

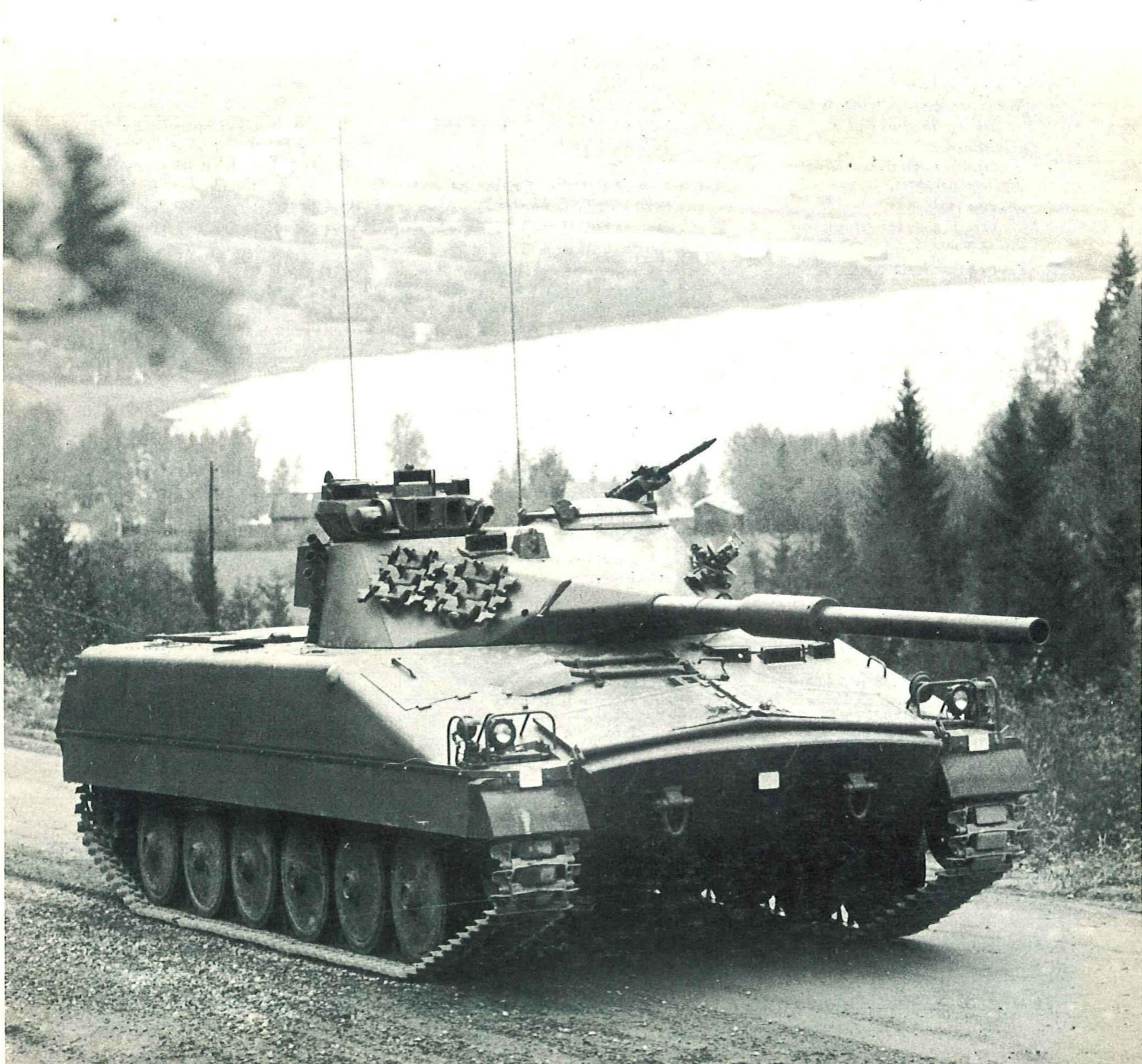
PROFILE

AFV  
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42

# Modern Swedish Light Armoured Vehicles

by R. M. Ogorkiewicz



# AFV/Weapons Profiles

*Edited by DUNCAN CROW*

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Prototype of Pbv 302, the amphibious armoured personnel carrier built by AB Hägglund & Söner.

(Hägglund)

# Modern Swedish Light Armoured Vehicles

by R. M. Ogorkiewicz

THE production of armoured vehicles is an exacting and complex undertaking. It is not easy, therefore, to make a success of it in a short space of time. Yet this has been done by AB Hägglund & Söner, the engineering company of Örnsköldsvik in northern Sweden, who successfully produced several armoured vehicles within a few years of becoming involved in their development.

Hägglunds first became involved with armoured vehicles in 1957, when they were awarded a contract to build a number of tank turrets with a long-barrelled 75mm gun. The turrets were designed by the Swedish Army Ordnance for mounting on the chassis of the Strv m/42, a 22.5-ton tank originally built in 1943 with a smaller turret and a short-barrelled 75mm gun. The new turrets were manufactured by Hägglunds from March 1958 to June 1960 and when mounted on the chassis of the Strv m/42 in place of the original turrets they converted them into the Strv 74, while the remaining, unmodified tanks were redesignated Ikv 73, the Ikv being an abbreviation for *infanterikanonvagn*, or "infantry gun vehicle".

The turrets for the Strv 74 were however also built by AB Landsverk, Sweden's oldest tank manufacturing company, and Hägglunds did not really make their mark until their second venture into the armoured vehicle field, which was the production of the *Pansarbandvagn*, or Pbv, 301—the first Swedish tracked armoured personnel carrier.

## STRV M/41

Development of the Pbv 301 originated with Sven Berge, the head of the tank design section of the Vehicle Division of the Swedish Army Ordnance, who later also originated the development of the S-tank. Thus, in 1954, when there was still no Swedish Army requirement for tracked armoured personnel carriers, Berge foresaw the need for them and proposed the conversion into them of a light tank which had become obsolete as a fighting vehicle but whose automotive performance had been very satisfactory.

This tank was the Strv m/41, a 10.5-tonner armed with a 37mm gun which was based on a design evolved in the mid-thirties in Czechoslovakia by the Ceskomoravska Kolben Danek company. An earlier light tank designed by the same company, the AH-IV-Sv, was adopted by the Swedish Army as the Strv m/37 and forty-eight of these tanks were built in Sweden, under licence, by the Jungner company in 1938 and 1939. By then, however, Ceskomoravska Kolben Danek had developed another and more powerful tank, the TNH. This attracted the attention of several armies, including the Swedish which placed an order for about 90 to be delivered in 1939 and 1940. However, none of these vehicles ever reached Sweden because of the German occupation of Czechoslovakia in 1939. Instead they were delivered to the German Army which used them with considerable success, particularly during the 1940 campaign in France,



*Strv m/41 which was based on the Czech TNH light tank.*

(Swedish Army)

*Prototype of Pbv 301 with a mock-up of a conventional, domed turret.*

(Hägglund)





*Production version of Pbv 301.*

(Hägglund)

as the PzKpfw38(t), together with other tanks of this type.

The Swedes did, however, manage to secure German agreement to the manufacture of the TNH, under licence, in Sweden. It was produced in 1942 by the Scania Vabis company as the Strv m/41 and built for itself a reputation for reliability and mobility, which recommended it later for conversion into an armoured personnel carrier. Another factor in favour of converting the Strv m/41 into a carrier was the development in the early 1950's of an air-cooled gasoline engine which could replace its original, water-cooled Scania Vabis engine and at the same time occupy less space, weigh less and yet deliver more power. The engine was the 150 bhp horizontally-opposed 4-cylinder B 44 which was made by Svenska Flygmotor AB, now the Volvo Flygmotor, of Trollhättan. It was originally developed for the Ikv 103, an improved, 105mm gun version of the 8-ton Ikv 72 turretless assault gun. When it was originally produced, by AB Landsverk, in the early 1950s, the Ikv 72 was armed with a short 75mm gun but it was later rearmed with the same short-barrelled 20-calibre long 105mm gun as the Ikv 103 and redesignated the Ikv 102.

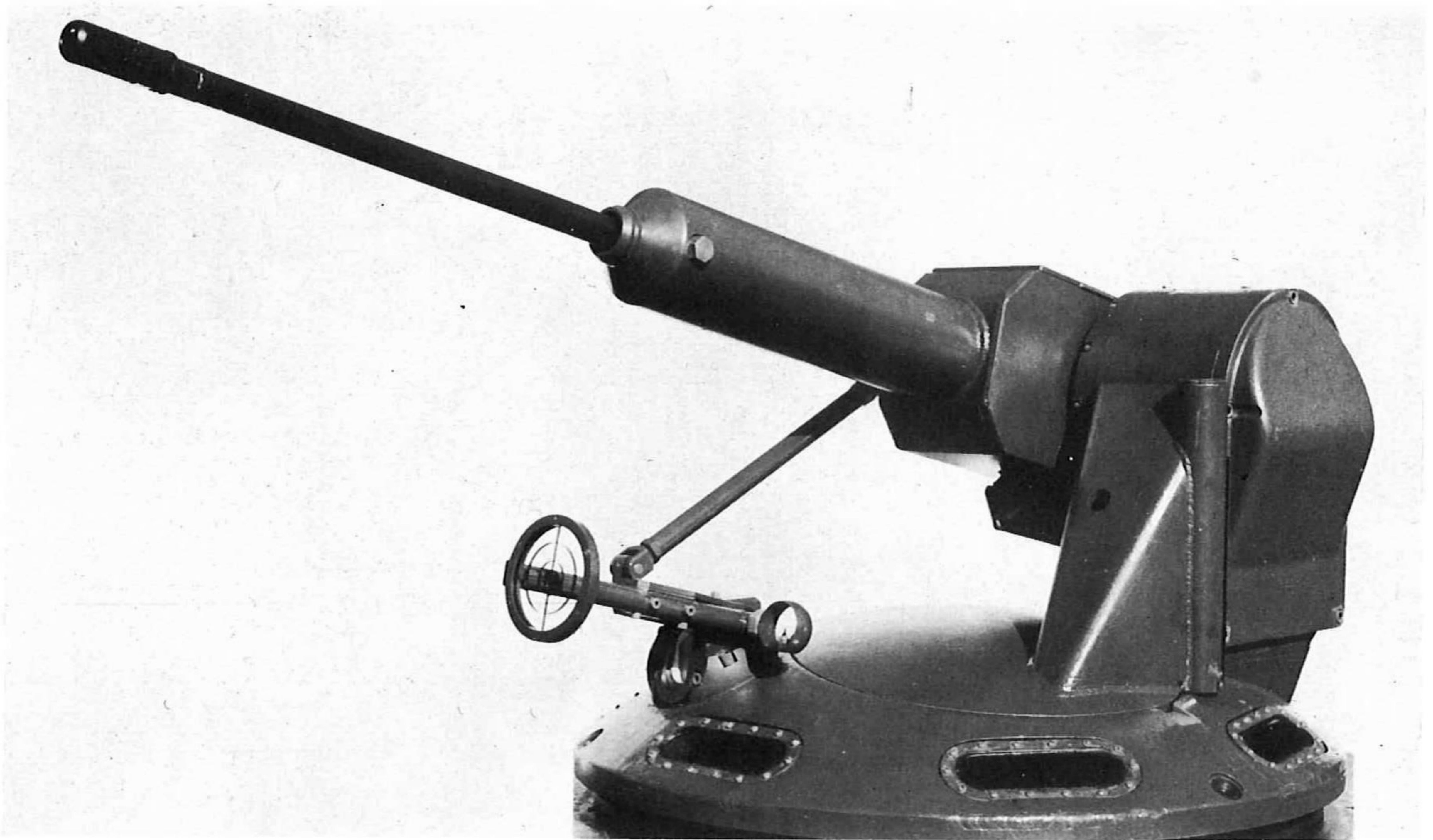
### **PBV 301**

After two years of studies of the possible conversion of the Strv m/41 into an armoured personnel carrier the Swedish Army placed orders in 1957 for the construction of two carrier prototypes. One of these was ordered from



*Pbv 301 with its 20mm gun elevated for anti-aircraft fire.* (Bofors)

Hägglunds who delivered it in February 1959, and the other from Landsverk who delivered it a little later. Both then began to be tested by the Swedish Army but already in June 1959 Hägglunds received an order for seven additional prototypes and Landsverk for three more. These were delivered during the first four months of 1961 but before this stage of the development had been reached the Swedish Army in June 1960 placed a production order with Hägglunds. In consequence, Hägglunds



*Bofors TAKv 20 L/70-7 cupola of Pbv 301.*

(Bofors)

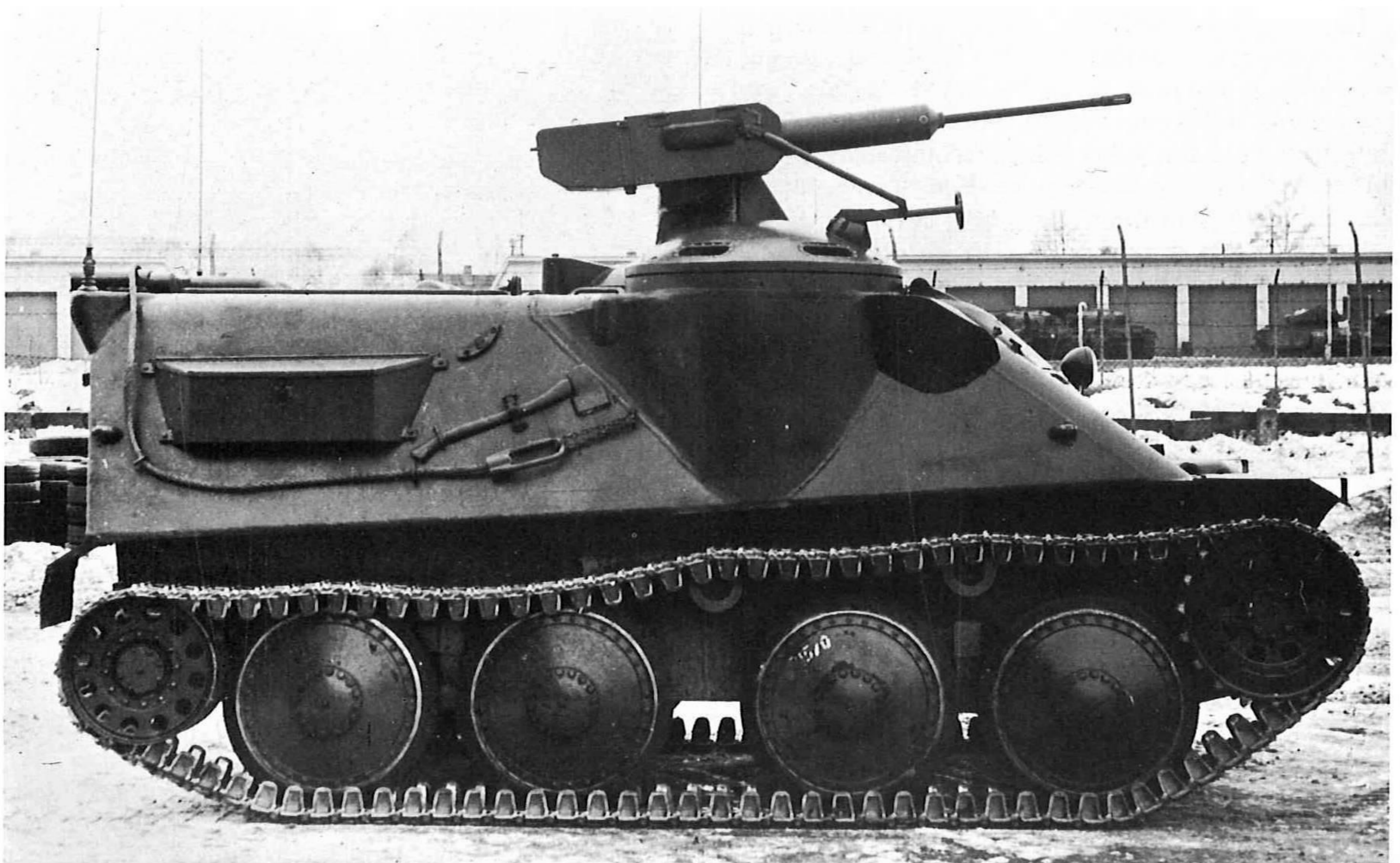
began to rebuild Strv m/41 into carriers in quantity. The first of the resulting vehicles was delivered in January 1962 and the last in April 1963, and when they were accepted by the Swedish Army they became known as the Pbv 301.

The production of the Pbv 301 from the basis of the Strv m/41 was a thorough and successful undertaking.

Fully equipped the Pbv 301 weighed 11.7 tons, which made it 1.2 tons heavier than the Strv m/41, but because it had a more powerful engine it had the same, 45 km/h, maximum road speed as the parent vehicle. Apart from the change of engine, the conversion involved not only the inevitable removal of the two-man 37mm gun turret but also the replacement of the original superstructure

*Side view of a Pbv 301 production model.*

(Hägglund)





No. 1 prototype of Pbv 302 without its trim vane.

(Hägglund)

by a new one, to create a compartment for carrying infantrymen. As the Strv m/41 was relatively narrow, the width of the superstructure was severely restricted but nevertheless it was found possible to provide in the Pbv 301 sufficient room for 10 men, including the driver, which is as many as armoured carriers are normally expected to carry in order to accommodate an infantry section or squad of the traditional size. Moreover, the Pbv 301 was provided with a 20mm gun cupola and a separate cupola for its commander, who could therefore concentrate on his proper rôle of commanding the vehicle instead of being reduced to the rôle of a gunner, as commanders had been in other contemporary carriers.

Apart from providing the Pbv 301 with an effective weapon against other light armoured vehicles and low flying aircraft, which most armoured carriers have lacked, the 20mm gun cupola was in itself noteworthy. It was originally developed not only for Pbv301 but also for the S-tank. However, on the S-tank it was found to be too exposed to ricochets bouncing off the exceptionally well-sloped hull glacis plate. In consequence, the S-tank was fitted with a different, low cupola with an externally mounted 7.62mm machine-gun but the 20mm gun cupola was adopted for the Pbv 301, which was originally built with a small, conventional hemispherical cupola with a 7.62mm machine-gun mounted within it.

The 20mm gun cupola was devised by Sven Berge and built by AB Bofors, the Swedish company world-famous for its guns, and represented an original solution to the problem of mounting light automatic guns in armoured vehicles. Previously such guns were mounted within conventional turrets, but in the Bofors cupola the 20mm gun was mounted externally on a pedestal and fired by remote control from within, without the gunner exposing himself. Moreover, the ammunition was also fed to the gun from within the cupola by a belt passing up the pedestal and through the large elevation bearing of the gun.

The external mounting of the gun eliminated the problem of powder fumes in the cupola and also eased that

of providing sufficient elevation for anti-aircraft fire. The size of the cupola could also be greatly reduced and under suitable circumstances the gun could be fired with a minimum exposure of the vehicle from behind cover. The best testimony of the success of Bofors' cupola gun mounting is provided by the fact that its essential features were subsequently copied in the 20mm gun turret developed in Germany by Keller & Knappich for the Marder armoured personnel carrier and in a 25mm gun cupola developed in Switzerland by Oerlikon.

### PBV 302

Within a year of being awarded the production order for the Pbv 301 Hägglunds began to work on a second armoured personnel carrier. Preliminary studies of the new vehicle started in February 1961 and eight months later, in October 1961, Hägglunds received from the Swedish Army a contract for the design and construction of two prototypes, which followed with remarkable speed. Thus at the end of December 1962 Hägglunds delivered the first prototype of the new carrier, which was designated the Pbv 302.

In some respects the Pbv 302 resembles the U.S. M113 armoured personnel carrier, which began to be produced shortly before its development started and one of which was acquired, for study, by the Swedish Army. In particular, the Pbv 302 has a hull similar to that of the M113 and it is also inherently amphibious. However, the Pbv 302 differs from the M113 in having steel, instead of aluminium, armour and in several other respects.

The most important difference between the two carriers is that the Pbv 302 has a turret with a 20mm Hispano-Suiza gun. The turret, unlike that of the Pbv 301, is of a conventional design which was adopted by Hägglunds in keeping with the general policy of making the Pbv 302 simple and inexpensive to produce. Nevertheless, the 20mm gun turret has made the Pbv 302 superior to the M113 and several other contemporary armoured personnel carriers which are armed with nothing better than a 7.62mm or at most 12.7mm



*Pbv 302 prototype showing the driver's position between the gun turret and the commander's cupola.* (Hägglund)



*Side view of Pbv 302 prototype.* (Hägglund)



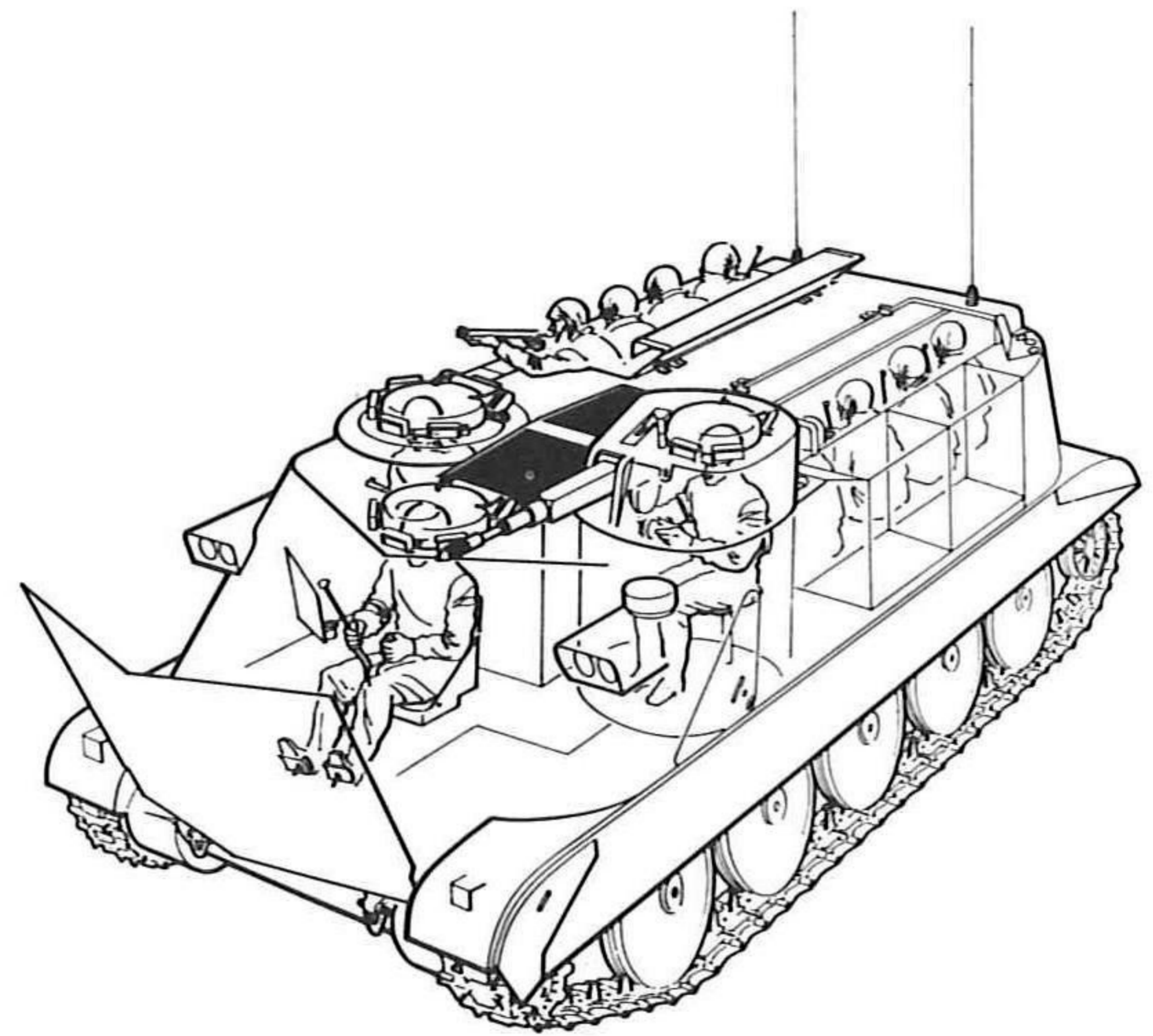
*Pbv 302 prototype swimming* (Hägglund)

machine-gun, mounted externally so that the vehicle commander has to expose himself to fire them. In the Pbv 302, on the other hand, not only is the 20mm gun mounted in a fully enclosed turret but the commander is provided with his own hatch and periscopes, so that he can observe without exposing himself and is unlikely to become preoccupied with the vehicle's gun to the detriment of his proper duties.

The 20mm gun turret and the commander's station are both located well forward, on either side of the hull, only slightly behind the centrally located driver's station, which provides a very good view forward. All this has been made possible by the location of the engine under



*Pbv 302 prototype with its trim vane hinged forward.* (Hägglund)



*Drawing showing the location of the Pbv 302's crew.* (Hägglund)



*Late production version of Pbv 302.* (Hägglund)

the floor of the front portion of the vehicle, so that the driver, commander and turret gunner sit over it.

### VOLVO ENGINE

The engine is a Volvo model THD 100 B, a water-cooled six-cylinder in-line turbo-charged diesel with a total swept volume of 9.6 litres out of which it develops 270 bhp, giving the Pbv 302 a power-to-weight ratio of 20 bhp per ton. It is a standard engine produced commercially and therefore very much less expensive than such possible alternatives as the Rolls-Royce K.60 diesel specially developed for armoured vehicles, which has been adopted for the contemporary British FV 432





*Early production version of Pbv 302 with troops firing out of the roof hatches.*

(Swedish Army)

armoured carrier and also for the Swedish S-tank as one of its two engines. The transmission of the Pbv 302 is also of a commercial type and consists of a conventional clutch and a manually operated but fully synchronized Volvo R 60 gearbox with eight forward and two reverse speeds. From the gearbox the drive is taken forward to a cross shaft with clutches and disc brakes at either end which provide a simple but effective, clutch-and-brake steering system.

The front-mounted sprockets drive tracks which are similar to those of the M113 and other contemporary light armoured vehicles. In other words they are made up of links with single, rubber-bushed pins and replaceable rubber road pads as well as pads bonded to their road wheel faces. The track links are 380mm wide and the tracks exert a nominal ground pressure of 0.6 kg/cm<sup>2</sup> when the Pbv 302 is at its fully laden weight of 13.5 tons.

In addition to their normal functions, the tracks also propel the vehicle in water, at up to 8 km/h. This is sufficient for the crossing of moderately fast flowing rivers, as well as lakes and other calm inland waters. The Pbv 302 has also swum in the sea but its ability to do this depends on the absence of swell, because of its inevitably low freeboard. Given suitable conditions, all that is required for it to swim is to raise the V-shaped bow-board or trim vane, which can be done very quickly by the driver, half-leaning out of his hatch. On land the Pbv 302 has nominally a maximum speed of 65 km/h on roads but the author was driven in one of the prototypes, along a winding forest track, at between 70 and 75 km/h.

To improve their thrust in water, the top runs of the tracks are shrouded, the shrouds being originally of rubber but later of steel. Like most other modern vehicles, the Pbv 302 has no track return rollers, which has saved a significant amount of superfluous weight. Instead, the return run of the tracks rests on top of the road wheels of which there are five per side. The wheels are independently located on relatively light, hollow trailing arms and they are sprung, as in most contemporary tracked armoured vehicles, by transversely located torsion bars.

Apart from having a 20mm gun turret and an unusual engine location, the Pbv 302 is also noteworthy for having a double skin hull. The outer skin is relatively thin and its main function is to provide sufficient additional buoyancy for the carrier to float in water without aids. However, the double skin construction also provides a form of spaced armour and therefore improved protection, particularly against shaped charge rockets. It has also provided an opportunity for shaping the hull to reduce its water resistance, which has been studied with models, without compromising its ballistic characteristics.

At the rear of the hull there are two side-hinged doors to provide access to the crew compartment, which can accommodate up to nine riflemen. In the roof of the crew compartment there are two long, hydraulically operated hatches which, when opened, enable the riflemen to observe and fire their weapons. The opening and closing of the hatches is controlled from the commander's station but along the edge of each there is sensitive



Prototypes of Pbv 302 and of the S-tank at a demonstration in September 1965.

(Swedish Army)



Pbv 302s followed by S-tanks on manoeuvres.

(Swedish Army)

pressure bar which prevents a man having his hand or weapon trapped by the closing of a hatch.

### DEVELOPMENT AND PRODUCTION

Virtually all the features of the Pbv 302 were incorporated in its first prototype whose development testing started in January 1963. A production order followed remarkably quickly, in October 1963, when the Swedish Army ordered the Pbv 302 in quantity and also presented it for the first time to the world at large.

The first production vehicle was delivered by Hägglunds in February 1966, which was only two years and four months from the receipt of the production contract and just short of five years from the commencement of the design studies. By either yardstick it was a praiseworthy achievement, particularly in view of the fact that

when the author visited it in September 1965 the new building specially put up at the Hägglund plant in Örnsköldsvik for the assembly of the Pbv 302 was still an empty shell.

Since the Pbv 302 has been delivered in quantity it has been issued by the Swedish Army to its *pansarbataljoner*, or armoured battalions. These, in contrast to units of a similar size in other armies, have a mixed composition consisting as they do of armoured infantry and artillery as well as battle tanks. Thus two companies of a *pansarbataljon* are armoured infantry companies equipped with the Pbv 302 while two other companies are battle tank companies equipped with S-tanks or British-built Centurions, the former being officially designated Strv 103 and the latter Strv 101. Such an organization provides a close and permanent combination of tanks with rifle-

men which is most valuable but which can only be achieved effectively if the infantry are equipped with vehicles such as the Pbv 302 whose mobility and fighting capabilities are compatible with those of battle tanks.

### BGBV 82

The adoption by the Swedish Army of the Pbv 302 inevitably gave rise to a need for vehicles to support it and in particular for a suitable armoured recovery vehicle. An even more urgent need arose at about the same time out of the introduction into service of the S-tank. Until then the needs of units equipped with armoured personnel carriers and battle tanks had been met by the development of different supporting vehicles. In this case, however, preliminary studies by the Swedish Army Ordnance Vehicle Division indicated that one type of armoured recovery vehicle could be developed from the basis of the Pbv 302 to meet not only the needs of units equipped with it but also of those equipped with S-tanks. The conclusion in favour of such a vehicle was swayed by at least two special considerations. One was the fact that at 37 tons the S-tanks were lighter than most other battle tanks. The other was the argument that it was more cost-effective for S-tanks to haul other, disabled S-tanks out of the line of fire than to develop a special heavily armoured recovery vehicle for this purpose, other recovery operations being well within the capabilities of a lighter, less heavily armoured vehicle, such as that which could be developed from the basis of the Pbv 302 components. A lighter armoured recovery vehicle could also be made amphibious and a better amphibian than either the S-tank or the Pbv 302, so that it would help them to

cross difficult water obstacles.

As a result, Hägglunds received a contract in July 1966 for the design of an armoured recovery vehicle, which became known as the Bgbv 82. Once again Hägglunds worked with commendable speed and delivered a prototype in July 1968. As usual, the prototype was subjected by the Army to various tests and their satisfactory outcome led to the award to Hägglunds of a production order in April 1970.

The Bgbv 82 resembles the Pbv 302 but it is wider and longer: its overall width is, in fact, 3.21 m compared with 2.86 m and its overall length 6.75 m compared with 5.35 m; it also has six, instead of five, road wheels per side. It is also considerably heavier as its combat weight is 26 tons when it carries its full load of 5 tons. Its heavier weight is, however, in keeping with the requirement that it should be able to recover vehicles weighing up to 40 tons. To meet this requirement it is fitted with a powerful winch and heavy ground anchor spades. The winch is driven by a high torque hydraulic motor which enables it to exert a maximum pull of 20 tons and the two hydraulically operated spades mounted at the rear of the hull are fully capable of absorbing this.

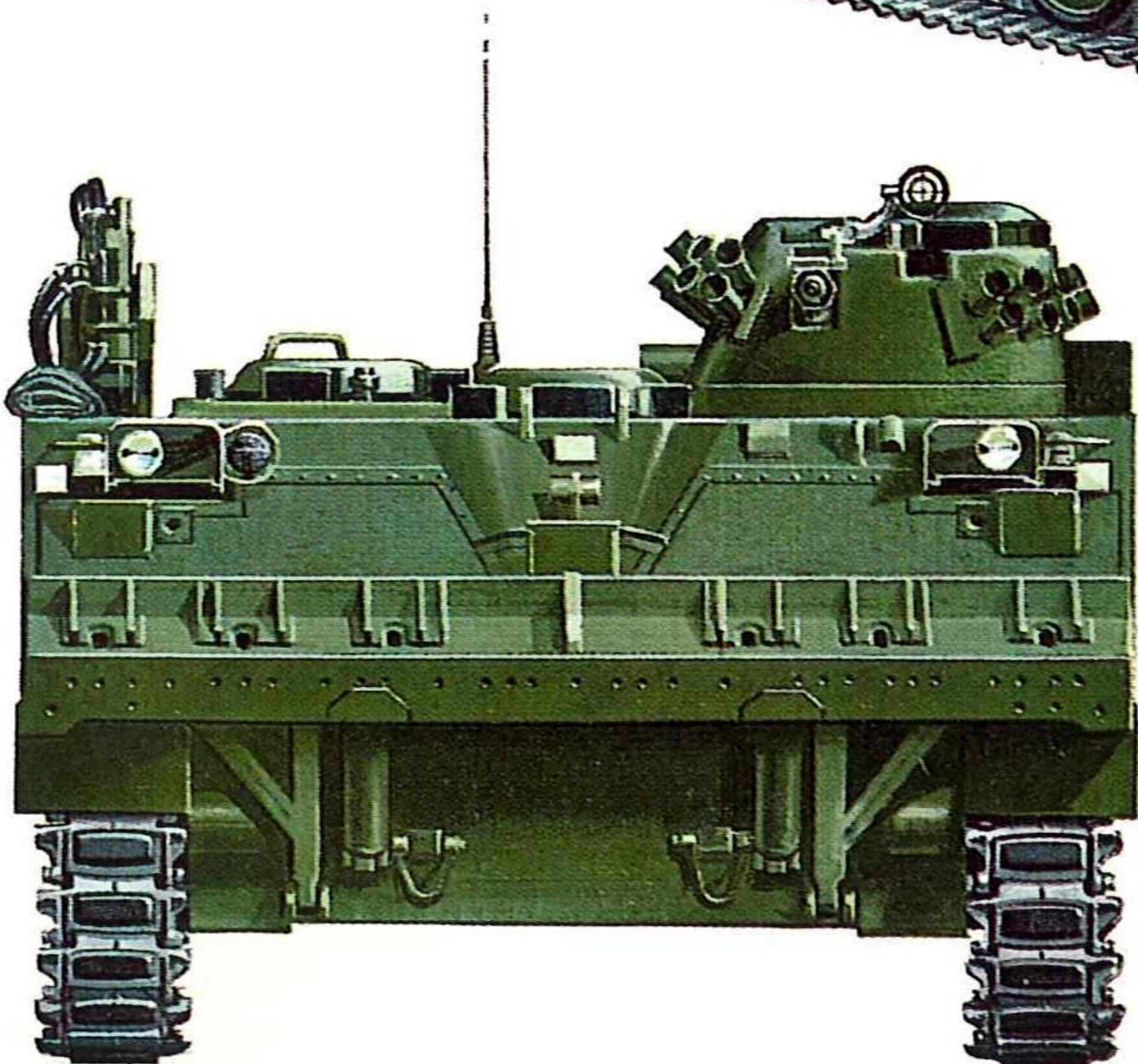
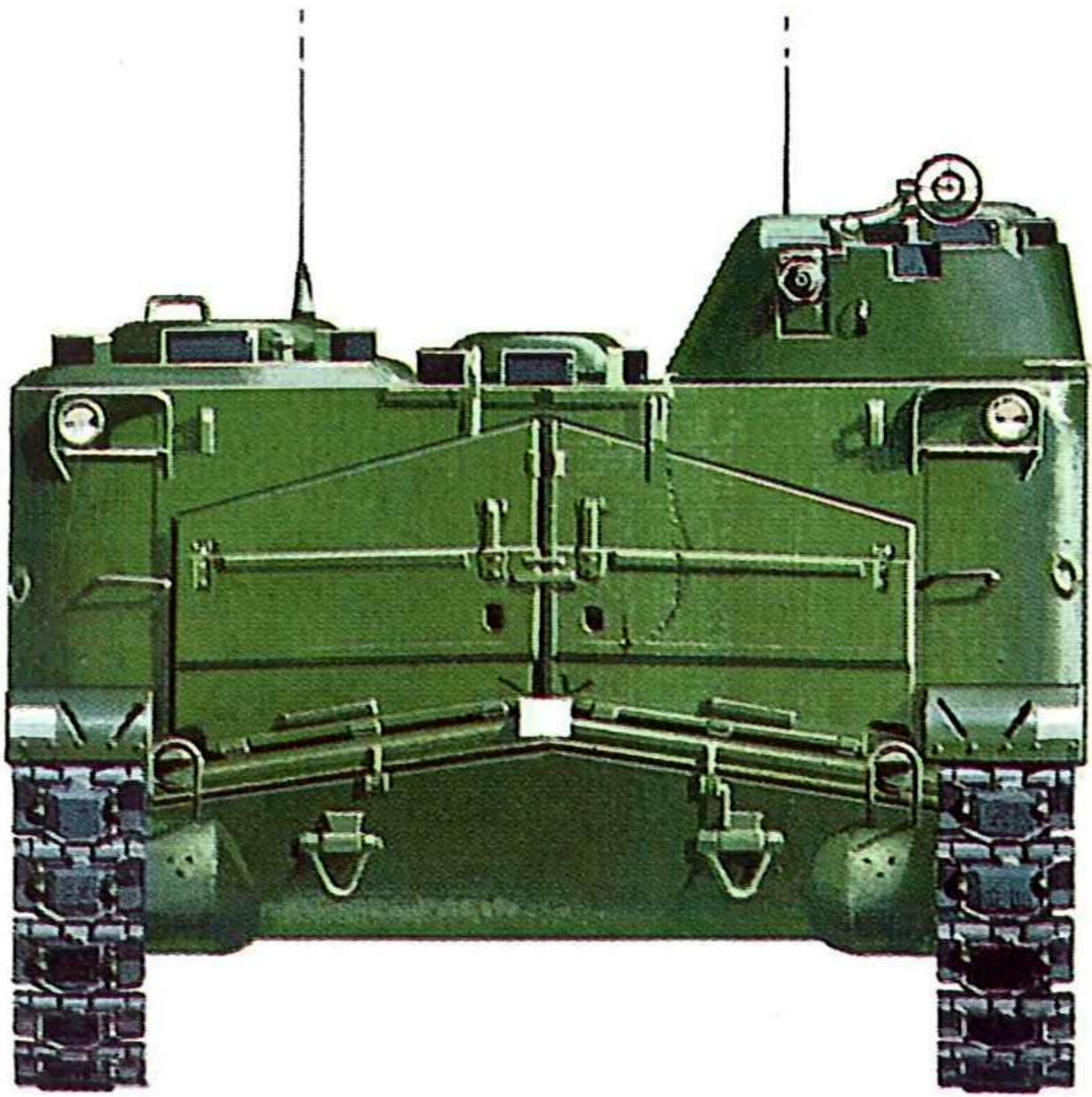
In addition to its winch the Bgbv 82 is also fitted with a high capacity lifting crane and a bulldozer blade, both hydraulically operated; the crane is intended mainly for use in carrying out major field repairs, such as the replacement of engines in battle tanks.

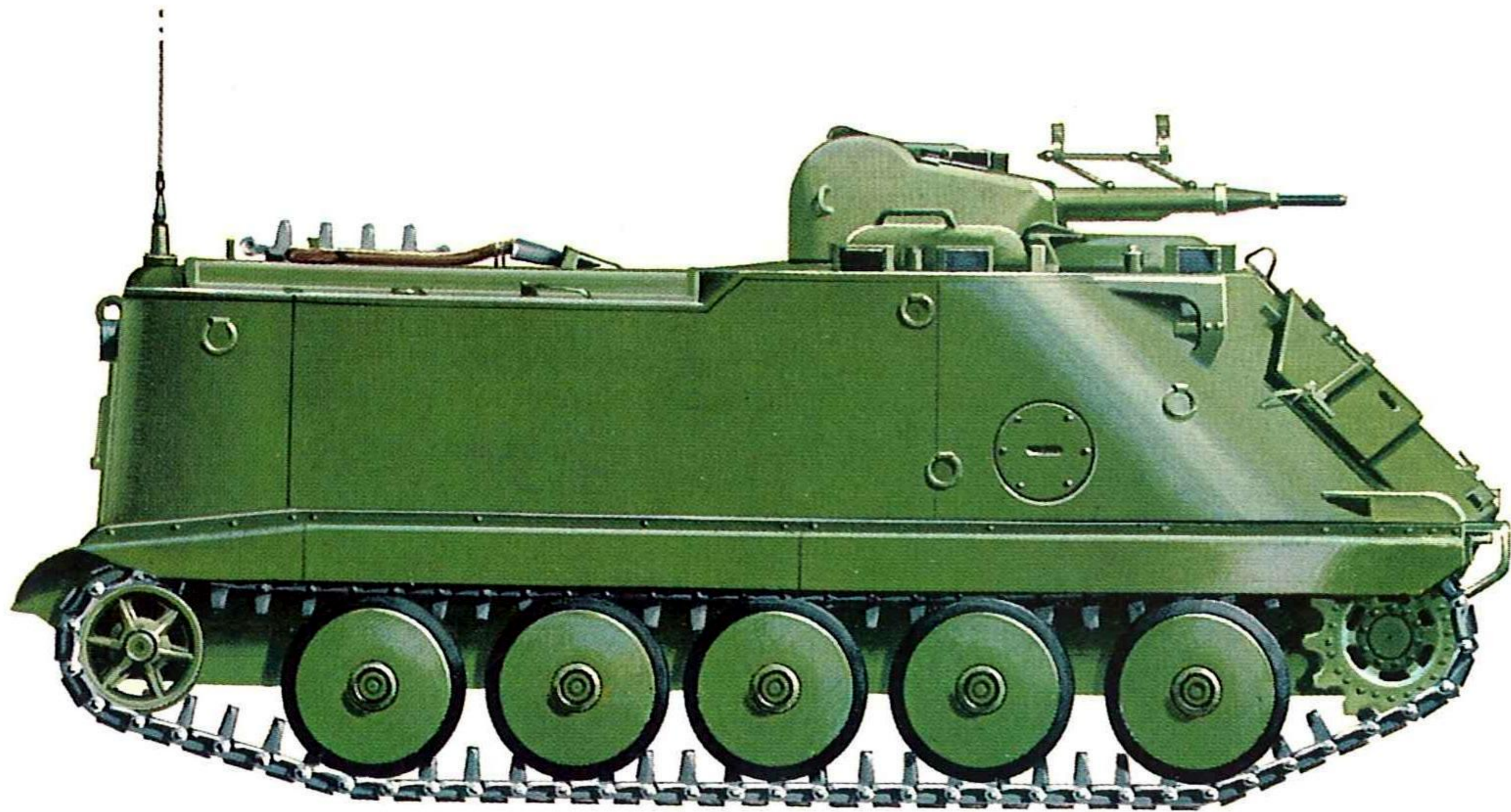
To offset its heavier weight the Bgbv 82 has been fitted with a more powerful, 310 bhp version of the Volvo THD 100 diesel which gives it a maximum road speed of 56 km/h. It also has wider tracks, with 450mm wide links and this together with greater length of the tracks in

*Prototype of Bgbv 82, the armoured recovery vehicle derived from the Pbv 302.*

(Hägglund)





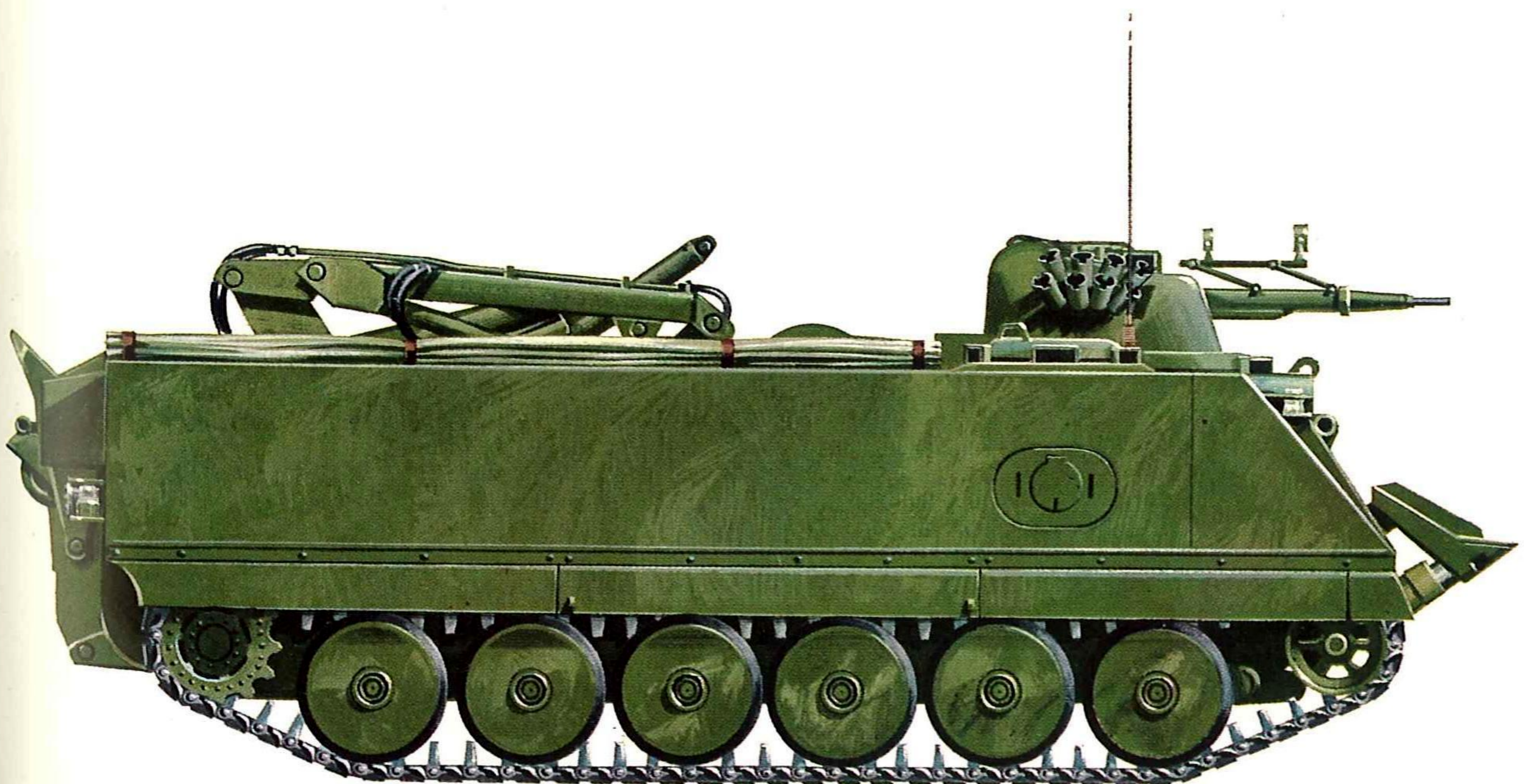


*Top:* Side and (*left*) front views of Pbv 302. (Pbv = Pansarbandvagn, or Armoured Personnel Carrier).

*Centre Left:* Amphibious Ikv 91 with 90mm gun in rotating turret for Infantry Support against enemy tanks. (Ikv = Infanterikanonvagn, or Infantry Gun Vehicle).

*Bottom:* Side and (*left*) front views of Bgbv 82, the Armoured Recovery Vehicle derived from the Pbv 302.

*M. Roffe © Profile Publications Ltd.*





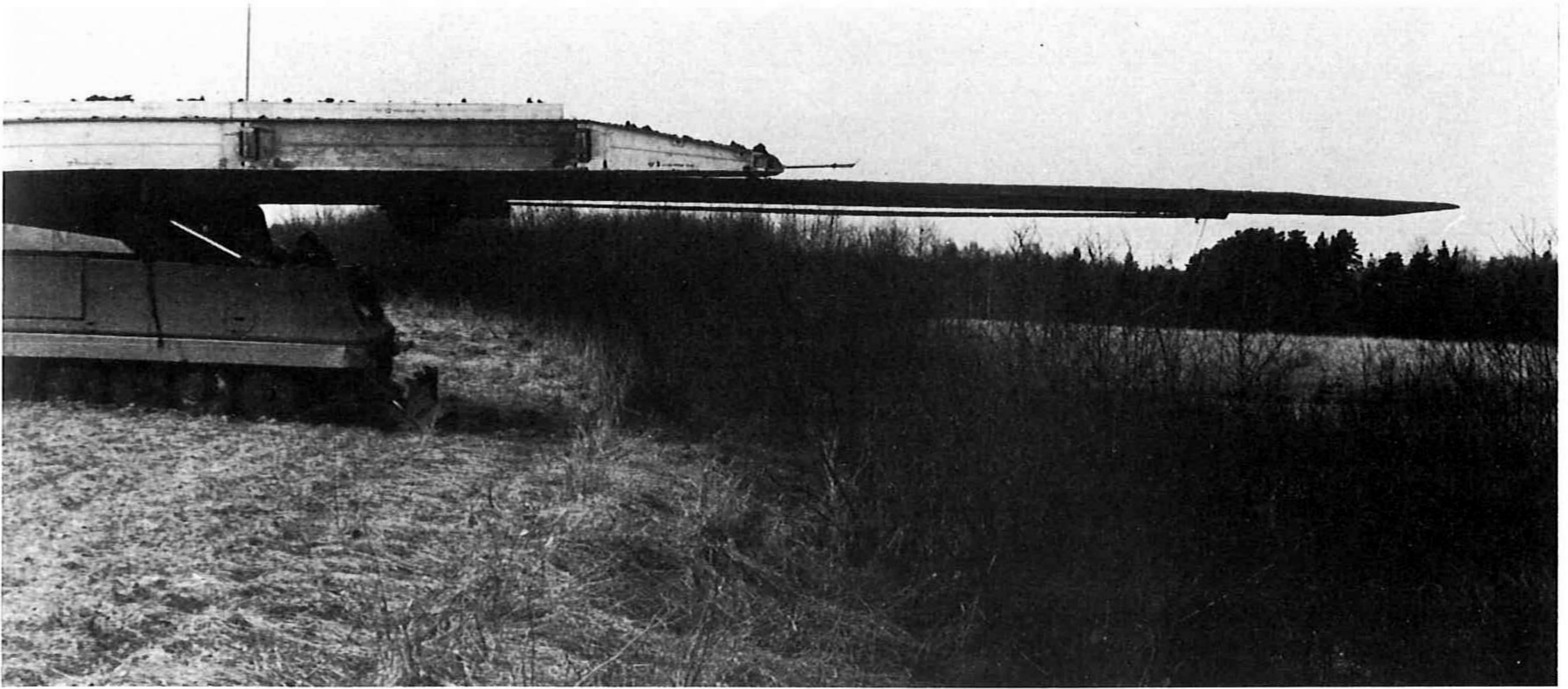
*Bgbv 82 with its ground anchor spades lowered on to the ground.*

(Hägglund)

*Pre-production version of Bgbv 82 with a collapsible flotation screen added to increase the freeboard.*

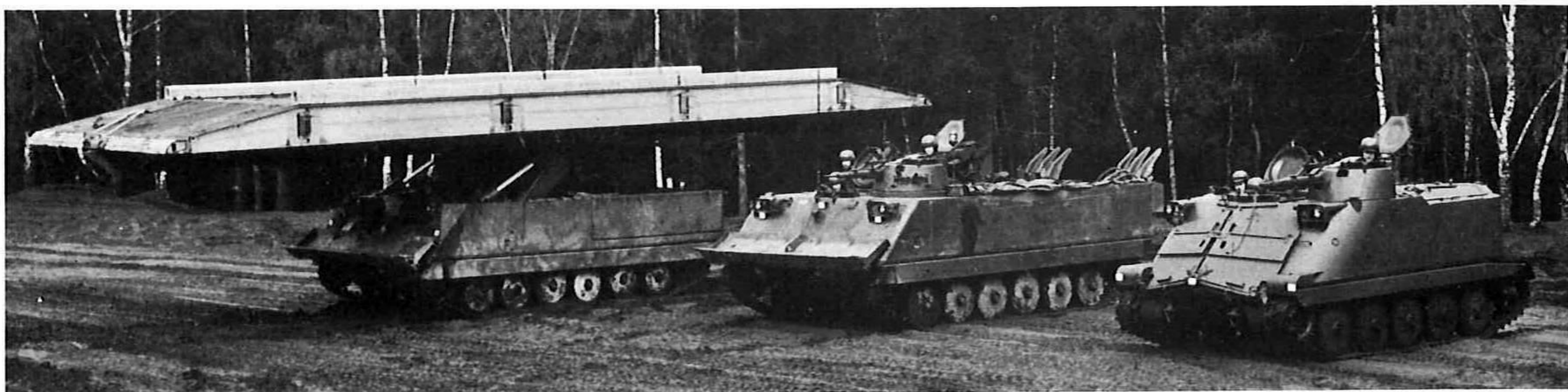
(Hägglund)





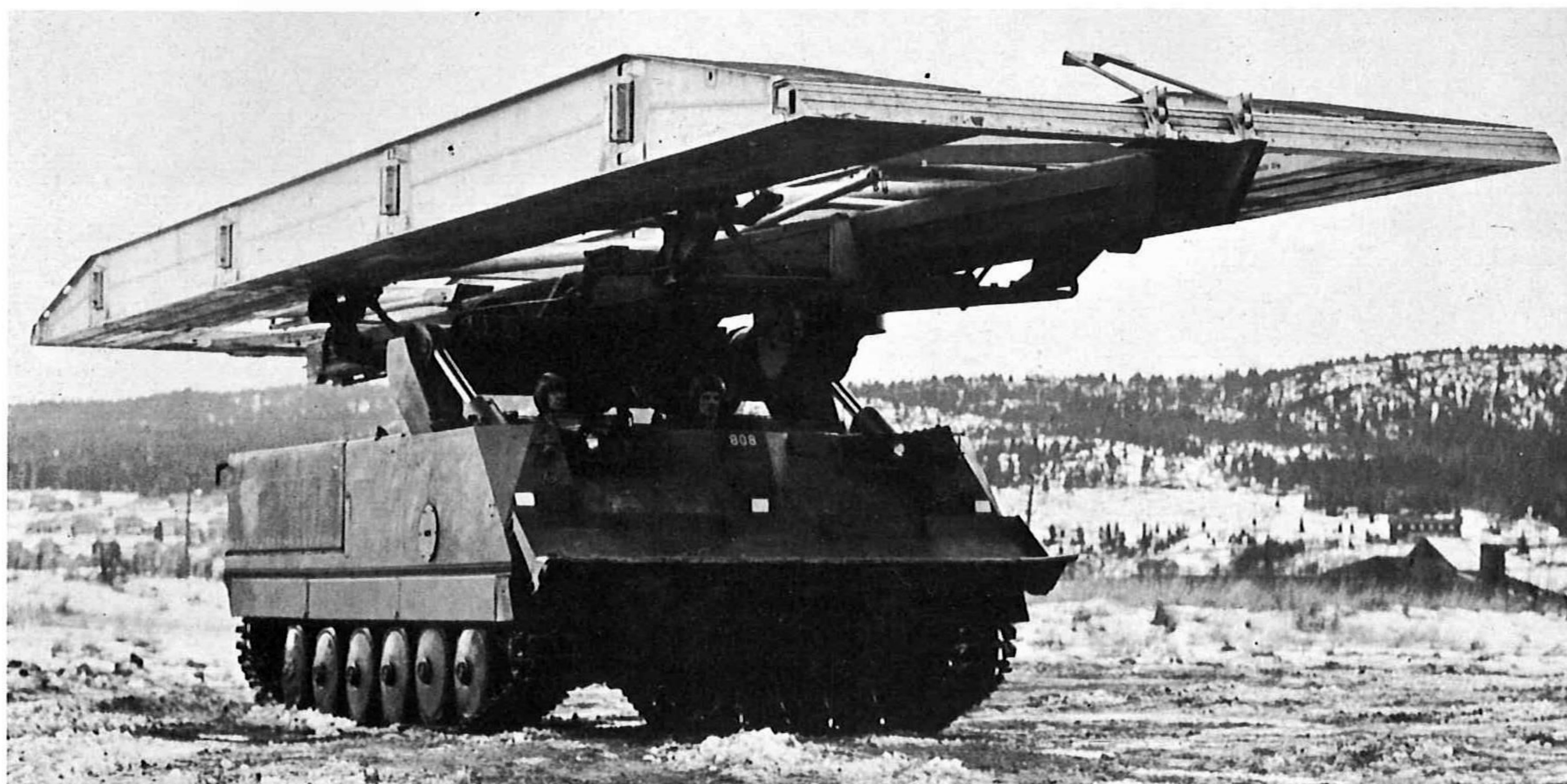
*Sequence of three photographs showing the laying of a bridge by the Brobv 941: (top) bridgelaying extending its telescopic beam over the obstacle; (centre) bridge being slid over the extended beam; (bottom) with the beam retracted the bridgelaying is lowering the bridge on to the ground. (Hägglund)*





*Brobv 941 (left) and Bgbv 82 (centre) compared with the Pbv 302 (right) from which they were both derived.*

(Hägglund)



*Prototype of the Brobv 941 bridgelayer.*

(Hägglund)

contact with the ground has kept its nominal ground pressure down to about 0.7 kg/cm<sup>2</sup>.

In spite of its heavier weight the Bgbv 82 is amphibious and has the same one-man turret with a 20mm automatic gun as the Pbv 302. It can, therefore, cross water obstacles with a minimum of preparation and defend itself against light armoured vehicles, attack helicopters and other threats while it carries out its recovery operations.

### **BROBV 941**

The development of the Pbv 302 and of the S-tank created not only a need for an armoured recovery vehicle to support them but also for an armoured bridgelayer. Again it was decided that one vehicle, closely related to the Bgbv 82, could meet this need. In consequence, the contracts which Hägglunds received to develop and build the prototype of the Bgbv 82 also called for the development and construction of a prototype of a bridgelayer, which became known as the Brobv 941.

The prototype of the Brobv 941 took only five months longer to complete than the Bgbv 82 prototype and the production of the Brobv 941 was ordered by the Swedish Army at the same time as that of the Bgbv 82. Without its bridge the Brobv 941 looks very much like the Bgbv 82, except for its lack of the gun turret and anchor spades. Its automotive characteristics are also very similar to those

of the Bgbv 82 and it is also manned by a crew of four. However, in place of the winch and crane it has a hydraulically operated cradle for the bridge and a telescopic cantilever beam which is used to lay and to recover the bridge.

The bridge itself weighs approximately 7 tons and is capable of carrying vehicles weighing up to 50 tons while spanning rivers or gaps up to 15 m wide. The bridge is of the single-span type and the method developed by Hägglunds for laying it is original. In essence it amounts to extending the telescopic beam over the gap to be bridged, sliding the bridge over it and then withdrawing the beam while the bridge rests first at the far end and then at the near end of the gap it spans. This avoids raising any part of the bridge above its normal transport position, in contrast to the folding, scissors-type assault bridges or the "flip-over" method of laying single-span bridges, which are much more conspicuous in action.

The bridge can be picked up, from either end, by reversing the laying procedure. All handling of the bridge is done hydraulically and controlled by one man from within the vehicle. The whole operation of laying or picking up the bridge takes no more than 3 to 5 minutes.

Without the bridge the Brobv 941 weighs 21 tons and like the Bgbv 82 can swim with a minimum of preparation. The bridge also has sufficient buoyancy to float and it can





*Prototype of Ikv 91, or "infantry gun vehicle 91".*

(Hägglund)

therefore be towed across water obstacles wider than its span by the bridgelayer. Thus Swedish armoured battalions equipped with the Brobv 941, as well as the Bgbv 82, Pbv 302 and the S-tank, have the unique advantage that all their armoured vehicles are amphibious, since the S-tank can be made amphibious by means of the collapsible flotation screen which it carries, while the other vehicles are inherently amphibious.

### **IKV 91**

The experience gained in the development of the Pbv 302 and the two armoured vehicles derived from it has also provided the basis from which Hägglunds developed yet another vehicle, the Ikv 91. This "infantry gun vehicle" has been designed to meet a Swedish Army requirement for a mobile weapon system to support its infantry against enemy tanks. To fulfil this rôle the Ikv 91

*Ikv 91 prototype on its first public appearance in November 1970.*

(Swedish Army)



has had to be armed with an effective anti-tank weapon. It also has had to be capable of operating over difficult terrain, particularly as it is intended for use not only with the standard Swedish infantry brigades but also with the special brigades organized for the defence of Sweden's northern territories, or Norrland, much of which lies inside the Arctic Circle.

The basic requirements to which the Ikv 91 was ultimately designed were formulated by the Swedish Army in the mid-1960s and in response to them three different Swedish companies prepared no less than fourteen alternative designs. However, evaluation of the competing designs reduced their number down to three from which the final choice was eventually made.

The design which was chosen was Hägglunds, who were awarded a contract to develop it and to build three prototypes in April 1968. Yet again the work advanced rapidly and in December 1969 Hägglunds began testing the first prototype. By October 1970 two prototypes were completed and handed over to the Swedish Army; the third was delivered two months later, when its test programme was completed.

In essence the Ikv 91 is a 15-ton armoured vehicle with a turret-mounted 90mm gun and a crew of four. The gun is its most important feature for on it depends its ability to fulfil its primary rôle of destroying enemy tanks. The gun has been specially developed for it by AB Bofors and is of the low-pressure type. It is 54 calibres long and like the similar gun of the French AMX 13, the *canon de 90 M1e F1*, it fires fin-stabilised projectiles. These include a shaped charge projectile, which has a muzzle velocity of 840 m/s and is capable of perforating the frontal armour of battle tanks, and a high explosive shell with a mechanical time fuze.

One of the reasons for the adoption of a low-pressure type of gun for the Ikv 91 is that its recoil loads are less than those of more conventional guns. In consequence, in spite of its calibre and muzzle velocity, the 90mm low-pressure gun could be installed in a relatively light vehicle. It also made it easier to achieve a high degree of accuracy with fin-stabilised projectiles, which have to be used if the armour piercing performance of the shaped charge is to be fully realized without resorting to the complication and cost of mounting the charge in ball bearings within the shell casing. In addition, the low pressure gun offers the advantage over conventional guns of a smaller flash, which makes the Ikv 91 more difficult to spot when it fires, and produces less obscuration because of its low muzzle pressure. The low-pressure gun is also less conspicuous than recoilless guns, because it does not produce any back blast, and its ammunition is considerably lighter and less bulky.

Except for the French AMX 13, the Ikv 91 differs from other contemporary vehicles intended to support the infantry against enemy tanks not only in having a low pressure type of gun but also in having the gun mounted in a rotating turret. For instance, the *Jagdpanzer kanone*, which performs the rôle of a tank destroyer in German infantry brigades, and the ASU-85, which performs a similar rôle in Soviet airborne formations, are both turretless as well as being armed with conventional, high pressure guns. In having a turret the Ikv 91 also differs from the S-tank, which has clearly established several advantages of its turretless configuration. Nevertheless, a turret was considered more suitable for a lightly armoured, defensive vehicle such as the Ikv 91. In

particular, a turret was considered to provide greater freedom to take up advantageous firing positions and to increase the speed with which successive targets could be engaged from one position, as well as offering a less expensive solution than others.

### ADVANCED FIRE CONTROL SYSTEM

To increase its effectiveness, the gun of the Ikv 91 has been coupled to an advanced fire control system, similar to those being developed for battle tanks. The Ikv 91 is, in fact, the first light-weight vehicle to be provided with such a system, which significantly increases first round hit probability and also reduces reaction time, making it possible to engage targets more rapidly.

The fire control system, which has been developed by Honeywell, incorporates an optical rangefinder, a number of sensors and a ballistic computer. The computer determines the elevation required by the gun from information about the range of the target, which is fed automatically into it by the rangefinder or manually by the gunner or the commander, signals from the trunnion cant sensor and a number of manual inputs for non-standard muzzle velocity, ambient conditions and cross-wind. If the target is moving and the gunner is tracking it the computer is fed with additional information about the rates of turret traverse and gun elevation from two sensors and this enables it to compute the lead angles.

The rangefinder is of the coincidence type and has a base of 65 cm. It is combined with a 10-power binocular and is mounted in the commander's rotating cupola. In consequence, the commander can acquire a target and range without the gun pointing in the direction of the target. Then, by pressing a target designation button, the commander can swing the turret round at high speed to align the gun and the gunner's sight with his own optics. At the same time as the turret is swinging round the electrically powered cupola is counter-rotating, so that the commander does not lose sight of the target. However, as an alternative to the automatic counter-rotation, the cupola can be locked aligned with the gun or released so that it can be turned by hand.

In addition to the 90mm gun the Ikv 91 is also armed with two 7.62mm machine guns. One is mounted coaxially with the gun in the usual way but the other is externally mounted on a low loader's cupola, which can be manually traversed through 360 degrees. This means that the commander is not expected to act as a machine-gunner, as commanders are in so many contemporary tanks, but can concentrate on his proper function, which is to command the vehicle.

Because the Ikv 91 has to be relatively large it can carry a good supply of ammunition, which makes for a sustained combat capability. In fact, its prototypes could stow as many as 68 rounds of 90mm gun ammunition. Of these 18 were around the left of the turret basket while the remaining 50 were behind the turret and in front of it, on the right hand side of the hull. In addition, the Ikv 91 can carry 4,000 rounds of machine-gun ammunition.

The large size of the Ikv 91 has also made it possible to fit it with a relatively large 2 m diameter turret which makes for crew comfort and is particularly advantageous when crews have to wear bulky Arctic clothing, as they do during the winter in northern Sweden. At the same time the turret is commendably low, so that the height of



*View of Ikv 91 showing the commander's rotating cupola with rangefinder and the loader's hatch.*

(Hägglund)

the Ikv 91 from the ground to the turret roof is only 2.15 m and even to the top of the commander's cupola the height is 2.41 m. All this makes for a low silhouette and a more difficult target to hit. Yet, in spite of the low turret height, the gun can be depressed to the usual maximum of 10 degrees when pointing forward; its maximum elevation is 15 degrees. In addition to being low the turret has a ballistically very well profiled front and no rear overhang. In this respect it differs from all contemporary tanks, except the Swiss Pz.61 and Soviet tanks whose designers have long managed to dispense with turret overhang and thereby reduce their vulnerability although at the cost of some turret unbalance.

The general layout of the Ikv 91's hull is conventional, with the driver at the left front and the engine and transmission at the rear. However, all hull plates have been curved to stiffen them and to reduce the noise level within the tank. Crew comfort has also been increased by the installation of separate fans with heat exchangers in the driver's and fighting compartments for ventilating and heating them. There is also an electric fan in the air intake which sucks air through a dust filtration system and then blows it through a filter, creating a slight over-pressure in the crew compartments. Thus the crew are protected from fall-out and radio-active dust and chemical and biological agents when the vehicle is passing through contaminated areas, but the filter can be removed when dust filtration alone is sufficient.

### **LOW GROUND PRESSURE**

One reason for the relatively large size of the Ikv 91 is its need to have a large area of track in contact with the ground, in order to reduce the ground pressure and thus

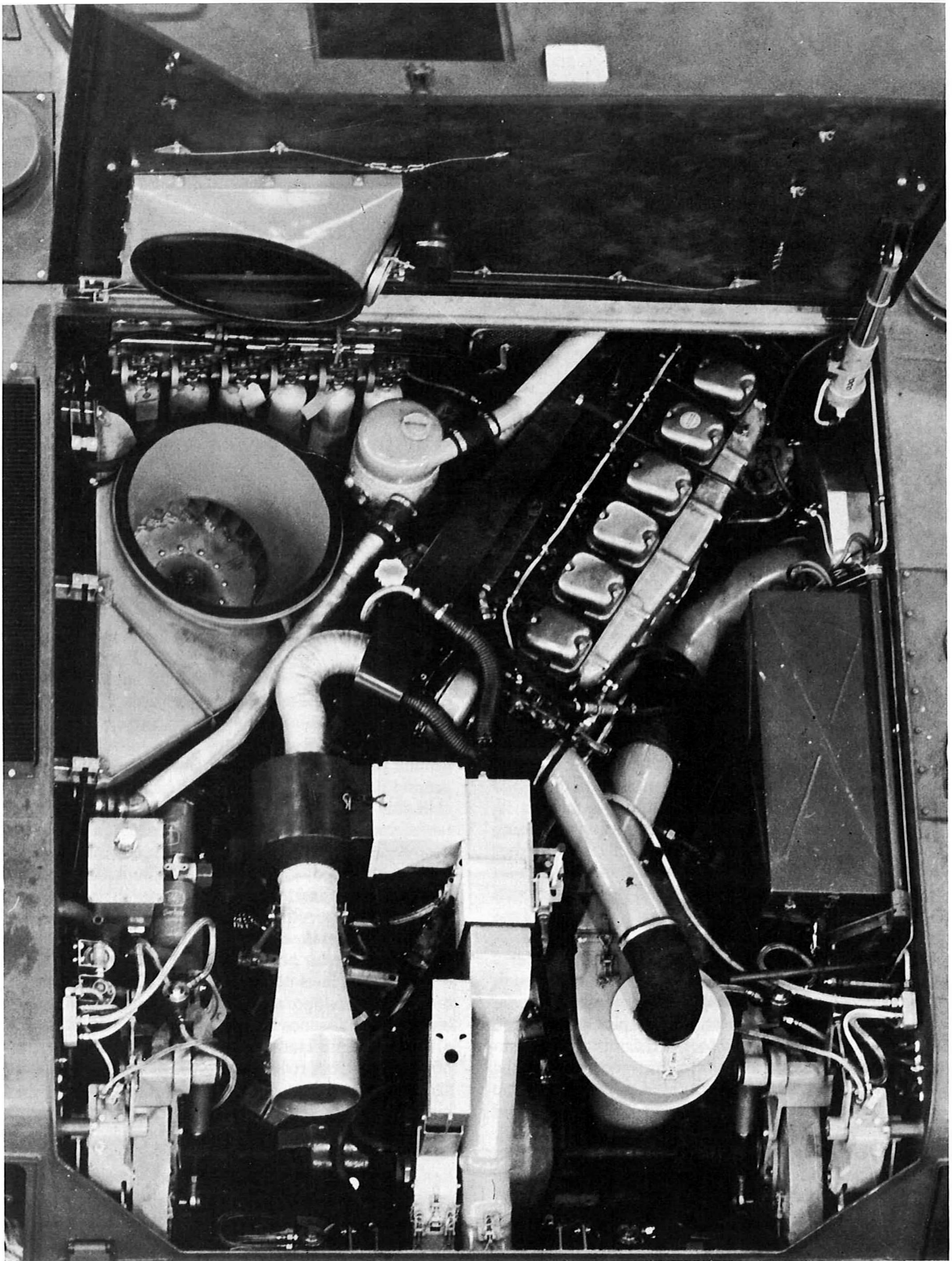
make it capable of operating more easily over snow and soft, marshy terrain. In this respect the designers of the Ikv 91 have been highly successful since its nominal ground pressure is only 0.4 kg/cm<sup>2</sup>. This is only half the ground pressure of contemporary battle tanks and considerably less even than the ground pressure of light tanks, such as the U.S. M551 Sheridan.

Another reason for the relatively large size of the Ikv 91 is the requirement for it to be amphibious, so that it can cross the rivers and lakes in which Sweden abounds with a minimum of preparation. In fact, the only preparation it requires to swim across inland water obstacles is the erection of a trim board which is carried folded down on the front glacis plate. This capability is matched by only one contemporary tank, the Soviet PT-76 amphibious reconnaissance tank.

In water as on land the Ikv 91 propels itself by means of its tracks. These were originally designed for the Bgbv 82 and Brobv 941 and are of a novel type with rubber-bushed pins but with the rubber bushes confined to one link at each joint, the pin being fixed in the other. As a result, the tracks have a much shorter pitch and are significantly quieter than other comparable tracks.

The suspension of the Ikv 91 is basically the same as that of the Pbv 302 but, like the Bgbv 82 and the Brobv 941, it has six road wheels per side and a rear driving sprocket. The road wheels are attached to the trailing arms on which they are mounted with one central nut and this makes it possible to change them very quickly, once an arm is unloaded, with the aid of a special tool.

Like the Pbv 302, the Ikv 91 is powered by a commercial Volvo-Penta 6-cylinder water-cooled turbocharged diesel which develops 330 bhp. This gives it a power-to-weight ratio of 22 bhp per ton and makes it as good in this



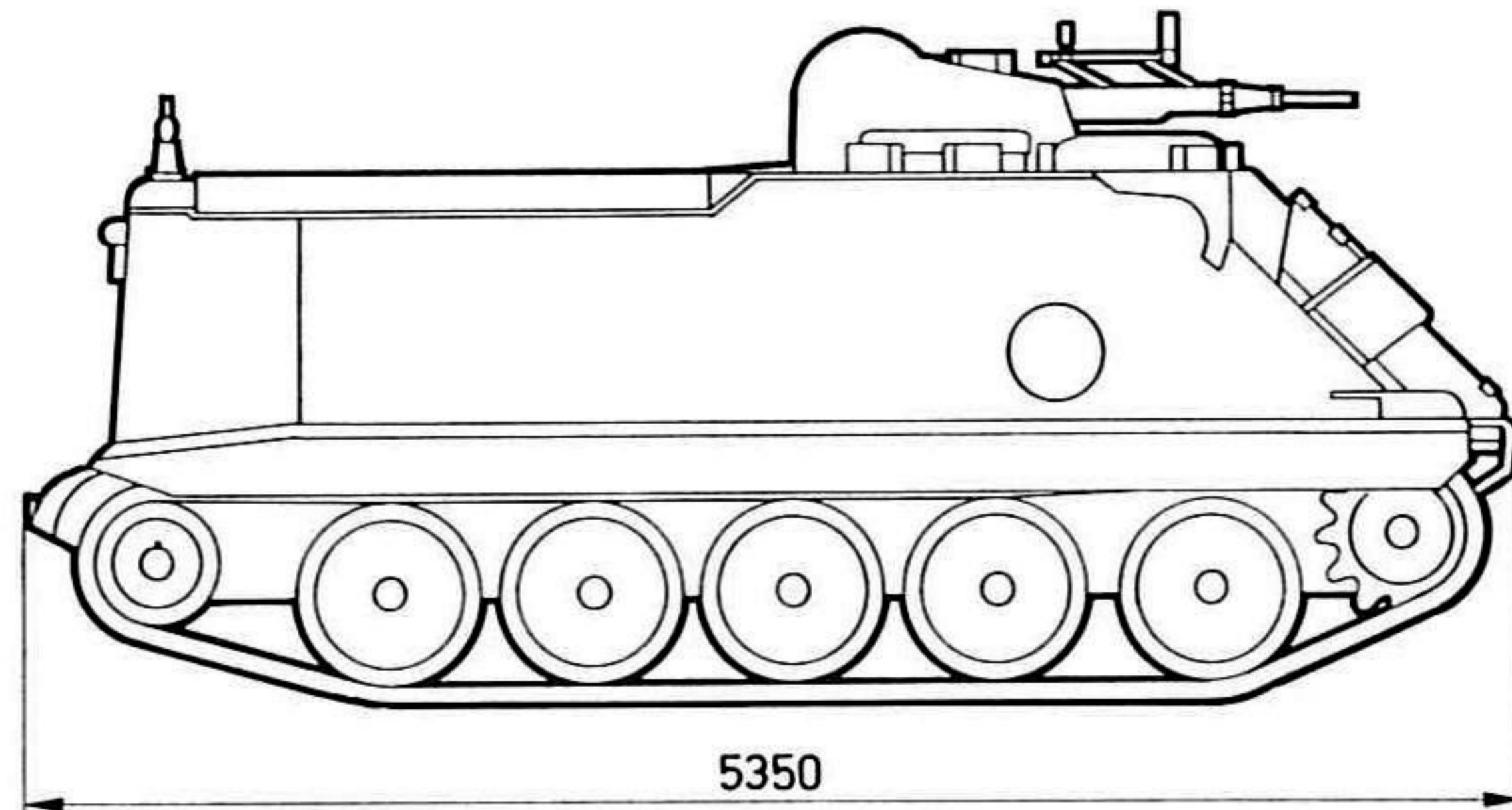
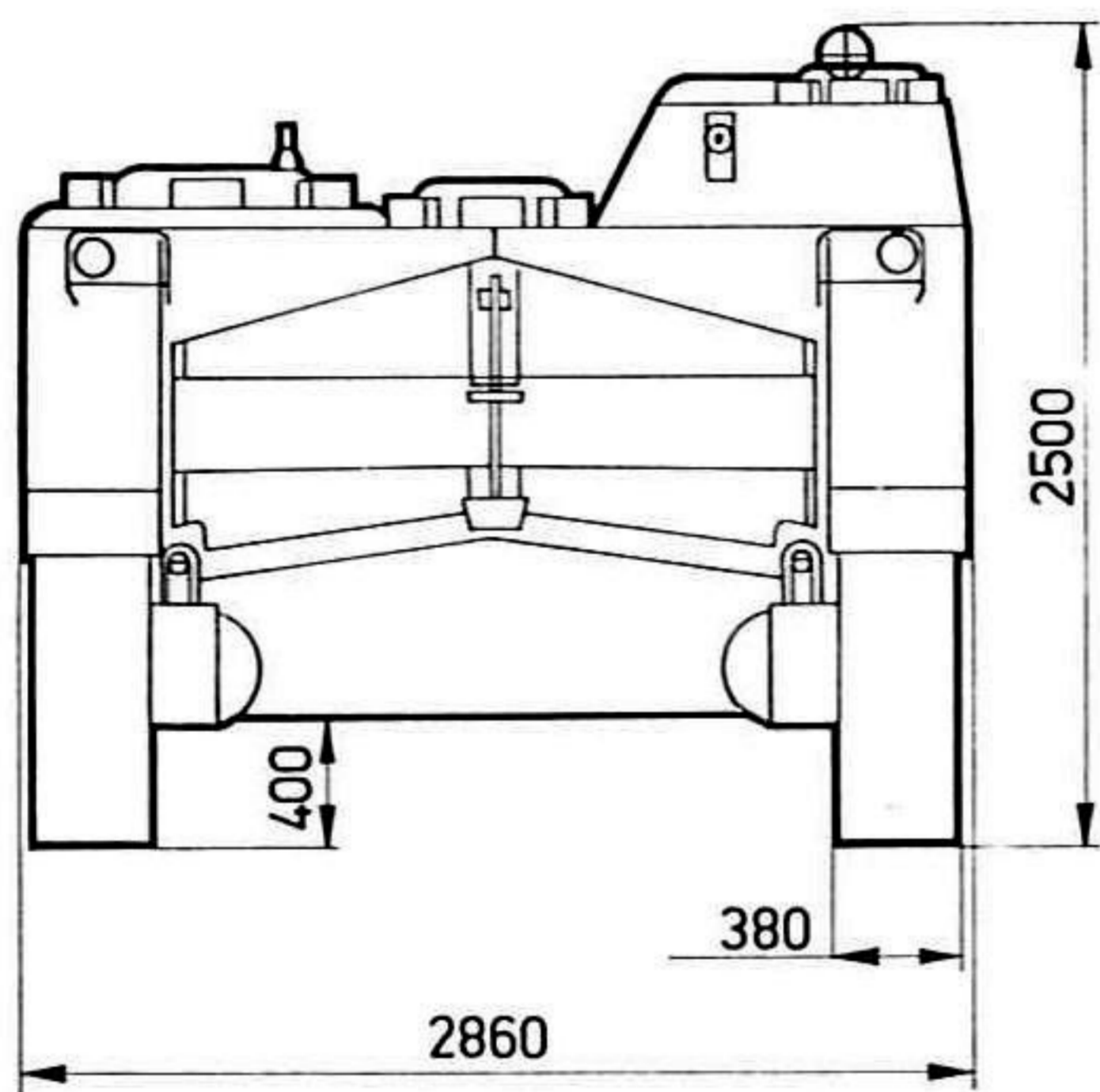
*Diagonal location of Ikv 91's Volvo engine; in the foreground the exhaust gas driven ejector for drawing cooling air over the brakes. (Hägglund)*



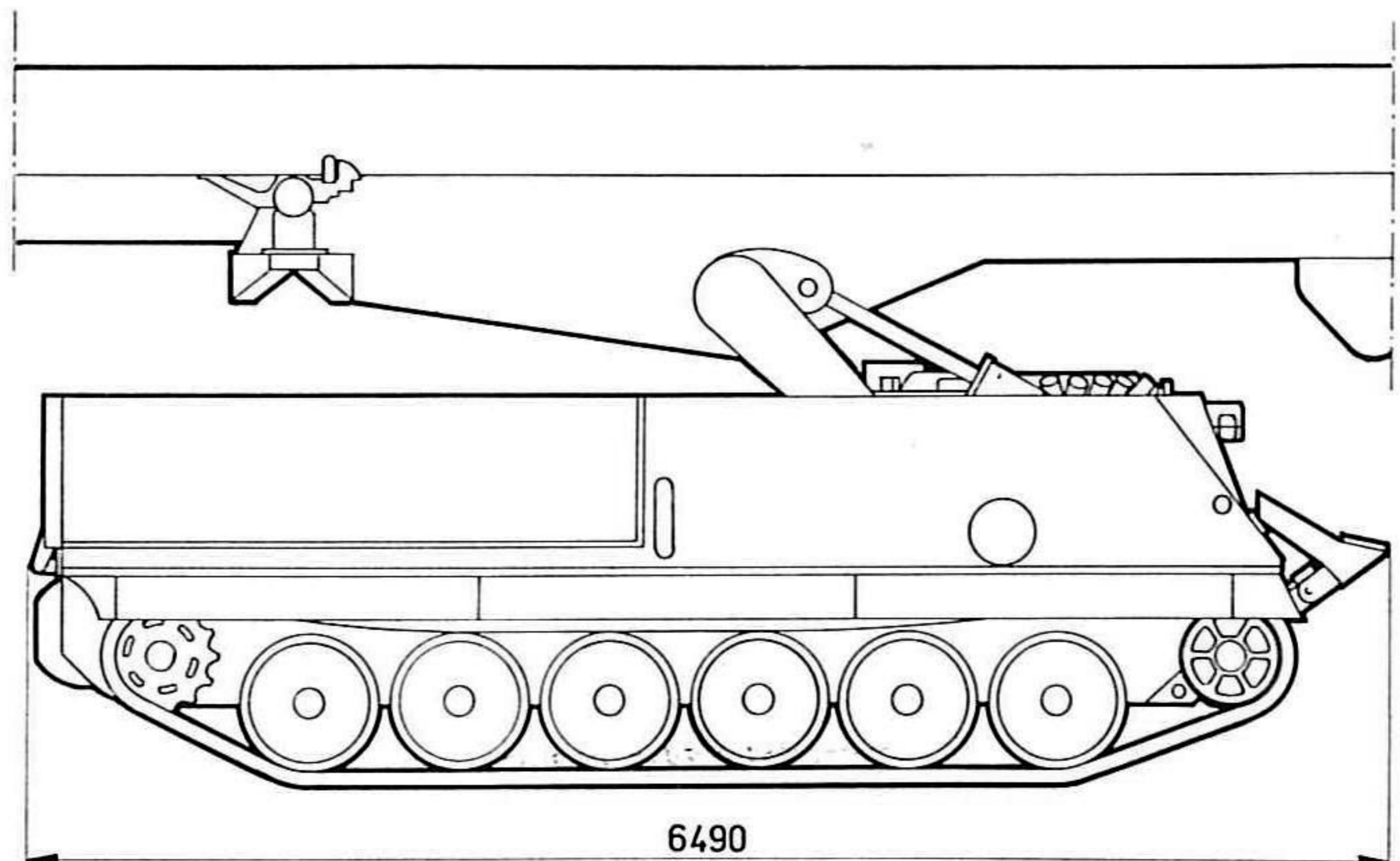
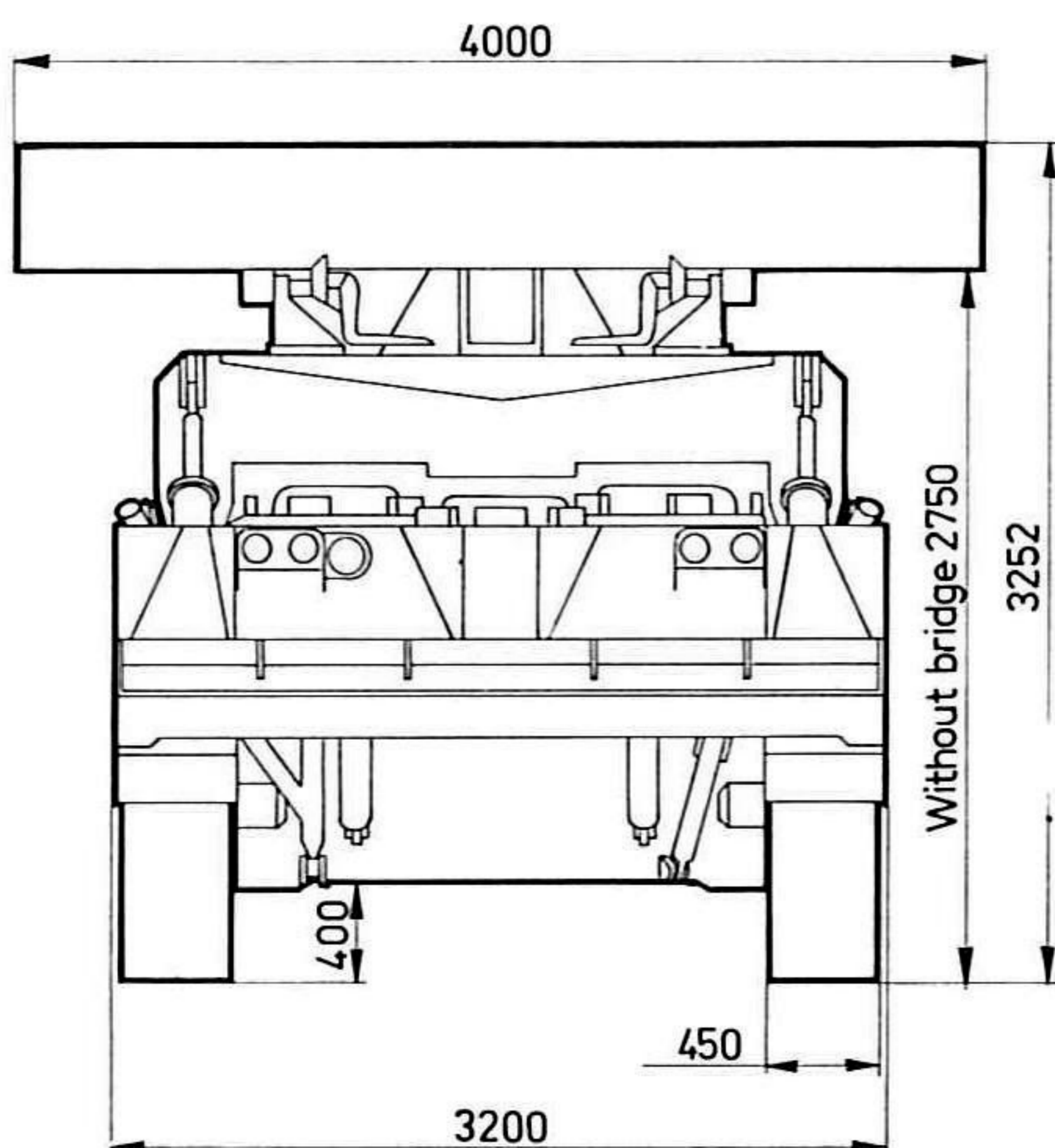
*Ikv 91 prototype swimming.*

(Hägglund)

*Scale drawings of front and side views of Pbr 302 APC.*



*Scale drawings of front and side views of Brobv 941 bridge layer.*



respect as the best of the contemporary battle tanks. The engine and the Volvo-Penta R 60 A gearbox are mounted at an angle to the hull centre line which shortens the engine compartment by comparison with the conventional longitudinal installation. At the same time it does not require as much gearing as the alternative transverse engine installation, a simple set of bevel gears being sufficient to take the drive across the vehicle.

The engine installation includes other interesting features, such as the use of the engine exhaust not only to drive the turbocharger but also to induce a flow of cooling air over the clutch-and-brake steering system by passing it through an ejector. Access to the engine compartment has also been made easy by the use of a one-piece cover plate hinged at the leading edge which can be lifted by a small hand-operated pump and hydraulic jack.

What is most important, however, is that the high power-to-weight ratio provided by the Ikv 91's engine combined with its exceptionally low ground pressure and

amphibious capabilities makes it highly mobile. A measure of its performance is provided by the maximum road speed of 67 km/h and a maximum water speed of 8 km/h. At the same time it carries sufficient fuel to cover 600 km on roads without refuelling. It constitutes, therefore, a highly mobile anti-tank weapon system capable of supporting the infantry in all types of terrain where enemy tanks might operate.

#### ACKNOWLEDGEMENTS

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*The author also wishes to thank the Swedish Army Materiel Department, AB Hägglund & Söner and AB Bofors for the photographs of the various vehicles.*

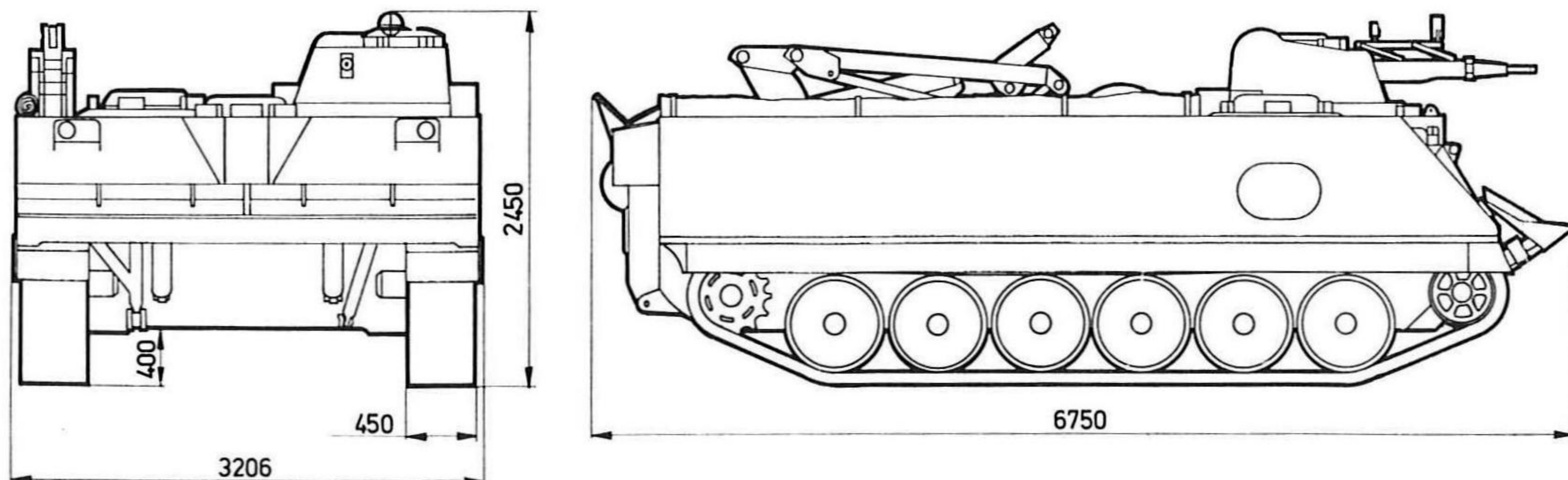
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Assembly of Pbv 302s at Örnsköldsvik.

(Hägglund)

Scale drawings of front and side views of Bgbv 82 Armoured Recovery Vehicle.



# AFV/Weapons Profiles

*Edited by DUNCAN CROW*

## FORTHCOMING TITLES:

### **43 PanzerKampfswagen IV**

While the Panther and Tiger have tended to capture the limelight, it was in fact the PanzerKampfswagen III and IV which established the reputation of the German armoured forces. The Panzer IV, whose first prototype was built in 1934, eventually became the only German tank which remained in production and troop service throughout World War II, a fact which demonstrates its sound basic design and the brilliant foresight shown in its specification. It was still in service in the Syrian Army as late as 1967. BY WALTER SPIELBERGER

### **44 Ferret and Fox Scout and Reconnaissance Cars**

Ferrets, developed from the Second World War experience with the Daimler scout cars, have become some of the world's most widely used armoured vehicles. Thus, they are in service not only with the British Army, but also with the armed forces of more than twenty different countries. The successful experience with them has, in turn, led to the even more effective Fox armoured car (or Combat Vehicle, Reconnaissance, Wheeled). This has aluminium armour and much more powerful armament but otherwise retains many of the characteristics of the Ferrets: BY R. M. OGORKIEWICZ.

### **45 Vickers 37-ton Main Battle Tank**

Called by the Indian Army "Vijayanta" (Freedom) this Main Battle Tank (the latest in half a century of tank design and tank production) was built by Vickers to meet an Indian request for a tank to replace the Centurion as India's standard battle tank. It incorporates the Chieftain power pack, gearbox, steering unit and brakes, and is now also being built in India: BY R. M. OGORKIEWICZ.

### **46 Light Tanks M22 (Locust) and M24 (Chaffee)**

In appearance rather like a miniature Sherman, the M22, called by the British the Locust, was designed as an airborne tank for the U.S. Army in World War II. But none were used in action by the Americans. The British, however, included some in the Rhine crossing operations of 6th Airborne Division in XVIII U.S. Airborne Corps. The M24 (Chaffee) though classified as a light tank was equivalent to the early British cruisers in weight and superior to them in armament. Though the Chaffee came in at the tail end of WWII, its days of glory were in Korea where it had to withstand the onslaught of North Korea's Russian T34/85s at the beginning of that war. It was still on active service in the Indo-Pakistan war in December 1971: BY COLONEL ROBERT J. ICKS. (M22 is new, M24 is a revised Armour in Profile.)

### **47 T-34**

The development of the Russian T-34 tank and the discomfiture and surprise of the German Army in finding its panzers outclassed by the T-34/76 ("the best tank in any army up to 1943" in Guderian's judgment) are described BY J. M. BRERETON. In the second half of this *Profile* a description of the even more powerful T-34/85 with its increased firepower, and a critique of the T-34 in service, are given BY MAJOR MICHAEL NORMAN, Royal Tank Regiment. (T34/76 is a revised Armour in Profile, T-34/85 is new).

### **48 PanzerKampfswagen VI - Tiger I and II**

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

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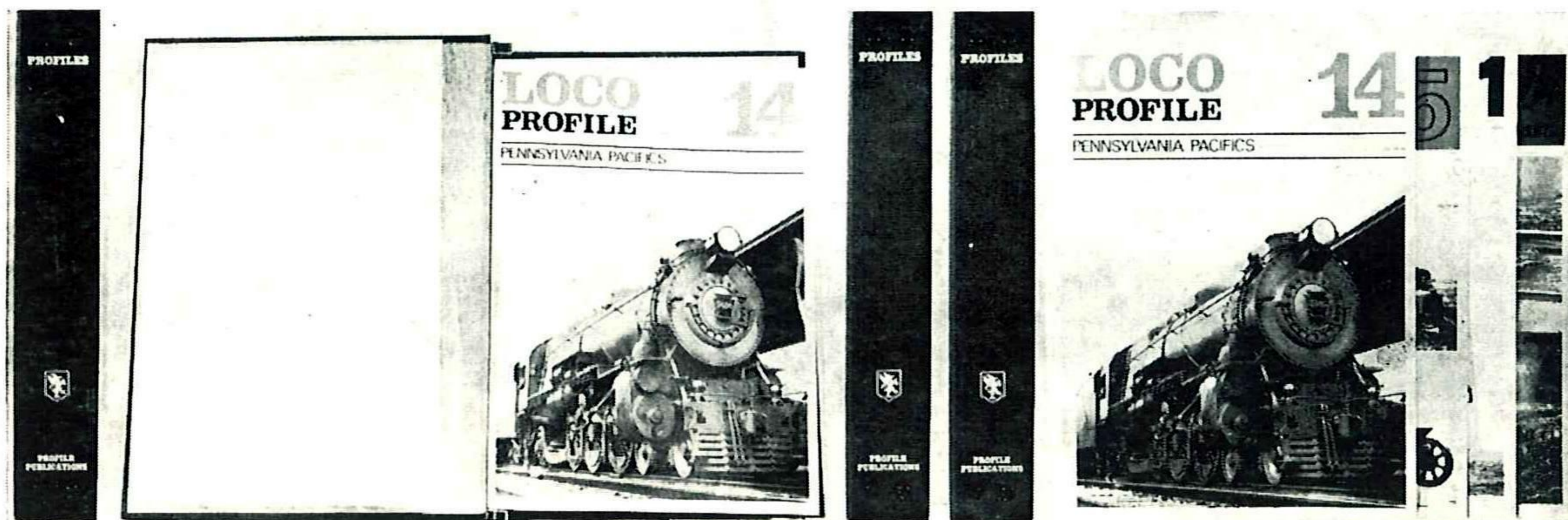
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