THE GENERAL BOARD

United States Forces, European Theater

ARMORED SPECIAL EQUIPMENT

MISSION: Prepare Report and Recommendations on Development, Procurement and Employment of Special Armored Equipment.

The General Board was established by General Orders 128, Headquarters European Theater of Operations, US Army, dated 17 June 1945, as amended by General Orders 182, dated 7 August 1945 and General Orders 312, dated 20 November 1945, Headquarters United States Forces, European Theater, to prepare a factual analysis of the strategy, tactics, and administration employed by the United States Forces in the European Theater.

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UNITED STATES FORCES, EUROPEAN THEATER
APO 408

REPORT ON ARMORED SPECIAL EQUIPMENT

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ARMORED SPECIAL EQUIPMENT

CHAPTER 1

INTRODUCTION

1. World War II witnessed the development of Armored Special Equipment on a scale that was unforeseen and unpredicted in the preceding years of peace. The greater part of this equipment was actually produced after the majority of the troops likely to use it had been deployed to Europe, either in the United Kingdom or on the continent engaged in combat. Consequently there were, initially, no units specifically designated and trained to employ a majority of this equipment. Furthermore, the number of officers and men in the European Theater familiar with the purpose, capabilities and limitations of the equipment was negligible.

2. Two radically different systems for the employment of special armored equipment evolved during the war. The British, a year prior to the invasion, designated the 79th Armored Division as a special equipment division, with the mission of developing, testing, training with, and employing specialized armor in combat. There was no counterpart to this unit in the United States Forces. Initially, some of the items of special equipment were added to the standard equipment of conventional tactical units in combat. Later, several tank battalions were converted into special equipment battalions for the employment of certain items. It is considered that the British were able to obtain the maximum benefit from their specialized armor on the occasions where its use was indicated, because their system provided the combat units with especially trained troops accompanying the special equipment.

3. Purpose of study. There is little doubt that armored special equipment will play an increasingly important role in modern warfare and that its proper employment will materially aid the success of our armies. In order to simplify the problems of incorporating this material in the army, the greatest possible number of items for which a requirement can be foreseen must be developed and full information thereof must be disseminated throughout the army prior to the outbreak of hostilities. It is inevitable that additional equipment will be developed during the war, and provisions must be made for efficiently incorporating this material into the military organization. Therefore, the purpose of this study is to analyze and evaluate the armored special equipment used in the European Theater, to include the manner in which requirements for this equipment were established, and how the equipment was introduced into units and employed, with a view toward formulating pertinent conclusions and recommendations relative to the future development and employment of items of armored special equipment.

CHAPTER 2

MINE EXPLODERS

SECTION 1

GENERAL

4. Background. Experience in the North African Theater coupled with intelligence reports on German coastal and national boundary fortifications on the European Continent, established the fact that the Allied offensive in Northern Europe would have to overcome numerous land mine fields layed by the Germans as an integral part of their defense installations. In addition, it was anticipated scattered mines and small, hastily prepared mine fields would be encountered during the advance between main lines of defense; particularly when the battle line was permitted to stabilize. Therefore, emphasis was placed upon developing an assault technique in combat training that would facilitate rapid passage of mine infested areas; with particular emphasis being placed upon the development in the Zone of Interior of specialized mine exploder equipment that could effectively clean a safe path by detonating mines, and at the same time withstand attack from enemy gunfire.

5. General Types of Mine Exploders. Two basic types of mine exploders were developed for detonating unlocated land mines:

a. "Pressure Type" Mine Exploder activates the mine fuse with pressure applied by a mechanical device, e.g., a roller, plunger, disc, or flail, that is relatively indestructable. In addition, this type mine exploder should be effective, maneuverable, and easy to maintain and operate.

b. "Concussion Type" Mine Exploder activates the mine fuse or sympathetically detonates the mine charge with the force of concussion or blast obtained by detonating a nearby charge of explosives. This explosive force may also displace mines from the ground without detonating them.

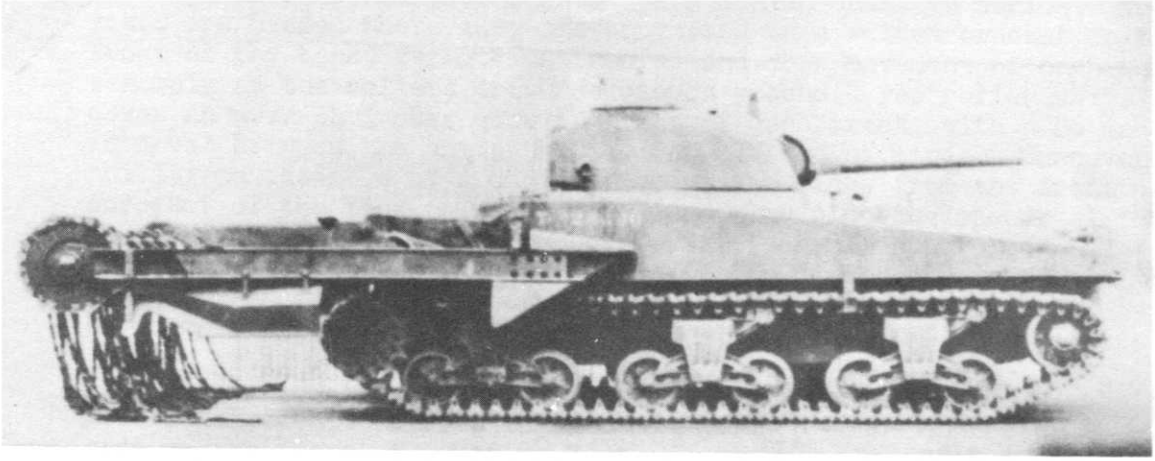
SECTION 2

PRESSURE TYPE MINE EXPLODERS

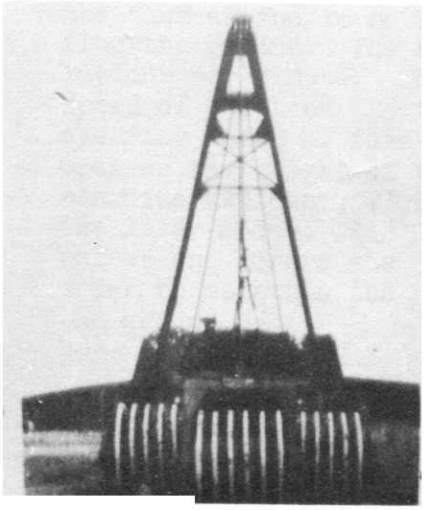
6. Description. Three different models of pressure type mine exploders were supplied this theater prior to "D-Day", and were employed in combat.

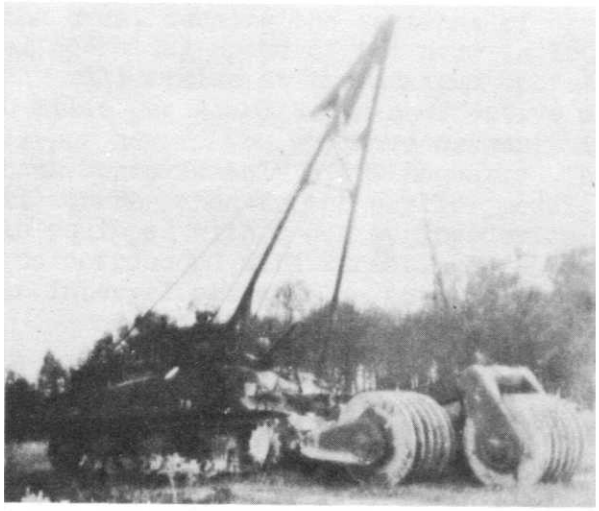
a. Mine Exploder, T1E1, consists of three yokes mounting six circular discs each to a yoke pivot bracket welded on the front of a tank recovery vehicle, M32. One yoke and disc assembly is positioned on each side of the vehicle in front of the track, and the third assembly rides in the center ahead of the other two units. The discs roll forward under their own weight as the exploder unit is pushed by the recovery vehicle. A cable attachment between the exploder units and the boom of the tank recovery vehicle acts as a leveling device and prevents the exploder units from impeding the advance of the prime mover over irregular terrain. The mine exploder vehicle has a cruising speed of ten miles per hour and a maximum allowable mine clearing speed of three miles per hour. The exploder discs are four feet in diameter and two inches thick. The exploder assembly weight, complete, is 32,270 pounds.[1]

b. Mine Exploder, T1E3, consists of two sets of five circular discs, each set independently mounted on horizontal axles in box

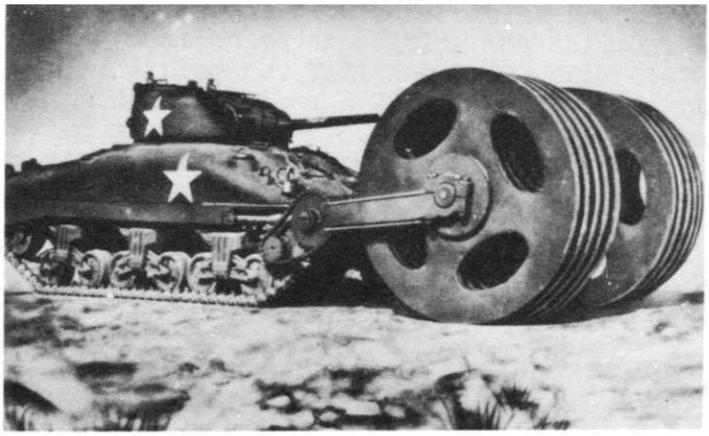


Crab (Sherman Flail)





Mine Exploder T1E1



Mine Exploder T1E3

frame yokes fastened to the front of a medium tank, M4 series. The yokes are hinged where they are converted to a welded bracket on the front of the tank, permitting free up and down movement of each roller assembly as the rollers traverse uneven ground. The roller units cover an area 34 inches wide in front of each track, with a 48 inch interval between the units that is not cleared of mines. Maneuverability is assisted by a chain drive to the discs from the front drive sprocket of the tank. The cruising and mine clearing speeds of the T1E3 correspond to the T1E1, above; viz., ten miles per hour and three miles per hour, respectively. The exploder discs are eight feet in diameter and two and three-quarters inches thick. The exploder assembly complete, weighs 58,500 pounds.[2]

c. CRAB is a British mine exploder consisting of 48 chain flails fastened to a rotating drum mounted on booms connected to either side of the front of a Medium Tank, M4 series. The CRAB is an improvement upon the earlier model SCORPION, which was developed by the British and first employed at EL ALAMEIN. The flailing drum of the SCORPION was rotated by a separate engine mounted on the right front side of the tank, while a power take-off transmission in the CRAB permits the tank engine to rotate the drum, causing the sections of chain to flog the ground. The normal operating speed of the drum is 140 revolutions per minute. The CRAB will cruise at the maximum operating speed of the tank (25 to 30 miles per hour) and has effective mine clearing speed of five miles per hour. The exploder assembly increases the weight of the tank approximately 3,000 pounds.[3] The American Mine Exploder, T3 (Flail) corresponds to the earlier model, CRAB I. The later model, CRAB II, is equipped with a contouring device that raises and lowers the drum to correspond with variations in terrain in order to maintain the proper interval between the rotating drum and the ground.

7. Establishment of European Theater Requirements.

a. In September 1943 the War Department advised the European Theater that SCORPIONS (early model "Flail") were being made available to theaters of operations,[4] and the European Theater established a requirement for 100 of these mine exploders.[5] However, the European Theater was informed in January 1944 that roller type mine exploders were being supplied against this requirement.[6] In February 1944, 1st U. S. Army Group established a requirement for 50 of these roller type mine exploders for their first six months of projected continental operations, and listed a negative requirement for flail type mine exploders.[7] However, Headquarters, European Theater of Operations placed a requirement with the British for 20 CRABS for delivery in May 1944; in addition to expediting the shipment and receipt of roller type mine exploders, T1E1 and T1E3, prior to "D-Day", a total of 50 mine exploders, T1E1, and 72 mine exploders, T1E3, were shipped to this theater in April, May, and June 1944. A total of 22 of the T1E3's were made available to the British, but only one of these vehicles was ever called for by them.

b. In October 1944, in anticipation of the problems concurrent with breaching the Siegfried Line, the European Theater concurred in the War Department proposal to produce 100 additional mine exploders, T1E3 kits.[8] Additional combat experience indicated this vehicle had only limited application, and the War Department was advised in January 1945 that the European Theater had no additional requirement for this vehicle.[9]

c. The CRAB performed most favorably when mine exploders were first carefully examined by American officers on the Continent in November 1944. The 20 CRABS initially obtained from the British in the United Kingdom were not sufficient to meet all requirements, and 15 additional CRABS were immediately obtained from the British 21st Army Group on a loan basis.[10] A requirement was placed through

the London Munitions Assignment Board for the procurement of 45 additional CRABS from the British in January 1945, and this requirement was increased to a total of 105 CRABS the following month.[11] Of this total 50 were to be used to convert the two mine exploder battalions to CRABS, and 55 were for the replacement of six months anticipated battle losses. This requirement was cancelled several weeks prior to "V-E" Day when it could be seen the requirement for additional mine exploders no longer existed.

8. Introduction of Mine Exploders into Units.

a. Two mine exploders, T1E3, were received with special Ordnance personnel in April 1944 in advance of the receipts of the bulk of the mine exploders from the Zone of Interior, and were demonstrated in the United Kingdom to representatives from the major commands the first week in May 1944. The following problems were immediately recognized and reviewed by Headquarters, European Theater of Operations:[12]

(1) What arm of the service should be responsible for the operation of these mine exploders?

(2) How should specially trained personnel be obtained for the employment of these mine exploders?

No solution of these problems was obtained prior to "D-Day" since the plan for the initial assault of the beach had been finalized, and these mine exploders were not initially called for by First U.S. Army.

b. When the Normandy battle line between CARENTAN and ST LO stabilized two weeks after "D-Day", mines encountered in communication lines became more numerous, and First U. S. Army called for the shipment of mine exploders from the United Kingdom. Twelve T1E1's, twenty-seven T1E3's, and nine CRABS were delivered to the Continent during July 1944 by transporting them with the personnel and equipment of the 702d and 744th tank battalions.

c. The Ordnance Department personnel who had accompanied the shipment of the mine exploders from the Zone of Interior, formed several mine exploder crews from the 539th Ordnance Heavy Automotive Maintenance Company and trained them in the assembly and operation of the T1E1 and T1E3. These crews were used to demonstrate this equipment to Staff Officers of First U. S. Army 26 and 27 July and to employ two T1E3's with the 6th Armored Division 29 - 30 July 1944.[13] (See par 9 a, below)

d. The 2d Armored Division obtained three CRABS from the British and converted a tank platoon for the employment of these vehicles during the ST LO "breakthrough" in July 1944.

e. The 6th Armored Division converted a tank platoon in a similar manner, but equipped it with three T1E3's the first week in October 1944, for a limited operation.[14]

f. As a result of the problems concurrent with this last minute substitution of this specialized equipment, two tank battalions (special) were converted to mine exploder battalions in the United Kingdom in September 1944, moved to the Continent late in October. These units, plus a corresponding provisional mine clearance company brought in from the Mediterranean Theater of Operations by Seventh U. S. Army, are discussed in detail in Section 1 of Chapter 10.

g. The British had equipped special detachments with CRABS, for use in the initial assault of the Continent under the

79th Armoured Division. (This unit is also discussed in Section 1 of Chapter 10.) At the cessation of hostilities the 79th Armored Division included a "Flail Brigade" consisting of three "Flail Regiments" of three squadrons of 15 CRABS each (See Appendix 1).

9. Employment in Combat. Mine exploders, T1E1 and T1E3, and the CRABS were used to clear roads and shoulders plus cross-country mine fields in the assault; and also for clean-up operations after a sector had been cleared of organized enemy resistance. The employment of these three devices by American forces was on a relatively small scale and was limited to several sectors. However, the British employed the CRAB beginning with the "D-Day" assault more extensively and in larger quantities.

a. The 6th Armored Division employed two T1E3's for a two day period in July 1944 and a platoon of three T1E3's for a corresponding period in October 1944. The mine exploders were called forward after mines had been encountered and the immediate frontal areas partially cleared by hand. The mine exploders were then moved to the head of the column under darkness and were used to spearhead a new advance, concentrating on rolling the shoulders of the road. In both instances no mines were encountered, one or two exploders became stuck in the road ditch, and were soon bypassed by the column.

b. The CRAB platoon formed by the 2d Armored Division (paragraph d, above) was employed with the 747th Tank Battalion which was attached to the 29th Infantry Division for the assault against ST LO, France, in July 1944. This town had been subjected to very severe air and artillery bombardment, and the resulting rubble that had collected in the streets made the flails ineffective. Therefore, these tanks were ultimately employed as fighter tanks, and, as such, materially aided in the assault.

c. The 738th and 739th Tank Battalions (Mine Exploder) attached one company to each of the Corps of First and Ninth U.S. Armies, respectively. The 6630th Mine Field Clearance Company was employed in a similar manner by Seventh U. S. Army. Small detachments equivalent to a platoon or section of mine exploders were normally attached to various engineer combat groups and battalions and were employed in clearing isolated sections of roads and mine fields encountered or bypassed in the advance to the ROER River and between the ROER and the RHINE Rivers in January, February, and March 1945.

(1) A platoon of five CRABS from Company "A", 739th Tank Battalion was attached to the 303d Engineer Combat Battalion to breach a large mine field on 30 January 1944 in the ROER River approach. The assault failed as two CRABS were destroyed by enemy anti-tank gun fire, two CRABS were disabled by anti-tank mines, and one suffered a mechanical failure.[15]

(2) One T1E1 was used to clear two large minefields on either side of a landing strip, and accomplished its mission by detonating 165 Regal mines and six pound charges, plus numerous anti-personnel mines during a three day period. Only one mine was detonated by the track of the mine exploder; however, several glass mines were bypassed as the space between the rollers bridged the mine field.[16]

(3) Approximately five sections of road, five to eighteen miles long, were rolled by T1E1's and T1E3's between the ROER and RHINE Rivers in March 1945. These operations were severly handicapped by road craters, wrecked equipment, snow and mud, and sharp turns in the roads. Several mine exploders were

temporarily disabled by mines detonated by the track in backing and turning to negotiate sharp road turns.[16]

d. The T1E1's of the 739th Tank Battalion with the Ninth U. S. Army were withdrawn from use indefinitely 15 February 1945. The mine exploder equipment was dismantled, and the prime movers were applied against an acute tank recovery vehicle shortage.

10. Merits and Deficiencies of Mine Exploders T1E1 and T1E3.

a. Merits:

(1) Most rapid devices available for clearing roads and shoulders.

(2) Provides armor protection for crew.

b. Deficiencies:

(1) Lack of cross-country mobility makes the T1E1 and T1E3 roadbound.

(2) Vulnerable to off-set mines, delay mine fuses, and relatively large explosive charges.

(3) Bulky and difficult to transport; necessitating frequent assembly and disassembly.

(4) The T1E1 does not have the fire power to double as a "fighter" tank, and the T1E3 has only a limited field of fire in this respect.

(5) The T1E3 does not clear a continuous path equivalent to the width of the tank.

11. Merits and Deficiencies of the CRAB (Flail).

a. Merits:

(1) Mobility practically equivalent to that of the standard medium tank.

(2) Can be employed as a "fighter" tank when not flailing.

(3) Provides the most rapid mechanical method available for breaching cross-country mine fields.

(4) Provides armor protection for crew.

b. Deficiencies:

(1) Vulnerable to off-set mines, delay fuses, and relatively large explosive charges.

(2) Vehicle practically blind when flail is in operation.

(3) Flails wear out rapidly on pavement or rocky terrain.

(4) Ineffective against mines buried in excess of five to six inches deep in normal terrain.

SECTION 3

CONCUSSION TYPE MINE EXPLODERS

12. Description. The concussion type mine exploders received and/or employed to a limited extent by the European Theater are described below:

a. Snake, Demolition, M2 is a linear charge of explosive encased in shaped metal plates providing sufficient rigidity to permit the charge to be pushed over rough terrain. It is assembled to a maximum length of 400 feet by combining a series of W-shaped channel plates, 14 inches wide and 9 feet long. Up to 320 feet of the Snake is loaded to a maximum of 14.4 pounds of explosive per foot. It has a pear shaped nose to deflect it from obstacles, a detonating assembly and a towing hook at the front end, and a pushing hook at the rear to received tank towing or pushing assemblies. In average soil, a Snake will detonate, throw out, or break up all anti-tank and anti-personnel mines within a path 12 to 15 feet wide.[17]

b. The Two-Inch CONGER, Mark I is a British device which projects a five inch rocket pulling an empty canvas hose (two inch diameter, 330 yards long) over a minefield. The hose is then filled with a liquid explosive which is detonated to clear a lane approximately 20 feet wide. All the equipment is carried in a towed Bren gun carrier from which the engine and other components have been removed to make room for the unit.[18]

c. WURLITZER is a British Churchill tank equipped with 20 bangalore torpedo tubes on each side of the tank above the track, that project bangalores approximately 12 feet long to a position 50 to 100 yards in front of the tank. This device was not employed in combat, but is listed here merely as an experimental device that was viewed in the European Theater, and is considered to show promise.

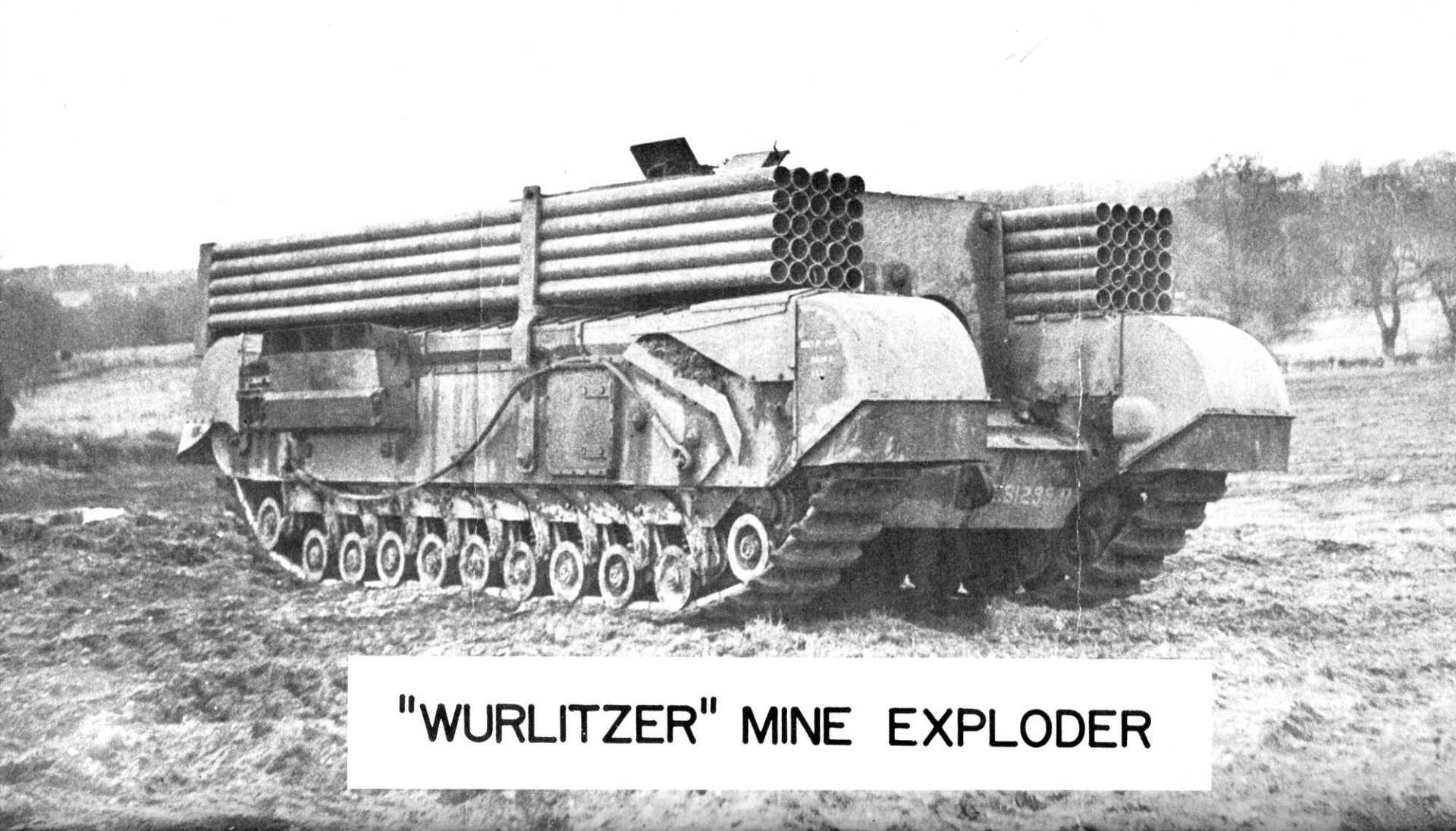
13. The Establishment of European Theater Requirements for both the Snake and the CONGER was accomplished prior to "D-Day".

a. A requirement had been placed upon the Zone of Interior for a total of 1,028 Snakes, Demolition, M2, prior to 15 May 1944 based on an analysis of advance technical information received from the United States. A total of 100 Snakes had been received in the United Kingdom as of 25 May 1944. No additional Snakes were requisitioned. The estimated requirements of First and Ninth U. S. Armies by the Spring of 1945 were only ten per month.

b. A requirement for a total of 125 CONGERS was placed upon the British in April 1944 after representatives of the Office of the Chief Engineer, Headquarters, Communications Zone, had witnessed a demonstration of the production pilot in the United Kingdom. The first 69 CONGERS shipped against this requirement were received on the Continent the last week in September 1944. The armies cancelled all CONGER requirements in February 1945.

14. Employment in Combat. The Snake was employed in combat by American Forces only to a very limited degree. The CONGER was not employed.

a. It was originally intended that one Snake be allocated to each tank battalion for training in the United Kingdom prior to the assault of the Continent. However, Snakes did not become available until May 1944 and units were busily engaged in modifying equipment, and in assault training connected with transportation to the Continent and the initial phases of the attack. The first 20 Snakes were called forward to First U. S. Army depots 20 July 1945, but were not employed in the Normandy Breakthrough that ensued.



"WURLITZER" MINE EXPLODER

b. The only tactical employment of Snakes on record was in the Third U. S. Army assault of FORT DRIANT of the METZ defense works on 31 October 1944, and this attack was unsuccessful. One dummy Snake was assembled 1 October and used for training, and four "live" Snakes were ready the night of 2 October for movement to the Fort. The Snakes had to be moved approximately one mile to the Fort by tanks of the 735th Tank Battalion. One tank was to tow each Snake to the approximate site of detonation, and another tank was to follow, maneuver the Snake into the exact location desired, and detonate it.

(1) Two Snakes broke in two when the propelling tanks were forced to make sharp turns during the approach march.

(2) One Snake was lost a half mile from the Fort when the propelling tank was passing over some timber and logs.

(3) One Snake was dropped just short of the Fort by the tow tank, but it buckled and twisted when the rear tank attempted to push it up the rise to the Fort.

c. In experiments conducted in the Siegfried Line by VII Corps units in October 1944, the 294th Engineer Combat Battalion attempted to clear a breach in the dragon's teeth obstacle band with a Snake for the passage of vehicles. The placing of the Snake was very difficult, and the results were considered unsatisfactory. In one particular test only one tooth was demolished. The crater which resulted increased the effectiveness of the existing obstacle.[19]

d. The Snake was finally demonstrated to Staff Officers and Commanders in First and Ninth U. S. Armies 8 November 1944 by personnel from the 746th Tank Battalion and the 1111th Engineer Combat Group. However, it was not employed by these commands. After that time the battle lines stabilized for the most part at river lines.

e. The CONGER was not employed for the following reasons:

(1) A 60 day delay in the receipt of CONGERS from the British resulted in an indefinite delay in the training of instructional teams by the Theater Engineer Bridge School.

(2) Combat commanders were not familiar with the capabilities and limitations of the CONGER. Technical information was not available until August 1944, and the CONGERS themselves did not become available until after September and October 1944, when assault techniques for the Siegfried Line were being developed by units.

(3) Cold weather caused the moisture in the element used to desensitize the nitroglycerin explosive ("Nobel 822C") of the CONGER to freeze. This made the cans of explosive too sensitive to be handled in temperature below 32° F.[20]

(4) There are a considerable number of hazards in the employment of the CONGER that are very apparent to the user.

f. Considerable difficulty was encountered in storing and issuing the CONGER, and particularly the Snake, since the explosive was stored in Ordnance depots and the rest of the equipment in Engineer depots. The Snake consists of approximately 1,100 parts packed in seven groups. Many of the non-explosive components were shipped

to Ordnance depots, and it was extremely difficult to gather a Snake for operation. For example, the groups containing the bolts for assembling the Snakes were lost in the initial shipment of this equipment to the Continent. Finally, 17 November 1944, action was instigated to assemble all Snake and CONGER equipment in Ordnance depots.

15. Merits and Deficiencies of the Snake and CONGER. The Snake is more reliable than the CONGER and less vulnerable to enemy fire. However, the CONGER is a mobile, self contained unit that is easier to place, and thus overcomes the vulnerability of the Snake to irregular terrain and the difficulty with which the Snake is maneuvered. In addition, the Snake and CONGER have the merits and deficiencies inherent in concussion type mine exploders outlined in paragraph 2, immediately below.

SECTION 4

SUMMARY

16. Merits and Deficiencies of Pressure Type Mine Exploders.

a. Merits.

(1) Provide armor protection for the crew.

(2) Craters are not made where mines do not exist.

(3) Most rapid method available for clearing scattered mines on lines of communication.

(4) Several models can be used in alternate role as a "fighter" tank.

b. Deficiencies.

(1) Extremely limited mobility, including an excessive turning radius, and therefore not considered an assault weapon.

(2) Vulnerable to offset mines, delay mine fuses, and large explosive charges.

(3) Difficult to transport.

(4) High maintenance demands and rapid deterioration of equipment.

(5) Prime mover vulnerable to mines bypassed in turning or to mines whose fuse is bridged by the rollers or flails.

17. Merits and Deficiencies of Concussion Type Mine Exploders.

a. Merits.

(1) Detonates mines on enemy side of obstacles.

(2) Capable of employment in terrain that cannot be negotiated by pressure type mine exploder.

(3) Capable of employment with minimum of exposure of crew.

(4) Most effective method of clearing all types of mines except those located in road ways.

b. Deficiences.

(1) Elaborate preparatory work required prior to employment. The Snake must be assembled near place of employment, while the hose of the CONGER must be soaked in water for six hours prior to use.

(2) Extensive reconnaissance and determination of mine field boundaries required.

(3) Ground is cratered and subsequent movement handicapped.

(4) Vulnerable to disablement or detonation by large caliber fire and vitally placed small arms fire during employment.

(5) Unsuitable for use in clearing airports or roadways.

18. Conclusions.

a. An urgent requirement exists for satisfactory methods of locating and breaching mine fields, and expeditiously clearing and/or detecting scattered mines on roads and trails.

b. The mine exploders, T1E1 and T1E3, failed to meet the requirements outlined immediately above.

c. The CRAB was the most satisfactory pressure type mine exploder employed in the European Theater. However, this device has definite limitations which must be recognized.

d. The European Theater's failure to extensively employ concussion type mine exploders for breaching located mine fields does not indicate this type of device is unsatisfactory.

e. In the development of concussion type mine exploders, emphasis should be placed on the following:

(1) The hazard to using troops should be minimized.

(2) The equipment should be supplied as a complete unit by one service.

f. A requirement existed in the European Theater for units that were primarily trained and equipped in the employment of mine exploders and other mine field gapping techniques.

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Chapter 2

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CHAPTER 3

EARTH MOVERS

19. Description. The special armored earthmovers described below were extensively employed in the European Theater.

a. Tank Dozer is a medium tank, M4 series, equipped with a bulldozer blade similar to that mounted on a standard tractor dozer. The moldboard and blade are pivoted to brackets on the middle bogie assemblies of the tank. A hydraulic jack, powered by an oil pump driven off the propellor shaft, is mounted on the outside front of the tank to raise and lower the blade. The blade may be jettisoned by the tank driver in ten seconds. The tank dozer blade assembly and all its appurtenances weigh 7,050 pounds.[1]

b. "Rhino or Hedgerow Buster" is a substantial, pointed or bladed steel projection extending approximately two feet forward from the front of the light and medium tank final drive assembly. The device was first improvised on the Continent during the first three weeks in July 1944. Various models were based upon steel plate, railroad rails, and sections of pipe; all reinforced with gussets, depending upon what materials could be hastily obtained. The "Rhino" was run into the hedgerow by the tank, thus loosening the dirt and roots, and permitting the tank to crash through to the next field with a minimum reduction in speed.[2]

20. Basis of Distribution for the Tank Dozer and the "Rhino" was determined within the theater.

a. A total of 390 tank dozers were requisitioned from the Zone of Interior prior to D Day as a Class IV item of supply. An additional 100 were requisitioned for the British and 24 for French Forces. A total of 24 were received in April and 81 more in May 1944. Initial receipts were allocated to the major commands by Supreme Headquarters Allied Expeditionary Forces; for instance, the first 30 received were allocated as follows: First U.S. Army, 13; British 21st Army Group, 11; Canadian Forces, six.

(1) Initially, First U.S. Army allocated its dozer blades to units based upon availability, but an attempt was made to provide dozer blades on the basis of six per tank battalion (separate or with armored division), plus four additional per armored division. The four D-Day Tank Battalions landed on the Continent with four tank dozers each.

(2) Third U. S. Army initially allocated one dozer blade per division in the United Kingdom for familiarization training, and on 24 June 1944 asked for dozer blades on the basis of one per tank battalion (separate), three per armored division, two per infantry division, three per tank destroyer group, and one per ordnance ammunition company and battalion, requesting additional tanks to meet the requirements of the three latter type units. However, these additional tanks could not be made available.

b. A standard basis of distribution for tank dozer blades (outlined below) was finalized through Headquarters, 12th U. S. Army

Group, the latter part of July 1944, and an additional 278 dozer blades were requisitioned from the Zone of Interior to meet this overall requirement. The European Theater subsequently recommended to the War Department that dozer blades be made a Class II item of equipment included in tables of organization and equipment and supplied on that basis, and that all armored units shipped from the Zone of Interior be so equipped.[3]

(1) Two per medium tank company per medium tank battalion, (total - six per battalion).

(2) Two per medium tank company per medium tank battalion with armored divisions (total six per battalion).

(3) Two per self-propelled tank destroyer company with tank destroyer battalions equipped with 3" Gun Motor Carriage, M10, or 90mm Gun Motor Carriage, M36, (total - six per battalion).

c. Tank dozers were included in the 738th Tank Battalion (Mine Exploder) on the basis of four per tank company (Chapter 10, Section 1, par 59 below). Tank dozers were also obtained from theater and army reserves and distributed among ordnance ammunition dumps including fifteen tank dozers for the Communications Zone.

d. All light and medium tanks engaged in operations in hedgerow country with the exception of tank dozers were equipped with the "Rhino" or "Hedgerow Buster" insofar as was permitted by time and materials available, with last priority to command tanks.

21. Employment in Combat.

a. The employment of the "Rhino" was limited to hedgerow country.

(1) The infantry - tank (and in some cases, engineer) assault team would advance from one small field to the next, with the tank making the breaks through the hedgerows, digging out machine gun nests, and pinning down the enemy with fire. Some units developed the technique of having the tanks advance alone 300 to 500 yards forward from the line of departure making breaks in the hedgerows and disorganizing enemy resistance while operating under artillery "time fire", finally returning and advancing again in conjunction with the infantry. The "time fire" would serve to pin down the enemy and protect the tanks against attack from hollow charge weapons, in the absence of supporting infantry.

(2) This hedgerow busting device was removed from surviving tanks, and the installation by the armies to replacement tanks was discontinued once the bocage country of Normandy and Brittany was left behind.

b. The tank dozer was employed extensively for numerous purposes commencing immediately after D-Day. Some of the missions for which the tank dozer was employed in the European Theater are outlined below:

(1) Shortly after D-Day a platoon of four tank dozers of the 741st Tank Battalion operating on the beaches under intense fire, removed beach obstacles, opened roads, and pushed off beached landing vehicles.[4]

(2) The tank dozer was used to break through hedgerows, broaden existing gaps and gaps blown with explosive charges; and thereby facilitated the use of other than normal entrances through hedgerows.[5]

(3) Tank and gun emplacements were prepared.

(4) Road blocks were cleared; and in addition, rubble, wrecked vehicles, and snow were removed, and craters filled. It was found necessary in many instances to provide a tank dozer for these purposes to work in conjunction with the roller type mine exploders in sweeping roads and shoulders.

(5) In connection with the Roer and Rhine River operations, bridge approaches were built, launching sites for LCM's and LCVP's and crane sites were prepared, and cuts dozed in the river dykes.[6]

22. Merits and Deficiencies of the Rhineo and the tank dozer.

a. The "Rhino" or "Hedgerow Buster" was simple, reliable, and effective. The only criticism applicable is that it's need was not anticipated, the most effective design conceived and standardized, and tanks equipped accordingly prior to landing.

b. The Tank Dozer has the following merits and deficiencies:

(1) Merits:

(a) The tank dozer provides armored units with a standard vehicle that can be readily employed to reduce obstacles and assist in the advance of units or to assist in the preparation of defensive positions.

(b) Armor protection is provided for the crew.

(c) The tank dozer can also be employed as a fighter tank.

(d) The tank dozer installation is simple, reliable, and its maintenance demands are negligible.

(2) Deficiencies:

(a) The tank dozer installation overloads the front of the tank suspension system, and increases bogie tire failures and suspension maintenance demands.

(b) The tank dozer installation materially limits the driver's field of vision.

(c) There is insufficient clearance between the

track and dozer blade arm to insure safe operation with the addition of the standard 3-5/8 inch track extended end connectors.

(d) Sufficient dozer blade accessories were not available so that dozer blades salvaged from burned tanks could be readily reinstalled on other tanks.

23. Summary.

a. An efficient and reliable "Rhino" or "Hedgerow Buster" design should be standardized, and all tanks should be equipped accordinly when combat in hedgerow or similar country is anticipated.

b. Tank dozer blades should be authorized in tables of organization and equipment on the basis of one per tank company.

c. Light weight, reliable tank dozer blade installations should be developed for such new model tanks as may be necessary to insure standardization of tank chassis within a tank company and the provision of dozer blades on the basis listed in paragraph b, immediately above.

d. All tanks on which a dozer blade can be installed should be manufactured with the necessary brackets in order that the blade, piston, pump and controls can be installed with the minimum of time and labor.

e. If full track cargo vehicles are provided for self-propelled artillery units, consideration should be given to equipping a corresponding portion of these vehicles with dozer blades.

f. A dolly or similar device that can be towed behind a tank should be developed to facilitate transportation of the dozer blade on extended road marches. Consideration should be given to developing a device that can receive the dozer blade when jettisoned by the tank, and thereby obviate the need for a crane.

g. An economical armored bulldozer should be provided fire fighting detachments protecting ammunition dumps to avoid the necessity of using tanks for this purpose.

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CHAPTER 4

DD TANKS

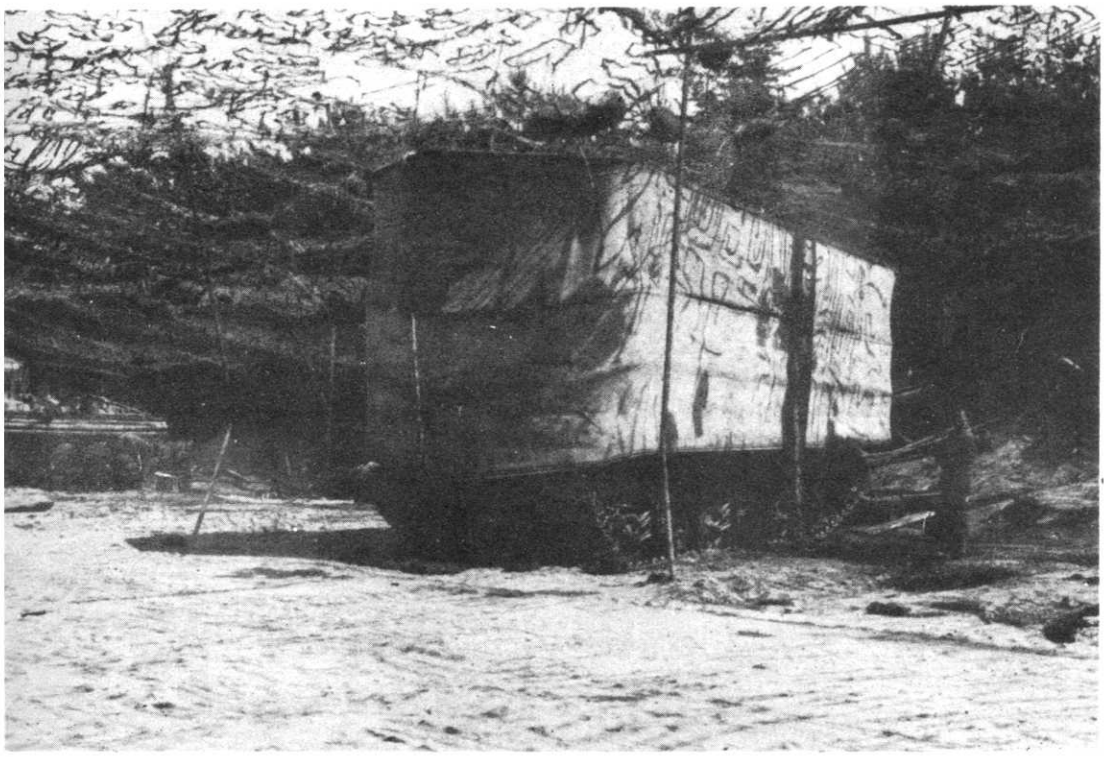
24. Description. The DD (Duplex drive) device is a modification of a standard M4 Medium Tank (Sherman) w/75mm gun in which a water proof canvas curtain is attached to a steel deck welded around the tank at the sponson line. The upper edge of the curtain is fastened to a rigid one-piece metal frame with folding vertical struts to assist in holding curtain in place when raised. Vertical rubber tubes, fastened to the inner side of the curtain raise the curtain when the tubes are inflated from compressed air bottles carried on the deck of the tank. The tank hull is water-proofed to the curtain line and a bilge pump is installed in the tank to pump out water that may leak or splash in. Propulsion is effected when the tank is water borne by means of twin propellers geared to modified track rear idlers. The water borne tank is steered by turning the propellers in a horizontal plane. As this was not entirely satisfactory, some tanks had, in addition, a simple rudder installed. The curtain, when raised, extends 26 inches above the highest part of the turret, which prevents the use of the tank weapons when afloat. The curtain is lowered for combat operations by the use of a driver-operated hydraulic system of valves. The vehicle is sea worthy in moderately rough water and has a water speed of four to seven miles per hour. The development of the equipment and the training of units in its use was carried out in utmost secrecy and so far as can be ascertained, its security was not compromised even after the two landings on the French coast. The device was first conceived by Nicholas Straussler, a British naturalized Hungarian inventor, in 1940. The first model was fitted to a "TETRARCH" (light tank) in 1941 and the first one floated in June of that year.

25. Special DD units were not organized. For the Normandy landings, two companies each of three separate tank battalions, (the 70th, 741st and 743d) were equipped and trained with DD tanks. Training cadres from these six companies received approximately thirty days training with the British 79th Armored Division at SAX MUNDUN after which each of the companies trained for a total of approximately three weeks at SLAPDON SANDS. Crews were trained in erecting, lowering, and maintaining the canvas curtains; use of individual escape devices; use of navigational instruments and aids; water borne handling of the tank; launching from landing craft; and unit tactical training. For the landings on the southern coast of France by the Seventh Army, four tank platoons, four tanks each (16 tanks per battalion), were equipped and trained from each of three tank battalions (191st, 753d, 756th). The crews were trained at BATTIPAGLIA and in the vicinity of SALERNO, ITALY. Total training time was approximately 30 days, covering essentially the same field as was covered by the units in England.

26. Employment on the Normandy Beachhead.

a. 70th Tank Battalion - Companies A & B (DD) were launched approximately 5000 yards off shore from UTAH Beach. Five tanks were lost at sea when their landing craft struck a mine and sank. One tank was sunk when its canvas was collapsed by the blast of a nearby rocket ship. The remaining 28 DD tanks reached shore successfully and fought in support of the 8th Infantry Regiment of the 4th Infantry Division. One tank was delayed in reaching shore due to a defect in its steering mechanism and finally had to be towed ashore. Sea was moderately rough.[1]

DD Device, Canvas down (fighting position)



DD Device, Canvas up (Swimming position)

b. 741st Tank Battalion - The DD companies, (B and C) were launched at approximately H-50, in spite of the fact that the sea was extremely rough, it having been decided that the advantage to be gained justified the risk. The tanks were launched approximately 6000 yards off shore from OMAHA Beach. Five tanks of Co B succeeded in reaching shore and fought in support of the 16th Infantry Regiment of the 1st Infantry Division. The remaining 12 tanks of Company B and all 17 tanks of Company C were sunk at distances varying from 1000 to 5000 yards from shore. These sinkings were due to the action of the rough sea, the high surf swamping the tanks, and were not due to enemy action.[2]

c. 743d Tank Battalion - Due to the roughness of the sea it was decided not to launch the tanks at sea but to move the landing craft to the beach and land as any standard tank would land. As a result of this, the tanks landed ahead of schedule. No losses were sustained prior to landing.

d. British 79th Armored Division - 130 DD tanks were launched in a very rough sea reported force 4 to 6. Of this number, 80 reached shore and fought on the beaches. There were no known instances where a DD was fired on by an anti-tank weapon. In one instance, a DD was sunk by mortar fire. It is believed the majority of the remainder were sunk by action of the sea.[3]

27. Landings on the South Coast of France.

a. Each of the three divisions of the VI Corps was offered a maximum of four platoons of four tanks each for support of the landings. After consideration of the proposed operational use and the LCT loading space available, DD's were requested and allocated as follows:

Inf Div	No Tanks	Tank Bn Furnishing Tanks
3d	8	756th
36th	16	753d
45th	12	191st
Total	36	

b. All the above tanks were employed. Twenty were water launched at distances varying from 75 yards to 4000 yards from the shore. The remain 16 were landed from the LCT's directly onto the beaches.

c. Eighteen of the twenty tanks launched reached shore successfully. One was swamped by the wake of a passing craft and sank. One was sunk by an underwater mine about 25 yards from its landing point. There were no tank casualties among the sixteen which were landed directly onto the beaches.

d. The water was calm and there was little enemy resistance on the beaches. Definite conclusions, therefore, cannot be drawn from this operation.

28. Use of DD's on the Rhine crossing.[5]

a. The use of the 70th, 741st and 743d Tank Battalions as DD Battalions for the Rhine crossing was considered. However, the losses among the tank crews of these battalions had been so high that the training problem would have been as great as with a battalion which had not been previously DD-trained. It was not neces-

DD Device, Canvas partially lowered
Showing propellors

DD Afloat

sary, therefore, to consider previous DD experience in selecting tank battalions to operate the DD's for this operation. In the case of the First US Army, it was decided that no tank unit could be spared from their normal operational requirements for the time required for DD training. DD's, therefore, were not used by the First Army in the crossing.

b. Company C, 736th Tank Battalion, was equipped with 17 DD tanks and was attached to the 743d Tank Battalion for the support of the 30th Infantry Division of the Ninth Army in their Rhine crossing operations on 24 March 1945. The crossing commenced at 0345 and was completed at 0554, all 17 tanks crossing successfully. Upon completion of the crossing the DD Company continued in support of the infantry. There was negligible opposition to the actual crossing.[6]

c. 748th Tank Battalion was partially equipped with DD tanks and actually swam these tanks across the Rhine River the last days of March 1945 in support of the 89th and 65th Infantry Divisions. These were not assault crossings. Due to long approach march (175 miles), many curtains were damaged. Out of 51 tanks, only 18 were floatable. Of these, 8 were launched, of which one sank. Ten were ferried across due to the muddy banks, and the delay which preparation of the banks would have caused.[7]

d. British 79th Armored Division - 66 DD tanks were schedule to cross the Rhine River in Operation PLUNDER commencing at 0200. Of this number, 59 actually crossed by 0800. The seven that failed to make the crossing were accounted for as follows:

One screen (canvas side curtains) torn on way to inflatio area.

Two screens torn by shrapnel in inflation area.

One screen torn by shrapnel between inflation area and launching point.

One sunk from shrapnel holes in screen.

Two had mechanical trouble in inflation area.

Of those that crossed, three tanks were bogged down at the exit point and were left behind. DD tanks were assisted in their crossing by carpet laying Buffaloes (LVT-4) which prepared entrances and exits at the river bank.[8]

29. Merits and Deficiencies of the DD Equipped Swimming Tank.

a. Advantages:

(1) Element of surprise gained, insofar as the landings in France were concerned.

(2) A standard land fighting tank on shore results from a successful landing.

(3) Low silhouette in water.

(4) Same shipping space as standard tank.

b. Disadvantages.

(1) Tank weapons cannot be fired while vehicle is water borne.

(2) Vehicle is not sufficiently sea worthy to be used successfully in a rough sea.

(3) Canvas is easily damaged and requires excessive maintenance.

(4) Extremely vulnerable to small arms fire and shell fragments.

(5) Device is not readily adaptable to tanks mounting high velocity long barreled cannon.

(6) Lack of mobility in mud such as is ordinarily found on river banks. It should be noted, however, this defect is inherent in the type of tank which was used and not attributable to the DD device.

c. Opinions of Users:

(1) Colonel J. C. Welborn, Lt Col R. N. Skaggs and Lt Col W. D. Duncan, who commanded the 70th, 741st and 743d Tank Battalions respectively on D-Day, stated that in their opinion, the DD device was not satisfactory for the purpose intended, and that medium tanks can be landed more effectively from LCT's directly onto the beaches than by swimming in. Losses, in fact, were lower among the units which landed directly onto the beach.

(2) Operation DRAGOON - Due to ideal sea conditions and lack of beach resistance the officers concerned with the landings did not feel that the device had had a fair operational test. It was generally believed, however, that it would also have proved satisfactory under more adverse conditions.[4]

(3) British opinion - Final Report, 79th Armored Division states that the DD tank was a great factor in the rapid and successful actions on D-Day, and lists certain improvements that are required.[5]

30. Summary.

a. The DD device is reasonably satisfactory as a means of supplementing bridges, ferries, landing craft and other more efficient methods of crossing a body of water.

b. The element of surprise now having been lost, the DD tank has no advantage over a tank landed directly on the beach for the direct support of landing operations, and in many respects is inferior.

c. Direct support of landing operations can be accomplished better by means of specially designed amphibious tanks, capable of fighting both in the water and on the beach, operated by amphibious tank units especially trained in their use. Such a vehicle would possess the same desirable characteristic of a low silhouette in

water and in addition would be less vulnerable to shell fragments and blast and would have superior beach mobility. Standard land fighting tanks for the fight inland would be landed directly from landing craft after the initial securing of the beach head.

d. Although the DD device does not satisfy requirements, a study of each model tank produced, to determine the feasibility of developing a swimming device which will enable the tank to cross a body of water independently of bridges, ferries, and landing craft is indicated. It is essential that such a device not impair the land fighting ability of the tank and that it impose no additional maintenance load on the crew.

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CHAPTER 5

LVT'S

31. Description. The LVT (Buffalo) is a full track amphibious vehicle of light weight construction that is capable of negotiating five to six feet of surf. Propulsion and steering are obtained through the rotation of the tracks. Maximum water speed is approximately six miles per hour. The vehicle has exceptionally good mobility in sand and soft ground but ability to travel on hard surface roads is definitely limited due to the deep track grousers. There are several different models of the LVT including armored amphibious tanks mounting either a 37mm gun or a 75mm howitzer in a turret and cargo vehicles; the later models of which are provided with a ramp type tail gate to facilitate loading or unloading when on land. Some cargo vehicles are lightly armored, the weight of the added armor reducing the 10,000 pound payload accordingly. The turretted vehicles were not employed in the theater. Approximately 500 cargo models were received.

32. Organization and Training of Units.

a. U. S. Units. The 747th Tank Battalion (Ninth Army), on March 6, 1945 stored its standard tanks and was re-equipped with LVT's, each of its four tank companies receiving 17 LVT(2)'s and 8 LVT(4)'s. Training in driving and maintenance was conducted for approximately 10 days. After the Rhine crossing the LVT's were turned in, their standard tanks taken out of storage and the battalion resumed its normal role. There were no other U. S. Units similarly equipped and trained in the European Theater.[1]

b. British Units. The 79th Armored Division contained one Buffalo regiment of three squadrons of three troops each. Each troop contained 6 LVT's. This unit was trained and functioned only in the LVT role. Squadrons were allotted as the tactical situation required.[2]

33. Employment.

a. First U. S. Army - LVT's were not employed by the first U. S. Army.

b. Ninth U. S. Army - The 747th Tank Battalion, on the 24th, 25th and 26th of March 1945, made a total of 1112 round trips across the Rhine River. During this operation two battalions of the 30th Infantry Division and one battalion of the 79th Infantry Division, in addition to ammunition, quarter-ton trucks, infantry, cannon and 57mm AT guns, were transported across the river. Prisoners of war and wounded were transported on the return journeys. Three LVT's were sunk due to defective bilge pumps and overwork. Two were damaged by artillery fire, which was sporadic. There was no other enemy opposition.[1]

c. There are no other examples of LVT's employed by U. S. units specially trained and equipped. They were used to some extent by divisional units on a small scale, usually by the division engineers, as additional equipment.

d. British - LVT's were first used in the invasion of WALCHEREN. Assaulting infantry, support cannon, and later supplies and equipment were ferried ashore. Of 104 Buffaloes dispatched from OSTEND on 1 November 1944, 27 were completely written off. Owing to extremely arduous conditions, none of the remaining 77, though still

mobile, were mechanically fully fit. Of the 20 operating from BRESKENS, six were completely written off. Battle casualties were mainly from mines and shelling. The nature of these operations was such as to exploit to considerable advantage the capabilities of this type vehicle. The conclusions of the British regarding the Buffalo, as a result of this operation, are as follows:[2]

(1) Buffaloes are invaluable as assault vehicles in an amphibious operation of this kind. Their performance across the flooded and waterlogged country is better than any other vehicle available except the WEASEL. They must be well covered by fire support and by smoke, as required.

(2) Buffalo presents a small target when swimming, but on land is conspicuous and vulnerable.

(3) Buffaloes should be kept for assault. They require care and frequent overhaul. After each operation there is a great deal of maintenance to be done before Buffaloes can be used again. For supplies and transport purposes, DUKW's, TERRAPINS and WEASELS are suitable.

(4) Roads and hard surfaces must be avoided as tracks quickly become useless.

(5) Buffaloes can master a mud covered beach provided mud is NOT too deep or if a layer of sand surface exists.

(6) Thick wire obstacles and quantities of fallen telegraph wire proved an obstacle. Single coil concertina and apron fences can be overcome if craft has sufficient "way".

(7) The Buffalo is mechanically reliable and will perform well provided it is regularly overhauled, properly maintained and not subjected to the abuses mentioned above.

For the operation PLUNDER one troop of six Buffaloes was attached to each DD regiment. Two of these vehicles carried the reconnaissance parties and the remaining four carried the chespale carpets which were required in the preparation of the far bank for use of the DD tanks. Very close cooperation between DD and Buffalo personnel is required in order that lanes may be correctly located and properly prepared. This operation was considered successful.

34. Merits and Deficiencies.

a. Merits.

(1) Ability to travel both on land and in the water with no modification or change in the basic vehicle.

(2) Large cargo capacity (4 tons).

(3) Good mobility in mud.

(4) Low silhouette in Water.

b. Deficiencies:

(1) Still greater mobility in mud is required.

(2) High silhouette on land.

(3) Low power - weight ratio reducing hill climbing ability when fully loaded.

(4) Lack of ability to travel on hard surface without excessive track damage.

35. Summary.

a. There is a definite military requirement for a track laying amphibious cargo carrier for use in areas containing considerable water.

b. There is a requirement for a permanent organization equipped and trained with amphibious cargo carriers.

c. There is a military requirement for an amphibious tank for use in assault operations requiring landing of troops on a hostile shore.

d. There is a military requirement for permanent amphibious tank battalions trained and equipped with these vehicles.

e. For the usual river crossing operation, the LVT possesses no marked advantage over DUKWS and barges, provided the DUKWS are supported by troops and equipment to prepare approaches and exits to the river.

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CHAPTER 6

MECHANIZED FLAME THROWERS

36. Description. The two principal mechanized armored flame throwers that were employed in the European Theater are the British CROCODILE and the U. S. Model, E4-5.

a. The CROCODILE consists of a British CHURCHILL or American Sherman tank (medium tank, M4 series) towing a 6 1/2 ton armored, two wheel trailer containing pressure bottles and 400 gallons of flame thrower fuel. The fuel is discharged from a nozzle mounted on the front right hand corner of a Sherman tank or in the bow machine gun position of a CHURCHILL tank. The fuel is forced to the flame gun through a pipeline that links the trailer and the tank.[1]

b. The Mechanized Flame Thrower, E4-5, consists of two 25 gallon fuel tank and pressure tank groups installed on the inside front of a medium tank, M4 series, plus a flame gun that is interchangeable with the caliber .30 bow machine gun.[2]

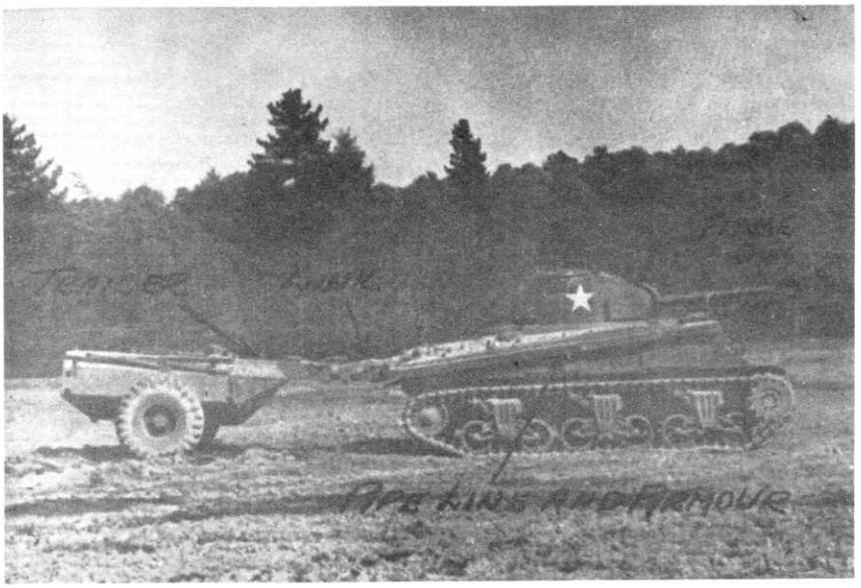
c. Pertinent comparative characteristics of the CROCODILE and E4-5 are outlined below:

	ITEM	CROCODILE	E4-5
(1)	Maximum Range (Thickened fuel)	120 yards	70 yards
(2)	Fuel Capacity	400 gallons	50 gals
(3)	Discharge Rate	4 gal per sec	1 gal per sec
(4)	Total firing time	100 seconds	50 seconds
(5)	Operating pressure	250-350 #psi	375 #psi
(6)	Gas bottle pressure	3000 #psi	2000 #psi
(7)	Elevation and Depression	+25° to -10°	+27° to -10°
(8)	Traverse	45° R and L	20° R and L
(9)	Total weight of equipment	Approx 7 tons	997 lbs
(10)	Principal armament ammunition removed from tank.	15 rounds	15 rounds

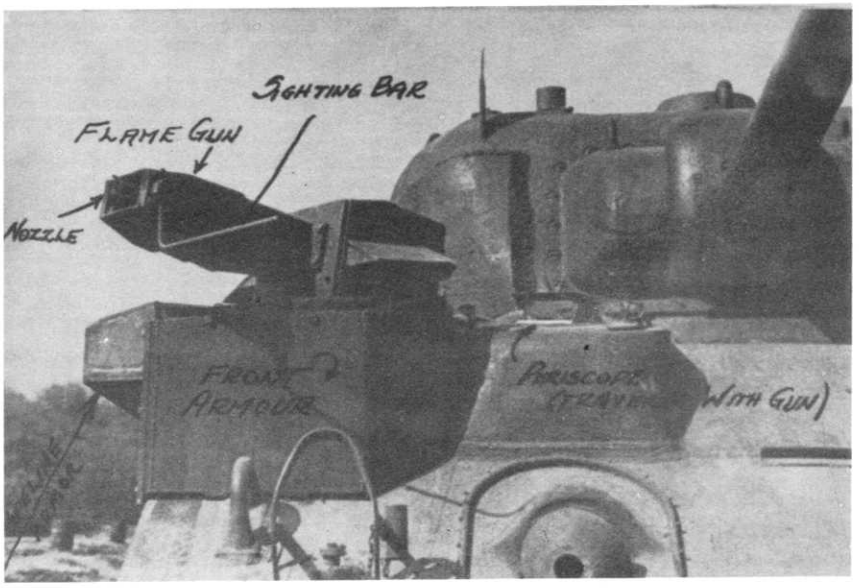
37. The Establishment of European Theater Requirements for the CROCODILE and the E4-5 was accomplished prior to D-Day, but neither item was employed with American forces until September 1944.

a. As a result of a preliminary examination by American officers in the United Kingdom, the British were advised in August 1943 that the American Forces had an estimated requirement for 100 CROCODILES. First U. S. Army established a firm requirement for 65 CROCODILES in February 1944,[4] and a formal requisition was immediately placed with the British for a total of 115 (making an anticipated allowance for needs of Third U.S. Army). This requirement was later modified to the extent that only four CROCODILES were actually delivered.[5,6,7] These were assigned to the 739th Medium Tank Battalion (Special) (Mine Exploder).

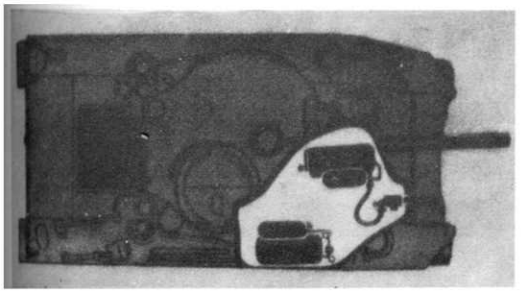
b. Based on advanced technical information received from the Zone of Interior, a requirement was submitted 21 April 1944 for the immediate shipment of one E4-5 flame thrower for demonstration purposes, and 100 additional units for early delivery. In July 1944, First U. S. Army established a requirement for 200 E4-5 flame throwers on the basis of one per medium tank platoon (or 9 per medium tank battalion).[8] This demand was brought about by the apparent need for a mop-up weapon for use in hedgerow fighting. The theater requirement was increased to 333, plus 10 percent per month for replacements, by



Crocodile Side View



Crocodile Front View



MOUNTING, E4-5 FLAME THROWER

12th Army Group, 6 September 1944, by broadening the above basis of distribution established by First U. S. Army to include Third and Ninth U. S. Armies.[9] A total requirement for 630 E4-5's had been placed on the War Department by December 1944.

c. To employ flame throwers, E4-5, a fuel filling kit and a servicing kit are required. The War Department basis of distribution for each of these kits was one kit per five E4-5 flame throwers. Tank companies were normally operating independently from their tank battalion headquarters with an infantry regiment, and combat experience made it necessary to increase the distribution of the refueling and servicing kits to one per three E4-5 flame throwers, (one per medium tank company),[10] One set of refill equipment and fuel weighed 6,850 pounds and occupied 194 cubic feet. Therefore, it was also necessary to provide each tank company with one 2 1/2 ton truck to transport this equipment. Fuel was requisitioned initially on the basis of 15 "fills" per month per flame thrower.

38. The Introduction of Flame Throwers into Units was delayed by continued postponement of shipment of the E4-5 from the Zone of Interior, and the limited initial availability of the CROCODILE. One E4-5 was air shipped to the European Theater 15 June 1944 and used for demonstration purposes in the United Kingdom, 29 June 1944, and in Normandy, 23 August 1944. In the initial demonstration the flame thrower performed unsatisfactorily, failing to ignite after it had been refuelled (following a static demonstration). As a result, the flame thrower program temporarily lost its impetus until combat in the bocage country prompted a demand for the latter and more successful demonstration. The initial shipment of 100 E4-5's from the Zone of Interior had been scheduled for June 1944, but was delayed four months because of the necessity for design improvements. The first bulk shipment of E4-5's was made by air in September 1944.

a. Distribution was effected immediately on the basis of nine E4-5's per tank battalion, with first priority to the separate tank battalions. By the time sufficient E4-5's had been received to permit issue to tank battalions of armored divisions, this weapon had fallen into disfavor, and Armies were permitting them to be returned to depots. Approximately two E4-5's were installed in each tank battalion of the 14th Armored Division.

b. The E4-5 was received by tank battalions the latter part of November, appearing first in Ninth U. S. Army. A six day school was conducted in the six separate tank battalions in Ninth U. S. Army by a special CWS representative from the Zone of Interior and a team of personnel from the 57th Chemical Maintenance Company. A school was also operated by the 70th Tank Battalion for representatives from units in the other Armies.

c. The E4-5 was normally installed in medium tanks, M4A3E2, where this model was available, in order to provide the crew and flame thrower fuel with the maximum armor protection. Since this tank had the 75mm ammunition stowed in the lower hull, the flame thrower installation did not reduce ammunition stowage capacity.

d. The four CROCODILES drawn by the 9th Armored Group in the United Kingdom were moved to the Continent in November 1944 and were used to equip and train a platoon in the 739th Tank Battalion (Mine Exploder).

e. The British 79th Armored Division included a special

CROCODILE Brigade of three CROCODILE Regiments. Each of these regiments included three squadrons made up of four troops (platoons) of three or four CROCODILES and a headquarters of four fighter tanks (See Section 1, Chapter 10 and Appendix 1).

39. The Employment of Flame Throwers by American Forces was limited to several isolated, relatively small operations. The E4-5 was installed and carried as a weapon of opportunity, while a squadron and more often a troop, of CROCODILES was given a flame mission with a task force scheduled to assault a well organized defensive position.

a. In a few cases the flame from an E4-5 was credited with hastening the capitulation of an enemy force under attack. In most instances, however, it was considered that the work done by the bow gun flame thrower could have been more efficiently duplicated by the caliber .30 bow machine gun and/or white phosphorous ammunition from the tank cannon. Several typical examples are outlined below:

(1) The 70th Tank Battalion received four E4-5's 11 September 1944, they were installed, and two tanks so equipped were attached to the 741st Tank Battalion 15 September 1944 after one day of flame thrower training. One tank had a mechanical failure, but the other tank was employed in the assault of a pillbox on 18 September, with the following results:

(a) The tank had to approach within 25 yards of the pillbox before the flame could reach the embr sure.

(b) The flame appeared to lack the proper pressure;

(c) The pillbox attacked was manned, but the flame thrower was unable to reduce the defense of this fortification, and it was not captured by the infantry during the engagement.[11]

(2) Two E4-5 equipped tanks were employed with three other tanks from the 709th Tank Battalion in the assault of a section of woods near VOSENACH, Germany, in November 1944. The tanks transported the infantry almost to the woods with the flame tanks in action. The infantry dismounted, pressed the attack, meeting little opposition. No known casualties were produced by the flame. However, the mission was successfully accomplished.

(3) The 743d Tank Battalion employed flame three times during the drive from the ROER River to the RHINE River. One tank pinned down an anti-tank crew with high explosive fire from the tank gun, and routed the enemy into a nearby woods by flaming as the tank closed to the gun position. This tank also attempte to flame some German infantry lying in ditches at the sides of a road, but the bow gunner forgot to turn on his ignition switch, and sprayed the enemy with a wet burst. Another tank employed flame to drive 22 of the enemy into captivity from a house situated on a sharp slope so that the tank could fire its 75mm gun into the upper floors only.

(4) In April 1945 a flame tank of the 736th Tank Battalion was used in conjunction with a loud speaker tank to encourage a group of Hitler Jugend and SS troops in GRONNGEN, Germany, to surrender. The flame tank was only able to force these fanatical troops to abandon a burning house and move to another.[12]

b. Considerable difficulty was encountered in obtaining satisfactory performance with the E4-5, and using troops in many instances developed a pronounced antipathy for this weapon for the following reasons:

(1) They initially feared the addition of the flame thrower fuel to the inside of the tank, and the accompanying increase in the already intensely dreaded fire hazard.

(2) The range of the flame thrower was too short, viz., less than that of the highly effective German hollow charge anti-tank weapons. In actual practice the working range of the flame thrower was only 30 to 40 yards.

(3) The E4-5 and the E4R2-4R3-5R1 (later model which was shipped against a majority of the Theater's requirement) were not mechanically reliable. Considerable difficulty was encountered in obtaining ignition; particularly in firing British "K" type fuel. Units were received with a variety of mechanical defects. Other parts failed through moderate usage.[13] The failure of this weapon to prove itself in combat was further exaggerated by the following factors:

(a) There was an initial shortage of qualified instructional personnel to facilitate the proper introduction of the E4-5.

(b) The E4-5 was hurried into combat before the operating personnel were properly trained and thoroughly familiar with their new weapon.

(4) The E4-5 installation hindered the all-important escape from the tank. The transmission fuel group (4R3) blocked the alternate escape hatch of the driver and assistant driver; which had to be used by them in the event the tank cannon was centered over their own hatch. Consequently, this additional fuel capacity was not retained by a majority of units. Also the pressure bottle in the sponson fuel group made the exit from the bow machine gunner's hatch more difficult.

(5) The limited fuel capacity necessitated frequent refuelling and recharging.

c. The American Forces obtained one squadron of CROCODILES of the 141st Regiment, Royal Armored Corps, from the 21st Army Group for use by the VIII Corps of Ninth U. S. Army in the capture of BREST, France. The employment of these CROCODILES materially assisted this assault. Ninth U. S. Army also obtained a British squadron for the better part of the campaign between the WURM, ROER and RHINE Rivers. The squadron was attached to various divisional units for assault

operations. Some of the principal engagements are outlined briefly below:

(1) The CROCODILES of Squadron B, 141st Regiment, Royal Armored Corps were successfully employed with the 116th Infantry Regiment, 29th Infantry Division to assist in clearing pillboxes in the approach to Fort Montbarey in the BREST defenses, 14 September 1944; and also in the assault of this fort 15 and 16 September (See Appendix 2).

(2) Squadron B, 1st Fife and Forfar Yeomanry (British), was employed on three occasions by the 2d Armored Division in the advance between the WURM and ROER Rivers, 18 - 22 November 1944. Two troops were attached to a task force in Combat Commands "A" and "B", each task force employing a troop in the assault against three strongly defended towns.[13]

(a) The CROCODILES were only of moderate success in the assault of FREIALDENHOVEN as the infantry lagged behind the flame throwers and did not rapidly close after the edge of the town was flamed. However, the town was occupied and cleared on schedule 20 November.

(b) The CROCODILES were of material success in the capture of GERONSWEILER that same day. The infantry advanced with the CROCODILES as they razed haystacks and buildings, firing a hole in each building with the tank cannon and firing the flame thrower through the hole. Adequate flank protection was afforded by fighter tanks.

(c) A troop of CROCODILES was committed singly in the last stages of a costly assault of MERZENHAUSEN 22 November, and all four CROCODILES were destroyed by enemy action.

d. The CROCODILE platoon of the 739th Tank Battalion was employed with the 2d Armored Division in March and April 1945 after the crossing of the RHINE, but there was little opportunity to employ flame and the platoon was frequently assigned road block missions during this fluid period.

e. The British Forces employed the CROCODILE more extensively and with considerable success. In the assault of LE HAVRE coordinated day and night attacks were made with the 49th Infantry Division and one squadron of CROCODILES, with the flame terrifying and completely demoralizing the enemy. Resistance was rapidly disintegrated as the enemy ran to the flanks of the flame to surrender.[15] The experience of British and Canadian Forces indicated successful employment of flame throwers was characterized by the following:

(1) Assignment of well-defined objectives suitable for flame.

(2) A carefully prepared plan which includes covered approaches, flank protection, maximum fire support, and judicious use of smoke to get the flame throwers to their objectives with minimum casualties from anti-tank weapons.

(3) Thoroughly trained operating personnel.

(4) Employment of flame throwers in numbers rather than individually.

(5) Infantry immediately exploiting the demoralizing effect of the flame.

40. Merits and Deficiencies of the CROCODILE.

a. Merits.

(1) Provides a flame thrower and retains all of the fire power of the tank.

(2) Provided longest range and largest fuel capacity of any model flame thrower available to the European Theater.

b. Deficiencies.

(1) Trailer installation restricts mobility of tank with respect to backing up or negotiating sharp turns.

(2) The pintle line connecting the trailer and the flame gun "blew out" occasionally.

41. Merits and Deficiencies of the Flame Thrower E4-5.

a. Merits.

(1) Provides a flame thrower and retains the principal fire power of the tank.

(2) Simplicity of installation.

b. Deficiences.

(1) Range too short.

(2) Limited fuel capacity necessitates frequent refueling.

(3) Installation of flame thrower inside of tank:

(a) Makes rapid escape from tank by driver and bow gunner more difficult.

(b) Increases crew members' fear of apparent fire hazard.

(4) Mechanically unreliable.

42. Several Additional Mechanized Flame Throwers were considered by the European Theater and one additional model (Canadian) was employed.

a. The British developed the SALAMANDER during the Summer of 1944, and demonstrated it in September 1944. This vehicle consisted of a medium tank, M4 Series in which the flame gun of the CROCODILE had been installed in place of the 75mm gun, and fuel tanks (250 gallons) and pressure bottle installed inside the tank. No requirement

was established for this vehicle since the British considered the CROCODILE superior because it retained the tank cannon as principal armament and had greater fuel capacity. At that time, American representatives anticipated that the E4-5 would satisfy their flame thrower requirements.[16]

b. The European Theater requisitioned ten mechanized flame throwers, E12-7R1, and accompanying technical personnel in February 1945 in order to complete an acceptance test desired by the Chief Chemical Officer, Army Service Forces, and at the same time permit Army Commanders to determine firm requirements based on tactical performance.[17] This flame thrower corresponds in principal to the SALAMANDER described in paragraph a, above, and employs the American developed "Q" gun. However, this shipment was diverted to the Southwest Pacific area in May 1945.[18] A new requirement for the shipment of five main armament flame throwers was immediately established in order to permit demonstration and practical training of this new equipment prior to redeployment of armored units to the Pacific.[19] It was considered such a use of this equipment might also serve to overcome the prejudice American troops had developed with regard to operating mechanized flame throwers. The shipment of this latter requirement was cancelled in view of V-J Day and the cessation of direct and indirect redeployment to the Pacific from the European Theater.

c. Canadian forces employed a limited number of WASP MK II flame throwers with results corresponding to those obtained with the CROCODILE. This vehicle consists of the CROCODILE gun installation plus fuel and pressure tanks mounted on a Bren Gun Carrier. The CROCODILE was generally preferred to the WASP because of its superior armor protection, fire power, and fuel capacity.

43. Summary.

a. The combat experience of the European Theater confirmed the need for armored mechanized flame throwers to assist in the assault of well-organized, defensive positions.

b. The CROCODILE was the most reliable and effective mechanized flame thrower employed in the European Theater.

c. The mechanized flame thrower, E4-5, was unsatisfactory for the following reasons:

(1) The range was too short, viz., less than that of German hollow charge anti-tank weapons.

(2) It could not be relied upon to function properly in combat.

(3) The installation of the E4-5 hindered the rapid escape of the driver and bow gunner from the tank.

(4) Limited fuel capacity necessitated frequent refueling and recharging.

d. The deficiencies listed in paragraph c, above, should be avoided in the design of future principal armament or "accessory" type mechanized flame throwers.

e. The following action must be taken to insure successful employment of a reliable, effective flame thrower:

(1) Well-defined objectives suitable for flame should be assigned.

(2) The attack should be carefully planned to include covered approaches, flank protection, maximum fire support, and judicious use of smoke in order to permit the flame throwers to reach their objectives with minimum casualties from enemy fire.

(3) The operating personnel should be thoroughly trained.

(4) Flame throwers should be employed in numbers, rather than individually.

(5) Infantry should immediately exploit the demoralizing effect of the flame.

f. No definite conclusions can be drawn with regard to the relative merits of a principal armament type flame thrower as compared with an "accessory" type flame thrower (added to the tank without decreasing fire power), since the principal armament type flame thrower was not employed in combat. However, for future guidance, the experience of the European Theater indicated that;

(1) The fire power of the CROCODILE and the E4-5 materially assisted the advance of the flame thrower tank to within flame range.

(2) To insure successful employment of the CROCODILE and E4-5 it was necessary to provide the same over-watching and flank protection with fighter tanks as would be required in the employment of a principal armament type flame thrower.

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Chapter 6

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CHAPTER 7

CDL TANKS

44. Brief description and history.

a. The CDL tank is an M3 (Grant) Medium tank with the 37mm gun turret removed and a special searchlight turret installed in its place. The special turret is divided longitudinally into two compartments, the left compartment providing space for the CDL operator and his various controls and the right compartment containing the carbon arc light and reflectors. The light beam is formed by a parabolic elliptical reflector located in the right forward part of the compartment, whence the beam is directed onto a flat alluminum mirror located in the rear of the turret. The beam is then projected through a slit two inches wide and twenty-four inches high located in the center of the front of the turret. The beam, 1.9° wide vertically and 19° wide horizontally, has a vertical height of 34 yards and a horizontal width of 340 yards at 1000 yards. Optical elements are so arranged with respect to the slot that the possiblility of extensive damage due to small arms fire entering the slot is remote. The light, therefore, can be expected to function until the tank itself is destroyed by anti-tank fire. A shutter is provided whereby the light may be made to flicker at varying rates up to two flicks per second. The purpose of the flicker is to dazzle the enemy and cause him discomfort by preventing his eyes adjusting themselves to either light or darkness. In addition to the white light, either a blue or an amber light may be produced by suitable filters which are provided. The effect of a combination of blue and amber lights by adjacent tanks is to illuminate the target with white light, whereas the enemy is confused in his ranging by the colors, CDLs with blue lights appearing at a greater range than those with amber lights. The turret can be rotated 180° in either direction. The beam can be elevated or depressed 10° from the horizontal.[1]

b. The primary mission of CDL tanks was to provide illumination in order that aimed fire might be placed on the target. The secondary missions were (1) to confuse and dazzle the enemy by means of the flicker, varicolored lights and surprise effect of a new weapon, and (2) to provide protection to our own standard tanks and foot troops by means of the triangles of darkness formed between adjacent lights. It was intended that the above missions be accomplished by employing CDL tanks in mass in an appropriate situation.

c. The pseudonym CDL (Canal Defense Light) was given to the project in 1939 in order to insure secrecy. Such information as had to be given to interested parties only referred to high-powered searchlights, required for the defense of the Suez Canal. The entire development was carried out by the British and was released to the U. S. in October 1942 subject to the conditions that (1) the equipment not be used in action by U. S. forces in the first instance without prior reference to and agreement by the British War Office and that (2) the manufacture of any CDL equipment in the U. S. be undertaken by different firms in order to maintain secrecy, the various components being finally assembled under military supervision.[2] Secrecy was actually maintained until the Rhine crossings in March 1945.

d. The CDL tank was also known as the LEAFLET among U.S. troops. This designation was later dropped to avoid confusion. The vehicle was shipped under the nomenclature "Shop Tractor T-10".

45. Organization and training of units.

a. U.S. units - The 701, 736, 738, 739, 740 and 748 Tank

Battalions were organized under T/O & E 17-453 and were equipped and trained with CDL tanks under supervision of the 9th and 10th Armored Groups. In addition, the 526th Armored Infantry Battalion, the 538th and 554th Ordnance Companies, HM (Tk) and the 150th Station Hospital were included in the project. The training was carried out in utmost secrecy at Fort Knox, Kentucky and at the Desert Training Center, California. Training of the units was completed at various times between December 1943 (736th and 748th Tank Battalions) and April 1944 (739th Tank Battalion). The Medium Tank Battalion, Special, consisted, in brief, of a Headquarters Company, a Service Company and three Medium Tank Companies. Each tank company consisted of three platoons of six CDL Tanks and one standard fighter tank each. Battalion headquarters contained three, and each tank company two standard fighter tanks as command tanks. Total for a battalion - 54 CDL's and 18 fighter tanks.

b. British units - The 35th Armored Brigade (CDL) consisted of three regiments of three squadrons each. Each squadron contained three troops, each of six CDL tanks and two standard fighting tanks. Three standard tanks were assigned to squadron headquarters and four to regimental headquarters for command purposes. The regiment thus contained 54 CDL tanks and 31 standard fighter tanks.

c. Neither the British nor the U. S. CDL units were employed in combat in their CDL role. The adequacy of the organization cannot, therefore, be commented upon.

46. Tactical Doctrine.

a. It was considered that for maximum effectiveness and greatest possible exploitation of the element of surprise, CDLs should be used, at least initially, in mass.[3] The CDL tank and tank units can be employed offensively or defensively, by day or by night. Daylight employment is identical to that of ordinary tanks and offers no advantages over the standard tank units.[4] If employed defensively, particularly in daylight, the CDL unit is handicapped by the same limitations as any standard tank unit employed defensively.[5]

b. The characteristics of the CDL tanks are: firepower, armor protection, mobility, shock action and illumination. Employed at night under proper conditions, the enemy is illuminated by the beam whereas our own troops, other than the CDL itself remains in darkness between or behind the beams. The flicker and the colored filters also may be employed to further discomfort and confuse the enemy.

c. The CDL company is the basic tactical unit. Standard formations are the line, wedge, echelon or box. CDL tanks are so placed that the target area is illuminated by overlapping beams. Beams are turned on intermittently, by platoons, to facilitate forward movement in darkness and to permit replacing carbons. Standard fighter tanks are placed either on the flanks of the platoons or in the interval between CDL tanks. Normal interval between CDL tanks is 25 yards.

d. The flicker and color features are not normally employed at ranges less than 500 yards.[6]

e. The plan of attack must be kept simple, with a minimum of complicated maneuver or changes in directions involved.

f. The CDL is particularly sensitive to terrain and weather. Its effectiveness is largely lost in hilly or mountainous terrain, in woods, villages and towns, or in fog, smoke or dust. Its effectiveness is greatest in flat, open country, with uninterrupted line of site from tank to target.

g. As is the case with other tanks, CDL's cannot be employed alone. The attack must be properly supported by air, artillery, infantry and other tanks. Close coordination between CDL's and infantry is particularly important. The proper proportion of infantry is not available within the CDL organization and infantry must, therefore, be obtained from other sources. Ten days familiarization and training is considered essential for proper coordination of a CDL-Infantry attack.

47. CDL units were never used in combat as such. The reasons for this were twofold: (1) The need for standard type tank battalions and mine exploder battalions necessitated the conversion of CDL battalions. (2) The high security classification imposed on the equipment precluded the training of supporting troops or their familiarization with the capabilities and limitations of the CDL equipment. Commanders knew little of the project and thus had not considered the possibility of its use in their plans.

a. After the invasion of Normandy, it became apparent that the required ratio of separate tank battalions to infantry divisions was at least one to one. This was necessary to permit a particular tank battalion to remain attached to the same infantry division in order to develop the necessary tank-infantry coordination and cooperation essential to successful combat. The troop basis did not permit this and there were not enough tank battalions in the zone of the interior to supply the deficiency. The training of a CDL battalion in the role of a standard battalion is a relatively simple matter, the tank chasses being similar and the same type tank cannon being mounted on each. The value of the tank-infantry team had been proven in combat. The combat value of the CDL was still unknown. Consequently ETOUSA requested authority on 23 October 1944 to convert four CDL battalions to standard battalions.[7] This authority was granted by the War Department and the 701, 736, 740 and 748 tank battalions were converted. The completion of this conversion was considerably delayed due to the insufficiency of M4 medium tanks with which to equip these battalions. The conversion of the 738th and 739th battalions into mine exploder battalions is covered in Chapter 10. By this time, the Armored Infantry battalion and Ordnance Maintenance Companies had already been removed from the CDL project, having been required for other use.

(1) The personnel of the British 35th Armored Brigade were required as replacements in their standard tank units and were so used.

(2) On 17 November 1944 a request for two CDL battalions and a group headquarters was received from 6th Army Group. At the time reorganization of the battalions had not proceeded beyond recall. The need for standard battalions was such, however, that this request was refused, unless 6th Army Group had planned a specific operation around these tanks. Since no specific operation had as yet been planned, the units were not furnished.

b. During the latter part of September and the early days of October, Colonel Walter Burnside, Commanding Officer 10th Armored Group (CDL) reconnoitered the terrain on the fronts of the armies of the 12th Army Group for the purpose of determining the suitability of the ground for CDL use. The terrain in the sectors of the VII and XIX Corps was found to be suitable. General Corlett, Commanding XIX Corps, stated he intended using CDL's in a night attack provided the Army Commander approved and allocated the CDL units. General Hodges, Commanding First U. S. Army stated that he would require a demonstration of the equipment

prior to rendering a decision as to whether or not the equipment would be used in the attack and whether a rehearsal of the participating troops would be required. Due to the high security classification (TOP SECRET), the demonstration could not be arranged without prior clearance from SHAEF. Accordingly, Colonel Burnside drew up a plan of attack utilizing a CDL task force and presented it to 12th Army Group together with a request for a clearance for the necessary demonstration and possible rehearsal. He was informed at this time that use of the CDL in that role would be disapproved as orders for the conversion of the CDL battalions had been issued and that it would be necessary for the Group to turn in its CDL equipment and proceed with the conversion to standard type units. The plan, therefore, was dropped.[8]

48. Employment. Although CDLs were never employed in the assault role, the vehicles were used extensively during and after the Rhine crossing for the purpose of illuminating bridge sites and for detecting floating mines, barges, swimmers, etc. that might be used by the enemy in an attempt to destroy the bridges. During the early stages, part of these operations were conducted under fire, and the fire power of the CDLs was occasionally used, particularly to destroy floating objects. After the battle had moved to the East, the CDL continued in use at the bridge sites, primarily for the purpose of facilitating maintenance and repair of the bridges. For the latter purpose, ordinary searchlights would have sufficed and would have provided more efficient illumination, but they were not readily available and the CDLs were used in lieu thereof.

a. Ninth U. S. Army Area - Company B, 739th Medium Tank Battalion (Mine Exploder) was equipped with CDL tanks for the operation and commenced their mission of illuminating bridge sites in the Ninth Army sector on 23 March 1945. Until the far bank was entirely in friendly hands considerable small arms and artillery fire was experienced. On 1 April the unit moved eastward and was engaged primarily in providing illumination for various Engineer projects.[9]

b. First U. S. Army Area - 738th Medium Tank Battalion (Mine Exploder) commenced CDL operations at the REMAGEN BRIDGE on 9 March 1945 with four CDLs of Company C assisting the Engineers in erecting a boom by furnishing illumination. Additional CDLs from the same company were added to the project as required. Company A with six CDLs commenced operations along the Rhine on 21 March and Company B on 23 March. These operations were conducted under considerable artillery fire and occasional air attack. CDLs operations terminated on 18 April when the battalion moved to the east.[10]

c. Third U. S. Army - One platoon from each of the four letter companies of the 748th Tank Battalion was equipped with seven CDLs each. These were used to illuminate bridge sites at ST GOAR, BAD SALSIG and MAINZ. This mission continued until 9 April 1945.

d. Fifteenth U. S. Army - Control of Rhine crossings having passed to Fifteenth U.S. Army, responsibility for illumination of the crossings fell to the XXII and XXIII Corps. No trained CDL units or personnel were available. Personnel, therefore, was drawn from Corps Artillery and trained by instructors borrowed from the 738th Tank Battalion. CDLs were used statically to provide illumination from 15 April to 1 June 1945. CDLs proved uneconomical and difficult to maintain when used in this role and were gradually replaced with re-conditioned captured German searchlights.

49. Infra-red Developments - Information was received at ETOUSA in July 1944 of the development of a CDL type tank equipped with

infra-red light and suitable viewing devices. The advantages of such a device over a standard light are many. In addition to its absolute invisibility by personnel not equipped with suitable viewing devices, its superior ability to penetrate fog or smoke might well render it useful for day use under conditions of poor visibility. If standard tanks and accompanying foot troops could also be equpped with effective viewing devices to enable them to take advantage of the invisible light, its effectiveness would be further enhanced. No infra-red equipped CDL ever actually reached the theater, hence the ability of the development tank to accomplish the above cannot be commented upon. The theater concurred in this development.[11]

50. Summary.

a. The introduction of a new weapon, particularly a secret weapon, on the battlefield without prior indoctrination of the troops that must work closely with that weapon, is impractical.

b. Any organization intended to employ a highly classified weapon in combat should include the arms and services necessary to the close support of the troops employing that weapon.

c. For proper training and employment of a secret weapon such as the CDL, a special organization that includes the necessary supporting arms and services, is superior to a group or groups of separate special tank battalions.

d. Development of special night fighting equipment should be continued.

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CHAPTER 8

TANK ROCKET LAUNCHERS

51. Description.

a. The T-34 is a 60 tube 4.5 inch multiple rocket launcher designed to be mounted above the turret of the M4 (Sherman) medium tank. The rockets are discharged electrically from inside the tank at the rate of one round each half second. The 60 rockets can thus be discharged in 30 seconds. The launcher is linked to the gun tube and is elevated and depressed by means of the gun elevating machanism. The launcher rotates with the turret. Maximum range is 4000 yards. Range dispersion is considerable and was found to be unpredictable. The launcher can be jettisoned from inside the tank.

b. The 7.2 inch multiple rocket launcher M-17 is a tank mounted launcher with similar mounting, firing and jettison features as the T-34. Two types of ammunition are supplied for use with this launcher. The Rocket, HE 7.2 inch, T-37 weighs 61 lbs, has a maximum range of 230 yards and is intended for demolition work. The Rocket, gas, CG 7.2 inch T-21 weighs 51.8 lbs and has a range of 3430 yards. The launcher fires 20 rockets, either selective or ripple fire. None of these launchers reached the European Theater in time to be used operationally.

52. Use in Combat.

a. One operation employing a large number of rockets was planned. Thirty rocket launchers were installed on the tanks of the 743d Tank Battalion and training was conducted under supervision of the 7th Armored Group. The operation, involving an attack by the 30th Infantry Division was scheduled for the middle of December. The German Ardennes offensive of 16 December prevented the mounting of the attack and the 743d Tank Battalion jettisonned all launchers and moved to the threatened area. They were never reinstalled.[1]

b. Launchers were also installed at various times and in small numbers on tanks of the 2d, 4th, 6th, 12th and 14th Armored Divisions and of the 712th, 753d and 781st Tank Battalion.[2] It was generally felt that the results obtained could be better obtained by use of artillery and mortars, leaving the tanks free for their own job and own method of fighting, rockets, if used, being more effectively employed by artillery.

53. Summary.

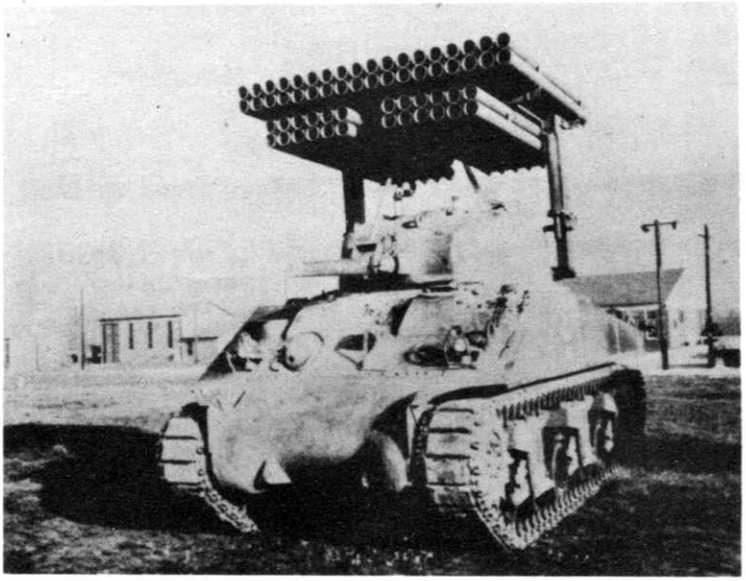
a. Users felt that the addition of the T-34 rocket launcher to the normal tank armament unnecessarily complicated an already very complicated vehicle and detracted from its primary role of assault by direct fire. It was also felt that the launcher could be used as effectively when mounted on a truck or on the ground, protection being afforded by remote control firing. Specific deficiencies noted were:

(1) Frequent misfires.

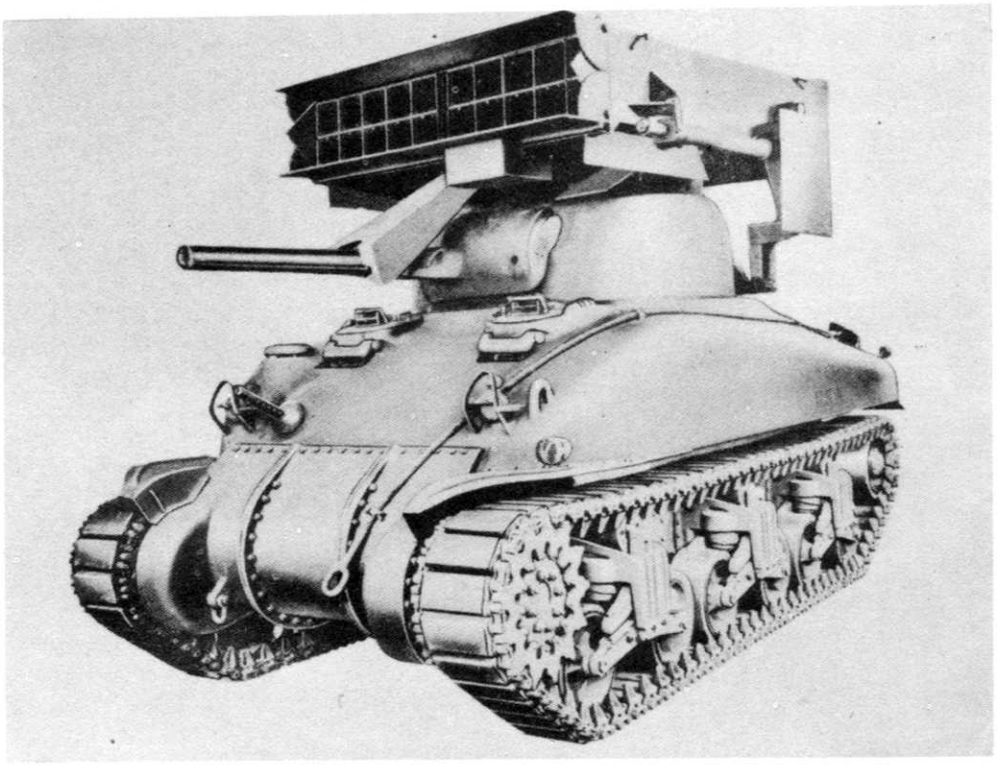
(2) Excessive range dispersion, precluding overhead fire.

(3) Jettison feature did not always work.

b. Inasmuch as the 7.2 rocket launcher was not used in combat, no conclusions as to its value can be drawn. There is, however, a need



4.5 Inch Multiple Rocket Launcher T-34



7.2 Inch Multiple Rocket Launcher M 17

for a rocket launcher, mortar, or other weapon specifically designed for the purpose of destroying fortifications, pillboxes, walls, and for other demolition work, mounted in or on a heavily armored vehicle and capable of being fired from within the vehicle.

Bibliography

Chapter 8

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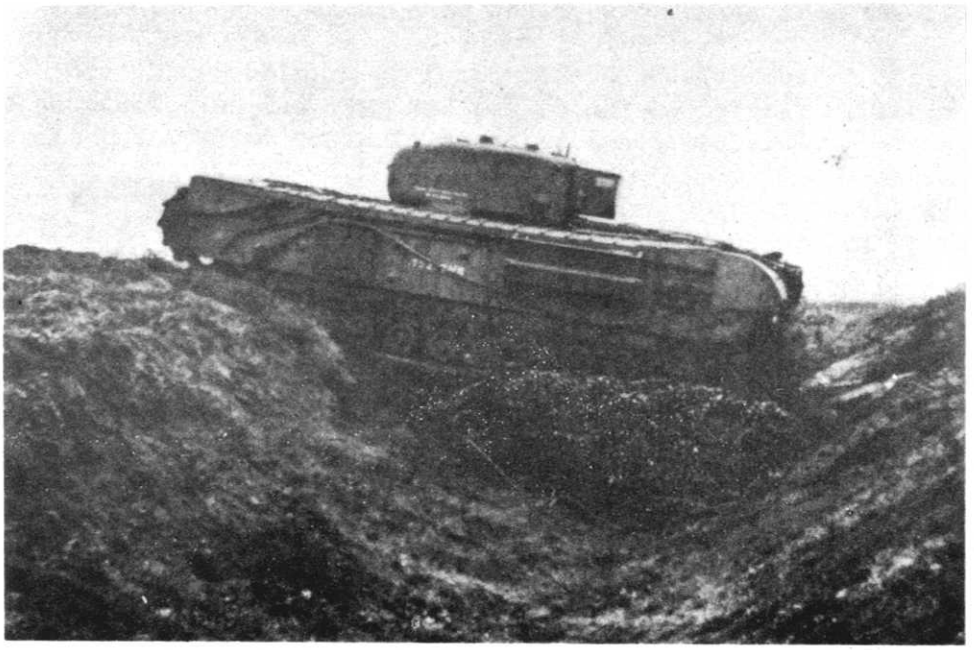
Chespale Fascine (8 ft) carried on AVRE



Chespale Fascine used in bridging ditch

CHAPTER 9

ENGINEER ARMORED VEHICLES

54. General. Armored engineer vehicles being constructed on standard tank chasses, and having the general appearance of a tank, are often erroneously called engineer tanks. Through long usage, a tank may be defined as an armored track laying combat vehicle, designed to destroy the enemy by means of its fire power, shock action and mobility. On the other hand, the armored engineer vehicle is designed for purely engineer work, and as such mounts a minimum amount of armament. It is unable to accomplish tank missions effectively and any attempt to use it as a tank will prevent its accomplishing its own job properly.[1]

55. AVRE is basically a British CHURCHILL tank stripped of its gun and stowage. It was designed to carry a crew of six demolition men, together with hand placeable charges. A shaped charge of HE can be projected to a range of 80 yards from a 12 inch spigot mortar installed in the turret. Three armored engineer regiments of the 79th British Armored Division were equipped with 40 AVRE's each.[2] Many additional contrivances for use on the AVRE have been developed. Some of the more successful are noted below.

a. The SBG assault bridge, which mounted on the nose of the AVRE, could carry 40 ton loads over wet and dry gaps up to 30 foot span, or scale sea walls. It could alternatively be mounted on a trailer and towed.

b. The Fascine, a 7 foot diameter bundle of chestnut paling, could also be carried on the AVRE and dropped in ditches, craters and the like.

c. The Snake and CONGER could be operated from the AVRE.

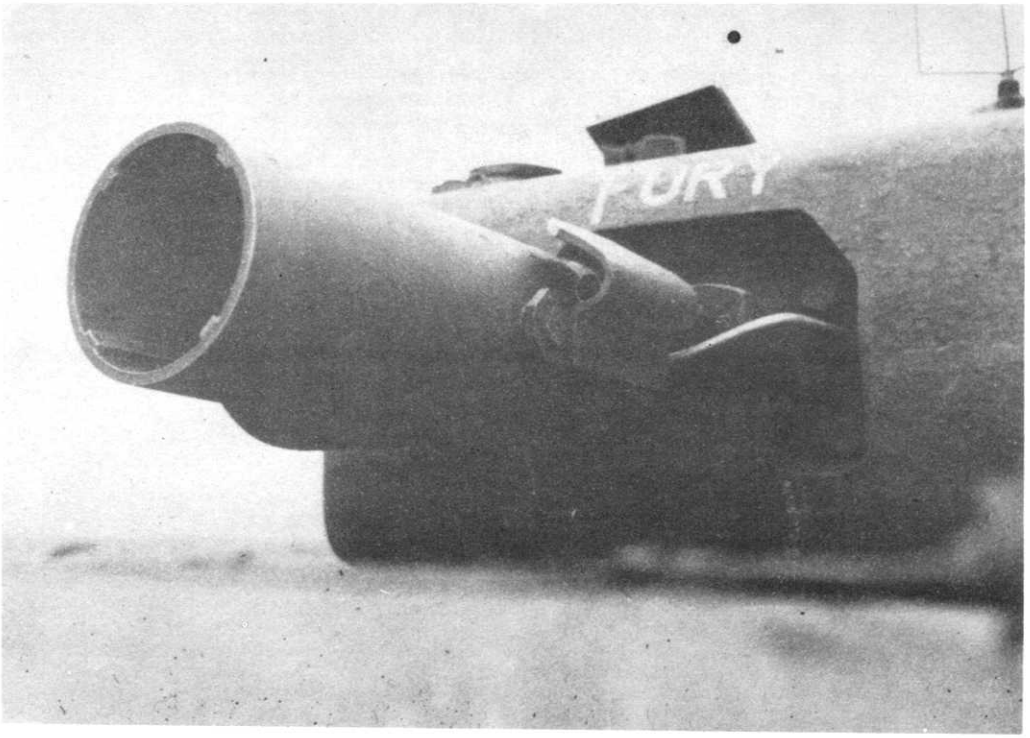
d. The Bobbin, a 70 foot roll of pre-fabricated matting, could be mounted on the AVRE and rolled across patches of boggy ground to permit the AVRE to cross, followed by other vehicles.

e. The Skid Bailey, consisting of a 60 foot Bailey (pre-fabricated truss bridge) mounted on skids, could be pushed by an AVRE to the place required.

56. Bridge Laying Tanks. In addition to the bridging devices covered in paragraph 2 above, the British developed the ARK. This consists of a CHURCHILL tank with the turret removed and trackways installed along the top of the hull. By placing itself in the ditch or other depression requiring bridging, the ARK could thus provide a 54 foot span, other vehicles simply running over the ARK. There was no U. S. counter-part to this vehicle.

57. Engineer Armored Vehicle (US).

a. The requirement consists of a tank of the medium series currently used by the armored units and modified to adapt it to engineer requirements. The modification should consist of installing a hull door in each side and removal of the gun and mount and ammunition racks to provide stowage for demolitions and other engineer equipment. It should have sufficient space inside the hull to accommodate a crew of six men and 1200 pounds of explosives, and should have the following attachments:



"Petard" (Spigot Mortar) mounted on AVRE

"Flying Dust Bin", 20 lb. charge fired from Petard

(1) A launcher for projecting charges capable of reducing walls, pillboxes, and barricades. It should throw a 30 pound demolition charge up to a distance of 300 yards and be designed so the charges can be loaded and fired from within the vehicle without exposing the crew.

(2) A dozer blade for clearing paths through rubble, repairing approaches and paths through natural and artificial obstacles and other missions requiring a dozer under fire. The dozer should have attachments for placing prepared charges against walls and other obstacles and provisions should be made for attachment of removable teeth to the blade for use in mine removal.

(3) Attachments to permit it to mount, when required for special missions, a short span bridge and a rocket launcher.

(4) Snake pushing and pulling attachments.

b. The engineer armored vehicle modification kits, consisting essentially of the modifications listed above, did not arrive in the European Theater in time to be installed and used in combat. It was intended that the armored engineer vehicle be included in the Medium Tank Battalion (Special) (Mine Exploder) and in the Engineer Battalion of the Infantry and Armored Divisions.

c. The military characteristics of the Engineer Armored Vehicle are those described in Inclosure Number 6-0 of the Report of Army Ground Force Equipment Review Board (Engineer Armored Squad Vehicle) and meet the initial requirements.

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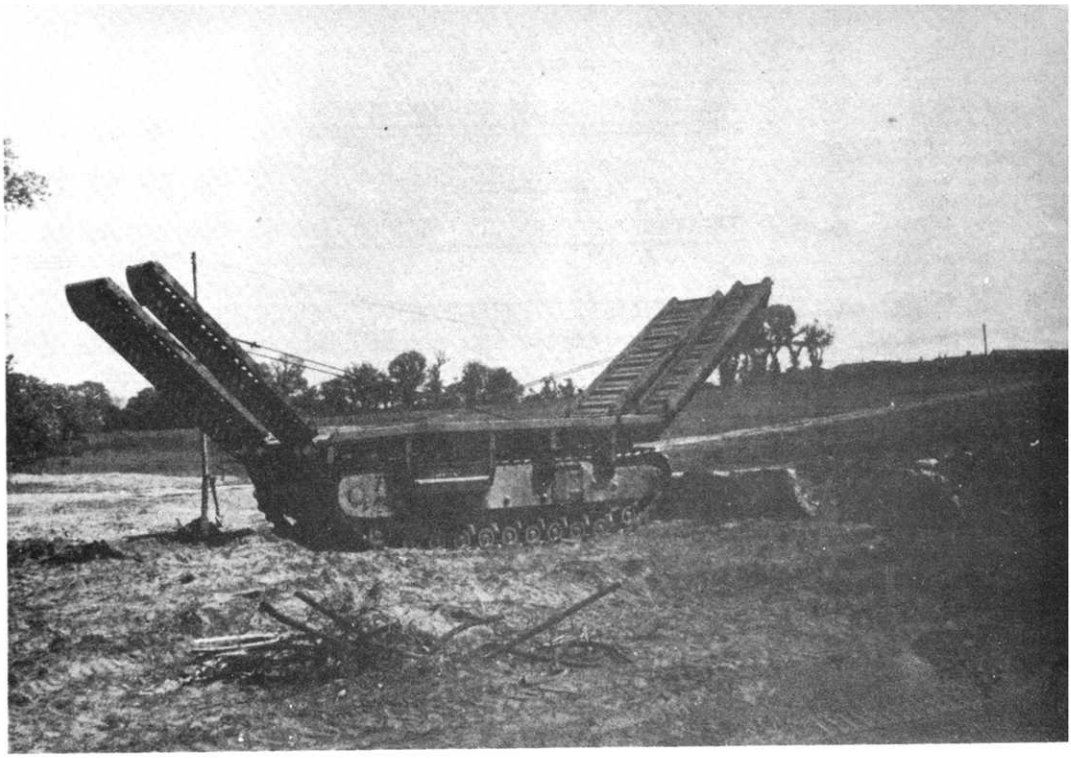
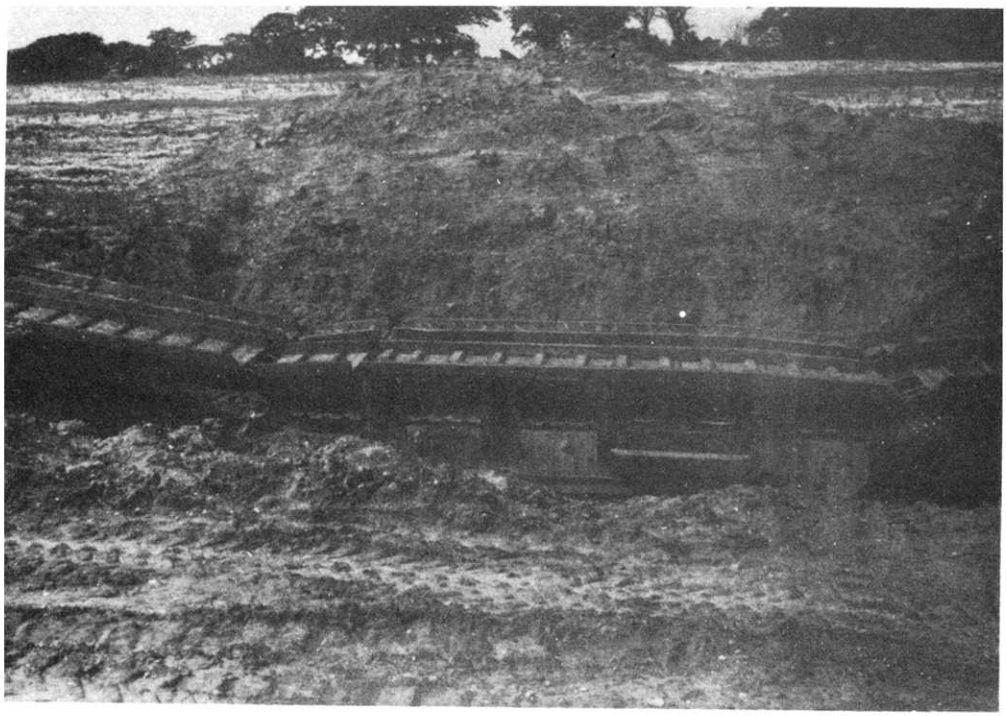


ARK, Traveling Position



ARK, Bridging Ditch

CHAPTER 10

SPECIAL EQUIPMENT ORGANIZATIONS

SECTION 1

U. S. AND BRITISH ORGANIZATIONS

58. Two methods of introducing special equipment were tried. In the British Army the 79th Armored Division was created to train the operating personnel, supply and maintain the equipment. In the U. S. Army the special equipment was at first superimposed on the existing combat organizations. Later, conventional tank battalions were converted to special equipment battalions.

59. U. S. Battalions.

a. The need for a special equipment battalion, to operate mine exploders and other type special armored equipment commencing to arrive in the theater, having become apparent, the 12th Army Group, on 6 August 1944 requested approval of the reorganization of three of the six CDL battalions into special equipment battalions. This was approved by SHAEF on 5 September. Due to the possibility of jeopardizing the security of the CDL by this move, approval by the British was requested and obtained.[1] Accordingly, on 24 September 1944, Headquarters European Theater of Operations directed Commanding General, United Kingdom Base to reorganize and train under the 9th Armored Group two Tank Battalions, Special, as Special Equipment Battalions. Although the 12th Army Group had recommended that each of the three letter companies be organized identically, each with a platoon of five tank dozers, a platoon of five T1E3's and a platoon of three CRABS and three T1E1's, Headquarters European Theater of Operations directed that each battalion contain one company of 18 T1E1's and two companies of 12 T1E3's and six dozers each.[2]

b. The 738th and 739th Tank Battalions (Special) were selected for conversion and on 24 November 1944 were assigned respectively to the First and Ninth U.S. Armies.[3]

c. On 27 December 1944 the Commanding Generals, First and Ninth U.S. Armies were directed to submit recommendations regarding the T/O & E to be adopted for Medium Tank Battalions, Special (Mine Exploder).[4] The recommendations of the two armies based on operational experience were as follows:[5]

FIRST U.S. ARMY

(1) Bn Hq & Hq Co

(2) Companies A, B, C, each having

(a) Co Hq

(b) 2 Tank Platoons each consisting of 2 T1E1's, 2 T1E3's, 1 Tank Dozer, 1 Fighter Tank

(c) 1 Support Tank Platoon consisting of 1 T1E1, 1 T1E3, 2 Tank Dozers, 1 Fighter Tank

(3) Service Company

NINTH U.S. ARMY

(1) Bn Hq & Hq Co

(2) Companies A, B, C, each consisting of

(a) Co Hq

(b) 2 Mine Exploder Platoons each consisting of 4 T1E3's.

(c) 2 Mine Exploder Platoons each consisting of 5 Sherman Crabs.

On 27 May 1945, Headquarters 12th Army Group forwarded the recommendation of the two armies which had utilized the mine exploder battalions and recommended that consideration be given to the organization of mine exploder battalions on the basis of one per field army, each battalion to consist of three balanced teams. The mission of these units was not only to include minefield clearance but also the attack of certain fortified areas requiring the individual or combined employment of mechanized mine exploders, engineer tanks, tank dozers, demolition snakes, special demolition parties, flame thrower tanks and such other special armored equipment as may be developed.[6]

60. 6638th Engineer Mine Field Clearance Company (Provisional). This unit was activated as the 6617th Engineer Mine Field Clearance Company on 21 August 1943 in the North African Theater of Operations, and was redesignated 6638th Mine Field Clearance Company on 1 November 1944 in the European Theater. The equipment varied with availability and requirements. It consisted, at various times, of tank dozers, mine exploders T1E1, T1E3, and flails, an improvised bridge laying vehicle consisting of a tank recovery vehicle M32 with welded brackets carrying a bridge suspended from the front, and a modified CHURCHILL tank with a small box girder bridge. The Company contained seven officers and two hundred nineteen enlisted men and was so organized that it could be broken down into detachments. One detachment normally was attached to each corps, where it operated under the Corps Engineer, usually further attached to an engineer unit of the corps. It was disbanded 18 August 1945.

61. British Units.

a. In April 1943 it was decided by the British to concentrate all their specialized armor in the 79th Armored Division in order to aid in the development and employment of this type of equipment and to advise on its use. At the conclusion of the campaign the equipment had included Flails, CROCODILES, AVRE's, DD's, Buffaloes, Kangaroos, and CDL's. The 79th Divisional organization is shown in Appendix 2. Throughout the campaign various sub-units of special equipment were allotted to corps and divisions as required. Specific examples are given elsewhere.[7]

b. During the campaign in Northwest Europe, units of the 79th Armored Division supported in action, at various times, the following United States Army units:

2nd Armored Division
5th Armored Division
29th Infantry Division
75th Infantry Division
78th Infantry Division
79th Infantry Division
84th Infantry Division
102nd Infantry Division
17th Airborne Division
82nd Airborne Division

SECTION 2

FUTURE REQUIREMENTS

62. Types - It appears likely that future developments will involve a greater variety of special armored equipment than has been seen heretofore. There is no present means of predicting the types that may be developed in the future or the trends that may arise. Present indications are, however, that they will fall into the following categories:

a. Amphibious vehicles, capable of fighting either afloat or on land, and companion cargo vehicles.

b. Support vehicles, such as mine exploders, bridge layers, and demolition vehicles. These may also be classified as engineer armored vehicles.

c. Special fighting vehicles such as flame thrower tanks.

d. Night fighting tanks, such as the CDL.

e. Other secret equipment, whose security classification requires a special organization for its employment.

63. Special equipment, when issued, must either be absorbed by existing organizations or special units must be organized for its employment. Prior to superimposing an item of special armored equipment on the T/O & E of a standard unit, the following must be determined:

a. Does the item change the tactical capabilities of the unit sufficiently to require a change in the doctrines in which the unit has been trained?

b. Does the item reduce the mobility of the unit?

c. Will the item be required a sufficient percentage of the time to warrant inclusion in the Tables of Equipment?

d. Is the item such that operating personnel can be readily trained in its use in a short period of time?

In general it will be found that armored special equipment will be more effectively utilized in combat when employed by special equipment organizations especially trained in its operation and employment. Appropriate teams or sub-units of the special equipment organizations are then sub-allotted to tactical units when required for specific operations. Those items found desirable for universal issue, such as the tank dozer, should be included in the Tables of Equipment for all units requiring them. Provision must be made for general issue of those items required for successful combat in specific localities, such as the Normandy Hedge Buster for use in hedgerow country.

64. Improved models of standard weapons must not be included in the same category with armored special equipment. An organization well trained in the operation and employment of a weapon requires only brief familiarization training with the improved model of the same weapon. For example, light tank units trained and equipped with the M5A1 light tank were able to assimilate the M24 light tank without difficulty and with minimum familiarization training.

65. Organization for Peace.

a. In order to further peace time development of special

armored equipment it is highly desireable that a Special Equipment Headquarters be established, at Fort Knox, Kentucky, to command such special equipment organizations that may be required for the employment of the items currently developed. It should be the function of this headquarters, in conjunction with the Armored School and the Armored Board, to test, tactically and operationally, items of armored and self propelled special equipment, regardless of the arm or service ultimately to employ the items, and to further the development of new items. This headquarters and its assigned units should be specifically charged with the following missions:

(1) By participating in maneuvers, tactical exercises and problems, to test, tactically and operationally all items of special armored equipment, and to formulate tactical doctrines and technique of employment.

(2) To assure security of secret items which cannot be issued for general use.

(3) To establish requirements for new items of armored special equipment.

(4) To recommend Tables of Organization for units employing special equipment.

(5) To determine whether particular items of special equipment are suitable for general issue or for employment only in special units.

(6) To become the nucleus of the organization for employment of special equipment in combat.

b. Considering only the equipment which was actually employed in the European Theater, or was known to have been developed prior to the cessation of hostilities, suitable units are required for the employment of each of the following classes of special equipment:

(1) CDL tanks, night fighting and infra-red equipment, and such secret equipment as may be developed.

(2) Amphibious tanks and tractors and such tank floating devices as may be developed.

(3) Mine exploders of all types, flame throwers, engineer armored vehicles, bridge layers and similar equipment.

66. Organization for Combat.

a. Immediately upon outbreak of hostilities, the headquarters, special equipment troops augmented as required should be dispatched to the Theater of Operations, where it will assume, under the Theater Commander, command of all special equipment units organized or to be organized. In addition, it will assume the following functions:

(1) Make appropriate recommendations to tactical commanders concerning the employment of special equipment units.

(2) Effect attachments of special equipment units as directed.

(3) Through careful study of the terrain and the enemy

defenses and equipment, develop, or recommend for development, special equipment for specific missions.

(4) Continue experimentation and testing of items developed in the theater and submit recommendations to higher headquarters concerning their production and issue.

b. It is essential that any units equipped with secret combat equipment also have included in their organization the necessary close support units and service elements, in order that they may be ready for immediate employment without the necessity of withdrawing conventional combat units from the line for familiarization or training with the new equipment.

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Chapter 10

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7. 79th Armored Division Final Report.

CHAPTER 11

CONCLUSIONS AND RECOMMENDATIONS

67. Conclusions.

a. Combat experience in the European Theater substantiated the requirement for the following types of armored special equipment:

(1) Mine Exploders.

(2) Amphibious tanks and tractors.

(3) Mechanized flame throwers.

(4) CDL Tanks and similar and allied night fighting equipment.

(5) Engineer armored vehicles, including bridge laying vehicles.

(6) Tank dozers.

b. The requirement for the following types of armored special equipment was not substantiated by the combat experience of the European Theater:

(1) The DD device.

(2) Multiple anti-personnel rocket launchers mounted on standard tanks.

c. The lack of units especially trained in the use of armored special equipment hampered the employment of this equipment by United States Forces.

d. The 79th Armored Division (Br) provided the 21st Army Group with properly trained personnel accompanying armored special equipment, and also served to assist in the development of new special equipment and tactical doctrine pertaining to its employment.

e. There is a requirement, in an active theater of operations, for a Headquarters, Special Equipment Troops, with the necessary units, for the employment and continued development of armored special equipment.

f. There is a peacetime requirement for a Headquarters, Special Equipment Troops, in order to further, in conjunction with the Armored School, the development of armored special equipment, the formulation of tactical doctrine, and the training of troops in its use.

g. The peacetime special equipment headquarters must be so organized that upon outbreak of hostilities it can be displaced, in whole or in part, and augmented as required, to an active theater to command such special equipment units as may be currently organized or organized later.

68. Recommendations.

It is recommended that:

a. The development of armored special equipment be continued with particular emphasis placed on the development of satisfactory

equipment in the following categories:

(1) Mine exploders for:

(a) Breaching located mine fields.

(b) Expeditiously detecting and/or clearing scattered mines on roads and trails.

(2) Amphibious tanks and tractors.

(3) Mechanized flame throwers.

(4) CDL and other night fighting tanks and allied equipment.

(5) Engineer armored vehicles, including bridge layers.

(6) Dozer blades for all types of standard fighting tanks.

b. No further consideration be given to the development or employment of:

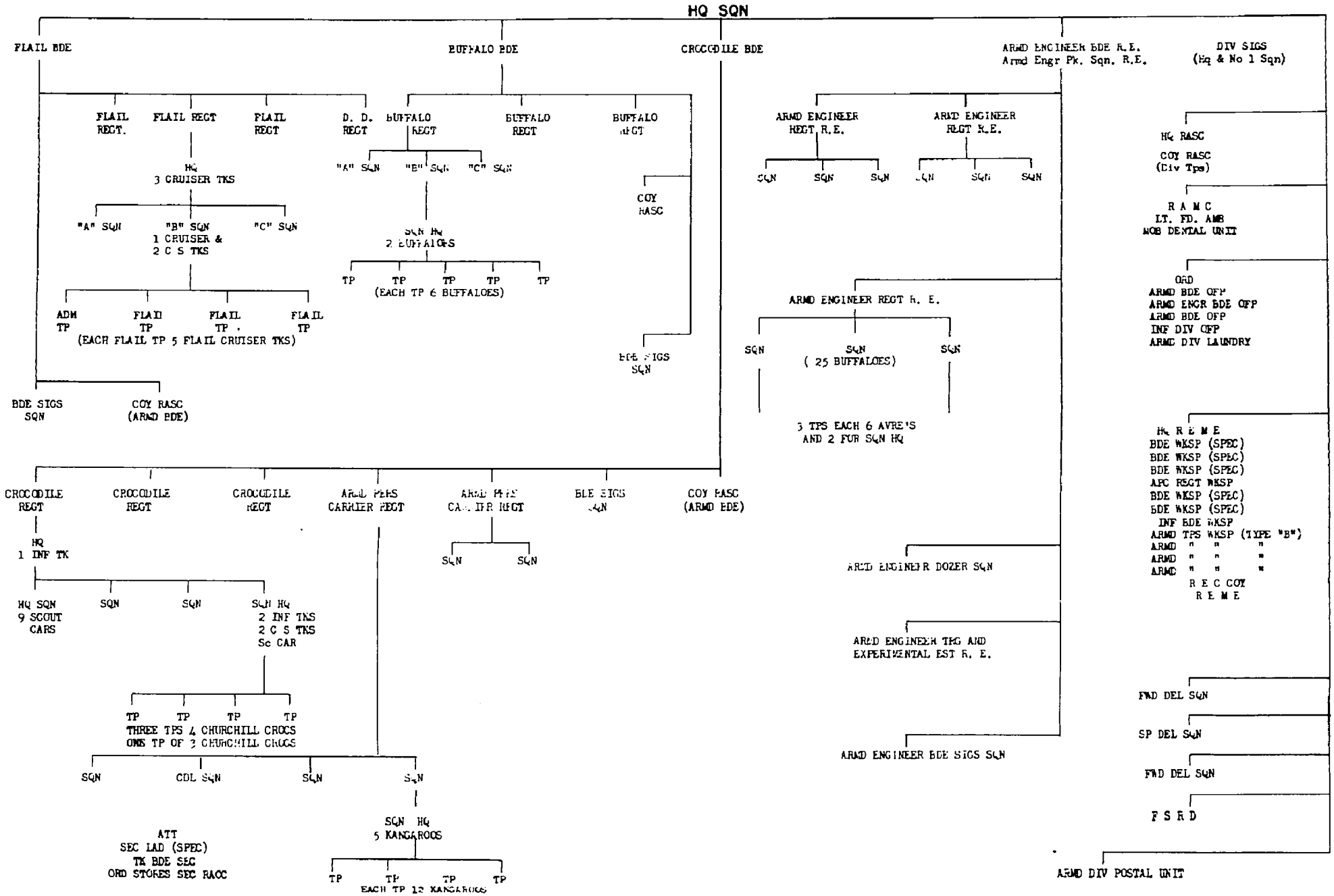
(1) The DD device.

(2) Rocket launchers mounted as additional equipment on standard fighting tanks.

c. A Headquarters, Special Equipment Troops, with the necessary units, and with the function essentially as outlined in paragraph 65, Chapter 10, be organized at the Armored School.

SKELETON ORG OF 79 ARMD DIV

HQ ARMORED DIV



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COMBAT OBSERVER
12th Army Group
Headquarters VIII Corps

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REPORT NO 13

EMPLOYMENT OF CROCODILE (FLAME-THROWING) CHURCHILL TANKS IN ATTACK ON FT. MONTBAREY NEAR BREST, FRANCE.

1. Squadron B, 141 Regt. Royal Armored Corps, equipped with 15 crocodile (flame-throwing) Churchill Tanks and 4 Gun and command Churchill Tanks, was employed on 14 and 16 September in support of the attack of 1st Battalion, 116th Infantry, 29th Division on Fort Montbarey, defending a western approach to Brest, France. The action was probably the first employment of this equipment in support of U. S. Forces. Training exercises in infantry - flame thrower tank coordination were conducted prior to the operation. (See Operation Memo. Number 18, Hq 29th Inf. Div. dated 14 Sept. 44 Encl. No. 2)

2. Situation: Montbarey is an old French casemented fort with earth-filled masonry walls about 40' thick surrounded by a moat approximately 40' wide and 15' deep, with outlying defenses of 20mm guns and rifle positions sited along a sunken road 100-200 meters to the northwest protecting a mine field, of 300 lb. naval shells equipped with pressure igniters located N and W of the road. 1st Bn., 116th Inf. had succeeded in infiltrating as far as the sunken road and around the western side of the fort, but the enemy garrison estimated at 200 to 250 defended stubbornly. (See marked air-photo of Ft. Montbarey and vicinity Encl No. 3)

3. Mission: On 14 September, 1st Bn. 116th Inf. (less Co. A) supported by 1 platoon of Engineers, 1 platoon 4.2 in. Chemical mortars, 3 - 76mm TD (SP) M-10, and RAC Tank Squadron was ordered to attack with a mission of reducing the fort.

4. Narrative: a. The engineer platoon under cover of mortar smoke swept and taped a tank lane through the mine field suffering casualties of 1 killed and 1 wounded. Co. C, 116th Inf. held positions along the sunken road and to W of fort.

b. At 141645 the initial attack was launched from a Tank assembly area 800 m NW of the fort, Co. C remaining in line about the fort while Co. B accompanied 3 Flame Tanks moving in column from tank assembly area, Engineer platoon in reserve. 4 Gun Tanks (including the command tank), and 3 - 76mm TD (SP) M-10 fired in support. Mortar platoon maintained a smoke screen E of the fort to prevent hostile observation and support. No enemy artillery action was observed. 50 lb. demolition charges were carried by about 6 infantry men. Weather and visibility: excellent.

c. First flame tank reached the sunken road and successfully flamed the fort until fuel was exhausted then supported the infantry attack with 75mm and machine gun fire. It was hit in motor by 20mm shell without effect, but subsequently dropped into a well camouflaged concrete emplacement 10' deep and was disabled. No casualties. Second flame tank struck a mine - rt. track was blown, driver killed and remaining 4 of crew injured. Third flame tank by-passed the second after engineers had cleared a lane, reached the fort about 1800, but did not get into a suitable position for flaming. A 75mm gun tank struck a mine and had its turret blown off - 2 killed, 3 not seriously wounded.

d. Engineer platoon was committed as an infantry reserve. Co. E (made available by Regt. CO) was used to assist in holding a ring about Fort for night, and engineers withdrawn. 2 Gun tanks were employed in close support and 3 additional flame tanks were held in

reserve, but not employed. Attack was suspended. Tank results reported by Tank Bn. CO: 2 - 20mm guns knocked out, 2 Infantry strong points reduced - outside the main fort.

e. On 15 Sept. the engineers further improved the tank lane and prepared demolition charges totaling 2000 lbs. to fill the moat and breach the fort.

f. On 16 Sept. the attack was renewed with 2 rifle companies in assault and 1 in reserve. At 1030 3 flame tanks went into the edge of the moat and flamed into the moat and over the fort wall until fuel was exhausted.

g. At 1300 3 flame tanks attacked with a support tank firing HE at the fort gate - 3 prisoners came out. At 1500 3 flame tanks moved into position and covered the filling of the moat and breach of the fort wall by engineers. Meantime a 105 howitzer of the cannon company was placed in position to fire at the main gate from a range of about 200 yards and created a breach with about 200 rds. Tanks flamed until fuel was exhausted - one going into the moat to flame the sides of the fort. Smoke from the flames provided an excellent screen for the engineer and infantry operations. After exhausting fuel, tanks remained in position throwing WP hand grenades to cover the final assault by engineers and infantry through the breaches. The fort capitulated at 1700.

5. RESULTS:

a. Inspection of the fort on 17 Sept. showed: walls of fort extensively seared on three sides, flames had penetrated and burned out one casemate within fort. Trees around strong points outside moat extensively burned.

b. Moat had been filled and fort wall breached by engineer demolition; main gate breached by 105mm fire. There were several bomb craters about 15 feet in diameter and 10 feet deep in the center of the fort and outside the moat. In one case a bomb or shell had penetrated a casemate.

c. Prisoner of war interrogation indicated that flame-throwing tanks materially reduced the will of the garrison to hold out - several cases of Germans being burned alive were reported. 80 prisoners were taken in the fort.

d. Commanding General, 29th Division attributes the final capitulation to the infantry assault assisted by engineers.

e. CO, 116th Inf. believes that the flame-throwing tank is a very useful weapon, but possesses some limitations.

f. Officers of the tank squadron describe the terrain as the most difficult and heavily mined which they have encountered.

g. CO, 1st Bn. 116th Inf: "Every arm and service employed was needed. Each contributed its part to the operation. The tank battalion officers were very cooperative and crews brave and it was a pleasure to work with them. My officers and men had confidence in the weapons and in the crews operating them. My infantry casualties for the entire operation were about 80. Flame-throwing tanks would have been a great value in the first 25 miles of hedge-row country after we landed in Normandy. Their principal limitation was the heavily mined terrain."

h. CO, Squadron B, 141 Regt. RAC: "If flame equipment is installed in U. S. Tanks the 75mm should be retained as well. It gives tremendous moral effect to crew by furnishing a means of destroying AT Guns which open up at close range."

6. Special Materiel Employed:

a. Flame tanks - 5 troops of 3 tanks each.

Tank tows an armored trailer containing 400 gallons of petroleum fuel and 5 nitrogen tanks under 2500 lbs/sq. in. pressure to force fuel through tube to tank and project about 80 yds. in front of tank. Ignition by electric spark. 120 to 160 1 - second bursts fired by gunner seated to left of driver - aiming with telescope sight.

Other armament: 1 - 75mm gun.
1 - 7.92 mm machine gun.
1 - 2" Smoke mortar.

Support Tanks - 1 troop of 4 tanks - 2 with 95mm guns (anti-personnel fire only)

2 with 75mm guns capable of firing smoke, shell and APC (same as medium tank, M4 series)

Other armament: 2 - 7.92mm machine guns.
1 - 2" Smoke mortar.

b. All tanks are equipped with 4 smoke generators in tail to cover withdrawal, Bren gun for AA fire, 6 - HE grenades and 6 - WP hand grenades.

Individual arms: Pistols and sten guns.

7. Communications: All tanks carry 4 radios.

(1) "A" Set for regt and squadron communication.
(2) "B" Set for communication within Troops.
(3) An inter-communication set from driver to tank commander
NOTE: These three sets are inter-connected so tank commander can hear all three.
(4) An infantry communication set (Br) Type 38 - does not fit wave lengths used by U S Infantry. Infantry Battalion commander and Tank Bn. CO employed the command tank radios in initial attack to communicate with tanks and infantry through the tank commanders.

/s/ F.W. WILKINSON
Col., F.A.
Combat Observer

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TANK DITCH
SUNKEN TANKLANE
FORT KERANROUX
TANK ASSEMBLY AREA
SUNKER ROAD
116
BREACH IN WALL, MOAT FILLED
MAIN GATE
FORT MONTBERY
GERMAN STRONG POINT
TANK DITCH
LA TRINITE
Fort du Portzic