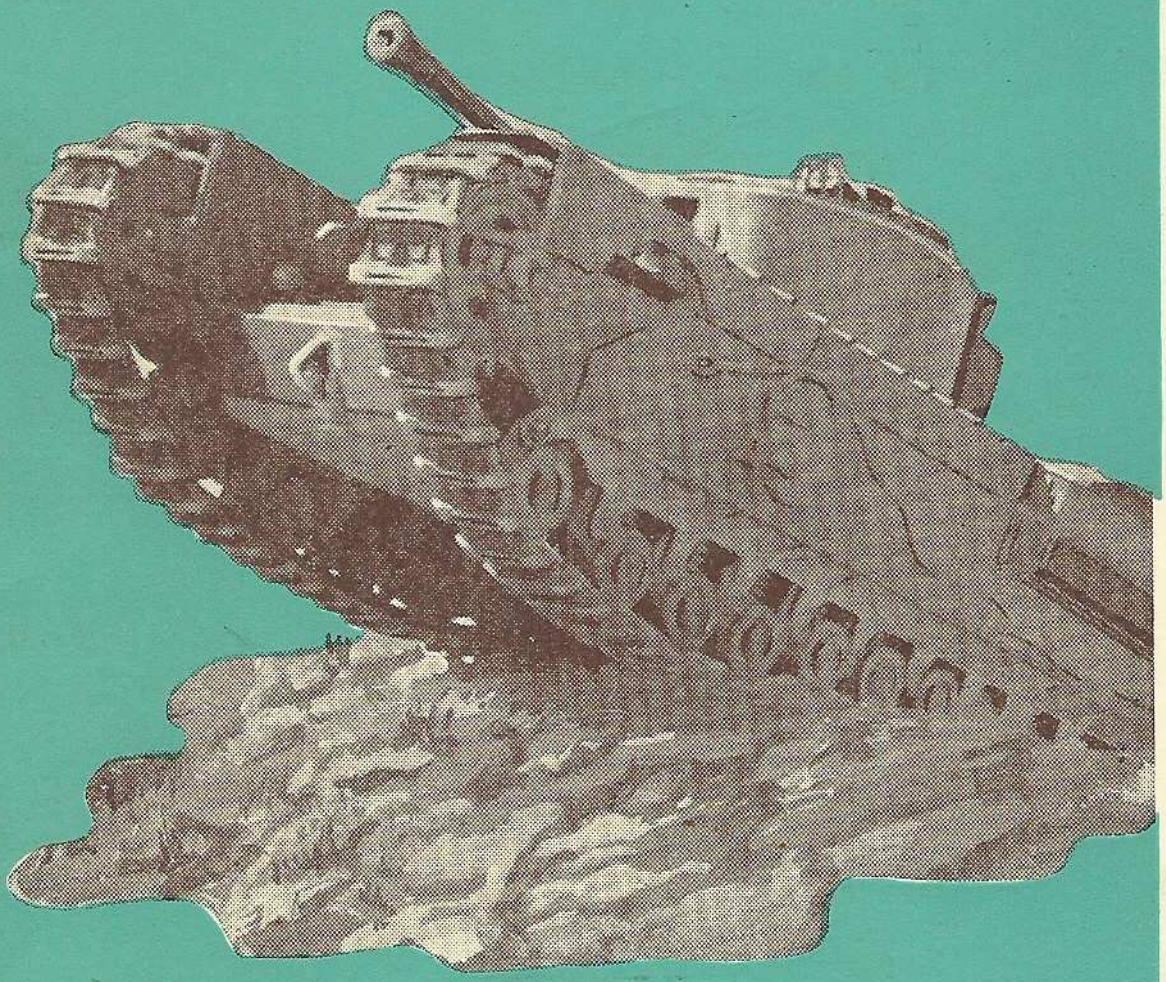


THE

ROYAL ARMOURED CORPS TANK MUSEUM

BOVINGTON : DORSET

AN ILLUSTRATED RECORD OF THE DEVELOPMENT OF THE BRITISH ARMOURED FIGHTING VEHICLE

●

TANKS
1940 - 1946
The
Second World War

●

WITH A SUPPLEMENT ON AMERICAN AFVs USED BY THE BRITISH

●

PRICE
TWO SHILLINGS
AND
SIXPENCE

The following publications are on sale:—

"TANKS, 1915—1918: The First World War."

"TANKS, 1919—1939: The Inter-war Period."

"TANKS, 1940—1946: The Second World War."

"ARMOURED CARS, 1900—1945."

"TANKS OF OTHER NATIONS."

These booklets are an illustrated record of the development of the armoured fighting vehicle. The booklets may be purchased singly or as a set.

Every effort has been made to ensure the accuracy of the information given, but the Curator would welcome particulars of any inaccuracies which have unknowingly been included.

The address to which all communications should be sent is:—

THE CURATOR,
ROYAL ARMOURED CORPS
TANK MUSEUM,
BOVINGTON CAMP,
WAREHAM, DORSET.

THE
ROYAL ARMOURED CORPS TANK MUSEUM

The Second World War 1940-46

Second Edition 1965
Third Edition 1967

ROYAL ARMOURED CORPS CENTRE
BOVINGTON : DORSET

© 1956: Royal Armoured Corps Tank Museum

CONTENTS

THE WAR YEARS .. .. Page 3

CRUISER TANKS .. .. Page 6

INFANTRY TANKS .. .. Page 11

AMERICAN TANKS used by British troops .. .. Page 16

SPECIAL PURPOSE AFVs:—

- AIR PORTABLE TANKS .. .. Page 21
- AA TANKS .. .. Page 21
- AMPHIBIOUS TANKS AND VEHICLES .. .. .. Page 23
- MINE SWEEPING TANKS .. .. Page 26
- FLAME THROWING TANKS .. .. Page 27
- BRIDGELAYING TANKS .. .. Page 28
- C.D.L. TANKS .. .. Page 31
- ARMOURED PERSONNEL CARRIERS .. .. .. Page 32
- ARMOURED RECOVERY VEHICLES .. .. Page 33
- SELF-PROPELLED GUNS .. .. Page 35

COMPARATIVE AND CHRONOLOGICAL TABLE OF TANKS 1940—1946 .. .. Page 36

COMPARATIVE AND CHRONOLOGICAL TABLE OF GERMAN TANKS .. .. Inside back cover

The war years

THIS book describes the tanks and special purpose vehicles which were developed during the Second World War under four main headings: chronological tables for British and German tanks are also included.

In spite of attempts to increase the pace of re-equipment of the Army the outbreak of war in 1939 found us weak in armour. There were enough Infantry tanks Marks I and II to equip 1st Army Tank Brigade: their immunity to hostile anti-tank fire gave them liberty of movement on the battlefield of which they took full advantage particularly at Arras, although their slow speed and limited track endurance coupled with the shortage of transporters made movement difficult.

Cruiser tanks had begun to reach the Army in 1938 in limited numbers. The earlier versions were not particularly reliable and trouble was experienced with the power traverse and the gun mounting. Deficiencies in cruiser tanks were made up by the use of light tanks which were withdrawn from service in 1940/41. Some of these were later modified for use as AA tanks with special turrets mounting either two heavy or four light machine guns but with the exception of airborne vehicles, light tanks have not been built for the British Army since the light tank Mark VI series.

Crusader was followed by Cavalier and Centaur cruiser tanks. Except for a few Centaurs armed with 95mm. howitzers and used by the Royal Marines in N.W. Europe, neither these nor Cavalier tanks were in action. With a Liberty engine they were under powered and were only used in a training role.

Cromwell, which appeared in 1943, was the first cruiser tank to be fitted with the Rolls Royce 600HP Meteor engine and the Mark IV version with a 75mm. gun was used by armoured brigades in N.W. Europe. The upgunned version of this tank, mounting a 17-pr. (Challenger) also saw service.

The Comet, with heavier armour and an extremely accurate 77mm. gun, was produced just in time to take part in the 1945 operations in Germany. This tank remained in service up to 1954 and marks the transition from the cruiser/infantry tanks to the universal tank typified by Centurion I. This appeared in 1946 with a 17-pr. gun and was replaced by later Marks mounting a 20-pr. in a stabilised mounting.

Infantry Tank Mark IV, the Churchill, first appeared in 1941. This was a large tank heavily armoured: Mark I was armed with a 2-pr. and a 3-in. howitzer between the horns but this was soon replaced by a Besa machine gun. Later Marks were upgunned to 75mm. and uparmoured while an experimental tank, Black Prince, based on Churchill components, was to mount a 17-pr. gun but never came into production.

The British Army used American tanks extensively; Stuart, Grant, Lee, and Sherman, and the upgunning of the Sherman to a 17-pr. by the British went far to reducing the superiority of the Germans in the gun/armour race.

The beginning of the war found British tanks excluding light and close support types armed with the 2-pr. gun. This was a relatively high velocity accurate shot firing weapon whose theoretical performance proved disappointing in practice because the shot broke up on German face hardened armour. The 6-pr. with an improved performance did not radically alter the situation, primarily because solid shot was ineffective against entrenched positions. Squadrons of cruiser and infantry tanks each had two Close Support tanks on their H.Q., mounting a 3-in. and later a 95mm. howitzer, principally to give cover for manoeuvre by firing smoke, although HE rounds were also carried.

American observers working with the Germans before Dunkirk saw and appreciated the value of the dual purpose weapon which became a prime requirement when American tank production got under way. It is only just to say the need for a larger gun was continually stressed by British armoured forces from the opening days of the war but the problems of production and installation presented great difficulties to a country whose resources were as stretched as ours were at that time. The 75mm. gun revolutionised tank gunnery and its introduction is America's most important contribution to tank warfare. It had a good performance against hostile tanks as a shot firing weapon while HE fire could be brought to bear against hostile entrenchments by either direct or indirect laying.

The British version of this gun was mounted in Cromwell and Churchill tanks for the invasion of Europe. A noteworthy conversion was that of 120 Churchills which were fitted with Sherman 75mm. guns for use in Italy.

The War years saw the introduction of an effective communication system within the tank with the introduction of the 19 Wireless set which enabled the commander to direct his driver and select targets for his gunner without the pre-war complication of voice tubes and indicator lights.

This period also saw the development of vision devices for the commander and his crew. These evolved from bullet-proof blocks of glass to rotatable periscopes for all the crew and eventually to a rotatable cupola, with all round vision through episcopes, for the commander: in combination with the blade sighting vane this considerably reduced the time needed to bring down fire on hostile targets.

Local protection for tanks caught under hostile fire was originally provided by 4-in. smoke dischargers on the turret sides. In turn these were replaced by a 2-in. smoke mortar: in addition to this mortar, later cruiser tanks were fitted with a multi-barrelled smoke discharger which laid a curtain of smoke 50 yards ahead and around the tank.

For the assault on the European fortress, a large number of special purpose vehicles were developed. It was first necessary to get tanks ashore and build up armoured strength on the beaches. For this purpose the DD (Duplex Drive) or swimming tank, was designed. This is a normal fighting tank with a canvas screen held up by inflatable pillars, which can be driven in water by twin propellers. The screen was dropped immediately on landing, the propellers raised in order not to interfere with cross-country movement, and a normal fighting tank remained. Valentine tanks were used for training in this rôle and Sherman tanks for operations on the Normandy coast and on the Rhine.

Mines were dealt with by Flails, a Sherman tank fitted with mine sweeping gear. They operated with the Armoured Vehicles Royal Engineers (the "AVRE") which carried the engineer personnel required to demolish obstacles and which mounted the large calibre

Petard mortar capable of breaching a concrete wall. To deal with mud and clay patches on the beaches, armoured vehicles were equipped with a form of carpet which could be unrolled in front of the vehicle from a large bobbin.

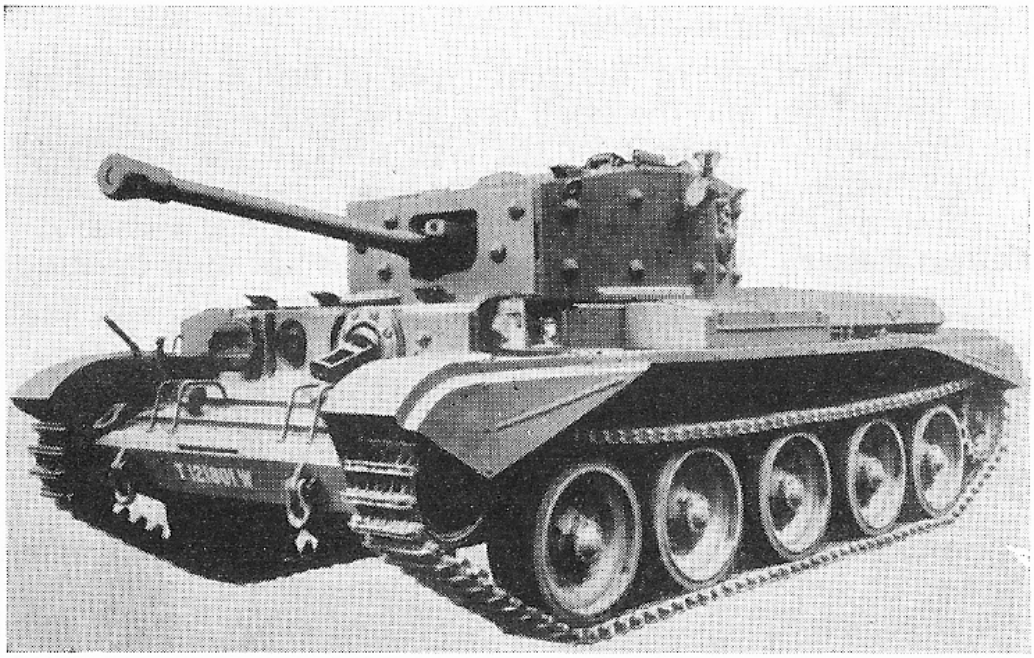
To bridge craters, a variety of different types of bridge were mounted on tanks, including the tank bridgelayer and the small box girder assault bridge. To cross anti-tank ditches, fascines (brushwood bundles), of the type used in the First World War, were dropped by AVRES, while to surmount concrete walls, ramps were mounted on tanks allowing one to climb over the other. A special type of bridge launched by rocket and known as the "Great Eastern" was also designed but was not used operationally.

For this assault also, the flame throwing Mark VII Churchill tank, named the "Crocodile" came into its own, carrying a flame gun with a range of 100 yards and towing a trailer with a fuel capacity of 400 gallons. This vehicle proved most effective against hostile positions once it was within flame range.

We also developed the armoured tank-mounted searchlight known as the "Canal Defence Light", which provides a dazzling beam for about 2,000 yards: the light itself was in the turret protected by an armoured shutter. These special tanks were unfortunately never used in the assault, but small numbers of them took part in the crossing of the Rhine as stationary armoured searchlights when they destroyed many floating mines by gunfire.

Light tanks which can be carried by air have also been developed. The Tetrarch light tank was used with success by the 6th Airborne Division in the landing on D Day: the tank was carried in the Hamilcar Glider and could be unloaded through the nose immediately on landing. The American Locust light tank was also used by the same airborne formation during the crossing of the Rhine.

CRUISER TANKS



Cromwell Mk 7 (1944)

Cavalier (1941)

The first of a new series of cruiser tanks was the A24 Cavalier which was based on the Crusader but incorporated modifications based on battle experience.

The armour was thickened all round to a maximum of about 3-in. from the 2-in. of the Crusader Mk 3. The 6-pr. gun (57mm.) was retained with a coaxial 7·92mm. Besa MG and a hull MG operated by the co-driver. A Nuffield Liberty 12 cylinder engine of 395 BHP was used to give a speed of 24 m.p.h. at 26 tons weight. The track width was increased to 14-in. and Wilson epicyclic steering retained.

Centaur (1942)

The Cavalier was followed by the A27 Centaur which had the same armour and armament, it had the Liberty Mk 5 of 395 BHP to give a speed of 27 m.p.h. and was fitted with Merritt Brown controlled differential steering.

Two further developments of the Centaur were the replacement of the 6-pr. gun by the 75mm. Mk 5 gun, and in a later model, the fitting of the 95mm. howitzer for the close support rôle; the two tanks were known as Centaur Mk 3 and Mk 4 respectively and were fitted with Nuffield Liberty engines. These two marks of Centaur chassis were also used as anti-aircraft tanks and in that rôle had a Crusader Mk 3 AA turret modified to accommodate an extra man, new type of sight, auxiliary engine for powered traverse, and two Polsten 20mm. cannon which were a simplified version of the Oerlikon.

Although engine power had been increased on the cruiser tanks, to maintain their road speed with the greater weight of armour, still more speed was required.

Cromwell (1943)

The Cromwell Mk 1 was the next stage in the development of the cruiser tank. It was fitted with a Rolls Meteor engine of 600 BHP which gave the tank a road speed of nearly 40 m.p.h. at 2,500 engine revolutions a minute; this speed was found to be too much for the suspension, and the final drive ratio was altered to bring the speed down to about 32 m.p.h. A wider track of 15½-in. was used on later marks.

A summary of marks of the Cromwell is as follows:—

Mark	Tracks	Main Armament	Hull	Remarks
1	14-in.	6-pr. with coaxial 7·92mm. Besa MG	Riveted hull	7·92 Besa MG in hull
2	15½-in.	,, ,,	Riveted hull	No MG in hull. Mk 1 with new tracks
3	14-in.	,, ,,	Riveted hull	Centaur Mk 1 with Meteor engine. Besa MG in hull
4	14-in.	75mm. with coaxial 7·92mm. MG	Riveted hull	Hull MG
5	14-in.	,, ,,	Riveted hull	Hull MG
5w	14-in.	,, ,,	Welded hull	Hull MG
6	14-in.	95mm. howitzer with 7·92mm. Besa MG	Riveted hull	Hull MG
7	15½-in.	75mm. with coaxial 7·92mm. Besa MG	Applique armour Riveted hull	Mk 4 with new final drives, tracks and road springs. Hull MG
7w	15½-in.	,, ,,	Applique armour Welded hull	,, ,,
8	15½-in.	95mm. howitzer with 7·92mm. coaxial MG	Applique armour Riveted hull	,, ,,

The Cromwell was used in the liberation of Europe from D-Day onwards and proved itself to be a very reliable vehicle. Difficulty was experienced by drivers in getting out in a hurry when occasion demanded owing to the type of hatch fitted. Finally an outward opening hatch similar to that for the co-driver was fitted. A few Cromwell chassis were fitted with improved suspension, thicker armour and a large turret with a 17-pr. gun; this tank was known as the Challenger.

Challenger Mark 1

Comet (1944)

The COMET was the next development from the Cromwell. The chief changes were that a more powerful gun, the 77mm. Mk 2 was employed and the thickness of the armour increased. The suspension also was improved, the ground clearance increased and the top of the track supported on four guide rollers.

Centurion Mk 1

Centurion (1945)

The next tank in the cruiser series was Centurion Mk I, which appeared in 1945. It had a new suspension, thicker armour and bigger gun.

The frontal armour was sloped to increase protection, while the larger turret carried a 17-pr. gun with a 7·92mm. Besa machine gun in a ball mounting connected to the main armament by linkage which could be disconnected at will; when disconnected, the machine gun was designed to be fired independently of the main firing gear. The prototype tank was fitted with a Polsten 20mm. cannon instead of a medium machine gun.

Ram (1940)

The RAM was a cruiser tank built in Canada for the Canadian Army; its suspension was very similar to that of the American M4 medium. The hull and turret, however, were quite distinctive; the hull was provided with a side door and, in many instances, an auxiliary turret, while the main turret had a flat sloping front face which was screwed to the turret casting. In this front plate was mounted the 2-pr. gun (RAM Mk 1) or 6-pr. gun (in the RAM Mk 2 of 1943) with a coaxial ·30-in. Browning machine gun; another machine gun was mounted in the auxiliary turret, when fitted, or in the hull front plate.

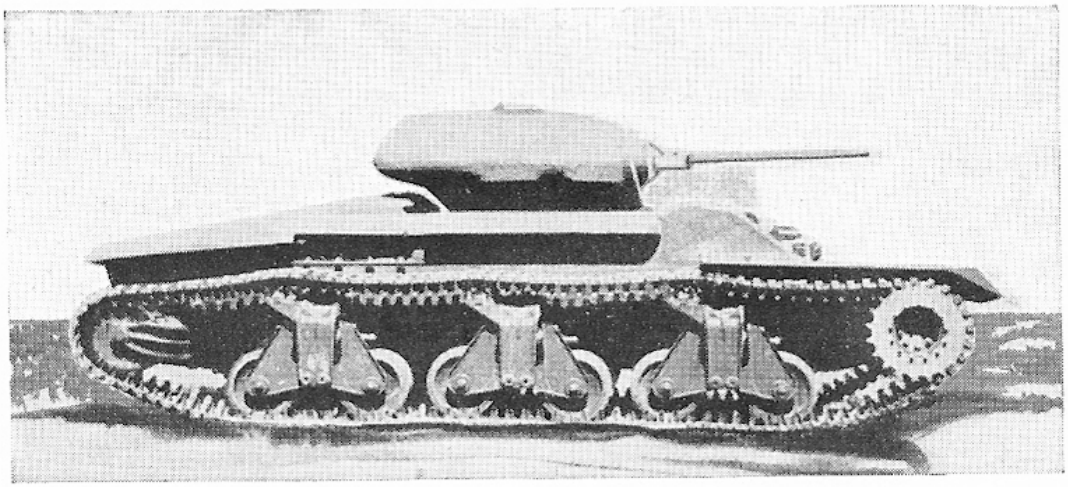
A feature of the tank was the plastic vision blocks provided in the hull and turret; these blocks were bullet proof and could be replaced from spares when damaged. The turret was rotated by hydraulic traversing gear or by hand.

Ram Mk 1

The Australian Cruiser Tank Mk 1 was built in Australia using American transmission and tracks. The hull and turret were of cast armour and the tank was powered by a Perrier-Cadillac engine of 397 BHP.

The suspension was scissor-type with volute springs. The Mk 1 was armed with a 2-pr. gun and coaxial Vickers ·303-in. machine gun in the turret, and another machine gun in the hull.

The Mk 2 was never produced, but the Mk 3 was similar to the Mk 1, with a 25-pr. gun and Vickers machine gun in the turret and carried no hull gun; the Mk 4 was also similar but armed with a 17-pr. gun and coaxial Vickers machine gun.

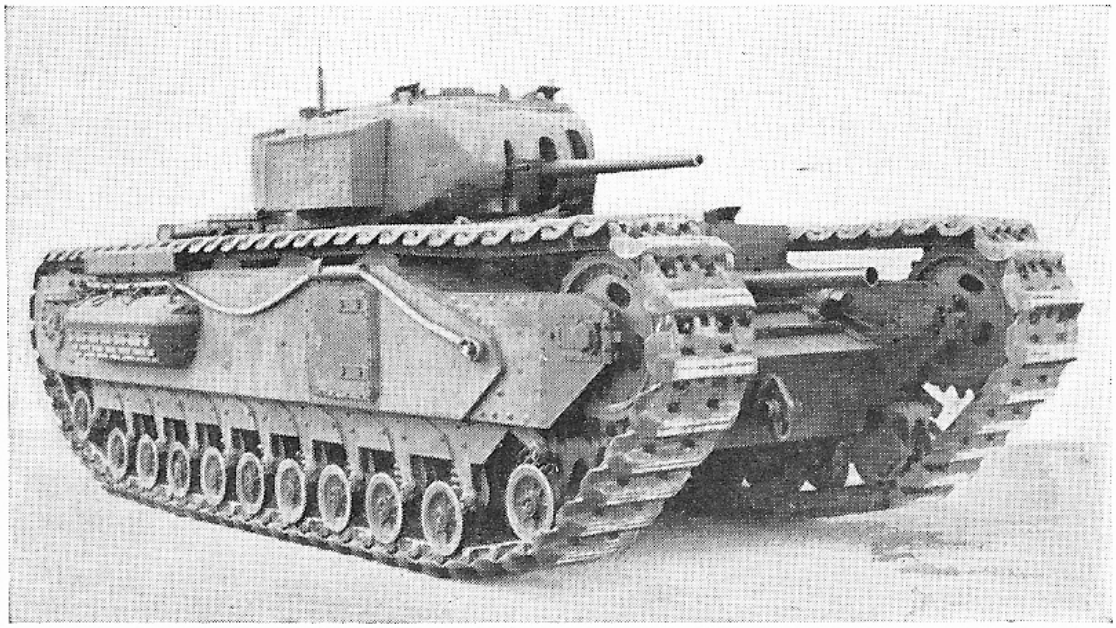


Australian Cruiser Tank Mk 1

Churchill (1941) INFANTRY TANKS

The Infantry Tank Mk 4 (*see* Booklet on Inter-war Period for Inf. Tks Mks 1, 2 and 3) produced in 1941, was named Churchill, a most successful series of tanks designed for the support of and co-operation with infantry. The production time of this tank was considerably reduced by cutting short the test time with consequent teething troubles. Because of the nature of the work it was to perform, the essential characteristics of the Churchill were heavy armour, good firepower and medium top speed. It had a maximum armour thickness of just over four inches and was armed with a 2-pr. and coaxial 7·92mm. Besa machine gun in the turret, and a 3-in. howitzer in the hull to the left of the driver for use in the close support rôle in the Mk 1 version.

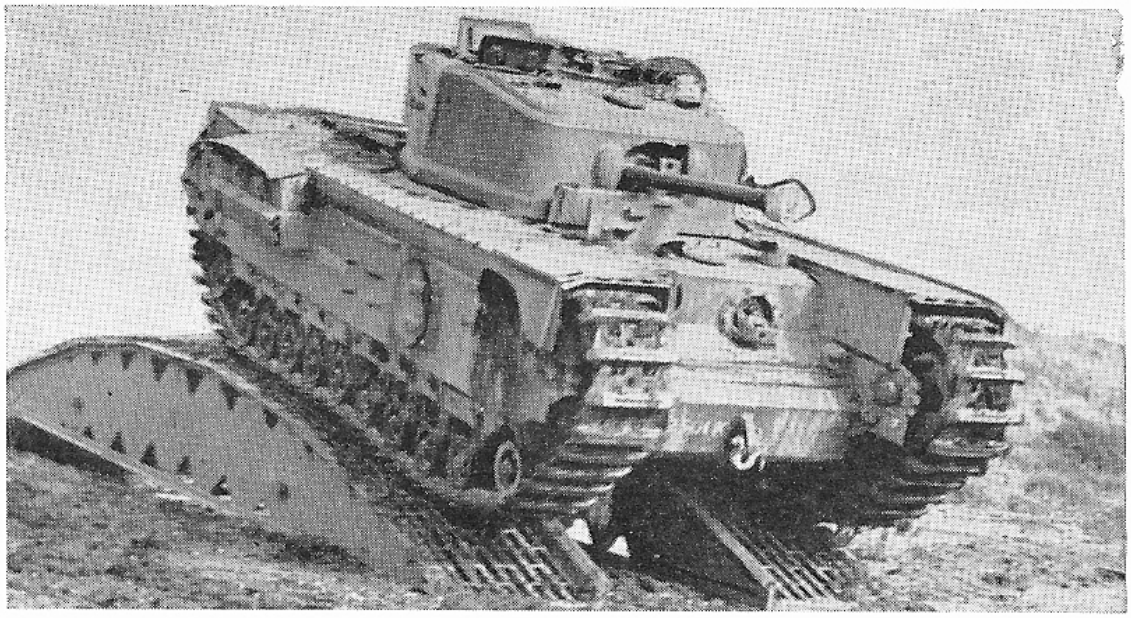
The tank was powered by a 12 cylinder Bedford horizontally opposed engine of 350 BHP which gave the vehicle a top speed of 17 m.p.h.; the suspension consisted of eleven small bogie wheels on each side, each bogie being independently sprung on triple helical springs; the tracks were 22-in. wide; the transmission included the Merritt Brown four-speed gear-box which provided controlled differential steering. Later marks of tank were fitted with a five-speed gear-box.



Churchill Mk 1

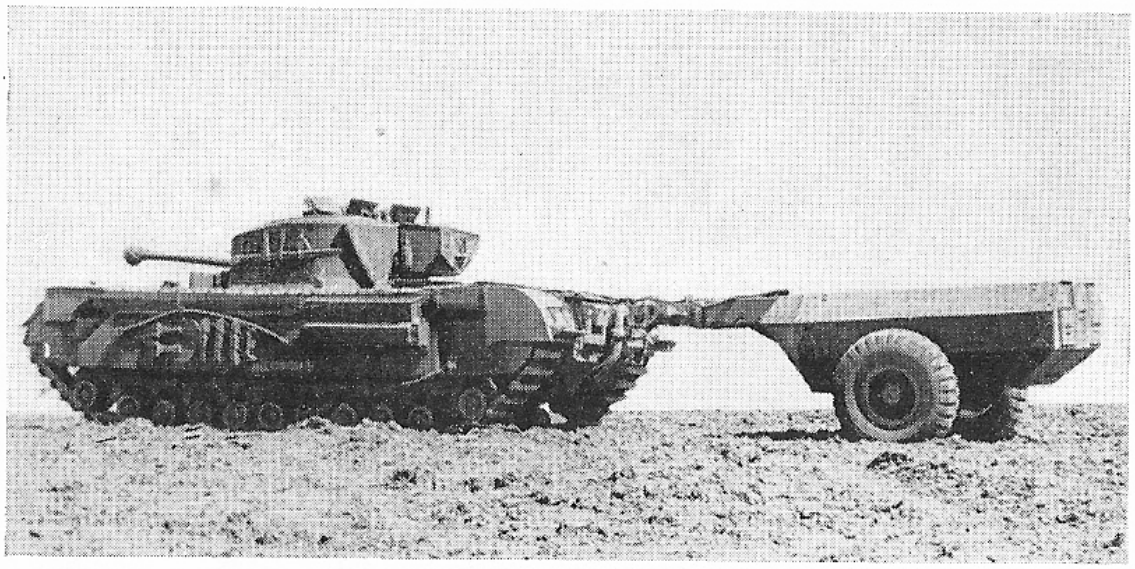
A summary of marks of the Churchill is as follows:—

Mark	Tracks	Main armament	Armour	Remarks
2	22-in.	2-pr. and coaxial 7·92mm. Besa machine gun	4-in. approx.	3-in. howitzer from hull replaced by 7·92mm. Besa MG
2CS	22-in.	3-in. howitzer and coaxial 7·92mm. Besa MG	4-in. approx.	2-pr. in hull
3	22-in.	6-pr. and coaxial 7·92mm. Besa MG	Welded turret slightly decreased in thickness	7·92mm. Besa MG in hull
4 (75mm.)	22-in.	75mm. M3 and coaxial ·30-in. Browning	Cast turret	
5	22-in.	95mm. howitzer and coaxial 7·92mm. Besa MG	Cast turret	Hull MG
6	22-in.	75mm. Mk 5 gun and coaxial 7·92mm. Besa MG	Cast turret	Hull MG
7	22-in.	,, ,,	6-in. approx. Redesigned welded hull. Cast turret	Hull MG. Principally used in flame throwing rôle
8	22-in.	95mm. howitzer and 7·92mm. Besa MG	,, ,,	Hull MG
9	Churchill Mks 2 and 4 re-worked and up-armoured with applique armour.			
9LT	As Mk 9 but retaining original turret (LT/Light turret).			
10	Re-worked Mk 6 with heavy turret and applique armour, new visor and glacis plate, heavy suspension units and H41 gearbox.			
10LT	Re-worked with normal turret.			
11	Churchill Mk 5 re-worked.			
11LT	As Mk 11 but retaining original turret.			



Churchill Mk 7 crossing the bridge put down by a Churchill bridgelayer

Due to modification and re-design, the appearance of the final Churchills, the Mks 7 and 8, is very different from that of the original Mk 1. The superficial changes may be summarised as follows:—The addition of dust guards to the front and rear horns and over the top run of the track, the re-designed hull with circular doors and driver's visor, the air louvres to the radiators re-designed, with the air inlets directed upwards to permit of deeper fording, the new shape turret and the increase in size of armament. In addition, there is the all-round vision cupola which enables the commander to fight the tank closed down, and the fitting of the blade sighting vane to engage targets accurately.



Churchill Crocodile

A special use of the Churchill Mk VII was as a flame thrower; when fitted with this device the tank was known as the Churchill Crocodile.

Mounted in the front hull in place of the MG was a flame gun and controls, with 400 gallons of fuel in a trailer; although the range of the flame thrower was restricted to about 100 yards, and a crosswind could deflect the flame jet, the device was very successful in action.

Valiant

Valiant (1945)

The Valiant was a development of the Valentine infantry tank and was not unlike that tank in general appearance except for its higher turret; it was much more heavily armoured than the Valentine and powered by a GM 210 BHP Diesel two stroke engine; the suspension consisted of six independently sprung bogies each side, the top run of the track being supported on three return rollers.

The tank was armed with a 75mm. QF gun with coaxial 7·92mm. Besa MG in the turret. The tank was an experimental design and was not used in action.

Black Prince (1945)

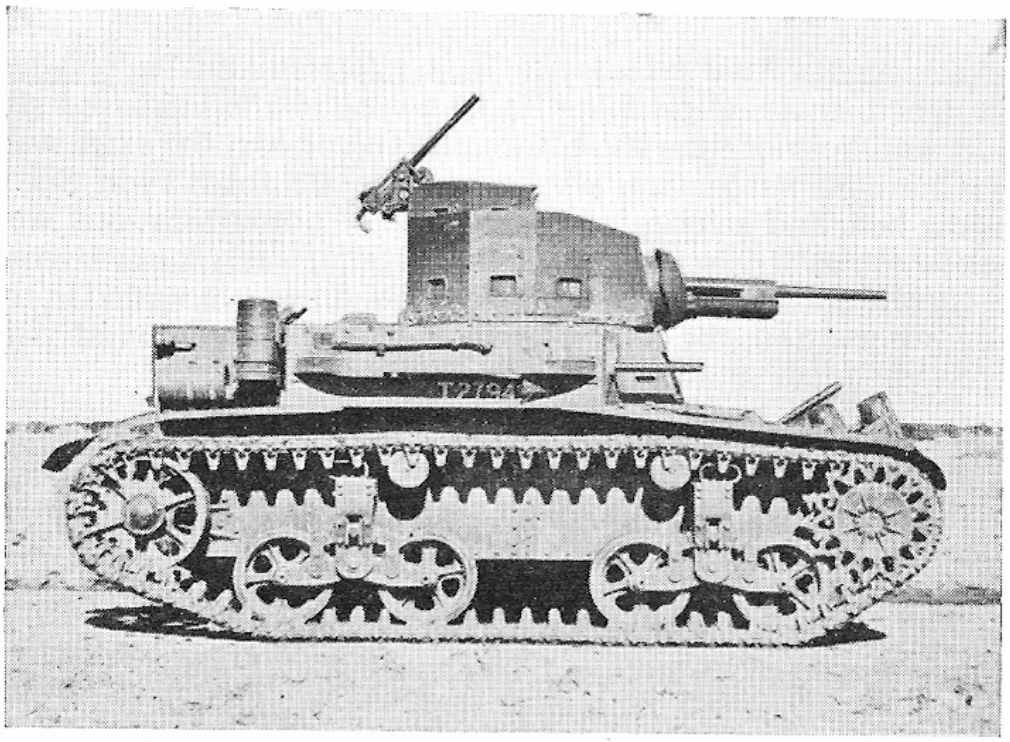
Another development of the infantry tank, the A45 BLACK PRINCE, was based on the Churchill and designed to carry the 17-pr. gun; owing to the increased size of the turret, the vehicle is wider and heavier than the Churchill. To support the extra weight, a strengthened version of Churchill suspension was used. The Bedford Twin Six engine and the Merritt Brown gear-box and steering were retained. Communications were provided by the No. 19 wireless set. A 7·92mm. Besa machine gun was mounted coaxially with the 17-pr. gun in the turret; another MG with telescopic sight was mounted in the hull to the left of the driver. For observation, the tank commander had the all-round vision cupola, and the rest of the crew each had a tank periscope.

Only six of these tanks were built and the tank was not used in action.

Black Prince

SUPPLEMENT

American Armoured Fighting Vehicles used by the British Forces 1940-1946

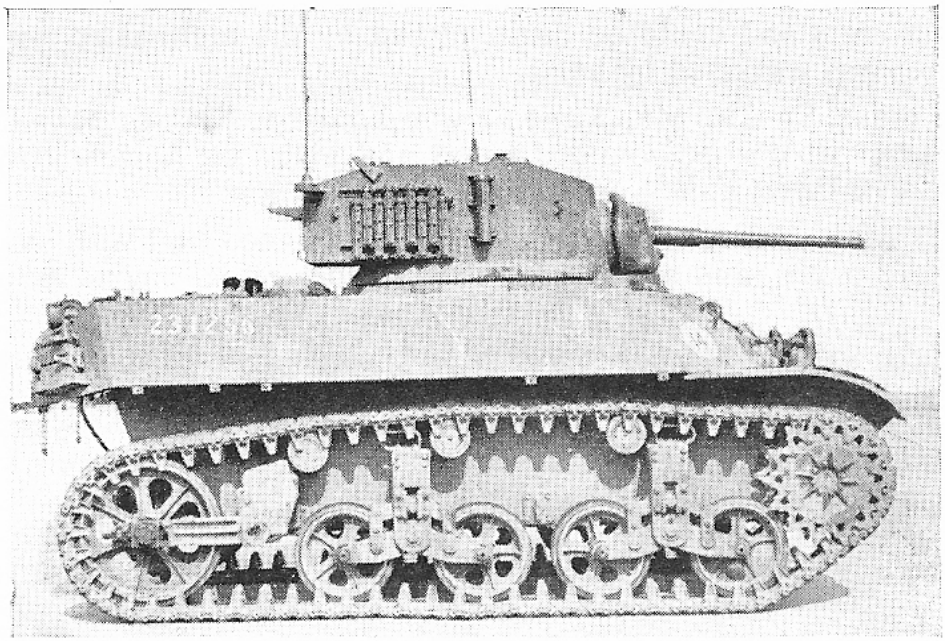


Light Tank M2A4 (1941)

The light tank M2A4 was the first American tank to be used by the British during the Second World War but was never in action being quickly superseded by the light tank M3, STUART Mark 1.

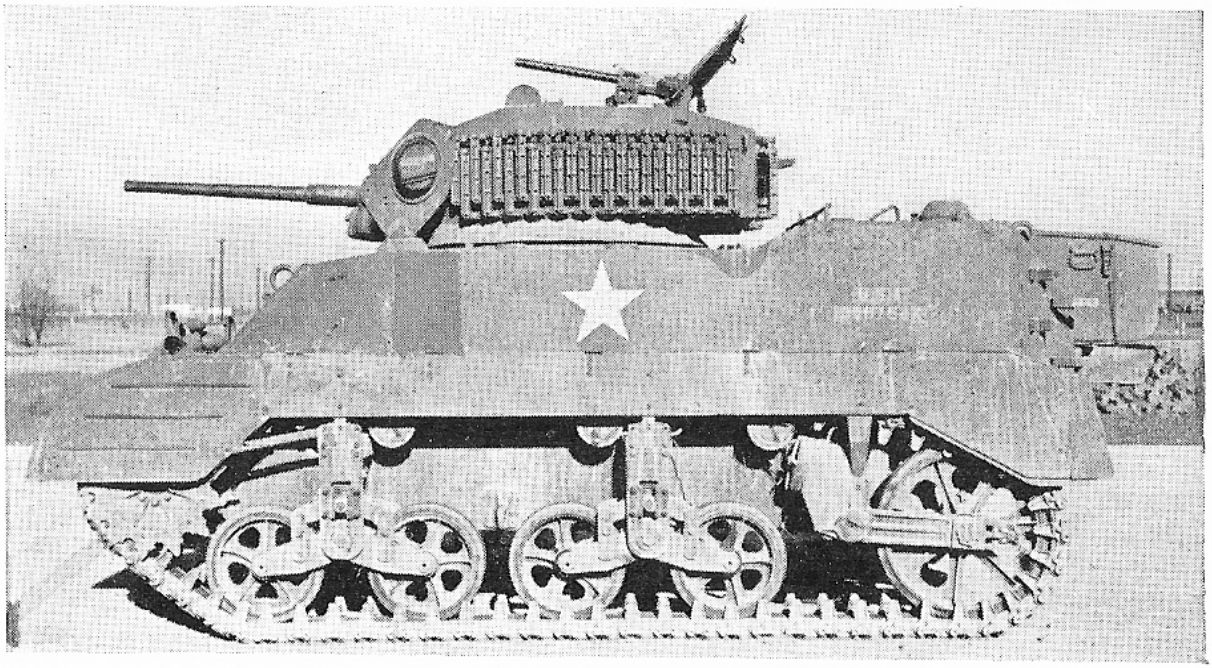
The M2A4 was armed with a 37mm. QF gun as the main armament with a coaxial ·30-in. Browning machine gun in the turret, and three ·30-in. machine guns in the hull, two of these being mounted in small sponsons; the turret was traversed by hand to lay the turret guns in the general direction of the target, a limited free traverse in the gun mounting being used for fine laying with geared elevation.

The tank was speedy and, for a light tank, heavily armoured, having plate nearly 1½-in. thick. A fourth machine gun was mounted on the fixed cupola for AA use.



Light Tank M3A3-Stuart Mk 5 (1942)

The STUART family of light tanks, also known as HONEYS, began with the light tank M3 in 1941; the tank weighed 12½ tons and had a crew of four; it was armed with the 37mm. QF gun with coaxial ·30-in. Browning machine gun with another MG in the front hull; provision was made for two other MGs in sponsons but these were generally removed. Like the M2A4 the armour was approximately 1½-in. thick and the engine was a 7-cylinder air-cooled radial of 250 BHP (STUART Mk 1) or 9-cylinder air-cooled radial Diesel of 220 BHP (STUART Mk 2). Both tanks had the volute spring suspension and trailing idler wheel



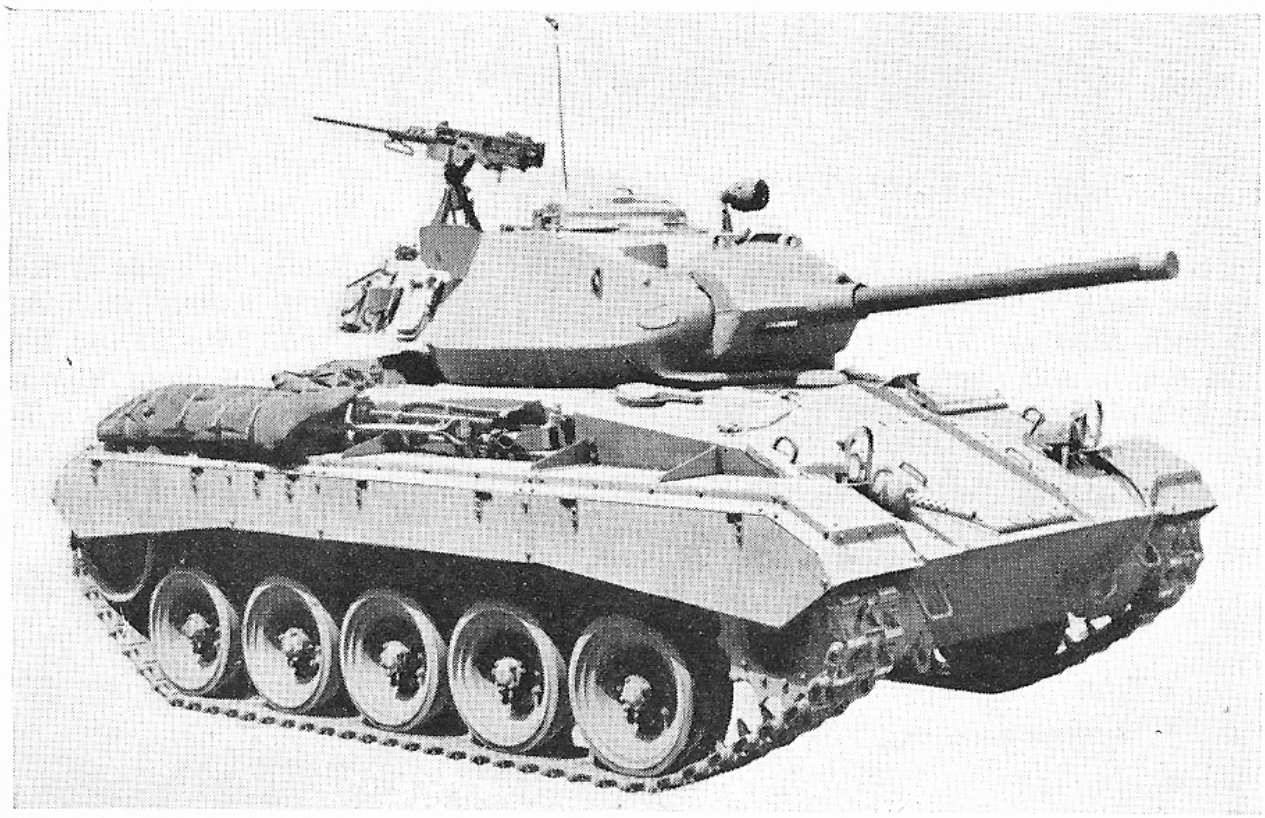
Light Tank M5A1-Stuart Mk 6 (1943)

common to all Stuarts and could be distinguished by the multi-sided welded turret with cupola; the turret was traversed by hand.

The M3A1 tanks, STUART Mks 3 and 4, were similar to STUART Mks 1 and 2, differing mainly in the turret which had rounded plates and hydraulic Oilgear traverse as well as hand operation. The turret guns were stabilized in elevation.

The STUART Mk 5, M3A3 light tank, had a re-designed hull with sloping front plate and superstructure plates, and a Continental 7-cylinder radial engine as on STUART Mks 1 and 3.

The hull of the STUART Mk 6, M5 and M5A1, was similar to that of the STUART Mk 5 but with vertical superstructure and higher rear deck; the armament was the same as on all the STUARTS but it had twin Cadillac V8 engines of 220 BHP and hydramatic transmission.



Chaffee Mk 1

The Chaffee was an entirely new design of American light tank and replaced the STUART in some British units at the end of World War II.

The tank weighed 17·6 tons and was armed with a light-weight 75mm. QF gun originally designed for use in aircraft; the gun, fitted with a concentric recoil system, was the first of its kind to be used by the British, and was extremely accurate; the coaxial and hull MG's were ·30-in. Brownings. The armour of 1½-in. was a little heavier than that on the earlier light tanks; the transmission was hydramatic, while the engines, Twin Cadillac V8 with a total of 220 BHP and the torsion bar suspension, gave the tank a top speed of 35 m.p.h.

Lee and Grant (1941)

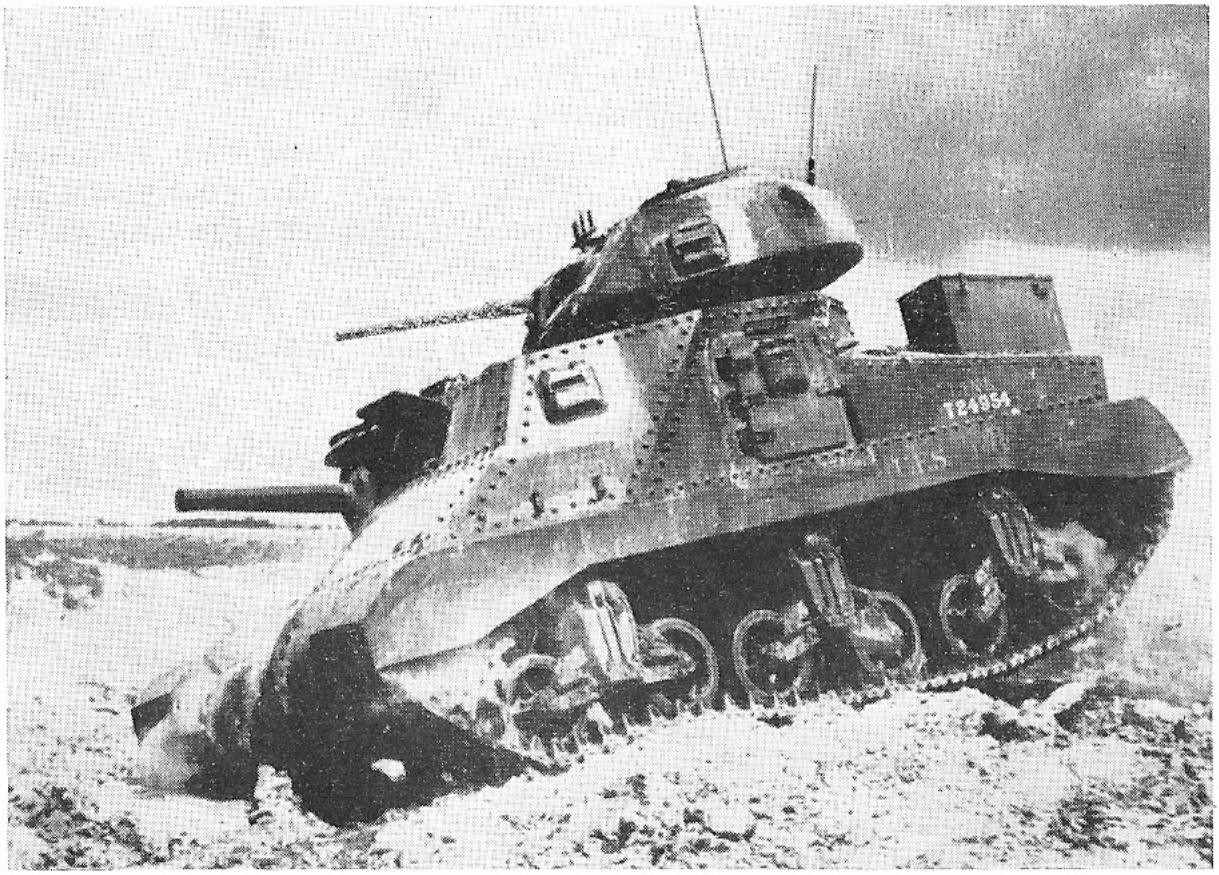
There were six marks of the Lee medium tank but the differences between marks were very slight. The tank weighed 26·8 tons and had a crew of six.

LEE Mk 1—continental 9-cylinder radial air-cooled 340 BHP.	(Riveted hull.)
LEE Mk 2 ,, ,, ,, ,, ,,	(Cast hull.)
LEE Mk 3 ,, ,, ,, ,, ,,	(Welded armour.)
LEE Mk 4 ,, ,, ,, ,, ,,	(Welded armour.)
LEE Mk 5—twin 6-cylinder Diesels 375 BHP.	(Welded hull.)
LEE Mk 6—Chrysler multibank 30-cylinder 370 BHP.	(Welded hull.)

The armour on the Lee was approximately 2¼-in. and the armament consisted of a 37mm. QF gun with coaxial MG in the turret and a 75mm. QF gun in the hull; the turret had all-round traverse by hand or hydraulic gear, and the 75mm. had a limited geared traverse of about 60°, both weapons having geared elevation. A stabilizer was fitted to the 37mm. gun mounting to allow of reasonably accurate shooting on the move.

Supported on volute spring suspension and with Cletrac type steering, the tank was fitted with rubber-block tracks.

The Grant was mechanically similar and differed mainly in the shape of its cast turret of British design and the absence of a cupola.



Grant Mk 1

Sherman (1942)

The SHERMAN tank was designed in 1941 as an improvement on the Lee and Grant: large numbers were issued to units of the British Army at a time when the need for tanks with thicker armour and larger calibre guns was being urgently felt.

Sherman Mk 3's

The Sherman Mk 1 which appeared in 1942, was more heavily armoured than its predecessors, the Lee and Grant, with a thickness of 3-inches.

A later mark of the 75mm. gun was mounted in the turret with a coaxial ·30-in. Browning; another MG was mounted in the hull. With a 353 BHP continental 9-cylinder radial air-cooled engine which gave the tank a speed of 30 m.p.h., the tank was mechanically similar to the Grant and Lee series.

The following types of Sherman tank were in general use in the British Army:—

M4A1—Sherman Mk 2—Wright Whirlwind air-cooled radial engine of 400 BHP.
M4A2—Sherman Mk 3—GM Twin Diesel engine of 375 BHP.
M4A3—Sherman Mk 4—Ford V8 engine of 500 BHP.
M4A4—Sherman Mk 5—Chrysler 30-cylinder multibank water-cooled engine of 425 BHP.

The tanks were fitted with the following types of main armament:

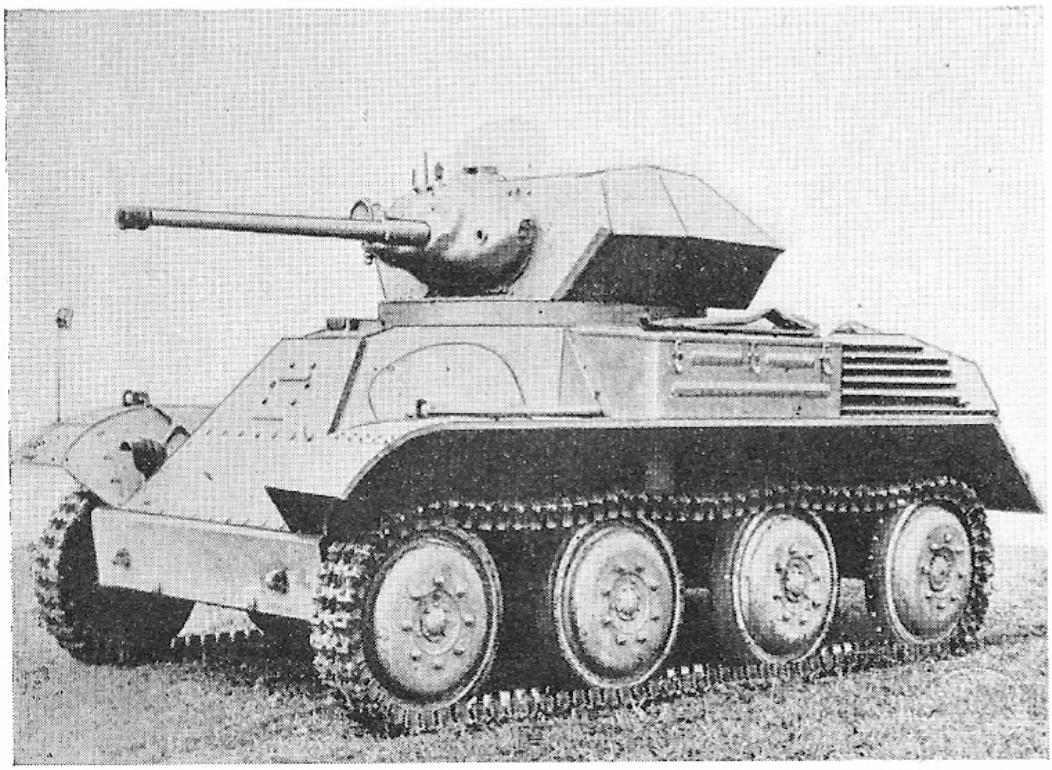
Sherman —75mm. QF gun.	Sherman B—105mm. howitzer.
Sherman A —76mm. QF gun.	Sherman C—17-pr. QF gun.

The Sherman tank incorporated an item of fire control equipment which was to be invaluable in the indirect fire rôle to which the tank was adapted, namely, the Azimuth Indicator M19.

All tanks of the Sherman series were originally fitted with a ·5-in. Browning machine gun carried on the turret roof for anti-aircraft use but it was not popular and generally removed by British units.

The traversing gear for the turret was either Oilgear hydraulic or Westinghouse electric, while the 75mm. gun was stabilized in elevation by hydro-electric gear for shooting on the move.

AIR PORTABLE TANKS



Light Tank Mk 8—Harry Hopkins (1943)

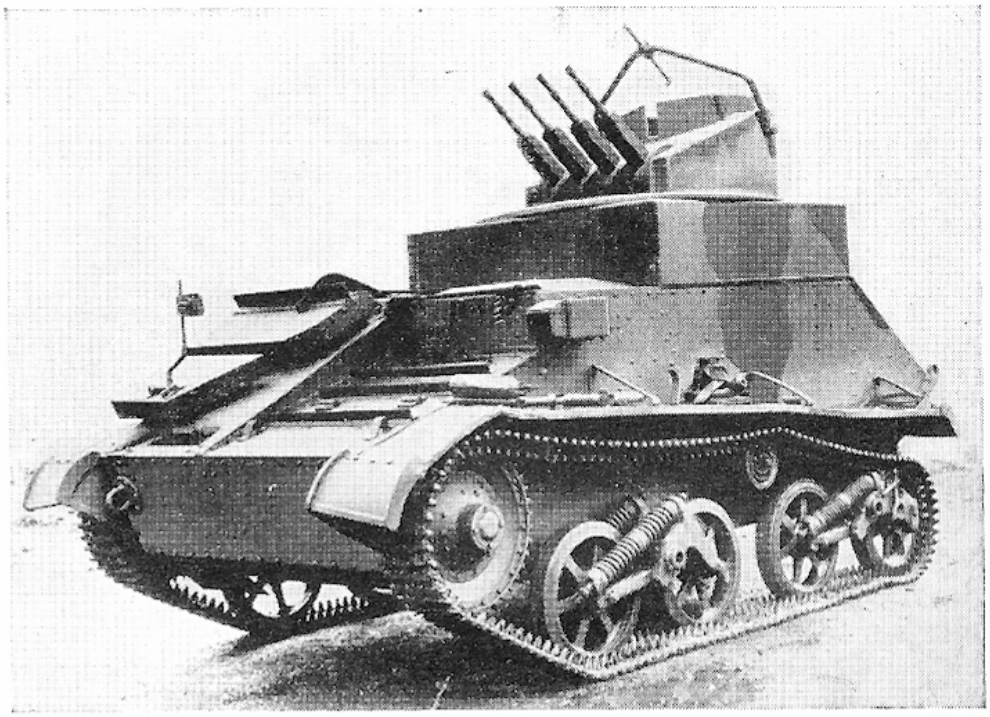
The HARRY HOPKINS was developed from the Tetrarch (*see* Booklet on Inter-war Period) and, except for its hydraulic servo steering, was mechanically similar to that vehicle.

The re-designed hull and larger turret provided more room for the crew and stowage while the thicker armour, 1½-in. with ½-in. as the minimum, gave greater protection against armour-piercing small arms fire. The 2-pr. gun was fitted with the Littlejohn adaptor to increase its penetration.

AA TANKS

Light Tank AA Mk 2

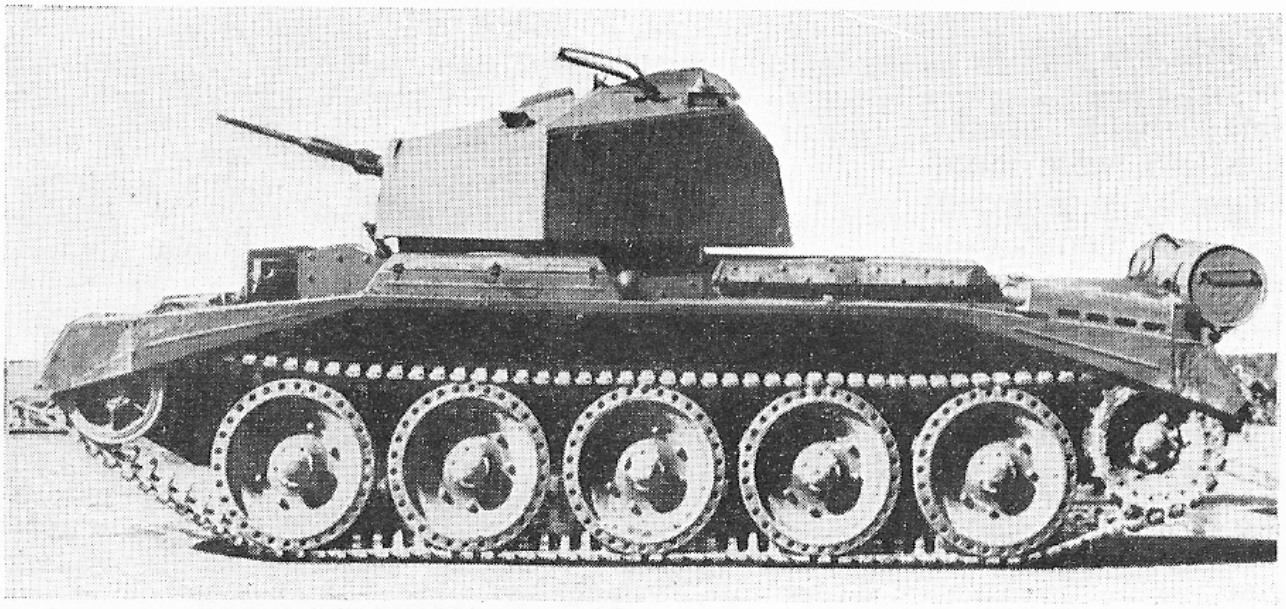
Some light tanks, Vickers Mk 6, were modified for use as anti-aircraft tanks. After modification the tanks were re-designated according to the type of armament carried; the Mk 1 and Mk 2 AA light tanks were armed with four 7·92mm. Besa machine guns, the Mk 2 having improved sighting and turret.



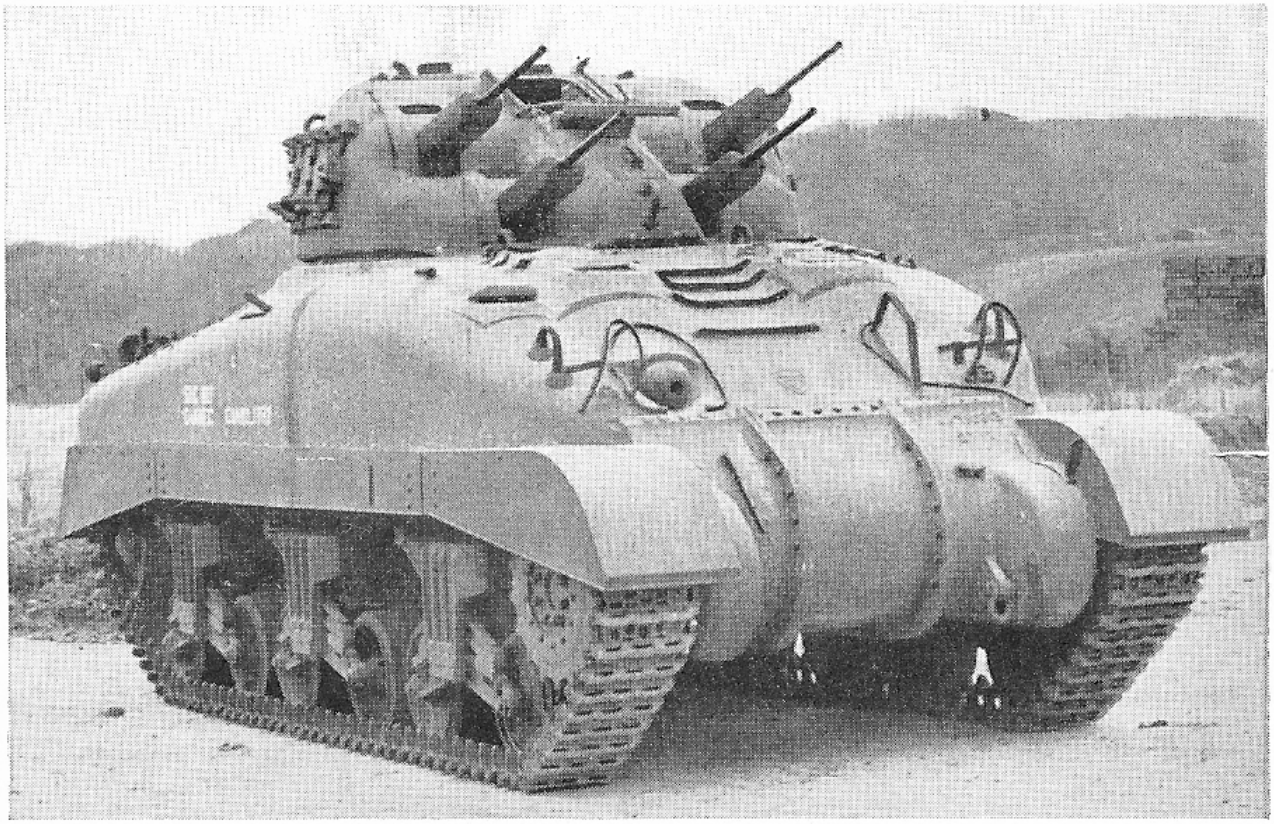
Vickers Mk 2 AA light tank

Later versions mounted quadruple Brownings or twin 15mm. Besas. Crusader tanks were also used in the AA rôle.

Crusader AA Mk 1—40mm. Bofors in power operated turret



Crusader AA Mk 2—twin 20mm. cannon in power operated turret



Skink AA Tank

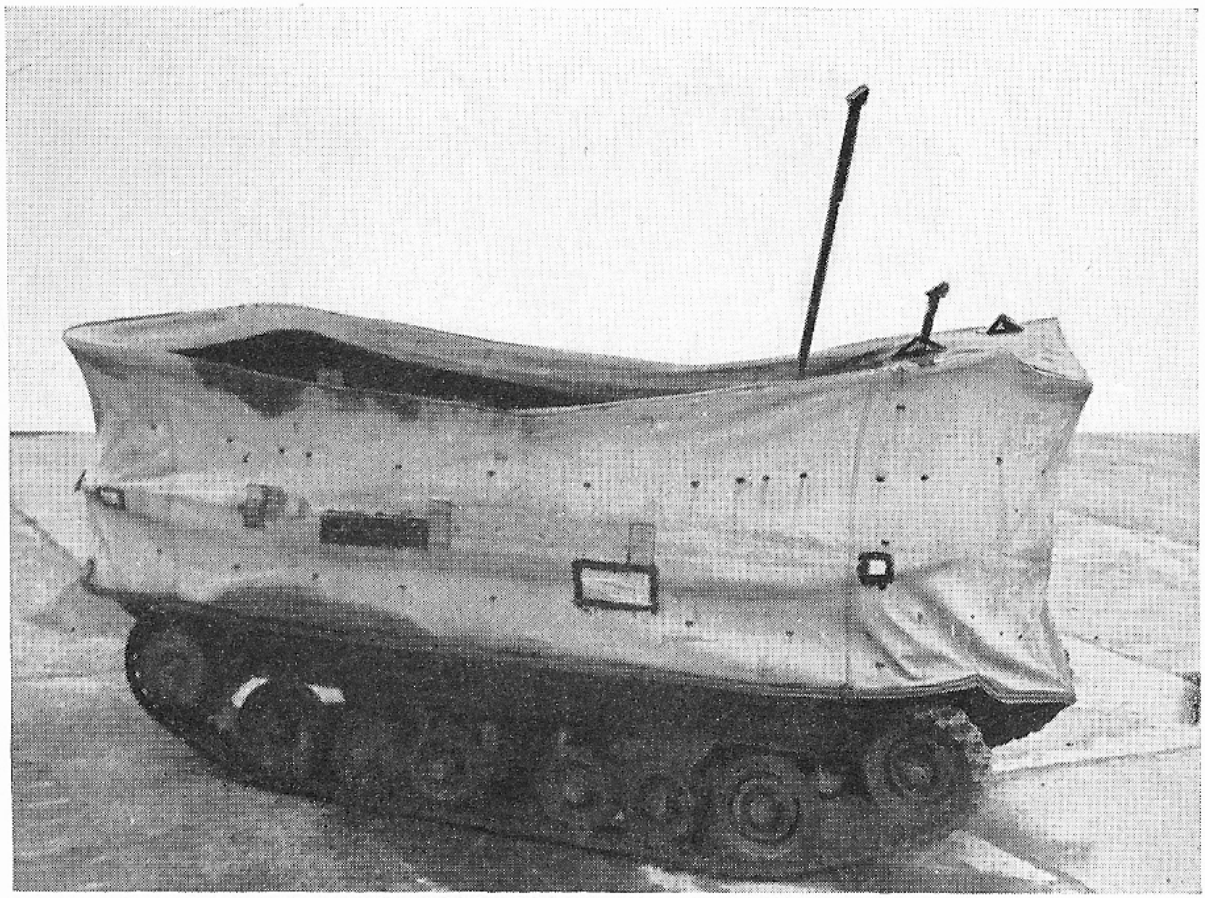
The Skink was a Ram tank (p. 10) adapted for AA work: it was armed with four 20mm. cannon mounted in special cast turret.

AMPHIBIOUS TANKS AND VEHICLES

No further marks of the Valentine tank were produced (*see* Booklet on Inter-war Period), but existing types were used for a variety of purposes. Valentine DD (Duplex Drive) had a deck round the hull, and to this was fixed the bottom of a collapsible canvas wall. At intervals round this wall were rubber air tubes which could be inflated by compressed air carried in cylinders.

On being inflated, the tubes raised the canvas wall, thus forming an extended hull which was locked in position with metal struts giving necessary displacement to make the tank float. It was driven through the water by a marine type propeller, power for which was taken from the bevel drive in the tank. Deflation of the tubes caused the canvas wall to collapse enabling the tank to function normally on land.

The Valentine was never used in action; it was superseded by the Sherman DD tank which has two propellers driven from the rear sprockets. The Sherman had a speed of 5 knots in the water and proved a seaworthy vehicle. DD tanks were used on all the assault beaches in the Normandy landings, although some were landed without swimming.



Valentine DD, screen raised, showing periscopes for vision when afloat

Sherman DD, screen lowered

Buffalo Mk II

Buffalo

The Buffalo was developed from a Landing Vehicle Tracked (LVT) originally designed by the Americans for rescue work in areas inundated by floods. It was powered by a 7-cylinder radial air-cooled engine. A closed cab at the front housed the driver and co-driver.

The British used it extensively in N.W. Europe and in Italy in two versions, Mk II, and Mk IV, the latter carrying the greater load and having an end loading door. Afloat they had a speed of 6 knots.

Armament was fitted to those vehicles used by the British Army in N.W. Europe and consisted of ·30-in. or ·5-in. machine guns, swivel-mounted round the cargo compartment, and a 20mm. Polsten cannon mounted on top of the driver's cab. The vehicle would carry 28 men or one of the following typical loads:—Jeep, Weasel, Airborne Bulldozer, Bren Carrier, Scout Car, 6-pr. Anti-tank Gun, or 17-pr. Anti-tank Gun (with special attachment to LVT). A Buffalo Mk IV is on display in the Museum.

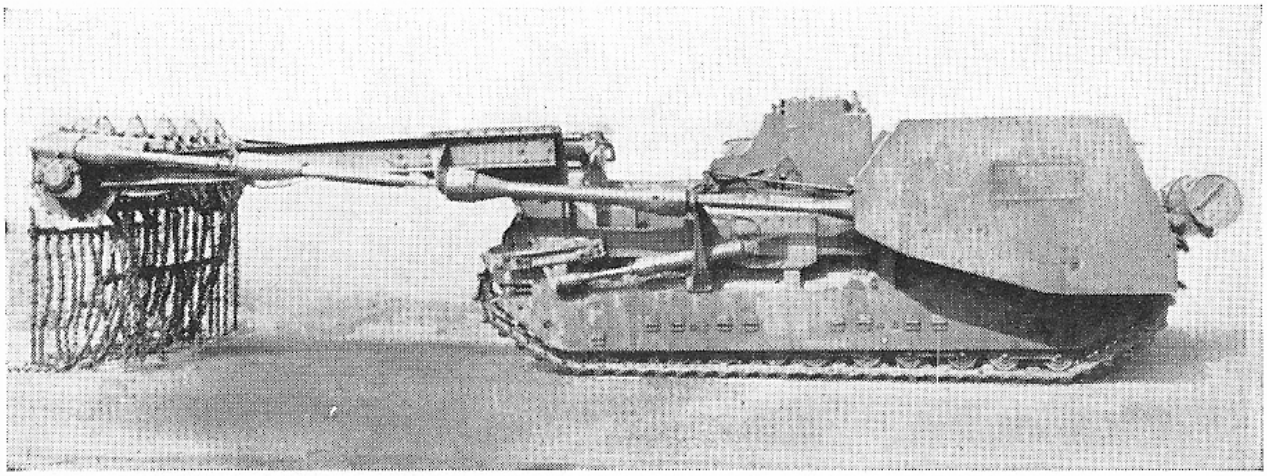
The Weasel

Strictly speaking the Weasel is outside the scope of this book but it proved such a useful load carrier to tanks that it has been included.

This was a load carrying amphibious vehicle which could lift ½ ton. It had a speed of 33 m.p.h. on land and 2.5 knots afloat. Track pressure was very low. The Weasel proved very useful carrying loads in flooded or marshy country.

MINE SWEEPING TANKS

Many attempts were made to defeat the anti-tank mine by mechanical means. Scorpion flails, built on Matilda chassis, were used at El Alamein in 1943.

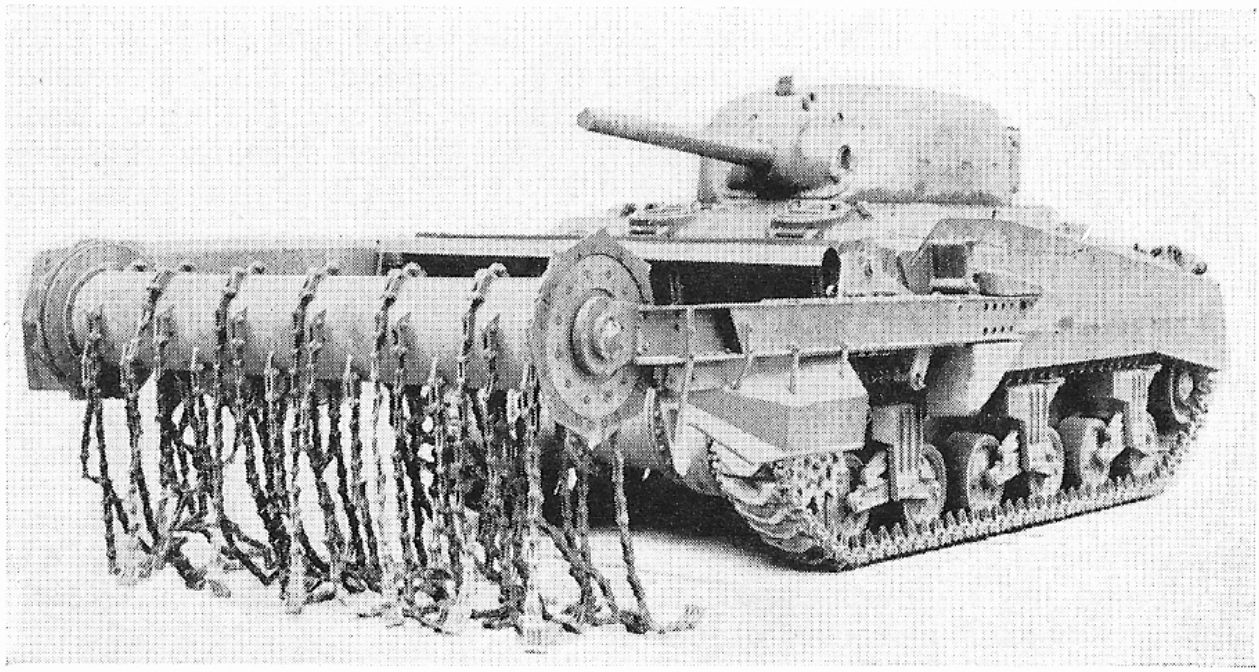


Matilda Baron

The Baron was a development of the Scorpion flail: it was a Matilda tank with a girder extension fitted on the front of the tank and supporting a roller to which was attached a number of chains terminating in ball weights.

The roller was made to revolve by means of a shaft drive and auxiliary engine; the chains then beat the ground in front of the tank as it advanced, to explode mines buried not more than four inches below the surface; the flail would clear a lane 10-ft. wide.

A similar device was used on a Valentine chassis with a special turret which housed two Ford V8 engines to drive the flail.



Sherman Crab

The Sherman Crab was fitted with equipment very similar to that used on the Valentine Scorpion and Matilda Baron. The later mark of Crab was fitted with a contouring device and wire cutters; the flail would clear a lane 9-ft. 9-in. wide. This proved very successful and was extensively used in N.W. Europe. The rotor drive was taken off the main engine—flailing speed 1½ m.p.h. The tank retained its main armament.

Churchill Bull's Horn

The Bull's Horn plough was attached to a standard Churchill tank and operated at a tank speed of 4 m.p.h.; the device cleared a lane the width of the tracks by lifting the mines and deflecting them outward away from the path of the tank; it worked best on soft going such as beaches. A similar device was the Farmer Deck Plough.

The AVRE also used the Snake which consisted of lengths of 4-in. iron piping filled with explosive and fitted with a special head to ride over the surface of the ground. A tank pushed the rear end until the head had reached the far side of the minefield. The charge was then detonated and cleared a lane 9 feet wide in favourable circumstances.

To deal with "S" mines, a device known as "Centipede" could be attached to the rear of a mine-clearing tank; it consisted of twenty-four small rollers mounted on parallel bars.

Rollers

Many experimental devices were devised. They proved unwieldy to handle and the problem of bridging the mine and failing to explode it with the roller was never satisfactorily overcome.

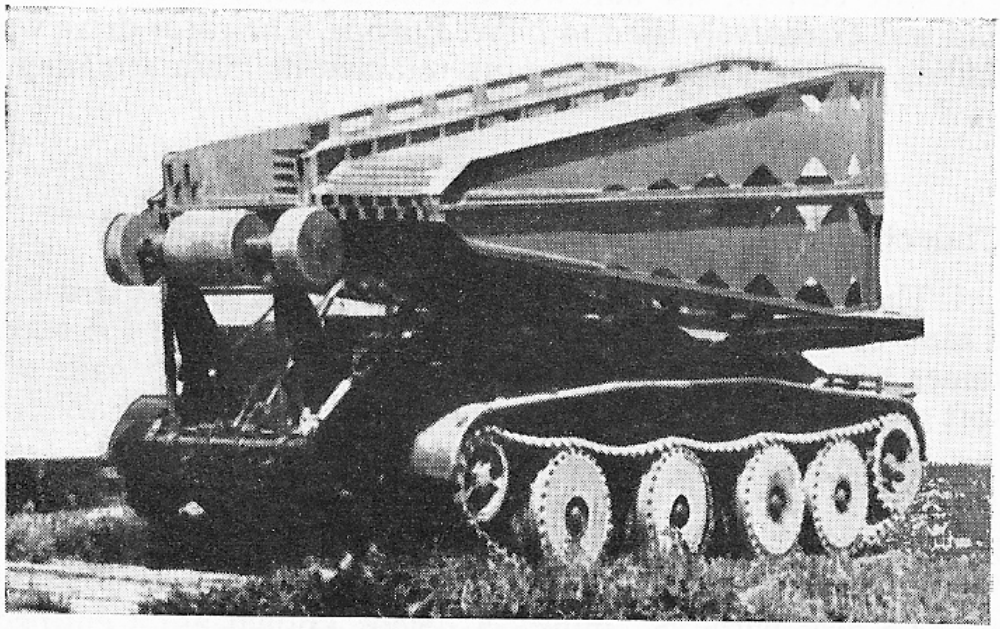
Flame Throwing Tanks

The Crocodile—Churchill Mk VII in the flame throwing rôle—has been referred to on page 14. The weight of the trailer was 6½ tons and it contained 400 gallons of flame throwing fuel and five bottles of inert gas. The gas pressure was sufficient to give an operational range of 90-100 yards and pressure kept up in the trailer after pressurising, for an average of six hours. Connection from trailer to tank was through the Link, an ingenious device through which passed the pressurised fuel. It was designed to operate at all angles of tank and trailer and gave no trouble. The equipment was extremely effective provided its tactical use was correct. The trailer was practically never hit in action.

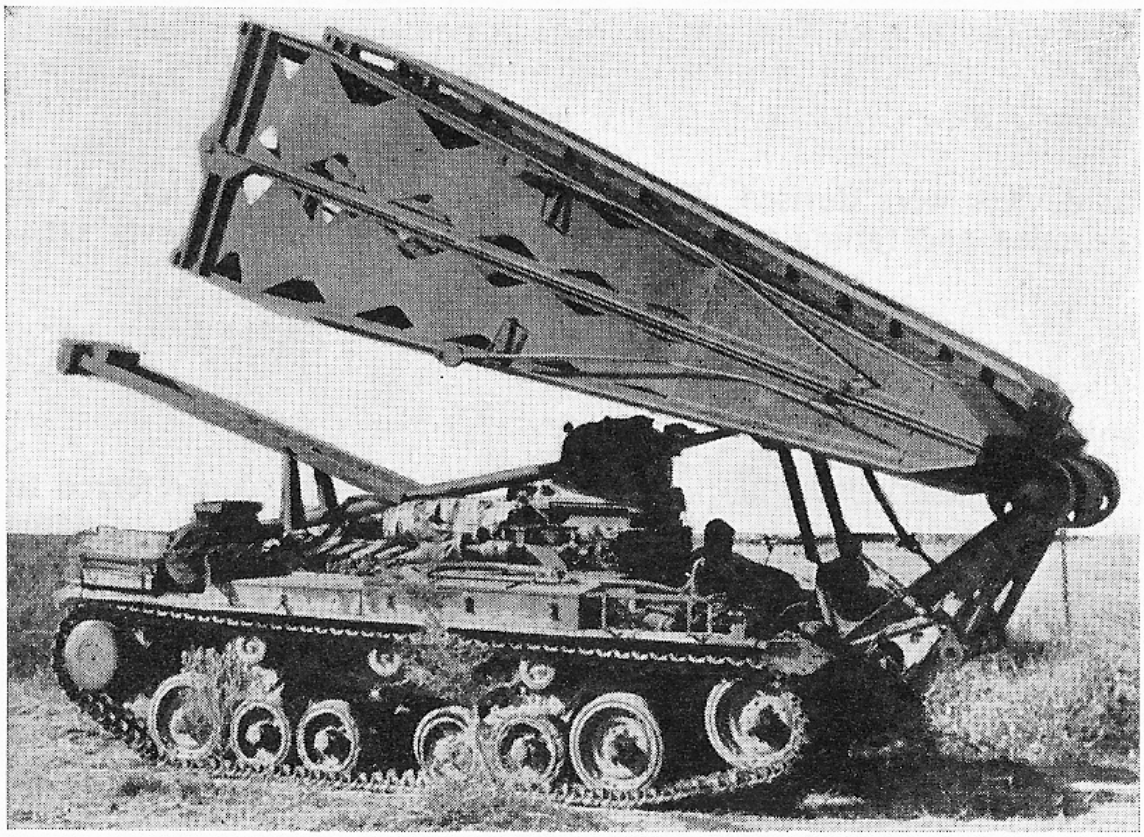
BRIDGELAYERS

Special bridge laying tanks and the Small Box Girder assault bridge were evolved to meet bridging requirements.

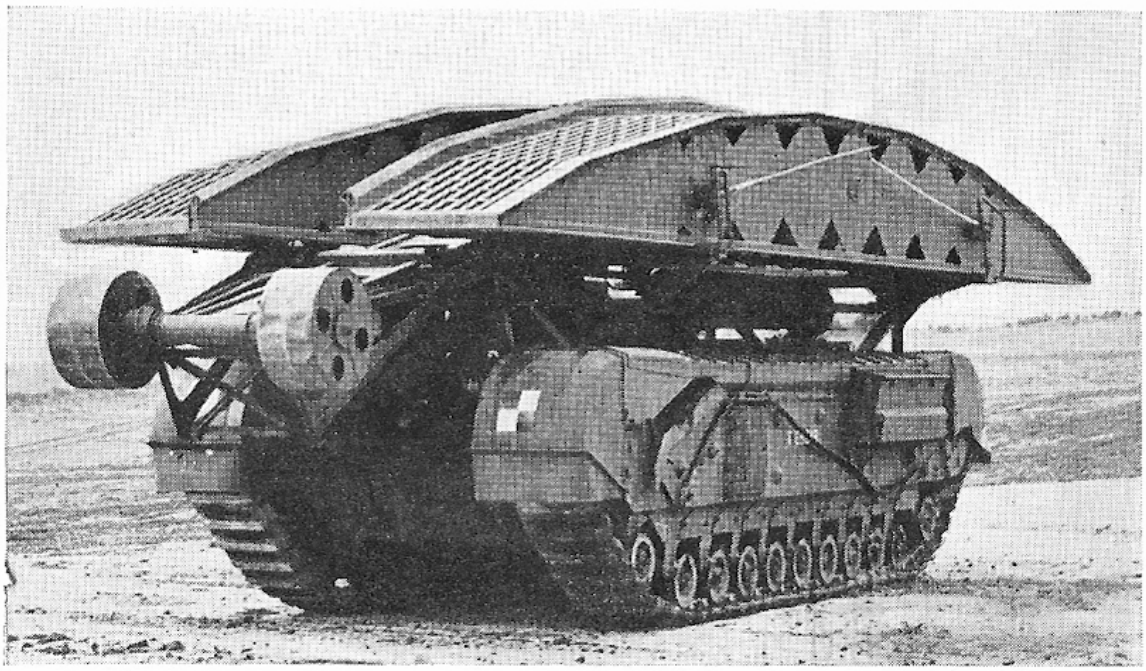
Covenanter Scissors Bridge
(*Bridge in travelling position*)



The Covenanter Mk 4 chassis (*see* Booklet on Inter-war Period for details of Covenanter tank) powered by a Meadows DAV 12 cylinder engine of 280 BHP, and less its turret, was fitted with a scissors bridge. The bridge was laid across the gap to be crossed, and then detached from the bridge-layer which retired until all vehicles were across; it then crossed and picked up the bridge which was then ready for further use. This type of bridge was also mounted on the Valentine chassis and was capable of bridging a 30-ft. gap and of carrying a load of 30 tons (tracked vehicle).



Valentine Bridgelayer
(*Bridge at the start of laying operation*)

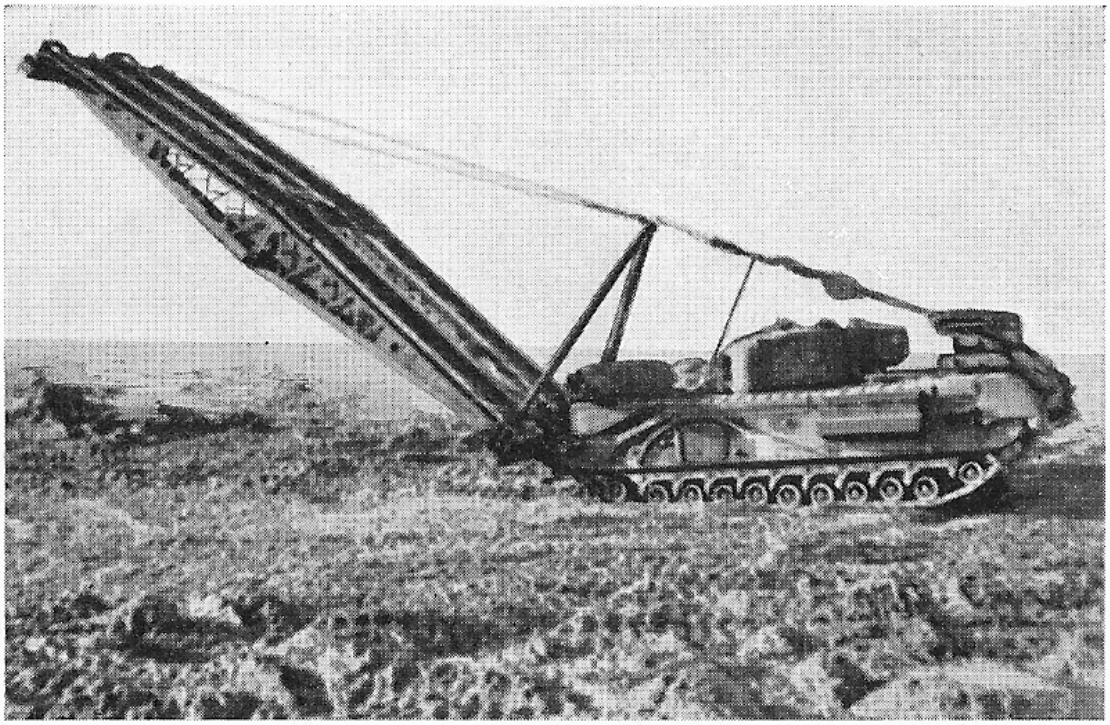


Churchill Bridgelayer

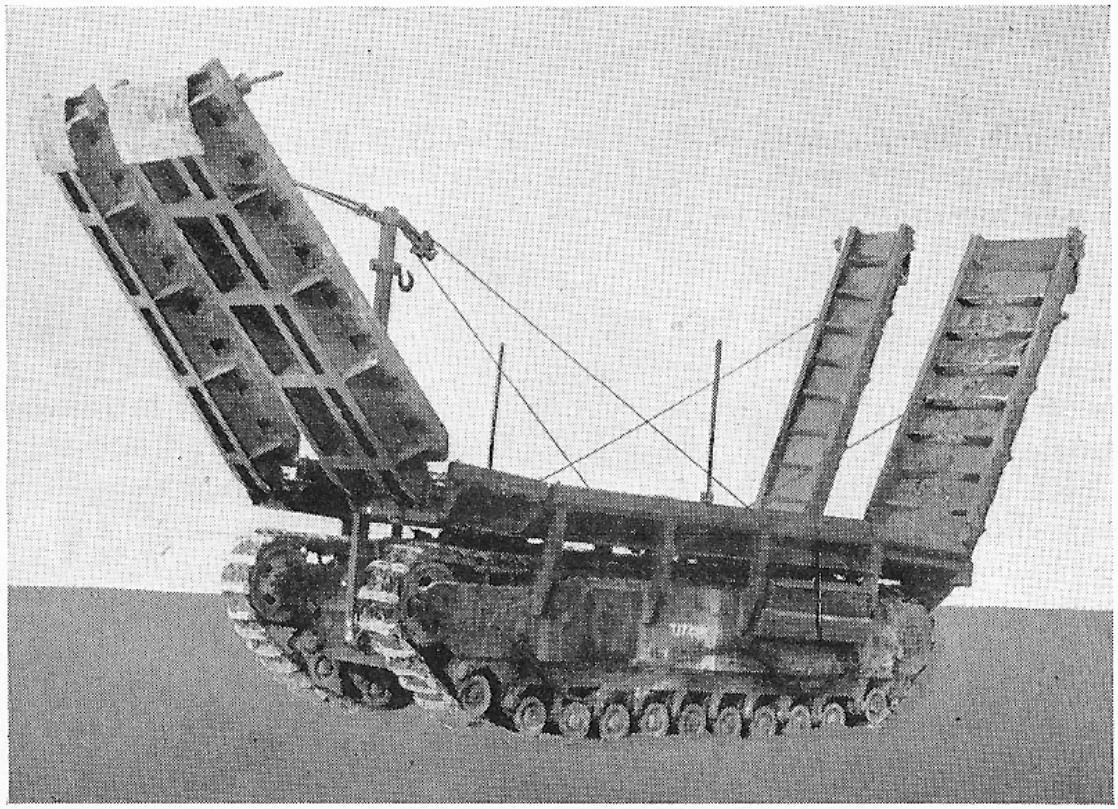
(*See page* 13 *for picture of bridge on ground*)

The Churchill bridgelayer was designed to carry a greater weight (60 tons) over a 30-ft. gap; the power for operation was taken from the main engine and the bridge could be placed in position in less than two minutes.

An assault bridge, the Small Box Girder, could also be mounted on the AVRE for use at wall and ditch crossings. This bridge could surmount a 15-ft. wall or span a 30-ft. gap and was often used in conjunction with the fascine, a bundle of brushwood of about 12-ft. in diameter. An AVRE placed the SBG bridge against a wall and then withdrew. A second AVRE climbed the bridge and dropped its fascine. It then went ahead, followed by other tanks who used bridge and fascine to cross the obstacle.



SBG Assault Bridge on Churchill AVRE—travelling position



Churchill Ark

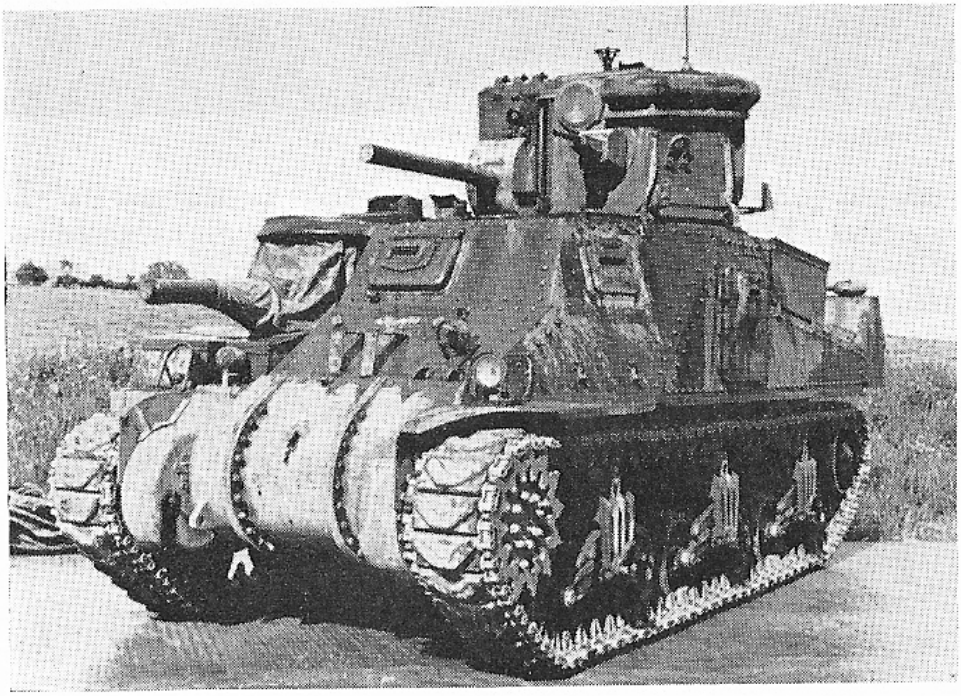
Another bridging device was the Ark; it consisted of a turretless Churchill tank fitted with a ramp over the tracks with extension ramps 11-ft. 9-in. long at the front and rear:

By the use of an Ark, a 12-ft. wall could be scaled and a ditch 30-ft. wide could be spanned. For vertical obstacles the Ark dropped its ramps on the obstacle and on the ground. Other vehicles crossed on the ramps, using fascines if necessary to reduce the drop.

ARMOURED SEARCHLIGHTS

Three types of tanks were fitted with the searchlight known as Canal Defence Light (CDL), namely the Matilda, Churchill, and Grant.

The equipment consisted of an arc light within a special turret provided with an armoured shutter; the light beam was dazzling up to a range of about 2,000 yards and made possible the engagement of targets at night. Matilda and Churchill tanks only carried a 7·92mm. Besa in the CDL turret. The Grant was of particular value because the main armament was retained. Grant CDLs were used at the Rhine crossing and accounted for many floating objects.



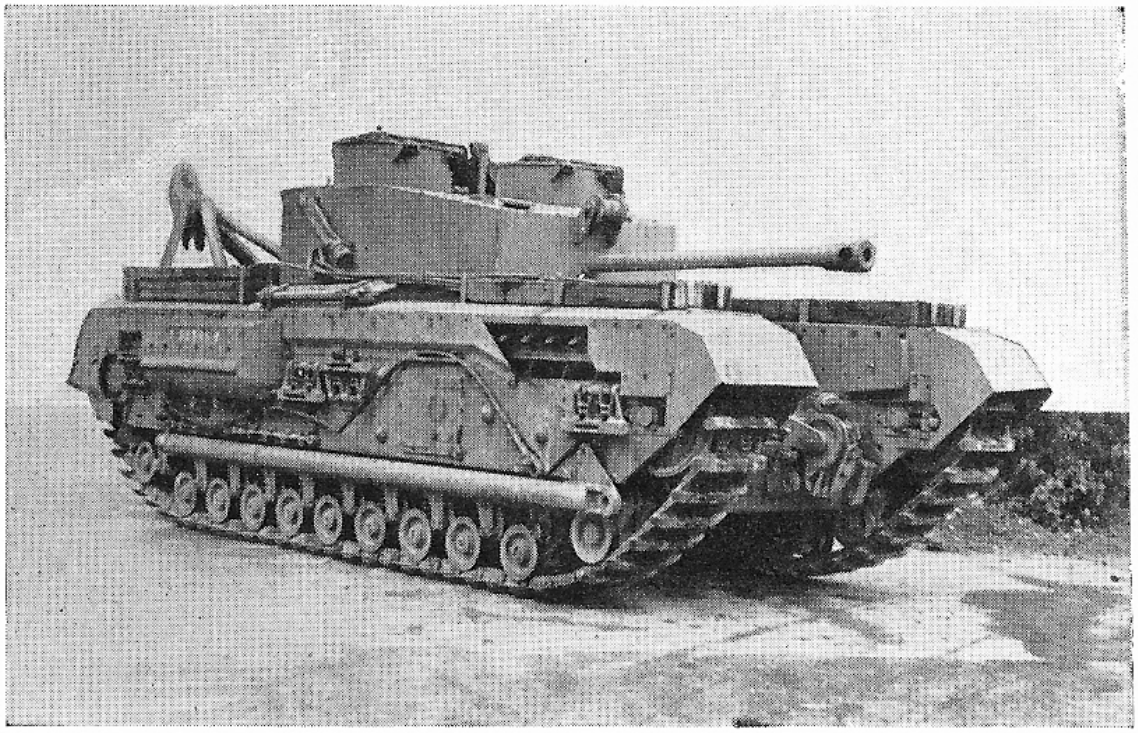
Grant CDL—dummy gun in the turret to left of light slit; 7·92 Besa on right, 75mm in hull.

ARMOURED PERSONNEL CARRIERS

Armoured Personnel carriers were used to reduce infantry casualties when crossing ground covered by enemy fire. They were extemporised in the first instance from Priests by taking out the 105mm. howitzer. Canadian Ram tanks had their turrets removed and were also extensively used in this rôle.

An APC could carry an infantry section and when modified to carry personnel were known as Kangaroos. The photograph shows a Priest Kangaroo with a Weasel in the background.

ARMOURED RECOVERY VEHICLES



Churchill ARV Mk 2

Some tanks of all types were modified for recovery work. They played a most important part in operations by salvaging damaged tanks on the battlefields, often under fire.

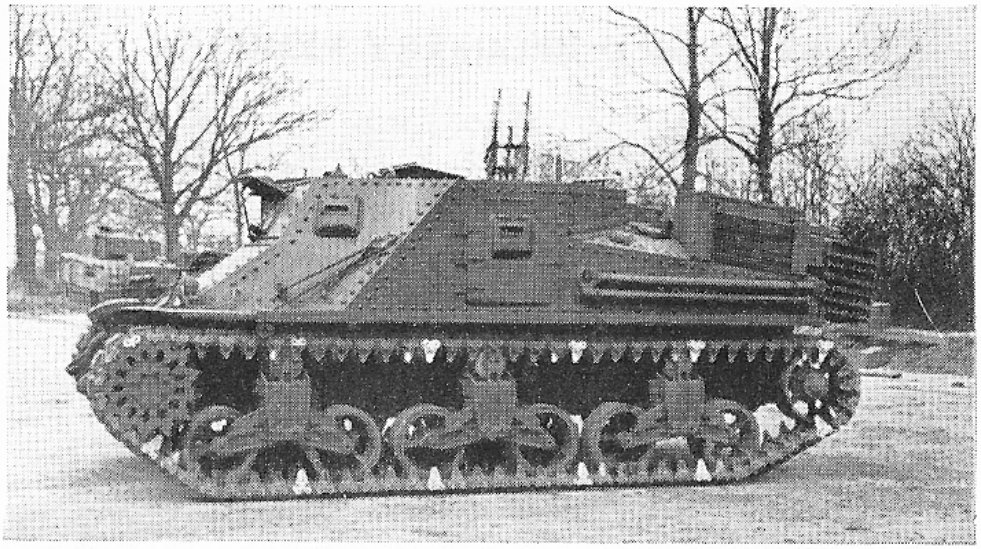
Churchill ARV Mk 2

The Churchill ARV Mk 2 was based on the Churchill Mk 4 chassis, the standard turret being replaced by a fixed turret with dummy gun and two cupolas; the special equipment consisted of a forward jib with a 7½-ton lift, a rear jib with a 15-ton lift and a 2-speed winch with a capacity of 25 tons.

Ram ARV Mk 2

The Canadian cruiser tank in the ARV rôle was fitted with equipment similar to that on the Churchill ARV.

Earlier marks of ARV tanks, i.e. the Cavalier ARV Mk 1 and Cromwell ARV Mk 1, were fitted with hand-operated winches of a very limited capacity.



Grant ARV

This was a turretless Grant fitted with winch gear and equipment; twin Bren guns were mounted in the hull for AA defence.

The Sherman ARV Mk 2 had a dummy turret and equipment similar to that on the British tanks.

Sherman BARV

The Sherman Beach Armoured Recovery Vehicle was a normal M4 chassis, with armoured superstructure and waterproofing for deep wading; it was equipped with the standard recovery equipment.

Sherman Beach Armoured Recovery Vehicle

SELF-PROPELLED GUNS

Priest—SP 105mm. M7

Two S.P. vehicles used by the British Forces were based on the M3 medium tank chassis and fitted with weapons designed for support of infantry and use in the anti-tank rôle.

The Priest carried a 105mm. howitzer as the main armament and a ·5-in. Browning for anti-aircraft defence.

The M10, with a special open turret mounting a British 17-pr. was used by us in the anti-tank rôle.

M10—SP 17-pr. A/Tk gun

APPENDIX

COMPARATIVE TABLE OF PRINCIPAL TANKS 1940 TO 1946

DATE	TYPE	WEIGHT	CREW	ARMAMENT MAIN	ARMAMENT SECONDARY	ENGINE	ENDUR-ANCE	MAX. SPEED	ARMOUR	REMARKS
1940	Infantry Tank Mk 3—ValentineMk I	17 tons	3	2-pr. QFSA gun	7·92 mm. Besa MG (coaxial)	A.E.C. 131 BHP	90 miles	15 m.p.h.	65-8 mm.	
1940	Cruiser Mk 5 —Covenanter Mk I	18 tons	4	2-pr. QFSA gun	7·92 mm. Besa MG (coaxial)	Meadows DAV 300 BHP	100 miles	31 m.p.h.	40-7 mm.	
1941	Cruiser Mk 6 Crusader Mk 2	18·8 tons	4	2-pr. QFSA gun	7·92 mm. Besa MG (coaxial)	Nuffield Liberty Mk 3 340 BHP	100 miles	26·3 m.p.h.	49-7 mm.	
1941	Infantry Tank Mk 4—Churchill Mk I	38·5 tons	5	2-pr. QFSA gun	3-in. QFSA howitzer 7·92 mm. Besa MG (coaxial)	Bedford 350 BHP Flat Twin Six	90 miles	17 m.p.h.	102-16 mm.	
1941	Light Tank M3—Stuart Mk I	12·5 tons	4	37 mm. QFSA gun	2 x ·30-in. Browning MGs (one coaxial)	Continental 7 cyl. radial 250 BHP	70 miles	36 m.p.h.	37-12 mm.	
1941	Grant Mk I	28 tons	6	75 mm. in hull 37 mm. in turret	·30-in. Browning MG coaxial in turret	Continental 9 cyl. radial 340 BHP	144 miles	26 m.p.h.	57-13 mm.	British designed cast turret
1942	Crusader Mk 3	19·7 tons	3	6-pr. QFSA gun	7·92 mm. Besa MG (coaxial)	Nuffield Liberty Mk 4 340 BHP	100 miles	27 m.p.h.	51-7 mm.	
1942	Sherman Mk 3 M4A2	30·8 tons	5	75 mm. QFSA gun	2 x ·30-in. Browning MGs (one coaxial)	Twin GM Diesel 375 BHP	150 miles	29 m.p.h.	76-12 mm.	
1943	Cromwell Mk I	27·5 tons	5	6-pr. QFSA gun	2 x 7·92 mm. Besa MGs (one coaxial)	Rolls Royce Meteor 600 BHP	165 miles	38 m.p.h.	76-6 mm.	Cavalier and Centaur were the same tank with Liberty Mk V 395 BHP engine
1943	Light Tank M5A1—Stuart Mk 6	15·1 tons	4	37 mm. QFSA gun	2 x ·30-in. Browning MGs (one coaxial)	Cadillac 220 BHP	120 miles	40 m.p.h.	38-12 mm.	American Light Tank
1943	Sherman Mk 5 M4A4	31·7 tons	5	75 mm. QFSA gun	2 x ·30-in. Browning MGs (one coaxial)	Chrysler Multi-bank 30 cylinder 425 BHP	100 miles	25 m.p.h.	76-25 mm.	M4A3 had 500 HP Ford engine
1944	Churchill Mk 7	40 tons	5	75 mm. QFSA gun	2 x 7·92 mm. Besa MGs (one coaxial)	Bedford 350 BHP Flat Twin Six	90 miles	12·5 m.p.h.	152-25 mm.	
1944	Light Tank M24—Chaffee Mk I	17·6 tons	5	75 mm. QFSA gun	2 x ·30-in. Browning MGs (one coaxial)	Cadillac Twin 220 BHP	150 miles	35 m.p.h.	37-9 mm.	American Light Tank
1944	Cromwell Mk 7	28 tons	5	75 mm. QFSA gun	2 x 7·92 mm. Besa MGs (one coaxial)	Rolls Royce Meteor 600 BHP	165 miles	32 m.p.h.	101-6 mm.	
1944	Comet Mk I	32·7 tons		77 mm. QFSA gun	2 x 7·92 mm. Besa MGs (one coaxial)	Rolls Royce Meteor Mk 3 600 BHP	123 miles	29 m.p.h.	101-14 mm.	
1946	Centurion Mk 2	48 tons	4	17-pr. QFSA gun	7·92 mm. Besa coaxial MG	Rolls Royce Meteor Mk 4 600 BHP	85 miles	21·4 m.p.h.		

COMPARATIVE TABLE OF PRINCIPAL GERMAN TANKS

DATE	TYPE	WEIGHT	CREW	ARMAMENT	REMARKS
1917	A 7V	33 tons	18	1—57mm. gun 6—MGs	Production 20. Further production models were built to be cargo carriers.
1917	A 7V-U	44 tons	7	2—57mm. guns 4—Maxim MGs	Prototype only.
1918	LK II	10.2 tons	2 or 3	1—37mm. gun 2—Maxim MGs	Total production: 2.
1919	'K' Wagen	165 tons	22	4—77mm. guns 6—Maxim MGs	Total production: 2. Built by Daimler Motor Co.
1933	PzKpfw I	5.25 tons	2	2—7.92mm. MGs	Model A.
1933	PzKpfw I	5.75 tons	3	1—7.92mm. MG	Model B converted into a commander's tank. In Tank Museum
1934	PzKpfw II	10.25 tons	3	1—20mm. gun 1—7.92mm. MG	Model F in Tank Museum. A reconnaissance tank.
1936	PzKpfw III	22 tons	5	1—50mm. gun 2—7.92mm. MGs	Model L is in Tank Museum. Later models had a short 75mm. gun.
1937	PzKpfw IV	23 tons	5	1—75mm. gun 2—7.92mm. MGs	Model G is in Tank Museum.
1942	Tiger	56 tons	5	1—88mm. gun 2—7.92mm. MGs	Model E is in Tank Museum.
1942	Panther	45 tons	5	1—75mm. gun (Long Barrel) 2—7.92mm. MGs	Model G is in Tank Museum.
1944	Tiger II	67 tons	5	1—88mm. gun 2—7.92mm MGs	Model B is in Tank Museum.
1944	Maus	185 tons	6	1—128mm. gun 1— 75mm. gun (Co-axial) 1—7.92mm. MG	Only two prototypes produced.

PUBLISHED BY R.A.C. TANK MUSEUM
BOVINGTON CAMP, DORSET
PRINTED BY
HENRY LING LTD. AT THE DORSET PRESS
DORCHESTER, DORSET