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RUSSIAN KV AND IS

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Front Cover: A platoon of KV tanks in 1942. While identical at first glance, the nearest vehicle is a KV-1A, having a fabricated turret, while the second is a KV-1C with a cast turret. ("Planet News")

A KV-1A. The upward continuation of the front plate to protect the turret ring and the bar welded to the turret front to protect the trunnions can be seen clearly.

Russian KV and IS

By Major Michael Norman,
Royal Tank Regiment

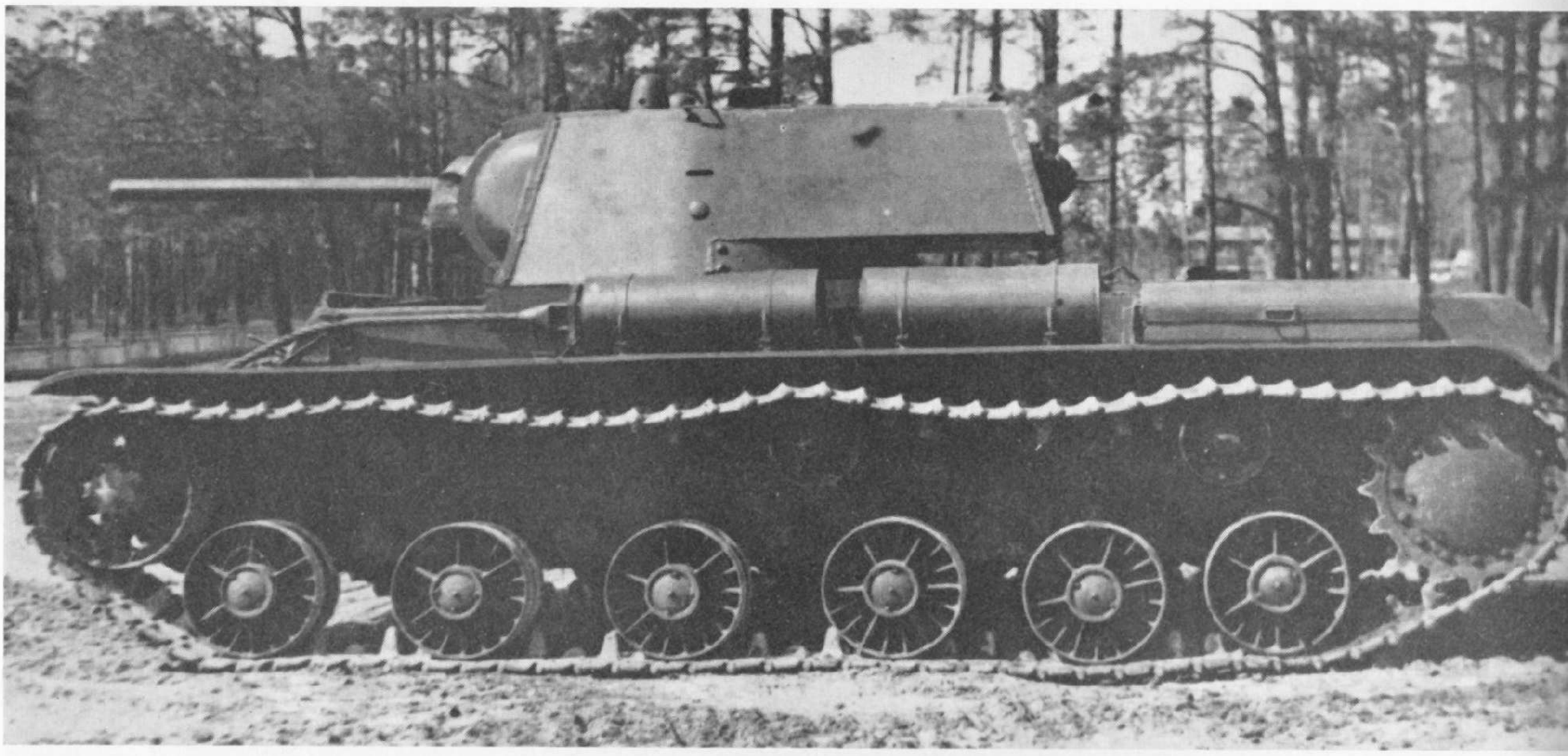
THE struggle in European armies over the pros and cons of mechanization, and especially the rôle of the tank, was often as not waged on moral and political issues, rather than on purely technical considerations, but nowhere more bitterly than in the Soviet Union. Like other armies, the Russians had difficulty in shaking off the idea of using tanks to batter their way head on through the enemy's defences, and as close support for the infantry, that had been necessary to break the deadlock in World War One. But during the mid-thirties, at the start of the struggle for supremacy within the Party itself, the ideas of Liddell Hart and Fuller gained ground although bitterly opposed by the traditionalists. The principal supporter of the mobile concept appears to have been Sergei Mironowicz Kirov and his ideas were probably reflected in the design of the T-35 heavy tank in 1932.

T-35

Influenced by the British "Independent" (as was the lighter T-28) and the French *Char de Rupture*, the T-35 was to be capable of operating completely independently and no less than five gun turrets were installed to permit simultaneous engagements on all sides. The central turret was armed with a 76 mm. anti-tank gun, the right-hand forward and left-hand rear with a 45 mm. gun for firing HE, and the remaining two with 7·62 mm. MGs. It is instructive to see that while other nations were to be convinced for some years more that the tank need only be equipped with anti-tank guns of about 37 mm. calibre, the Russians had no illusions about the need for more powerful guns, as well as an HE capability. The weight of the T-35 varied between 44 and 49 tons (long) according to the armour basis, its overall length was about 31 ft., width 10 ft. 6 in. and height 11 ft. 6 in. Although only a few vehicles were produced there were probably three distinct versions; T-35 with an armour basis of 30 mm., T-35A with a new version of the 45 mm. gun and T-35B with a heavier basic armour of up to 50 mm. thick. All three had a 10 man crew, a 500 h.p. M-17 petrol engine, a top speed of about 20 m.p.h. and a radius of action of some 95 miles. 96 anti-tank, 220 45 mm. and about 10,000 MG rounds were stowed. A few examples survived to support infantry formations in the early stages of the war with Germany.

SMK AND T-100

Unfortunately for Kirov his political influence was judged to be detrimental to the security of the régime and he was assassinated in 1934 although he was posthumously honoured two years later by having a possible successor to T-35 named after him. The SMK was designed to be relatively immune to the 37 mm. shot and the armour basis of 60 mm. raised the

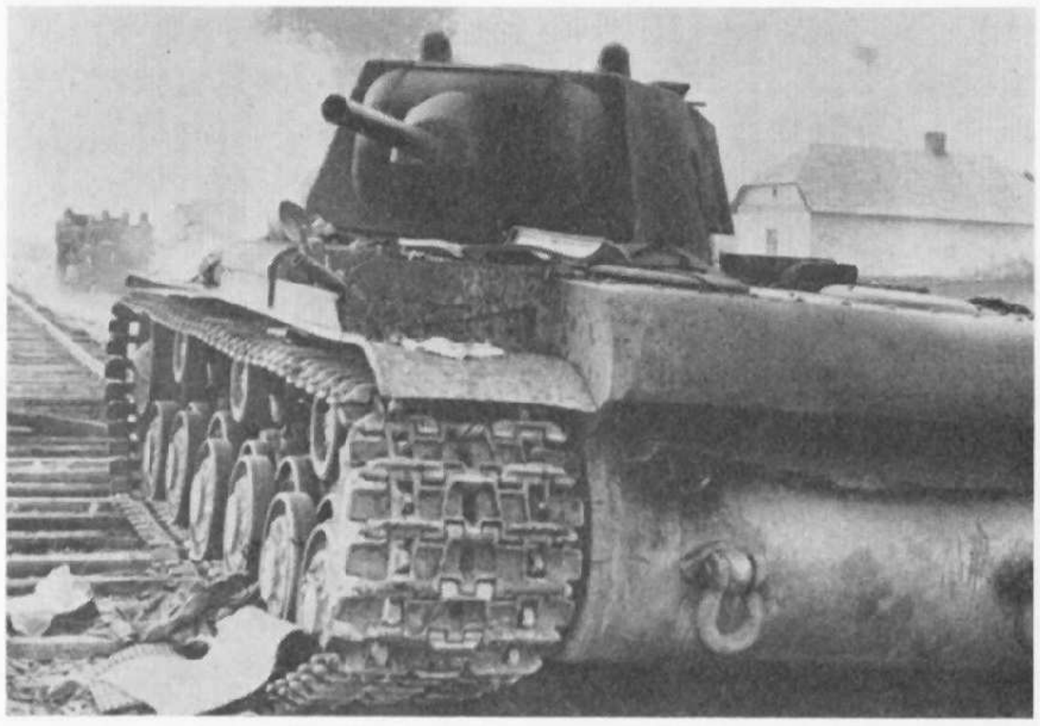


A KV-1A. Note the welding of the fabricated turret and the vision slit immediately above a pistol port in the side wall.
(Crown Copyright Reserved)

vehicle weight to some 56 tons. Only two turrets were mounted this time, the upper having a 45 mm. and the lower an improved 76 mm. anti-tank gun. The crew was also reduced—by three or four—and a new type of torsion bar suspension, pioneered by Dr. Porsche in Germany and used in the Pz. III, was installed. The steel tyres of the road wheels encased an inner rubber band and the earlier petrol engine was probably retained. SMK evolved into T-100 in 1938 with minor changes but very few of either model were actually built, although at least one SMK was used in the Russo-Finnish campaign.

Meanwhile, the Field Service Regulations for 1936 showed that the close co-operation of all arms in battle was fully appreciated and all that was needed now was a period of stability for intensive training in the new techniques. But this never came: in the purges of the army that started in the next year the doctrine of mobile warfare was denounced as being "reactionary, bourgeois and unworthy of a Marxist society" and its protagonists were either murdered or changed their views. The experiences in Spain were invoked to show that increases in defensive firepower —particularly anti-tank guns and mines—precluded the use of armour in independent operations and Russian tanks accordingly reverted to the task of supporting infantry as their primary rôle. The designs of both the SMK and T-100 were influenced by this change of emphasis.

A knocked-out KV-1A being bypassed during the 1941 campaign. Note the width of the tracks designed to increase flotation on soft ground. (Crown Copyright Reserved)



KV DEVELOPMENT

It seems likely, however, that both these tanks were unnecessarily heavy and the evolution of a 76 mm. gun capable of firing both HE and AP rounds made the second gun and turret superfluous. A newly developed compression ignition V-12 engine was also ready for use in AFVs after extensive trials in the BT-5 tank and would result in a better utilization of fuel by weight as well as a lower fire risk. The design of the new tank began in 1938 under the leadership of I. S. Kotin and it was named after Marshal of the Soviet Union Klimenti Voroshilov. Contemporary reports had it that Stalin took a personal interest in the concept, although it was his insistence that a German attack was out of the question in 1941 that prompted vacillations in the General Staff regarding the distribution and employment of both the KV and T-34 and only 243 of the former were built in 1940 and 508 by mid-June the following year.

Ditherings were not confined to the subject of these tanks. The *blitzkrieg* campaigns in Poland and France had shown that it was not superiority in equipment that had been decisive but a tactical doctrine which insisted on the closest co-operation between all combat arms, including the air force, at all levels. The Soviet High Command, clearly regretting their abandonment of the 1936 principles, now instigated yet another change in organization and tactics. Thus, when Operation Barbarossa opened in June 1941, the Red Army was in the throes of change and its superiority in armour was of little avail against the initial onslaughts of the panzer formations. Although the

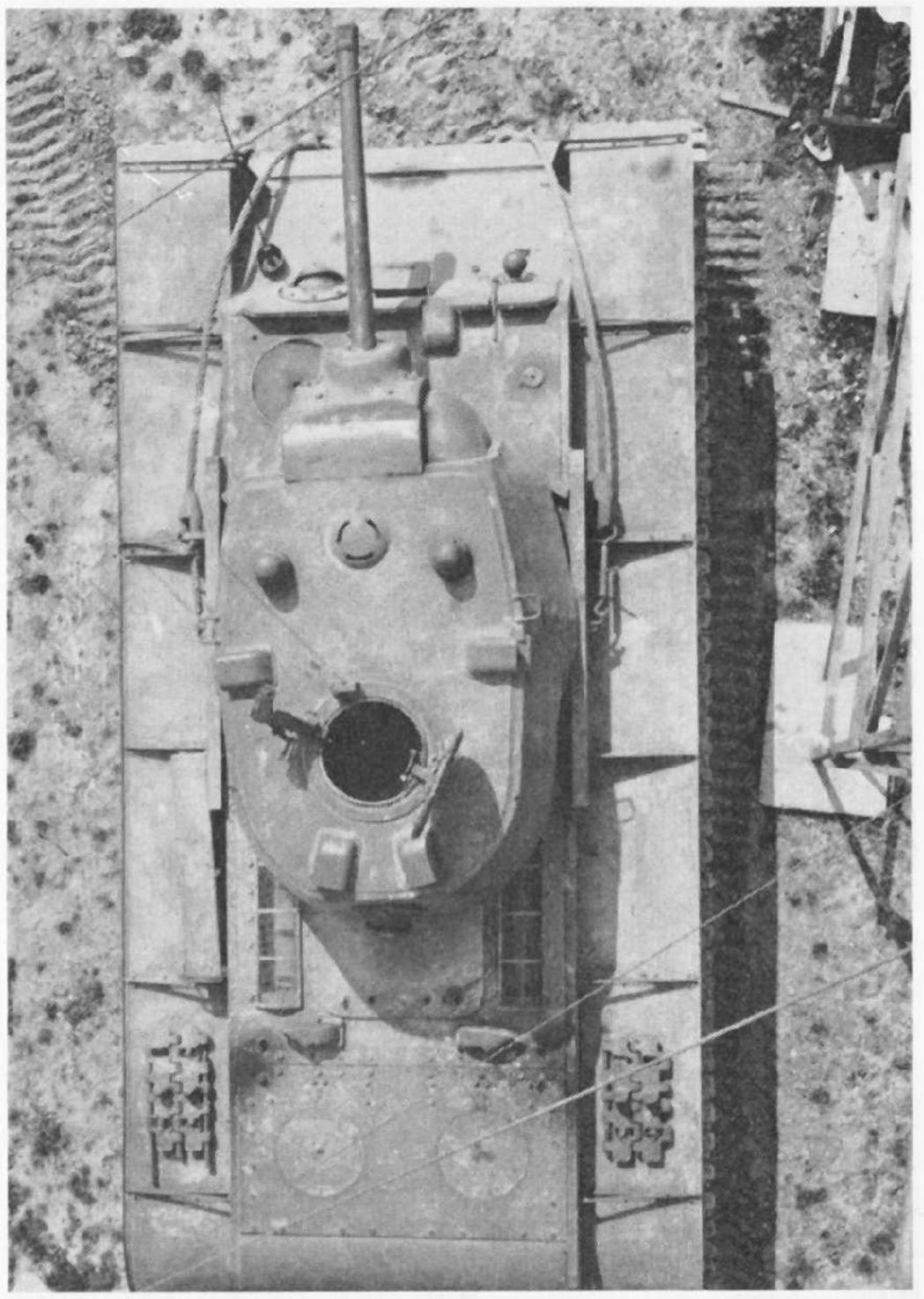
first KVs had entered service in 1939, a few having been involved in the final assault on the Mannerheim Line in Finland, the German army recognition handbook for 1941 made no mention of this tank (nor, indeed, of T-34), and although both these types saw action in the opening stages of the war, their individual superiority passed almost unnoticed in the organizational and tactical shortcomings now so apparent in the Red Army.

THE KV SERIES

Mounting the same 30·5 calibres long 76 mm. gun as the T-34, in a single fabricated turret, KV-1A weighed 43 tons and was armoured on a basis of 90 mm. The power plant consisted of the new V-2 engine which only differed from that in T-34 by virtue of it having been uprated to 550 or 600 b.h.p. by the use of bigger fuel pumps and injectors. The torsion bar suspension that had been proved in the SMK and T-100 was adopted virtually unchanged. Although the design of the armour was not as good as that on T-34 it was sufficient to defeat the German 37 mm. At roughly the same time as the Germans introduced their 50 mm. gun in the Pz. III the KV-1B appeared with appliqué armour on the turret sides, secured by large bolts, and the vehicle's weight rose to 47 tons. The more efficient M-1940 76 mm. gun, 41·5 calibres long, was introduced in the same year. The top speed quoted for the earlier vehicles of 22 m.p.h. and a much improved radius of action of 210 miles were offset by a number of defects. This speed, for example, proved illusory as gears could only be shifted easily when the tank was stationary, the clutch was too light to transmit the engine torque satisfactorily, the gearbox was itself very unreliable and at least one engine component had to be lubricated after one or two hours' running.

The KV-1C also appeared in 1941 with the fabricated turret replaced by a cast one of almost identical design, and increased armour on the hull sides. This version is described in detail in a later section.

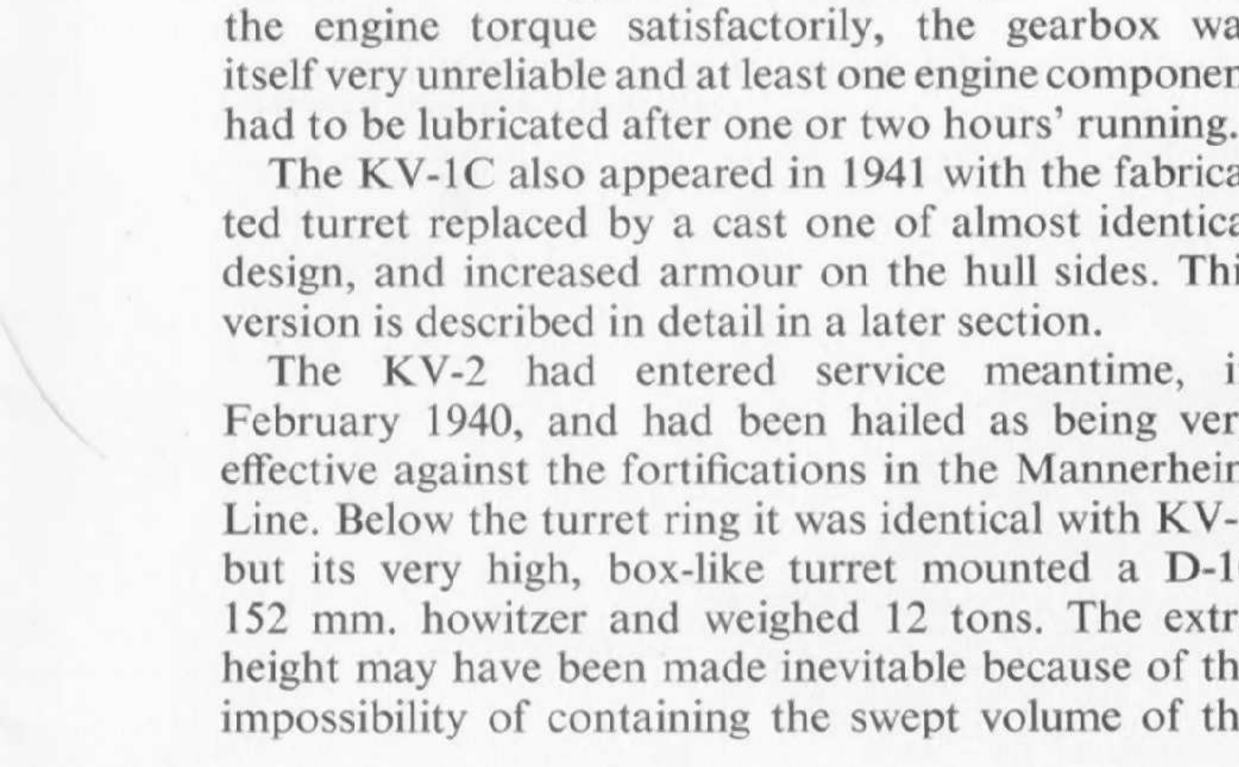
The KV-2 had entered service meantime, in February 1940, and had been hailed as being very effective against the fortifications in the Mannerheim Line. Below the turret ring it was identical with KV-1 but its very high, box-like turret mounted a D-10 152 mm. howitzer and weighed 12 tons. The extra height may have been made inevitable because of the impossibility of containing the swept volume of the



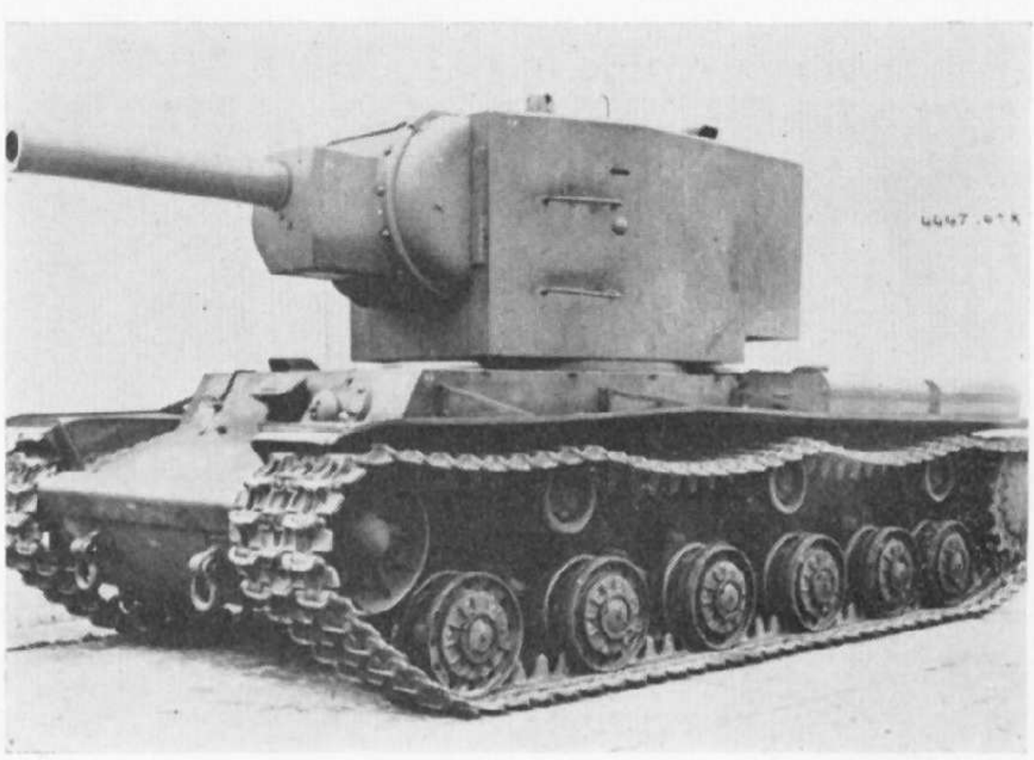
A near-plan view of KV-1C showing the large number of vision devices and the single turret hatch.
(Crown Copyright Reserved)

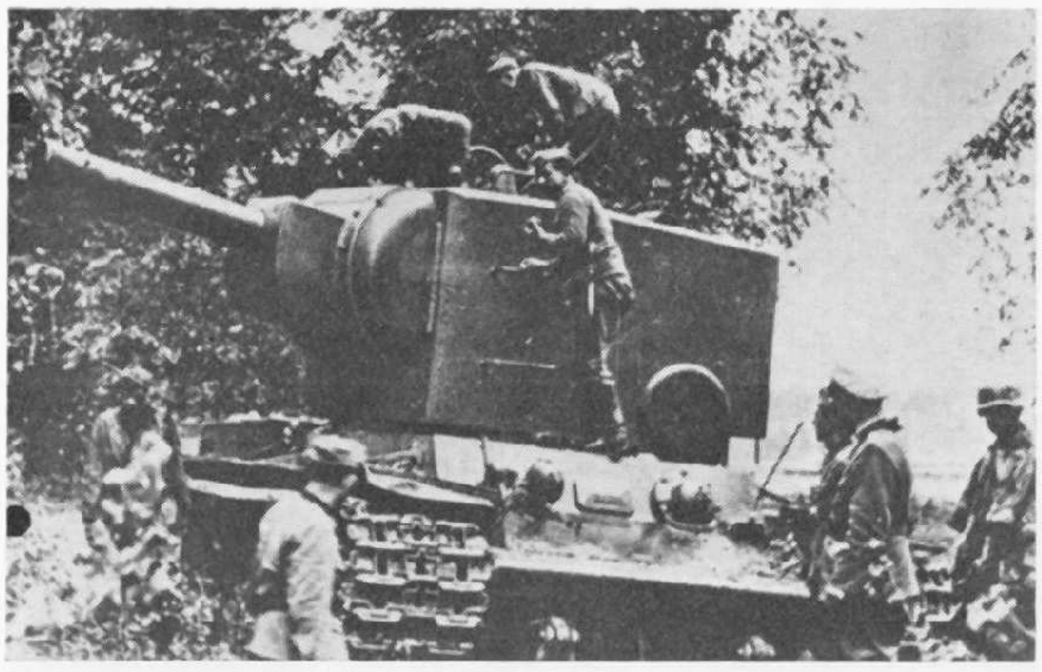
piece within the turret ring at angles of positive elevation and, if this was so, the British Conway tank destroyer makes an interesting comparison. The howitzer had a screw-type breech of Schneider design and had a hydraulic buffer and a hydro-pneumatic recuperator. A maximum elevation of 12 degrees and depression of five degrees was possible. Two types of separated projectiles were used: an anti-concrete round weighing 88 lb. with a base fuse and a muzzle velocity of 1,738 ft./second, and an APHE round of naval design weighing 112 lb. with a muzzle velocity of 1,430 ft./second. 36 rounds and charges could be stowed and both direct and indirect fire was possible although almost certainly at a very low rate. The turret crew differed from that in the

A general view of a KV-1C. (Crown Copyright Reserved)

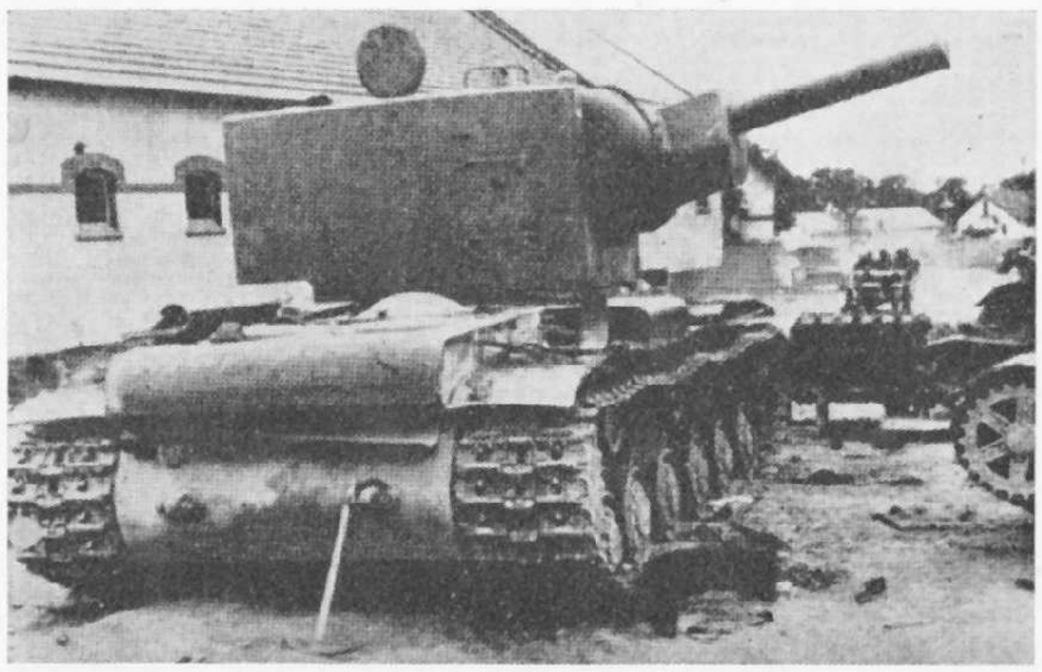


A KV-2. The box-like turret is mounted on a standard KV chassis. (R.A.C. Tank Museum)





An abandoned KV-2 being examined by German troops who provide a convenient scale to judge the great height of this vehicle. (Crown Copyright Reserved)



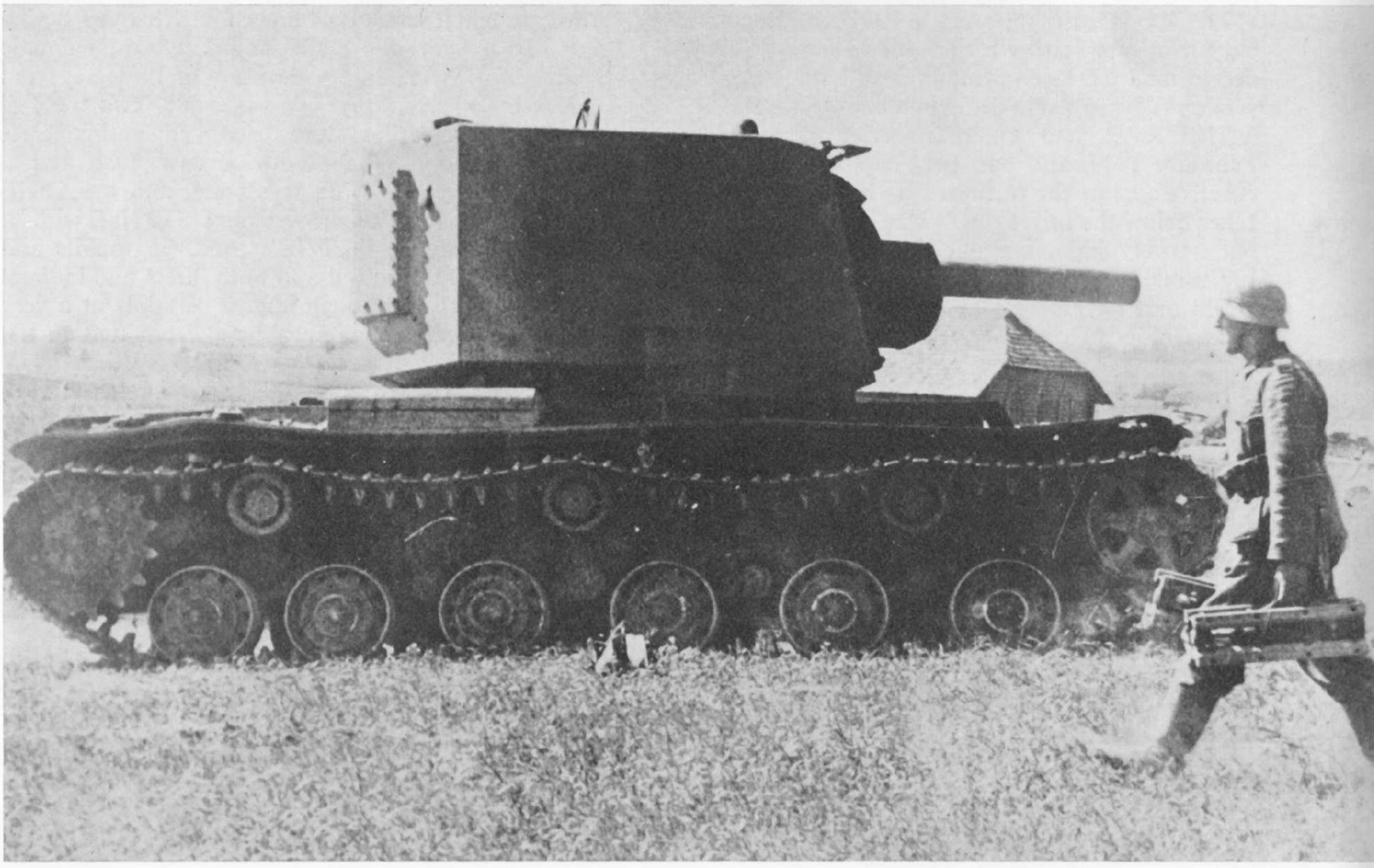
A rear view of another abandoned KV-2. (Crown Copyright Reserved)

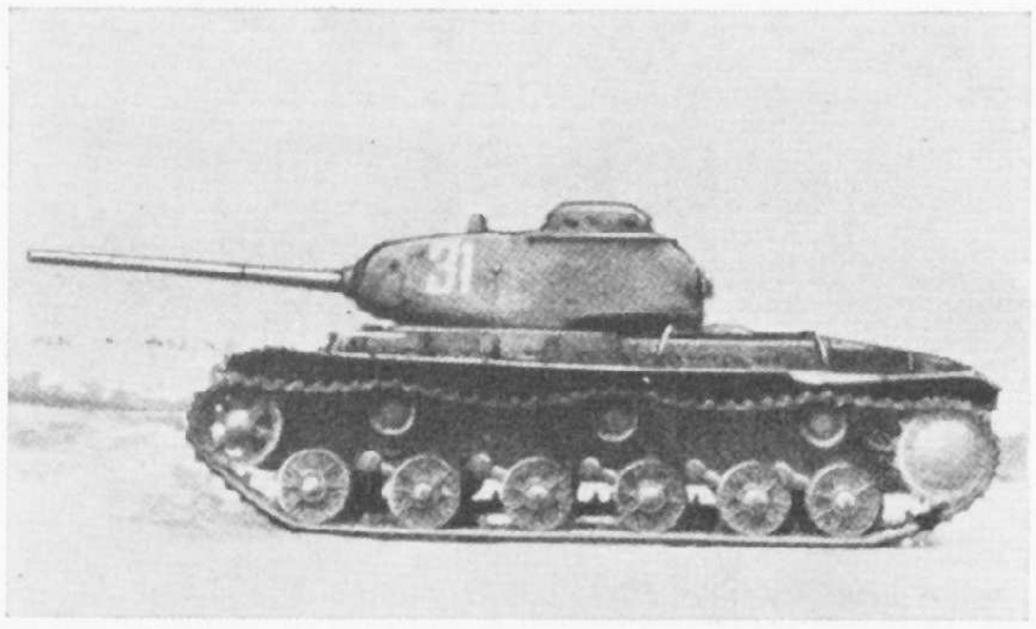
KV-1 in having a separate commander, a gunner, loader and a spare driver-mechanic who probably helped to manipulate ammunition. Automotively KV-2 suffered from the same defects as its smaller companions, with the added disadvantages of inadequate vision devices and a traverse system that was unable to drive the turret if the vehicle was canted on anything other than the smallest side-slope. Nonetheless, KV-2 was potentially a formidable weapon which could have been extremely effective in the defence of built-up areas if it had only been supported properly by infantry. As it was, KV-2 was usually neutralized after being out-flanked and the design was soon replaced by the much lower SU-152, a turretless AFV mounting a howitzer of the same calibre.

A new version of the KV-1 arrived in the autumn of 1942 whose design took cognisance of many of the disadvantages of the earlier marks. KV-1S had less armour, weighing about 42 tons combat loaded, its height was lowered slightly and its top speed increased to 25 m.p.h. The commander was given a small vision cupola and the engine and transmission covers were sloped. But probably the most important changes involved making the power train more reliable.

The introduction of better armoured German tanks, particularly the Tiger, reduced the effectiveness of the 76 mm. and KV-85 appeared in the Spring of 1943 with the M-1944 85 mm. gun, in common with T-34/85. The width of the basic KV-1S vehicle was increased to 11 ft. 4 in. to accommodate a larger turret ring, the weight crept up again to 45 tons and the radius of action on roads down to 205 miles. The cast turret was

Another abandoned KV-2. The bolted-on plate at the rear of the turret may have covered the aperture necessary to mount the howitzer. (Crown Copyright Reserved)





A KV-85. The superficial resemblance of the turret to that of T-34/85 is of interest. (Imperial War Museum)

Note the changes in the hull front of this interim KV-85 and the similarity to the IS-1 which followed soon afterwards. (Crown Copyright Reserved)

similar in design to that of T-34/85 although the rear turret MG was retained and the armour was thicker; front, side and rear dimensions being 110 mm. rounded, at 20° and 25° respectively. The rounded mantlet was 95 mm. thick, the nose plate 60–75 mm. at 25°, the upper part of the hull front 75 mm. at 30°, the vertical sides 60–65 mm. and the rounded rear plates also 60 mm. 71 rounds of 85 mm. ammunition were carried.

But KV-85 was only an interim design and it was replaced within the year. By the end of 1943 about 10,000 KV series tanks had been produced, many of them at the Kirovski Sovod works in Leningrad from where they were often driven to battle immediately after assembly.

THE IS SERIES

Kotin meanwhile had started a design study in 1941 aimed at increasing the firepower and protection of the heavy tank without exceeding the weight of KV-1S. Removing the machine-gunner/radio operator from the hull permitted a better ballistic shape for the glacis plate which was made as a single casting, faired into the side plates under the turret ring. The design of the suspension remained essentially the same although the sprocket, top rollers and track adjusting wheel were all lowered to permit the construction of panniers over the top run of the tracks and thereby a wider turret ring to accommodate a larger gun. The upper and lower tail armour was made from single plates, similar to T-34. Particular attention was again paid to improvements in reliability and the accessibility of components for repairs in the field. Predictably, the new series was named after Josef Stalin.

A few IS-1As appeared in 1943. Some were armed with the M-1944 85 mm. gun and others with the same D-10 100 mm. used in the SU-100 tank destroyer. The glacis plate was stepped from the front angle of 30° and the driver's vision slits were mounted centrally in the rear slope of 74°. His two episcopes were mounted in the front of the hull roof. By 1944 the earlier guns had been replaced by the 122 mm. D-25 (an AFV version of the M1931/37 field gun) and the modified vehicles were probably designated IS-1B. Auxiliary fuel tanks, similar to those on T-34, could be carried on either side of the hull armour. At the same time production of IS-2 had started at the Kirov plant in the Urals and the Germans reported their first contacts with this version in early 1944.

A battered IS-1. Note the lowering of the top suspension units compared with the KV design, necessary in order to accommodate a turret ring of a wider diameter on a hull of roughly the same width. (Crown Copyright Reserved)

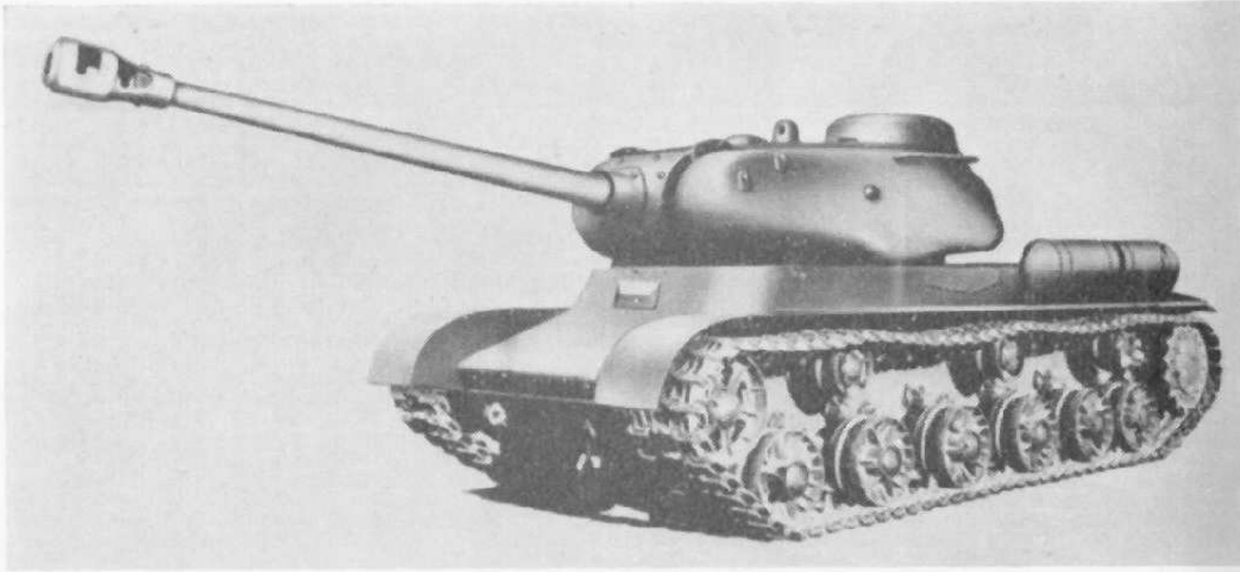
THE IS 2 DESCRIBED

The most obvious difference between IS-1 and IS-2 was a change in the glacis plate which was now 110 mm. thick and uniformly sloped at 60° into the forward hull sides and pannier armour in a single casting. The nose plate was 127 mm. thick at 30°, the rolled hull sides 89 mm. and the front pannier sides 133 mm. at 12°. The driver was again mounted centrally in the hull with a direct vision slit in the glacis and two episcopes in the front pannier. The turret was an unsymmetrical casting, the left hand side being near-vertical while the right sloped at about 20°. The turret side thicknesses were about 95 mm., the cast nose section up to 64 mm. (rounded), the mantlet 102 mm. and the two rolled turret roof plates were 45 mm. thick. The left rear of the turret contained a ball mounting for the commander's 7·62 mm. DT MG. The turret crew consisted of the commander, mounted at the left rear under a cast, non-rotating cupola with six vision slits protected by glass blocks, the gunner in front of him and the loader on the right of the gun. The hatch above the loader incorporated a mounting for a 12·7 mm. DShK anti-aircraft MG. Following previous practice there were two pistol ports, one in each turret side wall, as well as the usual sighting and observation instruments. A ventilator cover was positioned centrally in the front of the turret roof and handrails for mounted infantry were welded on the sides. There was no roof hatch for the driver who had to escape either through the turret or through a belly hatch well to his rear. His position was made the more precarious by the presence of fuel tanks on both sides. A rigidly mounted 7·62 mm. MG was under his control, firing through an aperture in the glacis plate.

The fighting compartment was also very cramped because of its low height, the large volume occupied by the 122 mm. gun and the intrusion of the hull sides inside the turret ring diameter. The 122 mm., 43 calibres long gun could be either quick-firing or semi-automatic in operation and had a horizontally-sliding breech block. Its buffer and recuperator were strapped above the jacket-type cradle which had a coaxial mounting for another 7·62 mm. DT MG on the left. A large double baffle muzzle brake on the gun helped reduce its long recoil distance. About 28 rounds of main armament ammunition were stowed, the primary type probably being APHE. The elevation arc was from plus 20° to only 3° depression.

The V-2K engine and transmission was almost unchanged from that in KV-1 except that the gearbox was redesigned by Blagonravov for greater efficiency and reliability. The track width of 25½ in., a vehicle weight of about 45½ tons and a contact length of about 14 ft 4 in. resulted in a ground pressure of about 11·5 lb./sq. in., significantly lower than that for the German Tiger which had correspondingly greater difficulty in crossing soft ground. Other dimensions of IS-2 were: length overall—31 ft. 7 in.; hull length—21 ft. 10 in.; overall width—10 ft. 3 in.; height 9 ft. and a distance between track centres of 8 ft. 1 in. Its top speed was quoted as 27 m.p.h. and it could wade unprepared to a depth of 4 ft. 3 in.

The Germans considered that the re-designed armour on the IS-1 and 2 gave some 50% better immunity than that on the KVs while the 122 mm.



A three-quarter view of IS-1 showing the development of the hull front from KV-85. The turret, too, shows some resemblance to that on the earlier tank. (Crown Copyright Reserved)

The IS-2 with a uniformly sloping glacis plate compared with the bent plate on the IS-1. Note also the change in the driver's vision device. (Crown Copyright Reserved)

The radical redesign of the hull front and turret are clearly visible in this IS-3. (Crown Copyright Reserved)

ISU-152s on close order parade. (Crown Copyright Reserved)

IS-3 on the Victory Parade in Berlin. The remarkable configuration of the armour and the mounting of the 12·7 mm. AAMG can be clearly seen. (Crown Copyright Reserved)

was roughly comparable to the 88 mm. in performance. Wartime production of IS-2 ended in 1944 after about 2,350 had been built. In keeping with the Russian dislike of ever scrapping anything of value, however, a number have remained in service—certainly up to 1966 when a group of IS-2s were pictured on exercises in the Soviet Union. 300 were also exported to Cuba in 1962.

IS-3

Good as the IS-2 was proving to be, a re-vamping of the design was in progress in 1944 and IS-3 first saw service in the closing months of the war. The smoothly cast glacis plate was replaced by a complex of angled welded plates. This new configuration was probably adopted to give equivalent or greater protection with some saving in weight although its fabrication must have been difficult to achieve in mass production. A large driver's hatch was positioned in a triangular section of the hull roof directly under the gun mantlet. The fixed MG in the glacis was abandoned and the rear turret MG replaced by a number of the standard pattern of pistol ports. The turret was completely redesigned to give a high obliquity as well as thicker armour; a basis of 200 mm. has been suggested. The absence of any significant shot traps is noticeable in the "turtleback" shaped casting. The combat weight and automotive components probably remained unchanged although the top speed dropped to 25 m.p.h. and the radius of action was about 120 miles. The new tank was first seen by the Western World at the Victory Parade in Berlin and its excellent protection, low silhouette (about 8 ft. 1 in. to the turret top) and massive firepower made it the most potent ingredient in the Soviet armoured forces until its replacement from 1957 onwards. Indeed its menace led to a number of hurried, and by no means always success-

IS-3 marching past on the Victory Parade in Berlin in September 1945. The lifting flap to allow full elevation of the 122 mm. gun can be seen on the nearest tank. (Burroughs/A.P.)

ful, attempts in the fifties to counter this so-called heavy gun threat. On the British side, for example, a number of adaptations of Centurion were tried and the A 45 design was resurrected to emerge as the heavy gun tank Conqueror. But the IS-3 was not without its own defects. The volume of the fighting compartment must have been even more limited than in the earlier marks and crew efficiency must have suffered. Even with a restriction on the height of tank crews the handling and loading of the separated ammunition must have been exceptionally difficult, especially at high angles of elevation, and the rate of fire was accordingly well below the acceptable minimum elsewhere. The only customer outside the Soviet Army for IS-3 appears to have been the United Arab Republic which had about 50 in 1956.

IS-3 on a May-Day Parade in Moscow. ("Planet News")

T-10 AND T-10M

The latest and last major development in Soviet heavy tank design started in 1953 with the T-10. Compared with IS-3 it is longer at 25 ft. 6 in. (having seven road wheels each side instead of six) and wider at 11 ft. 2 in. These dimensional relaxations may indicate that more ammunition and fuel can be carried and it seems likely the vehicle's agility has been improved by increasing the output of the veteran V-2 engine to 700 b.h.p. and the top speed may be of the order of 28 to 30 m.p.h. A radius of action equivalent to that of the current medium tanks also seems logical. The new 122 mm. gun has a concentric hydro-mechanical recoil system which doubles as the cradle, the barrel has a fume extractor as well as a new muzzle brake and the turret casting has been further improved in shape. Further changes occurred in 1957 when the T-10M appeared with minor changes in the turret configuration, a rear stowage bin, full infra-red night fighting equipment, MGs increased in calibre to 14·5 mm. as well as a new muzzle brake on the 122 mm. gun. Both T-10 and T-10M are still in service although it seems likely that they are being withdrawn from the Group of Soviet Forces in Germany to be replaced by the modern T-55 and T-62 mediums. Again, there has been only one other army to receive examples of this type, the East German NVA this time, having a number of T-10Ms.

VARIANTS

True to its insistence on the maximum possible firepower, the Soviet Army converted a number of heavy tanks to carry larger calibre weapons. Three versions

A further view of IS-3 tanks on the Victory Parade in Berlin as they move down Charlottenburger Chaussee. The gun travelling clamp is secured back on the rear hull plate which was partially removable to allow access to the transmission.

(Crown Copyright Reserved)

of the T-35 appeared in 1935, renamed SU-14, and mounted artillery howitzers of either 152 or 203 mm. calibre. The SU-100Y was based on the T-100 and carried a 130 mm. gun but neither this, nor the SU-14, seem to have passed the prototype stage.

The first heavy SU to see production was a development of the KV and probably replaced the ill-fated KV-2 as mentioned already. SU-152 mounted the M-1937 corps artillery gun/howitzer which fired a 95 lb. HE shell up to 19,000 yards at a remarkably high muzzle velocity for this type of weapon of 1,900 ft./second, although the extreme range could only be reached when the vehicle was parked on a reverse slope. The tank turret was replaced by a sloping superstructure of rolled steel plates roughly welded together and topped by a flat roof plate. The mounting was capable of about 5° traverse either side of centre, larger switches involving the slewing of the vehicle. About 28 rounds of ammunition were carried, and although the weight was greater than that of the gun tank, the SU had the advantage of a more powerful HE-firing gun and a lower silhouette. The shell was

IS-3 and their crews in the Berlin Tiergarten in 1945.
(Crown Copyright Reserved)

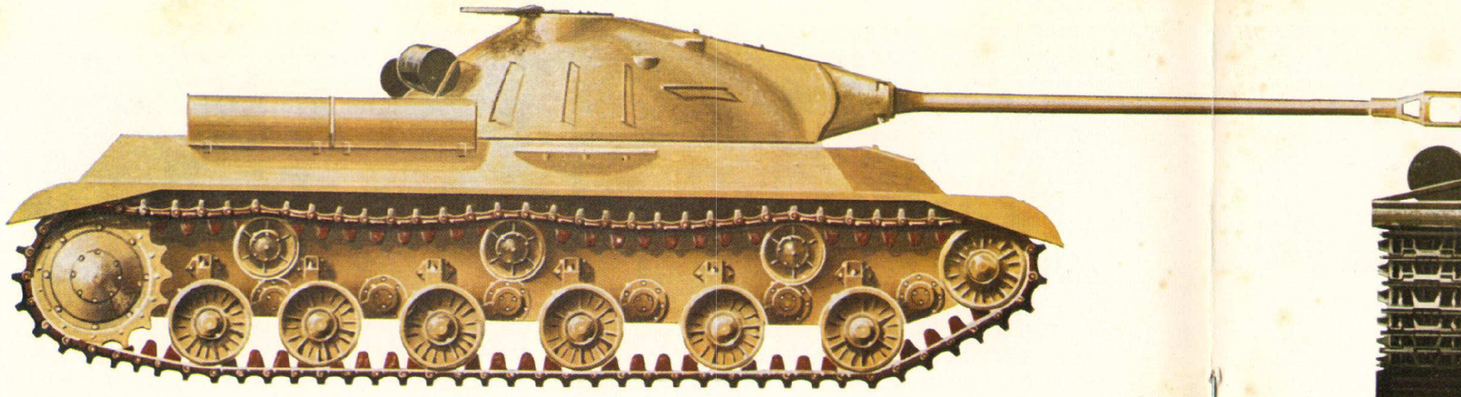
An IS-3 in Berlin. The low silhouette is accentuated by the trucks following. (Crown Copyright Reserved)

effective against lightly armoured vehicles as well as the usual artillery targets. The SU-122, not so common, was identical structurally but had the M-1931 122 mm. which was recognizable by its longer barrel without a muzzle brake.

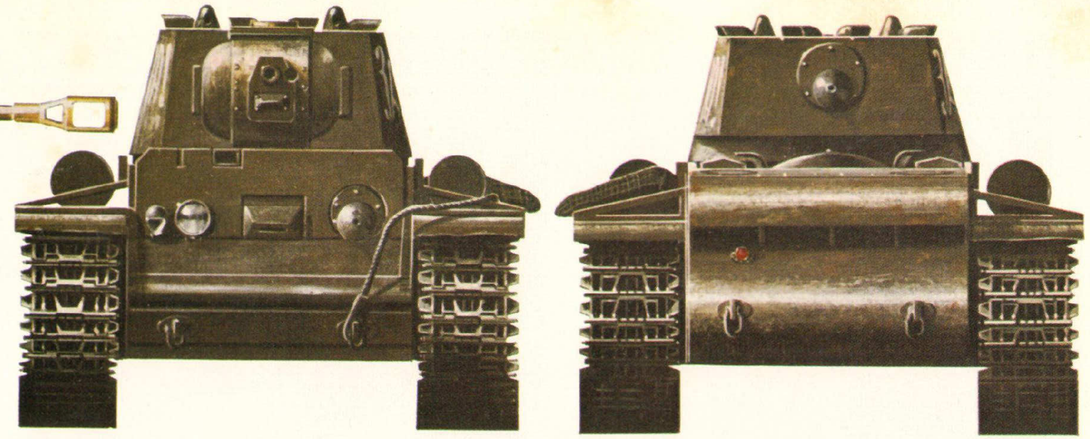
As the IS tank production got under way the IS-2 was similarly adapted to the SU role. The ISU-122 mounted the M-1944 A-19S 122 mm. and the ISU-152 the ML 20S 152 mm. which had a similar exterior appearance to the M-1937 model. A rather more uncommon version mounted the D-25S 122 mm. gun used in the conventional tanks and was variously known as the SU-249 and ISU-122A. The A-19S gun, with a plain section reinforcing collar on the muzzle probably had a slightly better performance than the D-25S which, with its muzzle brake and sliding breech block, must have had a higher rate of fire. But whichever gun was installed the basic vehicle was the same. The massive superstructure of rolled plate was not so steeply sloped as on the earlier versions and the commander had a cupola similar in appearance to that on KV-85 with a 12·7 mm. anti-aircraft MG mounted on the periphery. A crew of four to five was necessary, the driver and gunner being on the left of the gun and the commander on the right. A telescopic sight was normally installed for direct fire while the ISU-152 had a dial sight for shooting indirect. A total arc of traverse of 10° and elevation up to 31° was possible on ISU-152. 20 rounds of AP and HE ammunition were stowed in ISU-152 and 30 in ISU-122. Automotively the turretless vehicles were almost identical to the IS-2 although the gearboxes may have been modified to incorporate a "Hi-Lo" auxiliary gear. All-up weight was usually just over 45 tons.

With the ending of the war and as the numbers of conventional heavy tanks and the firepower of the mediums increased, the need for the ISU-122 tank killer diminished although the ISU-152 remained in service for much longer, it being able to put down heavy and accurate HE support more economically and quicker than the towed pieces available at the time. While neither appear to be in first-line service now it is inconceivable that the economical Russians have disposed of them entirely. A few ISU-122s went to the United Arab Republic and the Algerian Army has had a consignment of ISU-152s.

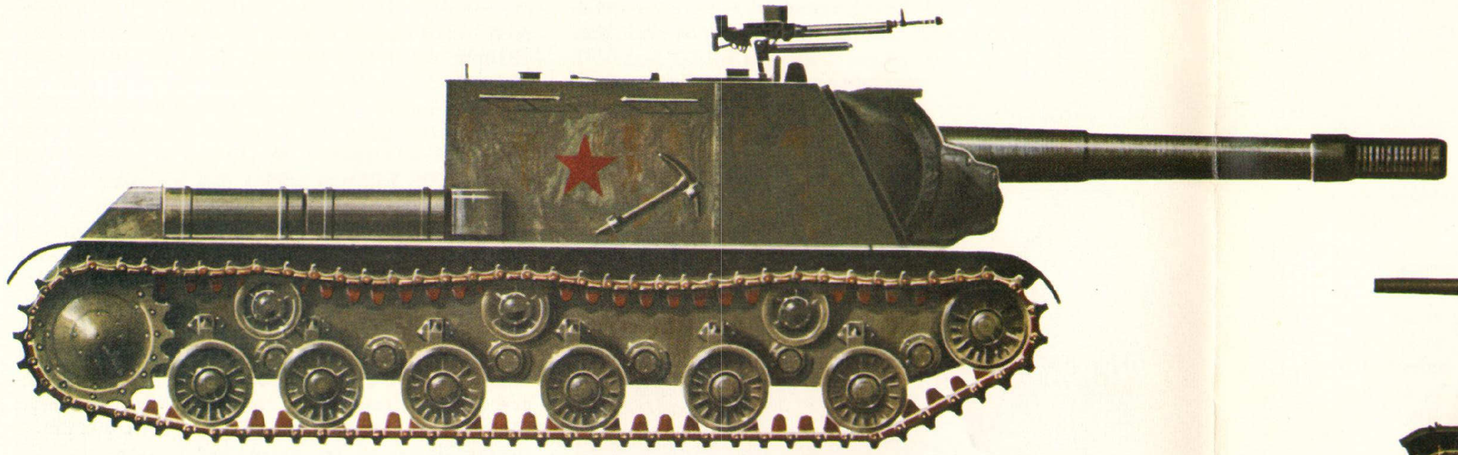
A number of IS-3 and T-10 chassis were converted



IS-3 in United Arab Republic service

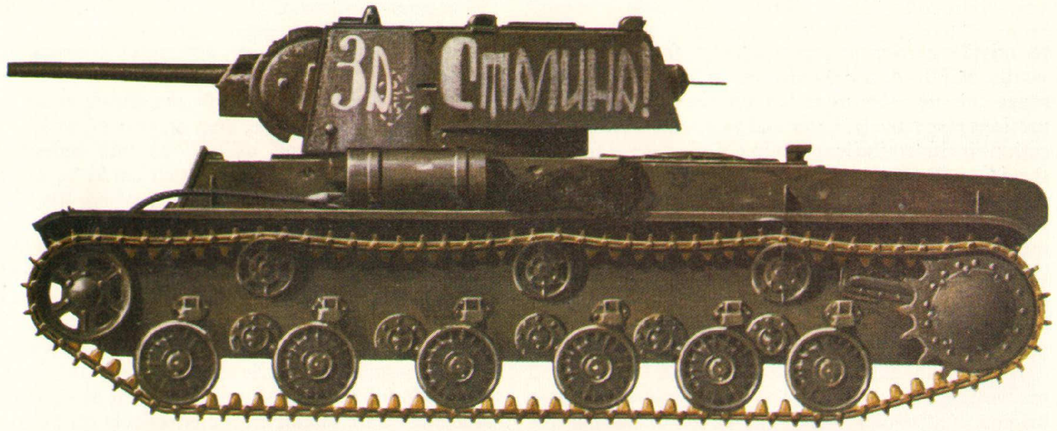


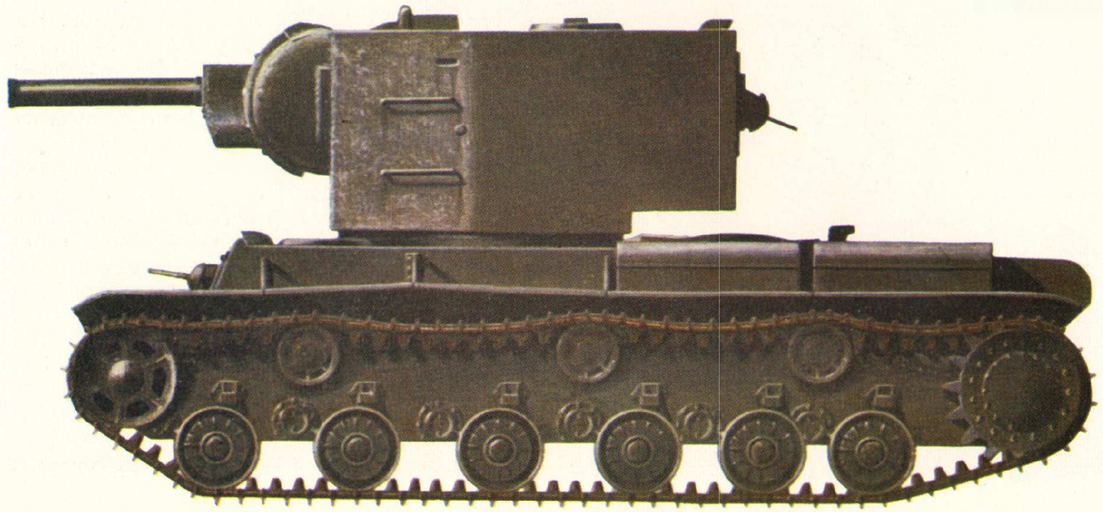
KV-1A weighed 43 tons and mounted a 30.5 calibres long 76mm. gun in a fabricated turret. In the KV-1C the turret was a cast one of almost identical design. KV-1B had appliqué armour bolted on turret sides. The first KVs entered service in 1939.

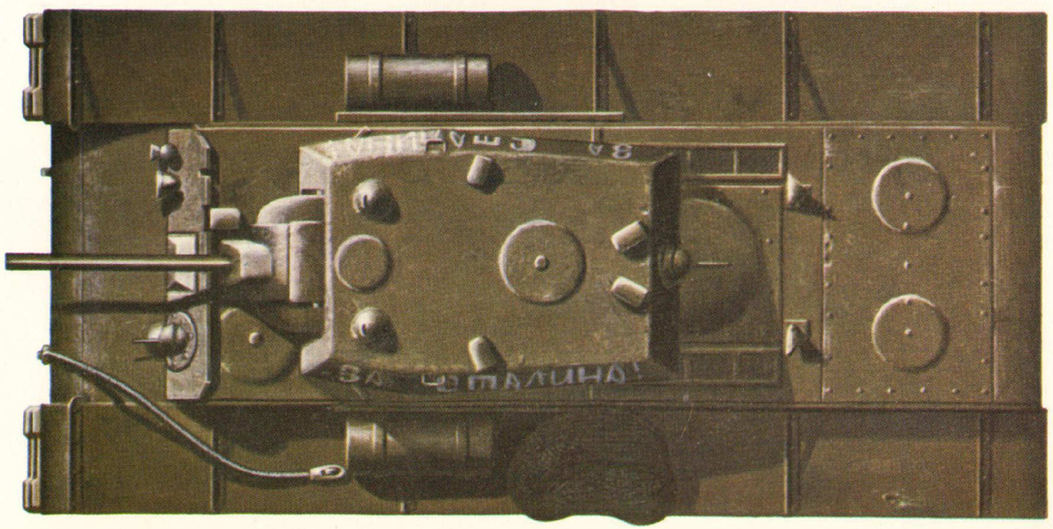


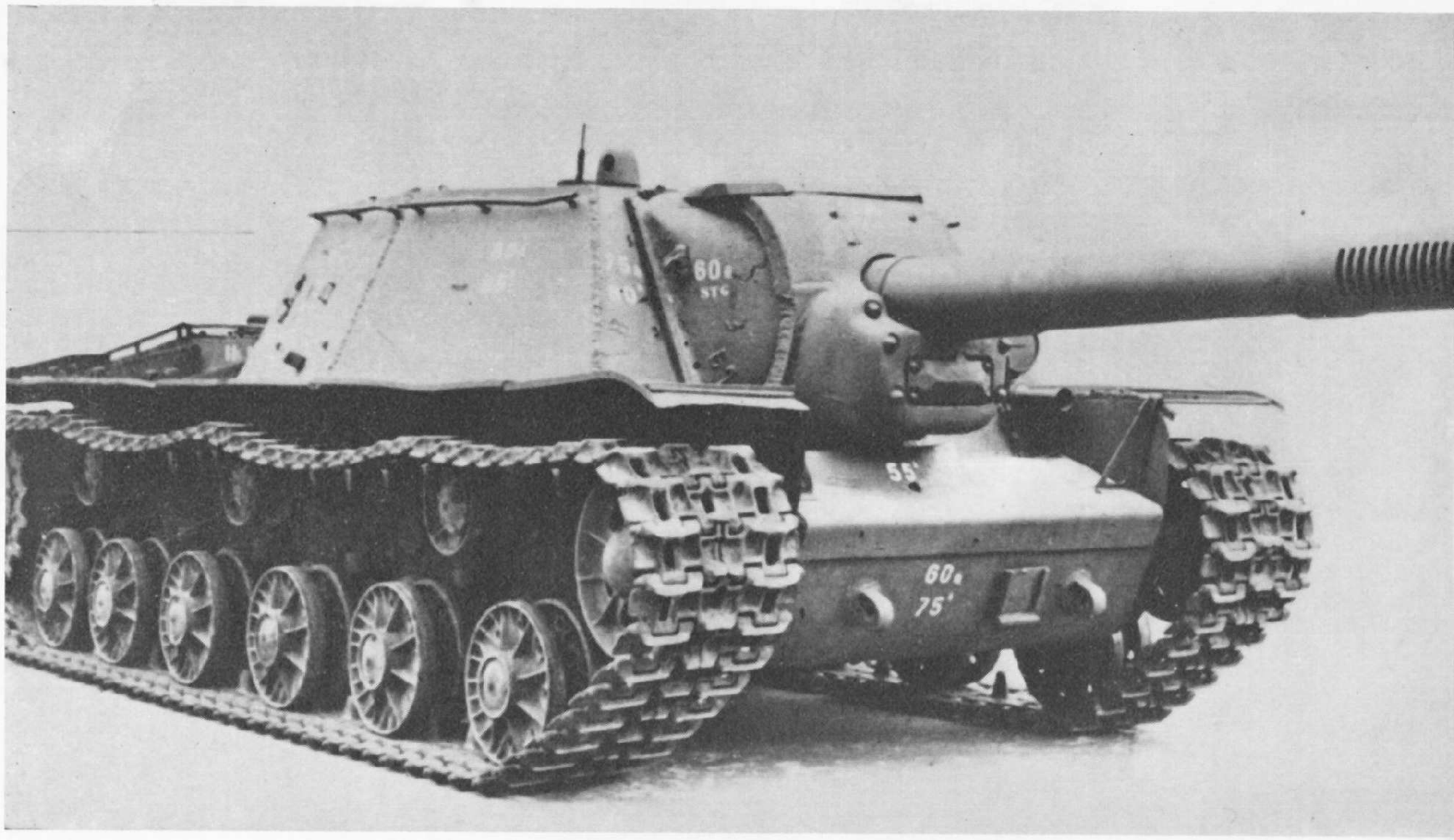
ISU-152. The IS-2 adapted to the SU role.

Below KV-2









SU-152. Note the squat construction, the head of the dial sight on the flat turret roof and the hand rails for mounted infantry.
(Imperial War Museum)

to missile carrier/launcher vehicles from 1957 onwards. SCUD-A, a 100 mile, and SCUD-B, a 120 mile range missile were mounted on the IS/A and IS/B versions respectively. Later and more extensive modifications included the lengthening of the chassis to carry the SCAMP (IS/E) and the SCROOGE (IS/F). Two rather more bizarre conversions were the IS/C which mounted a tube launcher for a missile of about 300 mm. calibre while the IS/D had an even longer 400 mm. calibre tube for an unguided projectile powered by ramjet. Although they were probably only research projects they duly impressed spectators at May Day parades for a number of years.

A more mundane conversion was that to armoured recovery vehicle (ARV). The IS-2T was simply the original hull with a steel plate covering the fighting compartment but the five subsequent versions (ISU-TA to TE) were based on SU hulls which were already an ideal shape for the job. Although the equipment varied according to the type a wide diameter schnorkel tube and a winch denotes the TD vehicle, designed to be the leading vehicle in a deep-wading operation and capable of recovering a medium tank unable to complete the crossing. The TE model has a large jib crane for lifting heavy assemblies in the field.

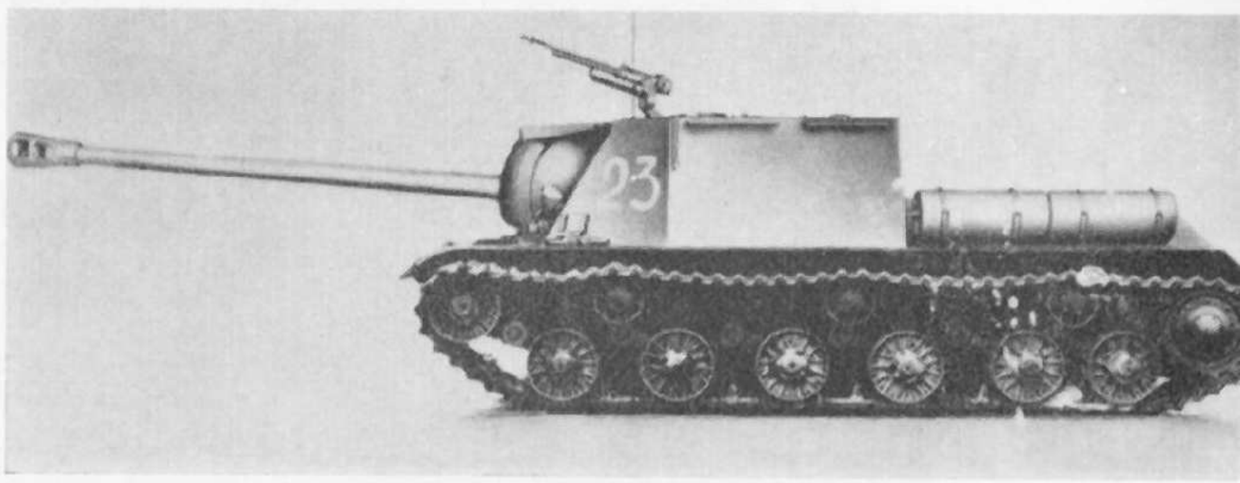
TACTICAL EMPLOYMENT

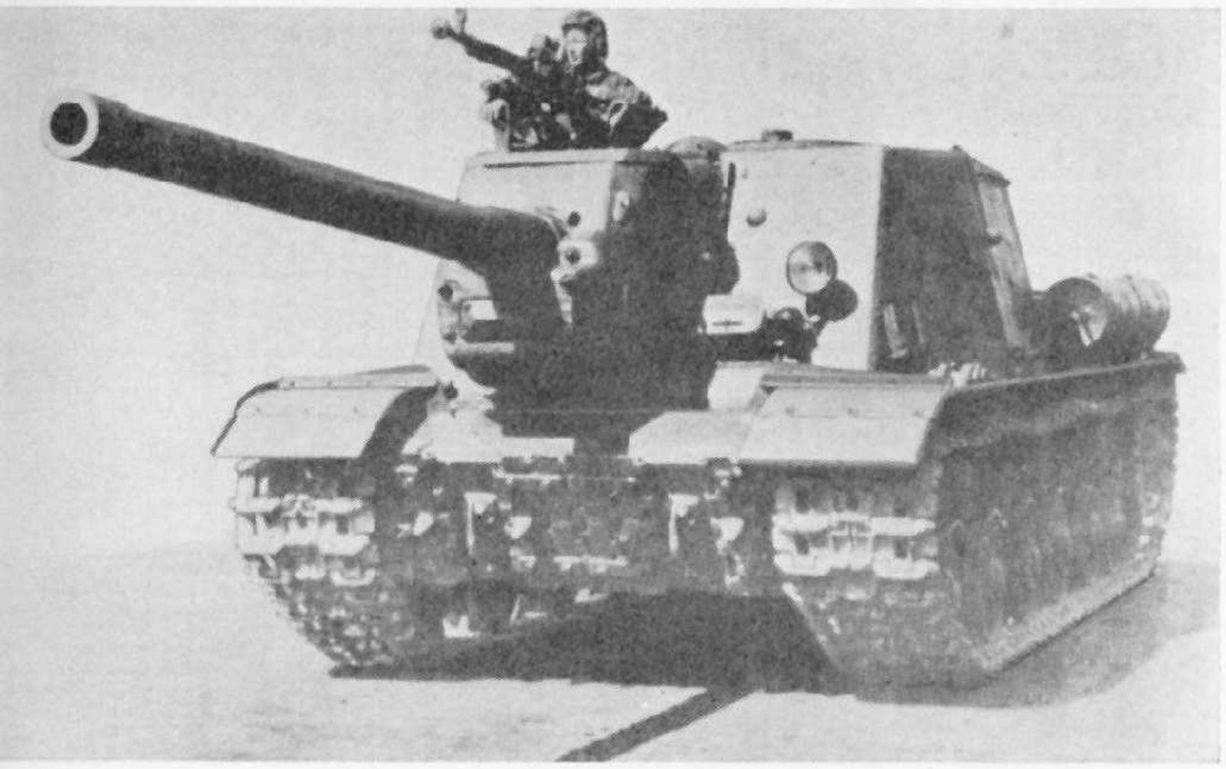
The original plans to use the heavy tanks on independent operations, the abrupt change to a purely support rôle, followed by the race to reform integrated armoured formations has already been mentioned briefly. Despite the Soviet superiority in both numbers and quality, in theory, by the winter of 1941 there was hardly a single effective armoured formation remaining.

As the forces were rebuilt the heavy tanks were grouped into battalions, one or two of which were assigned to a corps, as well as into independent battalions of tanks or SUs which could be attached temporarily to other formations where they were needed most.

In a combined-arms assault it was originally the practice to send the heavy tanks forward in the first wave to crush the main opposition on the objective, followed by medium tanks and infantry. But possibly because the KVs and ISs were less agile than the mediums and held up the assault, they were too few in numbers to risk against anti-tank guns at short range and they were unable to fire effectively on the move, the mediums took over the lead with the heavies some 500 metres behind. Sometimes opening fire up to 2,000 metres away their priority targets were listed as strong-points, anti-tank weapons and tanks that disclosed their positions to engage the first wave. As the

ISU-122A (or SU-249) mounting the D-25S 122 mm. gun as used in IS-3.
(Imperial War Museum)





The ISU-122 had the same superstructure and automotive design as ISU-152 but is recognizable by the smooth tube of the M-1944 A-19S 122 mm. gun. (Crown Copyright Reserved)

advance continued the heavy tanks would "leapfrog" forward to new positions. The SUs were used similarly, their quickness into action and accuracy if firing direct making them much more valuable than towed field artillery in the encounter battle. In the advance they were often used in small teams with infantry support to subjugate isolated strong-points or villages astride the road network. They could also be found being used individually as trail-blazers in forests with an obsolescent gun tank—perhaps a British Valentine supplied under Lease Lend—immediately behind to engage targets to the flank which the SU could not slew round to reach.

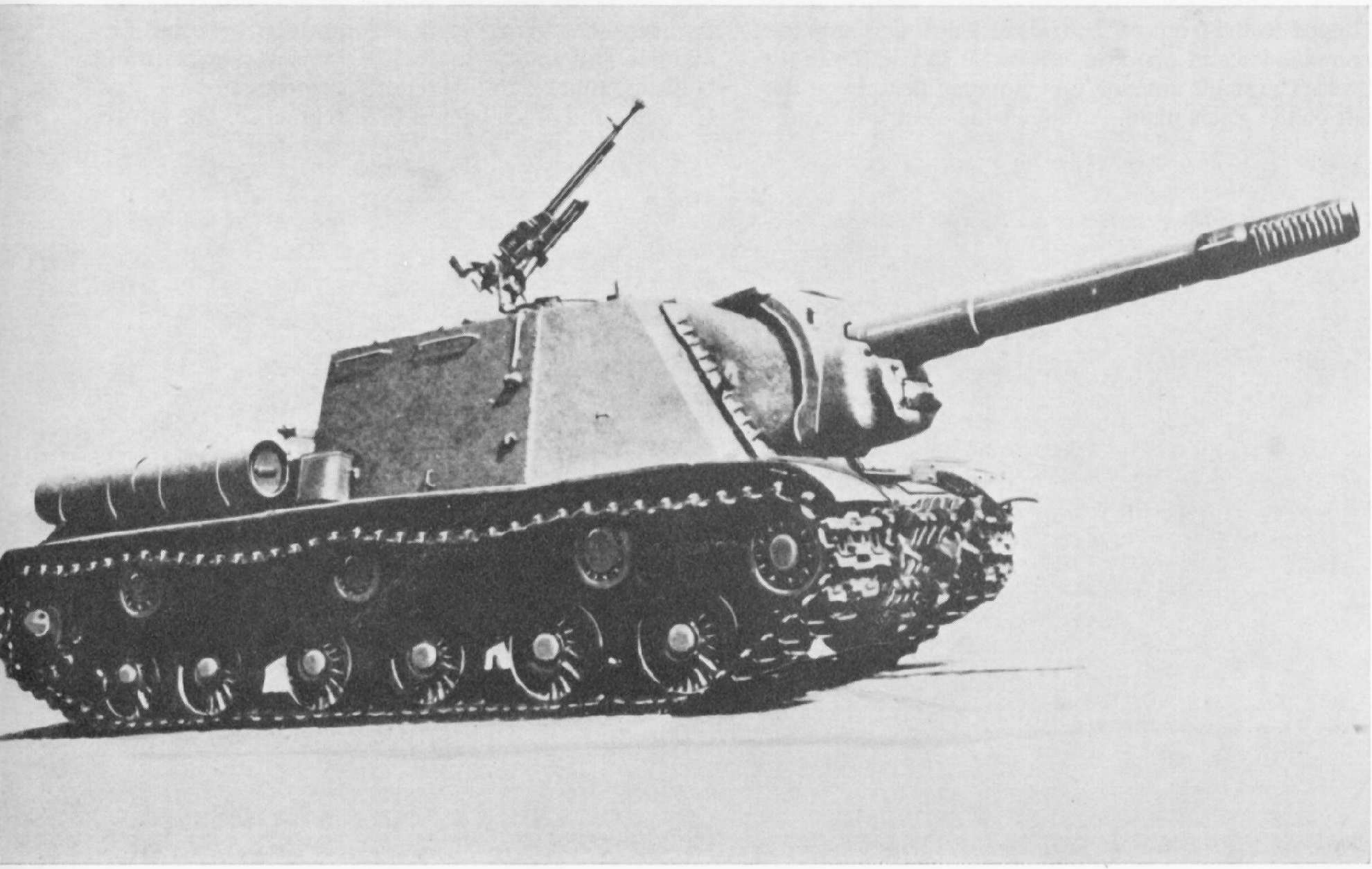
In the defence both tanks and SUs would take up positions in depth, protected by infantry, and were often allocated combat engineer support to dig them in and lay hasty minefields in order to canalize the enemy's advance into the most favourable fields of fire. SUs were sometimes paired with T-34s, the latter acting as bait to distract the enemy tanks whereupon the SU would engage from a concealed fire position.

THE KV-1C DESCRIBED

The first impressions of KV-1C were those of a straightforward and robust design—both for ease of production and operation—versatile armament and good protection.

The hull was constructed of rolled, homogeneous armour plate of a standard thickness wherever possible. The nose and lower rear plates were bent into shape and welding used extensively elsewhere, and although it does not appear to have been of a high standard, it was probably adequate. The front vertical plate was extended above the hull roof to give some extra protection to the turret ring and bars welded on the hull roof for the same reason. Vulnerable welds were reinforced in some places by bolts and internal supports. The front third of the belly plate was reinforced against mine attack. In some respects minimum weight was sacrificed in the cause of

ISU-152. The more steeply sloping superstructure and the 12·7 mm. AA MG distinguishes it at once from SU-152 with the similar 152 mm. howitzer. (Crown Copyright Reserved)



simplicity in manufacture. The turret roof was cast but the roof plate was a single plate, attached by welding.

The crew was five strong: the commander/loader, gunner and second driver-mechanic in the fighting compartment, and the driver-mechanic and hull gunner/radio operator in the front of the hull, in the centre and on the left respectively.

The driver's foot controls consisted of clutch and accelerator pedals, but no footbrake as the steering levers had a pawl and quadrant system which enabled them to be used together to operate the vehicle brakes. A change-speed lever was mounted on the driver's right and had an exceptionally large gate. Other controls and instruments included the usual starting and lighting switches and gauges. Two compressed air bottles were also stowed to his right for the secondary starting system. His vision devices included a rotatable periscope mounted in the hull roof and a visor with the slit protected by a glass block. The driver and hull gunner/radio operator shared a circular hatch on the left side of the hull roof, immediately above the latter's seat. The door was hinged at the front and had to be closed before the turret could be traversed as it would otherwise foul the 76 mm. gun barrel. An emergency escape hatch was located in the belly plate immediately behind the driver's seat for use by the entire crew if necessary. The 7·62 mm. Degtyarev MG was mounted in a ball assembly in the front plate and had open sights. The one or two radio sets were mounted forward of the operator with the intercom amplifier on the hull wall to his left. The radio transceiver operated on up to 12 pre-set frequencies determined by plug-in capacitor units although a normal tuning control was available. The earphones and laryngophones were incorporated in the crew crash helmets, the transmit/receive switch being clipped to the front of the overalls, although only the commander and operator were able to use the radio itself. The single antenna was mounted flexibly on the left of the glacis plate. Although the electrical equipment of the tank operated on a 24 volt earth return system, the radio used 12 volts, the connections being made across one bank of the four accumulators secured behind the operator's seat.

The fighting compartment was located centrally in the hull. The crew seats were fixed to the turret ring, that for the commander/loader on the right, the gunner to the left rear and the second driver-mechanic either in the centre rear (for approach marches or when using the AA mounting) or at the right rear when the main armament was in use or he was firing the rear turret MG. Three fuel tanks were mounted against the hull walls, two on the right and one on the left. The turret was mounted over the compartment on a ball race.

The 76 mm. (76·2 mm. precisely) F.34 gun was mounted on the centre line of the turret and identical to that used in T-34/76. The barrel was of monobloc construction with a detachable breech ring. The ring contained a falling-wedge type block which could be operated manually or semi-automatically. The percussion firing gear was operated by either foot pedal or hand triggers. The cradle was cast with machined sides to form recoil guide rails and the frame was bolted to the front plate of the turret casting. A cradle cap bolted to the front of the casting had drillings for the attachment of the buffer and recuperator rods and the trunnions were welded in two side pieces. The left hand trunnion casting contained the aperture and forward mounting for the gunner's sighting telescope, the aperture having a shutter for when the sight was not in use. The parallelogram link system for the periscopic sight was also attached to this trunnion. The right hand trunnion casting carried the ball mounting for the coaxial 7·62 mm. DT MG. A cast external mantlet protected the cradle and recoil system, being bolted to the front of the trunnion castings. Large rubber blocks were incorporated between the mantlet and cradle to reduce impact shocks from ballistic attack, an idea used subsequently by the Germans and much later in British practice. The recoil

IS/D impressing the spectators of the 1960 May Day parade in Moscow. ("Camera Press")

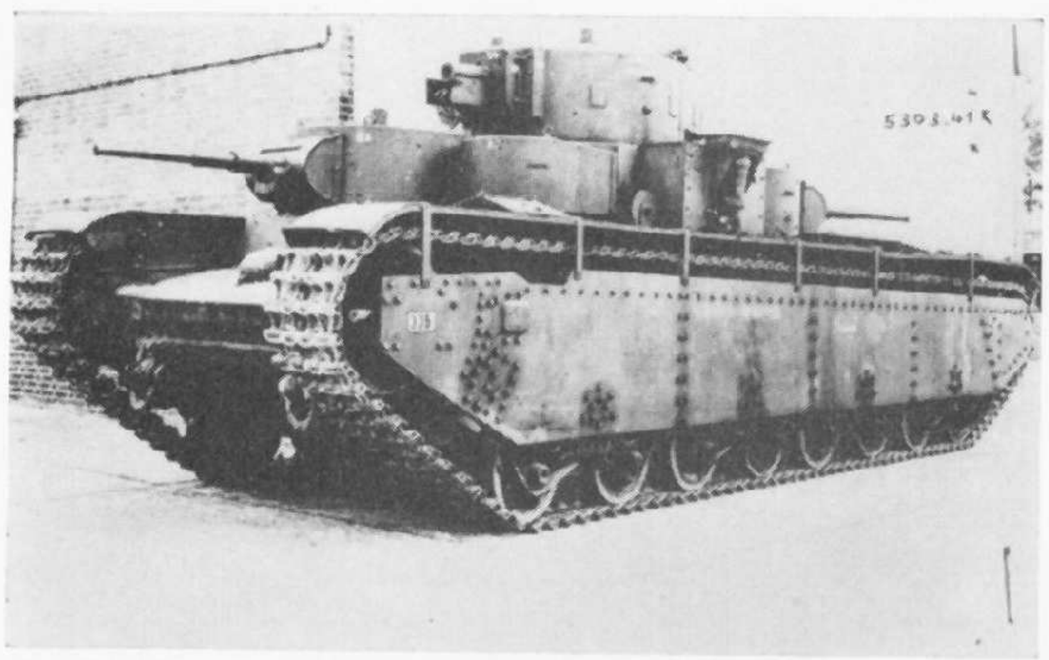
IS/B launcher vehicles mounting the SCUD surface-to-surface missile. ("Camera Press")

system, carried beneath the gun, consisted of a hydraulic buffer on the right and a hydro-pneumatic recuperator on the left. The cylinders recoiled with the gun, the rods being secured to the cradle cap. A deflector guard was fitted to the rear of the gun. Three main types of fixed ammunition were used: armour-piercing shot with an HE content and tracer for use against armour and trains; an HE shell with a fuse that could be set for instantaneous bursting for fragmentation, or delay for cratering; and shrapnel for use against unprotected targets and in self-defence.

The coaxial mounting was secured in a carrier on the right of the 76 mm. cradle and adjusting bolts permitted independent zeroing. This DT light MG was not only used in this position but also in the rear of the turret, the front of the hull and in the anti-aircraft

IS/C, a lengthened and much modified IS chassis mounting a 300 mm. tube launcher, on parade in Moscow in 1957. ("Camera Press")

A T-10 moving into Pilsen during the invasion of Czechoslovakia in August 1968. Extra fuel tanks on the rear decks were probably carried to reduce the logistical back-up for this operation. (Keystone)



The 49-ton T-35A with improved 45 mm. guns in two of the four subsidiary turrets. The nearest MG turret is traversed rearwards, the edge of the forward plate being just visible. The "handrail" radio antenna has been removed from the 76 mm. turret. (R.A.C. Tank Museum)

mounting and was the standard MG in the infantry (as the DP) and in other AFVs. It was gas-operated and belt fed from drums each holding 63 rounds. The barrel was of very light construction and probably had a very limited life if used for sustained fire.

The hand elevating gear was of the sector and pinion type, the handwheel being mounted to the gunner's right side and tilted at about 30° to the horizontal. Operation appeared to be made difficult because of the excessive free play in the mechanism and the cramped position for the gunner. An elevation lock was provided to secure the gun in the horizontal position when travelling. The traverse system incorporated both hand and power facilities although both drove a common spur type differential through non-reversing worm gears. The gearbox was mounted on the turret ring in front of the gunner and, although the handwheel was relatively easy to use, there appeared again to be excessive backlash in the gearing. Power traverse was available for making large switches only and could not be used for accurate laying. Three speeds were available but hand assistance was necessary if the tank was canted on a side slope and the gearbox was liable to overheat if used for more than a short time. A traverse lock was also provided.

The rear MG assembly was similar to that in the hull and was positioned slightly to the left of the turret centre-line.

The 76 mm. and coaxial MG were laid by the periscopic dial sight PT-47 and a cranked telescope TMFD. The dial sight was mounted in the front left of the turret roof and had a rotatable head and a movable top prism, thus permitting independent observation left and right of the turret axis and the measurement of angles of sight. For laying, the head was linked to the left hand trunnion so that it was elevated and depressed with the gun. Range scales marked for AP up to 3,600 metres, HE to 2,100 and MG to 1,000 metres were provided in the field of view and the system magnification was 2·5. The TMFD telescope also had scales for HE and MG but it is not clear why it was thought necessary to fit both these sights as the PT-47 did not seem to be particularly suitable for indirect fire and the telescope had no AP range scale. The commander/loader had a variety of observation devices available consisting of a rotating episcope on the right side of the turret roof, a vision slit and glass block in the right hand wall, with a pistol port just below it, as well as a PTK (a modified PT-47 instrument) on the right-hand forward side of the roof. In addition to his sights the gunner had a similar vision slit in the left hand wall and the second driver/mechanic had two rear-facing episcopes behind the access hatch. This proliferation of instruments certainly showed an awareness of the need for all-round vision but reflected the rather curious division of duties between the turret crew, the commander obviously having to rely heavily on the other two for observation. When he shed his loading duties in later marks it was then possible to concentrate most of the observation equipment around his position, in a cupola. Only one hatch was provided, in the centre rear of the roof. The cover was mounted on a rotating ring and opposite the simple but effective installation for the AA MG which could then be traversed through 360° independently of the main turret. The elevation arc, however, was probably too limited for really efficient use at high angles.

Up to 111 rounds of main armament ammunition were stowed, ten in the turret bulge and the remainder in boxes which, under rubber matting, formed the compartment floor. This seemingly economical solution probably made access to the rounds very difficult in action. 20 fragmentation grenades were stowed in one 76 mm. box. The 48 drums of MG ammunition were positioned near the various gun mountings. Ball and incendiary with or without trace appear to have been the natures available.

The engine was separated from the fighting compartment by a fireproof bulkhead containing ventilation and access doors. It was installed longitudinally on bearers welded to the floor with the radiators on each side and a small header tank on top. The armoured roof plates could be removed to allow access to the engine and ancillaries. The V-2K, 60° Vee, 12 cylinder, liquid cooled diesel engine was similar to that used in the T-34 and its derivatives but had been uprated to 600 h.p. Its design probably owed much to then current aero engine techniques but adapted to compression ignition and AFV use. The construction was light, the cylinder heads, blocks and crankcase all

being made of aluminium alloy. The blocks were detachable and fitted with wet liners. The combustion chamber was of the open type with the injector nozzles centrally in the head. Four vertical valves per cylinder were operated directly by the camshafts. The pistons were made of aluminium alloy and the crankshaft was supported in eight bearings. A bevel on the front end of the crankshaft drove the camshafts, injector pump, governor, generator and the water, oil and fuel pumps. A Bosch type injector equipment was located between the cylinder banks. Both summer and winter grades of fuel were available and if the ambient temperature fell below —20°C up to 40% kerosene was added. Lubrication was by a dry sump scavenge system driven by a triple gear pump. The cooling fan was driven off the main engine clutch and was mounted in a cowling in the bulkhead between the engine and transmission compartments. Air was drawn through the engine deck louvres and radiators, over the transmission and out through louvres in the rear of the hull. Two oil bath air cleaners were mounted, one on each side at the rear of the engine compartment. Exhaust gases from each bank were discharged to atmosphere via two short outlets on the top of the engine deck. Engine starting was normally electrical but compressed air could be used in an emergency.

The clutch was a simple multi-plate steel-to-fabric design and operated by mechanical linkage. A sliding mesh type gearbox had four normal speeds forward, one emergency low forward and one reverse gear. A clutch and brake system was used both for steering and vehicle braking. One combined assembly was mounted on each side of the gearbox and the drive transmitted via a splined coupling to the clutch and the external contracting brake bands acted as the driven drums. The final drive to the sprocket was by spur gear and epicyclic trains and housed in assemblies bolted onto the hull.

The suspension consisted of six twin steel wheels on each side, supported by transversely mounted torsion bars. The wheels were made of cast steel but incorporated a resilient rubber shock absorbing ring and were mounted on trailing axle arms. There were no shock absorbers although simple bump stops were provided. The rear driving sprockets each consisted of

An ISU-152 used to help quell the uprising in Budapest in November 1956. (dpa)

KV-1C. Note the MG ball mounting on the rear of the turret, the simple AA MG cradle to the left of the turret hatch and the twin exhausts on the top of the engine deck. (R.A.C. Tank Museum)

a cast steel hub onto which were bolted two toothed rings. The track adjusting wheels were made of single castings and the three top rollers on each side had rubber tyres. Track adjustment was effected by the cranked movement of the adjuster wheels. The tracks were manganese/chromium steel stampings and consisted of two types assembled alternately, plain and with a guide horn. Track pins were secured by circlips fitting in annular grooves in the heads.

CONCLUSION

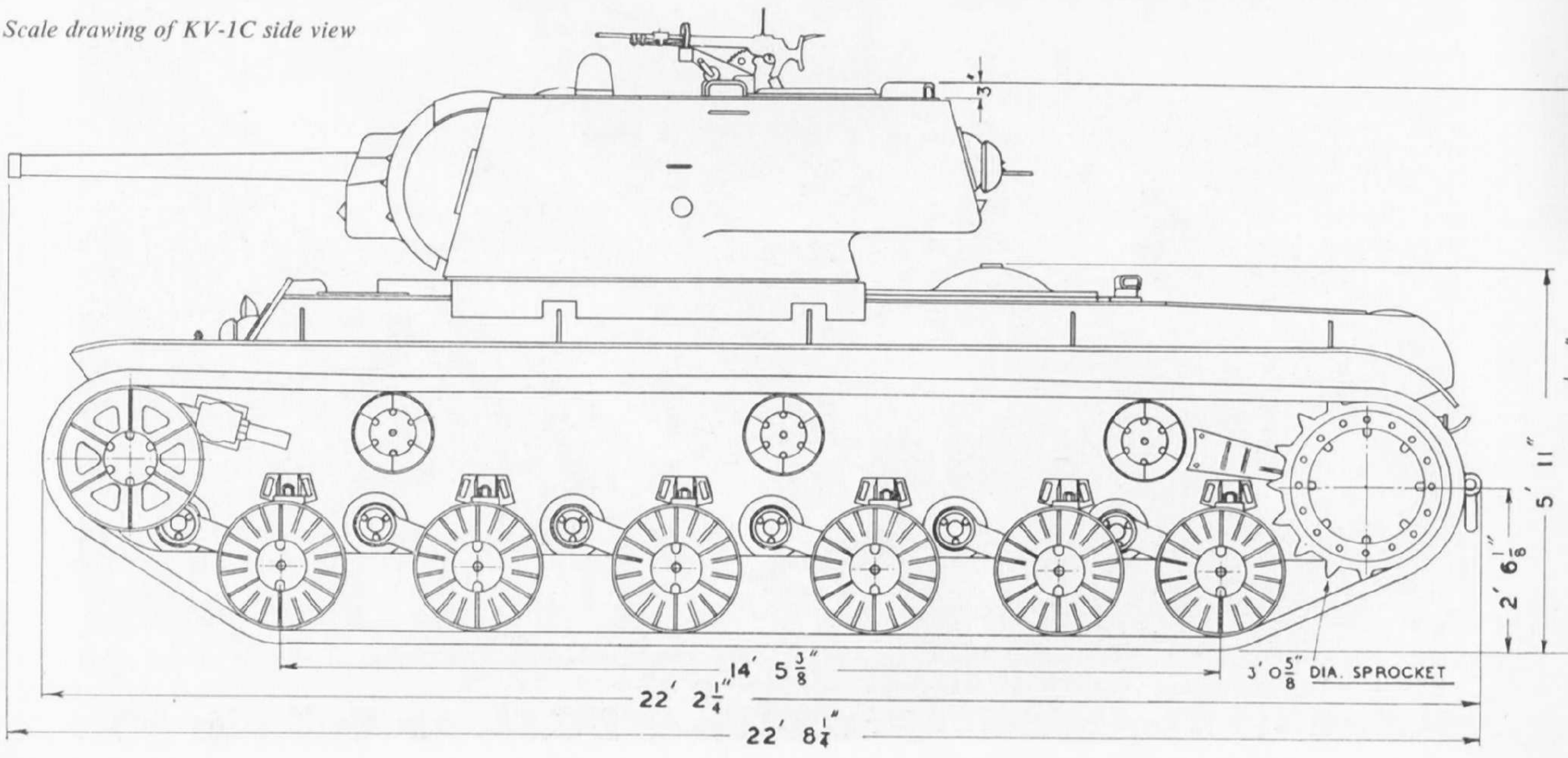
The history of Soviet heavy tanks has spanned just 30 years. Despite the initial uncertainty regarding their rôle, and the disruption to industry during the war, a series of tanks emerged which were often superior to their contemporaries elsewhere. This superiority was the result of a single-minded insistence on the best possible firepower, protection and mobility—probably in that order—coupled with reliability. Although new techniques were often adopted earlier for mass production than in other countries emphasis was placed on a long design life wherever possible. A lack of consideration for crew comfort, low rates of fire and unsophisticated fire control equipment may be drawbacks by Western standards but they are not necessarily regarded as such by the Soviet Army. Nowhere is cost-effectiveness in tank design better understood or more rigorously applied.

One of the few IS-3 tanks to be exported taking part in the Independence Day parade in Cairo in June 1956. The semi-circular plate on the hull may have partially protected the turret race which would be vulnerable at this point. (dpa)

T-10. Its derivation from the basic IS-3 design can be seen clearly. The new 122 mm. has a fume extractor as well as a muzzle brake. (Crown Copyright Reserved)

AFV Series Editor: DUNCAN CROW

Scale drawing of KV-1C side view



A KV-1C on test in England during World War II. Note the unusual design and mounting of the radio antenna on the glacis plate. This vehicle is now on display in the R.A.C. Tank Museum in Bovington. (R.A.C. Tank Museum)

IS-3 tanks loaded on rail flats in East Germany in 1956. The discs on the rear of the hulls were probably road safety signs. Note the gun travelling clamp and the unused brackets—possibly for smoke canisters—to its left and right. (dpa)

A T-10. The relative size of the turret compared with its three occupants indicates the cramped conditions in which they work. (R.A.C. Tank Museum)

An ISU-TD recovery vehicle in Czechoslovakia in August 1968. The schnorkel tube stowed horizontally and the large anchoring spade at the rear can be seen clearly. (dpa)

SPECIFICATION: KV-1C

Dimensions
Length of hull overall: 22 ft. 2 in.
Length overall with gun forward: 22 ft. 8 in.
Width overall: 10 ft. 11 in.
Height: 9 ft. 7 in.
Track centres: 8 ft. 7 in.
Ground clearance: 1 ft. 5 in.
Track contact length: 14 ft. 5 in.
Turret ring diameter: 5 ft. 2 in.

Armament
Main armament: 76·2 mm. F.32 or F.34.
Rate of fire at maximum: 5–6 r.p.m.
Maximum elevation: +25°.
Maximum depression: —5°.
Muzzle velocity: APHE 2,231 ft/sec.
Maximum recoil: 15 in.
Maximum speed of traverse by power: 360° in one minute.

Armour (thickness in mm. and slope in degrees).

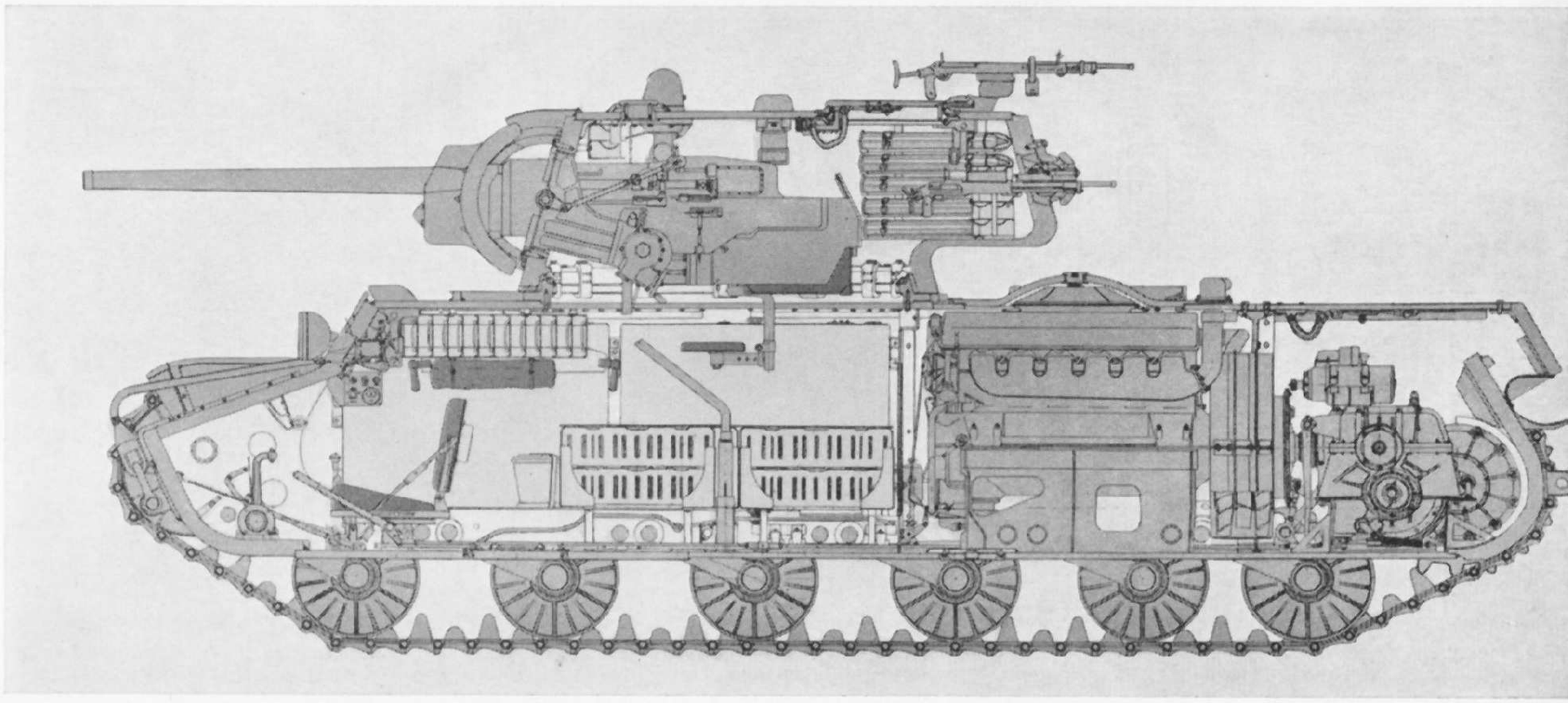
Hull
Front glacis: 75 at 72.
Front nose: 70 plus 26 at 25.
Front vertical plate: 75 plus 31 at 32.
Side hull: 77 vertical (plus 77 mm. bars welded on for turret ring protection).
Top, front, rear plate and engine decks: 42 horizontal.
Belly plate: 40 (front), 32 (middle and rear).
Tail plates: 52 (upper), 75 (lower) both curved.

Turret
Top front and rear: 30 at 40.
Sides: 100 at 15.
Rear: 97 at 15.
Front: 82 at 15.
Mantlet: 90 rounded.

Power Plant
Type: V-2K Cl 12 cyl. 60° Vee liquid cooled.
Bore: 150 mm.
Stroke: 180 mm. (left bank), 186·7 mm. (right).
Capacity: 38·88 litres.
Compression ratio: 15:1 (left), 15·8:1 (right).
Rated maximum horsepower: 600 b.h.p. at 2,000 r.p.m.
Fuel capacity (internal only): 129 imperial galls.
Specific fuel consumption in normal running: 0·35 to 0·40 lb./h.p. hour.
Oil capacity for lubrication system: 12·1 imp. galls.
Cooling system capacity: approx. 13 imp. galls.

Transmission and Running Gear
Gear ratios: 1:4·86, 2:2·60, 3:1·60, 4:1·05, 5:0·58. Reverse: 3·24.
Track links: 87–90 each side. Width: 27·5 in. Pitch: 6·25 in.

Performance
Average road speed: 15 m.p.h.
Maximum speed: 21 m.p.h.
Radius of action: 95–140 miles depending on conditions.



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8 Crusader—Cruiser Mark VI
9 Early (British) Armoured Cars
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11 M3 Medium (Lee/Grant)
12 Mediums Marks I–III
13 Ram and Sexton
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LOCO PROFILE

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Every effort has been made to present to the reader the history of the design, technical development and operational information of the famous locomotives since the introduction of steam to the railways of the world.

Each issue will feature a world-famous locomotive class, including previously unpublished facts.

3 The GWR Four-Cylinder 4–6–0s
formed the zenith of English locomotive practice up to World War I; after that war the *Star* design was developed much further into the *Castles* and then into the *Kings*, and the output of the last was just twice that of the first for an 18 per cent increase in weight and axle load.

4 The American 4–4–0
At least 26,000 of these locomotives were built between 1837 and 1897, and so they formed a world type rather than just an American favourite—the type of the cinema, of the wild-west stories, and of the hundreds of six-men "Family" railroads that could afford nothing else and didn't need anything else. It was as colourful and garish in its decoration as it was simple in design.

5 The British Single-Driver
This was the emblem of Victorian railway practice, though its construction lasted over four reigns. It had scarcely a bare handful of counterparts in the U.S.A. It was trim, elegant, beautifully austere, sometimes aristocratic. Of the more venerable members, the Stirling 8-footers, the Midland singles and the Great Western Dean singles are shown in full colour.

6 The Mallets
From 1903, when the first American Mallet articulated engine was built, the largest steam locomotive in the world to the end of steam traction was always of that type. The class culminated in the Union Pacific "Big Boy" class weighing 1,192,000 lb., but the Mallet ran the gamut from 27,000 lb. to the million mark.

7 The Rocket
The most famous locomotive in 140 years of world railways; from the Rainhill competition of 1829 it had instant effect on railway development by establishing speed as a railway commodity, and embodied this early three out of the five major features that eventually brought steam locomotives up to 10,000 hp and 125 mph.

8 Royal Scot, LMSR
9 Camels and Camelbacks
10 The "Met" Tanks
11 The Norris Locomotives
12 BR Britannias

Loco Profiles will contain 8,000 words, up to thirty photographs; dimensional drawings; routes and gradient diagrams and a double-page spread in full colour of side and front view, illustrating up to three locomotives.

Available from your local book or model shop at 8s. (40 np) or if in difficulty direct from the mail order department of the publishers at 9s. (45 np) inclusive of postage and packing.

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