PROFILE

AFV WEAPONS 27

The Saladin Armoured Car

By Major Michael Norman, *Royal Tank Regiment*

AFV/Weapons Profiles

Edited by DUNCAN CROW

Check list of published titles:

1 **Churchill—British Infantry Tank Mk. IV**
by B. T. White

2 **PanzerKampfwagen III**
by Walter Spielberger

3 **Tanks Marks I to V**
by Chris Ellis and Peter Chamberlain

4 **Light Tanks M1–M5 (Stuart/Honey)**
by Chris Ellis and Peter Chamberlain

5 **Light Tanks Marks I–VI**
by Major-General N. W. Duncan

6 **Valentine—Infantry Tank Mark III**
by B. T. White

7 **Medium Tanks Mks A to D**
by Chris Ellis and Peter Chamberlain

8 **Crusader—Cruiser Mark VI (includes Cruisers Marks I–VI)**
by Major J. K. W. Bingham, Royal Tank Regt.

9 **Early (British) Armoured Cars**
by Major-General N. W. Duncan

10 **PanzerKampfwagen V Panther**
by Chris Ellis and Peter Chamberlain

11 **M3 Medium (Lee/Grant)**
by Peter Chamberlain and Chris Ellis

12 **Mediums Marks I–III**
by Major-General N. W. Duncan

13 **Ram and Sexton**
by Peter Chamberlain and Chris Ellis

14 **Carriers**
by Peter Chamberlain and Duncan Crow

15 **PanzerKampfwagen I and II**
by Major-General N. W. Duncan

16 **Landing Vehicles Tracked**
by Colonel Robert J. Icks, USAR Retd.

17 **Russian KV and IS**
by Major Michael Norman, Royal Tank Regt.

18 **Chieftain and Leopard (Development)**
by Major Michael Norman

19 **Chieftain and Leopard (Description)**
by Major Michael Norman

20 **Churchill and Sherman Specials**
by Peter Chamberlain and Chris Ellis

21 **Armoured Cars—Guy, Daimler, Humber, A.E.C.**
by B. T. White

22 **PanzerKampfwagen 38(t) and 35(t)**
by John Milsom

23 **Soviet Mediums T44, T54, T55 and T62**
by Major Michael Norman

24 **The M48/M60 Series of Main Battle Tanks**
by Colonel Robert J. Icks

25 **Cromwell and Comet**
by Major James Bingham

26 **Hellcat, Long Tom, and Priest. PLUS Complete Check List of All U.S. World War II SPs**
by Colonel Robert J. Icks

27 **Saladin Armoured Car**
by Major Michael Norman

28 **S-Tank**
by R. M. Ogorkiewicz

29 **M4 Medium (Sherman)**
by Peter Chamberlain and Chris Ellis

30 **Armoured Cars—Marmon-Herrington, Alvis-Straussler, Light Reconnaissance**
by B. T. White

31 **Australian Cruiser-Sentinel; and Australian Matildas**
by Major James Bingham

32 **M6 Heavy and M26 (Pershing)**
by Colonel Robert J. Icks

33 **German Armoured Cars**
by Major-General N. W. Duncan

34 **Scorpion Reconnaissance Tank**
by R. M. Ogorkiewicz

35 **British Armoured Recovery Vehicles + Wheels, Tracks and Transporters**
by Peter Chamberlain and Major-General N. W. Duncan

36 **Chars Hotchkiss H35, H39, and Somua S35**
by Major James Bingham

37 **Russian BT Series**
by John F. Milsom

38 **Conqueror Heavy Gun Tank**
by Major Michael Norman

39 **Panhard Armoured Cars**
by R. M. Ogorkiewicz

40 **U.S. Armored Cars**
by Colonel Robert J. Icks

41 **M103 Heavy Tank + M41 Light Tank (Walker Bulldog)**
by Colonel Robert J. Icks

42 **Modern Swedish Light Armoured Vehicles**
by R. M. Ogorkiewicz

43 **PanzerKampfwagen IV**
by Walter Spielberger

44 **Ferrets and Fox**
by R. M. Ogorkiewicz

46 **Light Tanks M22 (Locust) and M24 (Chaffee)**
by Colonel Robert J. Icks

47 **T-34**
by J. M. Brereton and Major Michael Norman

48 **PanzerKampfwagen VI-Tiger I and II**
by Peter Chamberlain and Chris Ellis

49 **Japanese Medium Tanks**
by Lieut.-General Tomio Hara, Imperial Japanese Army, Retd.

The publishers regret to announce that as from 1st April 1972 all previously published prices and price lists are cancelled. No price increase has been made since August 1970 but due to the wide range of rising costs since that date, the following recommended retail selling price(s) will apply:

AFV/Weapons Series 1–42 inclusive 35p each; 43 onwards 40p each.

If you have any difficulty in obtaining Profiles from your local book or model shop please write direct to:

Mail Order/Subscription Department,
PROFILE PUBLICATIONS Ltd, Coburg House, Sheet Street, Windsor, Berks. SL4 1EB

Saladins of A Squadron, The Queen's Own Hussars. (CCR BIS)

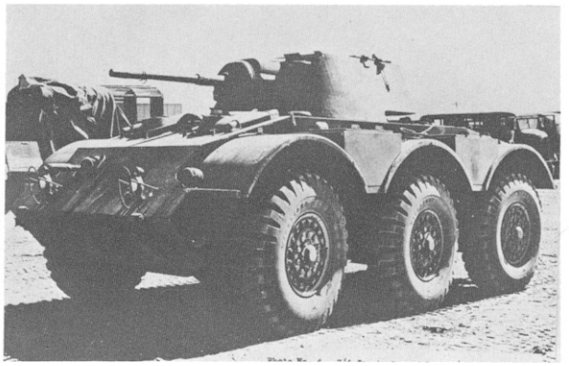
The Saladin Armoured Car

by Major Michael Norman, Royal Tank Regiment

THE mounting of weapons and armour on a wheeled chassis poses relatively fewer engineering problems than the development of an equivalent tracked vehicle and so it is not unnatural that the introduction of the armoured car preceded that of the tank by several years. The British kept their armoured car forces busy during the inter-war period with a diversity of operations in aid of the civil power, although most of the vehicles were still based on truck designs. Cross-country mobility was usually poor as a result and the development of fast and light tanks—such as the Vickers—tended to eclipse the wheeled vehicle for such tasks as exploitation and reconnaissance. But the Germans and French, among others, were not content with *ad hoc* conversions and began to develop armoured cars from first principles, with a significant increase in cross-country mobility as top priority. For example, a German requirement in 1928 led *inter alia* to the Büssing NAG Sd.234 series whose performance in World War II in Western Europe, Russia and North Africa was comparable with the best light tanks of the period.

The British Army, quickly re-learning the value of armoured cars in mobile operations, used them in increasing numbers during the war. Quite a number of designs saw service, and though most were fairly simple in concept, the superiority of a multi-wheel layout was recognized in the Marmon-Herrington Mark VI and the prototype of the Boarhound. One reason for the proliferation of designs is reflected in the classic controversy in armoured car practice: one school prefers to rely on stealth to obtain information and looks for mobility and a low weight and silhouette—at the expense of protection and firepower—while the other accepts that information may have to be fought for and covering operations carried out, with the penalties in size and weight that these rôles entail. Thus, apart from the small scout car, the light armoured car often needed a heavier vehicle to provide fire support. An attempt was made in the Coventry, a joint design by Daimler and Humber, to produce a single vehicle capable of both rôles but the User disliked it because of its indifferent mobility and protection—despite its all-up weight of

Prototype of the T19 armoured car developed by Chevrolet. (US Official)



The T19E1 prototype mounting a 37-mm. high velocity gun. (US Official)

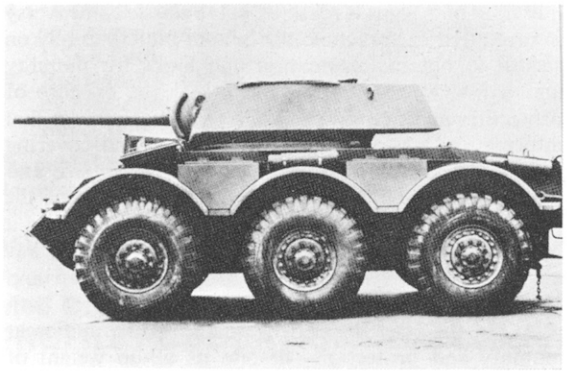
11·4 tons—and the use of an imported Hercules engine.

Meanwhile, the Chevrolet Division of General Motors had developed the T19 6 × 6 design based on the T18E1 heavy armoured car. The T19 had a specially designed six-wheel, independent suspension, but the E1 version, mounting a 37-mm. gun, was considered to be too heavy at 12½ tons. The project was developed for the Tank Destroyer Command as the 75-mm. Gun Motor Carriage T66 with an M3 75-mm. gun in an open turret, but this too was dropped.

The Chevrolet-built T28 (later M38) designed to replace the M8 light armoured car (known to the British as the Greyhound) incorporated features from the T19E1, including the layout and the suspension, but the M38 (known to the British as the Wolfhound) never went into production, only a few pre-production vehicles being built for trial purposes. Unfortunately the U.S. Army had by this time (end of 1944) convinced itself that tracks were more efficient and reliable than wheels for reconnaissance tasks, despite the German evidence to the contrary, and with sufficient M8s available to meet all needs no more armoured cars were to enter U.S. service for some time.

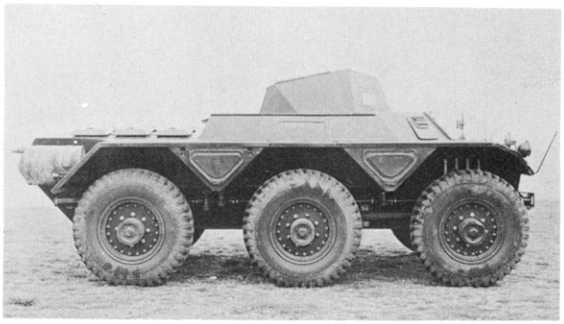
Luckily the British User was not persuaded by the American arguments. Having rejected the Coventry for future development it was decided to retain the war-time Daimler in its Mark II version and the heavier AEC Mark III pending the arrival of the "Post War Armoured Car". This had been under consideration for some time and it was significant that the General Staff specification issued in January 1946 stressed the need for "an improvement in performance over Daimler Mark 2 without materially increasing its dimensions, armour thickness or size of armament". The British Fighting Vehicles Design Department (FVDD) had already evaluated a number of suspension designs but it seems that the one proposed for M38 clearly had the best potential despite the complicated layout and unsolved problems, among them being the disposition of the differentials and the type of springs to be used. Thus, contrary to the normal trend, an American technique had to go to Europe for its successful development and, although a number of important changes were necessary, it seems that the original wheel base, track width and tire size were unchanged. A crew of four was preferred, but three would be acceptable if the extra man entailed dimensional or weight penalties, and the original scheme envisaged a three-man turret with a complex contra-rotating cupola for the commander. Experience with the well tried 2-pdr. (39-mm) gun led to the demand for an improved version of the same calibre having an armour penetrating performance equivalent to that obtained when firing non-rigid ammunition (APCNR—armour-piercing, composite, non-rigid) through the reducing

The T66 tank destroyer on the T19 chassis and mounting a 75-mm. gun. The similarity to Saladin in external layout is striking. (US Official)



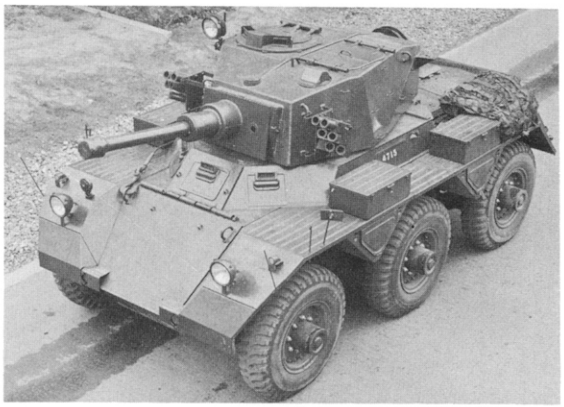
Early FV 601 prototype ballasted to simulate the expected all-up weight of the completed vehicle and with a light track fitted to the rear two pairs of wheels to enhance movement over difficult going. The track was very liable to shedding when steering and the idea was abandoned. (CCR MVEE)

Three-quarter rear view of FV 601 prototype. The earlier grille over the engine has been replaced by six separate and liftable armoured covers. (CCR MVEE)



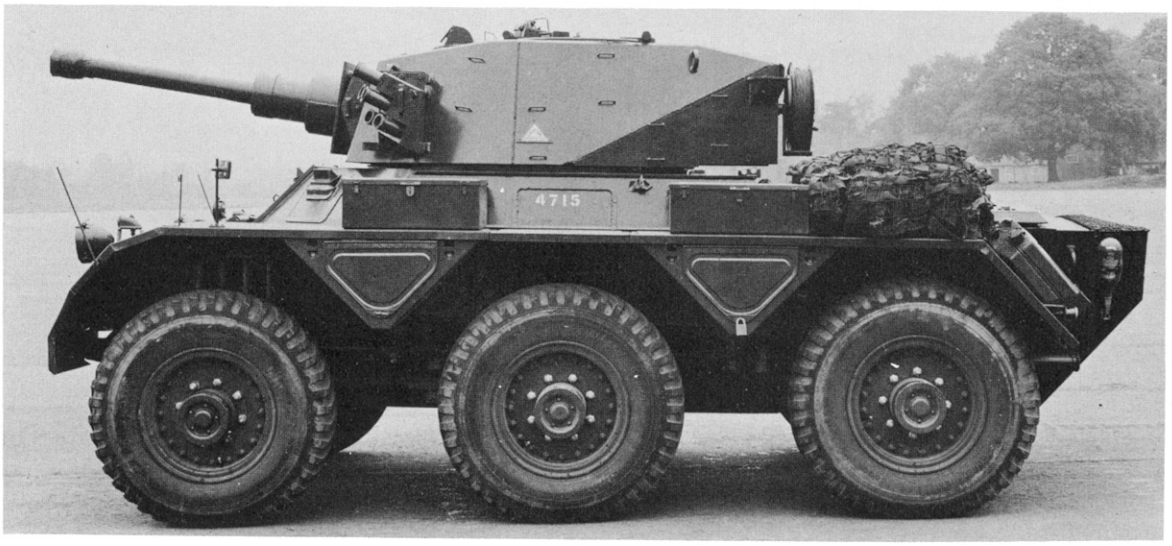
Side view of FV 601 prototype built for automotive trials. (CCR MVEE)

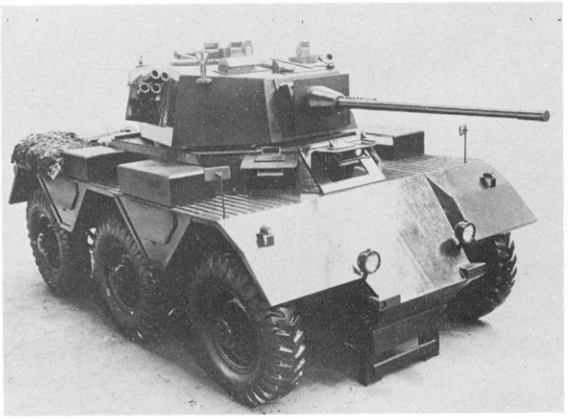
Three-quarter rear view of FV 601(B) showing the tapered and faired rear of the turret, and the periscope in the rear of the fighting compartment hull for driving rearwards in an emergency. (CCR MVEE)



Three-quarter front view of Saladin Mark 1 (FV 601(B)) showing the original sighting and observation equipment. (CCR MVEE)

Side view of the first pre-production version of FV 601(B) (Saladin Mark 1). The triangular plate on the turret warns that the vehicle is not built of armoured plate. (CCR MVEE)





FV 601(A) with Pipsqueak. (CCR MVEE)

Saladin Mark 2 (FV 601(C)) showing gun barrel with counterbalance collar at muzzle. This feature was not retained in series production. (CCR MVEE)

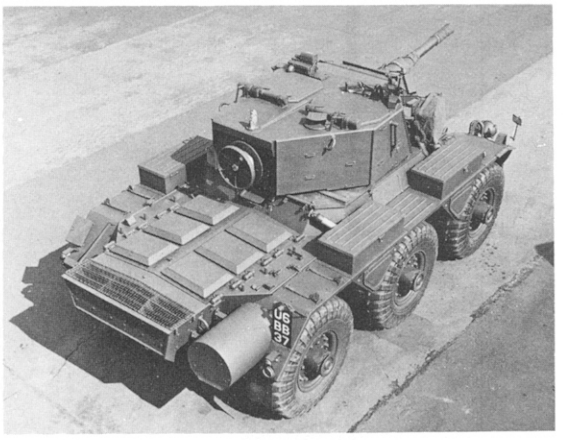
8

12

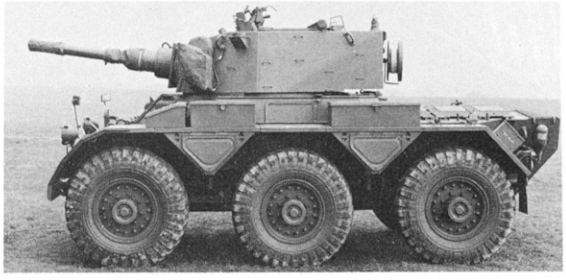
8 to 15 inclusive: Production versions of Saladin Mark 2 (FV 601(C)). Note changes from Mark 1 in turret shape, hatches, and sighting and observation equipment, including disappearance of rear view driving periscope below turret ring. The circular object on the left of the turret adjacent to the smoke grenade dischargers conceals an extractor fan to remove toxic fumes from the coaxial MG. (Alvis Ltd.)

9

10



11



13

calibre device known as the Littlejohn Adaptor. Although the muzzle velocity—and therefore the penetration—had been increased thereby, it precluded the firing of HE rounds and this was an obvious drawback. The outline design for the "Pipsqueak" was ready by February 1946 and as the APDS (armour-piercing, discarding-sabot) round with a muzzle velocity of 4250 feet/second was expected to be capable of defeating 85-mm. of armour at 30° at 1000 yards (an improvement on the specification) the concept was accepted by the following month. 60 2-pdr. rounds would be stowed in all.

FVDD soon saw that it would be impossible to keep the weight of the vehicle down to the seven tons or so of the Daimler—10 tons looked more likely—and a 170 b.h.p. engine was proposed with the double aim of providing a reasonable performance for this vehicle as well as influencing the parallel work on the standardized "B" series of engines for military applications. Protection against attack by the 0·303-in. AP round, a near miss by the 25-pdr. HE round, and the best possible defence against mines was also specified. A later document stressed the need for good performance on soft ground and a smooth ride over all types of terrain, ease of control, a low silhouette, a high reverse speed, optimum vision when closed down, ease of maintenance and a long service life, and a capability for unprepared wading to a depth of 42 inches. A contract for the construction of two prototypes to this FV 601 specification was placed with Alvis Ltd. of Coventry in October 1947*.

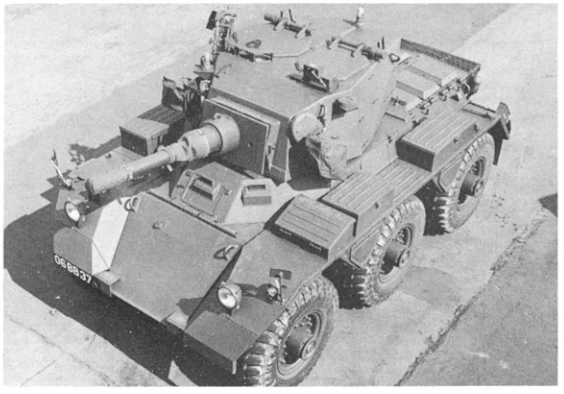
FV 601(A) AND FV 601(B)

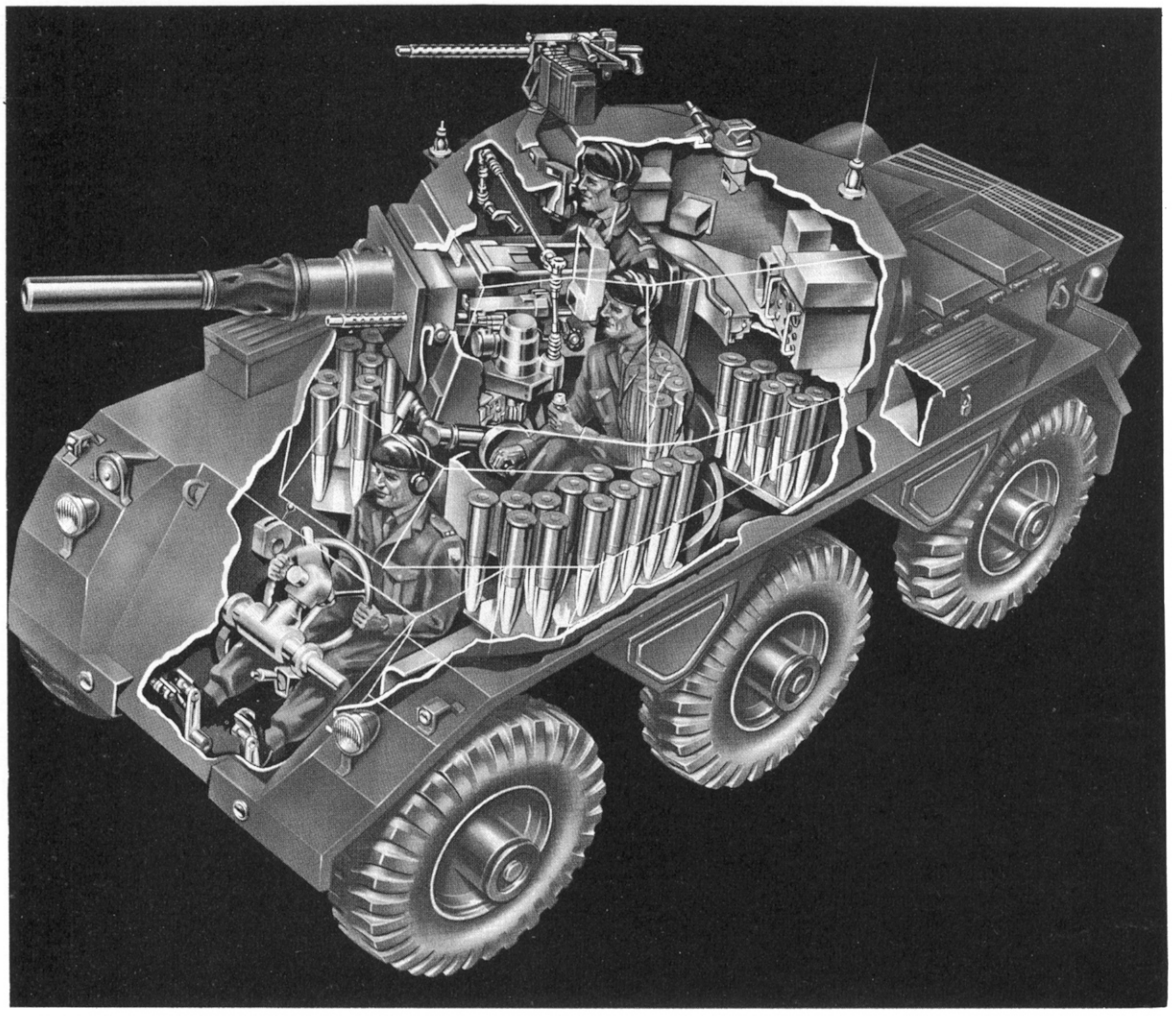
Hardly had work started on FV 601 before the User had doubts over his choice of gun and by February 1948 he was finally convinced that the HE content of the 2-pdr. round was too small. An increase in calibre was clearly

*This company, incidentally, had collaborated before the war with Manfred Weiss of Budapest in the development of an unusual light armoured car (the Alvis-Stranssler) which had a four-wheel suspension, driving and steering on all four; the top speed was 68 m.p.h., a 1 in 2 slope could be climbed and it had a welded hull. Its cross-country performance was said to be excellent and 12 were supplied to the RAF for use in Palestine and Aden before the war in 1939 brought the partnership to an end.

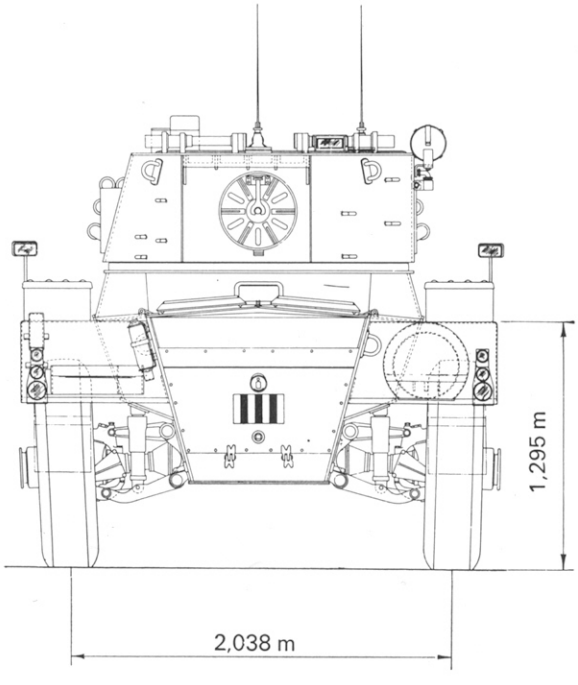
14

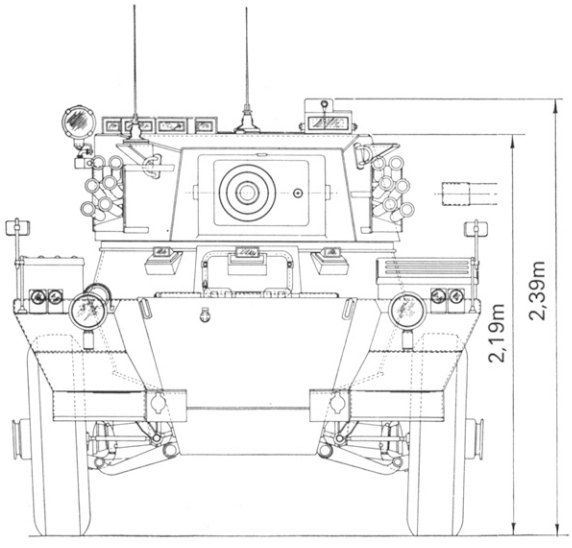
15





Saladin crew positions and 76-mm. gun ammunition stowage. (Alvis Ltd.)

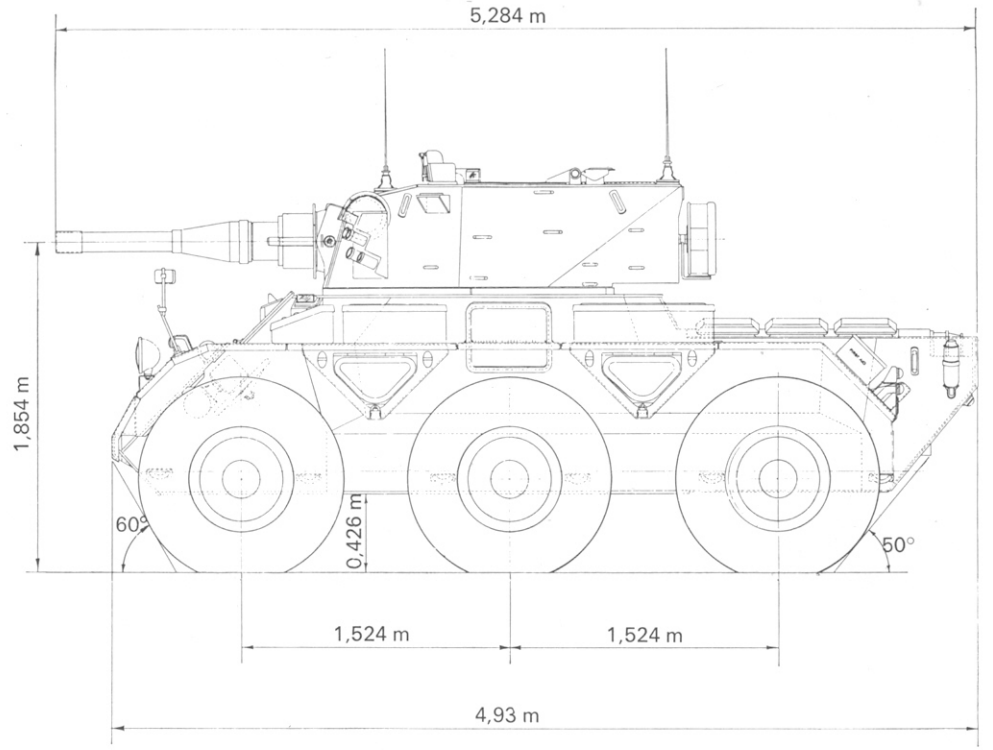


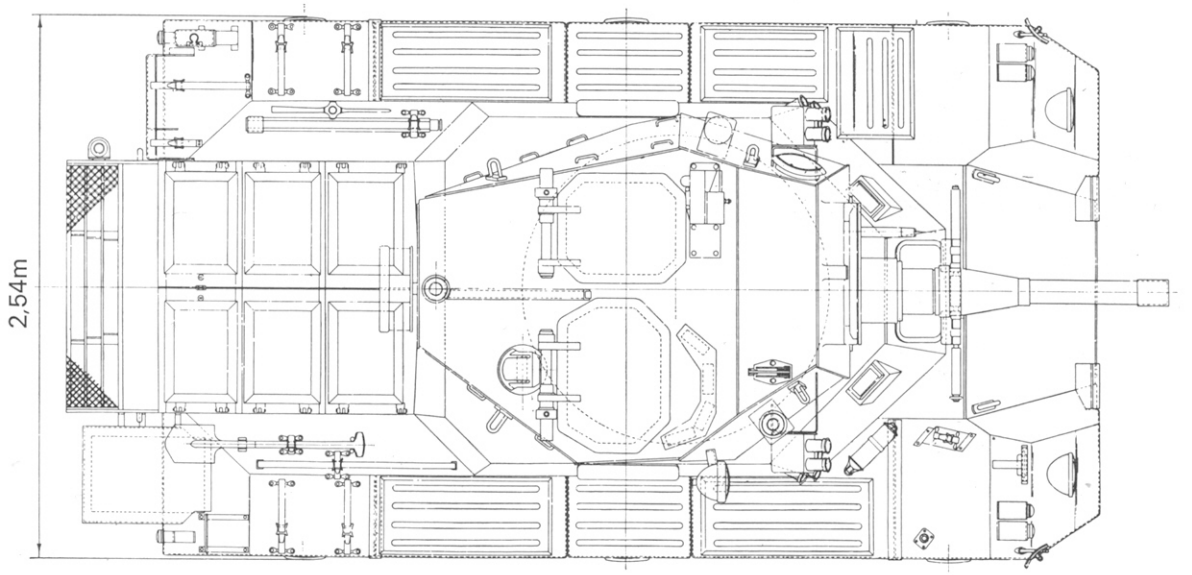


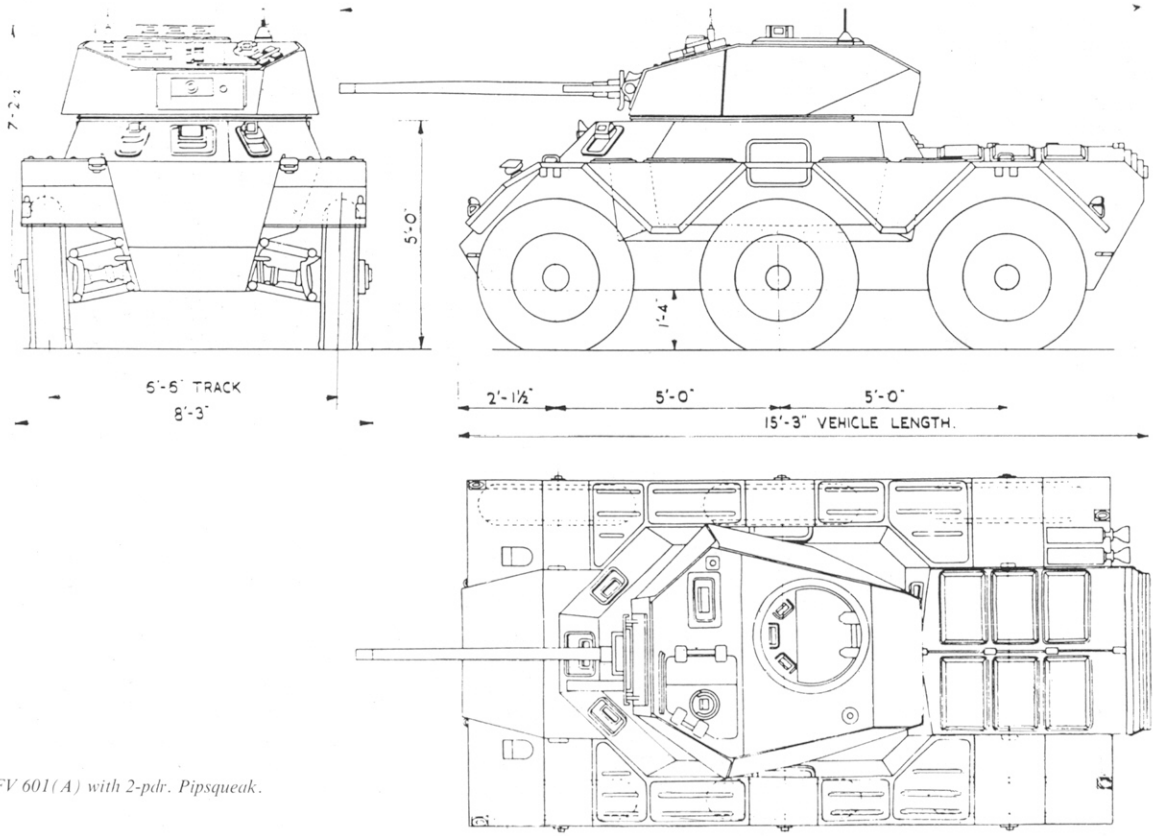
Scale drawings of Saladin Mark 2. Overall length dimension Front/Back Vechile is 4,93m

necessary but a suitable replacement was not easy to find. The low weight of the vehicle with its limited turret ring diameter precluded the installation of any of the current or projected AFV guns and it seems that the only design immediately available was an oldish 3-inch (76-mm.) Howitzer which had been used in the Mark I Churchill tank and proposed for a close support version of Daimler; but it was too inaccurate. The Armament Design Establishment at Fort Halstead proposed a new design of 76-mm. gun but warned that it would be five years before it could be ready for service. As things turned out this delay would not have been too serious but arguments over the merits of the various guns available (including the 75-mm. used in the American M24 Chaffee) continued until November 1949 when Pipsqueak was finally abandoned.

The first mockup with the 2-pdr. installation (601(A)) had been produced in April the previous year but work was now put in hand to build another with the new gun. The turret designers made it clear, however, that the choice of the larger calibre involved the displacement of the third member of the turret crew to allow for the greater swept volume of the gun and the stowage of the larger rounds. The User decided accordingly in April 1949 that the duties in the turret should be divided between two men such that the commander would act as gunner and the other would load (although he would also be able fire the coaxial MG on his own), operate the







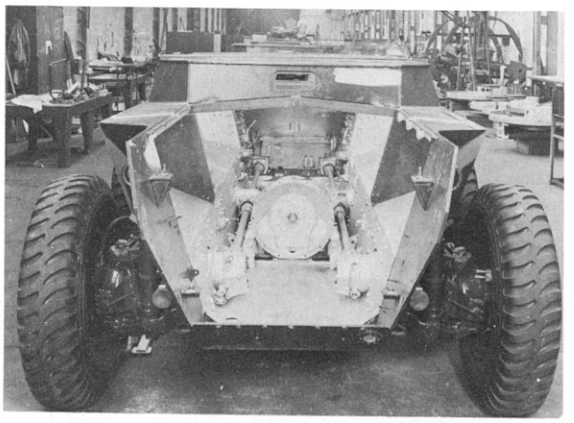
FV 601(A) with 2-pdr. Pipsqueak.

radios, as well as use the rear-facing driving controls for hasty moves in reverse. The commander/gunner now had an elaborate design of contra-rotating cupola to facilitate the acquisition of targets, but although ideal in concept it proved extremely difficult to put into practice. In 1954, following a number of studies by the User and a REME Maintenance Advisory Group, it was decided to remove the rear driving facilities in favour of better access to the engine compartment and stowage for a further eight 76-mm. rounds and more MG ammunition. The vehicle was re-designated FV 601 (B) at this stage.

FV 601(D) variant built for the BundesgrenzschutzKommando in the Federal Republic of Germany. Note the modified mantlet with no provision for a coaxially mounted MG. (Alvis Ltd.)

Although the two Mark I prototypes ordered from Alvis were delivered by early 1953 it was two years before the six pre-production vehicles were ready. The changes in design that have already been described were partially responsible for the long delays but contributory factors were that FV 603, the Saracen APC, was given a higher priority for reasons to be described later, and some funds were diverted to the urgent development of FV 214, the Conqueror heavy gun tank, in the early 1950s. Pending the building of new assembly lines at Coventry the pre-production vehicles were made by Crossley Ltd. at Stockport, although Alvis did most of the detailed drawing and jig construction.

The User, meanwhile, had second thoughts on the division of duties between the turret crew and it was decided that the commander should now take over the loading of the 76-mm. while the radio operator doubled as the gunner. This fundamental change in layout involved further serious delays, although the opportunity was taken to simplify the fire control equipment drastically as a result. The 0·50-inch MG for anti-aircraft fire, traversing on a ring above the commander's cupola, was also replaced by a 0·30-inch MG on a simpler mounting during this period. The new internal scheme for the turret together with alterations in hatch design were accepted in June 1956 and production of what was now named Saladin was scheduled for the beginning of 1958. But this too was put back—by a further six months—because of a last-minute increase in the specification for ballistic immunity which entailed rapid changes to the front and sides of the turret, as well as the hull. Saladin Mark 2 (FV 601(C)) finally went into production in mid-1958, nearly 13 years after its inception: it now remained to see whether it had been worth waiting for.



Saladin in the Assembly Shop. The engine has not yet been installed leaving visible the gearbox and the four propellor shafts connected to the bevel boxes at the six wheel stations. (CCR MVEE)

An experimental version of Saladin modified to swim by the raising of a rubberised screen, a method used inter alia *on the FV 432 APC.* (Alvis Ltd.)

SALADIN MARK TWO DESCRIBED

In its general layout Saladin resembles a conventional tank with the driver's compartment in the front of the hull, the fighting compartment and turret in the centre and the power plant at the rear. The hull, like the turret, is constructed from welded armour-steel plate and is boat-shaped in cross-section with an octagonal superstructure which encloses the crew compartment and supports the turret. The driver's hatch is hinged at the bottom, closing being assisted by a torsion spring, and it contains one of his periscopes for driving closed down; the other two being one either side in the hull superstructure. An emergency hatch is provided on both sides of the vehicle in the fighting compartment walls and a small flap at the rear of this compartment is the only reminder of the proposed facility for duplicated driving controls. Six interlocking hatches allow access to the top of the engine compartment, the rear plate of the hull hinges down to expose the radiator and there are a number of servicing plates and plugs in the hull floor.

The driver's compartment is relatively large and the controls and instruments are well positioned. The unusual attitude for the steering wheel is extremely effective in saving space while allowing quick movement in and out of the seat, and this layout is also to be found in the Daimler Ferret Scout Car. The foot controls are placed conventionally although the clutch is replaced by the gear-change pedal for the semi-automatic transmission, the gear selector being on the right hand wall and that for forward/reverse drive on the left. The handbrake is located between the driver's legs, and although it is applied by a ratchet action, release can be almost instantaneous. The comfortable seat is adjustable in two axes. The electrical distribution panel is mounted on the right of the compartment and contains the master switch to isolate the batteries from the vehicle systems, and the inter-vehicle starting socket.

The turret is unsymmetrical in form and fabricated from steeply sloped plate. The commander/loader is positioned on the right, and the gunner/operator on the left, of the turret, their seats being secured to pillars which also carry the turntable. Both crewmen have large, single-plate hatches in the roof which hinge rearwards. An extractor fan on the left wall prevents the undesirable concentration of fumes from the turret weapons.

ARMAMENT AND AMMUNITION

The 76-mm. gun that had been specially designed for this vehicle by ADE (now Royal Armament Research and Design Establishment) fires medium-velocity rounds of HESH (high explosive, squash head) to defeat armoured and other hard targets, HE, base-ejection smoke, as well as canister rounds containing about 780 steel pellets for

The FV 601(D) variant. Note the German smoke grenade dischargers among other detailed changes. (Alvis Ltd.)

Standard Saladin Mark 2 modified to carry the BAC Swingfire anti-tank GW system. Two missiles are carried in the "ready-to-fire" position on the sides of the turret, and a further two on the rear wheelguards. (Alvis Ltd.)

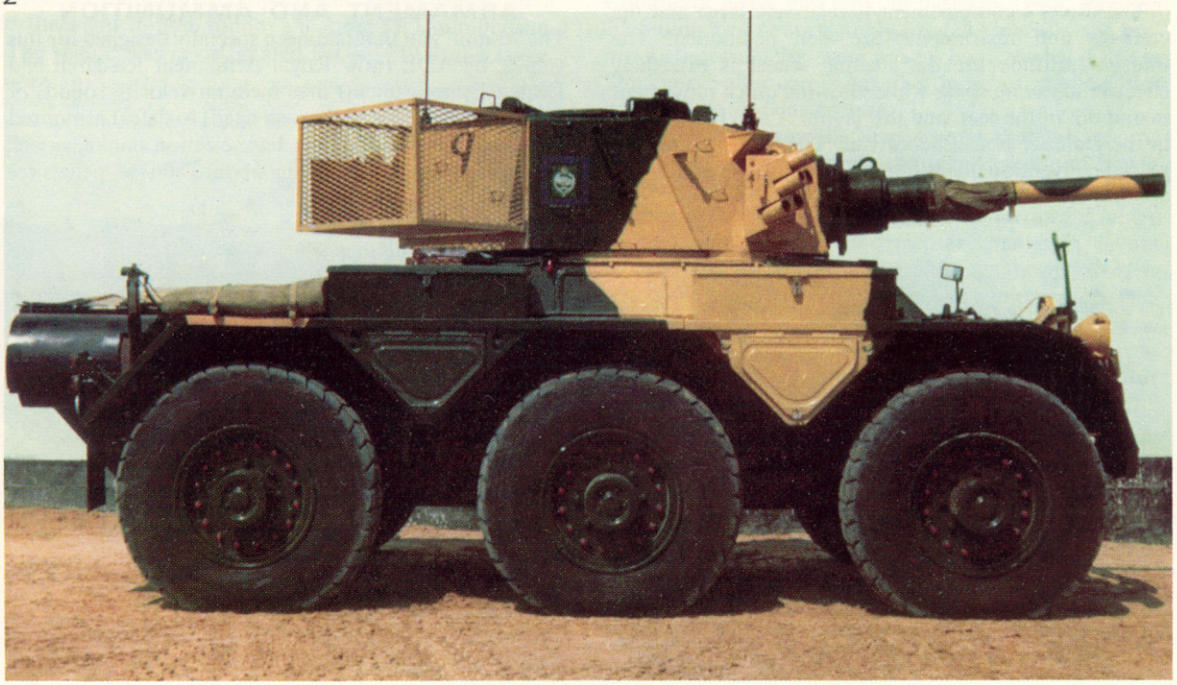
1

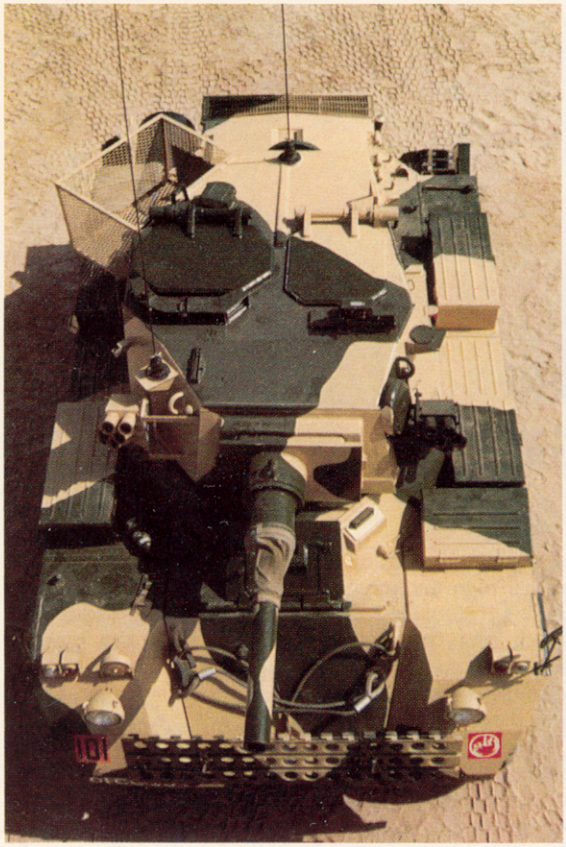
3

7: B Squadron, 3rd Royal Tank Regiment – sign on both sides of turret. (3RTR)

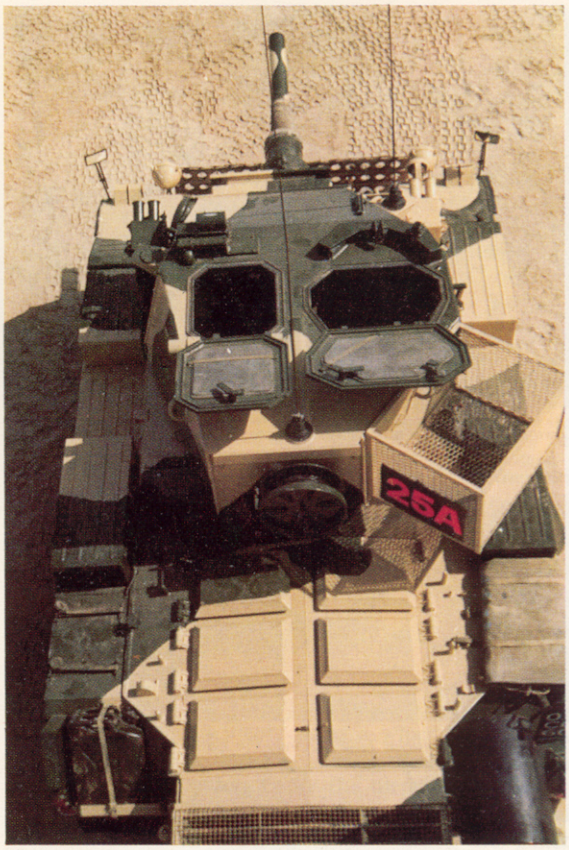
8: Unit sign. (3RTR)

2





5



6

1 to 6 inclusive: Saladin of B Squadron, 3rd Royal Tank Regiment, at Sharjah, Persian Gulf. (3RTR)

4

"Swimming" Saladin with rubberised screen raised. (Alvis Ltd.)

Saladin of The Queen's Own Hussars with its RH front and LH centre wheels removed moving across rough ground to demonstrate how the effect of mines can be minimised. (CCR BIS)

Saladin of the 3rd Royal Tank Regiment in Eastern Arabia with Sioux helicopter in the background. (3 RTR)

A well-camouflaged Saladin Mark 2 on exercise in Germany. (Army PR)

use against massed infantry at short range. The rounds are loaded by the commander and initiated by percussion primers. The gun barrel is a single forging attached to the breech ring by interrupted threads and the breech mechanism consists of a vertically-sliding block which is normally operated semi-automatically. Empty cases are ejected into a bin.

The coaxial mounting for the main armament and the 0·30-in. MG consists of a welded mantlet and a tubular cradle permitting a maximum elevation of about 20° and depression of 10° at all positions of the turret. Trunnion pins are welded on both sides of the mantlet to the rear of which is bolted the outer cylinder of the concentric recoil system, the forward end of which protrudes from the mantlet. The recoil system also acts as the cradle to support the gun which is connected to the recoiling inner cylinder by means of a screwed locating ring. A section of the outer surface of this cylinder is threaded to receive the piston head, and a single helical run-out spring is held between this and the rear inner face of the outer cylinder. Mineral oil absorbs the energy as the clearance between the recoiling piston head and the tapering internal diameter of the outer cylinder reduces towards the rear thus bringing the gun to a smooth halt about 10 inches behind the beating face. The compressed spring returns the gun to the firing position, the final movement being smoothed by means of a hydraulic buffer. During the run-out action the breech is opened automatically, the

The crew of a Saladin leaving their vehicle after it has been mined during the final days in Aden. (Associated Press)

Saladins and Ferret Scout Cars of 4th Royal Tank Regiment halted for a short rest during the Radfan Operations. (Army PR)

The 4th Royal Tanks in a less arid setting—a Saladin of 4 RTR drives through a rubber plantation in Central Malaya during Exercise "Lemon Squeezer." (Army PR)

While tippers of 7 Squadron Royal Corps of Transport toil away on the construction of the Dhala road in the Radfan Hills, a Saladin of the 4th/7th Royal Dragoon Guards stands by as protection against attack. (Army PR)

empty case ejected and the firing mechanism recocked. The anti-rotation gear and the range gear are attached to the mounting. A simple fabricated cradle is bolted to the left rear of the mantlet for the MG which is serviced and loaded by the gunner. Both guns are normally fired electrically, power being supplied via the rotary base junction at the centre of the turntable and the gunner's control box which incorporates a gun circuit selector lever. A foot pedal operates a mechanical linkage to fire either gun in the event of a power failure.

Both commander and gunner have hand traverse controls, and rapid switches are facilitated by the use of an electrically driven torque amplifier in conjunction with a high ratio in the gearbox. The elevating gear operates on the nut and screw principle and is controlled by the gunner.

Whereas the original scheme for the fire control equipment involved a somewhat complex arrangement for target acquisition, the production version has only a simple blade vane sight, using which the commander aligns the gun in azimuth only. A circle of four periscopes gives a field of view of about 150° forward for general observation and a single instrument faces rearwards in a flexible mounting. The gunner's periscopic sight is similar in construction to those used in the Centurion and Chieftain tanks: for direct fire with HESH, HE and MG there is a fixed ballistic graticule in an optical system which has a field of view of 11° and a magnification of six times. An observation window above the sighting eyepiece of ×1 magnification has a field of view of 42°. The object glass is protected by a hood on the turret roof and incorporates a wiper blade and a demisting element, and the sight itself is secured in a mounting which pivots under the turret roof, tangent elevation being transmitted by a link bar connected to the left of the mantlet. Targets which are either beyond the range of the ballistic graticule, or concealed from the gunner, are engaged by setting the range on the drum on the left of the gun cradle and elevating the gun until the clinometer bubble is level; a similar method to that used in the Chieftain. Line switches are measured by an electrically-operated traverse indicator, the transmitter unit being driven off the turret rack forward of the commander with the receiver to the left front of the gunner.

The secondary armament for Saladin consists of two 0·30-in. machine-guns of Browning design, one being mounted coaxially and the other on a pintle on the turret roof to enable the commander to engage close-range airborne and ground targets, although he has to

A troop in an armoured car regiment consists of two Saladins and two Ferret Scout Cars. (CCR BIS)

Saladin of The Queen's Own Hussars demonstrates its capability of crossing a deep and wide gully. (CCR BIS)

Guided by instructions over the inter-com from the commander, the driver of a Saladin reverses over a ford. (CCR BIS)

expose the upper part of his body in order to do so. The guns are operated by a gas-assisted recoil and spring action and have a cyclic rate of fire of 425–450 rounds per minute with ball and trace ammunition. Batteries of six dischargers are mounted one each side of the turret and the electrically fired smoke grenades quickly form a dense screen in an arc some 60 yards away, under cover of which the vehicle can quickly withdraw from trouble.

The 42 rounds of 76-mm. ammunition are all stowed vertically in the fighting compartment, 11 ready rounds between the commander and gunner, 23 on the left and right front of the compartment under the turret ring, and the remaining eight at the left rear. Most of the MG rounds are stowed on the turntable.

ENGINE AND TRANSMISSION

The engine compartment is separated from the fighting compartment by a fire-proof bulkhead. The engine itself is mounted longitudinally and centrally, with a fuel tank on either side and a third at the left hand front, the air cleaners at the left hand front and the twin cooling fans and radiator at the rear of the compartment. The engine is one of the Rolls-Royce series developed for military use and is of conventional design with eight cylinders in line. It is liquid cooled, operates on 80 octane gasoline and develops 160 b.h.p. at 3750 r.p.m. Lubrication is by a dry sump system, the gear-type pump drawing oil from a tank under the radiator and passing it through a full flow filter to the engine. A scavenge pump returns the oil from the sump through a cooler. Air for the sealed

cooling system is drawn through louvres in the engine access doors by the two fans, through the radiators and is expelled through grilles at the extreme rear of the engine decks. Aspiratory air passes through an oil bath filter before reaching the dual down-draught Solex carburetter. Ignition is by a coil system which is waterproofed and suppressed to avoid radio interference.

The main transmission assemblies are under the fighting compartment and are accessible for normal servicing through lifting plates in the turntable. Drive from the engine forward to the gearbox is transmitted by a fluid coupling of Daimler design mounted on the crankshaft, and is completely automatic and smooth in operation. Slip can be 100 per cent with the vehicle static and the engine idling but this decreases to less than 2 per cent at about 1900 r.p.m. The epicyclic gearbox, again, is a Daimler design and provides five speeds in one direction, all of which can be pre-selected. Depression and release of the gear-change pedal engages the gear selected by the driver and gives him the direct control of the transmission that makes for excellent agility across broken ground with a minimum of effort on his part. The transfer box is mounted on the forward end of the gearbox, transmits torque through right angles to the central bevel boxes, and incorporates a central differential and directional spiral bevel gears to obtain forward, reverse or neutral drive selected by the driver. This layout gives the use of all five gears in both directions and is a valuable attribute for a reconnaissance vehicle which may have to withdraw very rapidly in an emergency. Four propellor shafts connect the other bevel boxes, one at each wheel station. The road wheels are driven finally through tracta joints, which allow for the vertical movement of the suspension relative to the hull and the steering movement of the front four wheels, to epicyclic reduction in the wheels themselves.

Saladin of 3rd Royal Tank Regiment leaves a desert track to cross rough terrain during a training exercise in Eastern Arabia. Sand channels are stowed on the glacis plate. (CCR BIS)

SUSPENSION AND STEERING

The suspension assembly at each of the six stations consists of an upper and lower link, the former being attached to a longitudinal torsion bar which is splined to a tube secured to the hull. The outer ends of the links are connected to a swivel yoke—in the case of the steered wheels—and a fixed yoke for the rear pair. Double acting, hydraulic shock absorbers and bump and rebound dampers are fitted on the front and rear stations, with a simpler arrangement in the centre. About five or six inches upwards and four to five inches downward movement are available. Although this design is somewhat complex it is very effective in providing a smooth ride over most types of terrain at speed and a

Saladins of The Queen's Own Hussars come ashore during a beach landing exercise in Eastern Arabia. (CCR BIS)

Saracen Armoured Personnel Carrier. The small turret for the commander mounts a 0·30-in. Browning MG. (Alvis Ltd.)

useful performance over obstacles. In addition, up to two wheels can be incapacitated providing that they are not both on the same side and one from the front pair remains. Coupled with the use of "run-flat" tires, damage from enemy fire and mines can be absorbed to an extent which would completely immobilise a tracked vehicle.

An hydraulic system is used to assist in steering and to operate the brakes. The pump is driven from the main engine and the system is maintained at between 900 and 1450 lb/sq. in. the three accumulators being housed at the rear of the fighting compartment. Power assistance for steering is obtained by using hydraulic jacks superimposed on the linkage on either side and operated by a control valve on the upper steering bevel box. A recirculating ball layout operates on the front two wheels which are each connected to the wheel behind by a rocking beam. The geometry of this system ensures the correct tracking during turns in that the centre wheels have to move through a smaller arc than the front ones. Disc brakes are fitted on all six wheels.

ELECTRICAL SYSTEM

Saladin's electrical circuits are of the nominal negative earth return type operating on 24 volts. The two 12-volt batteries are positioned in the rear of the fighting compartment and they are charged by a belt-driven generator with a maximum output of 75 amps and mounted on the engine. An automatic, two-speed gearbox ensures that the charging rate is maintained by increasing the rotational speed of the armature when the engine revolutions drop below a pre-determined level. A boiling vessel to heat food and drink is among the more conventional components in the system.

A comprehensive system of fire detection and fighting equipment is installed. Flame detectors operate a warning horn in the driver's compartment and initiate a high pitched noise in the intercommunication system if excessive heat is detected in the engine system. Hand-held extinguishers and a fixed CO_2 system are provided.

Saracen Armoured Personnel Carrier with various ports and hatches open and smoke grenade dischargers uncovered. (CCR MVEE)

SALADIN VARIANTS

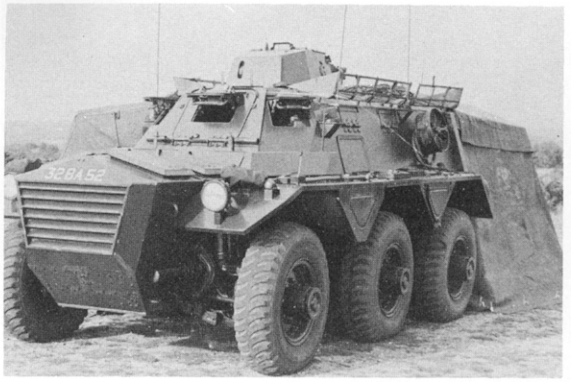
Having been designed for service world-wide the basic Saladin needs comparatively few modifications for a particular theatre of operations. However, some customers have specified a number of changes and these have included sand tires for use in the desert and additional heaters for the crew compartment. The *Bundesgrenzschutz Kommando*, the frontier protection force in the Federal Republic of Germany, were more demanding and the FV601(D) version has smoke grenade dischargers and driving lights of German origin and a smaller mantlet plate as there was no requirement for a coaxial MG.

All Saladins can be modified to mount the British Aircraft Corporation's Swingfire anti-tank missile system. Four missiles are carried, two of which are in the "ready" position on the turret and as they have a high chance of a kill to ranges well over 3000 metres the firepower of Saladin can be greatly enhanced.

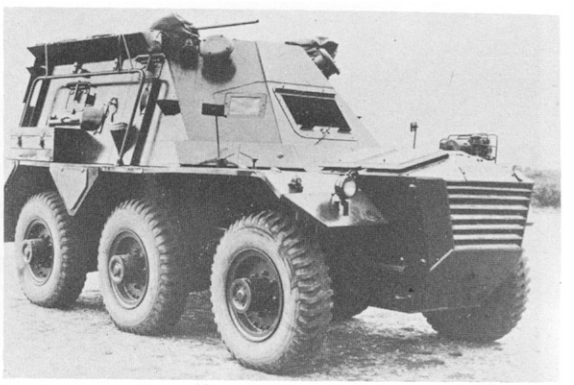
In addition to its being able to wade to a depth of seven feet with prior preparation Saladin can also be modified to swim after the erection of a bellows type screen which would be permanently stowed on the perimeter of the hull. Propulsion and steering are obtained by the rotation of the road wheels. Research is also being carried out on the possibility of using some of the automotive components of the amphibious load carrier, Stalwart, to increase further the agility of the armoured car.

SARACEN AND ITS DERIVATIVES

Although the specification for FV 603 Armoured Personnel Carrier (APC) was issued two years later than that for Saladin it was in production by December 1952—six years earlier. The reason for the haste—and the consequent delay to the Saladin programme—was the urgent requirement for an armoured vehicle with overhead cover to carry men and stores during the Malayan Emergency. Alvis Ltd. were again designated as the design parents. The development was extremely rushed, to the extent that production vehicles were being built at the same time as the prototypes and a number of fundamental modifications were necessary from July 1951 onwards when the trials began at FVRDE (Fighting Vehicles Research and Development Establishment, now Military Vehicles Experimental Establishment). Major worries involved the suspension and cooling, this last being particularly difficult to solve with a front-mounted engine but equally important for service in the tropics. Better known as Saracen, this APC has subsequently



Saracen as signal centre or HQ with extra radios and penthouse. (CCR MVEE)



FV 610: originally designed to meet a requirement of the Royal Artillery this armoured command vehicle has also been used by some formation HQs in Germany. (CCR MVEE)

seen service in a number of countries and carried the infantry battalion in armoured brigades in the British Army in Germany until the arrival of the tracked FV 432.

In many respects the Saracen chassis is that of a Saladin armoured car running in reverse—the selection of an equal range of gears for forward and reverse running in the transfer box making this possible—and about 48 per cent of all automotive components are common to both vehicles. The APC carries a section of nine men and a vehicle commander, radio operator and driver. Production versions of the Saracen mount the same design of turret used on the Ferret Mark 2 reconnaissance vehicle armed with a 0·30-in. MG. The layout of the suspension necessitates a boat-shaped hull and the infantrymen have to sit facing inwards in order to make the best use of the internal volume available, although there are small ports in the side armour and a circular hatch in the rear of the roof. Luckily this parameter did not clash with British policy at the time which saw the APC as a means only for carrying infantry to battle where they fought on foot. FV 603 (C), the latest version, and incorporating reverse flow cooling for the crew and infantry compartment, weighs about 22,900 lbs. combat loaded, and is 8 ft. 1 in. high and 17 ft. 2 in. long overall. Most other dimensions, and the performance, are the same or very similar to those for Saladin.

Even earlier than the APC, a specification for an armoured command vehicle (ACV) had been issued in 1946; but FV 602 appears to have been abandoned by late 1949 without going beyond the conceptual stage. It was partially replaced in November 1949 when a new requirement for two types of ACV was issued: FV 603 (B), for use at the unit or sub-unit level, and FV 603 (C), for a ground to air communications centre. The former evolved into FV 604 and, except for the installation of extra radios and stowage bins, an externally mounted generator and changes to the roof, looks similar to the APC. The original FV 603 (C) met a similar fate to FV 602. A further specification was issued in 1956 for a command vehicle with a higher working compartment for use primarily by the Royal Artillery; this was met by FV 610 which, with its extra generating capacity and width, as well as height, has also been used at formation headquarters. Two other versions have been FV 605, an ambulance for four (later three) lying and eight sitting casualties, and one mounting the Decca Robert radar for ground surveillance. Another concept foresaw the standard artillery 25-pdr. gun/howitzer in a mounting having 260° traverse and based on a vehicle from the FV600 series but this got little further than the drawing board.

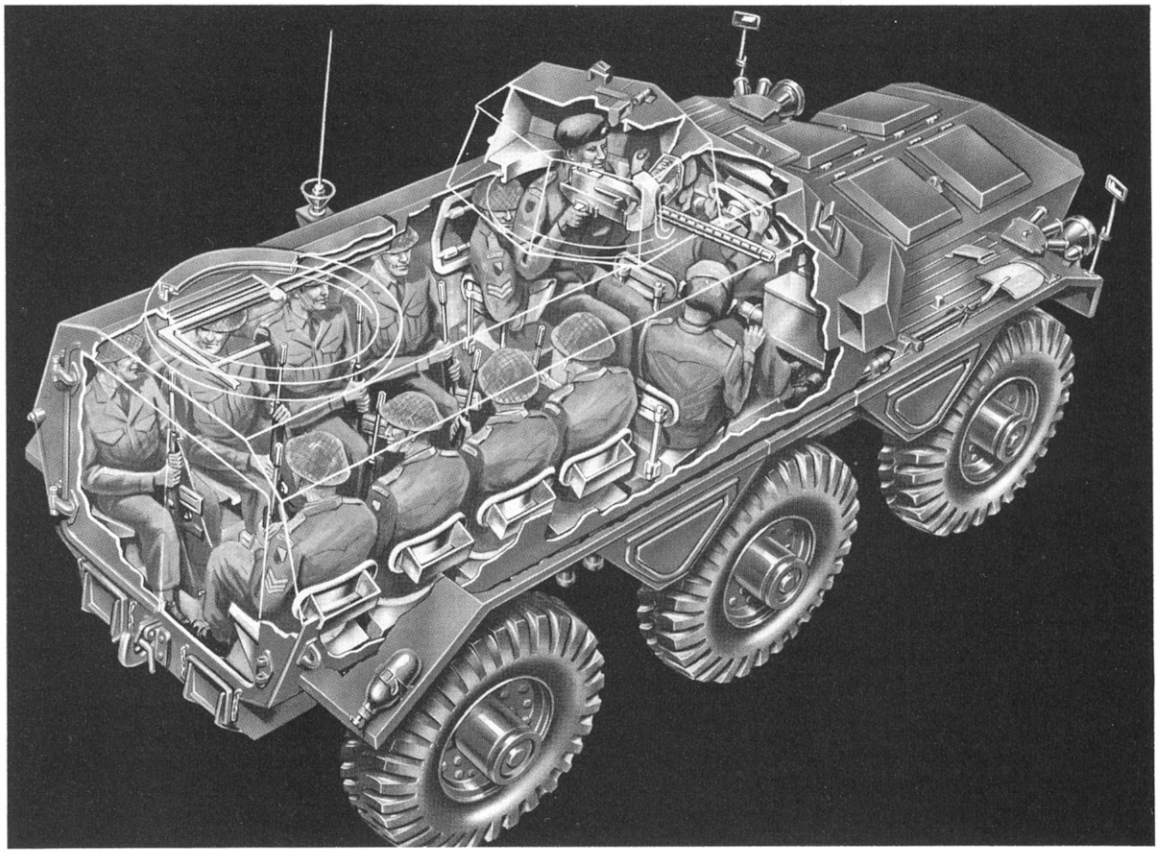
Two other vehicles from the Alvis stable must also be mentioned. FV 622, Stalwart, was conceived as a private venture in 1960 as a high mobility load carrier. The need for such a vehicle was recognized officially by the British army and the first squadron of the Royal Corps of Transport was so equipped in 1964. Stalwart can carry up to five tons of stores and its mobility across country is comparable to that of a tracked vehicle. Its excellent performance here and when swimming water obstacles, including the open sea, powered by Dowty marine jet units, and its agility in entering and leaving the water are further tributes to the design of the suspension which owes much to experience with the earlier vehicles in the FV 600 series. The basic vehicle can be adapted for many other rôles, including troop carrying, vehicle recovery and missile launching.

The second is FV 652 Salamander, an airfield fire and crash tender, again whose excellent mobility enables it rapidly to reach crashes which often occur beyond the perimeter of an airfield.

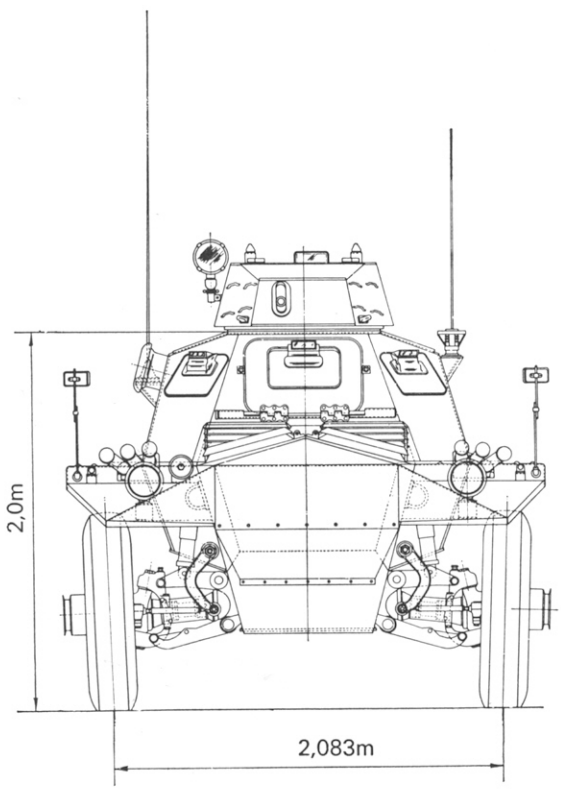
TACTICAL EMPLOYMENT

The first Saladins entered service in 1959 and were an immediate success. The British Army has used them subsequently on operations in Malaysia and the Arabian Peninsula and they are also deployed in the Strategic Command in the United Kingdom, Germany and Hong Kong. At least fourteen other countries have also adopted Saladin, among them being Jordan, Indonesia, Ghana and the Sudan.

The primary task for a British armoured car regiment is the speedy collection of accurate information and the employment of Saladin depends on a number of interrelated factors: mobility, protection, communications and firepower. In the first instance Saladin has a high road speed and makes little more noise than a truck of equivalent size, a most important consideration when stealth often has to make up for comparatively light protection. Its light weight also permits use in countries where roads and bridges are unable to bear the weight and damage caused by a tracked vehicle. Although the cross-country performance of even a multi-wheeled vehicle cannot always be as good as that of one on tracks,



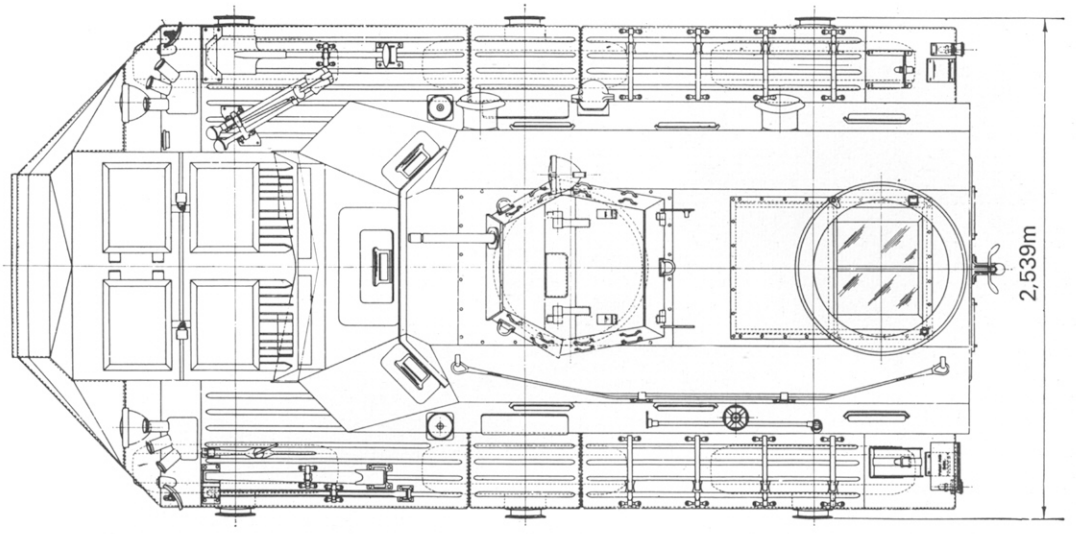
The Saracen carries a section of nine men, and a vehicle commander, a radio operator, and a driver. (Alvis Ltd.)



Saladin has shown itself to be more than adequate over most of the types of ground likely to be met on operations, including jungle and the sand and rock of the desert. Mobility and a high endurance in terms of radius of action are complemented by excellent communications to permit the flexibility of employment necessary in reconnaissance. As information gained must be passed back quickly—often over long distances—if it is to be of any value, the ability to communicate in all conditions is of prime importance in this rôle. Saladin has the firepower of a light tank, and it can be used as such although this will almost always be at the expense of its reconnoitring rôle.

A troop in an armoured car regiment consists of two Saladin armoured cars and two Ferret scout cars, which may be equipped with Vigilant anti-tank missiles. A Saracen APC may be attached to the troop, carrying a section of assault troopers. These men are trained both as infantry and pioneers and their tasks may include light demolitions, mine clearance, dismounted protection of the troop and the manning of observation posts. Helicopters from the Air Troop will often be used in support as well to supplement observation from the ground. The armoured car troop, of which there are five in a squadron, is tactically self-sufficient as it may be operating up to 10 miles away from the squadron headquarters, which itself may be 20 miles from regimental headquarters.

In limited or general war the main task will be medium reconnaissance and in an advance to contact this may involve moving up to 90 miles ahead of the main force.



As contact may be made initially with the enemy's own screening forces the skilful use of ground and some skirmishing may be necessary in order to establish the position of his main elements. A troop may also be required to form part of a surveillance screen in static conditions. Should nuclear weapons be used a troop may be ordered forward to report on the effect of strikes and carry out surveys of the residual radiation. Withdrawals could also see the troop being used as part of a delaying force, fighting probably taking priority over observation, and with artillery and engineers in support. Other rôles include guarding the flanks of an advance, countering airborne attacks or enemy helicopters, escorting vital stores or VIPs, the establishment of control posts during the move of a formation and, possibly, independent raids deep into enemy held territory. But all these other tasks (some of which apply to other types of warfare) must be reconciled with the primary aim of reconnaissance.

Saladins have also been used very successfully in counter-insurgency operations where it has been either physically impossible or politically inadvisable to use other weapons. They were so used in the Arabian Peninsula for direct fire support in the Radfan operation, and in Borneo where they often fired in the indirect rôle as artillery. Armoured cars are also valuable in internal security missions for such tasks as showing the flag or enforcing curfew restrictions, as well as the establishment of traffic controls and supplementing communication networks.

FV 622 Stalwart moving at speed across country. (Alvis Ltd.)

The armoured car is an essential element in all forms of war, from general nuclear to combatting a handful of insurgents. Yet if the former is unlikely, minor conflicts are not, and there is no sign of their becoming less frequent. In spite of its somewhat traumatic development Saladin has proved to be a most successful design under these conditions and its future in many countries seems assured.

AFV Series Editor: DUNCAN CROW

OUTLINE SPECIFICATION FOR SALADIN ARMOURED CAR MARK 2 (FV 601 (C))

Dimensions

Length overall:	17 ft. 4 ins.
Length of hull overall:	16 ft. 2 ins.
Wheelbase:	10 ft. 0 ins. (Wheels spaced equally)
Width overall:	8 ft. 5 ins.
Track width:	6 ft. 10 ins.
Height to top of hull:	5 ft. 1 ins.
Height overall (less Comd. MG):	7 ft. 10 ins.
Ground clearance:	1 ft. 5 ins.

Weights

Total basic: 23,072 lbs. (Mark 1: 19,376 lbs.)
gross: 25,536 lbs. (distributed: front – 7280 lbs;
centre – 8848 lbs;
rear – 9408 lbs)

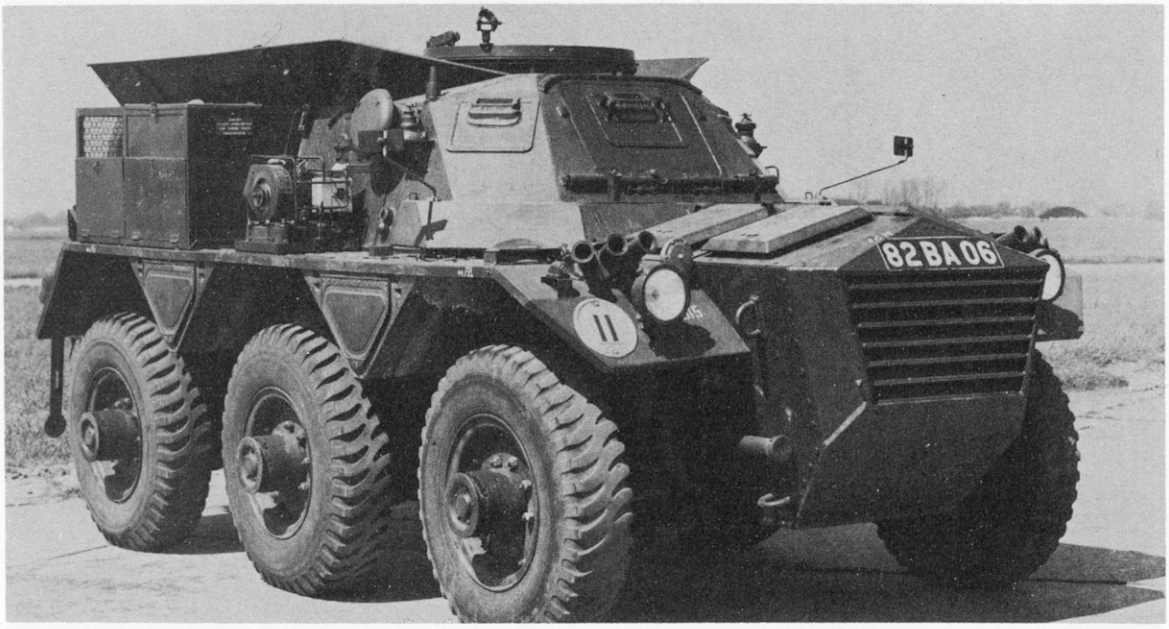
Armament

76-mm. Gun L5A1 and Coaxial Mounting No. 2 Mark 3

Gun length overall:	85·2 ins.
Calibre:	3 ins.
Breech mechanism:	vertical sliding block with semi-automatic action.
Fixed ammunition:	live and practice HESH (muzzle velocity 1750 feet/sec. approx.), HE, Canister and Smoke. Total stowage for 42 rounds.
Firing gear:	percussion operated by solenoid or mechanically.
Recoil system:	hydro-spring with one low pressure cylinder mounted concentrically on barrel. Length of recoil approx. 10 ins.
Elevation:	plus 20° to minus 10°. Nut and screw, hand operation.
Traverse:	360°. Hand operation with power assistance through torque amplifier.

L3A3, L3A4 or Browning M1919A4 Machine-Guns

Mountings:	one coaxial with 76 mm. and one on top right of turret roof (can be fired from ground mounting).
Calibre:	0·30 in. (7·62 mm.)
Length overall:	38 ins.
Weight:	31 lbs.
Operation:	recoil and spring with gas assistance.



FV 604: Saracen APC modified to become an armoured command vehicle. Note externally mounted generator, extra stowage bins, and changes to roof compared with the APC. (CCR MVEE)

Cyclic rate of fire: 425–450 r.p.m.
Total stowage of 3,500 rounds (14 boxes).

Ancillary Weapons
30 grenades, including 12 smoke for grenade dischargers.
Sterling SMG with stowage for 160 rounds.

Fire Control and Observation Equipment
Gunner's Equipment:
No. 17 AFV periscopic sight with ballistic graticule for direct fire and x6 magnification; x1 window for general observation.
Rangedrum and clinometer for semi-indirect and indirect fire; electric traverse indicator.

Commander's Equipment:
Blade vane sight for target acquisition; four No. 18 periscopes facing forward and one rear; hand-held binoculars.

Driver's Equipment
Three No. 17 periscopes.

Automotive systems
Engine

Type:	Rolls Royce B80 No. 1 Mark 6D gasoline, liquid cooled.
Cylinders:	8 in line
Max. b.h.p. (gross):	160 at 3,750 r.p.m.
Max. b.h.p. at flywheel (nett):	136 at 3,750 r.p.m.
Max. torque at flywheel (nett):	257 lb.-ft. at 1,750 r.p.m.
Bore:	88·9 mm.
Stroke:	114·3 mm.
Capacity:	5·67 litres
Compression ratio:	6·4:1
Lubrication system:	dry sump operated by gear-type oil pump. capacity—3·5 imp. galls.
Cooling system:	thermo-siphon, pump assisted. capacity—7·3 imp. galls.
Fuel system:	mechanical diaphragm type pump with down-draught carburetter. Capacity—53 imp. galls.
Engine coupling:	Daimler fluid type.
Main gearbox:	Daimler epicyclic, semi-automatic, pre-selector with five gears with forward/reverse selected on transfer box.

Overall ratios (engine to road wheels) via transfer box (2·43:1), bevel box (1·00:1) and hub reduction gearbox (4·125:1).

		Max. speed [m.p.h.]
1st:	103·20:1	4·4
2nd:	47·50:1	9·6
3rd:	26·60:1	17·4
4th:	16·20:1	28·2
5th:	10·05:1	45·5

Nett Power/gross Weight Ratio: 11·94 b.h.p./ton

Max. tractive effort:	5th gear: 135 lb./ton 1st. gear: 1,400 lb./ton
Steering:	recirculating ball, hydraulically assisted.
Turning circle:	48 ft.
Suspension:	fully independent with torsion bars and sleeves; double acting hydraulic-telescopic shock absorbers; wheel deflection: static to bump: 5–6 ins., static to rebound: 4–5 ins.
Wheels:	B8·00—20 ins. divided discs.
Ground pressure (with 12·00 tires):	15·9 p.s.i.
Brakes:	Hydraulic, power operated disc type with mechanical linkage for hand brake.

Performance

Speeds:	maximum—45·5 m.p.h. safe average on roads—30 m.p.h. safe average across country—20 m.p.h.
Max. gradient:	24° (1:2·5)
Average range of operation:	roads—250 miles cross country—140 miles
Average fuel consumption:	roads—4·7 m.p.g. cross country—2·6 m.p.g.
Ditch:	5 ft. 0 in.
Approach angle:	60° front; 50° rear
Fording depth:	prepared—7 ft. 0 in; unprepared—3 ft. 6 ins.
Swimming with screen erected (if fitted):	2·5 m.p.h. propelled by road wheels
Vertical step:	1 ft. 6 ins.
Angle of tilt:	45°

Protection
Turret:

Front:	32 mm. at 15°
Sides and rear:	16 mm. vertical
Roof:	10 mm.

Hull:

Glacis:	12 mm. at 45°
Nose:	14 mm. at 42°
Sides and rear:	16 mm. at 20°
Roof:	10–12 mm.
Floor:	8–12 mm.

Electrical Equipment and Radio
Supply:
24 volt negative earth system; 75 amp two speed generator; two 12 volt 60 amp./hr. batteries.

Radio:
One C 13 and one B 47 transceiver constitutes a typical British installation.

AFV/Weapons Profiles

Edited by DUNCAN CROW

FORTHCOMING TITLES:

45 Vickers Main Battle Tank
(publication delayed).

50 Swiss Battle Tanks
Prototypes of the Pz 61, the Swiss Army's Main Battle Tank, were built in 1958 and 1959 and pre-production vehicles with a 90mm gun appeared in 1961: they were designated Pz 58. The Pz 58 was then equipped with a 105mm gun and went into production as the Pz 61. The Pz 68 is a further development. The Profile also includes an account of Swiss tanks since World War I.
BY R. M. OGORKIEWICZ.

51 The Abbot
The Abbot (FV 433 105mm Field Artillery Self-Propelled) is the first British gun designed specifically for the self-propelled role. It was produced to replace the 25pdr field gun and went into troop service in 1965 when the first regiment to be equipped with it was the 3rd Royal Horse Artillery. This Profile by CHRISTOPHER F. FOSS also includes the Value Engineered Abbot and the Falcon Anti-Aircraft System.

52 M47 Patton
by Colonel Robert J. Icks
The tank that missed Korea. M26 M46 T42 M47 M48

53 FV 432
by Christopher F. Foss
The British Army's APC developed from the earlier FV420 series, originally called Trojan.

FUTURE TITLES WILL INCLUDE:

Japanese Light Tanks
by Lieut.-General Tomio Hara
Including combat cars and tankettes (to 1945).

Missile Armed Vehicles
by R. M. Ogorkiewicz
From the earliest installation of the pioneer French SS-10 through various French, British, German and Soviet applications to the American vehicles armed with gun-cum-missile launchers, i.e. M551 Sheridan, M60A1E1, and MBT-70/XM803.

German Self-Propelled Weapons
by Peter Chamberlain
An illustrated guide to all the SP weapons used by the Germans in World War II.

French Infantry Tanks, Part I
by Major James Bingham

French Infantry Tanks, Part II
by Major James Bingham
Having described the tanks used by the French cavalry in AFV/Weapons 36 Major Bingham, in these two Profiles, now examines in equal detail the tanks used by the French infantry from 1919 to 1940.

SdKfz 250 and 251
by Walter Spielberger and P. Chamberlain
German half-track vehicles of World War II.

Armoured Personnel Carriers
by Major-General N. W. Duncan
Their development and use in different armies.

The Twenty-Five Pounder
by Colonel Farrerly, R.A.
The history of the British Army's famous field gun.

Commando and Twister Armored Cars
by Christopher F. Foss
The multi-mission Commando and the revolutionary Lockheed Twister XM-808.

AMX-30
by R. M. Ogorkiewicz
France's Main Battle Tank.

French Armoured Cars
by Major James Bingham
The story of French armoured cars from before World War I until the end of World War II.

PT-76
by Christopher F. Foss
The Russian amphibious light tank and its many variants.

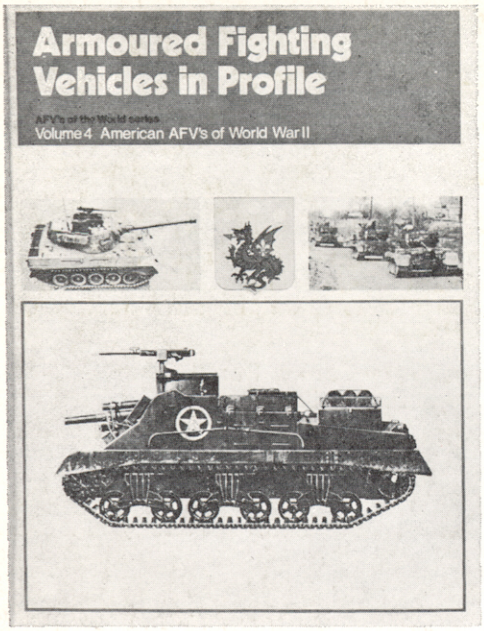
The publishers reserve the right to alter sequence of list without notice.

The publishers regret to announce that as from 1st April 1972 all previously published prices and price lists are cancelled. No price increase has been made since August 1970 but due to the wide range of rising costs since that date, the following recommended retail selling price(s) will apply:

AFV/Weapons Series 1–42 inclusive 35p each; 43 onwards 40p each.

If you have any difficulty in obtaining Profiles from your local book or model shop please write direct to:

Mail Order/Subscription Department,
PROFILE PUBLICATIONS Ltd, Coburg House, Sheet Street, Windsor, Berks. SL4 1EB



Armoured Fighting Vehicles in Profile

Volume 4 American AFVs of World War II

Contents

PART 1

PART 2

ISBN 0 85383 003 7

Once again Duncan Crow has produced along with his team of leading tank specialists and Profile artists an excellent volume in the AFVs of the World Series.

In addition to the comprehensive coverage of the AFVs, the editor has researched and recorded the complex details of the U.S. Armor-Cavalry 1917-67. This is another unique record – supported by 4 pages in full colour of the regimental badges. This superb collection of Coats of Arms and unit badges has rarely been seen outside the U.S.

312 pages with 28 in full colour, contains over 100,000 words, 500 photos, and 2 indices. Case bound. Colour Jacket. Size 10 × 7½ in. Price £6·00 (plus 25p P & P).

Available from your local bookshop or model shop.
In case of difficulty order direct from Profile Publications Limited.

Printed in England by Mears Caldwell Hacker Limited, London R November 1972