 500-mile test conducted by MERDC, the wheel bushing presented no further problem; however, the wire rope sheaves wore excessively. This excess wear was ultimately controlled by pressing a bronze bushing into the sheave.

The first roller under ENSURE 202.1 was delivered to a combat unit (the 11th Armored Cavalry Regiment based at Quan Loi) on 8 March 1970.

b. Rail-Impact Tests. In the preparation of a purchase description (used in lieu of a specification) by which the roller would be procured, the "standard" packaging requirements were set forth by the Standardization Division. These requirements included the railcar impact tests in accordance with MIL-STD-1186, Appendix I. (This test requires the loaded car to strike a string of five cars with draft gear extended at a speed of not less than 10 nor more than 11 miles per hour.)

Since the manufacturer's representative and the local railroad personnel in the area had never seen this test performed, they had no knowledge of the severity of a 10-mph impact. The contractor's packaging personnel made a good effort, but the test itself was a failure. Knowledge about packing and impact was learned very quickly by all witnesses of the test.

A second test was conducted about 2 weeks later with considerable effort obviously having been put into the preparation; however, the proper type of railcars to conduct the test was not available from the railroad. Box cars with steel decks prevented proper tie-down. The faulty tie-down was probably the major factor in the failure of the second test.

It was decided by cognizant authority of MERDC that further impact tests were unnecessary because:

(1) The contractor had made a diligent effort to meet the requirements and time was of the essence due to the urgency of the procurement.

(2) The hardware itself could probably never be injured in any impact.

(3) The shipments would not be made by rail but would be by air with only a short haul by motor freight.

It was further agreed that, if the purchase description ever evolved into a specification to be used in future procurements, the railcar impact tests would again

be a part of the requirements because rail shipment would probably be the most common mode of transportation. MERDC packing and packaging engineers agreed to this decision because of the urgency of supplying USARV with the rollers. It was contrary to their guidelines; but, because of the unusual situation, the exception was made with the approval of the Chief, Military Engineering Division.

Final component packing to prepare for shipment to Viet Nam is shown in Figs. 4, 5, and 6.

c. **Preproduction Tests.** The preproduction tests were performed by the Teledyne Monarch Rubber Co., Inc., as follows.

(1) **Background.** Under ENSURE 202, a few models of the expendable, mine-clearing roller were sent to USARV ACTIV for evaluation. This evaluation resulted in acceptance with certain modifications being recommended. These recommendations pertained to changing tolerances and materials and making other minor engineering improvements.

(2) **Test Requirements.** By confidential message from CGUSARV, dated 23 October 1969, an acceptance test consisting of 100 miles (50 on improved road and 50 on unimproved) was requested. This test was to be run on the first-production model.

It was decided to conduct the test at EPG, Fort Belvoir, Virginia. The 50 miles of unimproved road would be on the "torture" course.

(3) **Test Results.** The testing was begun immediately after the first-production model was received from the Contractor in early December 1969. A total-durability test of 126 miles was imposed on the first-production model.

The first 50 miles of running on the gravel road at high speeds (up to 25 miles per hour) resulted in the loss of three wheel bearings. This was later ascertained to be the result of overtorquing of the nut and thrust washer on the wheel axis. A torque limit technique was established with the manufacturer and has satisfactorily prevented a reoccurrence of this problem.

The rough-terrain, or "torture," testing brought out several latent defects in the welding design of the frame of the roller. The ends of the extension arms broke several times, and it was obvious that the welds were underdesigned. The pinning of the attach points (between roller frame and tank hull) was inadequate when the torture course produced a "racking" movement to the roller. The cotter keys sheared and the pins fell out. The broken welds were repaired

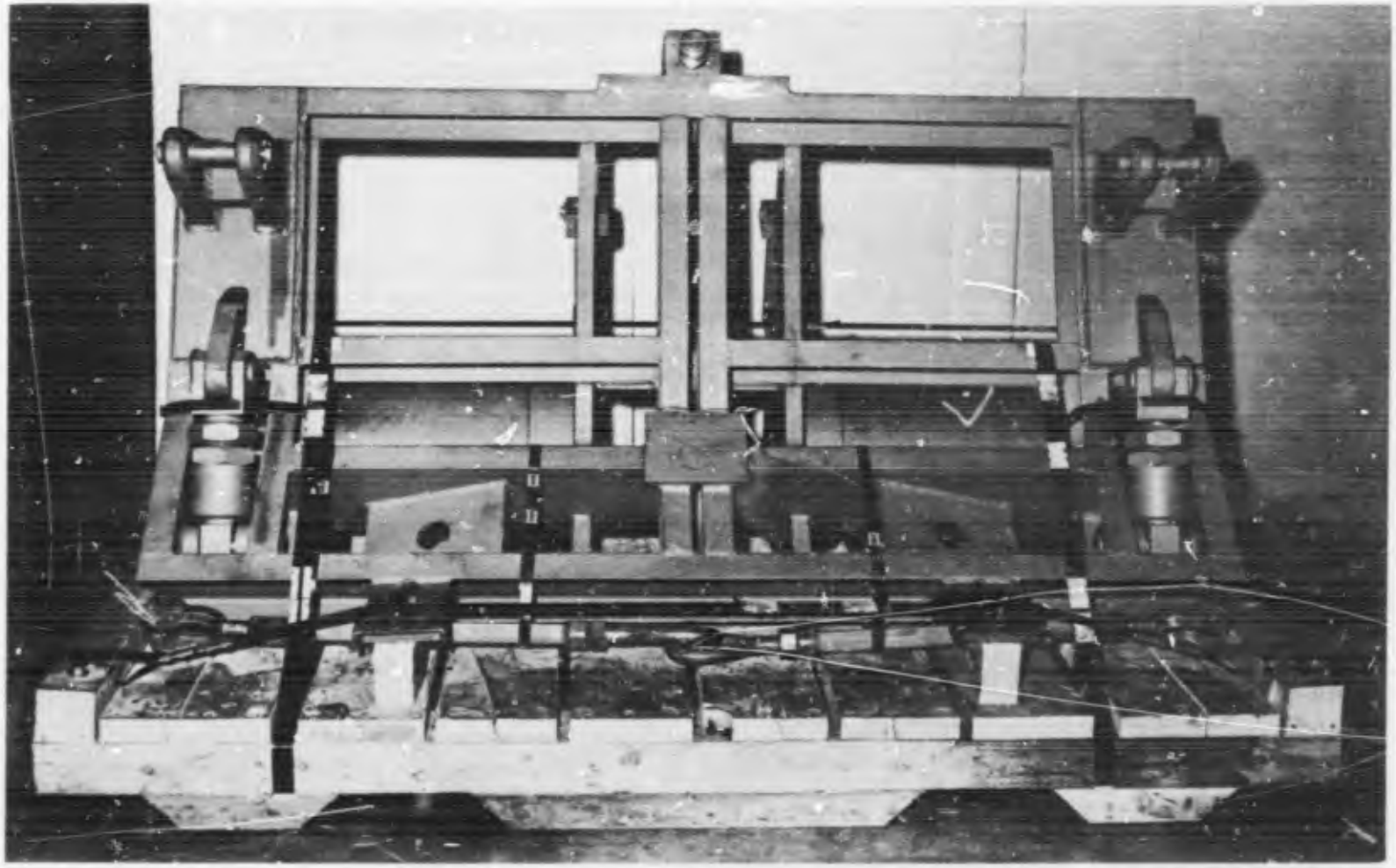

Fig. 4. Main frame ready for shipment.

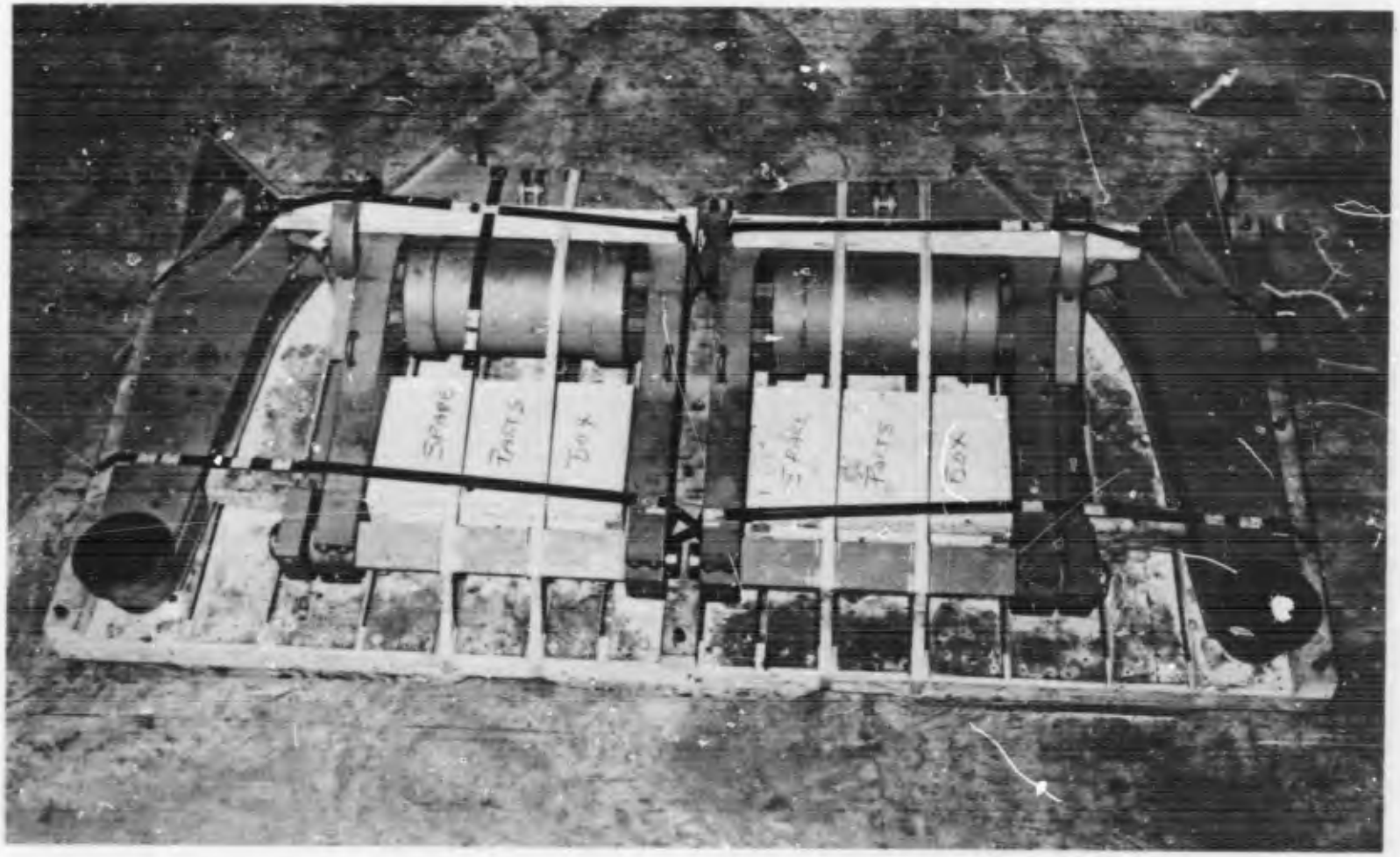

Fig. 5. Wish bone (secondary) frame and extension arms ready for shipment.

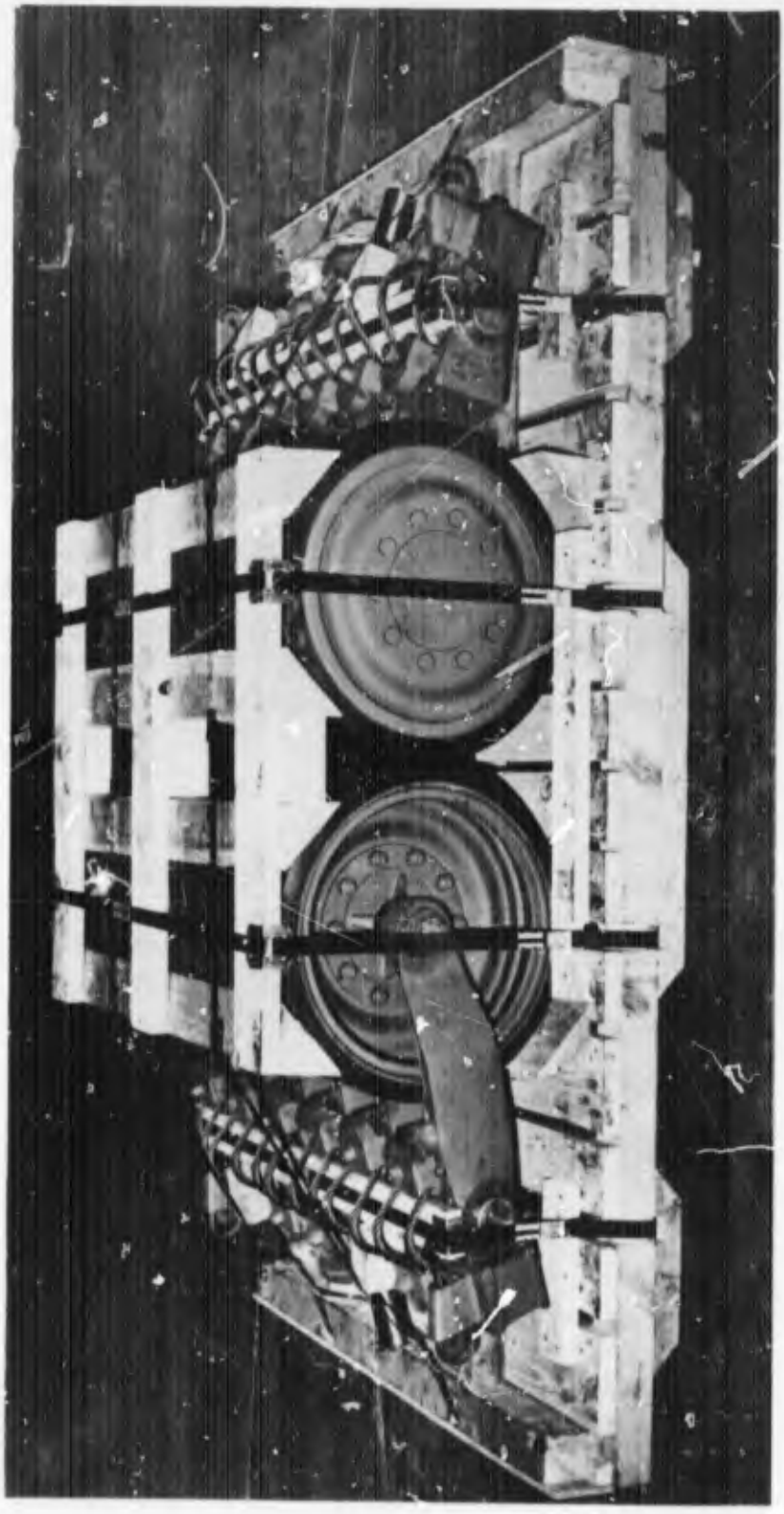

Fig. 6. Wheel yoke (expendable components) assemblies ready for shipment.

and reinforced on the spot on this first-production model and an Engineering Change Proposal (ECP) was prepared providing an adequate weld design. With the implementation of this ECP, there has been no further indication of this being an inherent weak area in the design of the roller. An ECP redesigning the method of locking the pins in place has also been incorporated in the Technical Data Package (TDP) and no reoccurrence of this problem has been experienced.

The temperature at EPG during the test was in the 0^{o} F – 25^{o} F range, and an unexpected characteristic of the roller was experienced. The torsion elements which are made of rubber and which provide for the weight transfer of the prime mover to the road wheels took on a "cold set" and the roller would not deliver its designed ground pressure. This phenomenon is not a factor in RVN but should be considered when broad environmental requirements, including low temperatures, are involved.

At the conclusion of the durability test, about 25 percent longer than suggested by USARV, it was decided that production could begin after incorporation of all Engineering Changes that corrected the deficiencies. Production testing on expendable assemblies randomly chosen from the first five units was scheduled to be performed at Fort Belvoir, Virginia.

d. Production Tests.

(1) Background. Confidential Message No. 70305 (5 July 1969) USARV to Department of the Army, Washington, D. C., required that expendable components of the tank-mounted, mine-clearing roller must be capable of 30 miles of operation before maintenance and 500 miles of operation before wearout. Two expendable assemblies, randomly chosen, were tested for compliance with the above requirements prior to release of this hardware to the user.

(2) Test Conditions.

(a) Duration – Minimum of 500 total miles.

(b) Terrain – Testing was split between the improved dirt loop, concrete loop, torture course, blacktop road, and improved and unimproved roads in the Range One area.

(c) Weather – Ambient temperatures of 20^{o} to 50^{o} F in extremes of mud and dust.

(d) Speed – Initial run-in – 5 mph
Torture Course – 5 mph
Loops – 23 mph
Range One – 10 mph

(3) Test Results. Tests began 20 February 1970 and were completed 12 March 1970. A total of 504 miles was accumulated on the roller. Two wheel-articulation cables failed at the following points:

(a) Driving on smooth open road at 10 miles per hour and 64 miles into the test.

(b) Driving in the torture course at 5 miles per hour and 433 miles into the test. Actual mileage on this cable was 384 miles at failure.

(4) Discussion. With the exception of the two broken cables, the two assemblies satisfied the durability and maintenance requirements. Following the test, one unit was disassembled and inspected. The cause of cable failure is identified as follows:

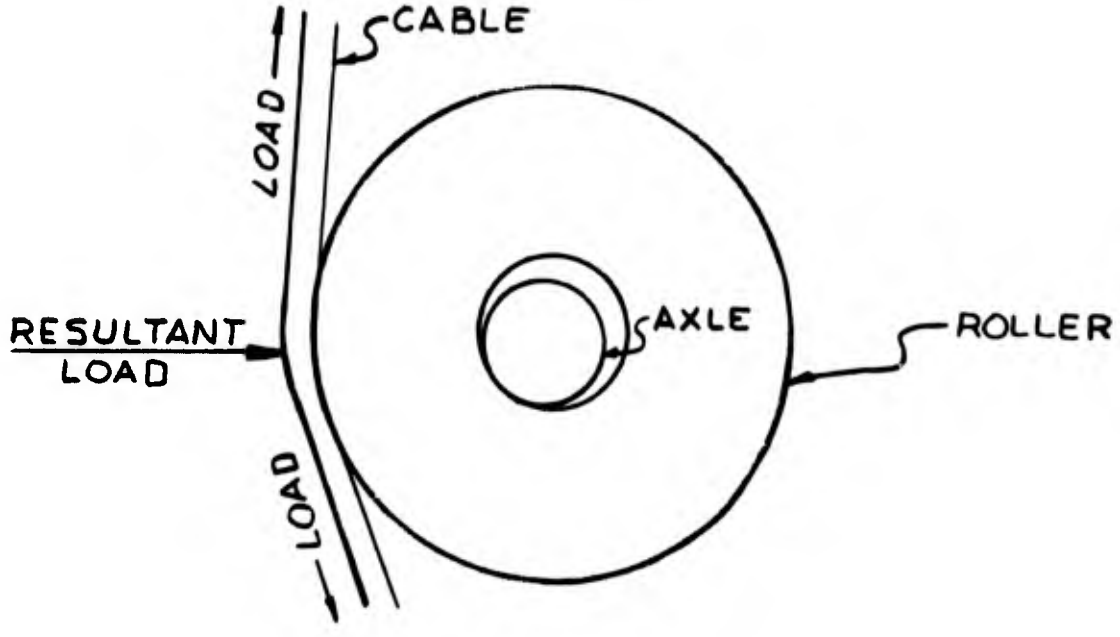

Fig. 7. Cable roller failure.

The resultant load (Fig. 7) caused the roller and axle interface to become galled to such a degree as to seize movement at that interface. The oscillating motion of the

cable then cut a path into the roller causing damage to itself and eventually failing at that point. (This condition existed in various degrees throughout the yoke assembly.)

The road wheel bearings, although somewhat worn, satisfactorily completed the 500-mile requirement. Micrometer inspection indicated that the most worn wheel bearing would probably have failed at about 700 miles. Increased maintenance would not prevent this and, therefore, was not recommended. Sheave bearings, upper wheel arm bearings, and pintle pin all showed tolerable wear within the limits of the 500-mile requirement.

(5) Actions To Be Taken to Correct Deficiencies.

(a) Axle (Fig. 7) – Increase hard chrome plating from .0005" – .0007" range to hard chrome minimum .001" – .002" thick.

(b) Roller (Fig. 7) – Improve existing 125-microinch finish on I.D. to minimum 62-microinch to be compatible with axle. Increase area of contact between roller and axle by decreasing the gap between their diameters. Actual dimensions will be determined as a function of axle plating waviness.

(c) Include one spare cable with every two yoke assemblies.

(d) Increase quality control to assure kink-free cable processing and assembly.

(e) Improve quality control on axle and roller components.

(f) Perform mandatory run-in (fitting) period for the wheel bearing assemblies at either the manufacturer's plant or in the field. Twenty-five miles at no more than 10 miles per hour is recommended.

(g) Accept a 30-mile maintenance requirement.

(h) Release to the user if above engineering changes are complied with.

(6) Comments. Engineering Changes were initiated to correct the above problems on production units. The Contract and the QAR were further restricted:

(a) To improve quality control on the affected parts.

(b) To provide "run-in" time on all bearing assemblies.

(c) To provide a spare cable with every two yoke assemblies.

3. **Summary Report of NET Team Field Work.** The NET team consisting of the project engineer and one mechanic arrived in Viet Nam on 21 February 1970. After locating the first article, the team proceeded to Quan Loi where the 11th Armored Cavalry Regiment (ACR) is based. The 11th ACR was not receptive to the roller and felt that it would detract from its mission; however, the regiment agreed to allow one tank to be outfitted. A roller was mounted on an M48 tank and the team departed. Subsequently, it was learned that after about 50 miles of rolling without an encounter the roller was cut off the tank and abandoned.

The team then went to Quang Tri where the 1st Brigade of the 5th Infantry Division is based. The attitudes were very much the same regarding acceptance of the roller; in any event, a roller was mounted on an M48 but the tank was deadlined because of a bad engine.

The NET team then proceeded to An Khe where the 4th Engineer Battalion was quartered. The third member, Don C. Price, a representative of the Teledyne Monarch Rubber Company, joined the team. The 4th Engineer Battalion previously had great success with the original rollers obtained under ENSURE 202 and was anxiously awaiting delivery under ENSURE 202.1. A roller was installed on a CEV, and sweeping began immediately (Figs. 8 and 9). On the fourth sweep, a mine was encountered. The roller performed exactly as designed; but, of course, one bank of wheels was lost (Fig. 10). The spare parts from ENSURE 202 were the only spares available at the time and these were used to put the roller back in action within about 2 hours (Fig. 11). Within the next 10 days, four more mines were detonated by the roller (thereby each time saving a tank or an APC) on sweeps of hard roads out of An Khe, and each time the roller performed as designed. Personnel of the 4th Engineer Battalion are very pleased with the performance of the roller and have now asked for more rollers than they had originally ordered.

The NET team split up at this point and visited various Depots trying to locate the rollers and spare parts as they arrived in-country. The inventory control had broken down, and the rollers were being transshipped in-country and were becoming hopelessly lost.

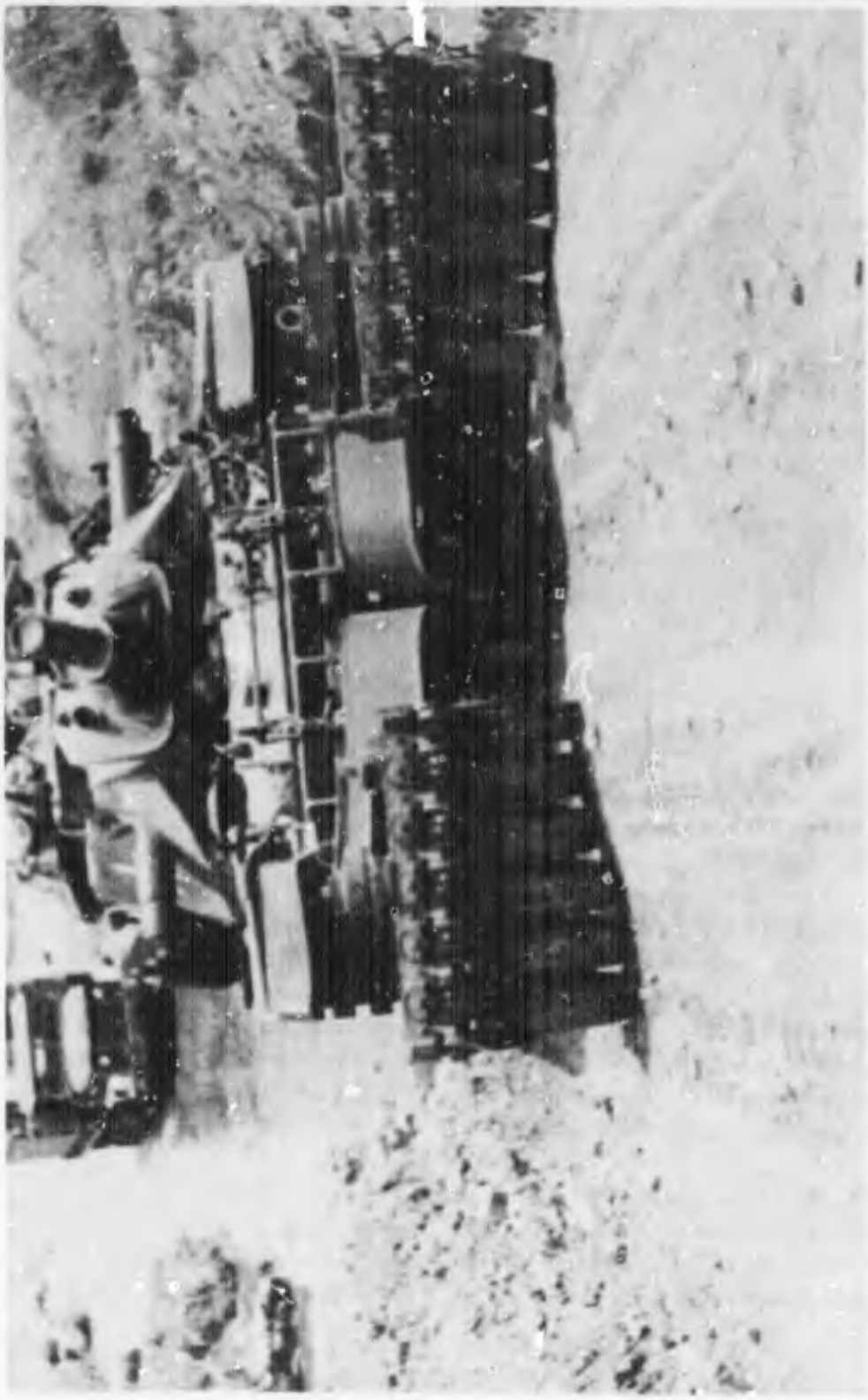

Fig. 8. Front view of roller mounted on a CEV.

Fig. 9. CEV fording stream on Route 308 near An Khe, RVN, 1 April 1970.

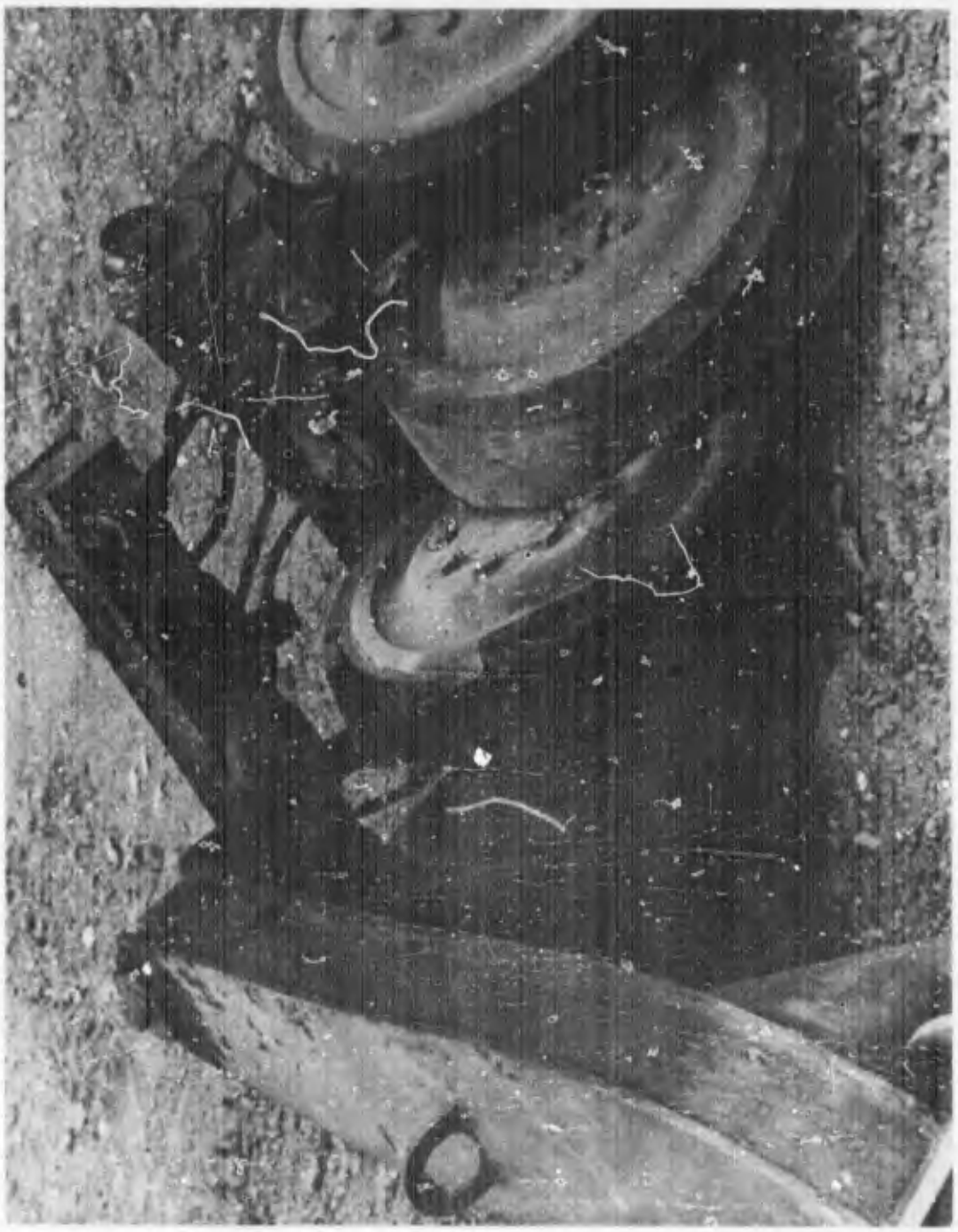

Fig. 10. Typical damage to wheel arm assembly from mine encounter.

Fig. 11. Self-help capability of the CEV.

Ten rollers and four sets of spare parts (which had been misshipped) were located. One roller was diverted to the Americal Division at Chu Lai where it was mounted on an M48.

Two members of the NET team departed RVN on 13 April 1970 while one (the Contractor's representative) remained until 17 June 1970.

4. Data Developed. A Technical Data Package for the Expendable, Mine-Clearing Roller consisting of a draft specification, full set of production (mono-detail) drawings, and an operational maintenance and installation manual was developed by MERDC.

(The specification has not been published to date and the manual which was provided by the contractor as part of required data has been superseded by an official A/G type manual published by USAMECOM.)

5. Type Classification Action. Preliminary action has been taken to type classify the expendable roller; however, USARV by TWX dated 13 January 1971 asked for an extension of evaluation time and recommended that the roller not be type classified standard A at that time (Appendix B). A final report dated 26 July 1971 restates this recommendation (Appendix C).

III. CONCLUSIONS

6. Conclusions. The expendable, mine-clearing roller performed its intended design function of detonating land mines buried in roads, thus destroying the expendable portion of the roller but protecting the propelling vehicle from damage.

Several of the shortcomings of the roller were expected in the expendable design, i.e. roller replacement after detonation, defeat of the roller by various firing devices, limited sweep area. However, all malfunctions of the roller cannot be classified as design shortcomings. Some malfunctions were a result of the roller being improperly applied in its intended use or improper maintenance during use. This can possibly be a result of improper training by the using units, a common occurrence on an item of equipment introduced to the using unit in the field.

The roller concept does have merit as a land-mine neutralizer when considered in its proper perspective.

APPENDIX A

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

U. S. ARMY
MOBILITY EQUIPMENT RESEARCH AND
DEVELOPMENT CENTER

FORT BELVOIR, VIRGINIA

* INSTALLATION
* OPERATION AND
* MAINTENANCE MANUAL

MINE CLEARING EXPENDABLE ROLLER FOR INSTALLATION ON M-48A2 OR M-48A3 TANKS FSN 2590-436-9784

FEBRUARY 1970 MODEL

Published by:
TELEDYNE MONARCH RUBBER
A DIVISION OF TELEDYNE MID-AMERICA CORP.
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U.S. Army
Mobility Equipment Research and Development Center
Fort Belvoir, Virginia 22060

Mine Clearing Roller Expendable
FSN 2590-436-9784

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GENERAL DESCRIPTION:

The "Expendable Roller" (Fig. A) is an anti-tank mine clearing roller, designed to transmit a force to the ground which is approximately equal to the average force exerted by the M-48A2 and 3 tank tracks. The ground force of the Expendable Roller is applied at a distance of approximately nine and one-half (9-1/2) feet ahead of the front tank road wheel. The ground pressure at the "Roller Wheel" approximating that of the tank track, detonates "Pressure Actuated" land mines that are normally actuated by the tank track.

The "Expendable Roller" is composed of two (2) yoke and wheel assemblies, each wheel assembly composed of six (6) individually articulating M-48 boggie wheels. The six (6) wheels cover a width of forty seven and one-half (47-1/2) inches (19-1/2) inches in excess of that covered by the tank tread towards center line of tank at the ground contact point on either side. The two wheel assemblies are attached to the main frame by means of an extension of the main frame. The extension is attached to the main frame by (6) bolts which represents the "break away" feature upon detonation. The main frame is attached to a tank mounted structural frame by means of a pivot shaft. The structural frame is attached to the tank by the use of turnbuckles to the lifting eyes, turnbuckles to two nesting blocks welded to the tank hull, and pins through the towing eyes on the tank hull.

Force is transferred to each wheel assembly by means of a rubber torsion spring assembly. One (1) torsion spring assembly is affixed to the structural frame and one (1) torsion spring assembly mounted in the main frame. The amount of force is proportional to the weight transferred from the tank through the spring assembly by means of lengthening or shortening the chains on the spring assemblies.

The weight of an "Expendable Roller" including tank mounting frame is approximately ten thousand (10,000) pounds.

FEBRUARY 1970 MODEL EXPENDABLE
MINE CLEARING ROLLER

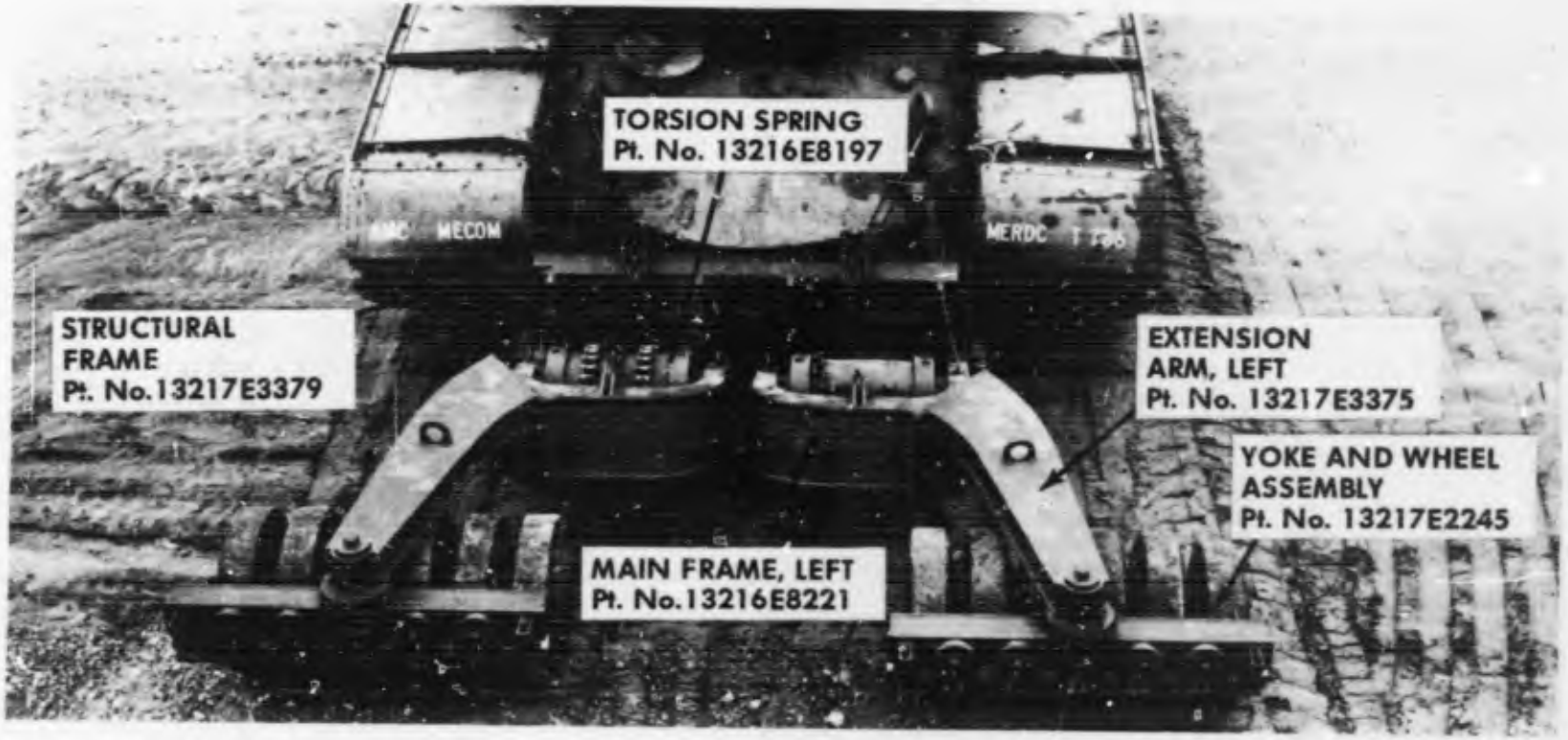
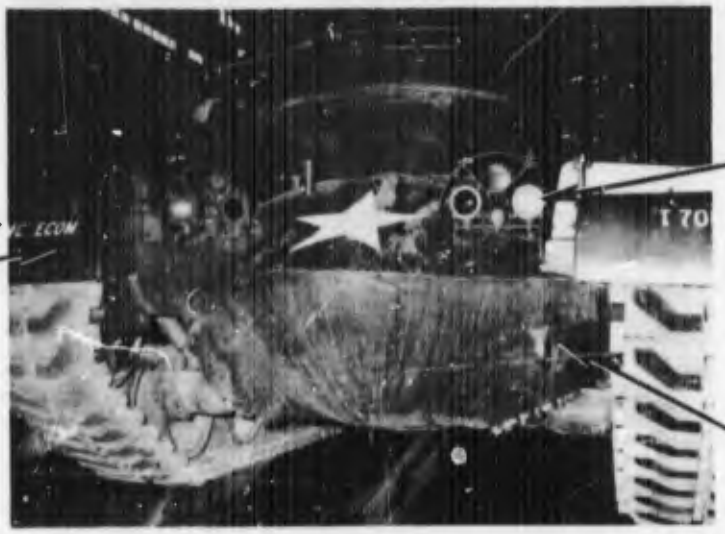


FIGURE A

MODIFICATION TO TANK HULL:

The first and most important job when making a field retro fit of the Mine Clearing Roller, Expendable, will consist of preparing the M-48 hull to receive the frame, structural.

Follow the steps and photographic instructions which are included below:



TANK HULL BEFORE MODIFICATIONS
Figure B

STEP 1. Remove front fenders

Figure C

STEP 2. Disconnect head lights and cut off mounting brackets.

STEP 3. Remove towing hooks from cast-in-place towing eyes.

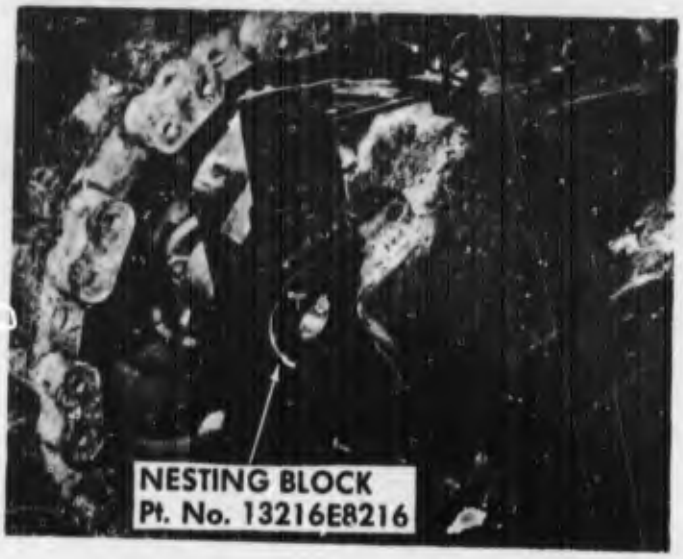


Figure D

STEP 4. Weld nesting block (part number 13216E 8216) to tank hull.
NOTE: Tack Weld, 1/4" long x 4 places, only.

IMPORTANT: - Final full filet welding will take place at the final assembly of frame, structural.

The nesting blocks are to be located 62 inches apart. Measure 31 inches, plus or minus 1/4 inches, from tank hull center line to inside of nesting block as it is shown on page 6, Figure E.

A fairly accurate tank hull center line may be obtained by following the three procedures outlined on page number 28, Figure L.

Perform this measuring activity with care. Later, this determined center line will be used to make some final adjustments between the roller assembly and the tank hull.

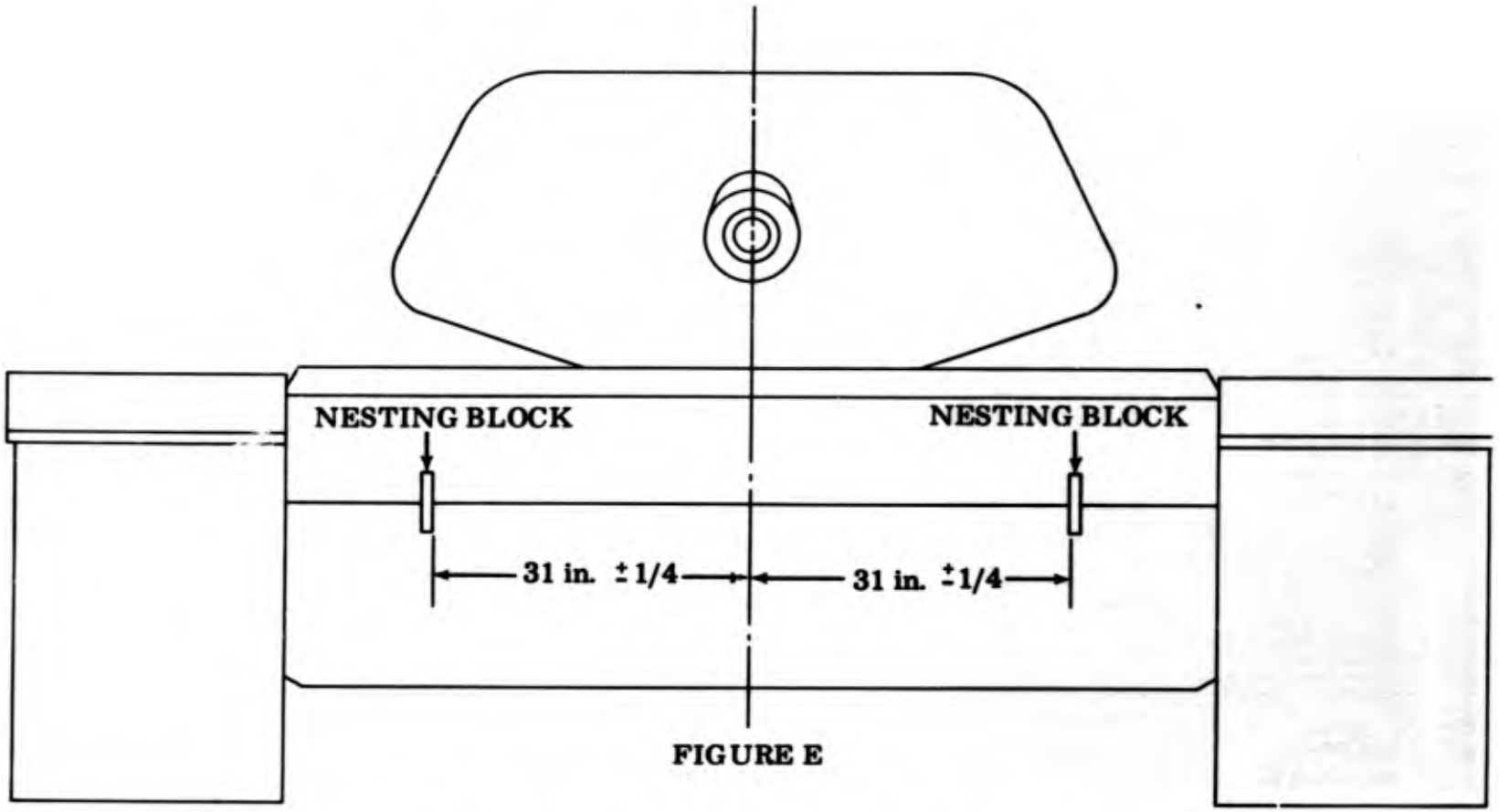


FIGURE E

TANK HULL MODIFICATION INSTRUCTIONS

TO DETERMINE TANK HULL CENTER LINE
SEE FIGURE L, PAGE 28, PROCEDURES 1 THRU 3

Tank Huli Modifications (Continued).

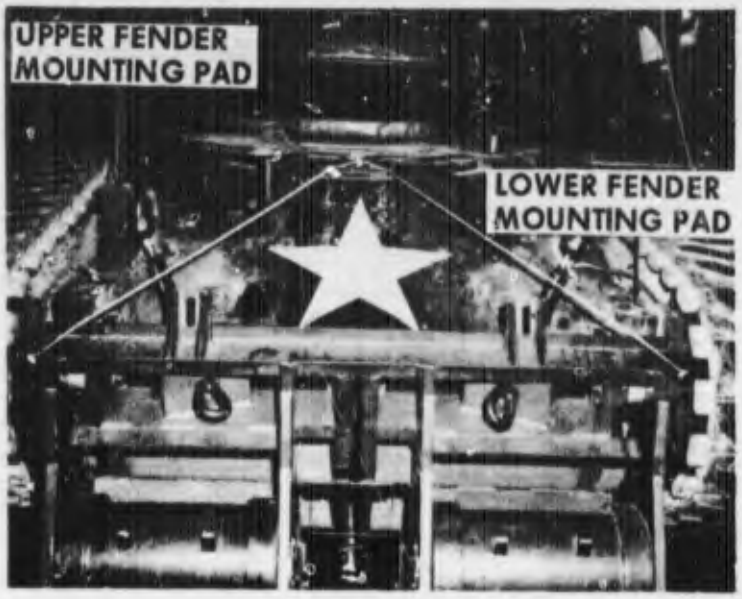


Figure I.

PROCEDURE
1. MEASURE DISTANCE BETWEEN CENTERS OF MATCHING HOLES ON LOWER FENDER MOUNTING PADS. MARK CENTER OF LINE BETWEEN THESE CENTERS WITH CHALK OR SHARP INSTRUMENT ON TANK HULL.
2. MEASURE DISTANCE BETWEEN CENTERS OF MATCHING HOLES ON UPPER FENDER MOUNTING PADS. MARK CENTER OF LINE BETWEEN THESE CENTERS WITH CHALK OR SHARP INSTRUMENT ON TANK HULL.
3. DRAW AN EXTENDED LINE BETWEEN THESE TWO CHALK MARKS. THIS LINE IS THE CENTER OF THE TANK HULL.

If the **Four Steps,** described on Pages 25 thru 28,, have been accomplished, the tank toexpendable roller assembly can be started without delay.

INSTALLATION INSTRUCTIONS FOR THE FEBRUARY 1970 MODEL EXPENDABLE MINE CLEARING ROLLER

STEP 1. Install main frame shaft turnbuckles to the tank.

Figure G

Connect turnbuckle, part number 13217E 3374,to tank idler wheel suspension housing as shown in Figure G. Be careful to position the pivot hinge upward on the large turnbuckle end.

The pivot hinge pin is positioned downward on the small, or main frame, connecting end.

No additional work is required with this turnbuckle until after Step 7. See Page 34.

STEP 2.

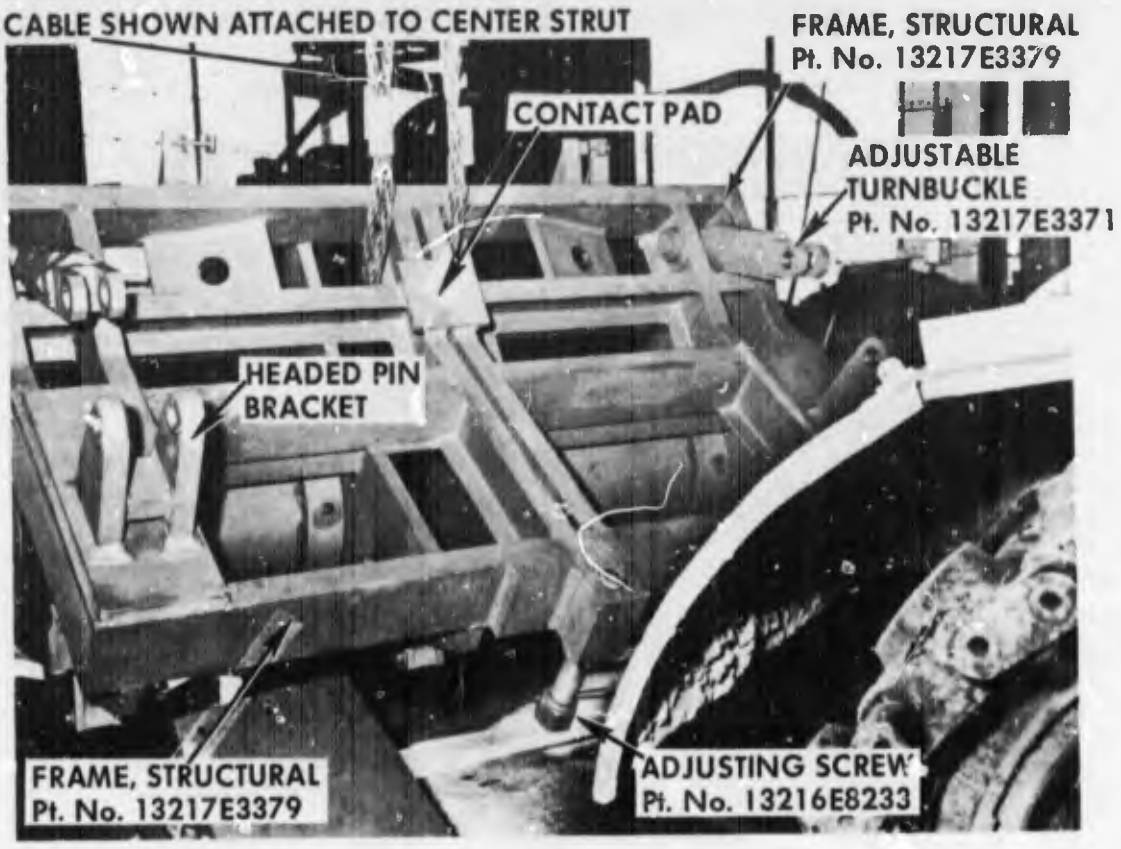


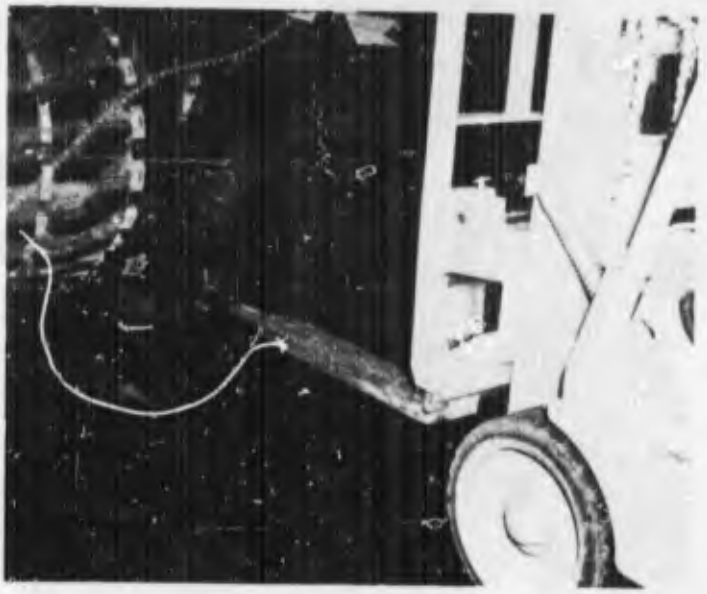
Figure F

Lift the main frame with a cable, sling,or steel belt by looping through the center vertical strut. This will give the frame balance and also some freedom of movement that will be helpful in connecting frame, structural,to the tank hull.

ALTERNATE METHOD

A rough terrain lift truck or crane may not be available for lifting the frame. In this situation, you may perform the above mentioned job by cribbing the structural frame in an approximate position, using timbers, OR by constructing an "A" frame from locally available material to which a hand hoist could be attached for lifting the frame. If this method is used, drive the M-48 tank forward until contact is made between the towing eyes on the tank hull and the headed pin brackets on the frame, structural.

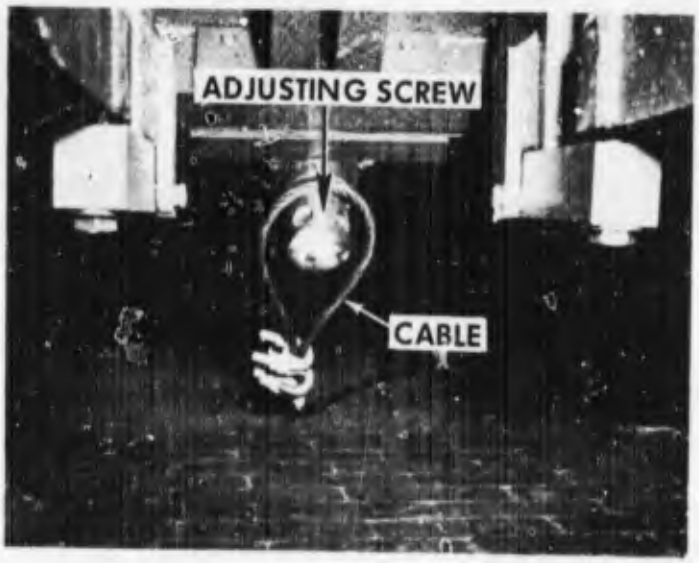
STEP 3. It is necessary to either push or pull the frame, structural,toward the tank huli. This can be accomplished BY USING ONE OF THE METHODS SHOWN BELOW.



PUSH BOTTOM OF STRUCTURAL FRAME TOWARDS TANK HULL.

Figure H

or



ATTACH CABLE TO ADJUSTING SCREW ON BOTTOM OF STRUCTURAL FRAME AND PASS UNDER TANK; ATTACH TO ANY VEHICLE AND PULL STRUCTURAL FRAME TO TANK HULL.

Figure I

STEP 4.

Figure J

Using the headed pins, flat washers, and cotter pins provided with the hardware kit, attach frame, structural, to the tank hull at towing eyes and nesting blocks. SEE FIGURE J.

After the headed pins are secure, use the threaded adjusting screw, SEE FIGURE F, in combination with the adjustable turnbuckles, also shown in FIGURE F, to adjust frame, structural, until CONTACT PAD, SEE FIGURE F, is tight against the tank hull.

The above operation is performed by alternately turning, first the turnbuckle, then the adjusting screw until contact with the tank hull is made.

TIGHTEN THE LOCK NUT ON THE ADJUSTING SCREW.

STEP 5.

Figure K

Pass rounded end of turnbuckle through slot provided in frame, structural. The opposite end of this turnbuckle is secured to tank lifting eye with a headed pin, washer, and cotter key. SEE FIGURE K, above.

STEP 6.

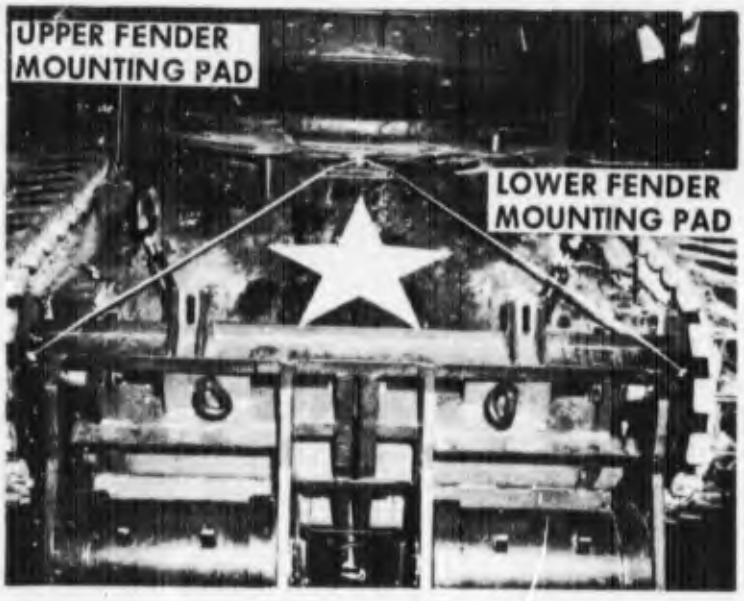


Figure L

Refer to page 28, Figure L. The tank hull center line was determined by following three (3) procedures.

FROM A POINT ON THIS TANK HULL CENTER LINE MEASURE TO THE TOP OUTSIDE CORNERS, FARTHEST FROM THE TANK HULL, OF THE STRUCTURAL FRAME. ADJUST VARIOUS TURNBUCKLES UNTIL THE DISTANCE FROM THE TANK HULL CENTER LINE TO EACH OF THE MATCHING POINTS ON THE STRUCTURAL FRAME IS EQUAL (±1/8").

STEP 6. - Continued

Structural Frame is now centered and squared to the tank hull.

NOTE:
RECHECK all turnbuckles, headed pins, washers, and lock nuts. Make sure these points are tight and secure.

IMPORTANT:
FINISH WELDING THE NESTING BLOCKS. REFER TO STEP 4, PAGE 26, FIGURE D.

A MINIMUM OF 3/8 INCH FILET WELD IS REQUIRED TO COMPLETE THIS JOB.

WELD COMPLETELY AROUND NESTING BLOCK.

STEP 7.

Attach cables or slings of equal lengths from a hoist hook to the lifting eyes on each side of the main frame.

Position the main frame under frame, structural. SEE FIGURE M, below. Left hand side shown.

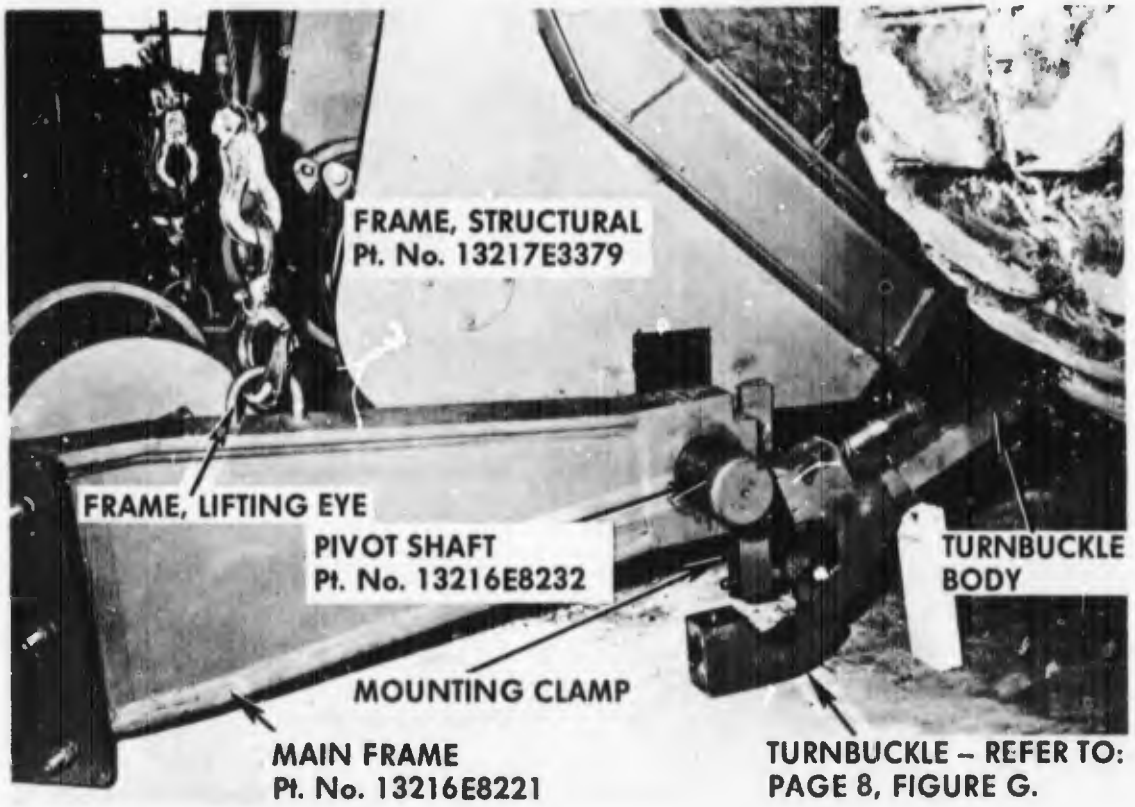


FIGURE M

Align the sides of pivot shaft with the squared cut-out in frame, structural.

Lift the main frame upward until the pivot shaft is fully engaged in the cut-out.

Close the mounting clamps against the pivot shaft on both sides of main frame and tighten securely.

STEP 8.

Place a 6 inch diameter x 3/4 inch thick flat washer on protruding round end of pivot shaft.

Close turnbuckle hinge around pivot shaft end and tighten 1-1/4—7 threaded cap screw as shown in FIGURE N.

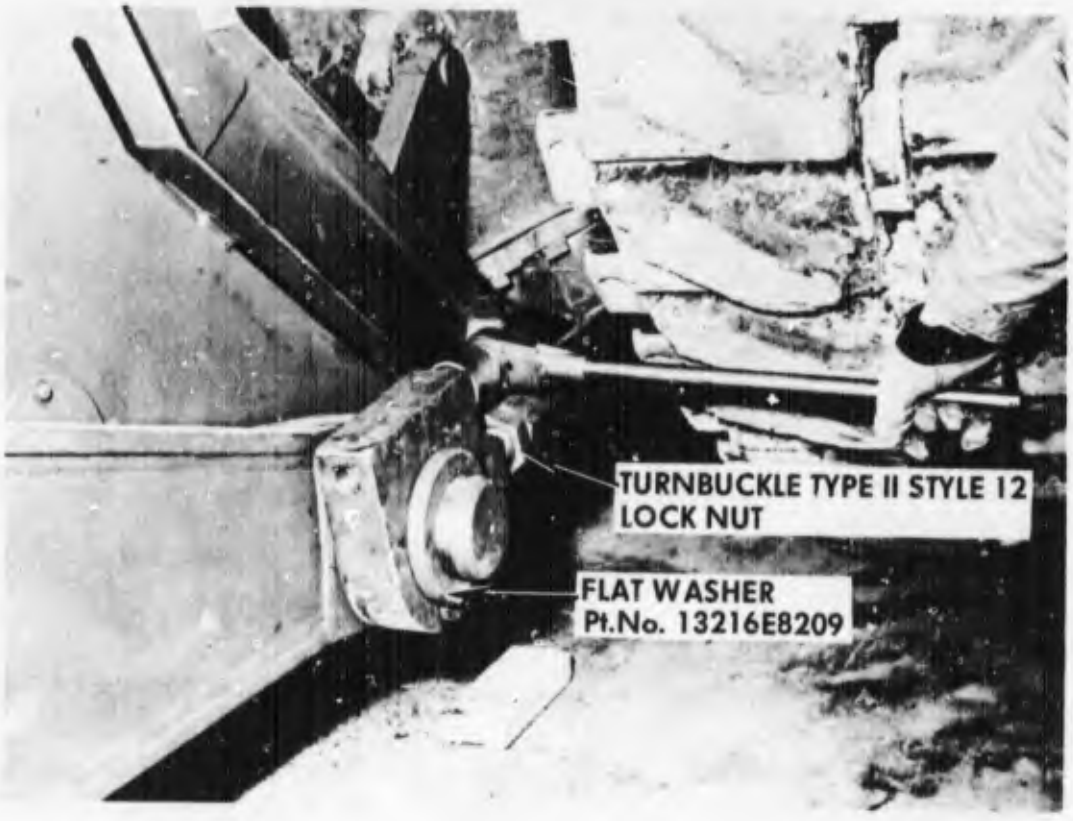


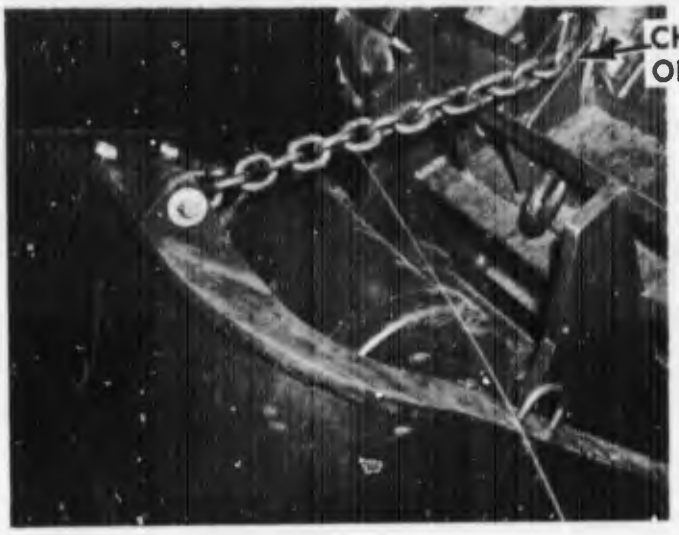
Figure N

Place a second flat washer between turnbuckle and end of pivot shaft end. Secure with 5 inch long cotter pin inserted through hole in the end of pivot shaft.

Before tightening turnbuckle locknut, see FIGURE N, rotate the turnbuckle body until the large end of turnbuckle is in contact with the back side of wheel suspension housing. SEE FIGURE G, PAGE 29. This operation will cause the main frame, and frame, structural, to be drawn toward the tank hull. SEE FIGURE W, PAGE 43.

Tighten turnbuckle lock nut.

STEP 9.



PLACE CARRYING CHAIN IN RETAINING BRACKET ON STRUCTURAL FRAME.

Figure O

Connect the carrying chain between main frame and chain bracket on top of frame, structural.

The main frame must be held high enough to allow the extension arm to be positioned against the shear face of main frame. SEE FIGURE P, PAGE 37.

Figure P

Align the six (6) holes in the shear face of the main frame with six (6) corresponding holes in the extension arm.

Install six (6) 5/8 diameter x 3 1/2 inch long screws. Each screw will require a spring lock washer and nut. Tighten all nuts very firmly.

STEP 10.

Raise the main frame and extension arm assembly high enough to permit the wheel and yoke assembly to fit under the pivot hole in the extension arm.

Secure the carrying chains to frame, structural.

AS A PRECAUTION, place some blocking under the main frame in case of chain, weld, or pin failure.

Notice that wheel and yoke assembly is being installed opposite from its true running position. This is done to simplify installation. SEE FIGURE Q, PAGE 38.

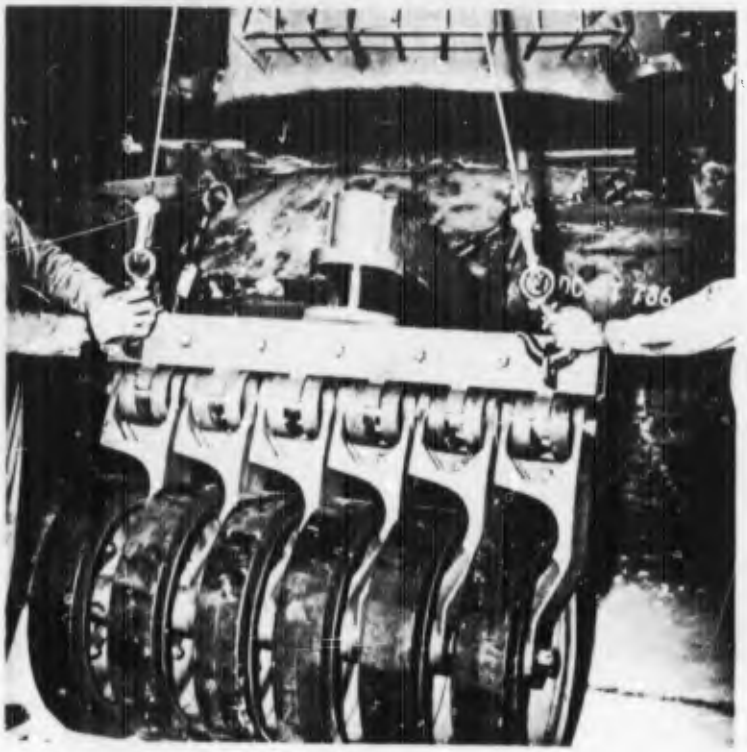


Figure Q

Before raising the yoke into its final fit-up position,apply a generous amount of grease to the plate bearing surfaces as shown on FIGURE R, PAGE 38.

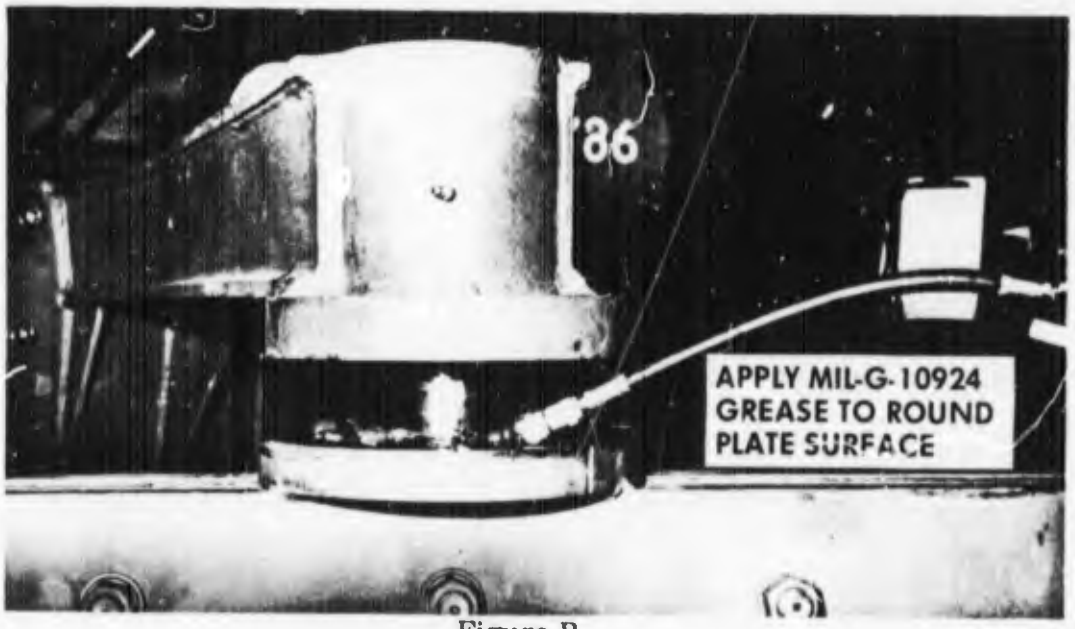


Figure R

Secure yoke and wheel assembly to main frame with keyed washer Pt. No. 13216E 8210, lock washer Pt. No. MS 35338-55, and Pt. No. MS 90725-273, cap screw.

Tighten using a 12 to 14 inch long wrench.

Rotate the wheel and yoke assembly 180° and lower the assembly to the ground or floor level. The wheel and yoke assembly should be self supporting.

Figure S

NOTE: Instructions have been given for the assembly of one side of the expendable mine clearing roller.

ASSEMBLE THE OPPOSITE SIDE.

Follow the Illustrations and Steps outlined on Pages 29 thru 39.

INSTALLING THE TORSION SPRING CHAINS

The roller chain which is furnished with the February 1970 expendable clearing roller is sixty-eight inches in length. There are thirty-five pins spaced two inches apart. One end of this chain will have a connecting link, or wide end, the other end, a roller link, or narrow end.

Special connectors and spacers are furnished with the roller chain to simplify installation.

The torsion spring chains cannot be installed until the wheels of the expendable unit are on different level than the plain of the tank tracks.

If heavy timber blocking is available, either in the field or at a repair shop location, the M-48 tank can be moved forward upon the blocks until the idler wheel and first bogie are raised. BOTH TANK TRACKS MUST BE RAISED AT THE SAME TIME.

SEE FIGURE T ON PAGE 40.

Figure T

In the absence of blocking, the same results may be obtained by driving the expendable wheel and yoke assembly down an incline, allowing the tank tracks to remain on level ground. SEE FIGURE U, PAGE 41.

Figure U

STEP 1.

Attach the narrow roller chain end to lugs on the rear torsion spring assembly. A special connector with a stepped shoulder will fit the chain link hole on one side. After passing the pin through the lug, insert a ring or spacer into the opposite link hole. SEE FIGURE V. I., PAGE 42.

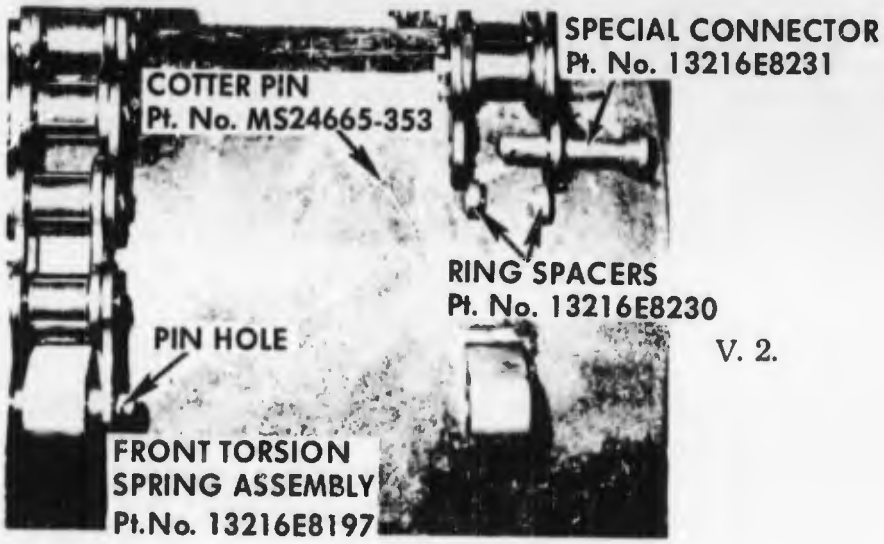
A cotter pin is then inserted through the second pin hole toward the special connector head.

STEP 2.

Thread the roller chain around the rear torsion spring "Clock-Wise" passing under the bottom. Bring the unconnected end upward and over the front torsion spring, threading the chain "counterclock-wise" downward to the front torsion spring lug.

The front torsion spring lug will be located toward the bottom of the main frame, or at about seven (7) o'clock. SEE LUG LOCATION ON FIGURE W, PAGE 43.

V. 1.



V. 2.

Figure V

STEP 3.

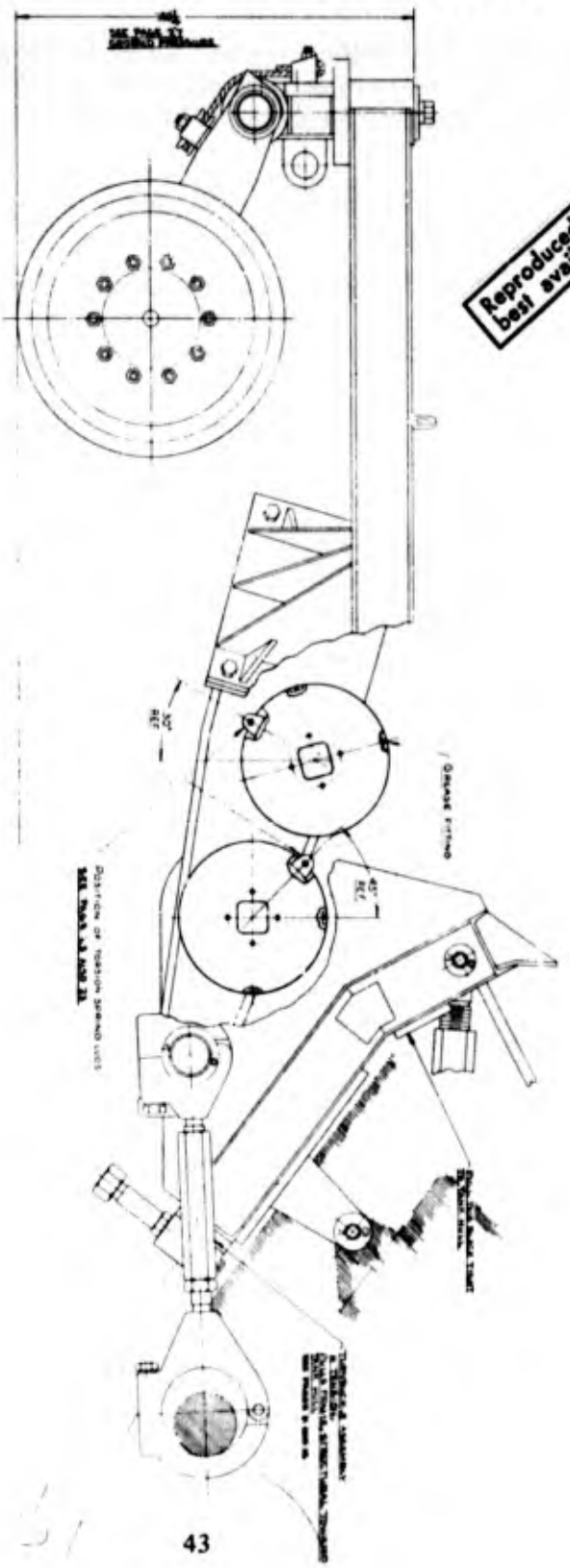
Using a special connector, same as the one used before, and two ring spacers, fasten the wide link end to the torsion spring lug. Figure V 2., above, shows the required parts and method of installation.

A ring spacer is required on both sides of the torsion spring lug between the wide link chain ends. The cotter pin fits into the second pin hole AWAY from connector head.

Recheck all eight (8) cotter pins which are in the ends of the special torsion spring chain connector. THE COTTER PIN ENDS MUST BE SPREAD OUT.

SIDE VIEW OF MINE CLEARING ROLLER SHOWING TORSION SPRING LUG LOCATION

Figure W



REPLACEMENT OF THE TORSION SPRING ASSEMBLIES

The February 1970 Mine Clearing Roller is shipped from the factory with the torsion spring assemblies, part no. 13216E 8197, installed and properly arranged for weight transfer from the M-48 tank to the mine clearing wheels.

If it becomes necessary to replace the torsion spring assemblies the following procedures will be helpful.

FOR THE TORSION SPRINGS ON FRAME, STRUCTURAL:

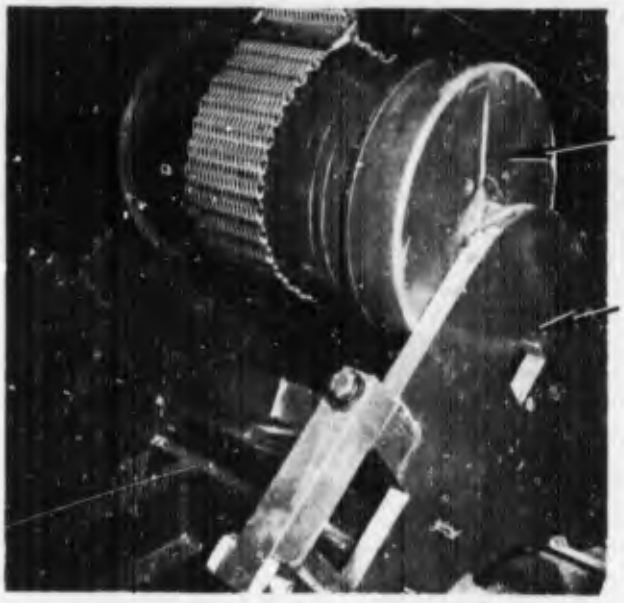


Figure X

STEP 1.

Determine the proper chain lug position from FIGURE W, PAGE 43.

Lower Torsion Spring into frame.

NOTE: It is easier to work with this unit if frame, structural, is turned upside down.

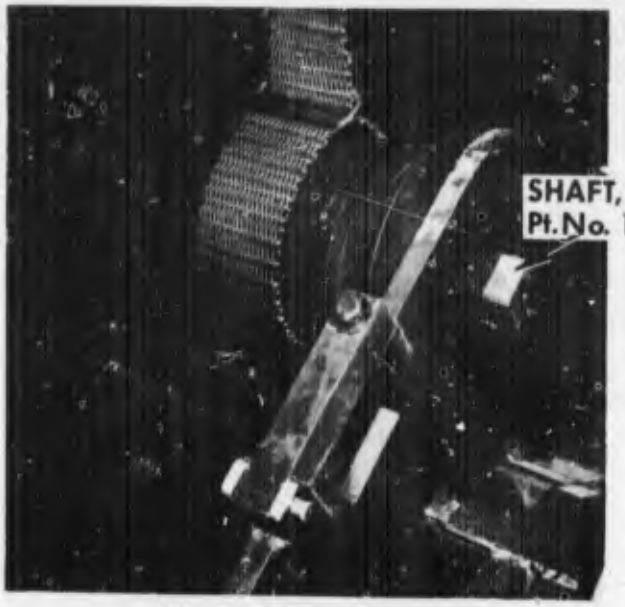


Figure Y

Install torsion spring suspension shafts, one each side.

Notice that the shouldered shaft is drilled and has an internal thread. This threaded hole will assist the removal of a shaft that is rusted or otherwise locked to the torsion spring end cap. If a standard puller is not available a temporary "Jerry Rig" with a 1-1/8 inch hole will extract the shaft.
STEP 3.

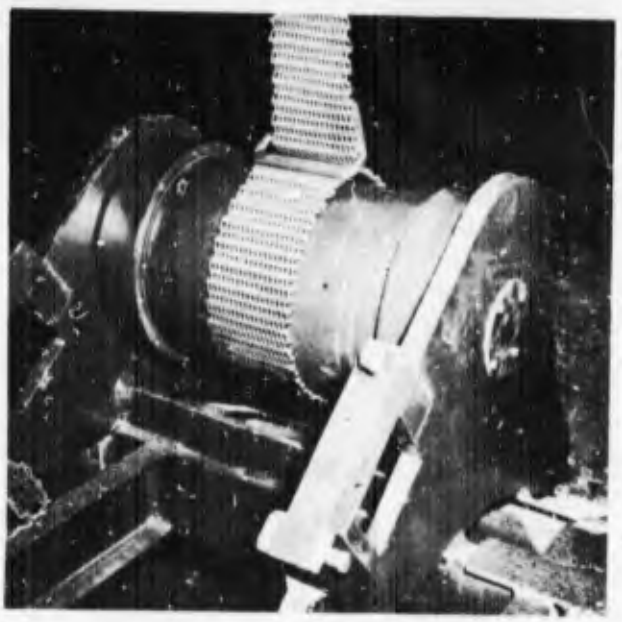


Figure Z

Place a round cover plate over the square hole and use (4) MS 35206-280 screws with spring lock washers to secure plate to side frame.

The front torsion spring assemblies are held in the main frame oy retaining "T" blocks, part number 13216E 8208.

First remove the "T" blocks, one each side. Lift torsion spring assembly upward with some angular pressure being exerted toward the frame pivot shaft.

An 8 to 10 foot long steel bar or timber could be used to pry the spring assembly slightly backward.

To replace the torsion springs in main frame:

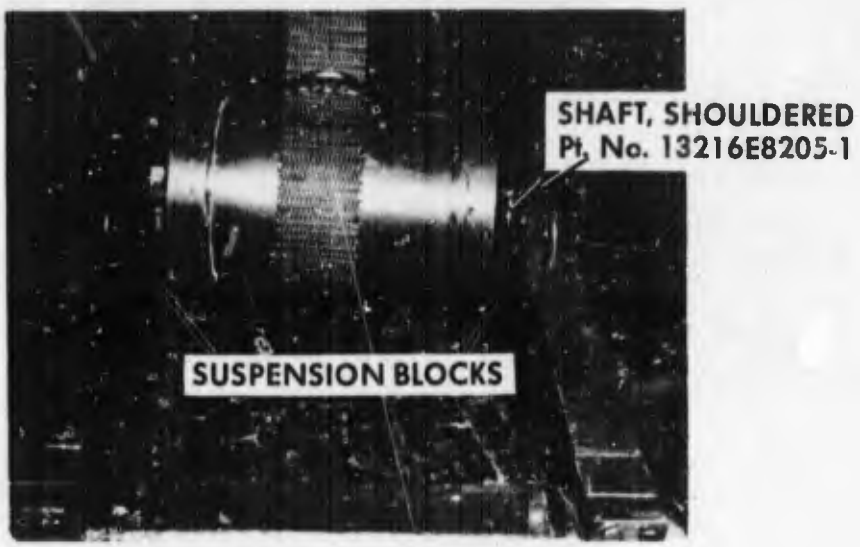


Figure AA

STEP 1.

Locate the roller chain lug, SEE FIGURE W, PAGE 43.

Insert the shouldered shafts into the torsion spring assembly end caps.

Lower the torsion spring assembly into suspension blocks.

NOTE: The square portion of the shafts on the front spring assemblies are 3/4 inches longer than the ones used with the back torsion spring assemblies described on PAGES 44 and 45, FIGURES X and Z.

STEP 2.

Figure BB

RECHECK SPRING LUG POSITION.

Tighten "T" blocks using the socket drive cap screws provided.

To relieve tension on the torsion spring assemblies, the M-48 tank is driven up an incline. At this point, the roller chains may be disconnected from the torsion spring lugs.

Figure CC

NOTE: SEE PAGE 41. FIGURE U. The described method is also suitable for disconnecting the roller chains.

GROUND PRESSURE - HOW IT IS DETERMINED

The preceding instructions and illustrations were useful in the assembly of the February, 1970 Model Expendable Mine Clearing Roller.

Before starting A MINE CLEARING MISSION, A FINAL AND ESSENTIAL TEST MUST BE EXECUTED.

If the roller has been assembled properly, that is:

1. All bolts, nuts, and screws are securely tightened.
2. The roller chain is attached to the torsion spring assemblies.
3. The shear face bolts, six on each side, are in place and tightened.
4. The suspension cable on the expendable wheel and yoke assembly is locked with the tapered drift on each side.

MEASURE 40 AND 1/4 INCHES FROM THE BOTTOM OF THE BOGIE WHEEL TO TOP OF YOKE SPINDLE.

SEE FIGURE W, PAGE 43

To correct the height to 40 and 1/4 inches, Block under the extension arm. Loosen one of the cable drifts and pull the cable upward to increase the height or relax the cable to decrease. Remeasure for 40 1/4 inches.

According to previous experience, the proper tank weight is transferred to the mine clearing wheels.

BUT -

Since a weight scale would not be available in the field for checking the ground pressure, which is necessary for effective mine clearing, a foot print image must be taken.

With the mine clearing roller setting on a flat and level surface, start the foot print test by:

1. Find a clean board or cardboard, or piece of paper which could be placed on a hard surface.

2. Find some grease, or ink, or paint.

3. Lift one of the twelve wheel arms upward using the available field hoisting equipment.

4. Apply the ink, paint, or grease to about six (6) inches of the tire surface.

5. Place the cardboard, or paper, directly under the raised bogie wheel.

6. Rotate the painted section around until it is directly over the paper or cardboard mat. Straight down.

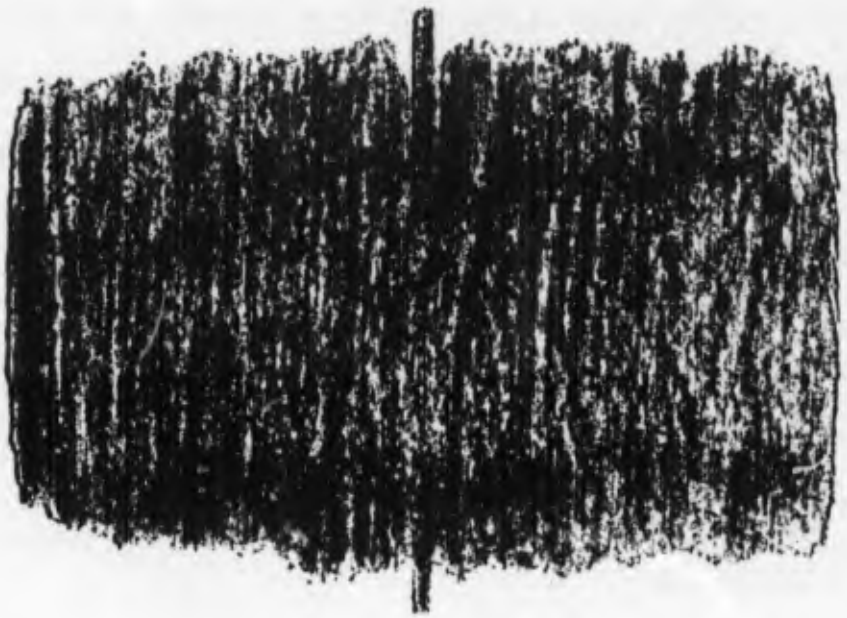
7. Lower the arm and wheel. All lifting tension must be removed.

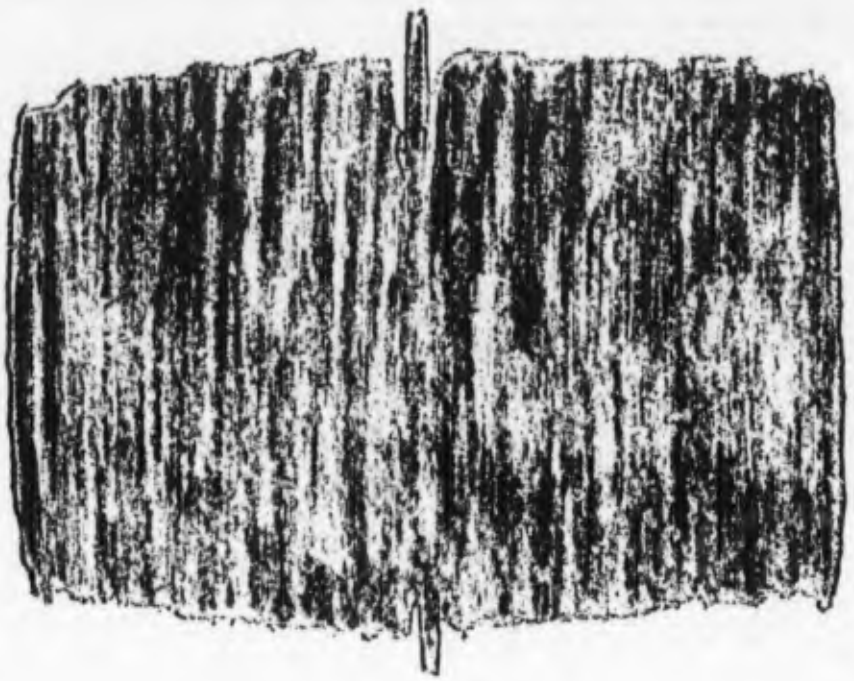
8. Raise the arm and wheel assembly. Find the blot which was transferred from the roadwheel tire to the cardboard.

9. Compare this blot with the examples shown on pages 50 and 51.

10. The new blot or image which was taken by the above nine steps should not be larger than the one shown on page 51 nor smaller than the image on page 50.

SEE PAGE 52 FOR CORRECTIVE MEASURES.





Do not rely upon one blot test to determine the accuracy of weight transfer.

Make a second or third blot test using a different wheel and arm assembly each time.

Follow the instructions on page 49 for each test.

If, after the second test, there is reasonable doubt about the foot print quality and size, a corrective step may be undertaken.

Disconnect the roller chains from the torsion spring assembly lugs. See Pages 40, 41, and 42.

IF THE FOOT PRINT IMAGE IS NOT LARGE ENOUGH: SEE PAGE 50.

Remove one (1) roller chain link from each of (4) four chains. The roller chains will now measure 66 inches long.

IF THE FOOT PRINT IMAGE IS TOO LARGE: SEE PAGE 51.

Add one chain link to each of (4) four roller chains. The roller chain now measures 60 inches long.

Reconnect the roller chain to the torsion spring lugs.

Make a new blot test and compare the results with page 50 or 51.

IMPORTANT NOTICE

The February 1970 Mine Clearing Roller is furnished with torsion spring assemblies which were designed to transfer weight and provide for ground response ability in Average North Temperate Zone Climatic Conditions.

When operating in extremely cold weather, be careful not to store or park the Mine Clearing Roller with the torsion spring assembly roller chains attached.

Remove torsion chain tension within thirty (30) minutes after each mission, otherwise the rubber springs will set (become stiff) and temporarily lose power to transfer weight.

In extreme hot weather, above 140° Fahrenheit, the same set condition could occur if the Mine Clearing Roller was stored for a long period with the torsion spring assemblies in tension.

The rubber compound used in the Torsion Springs on this model of Expendable Mine Clearing Roller will respond to motion and exhibit output characteristics similar to those determined at 72° Fahrenheit.

MAINTENANCE INSTRUCTIONS

A. SPECIAL TOOLS AND EQUIPMENT

No special tools or equipment are required by the operator for the maintenance of the expendable roller.

B. LUBRICATION

This section contains instructions for lubricating the expendable roller. Refer to the lubrication guide (Figure CC) for the general location and parts requiring lubrication. The lubrication schedule lists the lubricant, interval, and application of lubrication for the expendable roller.

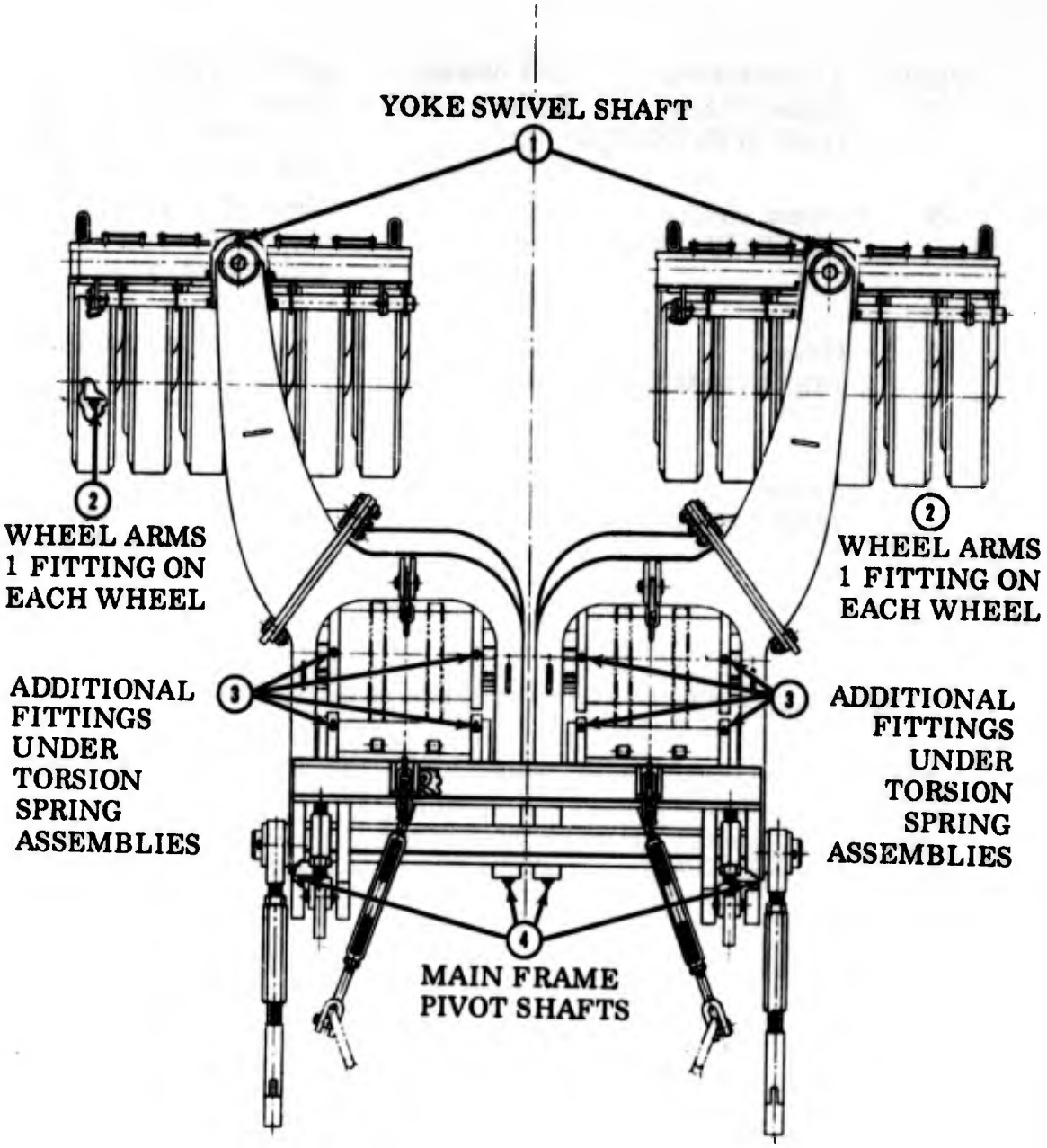
a. Detailed lubrication information

(1)Care of lubricants and lubricating equipment

Keep all lubricants in closed container and store in a clean, dry place away from heat. Allow no dust, dirt, or other foreign material to mix with the lubricants at any time. Keep all lubrication equipment clean and ready for use.

(2)Cleaning

Keep all external parts not requiring lubrication free from lubricants. Before lubricating the equipment, wipe all lubrication points free of oil, dirt, and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.



LUBRICATION GUIDE

Figure CC

LUBRICATION SCHEDULE
SEE FIGURE CC, PAGE 55

ITEM	LUBRICANT	INTERVAL	APPLICATION
1	Grease (GAA) (FSN 9150-190-0905)	Daily	Clean yoke swivel shaft zerk fittings and apply grease with pressure gun.
2	Grease (GAA) (FSN 9150-190-0905)	Daily and/or every 30 Miles*	Clean wheel arm zerk fittings and apply grease with pressure gun.
3	Grease (FSN 9150-664-0050)	300-400 Miles**	Clean torsion spring zerk fittings and apply grease sparingly with pressure gun.
4	Grease (FSN 9150-190-0905)	Daily	Clean main frame pivot shaft zerk fittings and apply grease with pressure gun.

*These fittings should be greased daily and/or every 30 miles.

**Inspect and lubricate as required after 300-400 miles of operation. Limit inspection to front torsion spring assemblies.

The torsion springs are made of neoprene rubber. Although neoprenes will not deteriorate when exposed to solvents, their use is not recommended.

OPERATION OF THE MINE CLEARING ROLLER

The February 1970 Expendable Mine Clearing Roller is furnished with most of the component parts pre-assembled and lubricated. However, after mounting on the M-48 tank is complete and all systems are "GO", it is advisable to keep the first thirty to sixty miles of travel within a ten (10) M.P.H. range. This speed range will permit the spindle and bearing assemblies to adjust to their proper fits and clearances. Frequent lubrication is also recommended during this period, especially the expendable parts.

The Mine Clearing Roller was designed to travel on paved, dirt, or graveled roads at speeds up to twenty-five (25) M.P.H., although it can be operated successfully off-the-road if certain precautions are observed.

When mines are expected, it is recommended that road travel is held to five (5) M.P.H. During off-the-road Mine Clearing Missions, care must be taken to avoid large holes, logs, and embankments. If these obstacles are present, proceed slowly and approach them at a slight angle.

The Expendable Mine Clearing Roller has operated successfully in wet and muddy conditions, but tacky mud four (4) to six (6) inches deep will impair operation due to clogging and plowing effect of the wheels.

AT NO TIME SHOULD THE EXPENDABLE ROLLER BE USED AS A DOZER OR RAM.

Try to avoid fixed obstacles which could do structural damage to the expendable parts. Experience indicated that even after a sizeable mine detonation it is possible to salvage some parts which can be used to rebuild additional wheel and yoke assemblies, thus extending the mine clearing operation capabilities.

If terrain conditions are encountered such that the rollers are 12 inches or more below the plane of the tank treads no mine clearing will be effected since the torsion spring tension will be drastically reduced. Without tension spring chains attached to the torsion springs the force exerted by one bank of rollers is three thousand one hundred (3100) pounds. Using the torsion spring chains with a length of thirty five (35) pinholes attached to the torsion springs the force exerted by one bank of rollers is five thousand nine hundred and forty (5,940) pounds.

Using the torsion spring chains with a length of thirty-four (34) pinholes attached to the torsion springs the force exerted by one bank of rollers is eight thousand three hundred and ninety (8,390) pounds.

These are the loads exerted on a level surface at ground level. Upward deflection of the wheel assembly increases torsion spring tension and thus the load transferred to the ground is greater. Downward movement of the wheel assembly causes a corresponding decrease in load transferred to the ground.

The roller is shipped with thirty-five (35) pinholes in the torsion spring chains and this is the recommended length for mine clearing.

Experiments have been conducted using thirty-four (34) pinholes in the torsion spring chains but the load applied with this length chain approaches the strength limit of the wheel arms. If conditions demand using 34 pinholes, extreme care must be practiced in order to avoid structural damage to the unit. The unit should only be used for road clearing under these conditions. Sharp turns and backing should be avoided.

Turning Radius. Since the Model Mine Clearing Roller is designed to detonate mines before they are encountered by the tread of the tank, the Mine Clearing Roller assemblies are necessarily situated forward of the tank prow and directly in front of the tank treads. Also in order to keep the width of the rollers comparable to that of the tank for mobility considerations, they overlap the tank tread paths only slightly in straight line travel. The combination of these factors causes the unavoidable creation of an uncleared area for the treads when negotiating corners. This uncleared area, although narrow in width, must, nevertheless, be recognized. The graph Figure shows the relationship between this uncleared area and the sharpness of the negotiated curve. Obviously, curves of the greatest turning radius are associated with the smallest uncleared area. When making turns of small radii, tank drivers should try, as best as possible,to follow the path of the Mine clearing Rollers. FIGURE EE schematically shows some specific values of turning radii in feet and their related uncleared areas. It is anticipated that most roads encountered (dirt and gravel) will have radii of three hundred (300) feet or greater. With a three hundred (300) foot turning radius, a vehicle will complete a 90° change of direction in four hundred seventy-two (472) feet of travel.

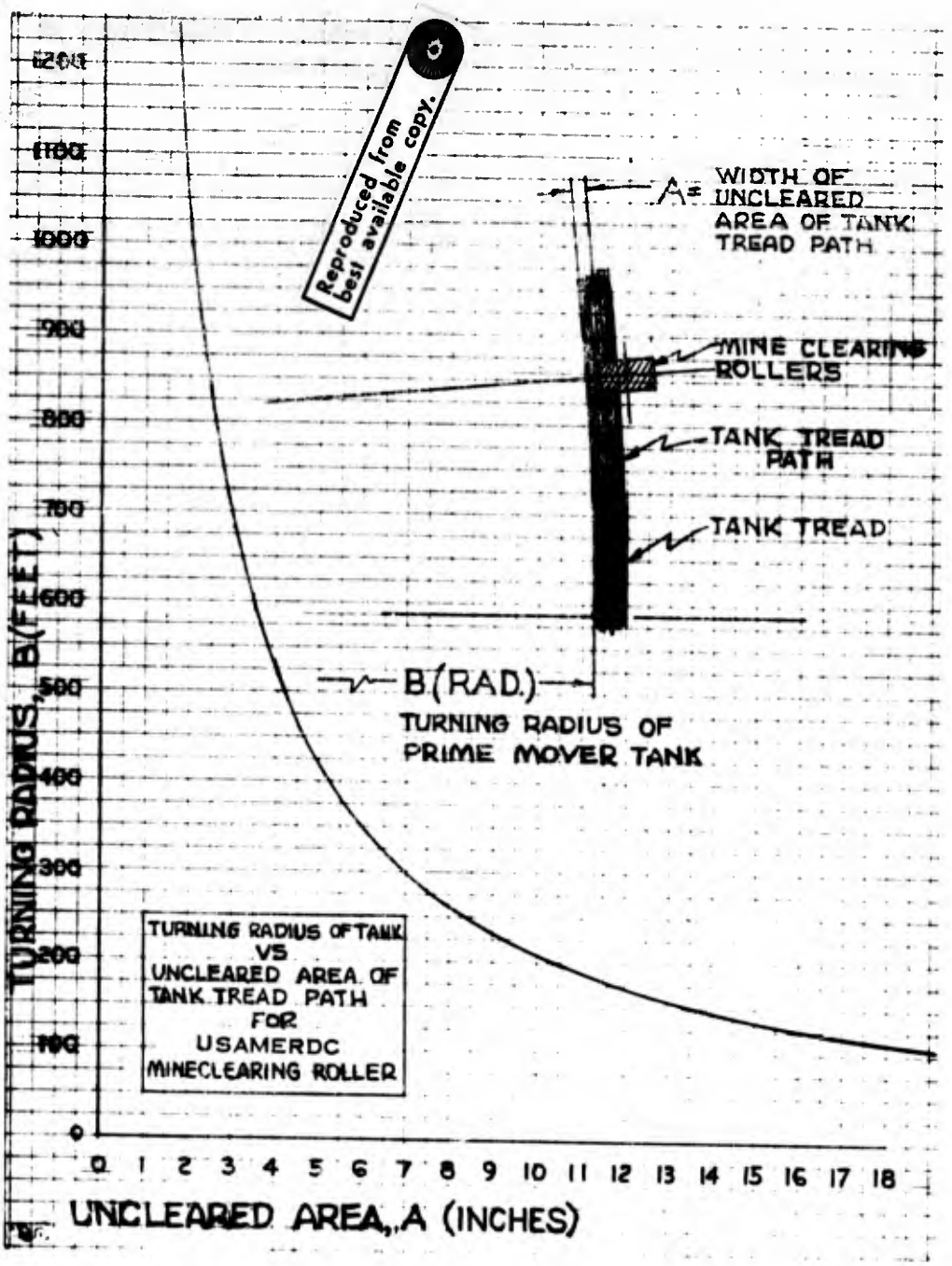
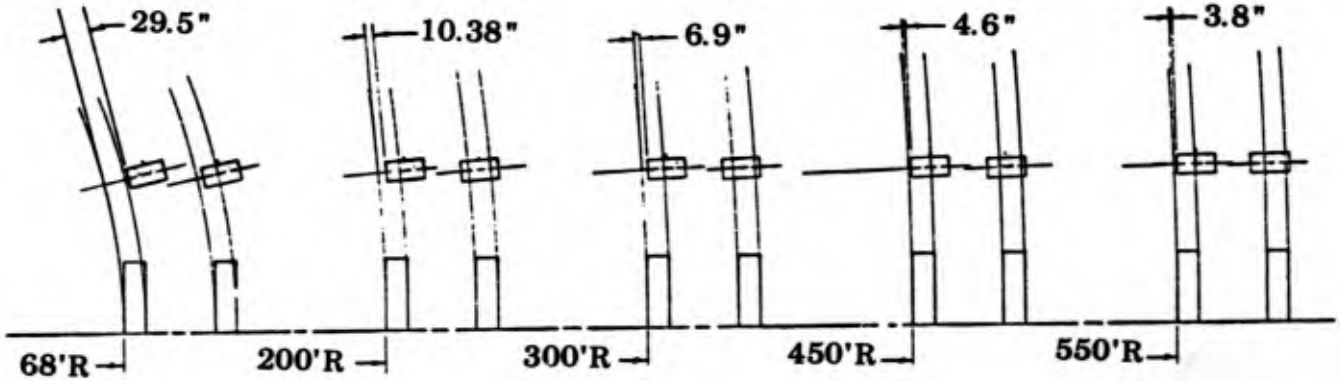


Figure DD TURNING RADIUS

Figure EE

UNCLEARED AREAS - DIMENSIONS IN INCHES



TURNING RADII - DIMENSIONS IN FEET
SCALE: 1/8"=1'

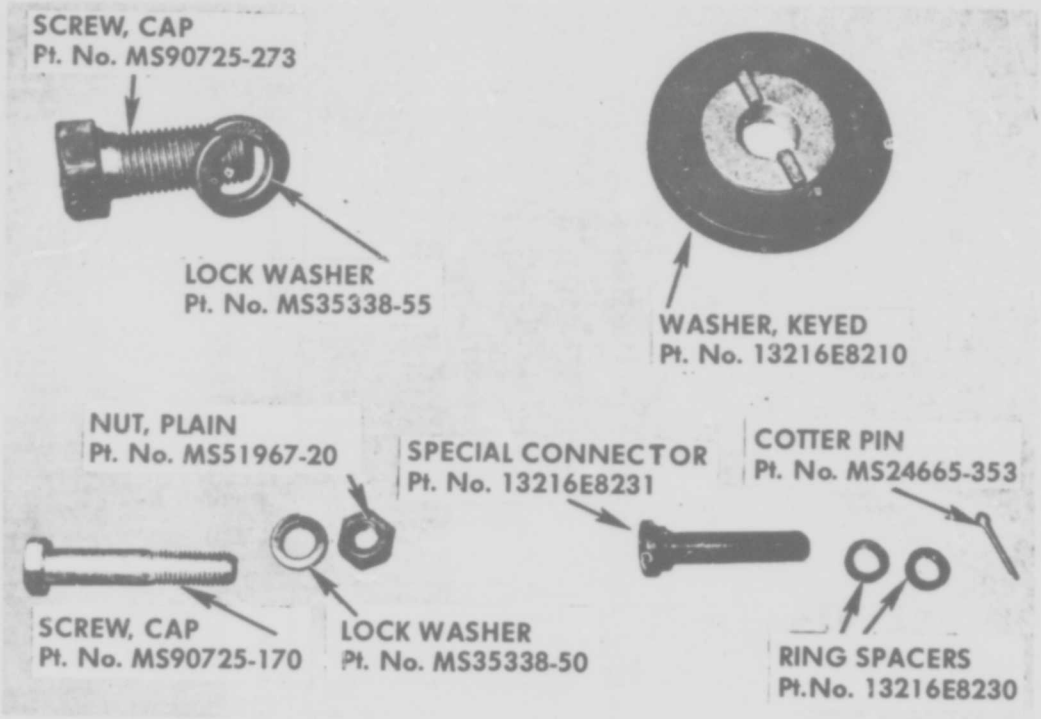


Figure FF

The above parts, FIGURE FF, PAGE 62, are contained in a separate package to be found with the Expendable Wheel and Yoke Assembly shipping skid.

After a mine encounter the spare hardware, above, will be required to assemble a new unit to the main frame. Follow the instructions and illustrations starting on PAGE 36. FIGURE O THROUGH PAGE 42.

CONTINUE WITH THE MINE CLEARING OPERATION.

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
A	Expendable Mine Clearing Roller	13217E3350	
D	Bracket	13216E8216	2
A,F,K	Frame, Structural	13217E3379	1
F,K	Turnbuckle Assembly Cad Plate	13217E3371	2
	Eye End, Turnbuckle	13217E3372	1
	Turnbuckle Body	13217E3370	1
	Nut., Hex., CS, CAD. PLT., 3-4 UNC-2B	Type 11 Style 12 FN-N-836	1
	Clevis, Rod End, Turnbuckle	13217E3373	1
	Grease, Automotive & Artillery	MIL-G-10924	
	Pin, Straight, Headed	13216E8207-3	2
	Pin, Straight, Headed	13216E8207-1	2
	Washer, Flat-RND. CS, CAD. PLT., General Purpose, 1.625 ID X 3.5 OD X .18 THK BSC Size	MS27183-32	4
	Pin, Cotter, Stl CAD PLT, .16 NOM DIA X 2 INS. LNG.	MS24665-426	4
F	Screw (Steel Cad. Plated)	13216E8233	1
	Nut: Hex., CS, CAD PLT, 2-8 UN-2B	Type 11 Style 12 FF-N-836	1
	Bolt, Eye-Turnbuckle, Stl, 2N CTD, LH THD 1-1/4-7 UNC - 2A X 18.5 LNG	MS27950-49	2
	Clevis, Rod End Turnbuckle, Stl., Galv. RH THD 1-1/4-7 UNC - 2A X .12 THD. LNG.	MS27120-56	2
	Pin, Straight, Headed		
	Washer, Flat-RND, CS, CAD. PLT., Gen. Purpose, 1.25 ID X 2.75 OD X .165 THK BSC Size	MS27183-29	2
	Pin, Cotter, Stl. CAD. PLT., .16 NOM. Dia. X 2 INS. LNG.	MS24665-426	2

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
	Nut, Plain, Hex. - CS, GR B CAD PLT 1-1/4-7 UNC - 2B	MS51967-35	2
	Turnbuckle, Body, Stl., CAD PLT 1-1/4-7 UNC - 2B X 18 Clear Opening LG.	MS27954-30	2
G	Turnbuckle Assembly Cad Plate . .	13217E3374	2
	Eye End, Hinged, Turnbuckle . .	13217E3377	1
	Turnbuckle Body	13216E8211	1
N	Nut: Hex., CS CAD PLT, 2-8 . . . UN-2B	Type 11 Style FF-N-836	12 1
	Eye End, Hinged, Turnbuckle . .	13216E8213	1
	Screw, Cap, Hex. HD., MED CS, CAD PLT, 1-1/4-7 UNC-2A X. 7.5 LNG.	Type 11 Style FF-S-85	10 2
	Washer, Lock-Spring, Helical, Extra Duty Ser, CS, CAD PLT 1.25 NOM. Size	MS35340-55	2
	Grease, Automotive & Artillery. .	MIL-G-10924	
	Support	13216E8229	4
	Pin, Straight, Headed - Drilled Shank, Aly Stl, CAD PLT, .75 NOM DIA X 3.531 EFF. LENGTH	MS20392-10C113	4
	Washer, Flat - Rnd, CS, CAD PLT, Genl. Purpose, .812 ID. X 1.469 OD X .34 THK, BSC Size . . .	MS27183-23	4
	Pin, Cotter, Stl, CAD PLT, .12 NOM DIA X 1.25 LNG	MS24665-355	4
M	Shaft	13216E8232	2
	Screw, Cap, Hex. HD. MDM CS, GR5, CAD PLT 3/4 - 10 UNC 2A X 3.5 LNG	MS90725-193	4
	Washer, Flat - RND, CS, CAD PLT, Genl. Purpose .812 ID X 1.469 OD X .134 THK, BSC Size . .	HS27183-23	4
	Washer, Lock-Spring, Helical, RGLR SER., CS, CAD PLT. .75 NOM. Size	MS35338-51	4

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
A	Frame, Left Side	13216E8221	1
A	Frame, Right Side	13216E8222	1
	Cap, Retainer	13216E8217	4
	Screw, Cap, Hex. HD, MDM CS GR5 CAD PLT 5/8 - 11 UNC - 2A X 3.25 L.	MS90725-169	16
	Washer, Lock-Spring, Helical, RGLR SER, CS, CAD PLT, .625 NOM. Size	MS35338-50	16
N	Washer, Flat	13216E8209	4
	Pin, Cotter, Stl, CAD PLT, .25 NOM. DIA. X 5L	MS24665-632	2
	Fitting, Lub Surface Check, 1/4-28 UNS-2A, Stl, CAD PLT, Type 1 STR .937 L.	MS15001-2	4
BB	Block, Retaining	13216E8208	
A, V1, V2	Spring Assembly, Torsion	13216E8197	4
	Cap, Torsion Spring Retainer	13216E8201	2
	Screw, Cap, Skt 4D-HEX, Aly Stl, CAD PLT, 1/2-13 UNC - 3A X 1L	MS16997-141	8
	Fitting, Lub Surface Check, 1/4-28 UNS-2A, Stl, CAD PLT, Type 1 STR	MS15001-1	4
	Seal, Plain	13216E8198	2
	Screw, MACH. -82° Flat CTSK HD, Cross-Recessed, CS, CAD PLT, No 10-32 UNF-2A X .75 L	MS35191-274	24
	Spring, Torsion	13216E8200	5
	Retainer, Torsion Spring	13216E8202	1
	Rod, Internally Threaded	13216E8199	4
	Sealing, Locking, and Retaining Compounds, Single-Component	GR B MIL-S-22473	
	Chain, Roller; Power XMSN, Flat Link Plates, 2 Pitch, Single Strand, St. 34 Links L approx. 68"	Type 160-IRC, GRA, CL 2 MIL-STD-421	

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
EE, V1, V2	Spacer	13216E8230	12
EE, V2	Pin	13216E8231	8
EE, V2	Pin, Cotter, Stl, CAD PLT, .12 NOM DIA X 1L	MS24665-353	8
	Shaft, Shouldered CAD PLT	13216E8205-1	4
	Plate, Shaft Retaining	13216E8206	4
BB	Screw, Mach. - Pan HD, Cross-Recessed, CS, CAD. PLT. 1/2-13 UNC-3A X 2 L	MS16997-145	8
P	Chain, Welded, CS, self-colored, .62 NOM Size X 60 LNG	Type 1, GR C, CL3 RR-C-271	2
	Link, End, W1, self-colored, .75 NOM. Dia. X 3 NOM. inside LG	Type 1 RR-C-271	2
	Pin, Straight, Headed - Drilled Shank Aly Stl., CAD PLT, 1 NOM DIA X 2.406 EFF LENGTH	MS20392-12C77	2
	Washer, Flat-Rnd, CS, CAD PLT, General Purpose, 1.062 ID X 2 OD X .134 THK BSC Size	MS27183-27	2
	Pin, Cotter, Stl, CAD PLT, .16 NOM DIA X 2LNG	MS24665-426	2
A,P	Extension Arm, Left Side	13217E3375	1
A	Extension Arm, Right Side	13217E3376	1
EE	Screw, Cap, Hex. Hd, MDM CS, GR5, CAD PLT, 5/8 - 11 UNC- 2A X 3.5 L	MS90725-170	12
EE	Washer, Lock - Spring, Helical, RGLR, SER, CS, CAD PLT .625 NOM Size	MS35338-50	12
E	Nut, Plain, Hex. - CS, GR B, CAD PLT, 5/8 - 11 UNC - 2B	MS51967-20	12

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
A,Q	Wheel and Yoke Assembly	13217E2245	2
	Spacer	13218E5059	5
	Roller	13217E2249	12
	Shaft, Straight	13217E2248	1
	Washer, .75 NOM. Size	MS35338-51	6
	Screw, 3/4 - 10 UNC - 2A X 5L	MS90725-199	6
	Wire Rope, Improved Plow Stl. UNCTD, 1w rc, .62 NOM. Rope Dia. X 262-259 L	Type 1, CL3, Constr 3 RR-W-410	1
	Grease	MIL-G-10924	
	Yoke and Pulley Assembly	13217E2247	2
	Yoke, Wheel Suspension	13217E2259	1
	Keeper	13217E2256-2	5
	Screw, 1/2-13 UNC-2A X 1L	MS90725-109	6
	Washer, .5 NOM. Size	MS35338-48	6
	Washer, .531 ID X 1.062 OD X .095 THK, BSC Size	MS27183-18	6
	Shaft	13217E2260	5
	Nut, 7/8 - 9 - UNC -2B	MS51967-26	10
	Washer, .875 NOM. Size	MS35338-52	10
	Washer, .938 ID X 1.75 OD X .134 THK, BSC Size	MS27183-25	5
	Washer	13218E5060	5
	Sheave	13217E2255	5

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
	Wheel And Arm Assembly	13217E2246	6
	Arm, Wheel	13217E2250	1
	Elbow, Pipe to Tube	13217E2257	1
	Screw, 1/4-28 UNF-2A x .75L.	MS90726-6	1
	Washer, .25 NOM. Size	MS35338-44	1
	Washer, .281 ID X .625 OD X .065 THK BSC Size	MS27183-10	1
	Fitting, 65°	MS15003-5	1
	Tube Assembly, Metal	13217E2258	1
	Elbow, CS, CAD or ZN PLT., .19 Tube OD X 1/8 NPTF EXT X 3/8 - 24 UNF-2A	Type 111 Style 2 MIL-F-18866	1
	Keeper	13217E2256-1	1
	Screw, 1/2-13 UNC-2A X 1L	MS90725-109	2
	Washer, .5 NOM Size.	MS35338-48	2
	Washer, .875 NOM. Size	MS35338-52	11
	Nut, 7/8 - 9 UNC - 2B	MS51967-26	11
	Road Wheel -Disc. Assembly, M-48, Steel	FSN 2530-701-3976	1
	Shaft, Shouldered, Wheel.	13217E2251	1
	Screw, 7/8-9 UNC-2A X 2.25 L.	MS90725-210	10
	Washer, Thrust	13217E2252	2
	Washer	13217E2253	1
	Nut, 1-1/2-12 UNF-2B	MS35692-109	1
	Pin, .25 NOM Dia X 3L.	MS24665-628	1
	Shaft, Shouldered	13217E2254	1
	Nut, 5/8 -11 UNC - 3 B	MS17829-10c	1

FIGURE NO.	NAME AND/OR DESCRIPTION	PT. NO.	QTY. In Unit
	Washer, .625 NOM Size	MS35338-50	1
	Sheave	13217E2255	1
	Washer	13218E5060	1
	Grease	MIL-G-10924	
EE, S	Screw, Cap Hex HD, MDM CS, GR5, CAD PLT, 1-1/4-7 UNC-2A X 3L	MS90725-273	2
EE, S	Washer, Lock - Spring, Helical, Regular SER, CS, CAD PLT, 1.25 NOM Size . .	MS35338-55	2
EE, S	Washer, Keyed	13216E8210	2
	Fitting, Lub Surface Check, 1/4-28 UNS 2A, STL, CAD PLT, Type 1, 45°	MS15001-3	
	Nut, Plain, Hex. - CS, GR B, CAD PLT, 1-1/4-7 UNC - 2B LH		

ABREVIATIONS

CADMIUM	CAD.
LONG	LNG.
GENERAL	G
GRADE	GR
HEAD	HD
THICK	THK
CARBON STEEL	CS
MEDIUM	MDM
ROUND	RND
NOMINAL	NOM.
SERVICE	SER.
PLATING	PLT

APPENDIX B

OPERATIONAL SUITABILITY STATEMENT

VZCZCEUF618
RTTUZYVW RUEACTA6142 0131733-UUUU--RUEOFUA.
Z NR UUUUU ZOV RUEACTA B142 031733
RR RUEADWD
DE RUMOAVA 693 01380845
Z NR UUUUU
R 130824Z JAN 71
F M CGUSARV LBN RVN
TO RUEBBNA/CGUSAMC
RUEADWD/CO USMERDC
INFO RUEADWD/DA
RUHHRGA/CGUSARPAC
ZEN/CGUSAECV (P) LBN
BT
UNCLAS
AVHDO-DR
DA FOR ACSFOR; USARPAC FOR GPOP-DT; AMC FCR AMCRD-J AND AMCRD-P (MR FLYNN); MERDC FOR SMEFB-W (MAJ GARDENER)
SUBJ: STATEMENT OF OPERATIONAL SUITABILITY FOR THE M48 TANK MOUNTED MINE CLEARING ROLLER (ENSURE 202.1)
1. THE M48 TANK MOUNTED MINE CLEARING ROLLER HAS BEEN EVALUATED BY US COMBAT FORCES AND FOUND UNSATISFACTORY FOR THE FOLLOWING REASONS:

A. THE INABILITY OF THE MINE ROLLER TO DETECT/DETONATE COMMAND DETONATED MINES. ONE UNIT RELATED AN EXPERIENCE WHERE SEVERAL VEHICLES HAD BEEN FOLLOWING THE MINE CLEARING ROLLER AND

PAGE TWO RUMOAVA4693 UNCLAS
THE LAST VEHICLE IN THE COLUMN WAS DESTROYED BY A MINE.

B. THE TACTICAL UNITS DISLIKED THE REQUIREMENT FOR A WRECKER

AND CARRIER VEHICLE FOR SPARE PARTS TO ACCOMPANY THE MINE ROLLER. REPAIRS REQUIRED CONSIDERABLE TIME AND EFFORT. MANY UNITS FELT THESE MAINTENANCE RESOURCES COULD BE USED TO GREATER ADVANTAGE ELSEWHERE.

C. WHEN THE ROLLERS WERE OPERATED ON UNIMPROVED ROADS, SAND AND DUST CAUSED EARLY FAILURE OF BEARINGS. IN ADDITION, LUBRICATION WAS A PROBLEM DUE TO ROCKS BREAKING THE GREASE FITTING LINES.

D. ONE UNIT REPORTED THAT THE WEIGHT OF THE MINE ROLLER CAUSED UNDUE WEAR ON THE COMPENSATING IDLER AND FRONT ROAD WHEELS WHILE IN TRANSIT.

E. THE USEFULNESS OF THE TANK ITSELF AS A COMBAT VEHICLE WAS NEGATED WHEN IT WAS USED WITH THE MINE CLEARING ROLLER; THEREBY NECESSITATING AN ADDITIONAL SECURITY ELEMENT TO ACCOMPANY THE VEHICLE.

2. HOWEVER, EVEN WITH ITS SEVERAL FAULTS, THREE OF THE FIVE UNITS EVALUATING THE TANK MOUNTED MINE CLEARING ROLLER STATED THEY WOULD CONTINUE TO OPERATE THE EQUIPMENT.

3. THE 20TH ENGINEER BRIGADE FOUND THE MINE CLEARING ROLLER

EFFECTIVE IN CLEARING ANTI-PERSONNEL MINE FIELDS. THE ENGINEERS SUGGESTED THAT ADDITIONAL MINE CLEARING ROLLERS SHOULD BE PLACED IN ARMOR UNITS WHERE THE PRIME MOVERS ARE AVAILABLE. THEY ALSO RECOMMENDED THAT THE EQUIPMENT BE TYPE CLASSIFIED STANDARD A. THIS LATTER RECOMMENDATION IS OPPOSITE TO THAT OF THE TACTICAL COMBAT UNITS.

4. A MAJORITY OF THE EXPERIENCE OBTAINED TO DATE HAS BEEN BASED ON USING THE MINE CLEARING ROLLER IN CROSS-COUNTRY OPERATIONS AND OTHER OFF ROAD AREAS WHERE THE MINE ROLLER WAS NOT PRIMARILY DESIGNED TO OPERATE. THE ENGINEERS HAVE RECENTLY REQUESTED AN ADDITIONAL MINE CLEARING ROLLER TO BE UTILIZED DURING ROAD CONSTRUCTION OPERATIONS. AN EXTENSION TO THE EVALUATION PERIOD WOULD ALLOW THE DATA OBTAINED BY THE ENGINEER COMMAND TO BE EVALUATED. IN A FONECON BETWEEN MERDC AND THEIR VLAPA REPRESENTATIVE, MERDC AGREED TO AN EXTENSION.

5. FOLLOWING IS A LIST OF SUGGESTED MODIFICATIONS:

A. A MEANS SHOULD BE PROVIDED FOR LIFTING THE ROLLERS WHEN TRAVELING TO PREVENT OVERLOADING THE FRONT ROAD WHEELS.

B. A PLATE SHOULD BE INSTALLED TO PROTECT THE TORSION CHAINS FROM BLAST DAMAGE.

PAGE FOUR RUMOAVA4693 UNCLAS

C. A TINE SHOULD BE PLACED BETWEEN THE ROLLER WHEELS TO PREVENT THE COLLECTION OF MUD AND STONES.

D. VERTICAL RODS SHOULD BE WELDED TO THE OUTER EDGE OF THE ROLLER TO ACT AS GUIDES TO THE DRIVER.

E. THE SWEPT AREA MUST BE INCREASED TO REDUCE THE UNSWEPT AREA AT THE CENTER OF THE ROADWAY. A FOLLOWING M1113 HAS ABOUT FIVE INCHES OF MARGIN TO REMAIN IN THE TRACKS OF THE TANK MOUNTED ROLLER. A WHEELED VEHICLE, E.G, 1/4-TON OR 1/2-TON, CANNOT FOLLOW IN THE SWEPT ZONE.

F. A MODIFICATION KIT SHOULD BE CONSIDERED FOR MOUNTING THE ROLLER TO THE COMBAT ENGINEER VEHICLE (CEV) AND/OR THE ARMORED VEHICLE LAUNCHED BRIDGE CHASSIS.

G. A QUICK RELEASE MECHANISM IS DESIRED WHICH WOULD ALLOW THE VEHICLE TO BE QUICKLY CONVERTED INTO A FIGHTING VEHICLE.

6. CONCLUSIONS:

A. THE EVALUATION WAS INCONCLUSIVE WITH RESPECT TO THE INTENDED USE OF THE MINE CLEARING ROLLERS.

B. AN EXTENSION OF THE EVALUATION PERIOD SHOULD BE REQUESTED. MERDC SUPPORTS THIS REQUEST.

C. THE PROPOSED MODIFICATIONS SHOULD IMPROVE THE EFFECTIVENESS

PAGE FIVE RUMOAVA4693 UNCLAS

OF THE EQUIPMENT.

D. THE CONCEPT HAS MERIT.

E. OVERALL, THE EQUIPMENT APPEARS TO SERVE A USEFUL AND WORTHWHILE PURPOSE, AND DOCTRINAL AND DEVELOPMENTAL WORK ON THE CONCEPT SHOULD BE CONTINUED.

7. RECOMMENDATIONS.

A. THE EVALUATION PERIOD BE EXTENDED TO 15 MONTHS.

B. THE EQUIPMENT NOT BE TYPE CLASSIFIED STANDARD A AT THIS TIME.

C. DOCTRINAL AND DEVELOPMENTAL WORK ON THE CONCEPT BE CONTINUED

BT

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APPENDIX C

FINAL EVALUATION REPORT

Department of the Army
Headquarters, United States Army Vietnam
APO San Francisco 96375

AVHDO-DR 26 Jul 1971

Subject: Final Evaluation Report on the M48 Tank Mounted Mine Clearing Roller (ENSURE 202.1) (ACTIV Project No. ACR-202.1E/71)

Commanding Officer
US Army Mobility Equipment Center
Research and Development
Fort Belvoir, Virginia 22060

1. Reference USARV message AVMDO-DR 130824Z Jan 71, subject: Statement of Operational Suitability for the M48 Tank Mounted Mine Clearing Roller.

2. This report covers the entire 15-month evaluation period and supplements and expands the findings stated in the above reference which remains valid, especially in the areas of modifications, shortcomings, and deficiencies. The evaluation was conducted in two periods: March-November 1970 (ref is interim report), and December 1970-May 1971.

3. A summary of unit comments concerning the evaluation is contained in Inclosure 1.

4. Conclusions:

a. The concept has merit. Doctrinal and developmental work should be continued.

b. The mine roller is easily defeated by several commonly used firing devices.

c. The swept area is limited.

d. Several modifications are required to eliminate shortcomings in the system's design.

e. The system is effective in clearing known anti-personnel mine fields, but is limited in detection/detonation of anti-vehicle mines randomly emplaced in roadways.

5. Recommendations:

a. Doctrinal and developmental work on the concept be continued.

b. The mine roller not be type classified at this time.

c. If the mine roller is produced at a later date the Basis of Issue should be on a mission-required basis.

d. No further procurement of the mine roller be made for use in RVN.

FOR THE COMMANDER:

/s/ T. H. Childress Cpt.
1 Incl for /t/ F. L. HONSOWETZ
as CPT. AGC.
Assistant Adjutant General

CF:
DA ACSFOR
CINCUSARPAC
CGUSAMC
CGUSACDC
CGUSAMECOM

Summary of Unit Comments on the Evaluation of the M48 Tank Mounted Mine Clearing Roller (ENSURE 202.1)

The M48 Tank Mounted Mine Clearing Roller was evaluated by units of the US Army and 1st Australian Task Force in the Republic of Vietnam from March 1970 to May 1971. Following are the summarized comments of the evaluation units:

1. Mode of Operation.

The mine roller was utilized in clearing cross-country trails, unpaved secondary roads, roads which were under construction, and anti-personnel mine fields. During the first phase of the evaluation the mine roller was used predominately in cross-country operation and other off-road areas in which the mine roller was not primarily designed to operate. An interim report was submitted at the conclusion of that phase in January 1971. An extension to the evaluation was requested at that time to evaluate it in the roles for which it was designed. The extension was approved and during the second phase of the evaluation the mine roller was used by the engineers to assist in the clearing of road beds being constructed as part of the Lines of Communication (LOC) program and on other unpaved roads. In addition, several anti-personnel mine fields were cleared by the engineers during the evaluation.

2. Type mines detonated and their effect on the equipment:

a. Russian TM-47 10kg Mine. The mine was detonated by the M48 Tank when it turned around on an unswept area resulting in a broken track and road wheel damage. The TM-47 mine uses a pressure plate fuze.

b. US M-14 and M-16. During the clearing of friendly emplaced anti-personnel mine fields, several thousand M-14 mines and approximately 30 M-16 mines were detonated with negligible damage to the mine roller system. These mines used standard US fuzes.

c. VC 5kg mine. The rollers detonated a VC 5kg mine which had a Rocket Propelled Grenade (RPG) warhead. One roller set had to be replaced. The mine had a pressure activated electric fuze.

d. VC 5kg blast mine. The rollers detonated a VC 5kg blast mine. One roller set had to be replaced. The type of fuze was unknown.

e. VC 15kg blast mine. The mine detonated under the tank and fractured the driver's escape hatch. The mine was suspected of having a tilt switch fuze.

Incl 1

f. VC 30kg blast mine. The mine detonated under the tank causing major damage to the prime mover. It is suspected that either an offset switch or command-detonated mine was used.

g. There have been three other instances reported wherein the mine roller and several vehicles in convoy behind the mine roller passed over the mine before it detonated. It was suspected that the mines were command-detonated, however, a "slap stick" firing device, which often requires repeated pressure loading before completing the firing circuit, may have been used. See Appendix 2 for the description of the common enemy firing devices found in RVN.

3. Shortcomings and problem areas.

a. The mine rollers do not sweep the area over which the tracks move when the tank is required to make a sharp turn. This was the cause of damage to the tank in para 2a above.

b. The area on the ground swept by the rollers is in the form of two parallel tracks with an unswept area between; therefore not all firing devices are contacted. This is especially hazardous when tilt switches are used because they are then activated by the hull, thus causing the mine to detonate beneath the tank.

c. Off-road operations are limited because the rollers tend to push up material in front of it. This becomes a major problem when the ground is soft or wet, e.g., when constructing road beds. The Engineer road construction units did not complete all of a section of road in one day. Frequently the unfinished portion was mined at night. In an effort to neutralize the mines the next day the mine roller was used. In the soft soil of the unfinished portions of the road the mine roller acted like a bulldozer blade by pushing the dirt ahead of it.

d. The extra weight of the mine roller placed a heavy strain on the tank suspension and drive mechanism and contributed to maintenance problems.

e. There was no easy way to place the rollers in a travel position at the end of the mine clearing mission so that the tank could be converted to a security role. When the roller was lifted, the added weight on the tank's suspension caused a reduction in ground clearance and a corresponding reduction in mobility.

f. Removing the mine roller from the tank is a time consuming and troublesome task.

g. Roller sets needed replacement after each detonation of anti-vehicle mines because of either breakage of the steel wire rope tensioner or buckling of the individual rollers. Replacement occasionally took up to two hours but this time could be reduced to approximately 30 minutes by having a wrecker and a spare parts vehicle traveling with the equipment.

h. Individual rollers are not sufficiently independent in movement to allow for unevenness in the ground of more than about two inches.

i. Rocks and debris easily jam between individual rollers preventing rotation and quickly stripping the rubber from the road wheels.

j. The vertical pins holding the roller assemblies tend to shear if too tight a turn was made.

k. The opinion was expressed that as a "proof vehicle" on smooth roads (paved or unpaved) the tank with mine clearing rollers could attain convoy speeds. On rough surfaces the rollers bounce, restricting the clearing speed. Most clearing operations were conducted at speeds less than 10 mph.

l. As in all current mechanical mine clearing devices, offset, delay, or command detonated mines can defeat the purpose of this equipment.

m. Because of the low clearance, the main frame mounting bolts drag on the ground over rough terrain. If these bolts were countersunk the possibility of damage to the bolts would be lessened.

4. Modifications.

To overcome the problem of tilt switches located between the swept areas of the two roller assemblies, one unit installed heavy rubber flaps mounted to drag along the ground between the two roller arms.

5. System effectiveness.

a. The mine roller is considered useful as a "proof roller" when employed after a minesweep by a unit utilizing hand-held detectors.

b. The system is very effective for clearing anti-personnel minefields and in this role proved a very useful device for the engineers.

6. Personnel attitude.

The units which evaluated the mine roller normally do not have tanks organic to their unit. Therefore, the personnel were more impressed with the additional fire power and armor protection provided by the tank than by the effectiveness and usefulness of the equipment in clearing mines.

7. Evaluation units.

The units which operated the mine roller during each phase of the evaluation and the number of rollers operated appears as Appendix 1 to this inclosure.

Number of M48 Tank-Mounted Mine Rollers Operated During the Evaluation

Phase One March 1970 through November 1970

Unit	No. of Systems Operated
20th Engr Bde	1
1st Bde 5th Inf Div (Mech)	1
23d Inf Div	2
11th ACR	2
IFFV	1
Total	7

Phase Two December 1970 through May 1971

Unit	No. of Systems Operated
Engr Comd	
35th Engr Gp	1
159th Engr Gp	2
23d Inf Div	2
1st Australian Task Force	1
Total	6

Appendix 1 to Incl 1

APPENDIX D

NET TEAM LEADER'S TRIP REPORT

U. S. Army Mobility Equipment Research and Development Center
Fort Belvoir, Virginia

SMEFB-MN TRIP REPORT 2 June 1970

SUBJECT:

SEE DISTRIBUTION

1. Purpose of Visit: To provide New Equipment Training to users of the Expendable Mine Clearing Roller and to advise potential users of the status development of the Antitank Mine Dispensing System.

2. Itinerary: Fort Belvoir, Virginia, to Long Binh, RVN, to Heidelberg, Germany, and return.

3. Individuals Contacted:

MAJ Badjer – ACTIV R&D USARV Long Binh
COL Clarkson – " " " " "
COL McCoid – CO, ACTIV " " "
COL Sheriff – CAO, USARV " " "
Bob Benn – STR MECOM " " "
MAJ Leonard G-3, USARV " " "
MAJ White G-3, USARV " " "
MAJ Griffin G-3, USARV " " "
MAJ Corby-Mine Warfare Officer " "
MAJ Seibert – POL, Directorate 1st Log Command Long Binh
COL Starry – CO, 11th ACR Quan Loi
LTC Bradley Dep 11th ACR Quan Loi
MAJ Good – S-3, 11th ACR Quan Loi
MAJ Volta S-4, " " " "
CPT Mohler S-4, " " " "
MAJ Lockay S-4, 1st Brigade & 5th Infantry, Quang Tri
CPT Oneil – CO, C Company 1st 77th Quang Tri
LTC Baird CO 1st & 77th Quang Tri

MAJ Harris – XO 1st & 77th Quang Tri
LTC Brinkerhoff – CO, 4th Engr Batt An Khe
MG Walker – CG, 4th Inf " "
MAJ Harris – XO, 4th Engr Batt " "
CPT Olivier – S-4, " " " " "
1LT Brady–Mine Warfare Officer " "
LTC Dutchysyn – CO, 26th Engr Batt Americal Division, Chu Lai
MAJ Ryan – XO, " " " " " " "
MAJ Hersch – S-3, " " " " " " "
1Lt Pendergass – S-4, " " " " " " "
MAJ Driscoll – CO, 3rd Sqdn 11th ACR Lai Khe
CPT Sharpe – S-4, 3rd Sqdn 11th ACR Lai Khe
Mr. Petersen – Chief, Long Binh Fire Department
COL Cordova – Ch, Mil Ops Div USAER Heidelberg, Germany
LTC Nowicki – Dep Chief, Mil Ops Div USAER Heidelberg, Germany
Mr. Jessup – DCSLOG, USAER Heidelberg, Germany

DISCUSSION:

Although this was an ENSURE effort, the majority of recipients were unaware of the roller. This is because their predecessors had rotated from RVN and had not advised their successors of the ACTIV evaluation and subsequent ENSURE buy; when told of the roller, these people were, for the most part, dubious and apprehensive as to the possible use of the roller. They were reluctant to use the roller for what it was designed to be used for but wanted to continue their mission with their combat vehicle with or without the roller attached. In other words, if their job had been to "bust jungle" before the roller, they wanted to continue to "bust jungle."

SIGNIFICANT ACTIONS: The Net Team did demonstrate and aid in the installation of a roller on an M48 tank for the 11th ACR based at Quan Loi and the 1st & 5th based at Quang Tri. A roller was mounted on a CEV belonging to the 4th Engineer Battalion at An Khe. The 26th Engineer Battalion at Chulai had a roller mounted on an M48 after two members of the NET team departed RVN. The 4th Engineers immediately began road sweeps with their roller and within about 10 days had encountered five mines each of which would have disabled a tracked vehicle and probably would have caused bodily injury if not a fatality. In each of the five instances, the roller performed as designed. "Old" expendable spare parts (from ENSURE 202) were used to replace the ones expended (from 202.1).

(ENSURE 202 was the original roller which led to the ACTIV evaluation and subsequent ENSURE 202.1)

CONCLUSIONS: The continuing success of the 4th Engineer Battalion with the roller may influence the other combat divisions in RVN to use the roller on their road sweeps, but this is merely an assumption at this time.

The roller, when used for the purpose for which it was originally requisitioned, was very effective and performed its function satisfactorily.

RECOMMENDATIONS: It is recommended that NET teams in the future be allowed to brief the officers of a unit which will be capable of making command decisions. In the case of ENSURE 202.1, only one division commander was briefed relative to the designed use of the roller, its potential, and its shortcomings. This, coincidentally, was the organization that utilized the roller successfully.

NOTE: The work discussed at USAER is of a confidential nature and the report covering this portion of the trip will be made orally to the cognizant personnel.

DAVID C. EDWARDS

cc:
Plans & Ops (Maj Vincent)
R&D Proc (Hildie Melchiori)

APPENDIX E

FIELD ENGINEER'S TRIP REPORT

Mr. David Edwards
Senior Project Engineer
Military Technology Laboratory
USA MERDC
Ft. Belvoir, Virginia 22060

28 June 1970

Sir:

Re: Contract No. DDAK02-70-C-0186, Section F, Special Provisions F-4-f. Field Engineering Services and Disclosure of Activities.

This report covers a period of time from March 26, 1970, to June 19, 1970. The reporting technique will consist of day to day activities as they relate to ENSURE 202.1 and its employment in the Republic of Vietnam. Critical evaluation of problems encountered or successes made will appear in the day time period if they are significant there, otherwise the summary will contain a broad comment on events that had reoccurred with recognizable frequency. Recommendations on future development and improvements to the Mine Clearing Device will become part of the closing remarks.

MARCH 26 – Departed Washington Dulles Airport for Saigon, RVN. Transferred to overseas flight in San Francisco with intermediate stops in Hawaii and Guam.

MARCH 28 – Arrived in Saigon, RVN, at about 9:00 A.M. Escorted from Saigon to Long Binh by Ralph Badger, Major, USA. Billeting Office assigned me to trailer number 4707. John Insani, Colonel, USA, was my trailer mate.

MARCH 29 – Vern Urie escorted me on Long Binh post for purpose of securing pass cards, uniforms, PX privileges, photographs, et cetera.

It is essential that civilians on military travel orders have clothing allowances written into those. Because of the formal military atmosphere on Long Binh and the military equivalency rating of some civilians, it is important and required to conform to military attire. Additionally, environmental conditions require adequate body protection.

MARCH 30 – Departed Bien Hoa at 0815 hours for En Khe via Qui Nhon on mission U-21-2.

David Edwards greeted me at the En Khe air strip. Traveled to Camp Radvliff by jeep.

Lieutenant Jim Brady, David Edwards, and myself were briefed by Colonel Brinkerhoff. Later that day, work was continued on the Combat Engineer Vehicle (C.E.V.) retro-fit which was almost complete by the time of my arrival.

Difficulty was experienced with the yoke stem interference at the extension arm pivot bearing fit. This problem was eliminated by tolerance changes on future units.

Joe Smith from MERDC also assisted with the mechanical work.

MARCH 31 – Work continued on C.E.V. Roller. It was evident that special welded shapes and machine parts are difficult to generate under combat conditions. The roller was completely assembled by 1700 hours this date.

APRIL 1 – A convoy was formed for the purpose of testing the roller under actual sweep conditions. I rode on the C.E.V. with Sergeant Cole, the tank commander. David Edwards and Captain Olivier followed with the support trucks. Just short of An Khe pass the enemy caught the column in a cross fire. Our convoy turned back to avoid actual contact with the enemy. Too damned bad.

Some other sweeps were made this day with the roller. I would estimate that a total of fifty miles was experienced with no difficulty.

David had the crew lubricate the roller according to instructions. Wear was evident on the cable rollers.

APRIL 2 – David Edwards, Joe Smith, and myself departed from En Khe on an Air Force C-130 transport bound for Tan Son Nhut air field. We took a bus trip from Saigon to Long Binh post. The temperature inside a C-130 is almost unbearable. I could not adjust to the sun or heat then. By the time of departure, almost three months later, the problem of heat adjustment still existed.

APRIL 3 – Stand down for maintenance.

APRIL 4 – Stand down for maintenance.

APRIL 5 – ACTIV Huey helicopter took David and myself to Quan Loi. We talked at length with Major Bradley about his mine sweep missions and frequency of encounter. This group was some part of the 11th Armoured Cavalry Regiment.

We were asked to visit Lai Khe and evaluate the mine clearing roller which was reported to be damaged.

APRIL 6 – Stand down for maintenance.

APRIL 7 – ACTIV helicopter took Joe Smith, David, and myself to Lai Khe. The roller assembly was very badly damaged. It appeared that this unit was used for clearing trees. In addition to the visible structural damage the machine had suffered, someone had removed the tank to roller interface connections with a burning torch. Departed Lai Khe at 1505 hours for Long Binh.

APRIL 8 – Took a driver's test for military vehicles on Long Binh post – passed.

APRIL 9 – Had additional immunization shots at the hospital on Long Binh post.

APRIL 10 – Joe Smith and myself searched Long Binh supply depot for roller shipments. Finally, we checked aircraft arrivals at Ton San Nhut. The cargo planes had not arrived according to schedule.

Supply distribution problems are difficult. Later experience proved this to be the understatement of the war.

APRIL 11 – Stand down for maintenance.

APRIL 12 – Attended "Hail and Farewell" meeting sponsored by ACTIV. Colonel Clarkson asked me to escort the Australian science advisor, Colonel Gibbson. He was a very interesting man. From our conversation, it was apparent that he had given considerable thought to Vietnamization and later, especially, the economic future of South Vietnam.

APRIL 13 – Departed Saigon at 1025 hours for Cam Ranh Bay on C-130 flight with Joe Smith. We stayed in the officers BOQ this night.

APRIL 14 – Departed Cam Ranh Bay on C-130 to Phu Cat. Departed Phu Cat, after

five hours of waiting, in the back of a PACAF pickup truck headed for Qui Nhon. Received several rounds of rifle fire from the paddies. Stayed in teh BOQ at Granite City Camp. (You should see the Granite City Hilton.)

APRIL 15 – Hitch-hiked a ride from Granite City Camp to Lony My where the 58th Field Depot had been reported to exist. The 58th Field Depot was not in existence as of this date, however, Qui Nhon Supply Depot does exist. We located three (3) complete units and one (1) expendable. Returned to Qui Nhon Air Field to await C-130 flight to Tan Son Nhot. Stayed in Saigon hotel this night.

APRIL 16 – Returned to Long Binh by USARV bus. Went to Long Binh depot by jeep. We found one (1) complete Mine Clearing unit and five (5) expendables. The experience of the last four days indicated that some information gaps exist in the Army warehouse management.

APRIL 17 – Stand down for maintenance.

APRIL 18 – Day spent in preliminary planning for Chu Lai mission. Also, had a debriefing with David Edwards and Joe Smith.

APRIL 19 – Departed Bien Hoa on U-21-1 flight to Chu Lai, an intermediate stop at Qui Nhon. Almost had an opportunity to meet our maker when the ammunition dump exploded beside the runway.

APRIL 20 – Organized the crew and equipment necessary to retrofit an M-48 tank with the roller. There was a shortage of adequate tools and the assigned welder was inexperienced.

APRIL 21 – Helped the crew with the assembly. Everyone was excited about having a device to stop the needless murder outside Fat City.

APRIL 22 – Finished the roller assembly at 0230 hours. Convoy with the roller equipped tank as lead vehicle started for Fat City. Returned to Tan Son Nhut by C-130 transport. Assisted Vern Uric with call to Ft. Belvoir. Secured a connected at 0230 hours after five preemptions. A total of six and one-half hours was required on this communication.

APRIL 23 – Morning at leisure. During the afternoon we reviewed the photographs taken at Quang Tri showing the mine roller in various stages of disrepair. Tried numerous times to reach Major Burchel at the 1st of 5th (Mech.).

We decided to make an unannounced visit to Quang Tri when time permits.

APRIL 24 – Held several meetings with Major Griffin, G-3, on possibility of clearing antipersonnel mines on perimeter of F.S.B. Mase. G-3 gave us the go-ahead for this mission.

APRIL 25 – Joined a truck convoy outside the perimeter of Bien Hoa. The 199th furnished me with an escort and full battle gear. We traveled ninety-three miles over unimproved roadway on the route to F.S.B. Mase. An ambush was expected. An M-60 was mounted behind the tractor cab with the gunner standing on the saddle tank cross over. I was scared, plenty.

APRIL 26 – The armour group moved out of F.S.B. Mase at 0730 hours to regroup at Bear Cat. Now the whole world knows why. The M-48 we had expected to use for mine clearing was part of the Cambodian push. The 199th C.O. ordered a helicopter to return me to USARV Hdqrs. The trip back was something to remember.

APRIL 27 – Boarded U-21-2 mission at Sanford A.F.B. bound for Quang Tri with planned intermediate stops. The flight from Phu Bai to Quang Tri was exciting. We passed over the plains area at 130 knots, wheels up, altitude about 25 foot above the ground. You should see the natives scatter.

Conducted briefing on mine clearing techniques with Lieutenant Colonel Harold Page, Lt. Robert Rollier, Lieutenant Colonel Meyer, and Major Gale Burchell. Later, I was escorted to the General's mess by Major Burchell.

APRIL 28 – Attended morning briefing session for 1st of 5th (Mech.). This was an outstanding experience for me. Used a jeep for transportation to Charlie II F.S.B.

Major Fred LoKay and Major Burchell assisted me with the survey of damage to the mine clearing rollers. It was evident that the one unit was used off the tank trails. Briefly, the trails leading from Charlie II to the DMZ are less demanding than the qualifying track at Fort Belvoir. Therefore, with proper care, no difficulty should arise with the roller at this site. In the early afternoon, Colonel Love came to pick up Major Burchell and myself with a Huey to survey the tank trails. We passed

over F.S.B. Alpha IV, the ARVN base, and followed along the DMZ for about fifty miles. I noticed that the hamlets in this area were neat and clean. The citizens were better dressed and industrious. Their industriousness was evidenced by the well cared for garden patches we could see from the Huey. Later, I discovered that pacification had reached a higher state of development here than in other parts of RVN. At about 2330 hours, our base was hit with mortar rounds and the Charlie's tried to run the perimeter. I was taken to the T.O.C. by Lieutenant Colonel Page. We spent about two hours there before the danger passed. It was just like in the movies.

APRIL 29 – Returned to Tan Son Nhut airport on C-130 transport. Took that miserable bus ride from Saigon to Long Binh.

APRIL 30 – Returned to Saigon to get the Visa Extension. Spent five hours in RVN State Department Visa Office.

MAY 1 – Second trip to Visa Office. Now feel that US forces should declare war on Saigon public officials. Vern Urie departs RVN for the great big PX. Asked USARV HQ to handle Visa problem. It is suggested that Visas should have at least one year of in-country clearance with provisions for multiple entrance and exit; otherwise, civilians on government contract are denied full freedom of movement.

MAY 2 – "Show and Tell" meeting. Also, report to Major Griffin on last mission to DMZ.

MAY 3, 4, 5 and 6 – Restricted to Long Binh post because of troop movements into Cambodia.

MAY 7 – Briefing by Major John Corby of the Mine Warfare Center.

MAY 8 – Planned a C.E.V. retro-fit with Colonel Trayers and Colonel Clarkson. I asked Colonel Trayers to make the M-60 available at some forward support base. The tank was being used in Cambodia at this time.

MAY 9 – Visited with Mr. Nowak of the Inventory Control Command, Vietnam. The 11th A.C.R. was requesting assistance on repair parts for their roller. Went to Long Binh Depot to on-load a roller necessary for the 25th Infantry Division. Later attended a meeting with G-3 on future planning for mine clearing roller requests.

MAY 10 – Meeting with Major Griffin, G-3. Arranged helicopter flight to Tay Ninh for inspection of M-48 tank and roller equipment. Escorted Major Wolfenberger to land clearing headquarters to inspect the Cat D-9's with Rome Plows which were newly delivered.

MAY 11 – Went to Tay Ninh by chopper via Cu Chi. Arranged the work site and had a crew appointed for welding and assembly work. The M-48 was allocated from the retrograde yard at Long Binh and requires extensive repairs before it can be used for mine sweeps. Picked up by chopper at 1505 hours.

MAY 12 – Colonel Clarkson held a briefing on mine detection for the Australian Science Team at ACTIV. I was invited to participate on the Expendable Roller concept.

MAY 13 – Returned to Tay Ninh by chopper. Started assembly at 0930 hours for the 20th Engineer Group. A considerable pressure was being exerted by the C.O. on this job. Consequently, we borrowed an extra welding machine and mechanics from the 65th Engineer Battalion. Stopped work on the assembly at about 2300 hours. Everyone was exhausted.

MAY 14 – At about 1030 hours the job was finished. We made a test run around the Tay Ninh area. All systems were go. Moved over to the 65th Battalion H.D.Q. and started field drawings on the M-60 CEV Retro-fit.

MAY 15 – Completed the hardware drawings about noon and sent them by carrier to Chu Chi for fabrication. ACTIV chopper came in for my pick up at 1350 hours. On the trip from Tay Ninh to Phuoc Vinh we were grounded at F.S.B. Thunder II by a storm front. This was no place for fat civilians. After an hour, the pilot asked permission to lift-off for Phu Vinh. We flew close to the ground using tank trails as guide lines to the 1st Air Cav. Base Camp. Later this same day we made the chopper trip from Phuoc Vinh to Long Binh by following the rivers and streams leading to home base.

MAY 16 – Telecom with Major Burchell at 1st of 5th (Mech.) regarding his problems with the roller. Held a briefing session with Major Corby and Major Wolfenburger on distribution of rollers to requesting units.

MAY 17 – Telecom with Colonel Trayers on roller hardware which was being made at Chu Chi.

Telecom with Chief Warrant Officer Hartley on the planning of a roller assembly at Camp Domesday. The tank for this mission was deadlined because of an engine cooler failure. Visited ICCV with Major Wolfenburger in an attempt to secure repair parts for rollers already in use. It was obvious that no provision was made to support the Expendable Mine Clearing Roller beyond the original introduction.

MAY 18 – Stand down for maintenance.

MAY 19 – Trip made to Long Binh Depot with Major Wolfenburger for an inventory of roller assemblies and expendable components. Telecom with Vern Urie at Fort Belvoir, also phone calls to Quang Tri, Tay Ninh, and Da Nang. Flight to Quang Tri canceled.

MAY 20 – Departed Bien Hoa on command mission U-21-1 for Quang Tri. Inspected the roller with Major Burchell. Asked the T.C. and his crew to make some repairs. One of the problems was a lack of lubrication. The tank crew did not have a grease gun in this tool box. Because of this lack of attention to lubrication, two wheel spindles froze and sheared at the flange area.

MAY 21 – Inspected roadway and general trail conditions between village of Quang Tri and the Cua Viet Naval Base. Every bridge, both rail and vehicular, had been mined in this area. We traveled by jeep between the two points. By the number of craters in the roadway, it was obvious that anti-vehicular mines were a significant part of Charlie's war strategy.

MAY 22 – Spent the morning with Colonel Rollier and his staff discussing the possibilities of improved mine detection and encounter. At 1315 hours departed Quang Tri on mission U-21-2 for Sanford Air Base.

MAY 23 – Attended the ACTIV "Show and Tell" meeting. Departed Long Binh at 1300 hours for Tay Ninh to inspect the M-60 retro-fit. Approved the mine sweep mission to Katoom. Returned to ACTIV HDQ at 1750 hours.

MAY 24 – Colonel Clarkson conducted a briefing on military planning for the R&D section of ACTIV. Afternoon at leisure. Attended the "Hail and Farewell" meeting at 1845 hours.

MAY 25 – Sick Call.

MAY 26 – Sick Call.

MAY 27 – Telecoms with various staff officers from the 20th Engineers. They were reporting a sizeable number of mine encounters around Tay Ninth.

MAY 28 – Went to Long Binh Depot with Chief Hartley to on-load eight expendables which were to be moved by truck convoy to F.S.B. Buell.

MAY 29 – Meeting with G-3 on future requirements for the Expendable Mine Clearing Roller. It will be recommended that the production option be extended to allow time for a more complete evaluation of actual requirements.

MAY 30 – Attended "Show and Tell" meeting at ACTIV HDQ. Afternoon at leisure.

MAY 31 – Departed Bien Hoa at 0715 hours for Chu Lai with Major Corby who expects to interview the S-2 section of the 26th Engineer Battalion regarding frequency of mine encounter. Upon arrival we were escorted to VIP trailer at Americal HDQ by Lieutenant Prendegast. At 1625 hours I was interviewed by Colonel John Insanti, Chief of Staff.

JUNE 1 – Lieutenant Dutchyshyn, Major Corby, and myself surveyed the mine sweep from a Huey, also visited an overnight position near Tam Ky. The 26th Engineer Battalion is responsible for mine clearing on all roadways in and around the Americal's area.

Most sweeps are made with hand held detectors. There was some indication that this method was not very effective. At the time of my visit, the roller was being used for second pass detection.

JUNE 2 – Organized a work crew and started to generate some additional hardware for the M-60 retro-fit. At about 1430 hours it was decided by Major Ryan, the XO, to deadline the assigned tank because of pack and turret conditions. Major Corby departed Chu Lai for a visit to Quang Tri.

JUNE 3 – Acquired another M-60 C.E.V and started disassembly of bulldozer blade and control.

JUNE 4 – Made several shop drawings and policed-up additional steel for adapter parts. This was just the beginning of a long and frustrating experience for everyone. Combat units are not prepared to generate weldments and machined parts.

JUNE 5 – Spent most of this day working on the roller assembled last April 20, 1970 at the Americal; the largest single problem was, again, lubrication.

JUNE 6 – Continued our work on the CEV, which included changing the pack and transmission. The outside temperature was about 118° F, this day. There comes a time when some enthusiasm for a mission is lost. The troops became a little quarrelsome with each other and seriously lacking in motivation for hard work.

JUNE 7 – Used the morning hours to work with the machinist and welders at the 729th maintenance group who had agreed to give us additional support. In the afternoon Delta Company stood down for the first half day in seven weeks.

JUNE 8 – Completed the roller assembly at 2330 hours. Everyone was exhausted to the point of total collapse. The temperature was 119° F at 1200 hours.

JUNE 9 – Made a twenty mile sweep with the roller. All systems were go. Departed Chu Lai on mission U-21-3 for Cam Rahn Bay and Sanford Air Force Base

JUNE 10 – Briefing session with Colonel Simpson, Major Corby, and Major Wolfenburger in mine emplacement techniques currently used by the enemy.

JUNE 11 – Departed Long Binh on Huey for Cu Chi and Quon Loi. Organized a crew and started work on an M-48 retro-fit. The rain hit us about 1030 hours. We are now working in mud. Joined Colonel Denz in a flight back to Long Binh in his Loach chopper.

JUNE 12 – Wrote a report to Vern Urie and Major Badger on various aspects of in-country roller applications and organized the exit briefing for June 17.

JUNE 13 – At 0815 hours departed Long Binh on ACTIV chopper for Quon Loi, the 31st Engineers of the 79th Group. Completed the roller assembly at 1200 hours. Departed Quon Loi for F.S.B. Buell on ACTIV chopper. Surveyed the operating condition of the roller assigned there. This tank crew did not have a grease gun and all running parts were dry. In spite of this, they had three encounters within a week. Departed F.S.B. Buell for Tay Ninth to visit the C.E.V. mine sweep team of 65th Engineers. Upon my arrival the T.C. and his crew were assembled for a briefing. They had an encounter about two hours before my arrival. From the description that was given to me by the T.C. I judged the mine to be a

forty pound charge. The interesting part of this scene was that the entire tank crew was riding outside the tank upon impact. No one was hurt.

JUNE 14 – Stand down for maintenance.

JUNE 15 – Went to Saigon to arrange transportation home. What a messy thing to endure in an age of space travel.

JUNE 16 – Exit briefing with Major Badger, Major Corby, Major Wolfenburger, and Vern Urie at the R&D Office of ACTIV HDQ.

JUNE 17 – Surrender of Government property and organization of personal gear.

JUNE 18 – Escorted to Tan Son Nhut by Pfc. Cherry and Vern Urie. Departed Saigon at 1230 hours for San Francisco.

JUNE 19 – Arrived in Canton, Ohio, at 1730 hours this date.

The expendable mine clearing roller is an important tool necessary for the protection of U. S. Forces engaged in a land warfare. The enemy, taught by our exposure, has effectively reduced the efforts of our fighting forces through anti-vehicular mine emplacement in Southeast Asia.

My experience with the officers and men responsible for implementing the use of the mine clearing roller in RVN was rewarding in terms of their generosity of effort, interest, discipline, intelligence, and devotion to a national interest. The responsiveness of the young American draftees, with whom I became associated, was typically the kid next door with an inordinately high capacity for the understanding of mechanical equipment and its intended use.

The distribution of equipment was by far the most frustrating element in our efforts to retrofit field units with the mine clearing roller. Despite this obstacle, we managed to have a measurable amount of success. The final record of encounters made is available from the Mine Warfare Center, USARV.

Based upon my recent experience with the mine clearing roller in an actual combat environment, plus a prior exercise with some of the developmental activities leading to the eventual production of the device for mine sweeps in RVN, I confidently offer the following critique:

1. Qualifying test procedures used on the expendable mine clearing roller were not valid or reliable in terms of end use in RVN. As an example, the five hundred mile durability requirement is far beyond present mission needs.

2. The lubrication frequency requirements were not given proper consideration in terms of support equipment readily available for use at the company level. Typically, both air powered and hand grease guns were in serious short supply.

3. The vehicles selected to accept the mine clearing roller were not designed for the additional weight imposed; therefore, many times the front suspension systems on the tank were broken or impacted after short periods of use.

4. By the installation of the roller on an M-48 or M-60 C.E.V., the vehicle is removed from its true and intended mission: Combat. It is my suggestion that a single vehicle be selected for mine clearing: Namely, the M-60A1 Armoured Vehicle, Launcher. For these reasons: One, retaliatory fire power is possible; Two, crew requirements are small; Three, a secondary power source is available.

5. Tank hull designs were not compatible with the as-produced hardware making retrofits very difficult. Future designs must draw a compromise between the various

vehicle configurations.

6. The functional area most sensitive to our criticism, the replacement of expendables, did not present a problem. Of course, it is time consuming and awkward, but after some practice the men could make the change within ten minutes. Incidentally, the most practical rigging machine for the job is an articulated front end loader.

7. The introduction of a new mouse trap, as it were, is difficult in any marketing area. One of the best tools that was easily obtainable, but not available to the NET team during the referenced time period, is the training film. I strongly urge a free use of film strips for new equipment offerings.

8. There was some indication that the enemy sought to counter the effectiveness of the roller in two ways. One, there developed a tendency toward the use of larger mines, this is, in explosive force. Two, we were suspicious that delayed fuses were being used. This was particularly true in the Northern part of South Vietnam. However, many anti-vehicular mines were of local manufacture and lacked a certain degree of technical development, causing me to question the "delay" suggestion. This particular area should be investigated more thoroughly.

It was a great experience and a great pleasure to me to have been associated with the Research and Development Laboratories at Fort Belvoir in such an important military program. I thank you for that opportunity and sincerely hope you will feel free to call upon me in the future.

Very truly yours,

TELEDYNE MONARCH RUBBER

/s/t/ DON C. PRICE
Manager Defense Products