PROFILE

AFV WEAPONS

19

Chieftain and Leopard (Description)

Lieut.-Colonel Michael Norman, *Royal Tank Regiment*

A production Leopard on a road march. (German MOD)

Chieftain and Leopard Main Battle Tanks

by Major Michael Norman, *Royal Tank Regiment*

CHIEFTAIN AND LEOPARD DESCRIBED

BOTH the Chieftain and the Leopard are conventional in layout with the driver in the forward part of the hull, the fighting compartment and turret in the centre and the power plant and transmission at the rear. The glacis on Chieftain consists of a cast armoured plate at a high obliquity and is faired into the fabricated hull walls in a way that is reminiscent of the Soviet IS-2 (KV and IS *Profile*) where, too, the driver sat in the centre. The diameter of the turret ring is such that panniers are required to carry it over the tracks either side and these panniers extend rearwards alongside the engine and transmission compartments and contain fillers for the bag-type fuel tanks. A resilient rail round the engine covers prevents metal-to-metal contact when the 120-mm. gun is being traversed to the rear. Both engine and transmission covers have louvres for the circulation of cooling air and a travelling clamp for the 120-mm. gun is hinged on the back of the exhaust silencer box. The Leopard hull is of simpler construction, being built up from fabricated armour plate throughout although, again, the diameter of the turret ring necessitated a pannier design. The exhaust grilles are prominent features on both sides of these panniers.

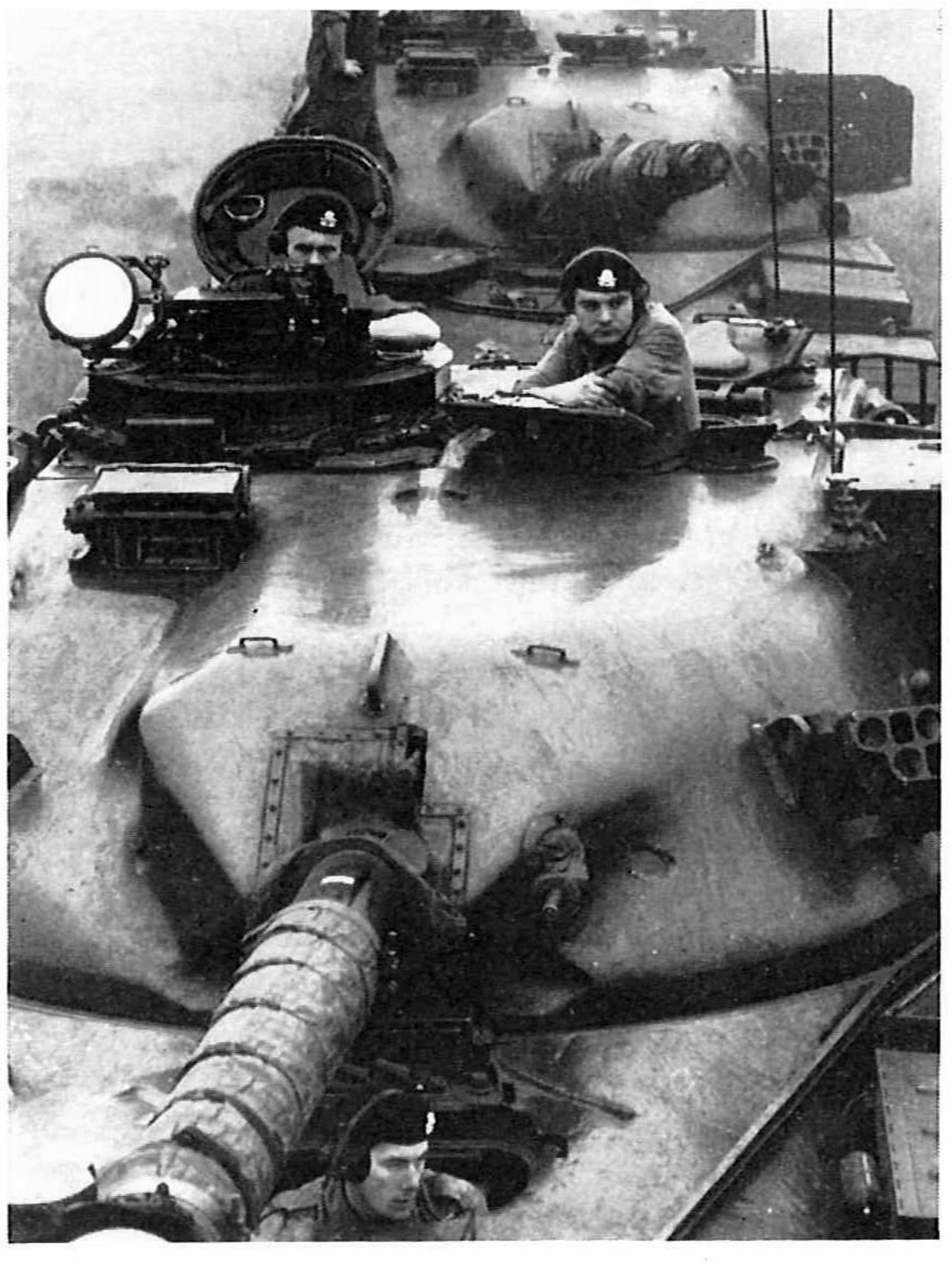
Whereas the Chieftain driver sits centrally with stowage for ammunition and batteries on either side, the installation of the L7 gun in Leopard has resulted in the driver's position being shifted over to the right of the hull to ensure that the loader on the left of the gun has access to the large bin of ammunition alongside the driver. A unique and most successful feature in the Chieftain has been the reclining position for the driver when his hatch is closed and has permitted a significant reduction in the height of the hull. Access for both drivers is through a hatch of the "lift and swing" type and emergency exits can be made rearward into the fighting compartments. The Chieftain has a single wide-vision periscope behind the hatch and Leopard has three in front giving an arc of vision of some 130°. Both tanks have automated transmission systems although the Chieftain driver has direct control of the gear ratios which are

Above: *Leopard Main Battle Tank.* (Krauss-Maffei)

Left: *Front view of Leopard.*

Bottom left: *Chieftain of the 17th/21st Lancers in Germany. The rubber pads inserted in the steel tracks limit damage to roads during training.* (Army PR)

Below: *Chieftain Mark 2 of the 17th/21st Lancers. The layout of the fire control equipment and the excellent ballistic shape of the turret casting are noteworthy. The muzzles of the 0·5-in. ranging gun and the coaxial 7·62-mm. G.P. MG are visible to the right of and above the 120-mm. barrel respectively.* (CCR)



Above: Standardpanzer *prototype with Type II turret mounting the 12·7-mm. ranging gun, later to be replaced by the cross-turret optical range finder.* (German MOD)

Right: *The driver's hatch in the centre of the glacis plate. The "lift and swing" hatch cover, the single, wide-view periscope behind the hatch itself and the non-slip surface on the armour are of interest in this Chieftain of the 1st Royal Tank Regiment.* (CCR)

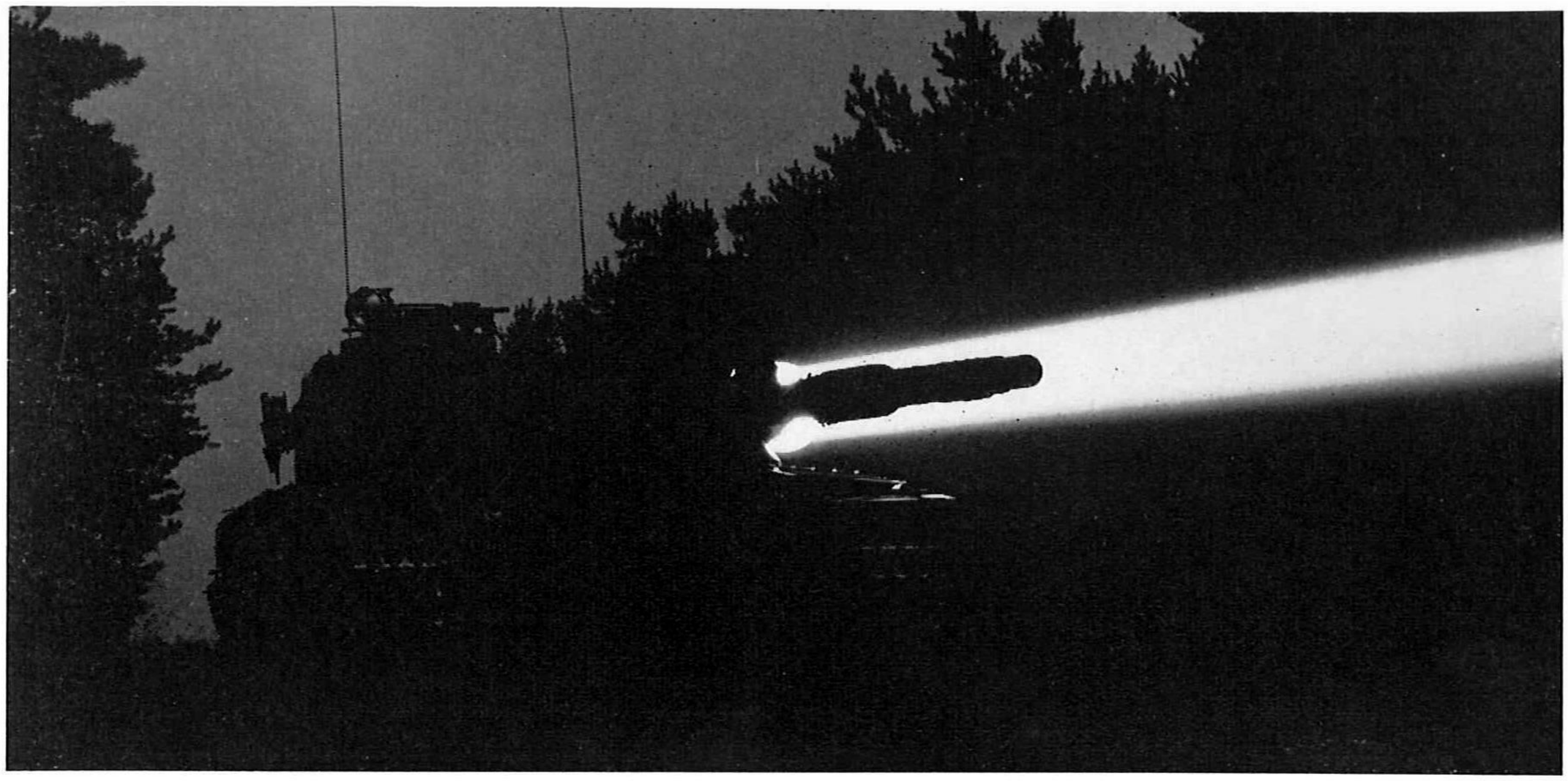
selected by a foot pedal, not unlike that used on a motor cycle, while the selector lever in Leopard has only four positions: two forward ratios (road and cross country), reverse and neutral. Chieftain is steered by conventional levers and Leopard has a steering wheel. An interesting feature on Leopard is the provision of driving controls for the commander which, though limited in scope, enable him to retain a modicum of control if the driver is incapacitated or in similar emergencies.

The fighting compartment in both tanks extends the full width of the hull with the turrets suspended on ball races. The Chieftain turret is unconventional in design, the front being cast while the rear is fabricated from rolled armour plate. The high obliquity of its frontal and side aspects and the absence of a heavy mantlet are of particular interest (features which are shared with modern Soviet tanks) although the premium on internal stowage space and the need to balance the turret with its very long gun barrel have necessitated the addition of the rear bulge which contains gun control equipment, radios, ammunition and external stowage racks. The large light projector is mounted on the left side of the turret wall and will be returned to later in this section. The turret on Leopard is again of a much more simple construction and it has a rectangular mantlet on which the light projector is mounted; centrally on pre-production vehicles and offset to the left in later models. The shell is cast except for an oval roof plate which is welded into position. The positioning of the cross-turret range-finder forward of the gunner's position has necessitated a flattened top surface for the casting but it was considered that the disadvantages of a less than ideal ballistic shape were offset by the need to keep the overall height of the vehicle down and to free the commander from the minutiae of engaging targets. The bottom rear of the turret is chamfered to clear the raised roof of the power compartment. Both turrets have smoke grenade dischargers on the walls.

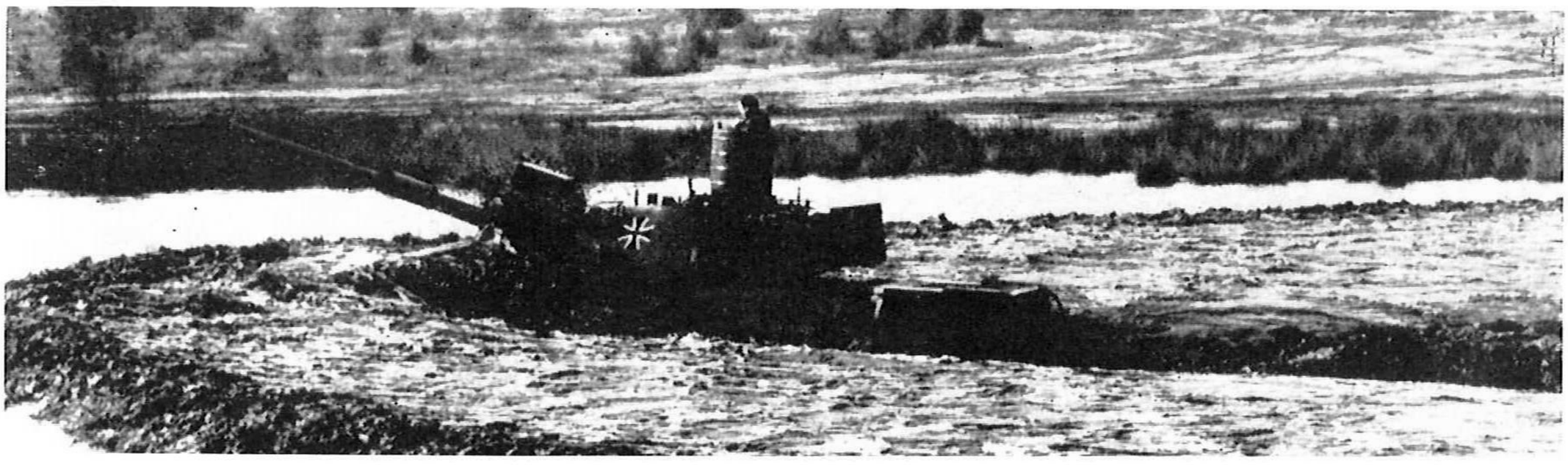
The turret crews occupy the same relative positions in both tanks, the loader on the left of the gun, the gunner opposite on the right with the commander behind him. The radio equipment, however, is under the control of the commander in the Leopard (as it is in T-54) and of the loader in Chieftain. The L7A1 105-mm. armament in Leopard fires fixed rounds of three main natures—APDS, HESH and HEAT—the primers are initiated electrically and the empty cases are ejected into a canvas bag, this having spring-loaded covers. The recoil system consists of two hydraulic buffers and a pneumatic recuperator and is claimed to enhance the accuracy of the gun compared with the British layout in Centurion. A cradle on the left of the gun contains a 7·62-mm. MG1 and both this mounting, and the 105-mm. spent case bag, are connected to a fume-extracting system operated by a fan on the inside of the mantlet. The more powerful L11 120-mm. gun with its recoil system occupies a greater inboard volume in Chieftain than that of the L7 but this is offset by the use of separated ammunition (thus reducing the space needed to manoeuvre the rounds into the breech) and combustible bagged charges which do away with the need for a bin for spent cases as well as reducing the toxicity level in the turret atmosphere. But as obturation cannot be carried out by the walls of a shell case, as it is in the L7, a steel sleeve in the chamber and an insert on the face of the breech block are required for this function and the mechanism incorporates several fail-safe features. The breech block is of the falling wedge type and is opened automatically during run-out in a similar way to the L7. The charges are fired by vent tubes stored in a magazine on the breech ring and loaded automatically into the breech block where they are initiated electrically. The 120-mm. cradle is of the ring type and carries the recoil system consisting of two hydraulic buffers and a hydro-pneumatic recuperator, all three being secured to a yoke on the front of the breech ring. Two MGs are mounted on the left of the gun, the uppermost being in a cradle specially designed to ensure the stability of the 0·50-in. (12·7-mm.) ranging gun. This uses special tracer ammunition and the mechanism permits rapid series of three rounds each to be fired by the gunner operating a foot controller. The second more

Leopard demonstrating its agility in climbing a vertical step from the water. (Stern)

Chieftain manned by a crew from The Blues and Royals wading a shallow pool. (CCR)



White light from the Chieftain searchlight. (CCR)

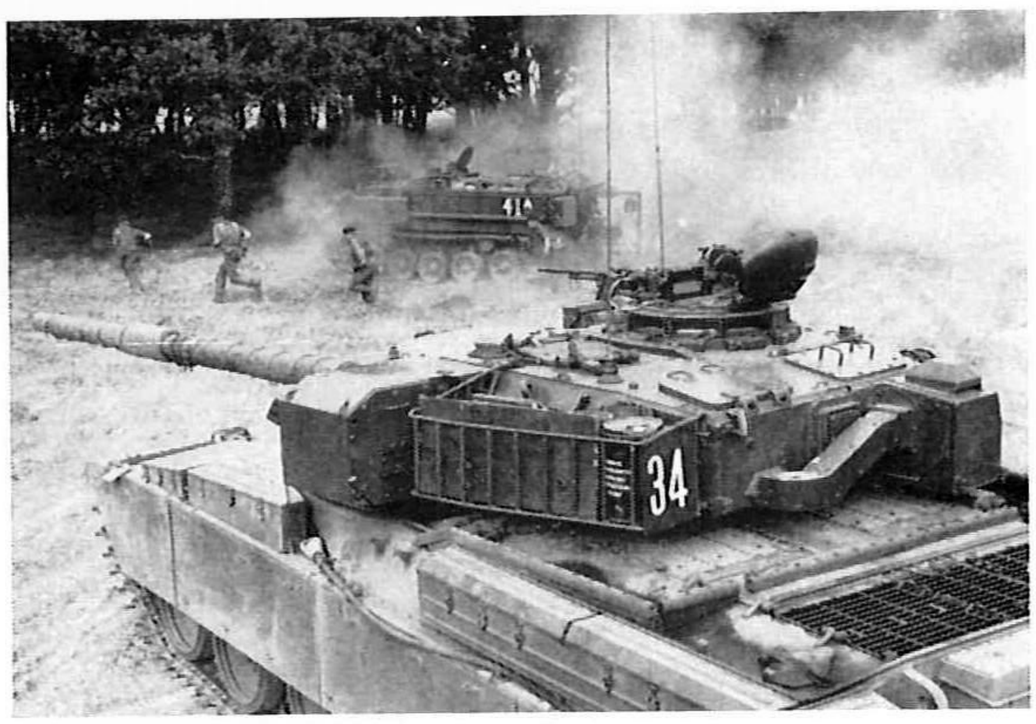


Leopard moving at speed through a muddy lake. (Stern)

Camouflaged Leopard moving through woodland.

Chieftain with turret traversed, showing extent of rear bulge. (Army PR)

A dazzle-painted Chieftain of The Blues and Royals negotiating a knife-edged obstacle. (CCR)



Fourth Troop Leader of C Squadron The Blues and Royals supporting infantry as they leave their FV 432 APC. Note the resilient rubber rail round the engine compartment of the Chieftain to prevent damage when the 120-mm. gun is traversed rearwards, the access hatches on the rear roof of the turret and the large fuel fillers in the transmission decking. (CCR)

Leopard driver's three periscopes in front give a 130° arc of vision. (German MOD)

Standardpanzer Prototype II during troop trials. (German MOD)

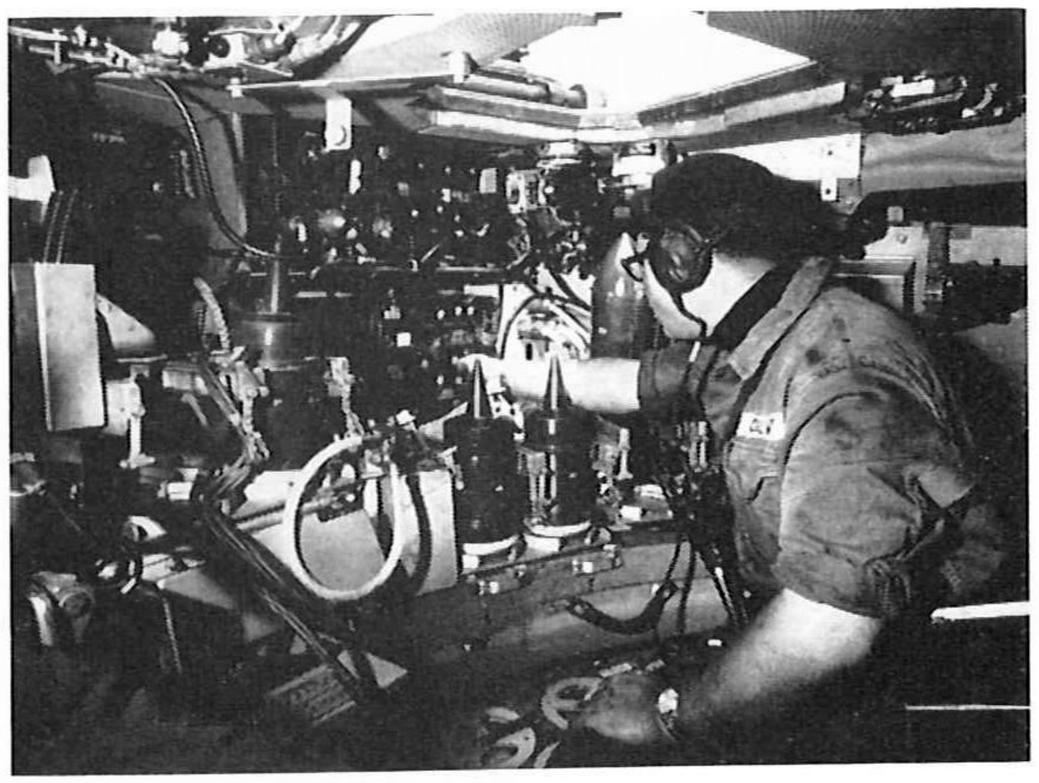
simple cradle contains the normal 7·62-mm. General Purpose MG (GPMG). Both main armament barrels have fume extractors and are usually fitted with thermal sleeves to minimize the possibility of bend, and consequent loss of accuracy, through the effects of differential heating or cooling. The design of the 105-mm. allows the barrel to be removed forwards very quickly but that on the 120-mm. has to be withdrawn through the rear of the turret. Experience having shown that most tank casualties are caused by ammunition fires, the opportunity has been taken in Chieftain to draw on naval experience and stow the 120-mm. charges in bins surrounded by pressurized water jackets.

Both tanks have conceptually similar facilities for laying the guns using power, hand and emergency modes, with over-riding controls for the commander. However, while Chieftain has a development of the well-proven system used in Centurion incorporating a closed loop electro-servo stabilizing equipment in both elevation and azimuth axes, the Leopard has an electro-hydraulic Westinghouse equipment of the type used on the American M48 and M60 tanks. A Cadillac-Gage stabilizer may be fitted to Leopard as a later, retrospective modification.

The fire control systems are markedly different, that in Chieftain being a natural derivative from the one in Centurion. The commander in Chieftain is seated under a cupola which is made in two main assemblies. The static ring contains nine periscopes which give an uninterrupted, all-round view, and a reticle image projector connected to the gunner's sight mounting which defines the latter's alignment when the commander's sight is at the 12 o'clock

A production Leopard fitted with a thermal sleeve on the 105-mm. barrel. (German MOD)

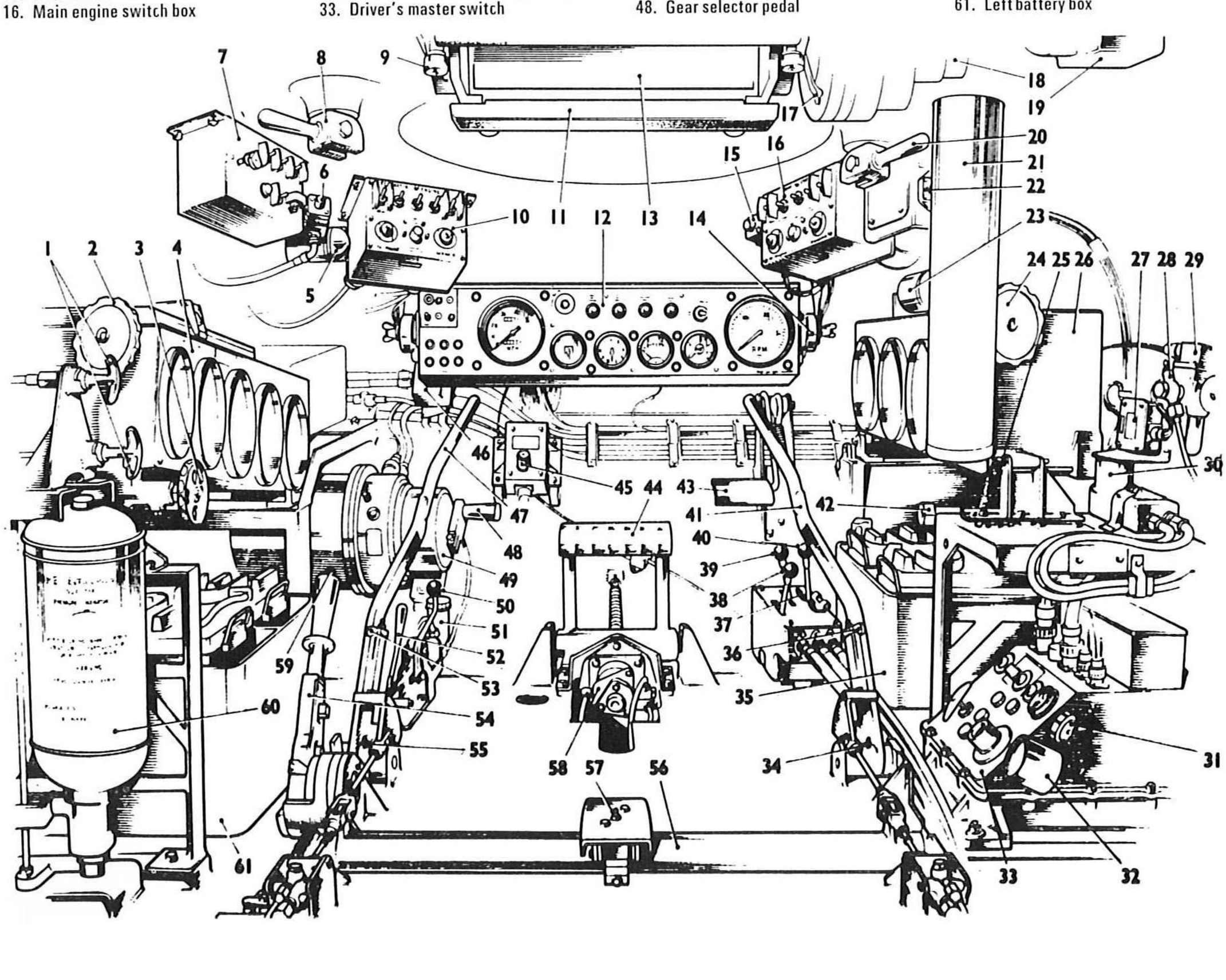
A tank commander of The Blues and Royals wearing a respirator and protective clothing. He is observing through his binocular sight and grasping his controller for powered elevation and traverse with his right hand. (CCR)



A loader/operator of The Blues and Royals tuning one of the radio sets at the left rear of the turret. Two APDS projectiles are visible stowed on the turret sill with charge bins below the turret ring. (CCR)

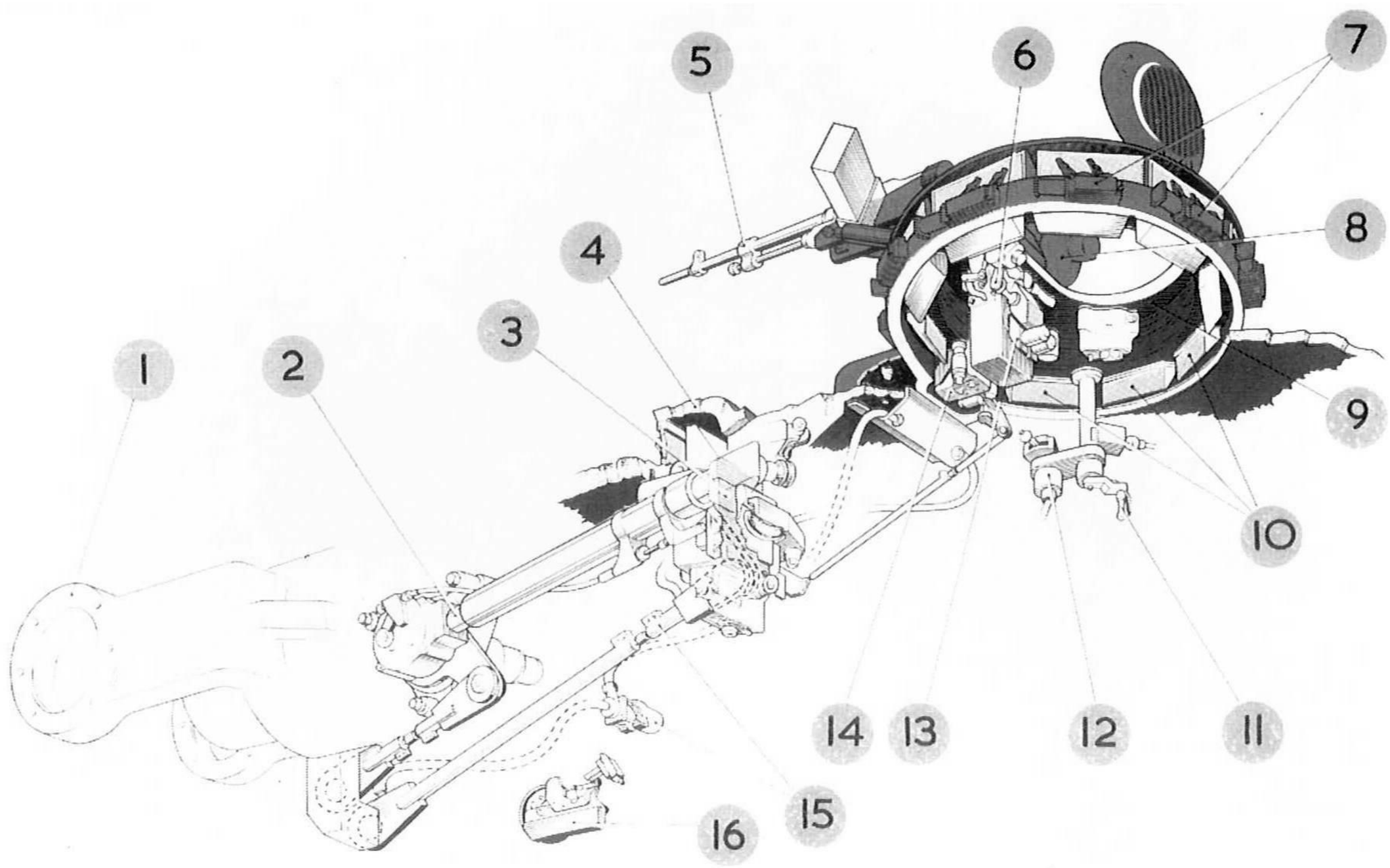
Chieftain turret (above), driver's compartment (below).

1. Fixed fire extinguisher operating handles
2. Projectile locking handle
3. Rack lifting jack operating handle
4. Projectile rack
5. Fire alarm warning light
6. Reverse button
7. Lights switchbox
8. Driver's access door locking handle (left)
9. Driver's periscope mounting knurled nut
10. Generating unit engine switchbox
11. Driver's periscope swing bar
12. Driver's instrument panel
13. Driver's periscope
14. Driver's instrument panel mounting
15. Horn button
16. Main engine switch box
17. Periscope wiper parkinglever
18. Periscope wiper motor
19. Radio distribution box
20. Driver's access door locking handle (right)
21. Driver's access door spring tube
22. Driver's safety switch
23. Fire extinguisher
24. Projectile locking handle
25. Rack retaining pin
26. Projectile rack
27. Battery thermal switch junction box
28. Bleed nipple
29. Main brake warning light pressure switch
30. Dozer equipment
31. Inspection light socket cover
32. Inter-vehicle starting socket cover
33. Driver's master switch
34. Steering lever lubricator
35. Right battery box
36. Right steering lever location pawl catch
37. Emergency gear lever locking plate
38. Generating unit engine governor control lever
39. Generating unit engine fuel cut-off lever
40. Emergency gear control lever
41. Right steering lever
42. Rack lifting jack
43. Accelerator pedal
44. Brake pedal
45. Driving lights dipswitch
46. Negative line junction box
47. Left steering lever
48. Gear selector pedal
49. Gear selector
50. Hydraulic starter pinion control lever
51. Hydraulic starter master cylinder reservoir
52. Hydraulic starter pump clutch lever
53. Left steering lever location pawl catch
54. Parking brake lever
55. Steering lever lubricator
56. Steering mechanism cross-shaft
57. Steering interlock lubricating nipple
58. Brake power valve
59. Release button (parking brake lever retaining pawl)
60. Fixed fire extinguishers
61. Left battery box



Interior of Leopard turret.

position. The rotating assembly contains the commander's binocular sight with a magnification of ten times (×15 on Mark 3), his 7·62-mm. MG which can be fired remotely from under armour, aimed by a graticule in the observation window of the sight, and a single hatch cover. The cupola can be rotated by means of a hand traversing gear to enable the commander to observe and acquire targets using his main sight, and by selecting "contrarotate" and gripping his duplex controller, the turret is driven into alignment with his line of sight. The gunner's equipment consists of a periscopic sight pivoting in the roof and connected to the gun cradle by a link bar whose length is maintained constant, despite changes in air temperature, by a compensating device. A ballistic graticule incorporates the range scales for APDS, HESH and the ranging gun (the latter having a pseudo-ballistic match with HESH up to about 1,300 metres in the Mark 2 and 2,500 metres in the Mark 3/3) and the 7·62-mm. MG. Ranging is accomplished by firing series of the 0·50 in. rounds aimed by laying successive aiming dots on the target and observing which series either strikes or falls plus. The equivalent dot on the APDS scale is laid on the target and the 120-mm. gun fired: the first round in a HESH or smoke engagement is even more simple due to the common ballistic markings with the ranging gun. A range-drum and clinometer bubble are used for engagements beyond the range of the sight or when firing indirect, in conjunction with an electric traverse indicator. An alternative ×7 sighting telescope is also available for direct fire only. The Mark 3/3 Chieftain will have an alternative ranging system in the Barr and Stroud LF2 laser instrument incorporated in the gunner's sight. With a 90 per cent chance of a system accuracy of plus or minus 10 metres to ranges well over 5,000 metres, engagements will become faster and more accurate. The 19-in., 2-3 kW light projector is used either for white light or near infra-red (IR) illumination and its aim is controlled automatically by



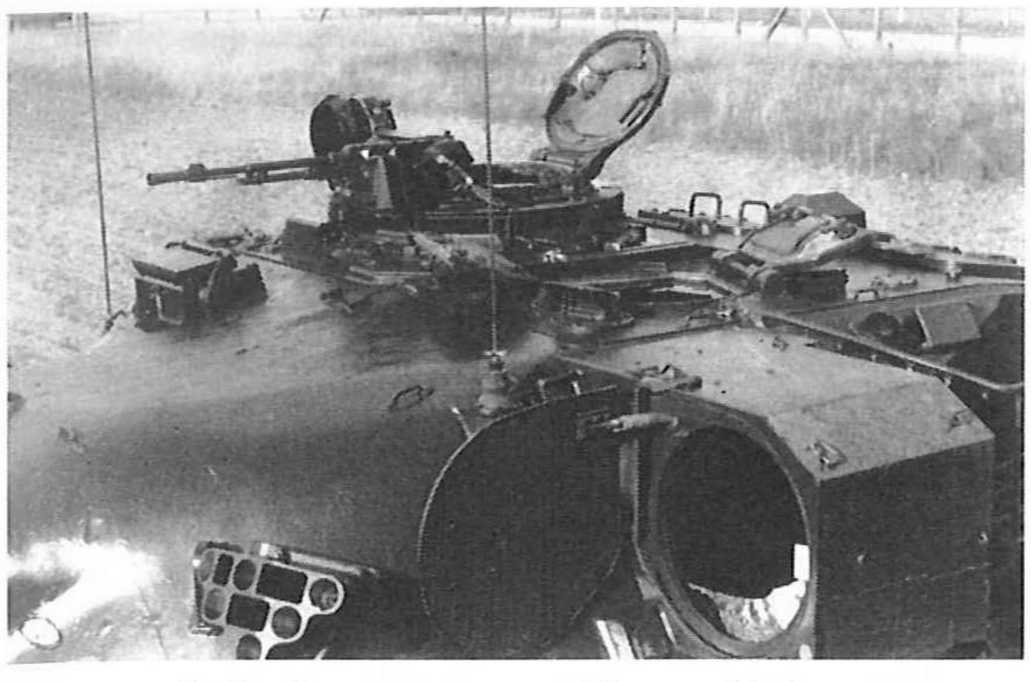
A general sketch of Chieftain fire control equipment. 1—Trunnion rings of 120-mm. cradle. 2—Gunner's telescopic sight. 3—Gunner's periscopic sight. 4—Hood with wiper equipment. 5—Commander's 7·62-mm. GPMG. 6—GPMG and sight elevating gear. 7—Periscope wipers. 8—IR spotlight. 9—Commander's rotatable cupola. 10—Periscopes (9). 11—Cupola traverse gear. 12—Cupola contra-rotation equipment. 13—Commander's periscopic binocular sight. 14—Collimator. 15—Temperature compensated link and pump. 16—Gunner's clinometer for semi- and fully indirect fire. (CCR)

a synchro system with the transmitter on the gunner's sight mounting. Both gunner's and commander's sights can be replaced by ×3 IR instruments whose optical systems contain image converter tubes to convert the reflected IR light into images visible to the human eye. The commander's spotlight can also be fitted with an IR filter and the system is completed by a detector which will give warning of IR illumination from any direction. The drivers on both tanks also have IR systems with a range of a few hundred metres. Passive Image intensification instruments are likely to replace IR in the future.

The commander of Leopard has a much simpler design of cupola, and a less comprehensive view through his seven fixed periscopes, although an intermediate position of the hatch cover allows him to observe over the top of the cupola sill. His main sight is a periscope mounted in the turret roof itself and the head can be rotated in azimuth independently of the turret. With its variable magnification of six to twenty times it is used for general observation, target acquisition and stadia ranging on targets of known dimensions. Once a target has been observed the commander can traverse the turret until the gunner's line of sight coincides with his own, the contra-rotation of the sight head and a flexible link to the azimuth indicator ensuring that the target will not be lost in the process. The tangent elevation of the gun

A hydraulically-operated dozer blade on a Chieftain Mark 1. (FVRDE, CCR)

A prototype Chieftain as it was first seen by the public. (CCR)



Close-up of Chieftain turret top with searchlight components removed.

Pre-production Leopards with Series III turrets.

is also transmitted electrically to the commander's periscope enabling him to lay and fire the guns in case of emergency. The gunner's sight is incorporated in the rangefinder which has a base length of 67 in. and a magnification of 16 times. Both stereoscopic and coincidence ranging can be selected, the former being the more accurate and efficient in poor visibility while the latter is for the less skilful operators or those without stereoscopic vision. Movement of the wander marks and prisms in both the commander's and gunner's instruments is controlled by foot pedals. Tangent elevation appropriate to the nature of ammunition to be used is applied automatically to the gun as ranging proceeds. In principle, this layout bears a strong resemblance to that in the M47 tank although it has been improved upon considerably. An interesting feature is the shutter in the gunner's sight which closes for a quarter of a second when the 105-mm. is fired to prevent his being blinded by the flash. As in Chieftain, an alternative sighting telescope is provided and the commander's periscope can be replaced by an IR sight for viewing at night. An additional 7·62-mm. MG can be mounted to the forward edge of either the commander's or gunner's hatches but the firer has to expose himself to use it. Two periscopes are fitted in front of the loader's hatch on Leopard compared with one on Chieftain.

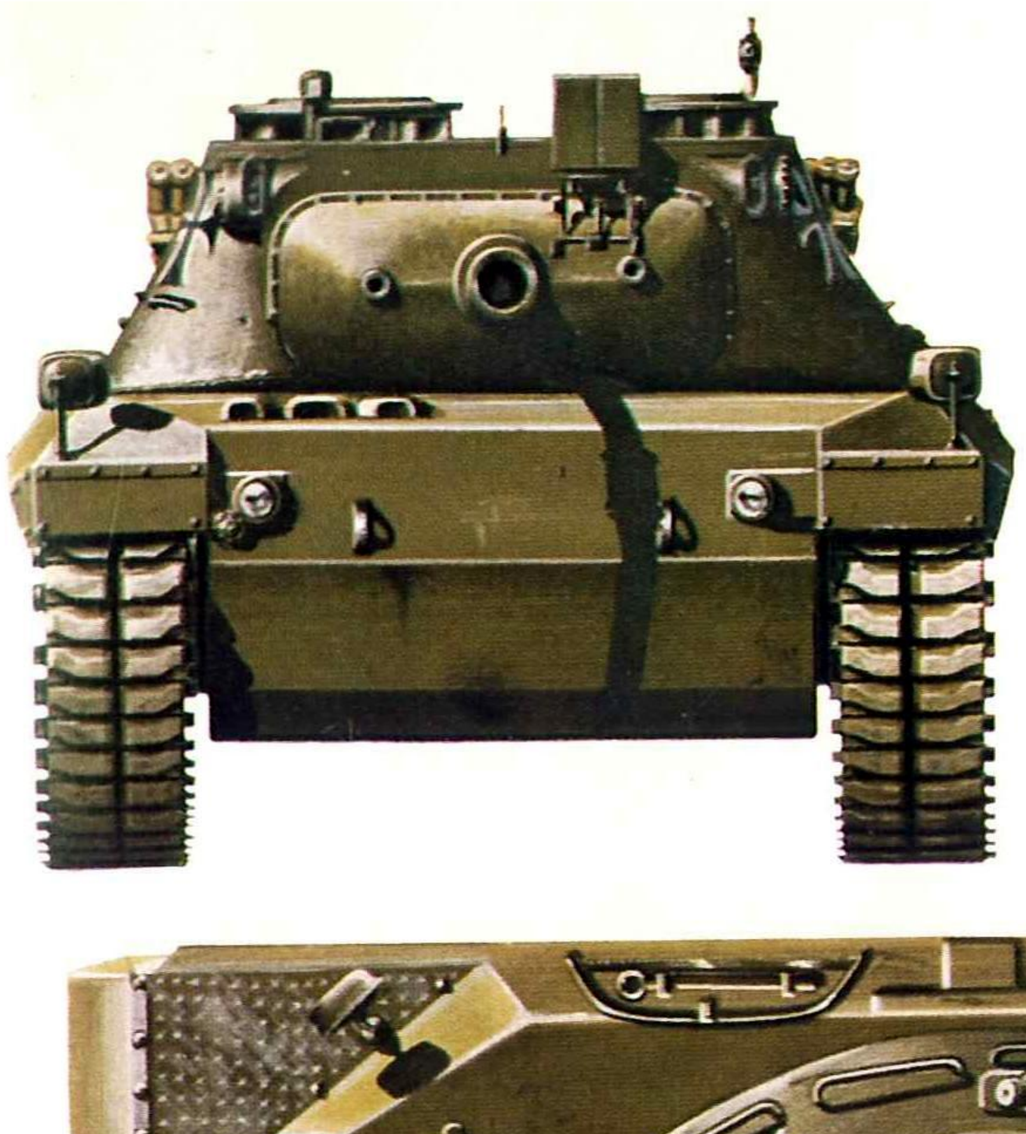
Both tanks have comprehensive heating and ventilation systems. The former in Leopard includes a fuel oil burning heater in the fighting compartment (again following American practice) that not only heats that compartment but can also be used to warm the engine coolant and the eight batteries to facilitate starting at low ambient temperatures. Air for ventilation in this tank is drawn in through a duct above the left track guard and filtered in a unit positioned in front of the large ammunition bin in the hull. The similar unit on Chieftain is mounted on the rear of the turret. Navigation systems can also be installed, that in Chieftain operating on the dead reckoning principle in which information from the speedometer drive and a gyro compass is analysed in a computer to derive position in the form of an eight figure grid reference and heading, both of which can be combined to plot the tank's movement on a map.

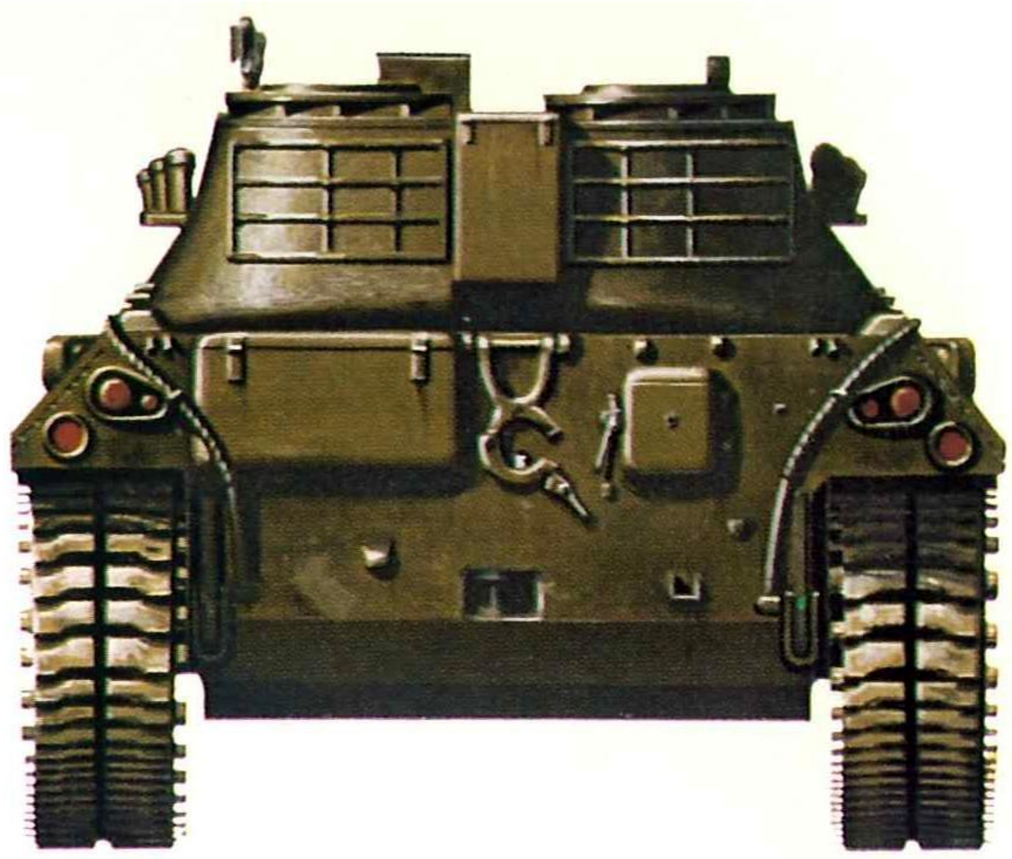
The engine in Leopard is the ten-cylinder, 37·4 litre, compression ignition, supercharged Daimler Benz DB 838 which can run on fuel oil or JP4 and delivers 830 b.h.p. at 2,200 r.p.m. It is a 90° upright Vee in layout and gives the tank an exceptional performance with an acceleration superior even to a number of light wheeled vehicles. At a sustained speed on roads of 40 m.p.h., a fuel consumption of about 1·7 m.p.g. and a capacity under armour of 220 imperial gallons Leopard has a radius of action of about 375 miles. Again, in keeping with American practice, the importance of a speedy removal and installation of the power plant and transmission is emphasized by the use of multiple connector plugs for electrical equipment, quick release couplings for fuel and other hydraulic pipes and all mechanical linkages have quick release pins and clips. A 9 kW 3-phase alternator

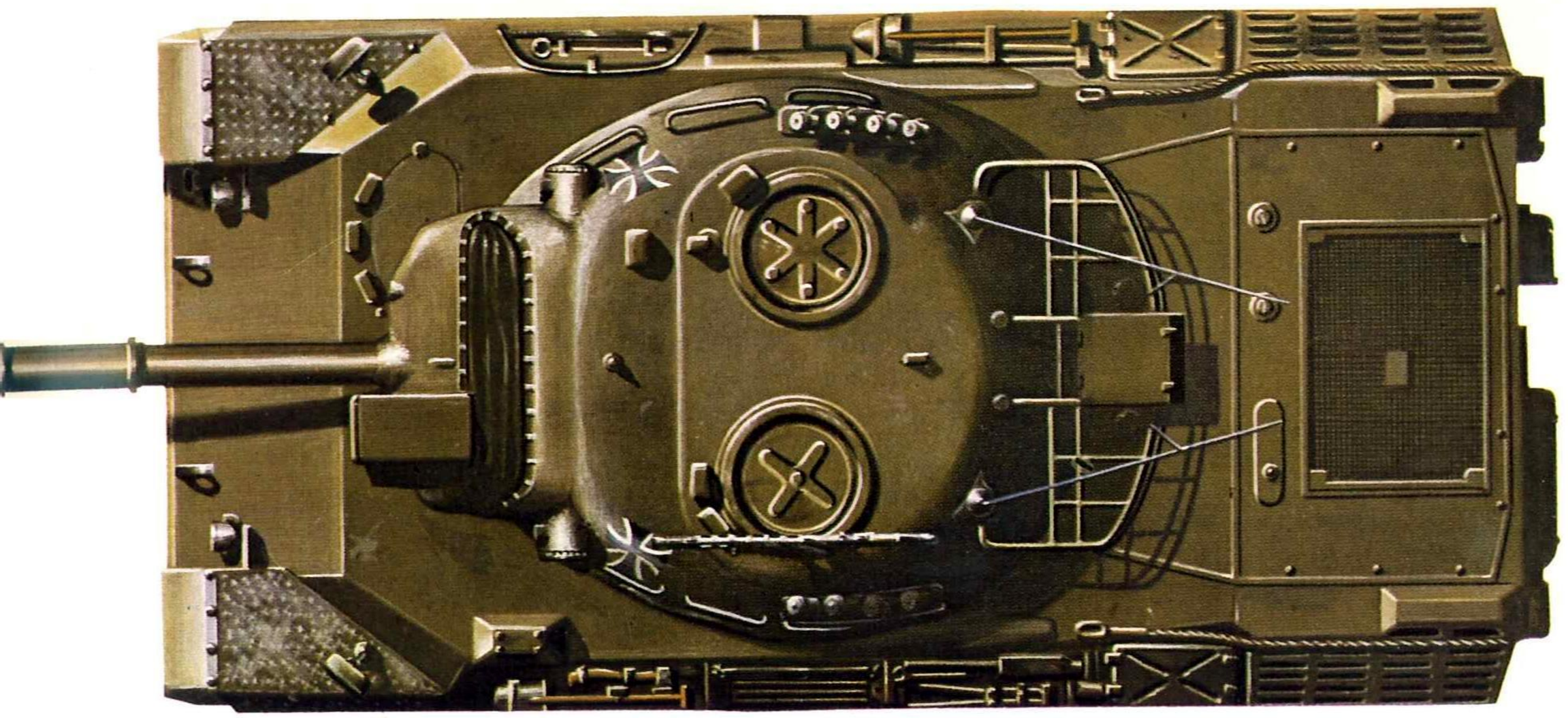
Leopard with schnorkel tower in place advancing through smoke to river crossing. (German MOD)

Bergepanzer standard lifting, and carrying, a complete Leopard power unit.

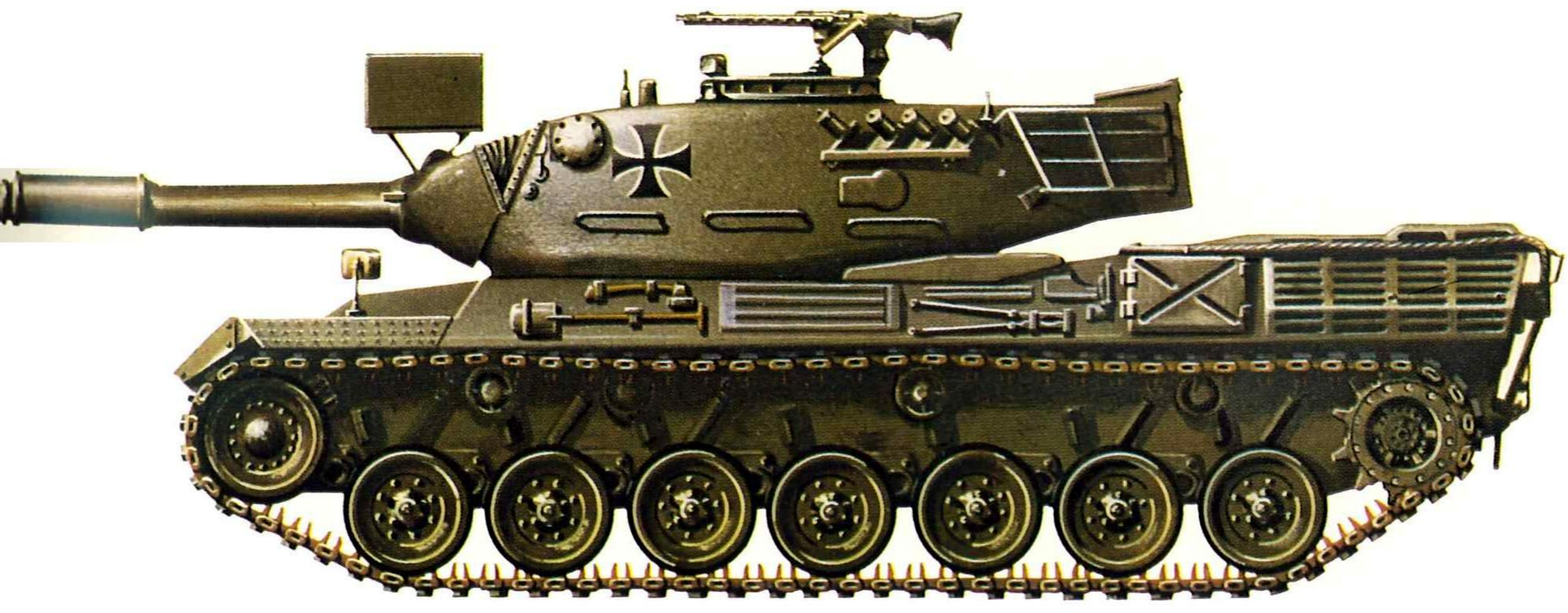
Leopard Bridgelayer Type B.







Leopard Main Battle Tank



Chieftain emerging from a deep-wading pit. The commander is standing at the top of the schnorkel tower. (Keystone)

Pre-production Standardpanzer, with the bottom section of the schnorkel tower only fitted, reversing at speed from a wading tank. (German MOD)

Leopard Standardpanzer crossing the River Rhine at Koln-Westhoven in July 1964. (Deutsche Press-Agentur)

An early Leopard undergoing deep-wading tests which include stopping and re-starting the engine while submerged.

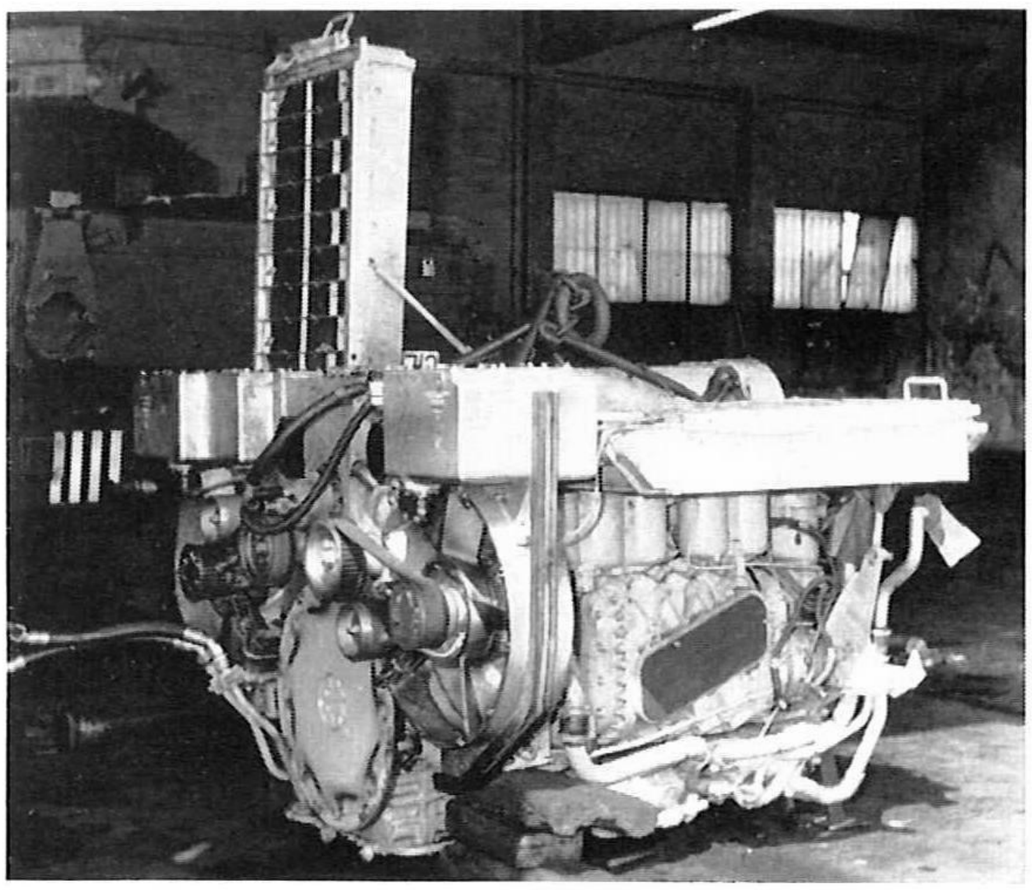
Leopard with a gunfire simulator mounted on the 105-mm. barrel. (GermanMOD)

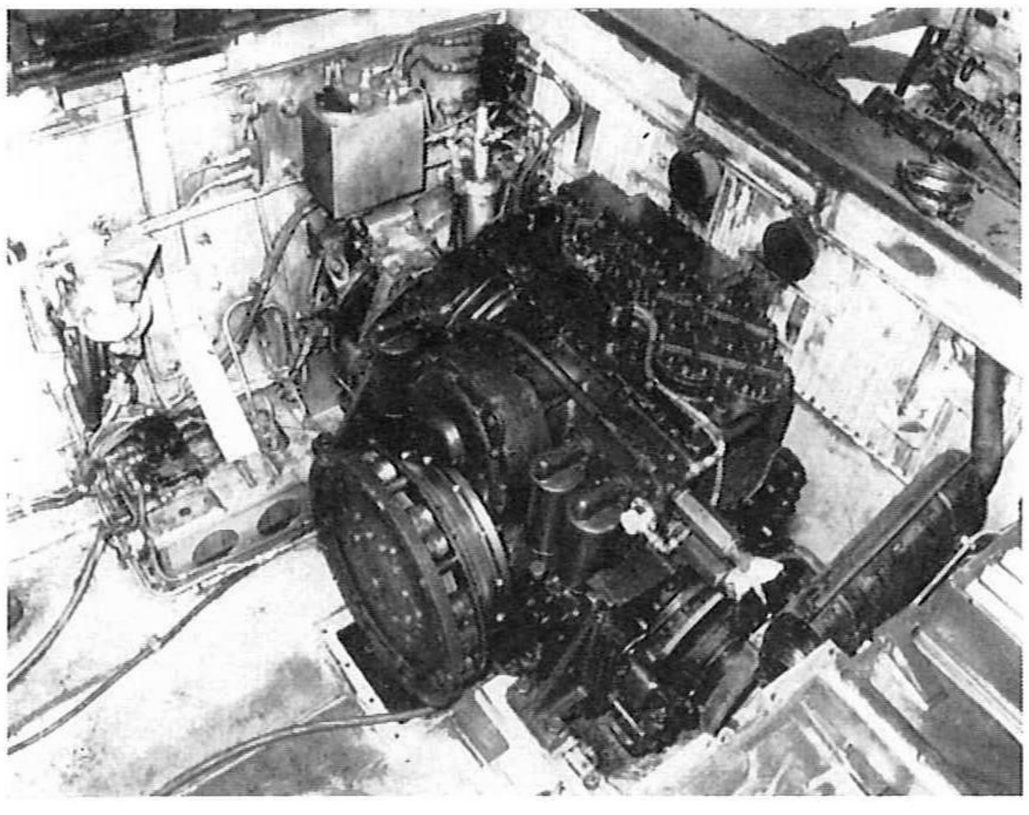
is driven from the engine and a silicon rectifier is used to convert the output to DC. This arrangement permits the batteries to be charged even when the engine is idling quietly and obviates the need for an auxiliary engine. The Chieftain two-stroke L60 main engine has six vertical cylinders with opposed pistons, a capacity of 19 litres and produces 650 b.h.p. (730 gross SAE) at 2,100 r.p.m. running on fuel oil. The maximum road speed governed at 25 m.p.h. and a range of about 250 miles are markedly less than those for Leopard*, reflecting the differing priorities for mobility, although acceleration from a standing start and the sustained speeds of both across country are not significantly different. A Coventry Climax A30, with three cylinders and six vertically opposed pistons drives a 24-volt 350-amp dc generator to supplement a 150-amp machine powered by the L60.

Drive from the L60 is transmitted through a centrifugal clutch, which becomes operative at a crankshaft speed of about 320 r.p.m., to the TN12 gearbox which is a combined change speed and steering unit using a Wilson epicyclic gear train and a Merritt differential steering system. The six forward and three reverse gears are engaged by brake bands applied hydraulically. A governor is incorporated to prevent changes up at low engine speeds and initiates changes down when the engine speed drops below 800 r.p.m. The main and steering brakes are of the disc type, also operated hydraulically, and drive to the sprocket is through a single 5:1 reduction gear. The transmission on Leopard consists of a single stage torque converter and the top three gear ratios have a "lock-up" facility to reduce power losses, and thereby fuel consumption, on road moves. Changes of ratio are made electro-hydraulically, although second gear can be engaged mechanically in case of a power failure. The steering mechanism is also integral with the gearbox and is of the two radii, regenerative type. This gives an infinitely variable range for the wider turns and fixed, gear-related radii for tight turns: a complete neutral turn on concrete can be made in ten seconds.

The suspension on Leopard consists of transversely mounted torsion bars with seven road wheel stations on either side—the first three and the last two incorporating hydraulic shock absorbers. The double pin type tracks with rubber pads are American in design and they can be replaced by anti-skid combat tracks. The top rollers are unusual in that two support the inside, and the other two the outside, of the track. Chieftain continues to use the modified Horstmann design that proved successful on Centurion and Conqueror, the three units on both sides having two road wheels each mounted on axle arms bearing against a pack of horizontal springs. The front units only have shock absorbers. The track plates are made of cast manganese steel with removable rubber pads; they are connected by dry pins and stretch is compensated for by moving the adjuster wheel forward on its eccentric mounting. Again, in common with Centurion, the side armour of the hull is given additional protection by the use of detachable spring-steel plates.

Both tanks are capable of deep wading, the Chieftain to a depth of 15 ft. and Leopard to 16·5 ft., using a wide tower over the commander's hatch for the air supply, commander's control position and as an emergency escape route.





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* The figures for the Chieftain Mark 3 have been raised to 30 m.p.h. and 310 miles respectively. The Mark 5 will have an L60 developing 750 b.h.p.; 840 gross at the SAE rating.

Top left: *A Chieftain power pack removed. Note the radiator shown in the raised position and the two fans under the hydraulic cooler reservoir.* (Army PR)

Bottom left: *The power pack being lifted out of a Chieftain.* (Army PR)

Below: *A Chieftain clutch and gearbox assembly, the power pack having been removed from the hull.* (Army PR)

Leopard Anti-Aircraft Tank, Oerlikon-Contraves version with twin 35-mm guns and radar fire control equipment.

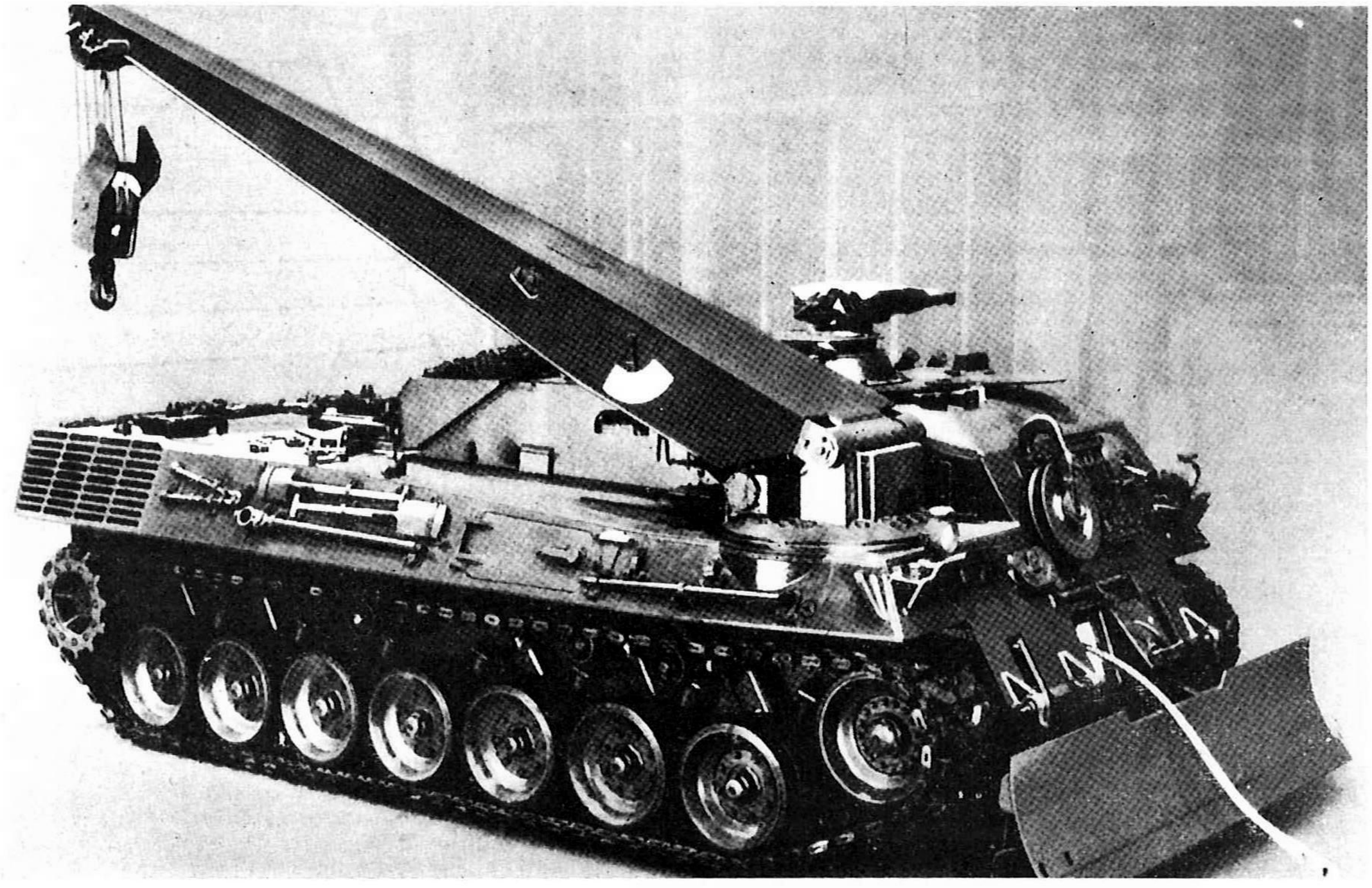
Leopard moving at speed through muddy lake.

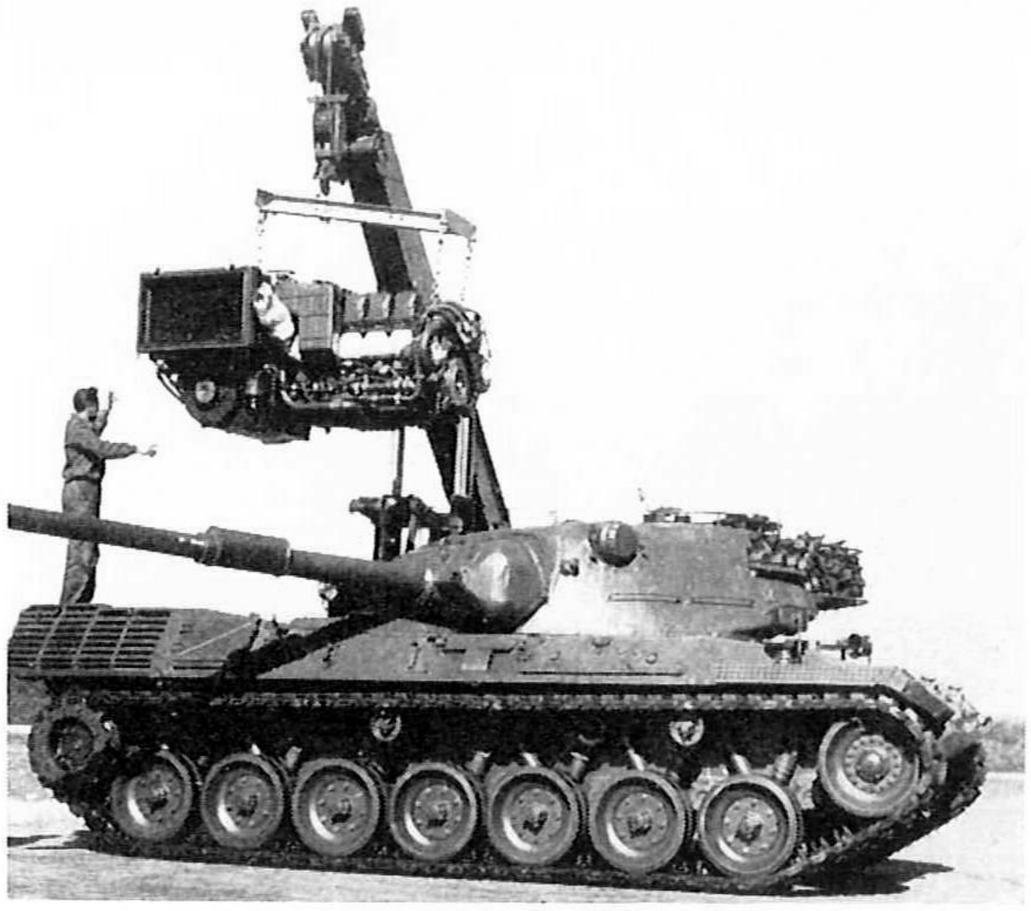
VARIANTS

It makes economic and logistic sense that the more specialized armoured vehicles should be based as far as possible on the design of the gun tank, although their appearance in service is usually delayed until production of the latter is nearly complete. The standard Chieftain and Leopard gun tanks can be equipped with dozer blades operated hydraulically and bridgelayers have been developed. That for Chieftain carries a folding "scissors" span with an effective span of 75 ft. and another version for use by armoured engineers will carry a shorter span and probably some form of demolition gun. Two types (A and B) of bridgelayer Leopard have been built with a 72-ft. span. The Armoured Recovery Vehicle (Bergepanzer Standard) based on the Leopard is already in service to replace the aged Sherman equipments and one for Chieftain is planned. Two versions of an anti-aircraft tank based on the Leopard are undergoing competitive development by Rheinmetall GmbH and Oerlikon of Switzerland respectively and both mount twin guns with radar fire control equipment.

The Rheinmetall anti-aircraft Leopard with twin 30-mm. guns. (Rheinmetall)

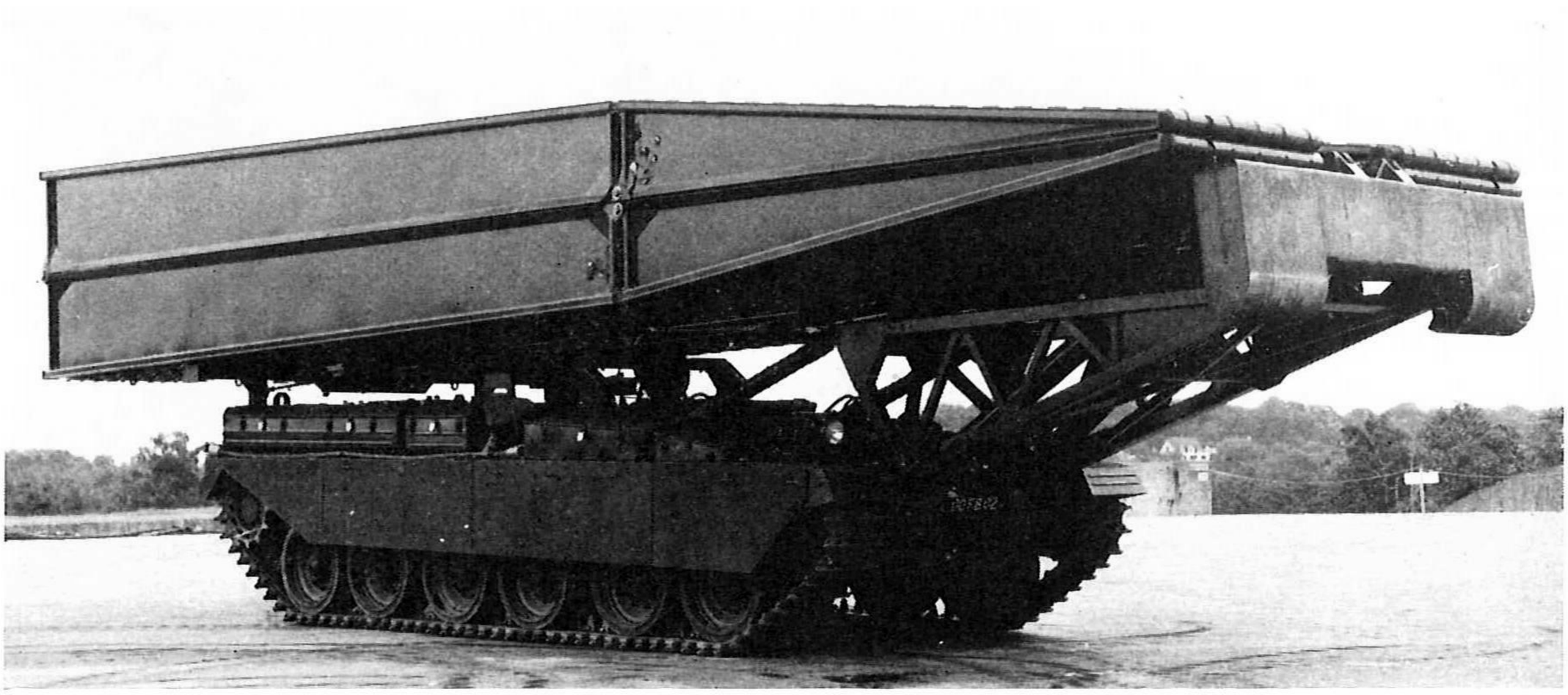
The advanced design of the Armoured Recovery Vehicle is based largely on Leopard components. (Soldat und Technik)





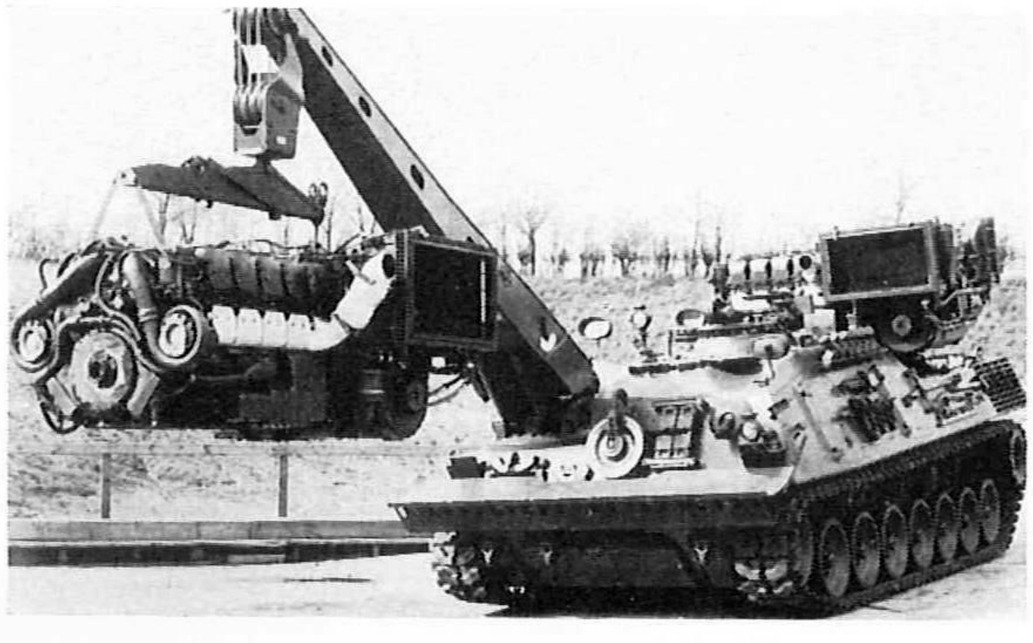
Lifting the power pack and transmission of a Leopard for servicing.
(Soldat und Technik)

An anti-aircraft version of Leopard designed by Oerlikon-Contraves, mounting two 35-mm. guns under radar control.
(Oerlikon)

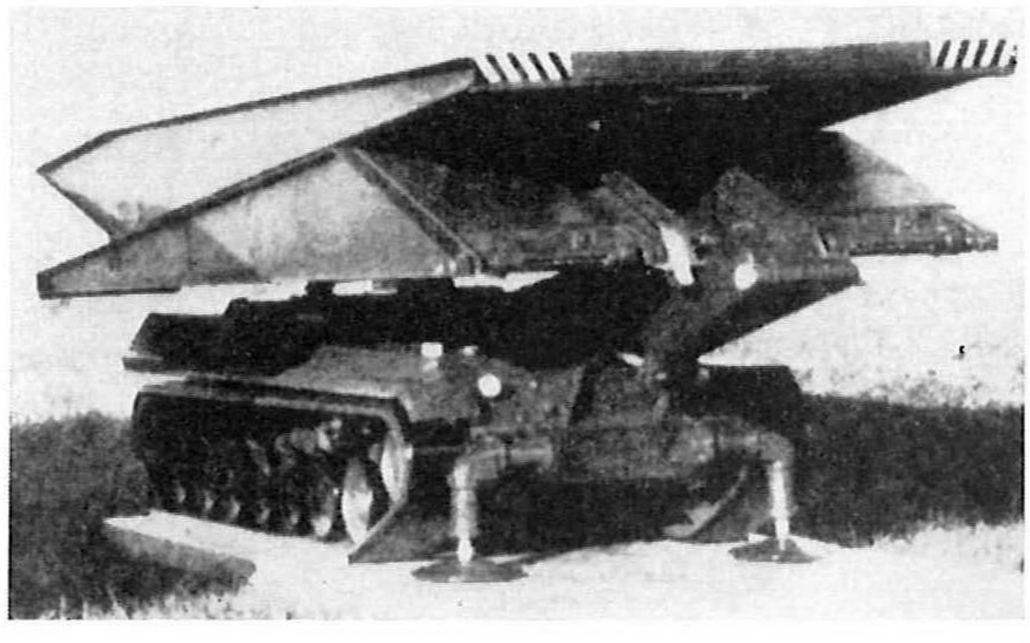


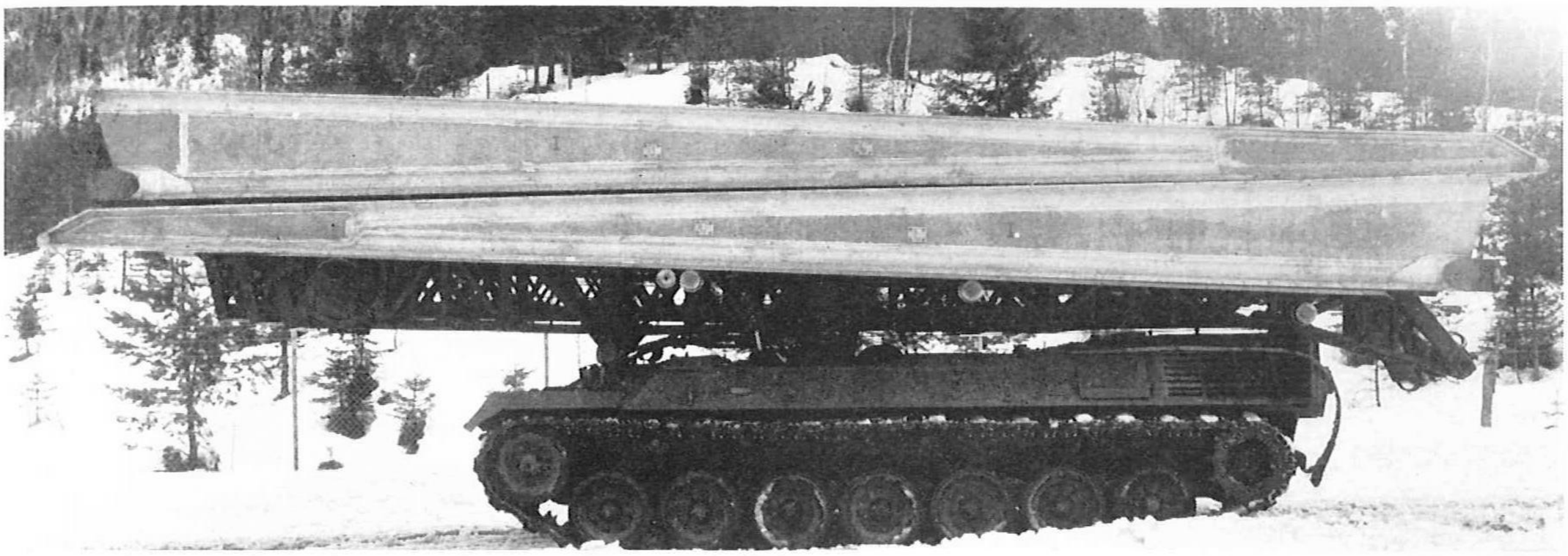
FV 4025 bridgelayer on Chieftain chassis with the folding spans in the travelling position. (FVRDE, CCR)

Bergepanzer armoured recovery vehicle lifting a complete Leopard power unit, with a second unit on the rear platform.
(Atlas-Mak)

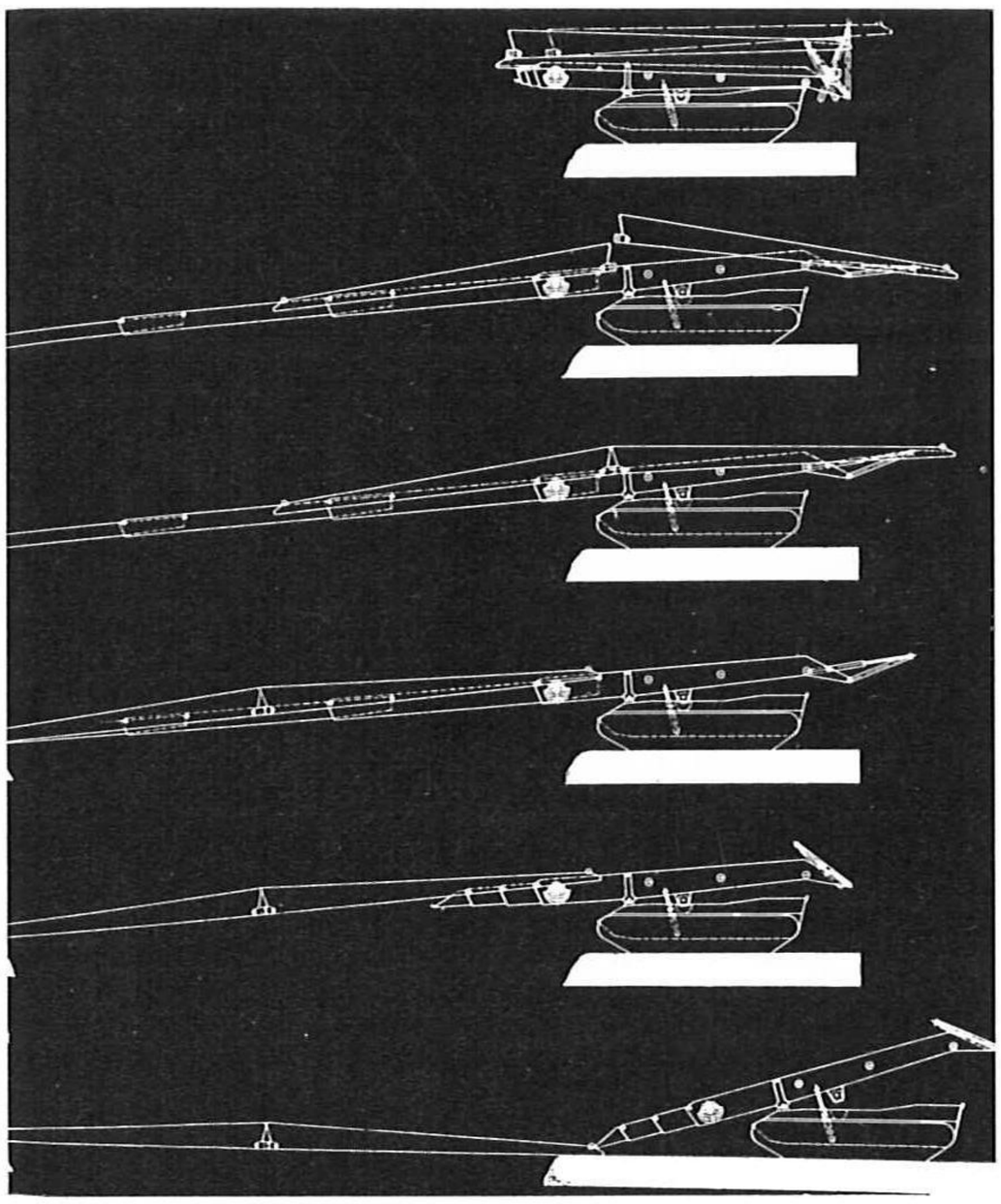


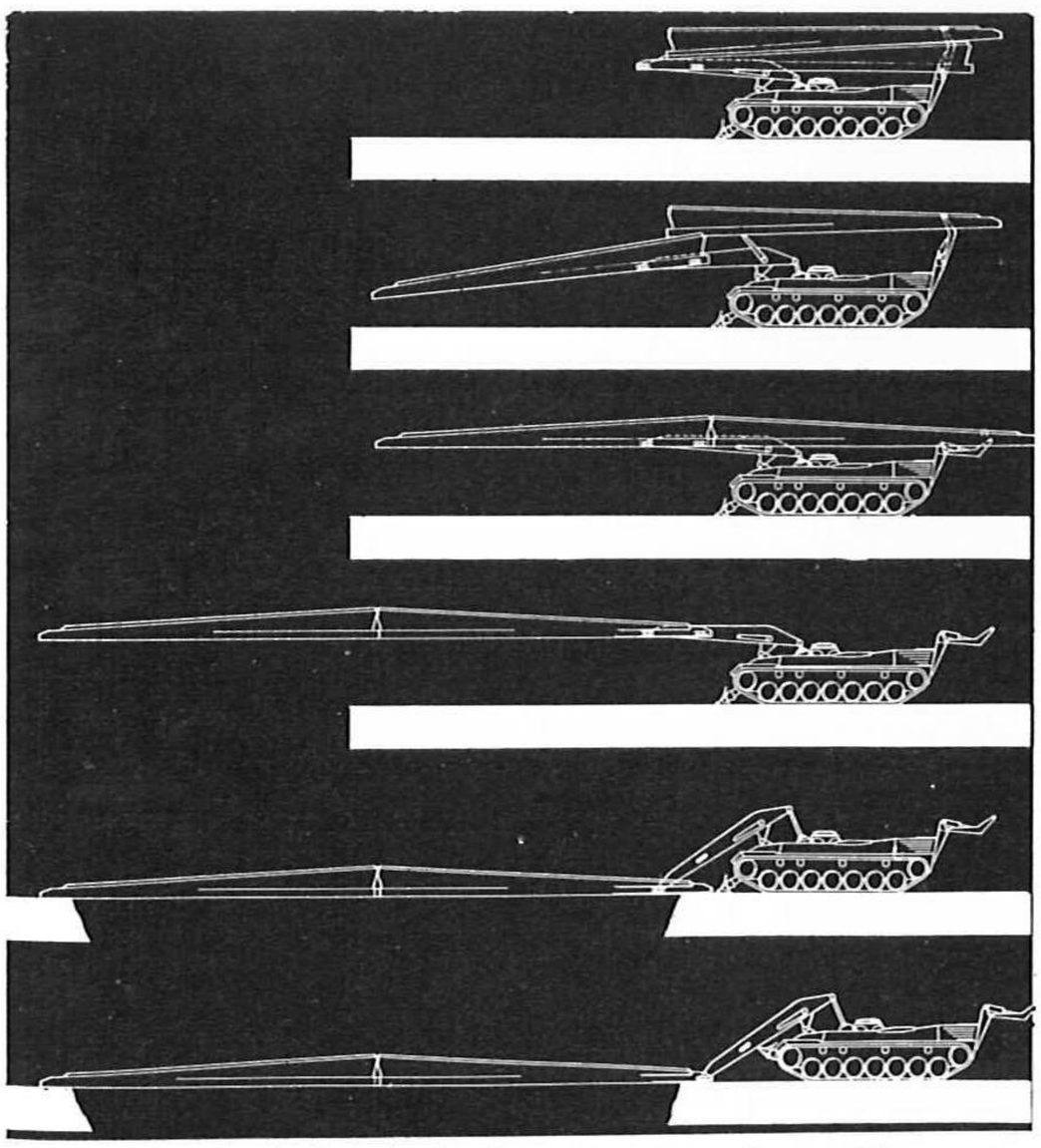
A small-scale model of a design for a bridgelayer based on a Leopard chassis.
(Soldat und Technik)





Bridgelayer Leopard Type A. (Krauss-Maffei)

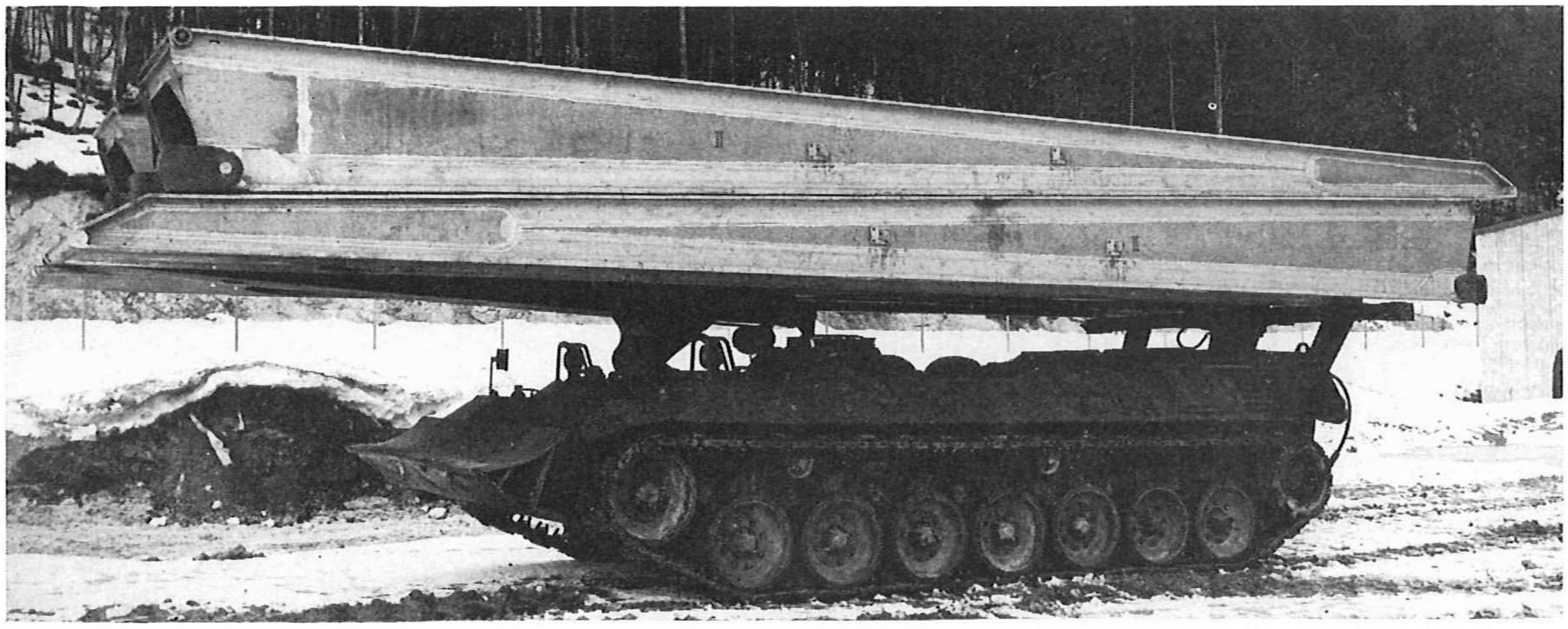


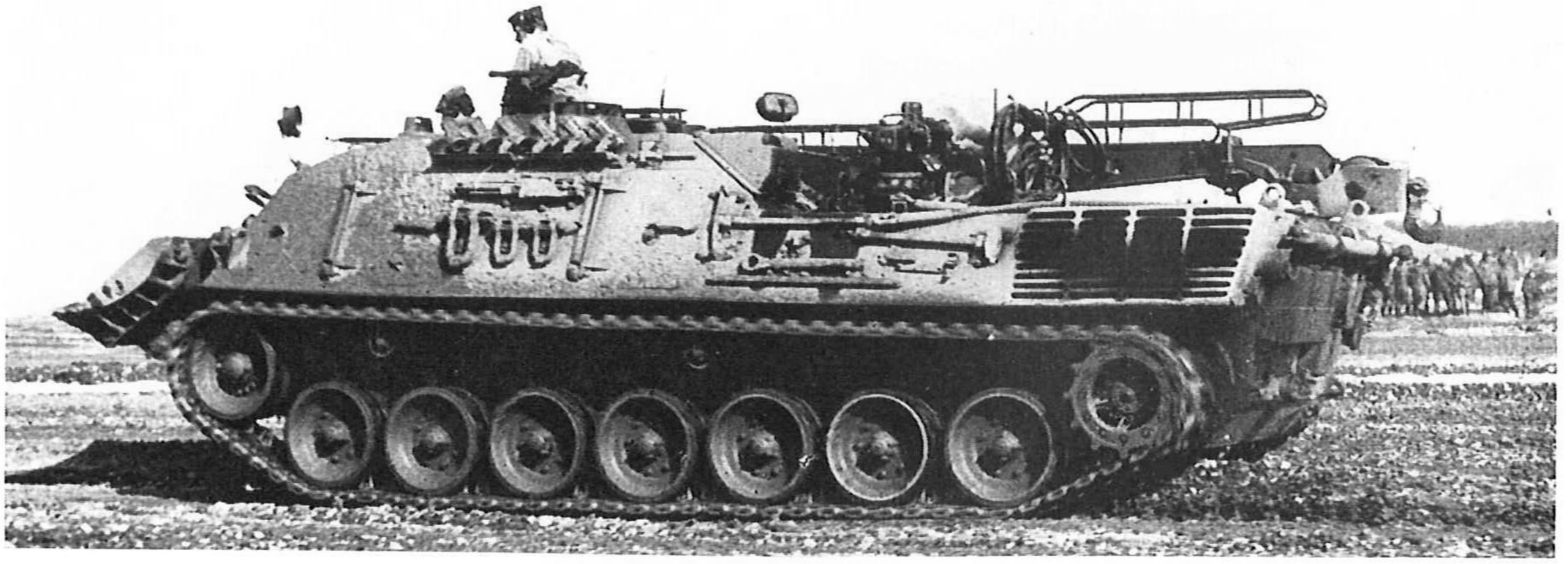


Above: *Diagram showing bridge in position. (Type B).*

Left: *Diagram showing bridge in position. (Type A).*

Bridgelayer Leopard Type B. (Krauss-Maffei)





Another Leopard variant is the armoured engineer vehicle. (Krauss-Maffei)

CONCLUSION

These two tanks have been designed to defeat a common enemy on the same type of terrain and in the context of the same alliance; and yet their basic characteristics differ widely. Part of the explanation may be sought in the experiences of World War 2 where, on the British side, poorly armed and armoured tanks defeated their opponents primarily through superior numbers and mobility. Yet casualties were high and there seems little doubt that those deficiencies have influenced British design ever since the inception of Centurion in 1943. The expected disparity in numbers in a future European war has tended to reinforce the insistence on a powerful combination of weapons and protection. The Germans, for their part, saw the weight of their tanks rise ten times in as many years, but their chance of survival on the battlefield against the proliferation of anti-tank weapons down to infantry section level decreased considerably. In addition, the need to build special bridges and transport in order to maintain some semblance of mobility on the battlefield convinced the Germans that the vicious spiral upwards of weight must be cut short. Although armour could not be discarded entirely, speed and shock action of armour manoeuvring *en masse* would more than make up for the reduction in passive protection, and these principles were added special point when considering operations on a nuclear battlefield where swift concentrations of effort from initial dispersal would be vital.

These arguments can be countered if it is accepted that there is a finite limit to the speed at which a tank with the present, conventional types of sus-

Leopard adapted for tank driving school. (Krauss-Maffei)

Chieftain at speed. (Army PR)

Production Leopard with combat carrier in front. (German MOD)

Leopard wading. (German MOD)

pension can cross broken ground without the turret crew being little more than hapless passengers longing for the journey to end. If this is the case then the efficiency of the tank as a weapon system during such moves is almost nullified. Added to this, it is difficult to see that the raising of the top speed in these conditions alters significantly the chance of hit by automated missiles flying at near-supersonic velocities, or modern guns with advanced fire control systems. In other words, it would be more economical to limit damage when once hit than to try to avoid hit at all. Again, on examining the history of armoured warfare there is little or no evidence to suggest that the lack of speed alone in tanks has ever been a decisive cause for failure in any operation. Where failures occurred they were more likely to have been precipitated by shortcomings in command, training and logistics, to mention but a few. If a significant increase in the tempo of operations is sought it seems more logical to concentrate on these—admittedly more intractable—factors, than on the addition of a few miles an hour to the top speed.

A further doctrinal difference involves the tactical handling of armour. Whereas the British view is that the best killer of a tank is another tank, and this process must start at long range, the Germans have long held that specialized anti-tank weapons are a better answer to attacks by armour and they use either the 25-ton Jpz 4-5 self-propelled gun mounting a 90-mm. gun or a similar chassis carrying SS 11 missiles for this purpose alone.

There is little doubt that these differences in opinion will dissolve in time when the increasing efficiency of power plants and new designs of suspension will permit the tank of the future to be better armed, armoured and more agile. But for the present the highly efficient gun and armour combination that is Chieftain and the less sophisticated but superbly mobile tank that is Leopard, will remain as tantalizing alternatives on the mechanized battlefield.

Leopards on manoeuvres. (German MOD)

Side view of Leopard with tactical markings on turret. (German MOD)

SUMMARY OF TECHNICAL DATA

	Chieftain MK. 2	*Leopard*
Dimensions, Weight and Crew		
Weight combat loaded:	115,600 lbs.	88,500 lb.
Length with gun front:	35' 4"	31' 4"
Length with gun in travel lock:	31' 11"	26' 10"
Height to forward roof of hull:	5' 3"	5' 2"
Height to turret roof:	8' 3"	7' 10"
Width overall:	12' 0"	10' 8"
Length of track on ground (nominal):	16' 10"	13' 10"
Distance between track centres:	8' 11"	8' 10"
Length: track centre ratio:	1·60	1·56
Ground clearance (nominal):	1' 10"	1' 6"
Crew:	4	4
Armament and Fire Control		
Main armament:	120-mm. L11A2 or 3	105-mm. L7A1
Maximum elevation:	+20°	+20°
Maximum depression:	−10°	−9°
Ammunition and muzzle velocity (feet/second)	APDS 4495 HESH 2198 Bursting Smoke Canister 2198	APDS 4850 HESH 2400 HEAT 3840
Total rounds stowed:	53	60
Rate of fire (rounds in first minute):	8	9
Method of ranging:	0·50-in. gun (600 rounds)	Commander: stadia Gunner: stereo and coincidence
Secondary armament:	Two 7·62-mm. GPMG	Two 7·62-mm. MG1
Limits of elevation and depression of external MG:	+45° to −10° (firer protected)	+75° to −15° (firer unprotected)
MG rounds stowed:	6,000	4,800
Smoke grenade dischargers:	2 ×6 barrels	2 ×4 barrels
Automotive systems		
Engine		
Type:	L60 No. 4 Mk. 4A	DB 838
Capacity (litres):	19	37·4
Output (gross b.h.p. at SAE standard):	730 at 2,100 r.p.m.	840 at 2,260 r.p.m
Torque (lb. ft. at r.p.m.):	1,460 at 1,320	1989 at 1,200
Bore (in.)	4·63	5·65
Stroke (in.):	5·75	6·0
Compression ratio:	16·1	18·1
Fuel under armour (Imp. gall.):	195	220
Transmission:	TN 12 Mk. 3 epicyclic: 6 forward ratios, 3 reverse	Single stage torque converter: 4 ratios with lock up on 2, 3 & 4
Steering:	Merritt differential	2 radii, regenerative
Tracks (width in.):	Steel with rubber pads: dry pin (24)	U.S. pattern (double pins (22))
Suspension:	Modified Horstmann	Torsion bar
Water crossing, unprepared	3' 6"	3' 9"
prepared:		7' 5"
schnorkel:	15' 0"	16' 6"
Performance		
Power/weight ratio (sprocket b.h.p. SAE/long ton):	11·1	14·5
Nominal ground pressure (lb./sq. in.):	13·8	12·2
Maximum trench:	10' 4"	9' 6"
Maximum grade:	32°	33°
Maximum step:	3' 0"	3' 9"
Road Range (maximum in miles):	250	375
Maximum speed (m.p.h.)	25	41
Communications (in standard gun tank):	SCR C 42, SCR B 47	SEM 25

Chieftains on manoeuvres. (Army PR)

Though slower on the road than Leopard, Chieftain Mark 2's sustained cross country speed is not significantly different.
(Army PR)

Head-on view of Leopard. (Krauss-Maffei)

Above: *The power pack of Chieftain being lifted out by REME fitters. The two cooling fans can be seen with, immediately above, the radiators that have been raised to the vertical position.*
(FVRDE, CCR)

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A general head-on view of a Chieftain Mark 2 of the 1st Royal Tank Regiment as it moves closed-down. (CCR)

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