

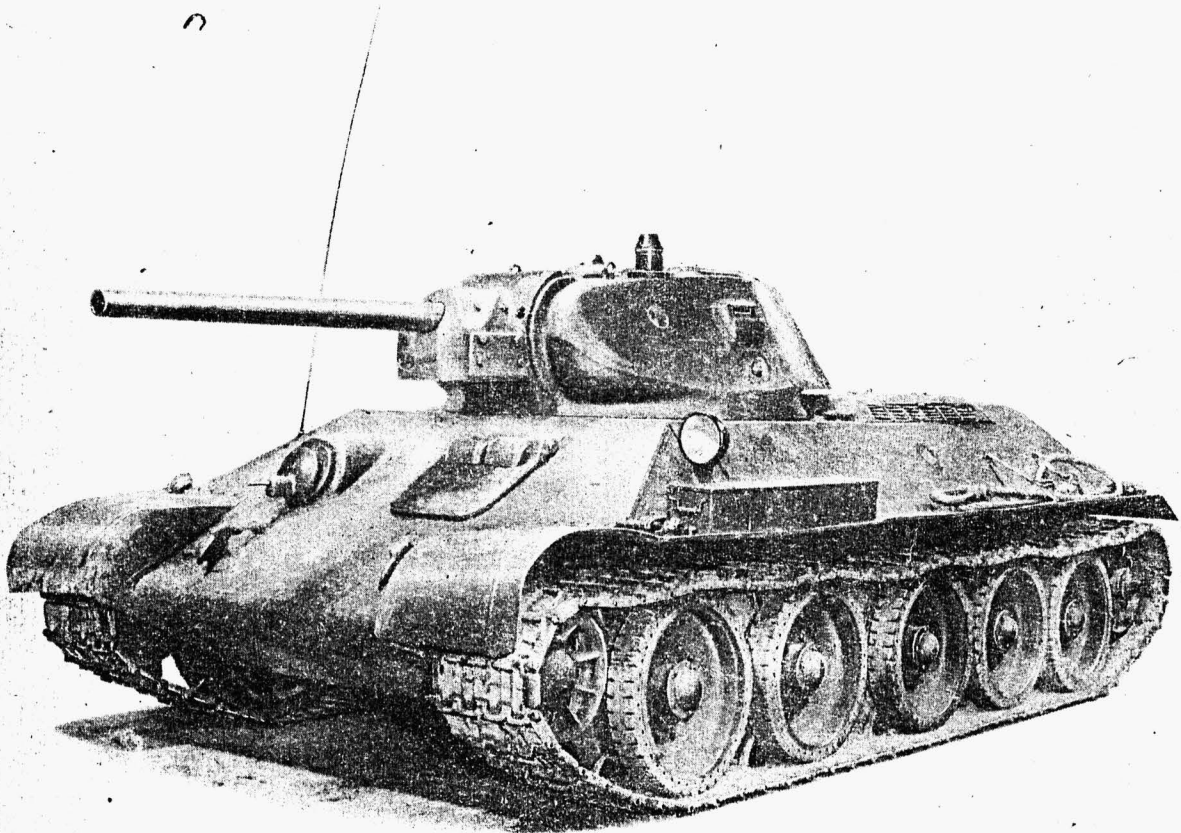
~~TOP SECRET~~
30/1/44

MOST SECRET

Copy No. 175-

PRELIMINARY REPORT NO 2/0

RUSSIAN T/34



Military College of Science
SCHOOL OF TANK TECHNOLOGY
Chobham Lane Chertsey



February 1944



This vehicle has been examined by the various specialist sections of the School of Tank Technology, and the report prepared and collated by the Foreign Vehicle Section.

The comments and opinions of various outside specialists who have inspected the machine during the period of examination have in many instances been incorporated.

FOREWORD

An example of the T. 34 cruiser tank reached the School on 22nd November, 1943. The vehicle was new and complete in all respects, being fully stowed with ammunition, wireless and other fighting equipment. It was accompanied by a comprehensive selection of spare parts, including some major assemblies, and a supply of fuel and lubricants.

Copies of the Russian handbooks were received and translated in the School prior to the arrival of the tank and these have been used in the preparation of this report. As the vehicle is to be submitted for gunnery and field trials at an early date no major components, except the engine, have been dismantled.

As in the case of our own cruiser tanks, the T. 34 owes its origin to the Christie design. Subsequent developments in Russia and Britain, however, have not been on parallel lines, the Russians having aimed at mechanical simplicity, a large general purpose gun, stout armour and above all a design facilitating quantity production with limited resources in specialised machine tools and skilled labour. As a result of the latter factor, certain features have received less attention than they would have had in this country, but a realistic outlook and a practical approach to the requirements of a fighting vehicle are strongly manifest.

The welded hull and cast turret appear excellent from the ballistic point of view, except that there is but limited splash protection. With a few exceptions, only three different thicknesses of rolled plate are employed. Exceptional accessibility of the transmission has been secured by a hinged tail plate, but it is not easy to get at the engine.

The 76.2 mm. gun is mounted in a two-man turret. The crew space appears to be restricted to an extent impairing the efficient service of the gun, but a final estimate of the fighting qualities must await the completion of the gunnery trials. The internal stowage arrangements are simple and the aim has been to carry the maximum quantity of ammunition irrespective of its accessibility.

The 39 litre 12 cylinder direct injection compression-ignition engine appears to have been developed from an aircraft power unit and, in contrast to other components, it is relatively costly to manufacture. The weight of all components is low - the main castings are in light alloy - and considerable courage has been shown by the designers in the adoption of certain features uncommon in modern British C. I. practice. It is a matter for surprise that although the Germans have developed apparatus for delivering hot water from another tank or other external source, the Russians include no special provision for starting in extreme cold, although a compressed air starter is provided as well as an orthodox electric starter. A translation of a report published in the German paper "V.D.I.", which gives a fairly detailed description of the engine, appeared in "The Oil Engine" for December, 1943.

The suspension is arranged so that the springs are protected by main armour without recourse to double skin construction. The spaces between the spring cases are occupied by fuel tanks.

The suspension follows the original Christie design very closely and roller sprockets are employed. The tracks are in cast manganese steel with detachable grousers.

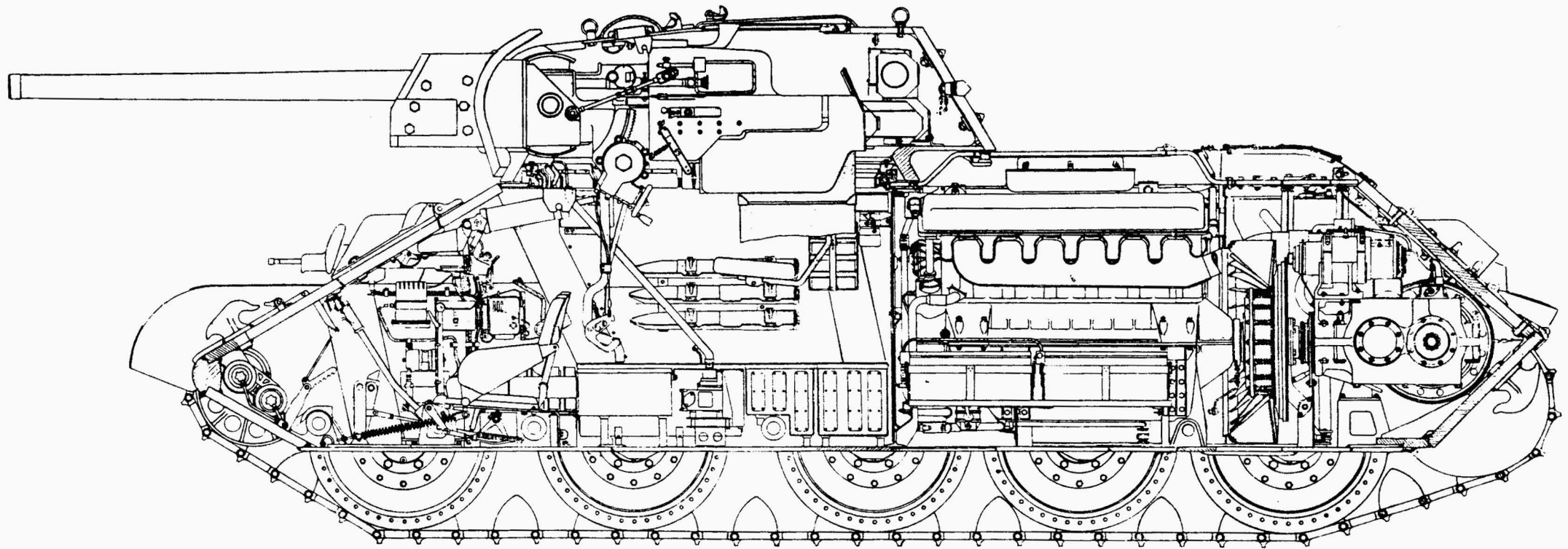
The simplicity of clutch brake steering has been retained and is in striking contrast with current British and German practice. There is no power assisted control gear.

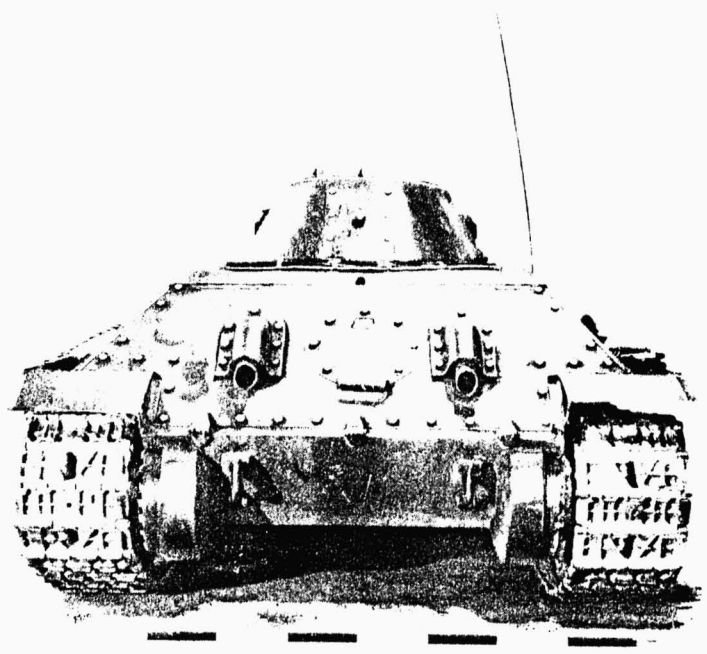
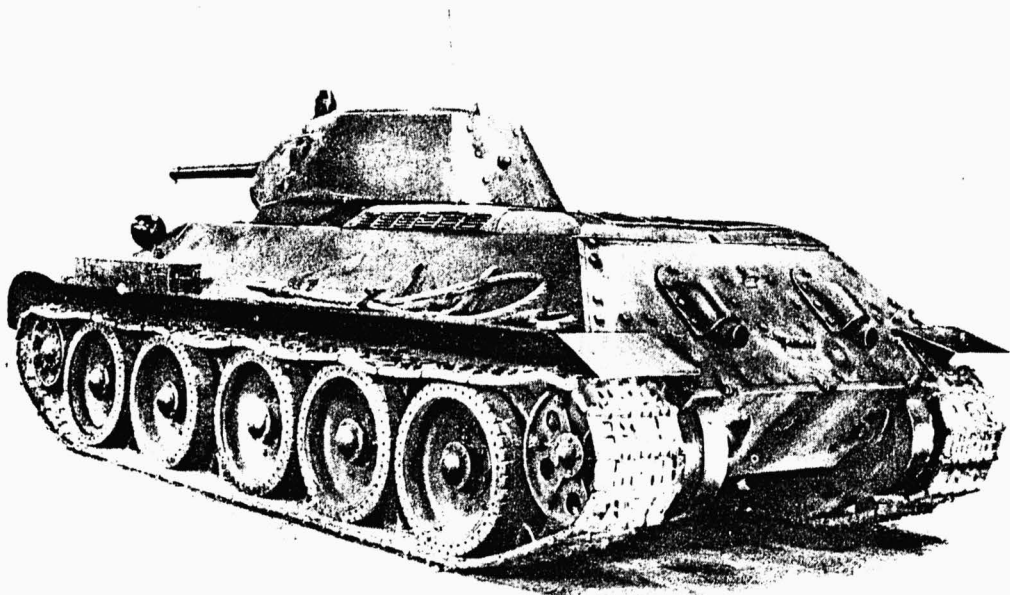
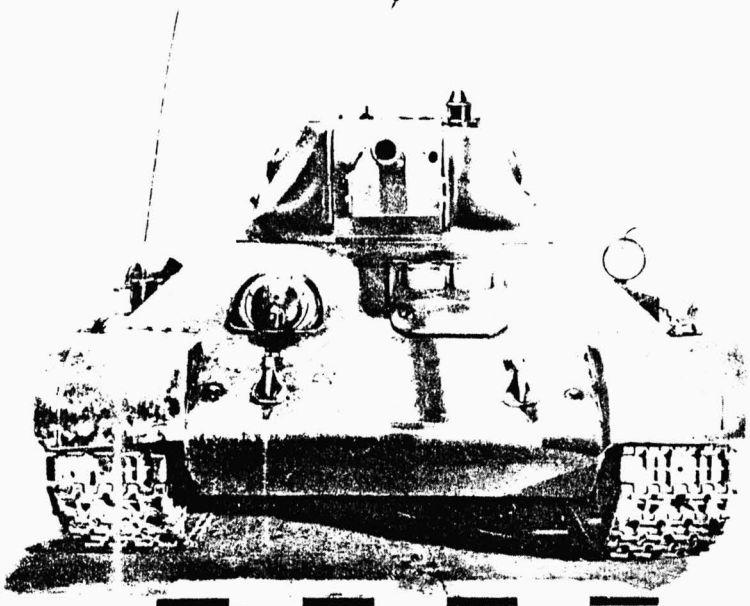
No evidence as to reliability has yet been obtained.

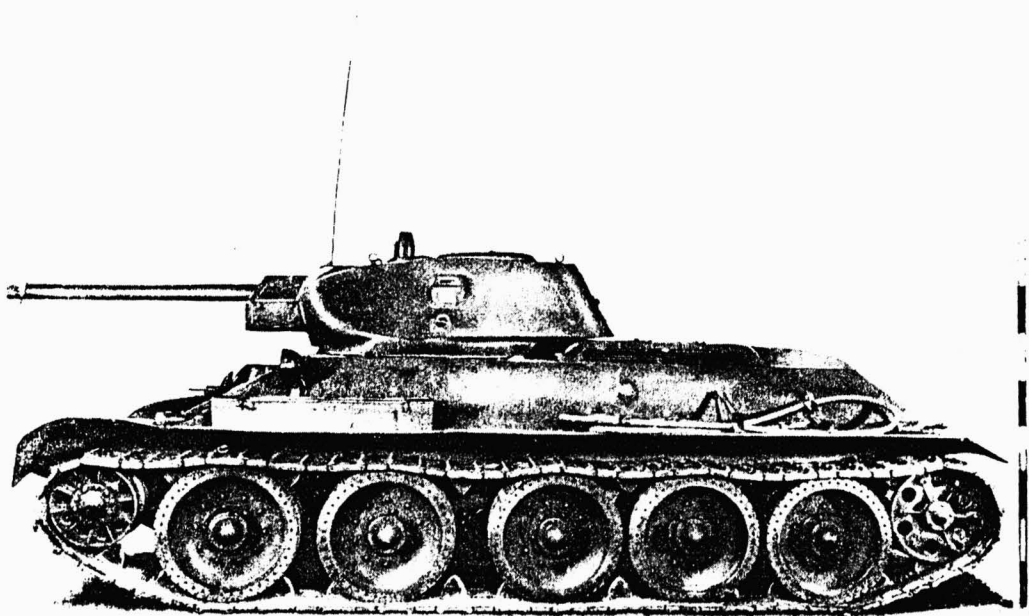
Materials have not yet been fully investigated, but there is no reason to suspect that they are not good. The machined surfaces of castings show no flaws. Aluminium is freely used for engine castings and gear cases.

Where necessary for efficient functioning, for example, in the periscopic dial sight, the fuel pump, and certain engine components, an excellent finish is attained, but where not essential, it is often rough. No military or mechanical advantage appears to be sacrificed thereby, but a more fully developed industry might be expected to show more refinement without necessarily expending more man-hours. For instance, prism holders have been cut out and soldered up by semi-skilled hand labour whereas a specialist firm would probably find it more economical to make by machinery and the better appearance and accuracy would follow automatically. Many components bear an unusual number of inspection stamps which may indicate a high degree of control in production.

The design shows a clear-headed appreciation of the essentials of an effective tank and the requirements of war, duly adjusted to the particular characteristics of the Russian soldier, the terrain and the manufacturing facilities available. When it is considered how recently Russia has become industrialized and how great a proportion of the industrialized regions have been over-run by the enemy, with the consequent loss or hurried evacuation of plant and workers, the design and production of such useful tanks in such great numbers stands out as an engineering achievement of the first magnitude.







I. GENERAL SPECIFICATION

TYPE Cruiser Tank T. 34

DIMENSIONS

Length with gun at 6 o'clock	19' 11 $\frac{1}{2}$ "
" " " " 12 "	21' 7"
Width	9' 10"
Height	7' 9 $\frac{3}{8}$ "
Ground Contact	12' 1 $\frac{1}{2}$ "
Track Centres	8' 0 $\frac{3}{4}$ "
Ground Clearance	1' 4"
Turret Ring Diameter	4' 9"

WEIGHT 27 tons 16 cwt. (fully stowed, less crew)

ARMAMENT One 76.2 mm gun, Model F.34 and one 7.62 mm M.G. coaxial in external roller mantlet in turret.
One 7.62mm. M.G. mounted in armoured hood on offside of glacis plate.

TURRET TRAVERSE All round, hand and electric - latter powered direct from the vehicle batteries.

AMMUNITION 76.2mm - 77 rounds (mixed A.P., H.E. and Shrapnel)
7.62mm - 35 magazines each holding 65 rounds

2. HULL & TURRET CONSTRUCTION

The outstanding features of the armour construction are :

- (a) The high angles of impact offered by the majority of the plates.
- (b) The extreme rationalisation of the rolled armour, i.e. 15mm, 20mm and 45mm. basic thickness, except for a few small plates.
- (c) The simple nose design and a high angle of impact.

The hull of the vehicle is of welded construction. A long sloping glacis plate rises at an angle of 60 degrees from the upper edge of the nose to the hull top plate.

The lower nose plate and the glacis plate are joined by welding to a simple cast section resulting in a nosing of approximately $4\frac{1}{2}$ " radius.

The pannier sides which form the upper part of the hull, i.e. above the tracks, are extended 15" out from the vertical hull side plates, and then inclined back so as to offer an angle of impact of 41 degrees. These pannier sides run from the glacis plate to the tail plate and the space thereby provided, whilst restricted by the large degree of slope of the plates, is utilised in the fighting compartment for various items of stowage, including S.A.V. and in the engine and rear compartments for the accommodation of fuel and oil tanks.

An interesting innovation is the hinging of the upper tail plate, which provides excellent accessibility to the gearbox and steering units. The plate is hinged at its lower edge and is secured by hexagon head set screws to steel angle seatings welded to the hull side plates and the lower tail plates. The estimated weight of this plate is 17 cwt. and hence mechanical assistance is needed for opening.

The turret is of cast construction employing small rolled plates to finally complete the roof. The rolled plates are embodied to carry various fittings, i.e. the periscope, ventilator, etc., and thus assist in production.

At the rear of the turret a rolled plate measuring 558mm. x 47 mm. is incorporated. This is readily detachable and is secured by hexagon head set screws. It is a necessary feature of design for the purpose of mounting the 76.2 mm. gun.

An external gun mantlet is fitted and protruding from it is an armoured encasement for the buffer and recuperator. A simple internal plate is also provided and is bolted to the trunnion bearing castings which are welded to the cradle. This affords some protection against splash. The encasement is composed of a number of small plates, bolts and short runs of welding being used in its construction.

No external protection at the turret ring joint is provided. There is insufficient space on the hull roof to allow for a protecting ring.

3. ARMOUR

THICKNESSES AND ANGLES

C.	Turret top front	15mm	85°
D.	" " rear	30mm	Horizontal
E.	" sides	65mm	31°
F.	" rear	47mm	31°
G.	" front	65mm	Round
H.	Gun mantlet	20 - 45 mm	Round
K.	Front glacis plate	47mm	60°
M.	" nose plate	47mm	61°
P.	Side hull plate (lower)	47mm	Vertical
	" " " (pannier)	45mm	41°
	Pannier floor	20mm	Horizontal
Q.	Top front plate	20mm	Horizontal
R.	" rear plate	20mm	Horizontal
S.	" " engine cover plate	20mm	Horizontal
U.	Belly plate	21mm	Horizontal
W.	Tail plate (upper)	45mm	49°
	" " (lower)	45mm	43°

The "Angle of Plate" given is the angle between the plate surface and the vertical, which is equal to the "Angle of Impact" for horizontal attack.

ARMOUR PLATE HARDNESSES

The rolled armour is of homogeneous quality but of greater hardness than comparable British quality.

The following are "Poldi" Brinell hardness figures of various plates:

Glacis plate	354 - 400
Pannier side plate (nearside)	388 - 434
" " " (offside)	387 - 398
Upper tail plate (outside)	400 - 410
" " " (inside)	389 - 406
Engine cover plate (cast)	405 - 407
Turret escape hatch (pressing)	390
Encasement for buffer and recuperator	416
Gun mantlet	407

The surface finish of the armour is rough when compared with British and American standards, but this gives no indication of its ballistic properties.

CAST ARMOUR

The turret casting is interesting in view of the high angle of its sides, i.e. 30 degrees, thus conforming with the general high degree of angularity. Although some rolled plates have been welded into the roof, the turret is essentially of the "all-cast" variety and not of the "composite" type.

The finish of the turret is not of the same standard as British practice demands - some porosity is evident. This does not necessarily indicate that the casting is inferior from a ballistic point of view.

Measurement by the "Poldi" equipment shows the hardness to be 370 - 375 Brinell. This is very high compared with British standards.

WELDING

The vehicle is essentially of all welded construction including samples of cast to rolled armour welding. From the point of view of finish the welding is not of a high standard, but there is no indication of weld failure either by cracking in the armour or in the weld metal.

It would appear that much of the welding has been executed without weldings jigs and therefore only a small amount of down-hand welding has been possible. This may account for the rough finish of some of the welds.

By visual inspection the weld metal appears to be austenitic. Little or no special joint preparation had been attempted.

The surface hardness of the weld metal by "Poldi" test is 150 - 180.

4. ARMAMENT

- One 76.2mm Tank Gun, Model F.34
- One 7.62mm D.T.(DEGTJAREV) M.G. co-axially mounted
- One 7.62mm D.T.M.G. in armoured hood on offside of glacis plate.

There appears to be no smoke apparatus and no stowage for a machine carbine, but it is probable that the crew carry pistols, or machine carbines - especially as pistol ports are provided.

A wooden box containing 20 hand grenades is carried on the vehicle.

76.2 mm GUN (F. 34)

This gun is referred to in the Russian drawings, but the gun handbook we have received refers to Model 1940, 1941, and 1942 guns. It is possible that the F. 34 is identical with the Model 1942.

THE PIECE

No. 11141. Year of manufacture - 1942.

Dimensions

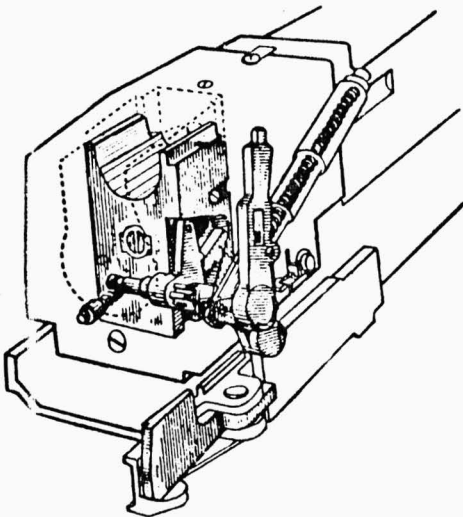
Length of rifling	2546 mm (100.2 ins)
Length of chamber	410 mm (16.1 ins)
" " bore	2956 mm (38.7 cal.)
Depth of breech opening	212 mm (8.3 ins.)
Overall length of piece	3168 mm (124.6 ins.)
Weight of piece complete	455 Kg (1003 lbs.)

No. of grooves	32
Angle of grooves	7° 49'
Depth of grooves	1.0 mm.
Width of grooves	5.5 mm.
Twist - Right hand	
uniform	1 turn in 25 cal.
Dia. of base of cartridge case	83.5 mm.
Dia. of rim of cartridge case	90.0 mm.
Dia. of neck of cartridge case	76.5 mm.
Bore	76.2 mm.
Length of cartridge case	380.0 mm.

Construction of gun

The gun is of monobloc construction, with a detachable breech ring secured by a locking ring. Two securing rings round the chase, retained by locking rings, carry the recoil cylinder and guides underneath the gun.

Breech Mechanism



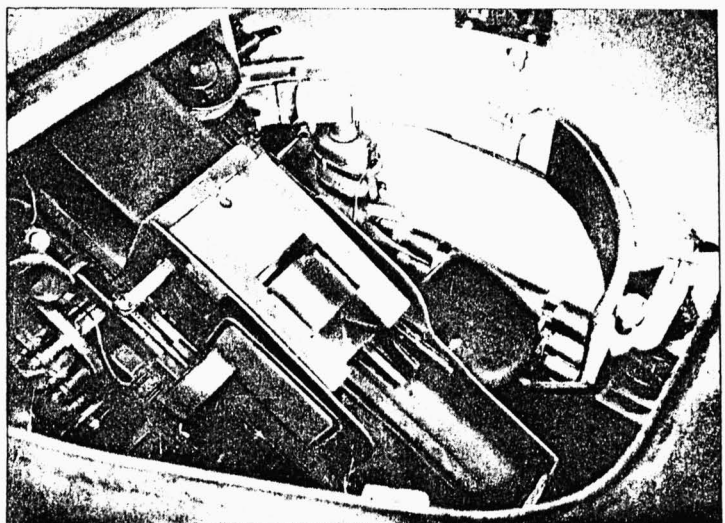
The breech mechanism consists of a falling wedge breech block, with hand or semi-automatic operation. Percussion firing is employed, the breech block carrying a readily removable striker and mechanism.

To open the breech by hand, the breech mechanism lever on the right of the breech ring is pushed forward against the compression of a breech closing spring also on the right of the breech ring. The breech mechanism lever returns to the horizontal position when the breech is closed. It may then be returned to the vertical, without opening the breech, by pushing a catch on its forward edge. The breech block is held in the forward position by the hooks on the extractors and can then only be closed by inserting a round in the breech or by lifting the extractor release lever on the right hand end of the extractor shaft. The shoulders on the breech block are renewable.

There is no firing hole bush. The semi-automatic gear is similar to that on the American 75 mm. M.3 tank gun. It consists of an actuating lever with a stud which engages a spring loaded cam on run out. The actuating lever is on the right hand end of the actuating shaft under the breech mechanism lever. The upward movement of the breech block is limited by a stop inside the right side of the breech ring. This stop can be withdrawn to allow of the upward removal of the breech block.

Cradle

The cradle is of cast and welded construction, the lower portion being in the form of a "U". The upper edges of the sides are formed into guide rails for the recoil of the piece. The cradle cap is bolted to the front of the cradle and has three drillings - two for buffer and recuperator piston rods and one for the filling hole. Two trunnion bearing castings are welded to the cradle, one either side, each fitted with a bronze bush. The trunnions themselves are carried in two internal cheek plates welded to the turret front wall. The internal plate is bolted to the trunnion bearing castings. The left one carries the telescope and the operating arm for the periscopic sight object prism, and the right the M.G. cradle.



The left hand cheek plate carries the gearbox and handwheel for the elevating gear. The gun is centrally mounted in the turret.

On the left of the cradle are carried the folding deflector guard, a small capacity (eight cases) empty cartridge bag, the externally toothed sector of the elevating gear, the firing gear for the 76.2 mm. gun, the brow-pad for the telescope and the recoil indicator. The semi-automatic cam is on the right of the cradle. The rear deflector plate carries a fibre pad, against which the empty cases are thrown on ejection.

Recoil System

The recoil system comprises a hydraulic buffer and hydro-pneumatic recuperator on the left, carried underneath the gun in eyes formed in the lower part of each securing ring. The piston rods are stationary, and are nutted to the cradle cap.

According to the Russian Handbook the buffer cylinder contains 8.8 pints and the recuperator 6.5 pints of "STEOL". The recuperator is filled through the opening in the cradle cap between the two cylinders. The handbook gives the air pressure in the recuperator as being from 19 - 22 atm. (279 - 323 lbs/sq. in.).

The recoil indicator on the left of the cradle is graduated from 310 - 390 mm. (12.2 - 15.34 ins.) "Stop" being at 390 mm. The Russian handbook gives the normal recoil of the gun as being from 320 - 370 mm. (12.6 - 14.56 ins.) and metal to metal recoil as 390 mm.

Mounting

The mounting is of rear trunnion type and formed by two internally projecting cheeks welded to the inside of the front turret wall and turret ring. These carry two trunnions secured by brass caps.

Elevation	30 ^o
Depression	3
Total Arc	33 ^o

Depression has been sacrificed in favour of low turret height and large angle of elevation. The elevation angle of 30^o is abnormally large and would have been a good feature if it had not been obtained at the expense of depression.

Balance

As the piece is in a rear trunnion mounting, it is considerably muzzle heavy. This is counteracted by means of four cast iron blocks of 648 cu. ins. total volume (168.5 lbs. approximate weight), bolted to the underside of the cradle. These are not fully effective and with the blocks fitted the piece is still muzzle heavy.

Firing Gear

Hand and foot firing for both the 76.2 mm. gun and the M.G. are provided. The foot firing for both guns is done from two pedals provided with return springs, and mounted on either side of a vertical pillar bolted to the left hand trunnion mounting. The firing pedal for the 76.2 mm. gun is on the left and the M.G. pedal on the right. The pedals are connected to the hand triggers on the guns by flexible cables. Foot rests are also provided on the pillar, above the pedals.

The hand firing gear on the 76.2 mm. gun consists of a spring loaded lever which presses on a plunger passing through the left hand breech ring side plate.

This plunger bears on another spring loaded plunger, mounted on a transverse axis in the breech block which carries the sear and holds back the cocking lever.

Elevating Gear.

Hand elevating gear is fitted. The handwheel is mounted on a longitudinal axis at about 30 degrees to the horizontal. It is on the gunner's right side and is mounted on the left hand trunnion bearing.

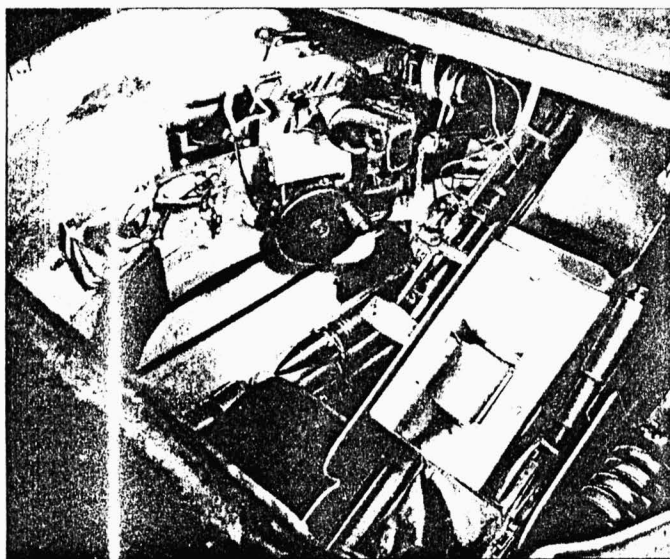
Radius of handwheel	$3\frac{1}{8}$ "
No. of turns of handwheel to cover full arc of 33°	$2\frac{3}{4}$
Ratio :	$1\frac{1}{2}$ degrees per turn approximately.

It is of the pinion and sector type, the sector (secured to the cradle) having external teeth. Drive is transmitted from the handwheel to a worm and wormwheel. The wormwheel shaft carries the elevating pinion. There is considerable play in the handwheel, and operation is jerky and not easy. The position is cramped and the gunner tends to catch his knees while elevating. The elevating lock (of screw plunger type) is mounted in the right cheek of the mounting and engages a recess in the cradle. It is provided with a star nut for clamping the gun, which can only be locked horizontally.

Traversing Gear

Hand and power traverse of the turret through 360 degrees is provided.

Both hand and power use a common gearbox, which consists essentially of a single epicyclic train. The sun pinion is driven by the motor, the planet carrier by the handwheel, and the annulus drives the rack pinion.



The drives for the motor and handwheel to the epicyclic train are through non-reversible worms and thus the driving member of the train that is not being turned is effectively locked in each case. It will therefore be seen that no change-over mechanism from one method of traverse to the other is necessary. The power traverse is merely a three speed switching (not laying) gear, controlled for speed and direction by a small handwheel on top of the traverse motor casing, having three positions, in either direction. There is no positive indication of the

three positions, but a catch automatically locks the wheel every time it is turned to "Neutral."

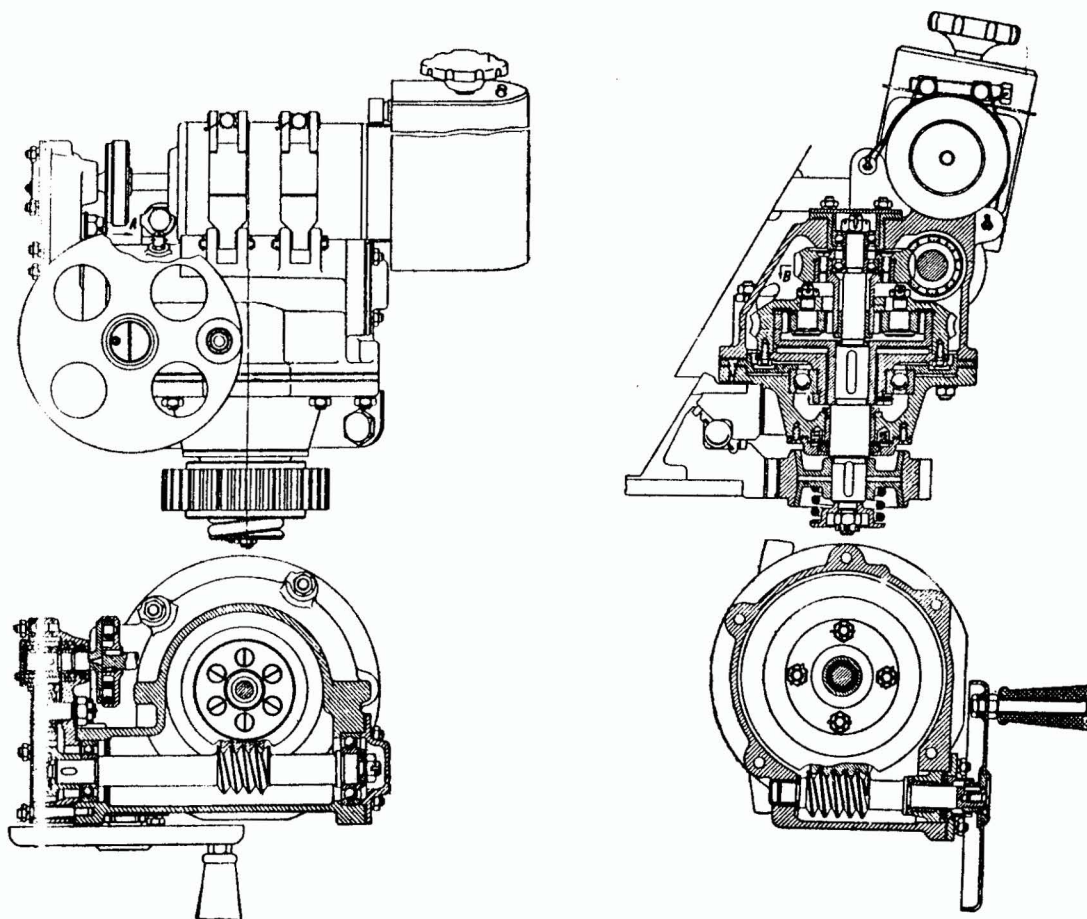
The motor is a 20 volt 1350 watt machine stated to give a maximum of 5800 R.P.M. at 110 amps, and is mounted on the left of the gunner. A Rheostat on top of the motor is controlled by the wheel. The resistance is apparently in series with the motor armature and is a starting resistance only. Rotation of the wheel operates sets of contacts which control the direction of rotation and short circuits the resistance.

The handbook recommends the general use of the third or highest speed when on power, to prevent overheating of the rheostat.

The drive from the motor is taken through a flexible coupling and a pair of spur gears with an idler, giving a small reduction to the worm shaft. The worm drives a wormwheel on a vertical shaft, which carries on its lower end the sun pinion of its epicyclic gear. A double cone clutch is incorporated in the traversing rack pinion.

Power Traverse speeds

LEFT - 360° in 13.8 secs. (26°/sec. approx.) RIGHT - 360° in 13.6 secs.



The hand traverse is controlled by a 4" radius handwheel on the left of the gunner, on a horizontal axis. The handwheel handle is not pivotally mounted on the wheel and considerable discomfort is caused to the gunner when traversing fast. It is awkwardly placed, being too far back for comfortable operation by the left hand, thus entailing the use of the right hand across the body. The handwheel carries on its shaft a worm which meshes with the wormwheel formed by the annulus of the epicyclic gear mentioned above. The annulus then transmits the drive to the rack pinion in the same manner as for the power traverse.

No. of turns of handwheel for 360° - 390
Ratio: 0.9 degrees per turn (approx.)

There is considerable play and back lash in the gearing making accurate laying difficult, ~~and the gunner is forced to~~

A traverse lock, of screw plunger type is incorporated in the front offside turret ring clip, in front of the loader.

CO-AXIAL MACHINE GUN

This is the 7.62mm. (0.3 ins.) D.T. light machine gun. It is gas operated and magazine fed from drum magazines holding 63 rounds. It has a shoulder piece with notched adjustment for length, butt-strap and pistol grip, which, when used in conjunction with the bipod provided in the stowage, permit of its dismounted use as a ground L.M.G. It has a very light barrel, of which no spares are carried - the barrel cannot be changed once the gun is mounted. The magazines are filled or unloaded on a crudely constructed filling platform, with a key. The magazines appear to be extremely simple and efficient in operation, as far as can be judged without firing the weapon. A deflector bag is fitted under the gun.

Dimensions

Weight of complete gun (without bipod)	19 lbs.
Weight of barrel	4 lbs. 5 oz.
Weight of bipod and foresight	2 lbs. 10 oz.
Overall length (shoulder piece fully extended)	1152 mm. (45.4 in.)
Overall length (shoulder piece closed)	977 mm. (38.5 in.)
Length of barrel	605 mm. (23.8 in.)
Length of chamber	53 mm. (2.08 in.)
Weight of full magazine	6 lbs. 5 oz.
Weight of empty magazine	3 lbs. 5 oz.

Rifling: No. of grooves - 4. Right hand twist.

The gun gives automatic fire only; a safety catch is fitted.

Maximum range on sights	1000 metres
Sight radius	42.6 mm.

The M.G. mounting is of ball type and is held in a carrier bolted and welded to the right hand side of the 76.2mm gun cradle. The gun is held in place in the ball by means of a rotating locking ring provided with three internal interruptions, which engage with a similar ring, with external interruptions, on the gun. An aperture for use with the open sight on the gun is provided in the mantlet, and may be closed by a rotating shutter operated by a handle above the gun. The aperture contains the M.G. foresight nib. Zeroing of the gun is possible by slackening the three bolts which lock the ball to its casing, and rotating it in the desired direction.

Firing Gear

The gun may be fired by the gunner from the right hand foot pedal, or by the loader from the trigger on the gun. The foot firing pedal is connected by Bowden cable to a lever, with spring return, mounted on the M.G. trigger guard, which operates the trigger on the gun.

AUXILIARY MACHINE GUN

This is of the same type as the co-axial M.G., and is mounted in an armoured hood, welded to the offside of the glacis plate. The mounting carries an external mantlet and an integrally cast armoured jacket, welded to an internal ball. The ball is similar to that in the co-axial mounting. An open sight aperture, with shutter, is provided and contains the nib of the M.G. foresight. The inner ball is retained in the hood by means of a horsehoe shaped ring, bolted to the front of the hood.

Elevation	- 20°	Traverse left	- 15°
Depression	- 6°	Traverse right	- 15°
Total Arc	- 26°	Total Arc	- 30°

The gun is fired by the trigger on the gun itself, and is controlled for elevation and traverse by the pistol grip. The mounting is well balanced with the gun mounted.

A travelling lock of screw plunger type is fitted at 8 o'clock in the ball carrier, and locks the mounting for elevation and traverse with the gun pointing forward and downward.

SIGHTS

(a) Turret Armament

The F. V4 gun and the co-axial D.T. machine gun are sighted by means of either:

- (i) a periscopic dial sight PT. 4-7, or
- (ii) a cranked telescopic sight, type TMFD

(i) Periscopic dial sight (PT 4-7)

This is a periscopic telescope, with rotating head, moveable top prism and illuminated moving graticules. It is mounted in the front of the turret roof on the nearside. The head of the periscope may be rotated independently of the turret by means of a knob on a vertical axis under the sight body. It may also be locked in the forward position by means of a spring loaded knob on the left of the body. A scale is connected to the head which may be read through a window in the rear of the body above the eye piece - this is graduated from 0 - 60 (at 6 degrees intervals) and gives the angle in a horizontal plane between the line of sight and the axis of the bore of the 76.2mm. gun. For sighting, the head must be locked at '30'. The object prism in the head may also be depressed and elevated with the gun by means of an adjustable linkage connecting an arm on the left hand trunnion bearing to a rotating arm on the right of the sight body. The arm on the sight is geared to a vertical push rod, against which the prism is spring loaded. Deflection of the crosswires is possible by the knob on the left of the eyepiece, and range is put on by the knob under the eyepiece. Three ranges are provided:

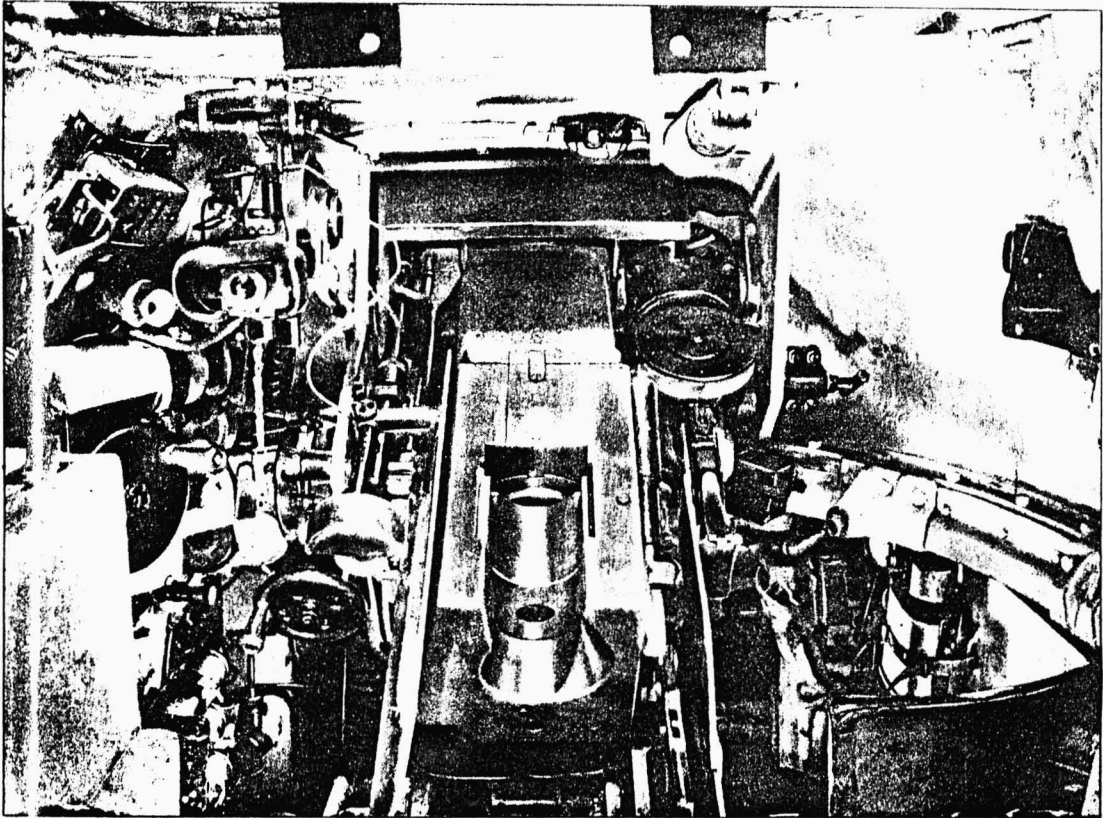
Scale "H"	-	M.G.	-	0 - 1000 metres in 200 metres
Scale "B"	-	A.P.	-	0 - 3600 " " " "
Scale "O"	-	H.E.	-	0 - 2100 " " 50 "

(In each case the zero is displaced to allow for negative jump)

A deflection scale graduated left and right from 0 - 32 in mils is provided under the range scales. Both the deflection and range scales are engraved on a glass carried in the vertical part of the body, whereas the crosswires are in the eyepiece body. Separate illumination of range and deflection scales, crosswires, and the external scale for the rotating top prism is provided, the current being taken from a junction box on the sight body. The intensity of illumination is not adjustable.

Magnification	x 2.5) Measured by	
Field of View	25° 30'		A.R.L.
Exit pupil diameter	6mm.		Teddington
Transmission of light	26.3%)

A rubber eyeguard and browpad, the latter adjustable so as to allow the use of either eye, are fitted. The eyeguard is not an efficient light excluder. The periscope is secured in the turret roof by means of a rotating locking ring, of similar pattern to that in the M.G. mounting, which engages with lugs on the periscope body and two horizontal adjusting screws on the mounting.



The object prism assembly is replaceable, and one spare is carried with each instrument.

No provision is made for zeroing in the instrument but lateral adjustment may be obtained by the mounting adjusting screws and vertical correction by the connecting link to the trunnions.

The object end of the periscope can be covered by a hinged hood on the turret roof.

(ii) Telescope TMFD

This is a straight tube moving eyepiece telescope, the object end being offset 23 mm. upwards from the axis of the body by the erecting prism assembly. It has an illuminated graticule and three range scales:

Left hand	$\left. \begin{array}{l} \text{C} \Gamma \\ \text{A} \Gamma \\ \text{O} \end{array} \right\}$	- H.E. (Old type	- 0 - 3800 (in 200 m)
Centre		- H.E. (Streamlined)	0 - 5000 (in 200 m)
Right Hand		- M.G.	0 - 1400 (in 200 m)

(In each case the zero is displaced to allow for negative jump.)

Range is put on by a milled knob under the eyepiece body. Above the range scales there is a deflection scale graduated left and right from 0 - 32 in mils. Deflection adjustment is given by the knob on the left of the eyepiece body. Separate illumination of range scales and crosswires is provided.

Magnification	x 2.5	$\left. \begin{array}{l} \text{A.R.L.} \\ \text{(Teddington)} \\ \text{figures} \end{array} \right\}$
Field of view	14° 30'	
Exit pupil diameter	4.6mm.	
Transmission of light	39.2%	

The telescope is mounted on the left of the 76.2mm. gun with its nose resting in the left hand trunnion casting. It is held secure by a compression spring shock absorber around the body which presses against a supporting bracket. The bracket is adjustable for zeroing - laterally by a transverse dovetail slide, and vertically by two adjusting nuts. The telescope is clamped in the bracket by a hinged strap and clamping nut. A rubber eyeguard is fitted, which

is not fully efficient as a light excluder and there is a browpad mounted on the cradle of the 76.2mm. gun.

Although the dial sight is fitted, it is not clear how it is to be used for indirect fire; possibly the sight is only rotated to obtain all round vision. The Azimuth scale is only graduated in divisions of 6 degrees, although a subdivision could be obtained by using the graticule scale in the field of view. The handbook refers to a clinometer "lamp", but no clinometer or place for fitting one has been found. It would be possible to lay for elevation by placing a field clinometer on the plane which is provided on the breech ring.

The elevating and traversing handwheels are not graduated.

(b) Auxiliary M.G.

No telescope is provided for the auxiliary M.G., the open sight on the gun being used.

5. AMMUNITION

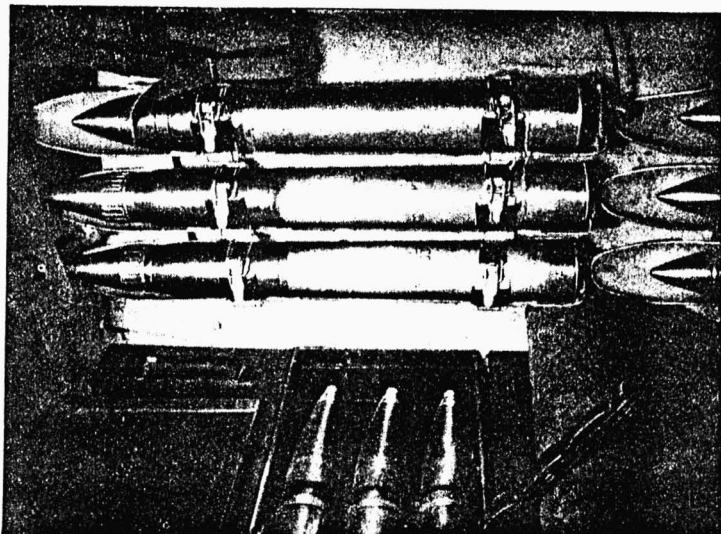
The ammunition sent with the tank comprised:

76.2 mm. - 77 Rounds. 7.62 mm. - 31 Mags.-2015 Rounds
Grenades - 1 Box of 20.

Storage is as follows:

<u>76.2 mm.</u> In two racks on left wall of fighting compartment	6
In rack on right wall of fighting compartment	3
In eight bins on floor of hull - (these bins form the floor of the fighting compartment and are covered by rubber matting)	68

The rounds are horizontally stowed, those in the racks being retained by metal quick-release straps. Those in the bins are held in position by shaped wooden rests, hinged to one side of the bin and resting on stops at the other. Six of the eight bins hold nine rounds each in three layers of three rounds. The remaining two bins, on the nearside, hold seven rounds each. The bins are provided with lids, but are unarmoured. They are difficult to get at in



action, as the lids fit tightly, and it is not possible to dispense with the lids and the rubber matting owing to the risk of damaging the rounds.

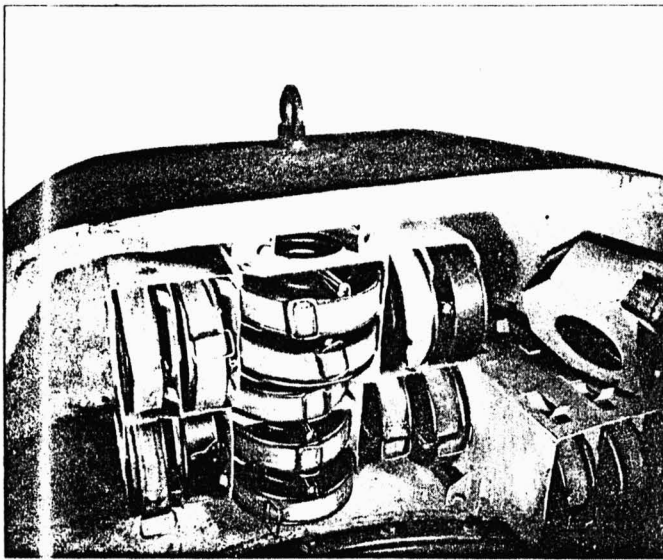
Three types of ammunition were stowed in the tank on arrival, in the following numbers

A.P. (tracer, with MA5 base fuse)		19 rounds
H.E. (with KTM I percussion fuse)		53 "
Shrapnel (ball, with 22 sec. T6 fuse)		5 "
	Length of Round	Wt. of Round
A.P.	614mm. (24.2 in.)	21 lbs.
H.E.	634mm. (25.4 in.)	20 lbs. 6 oz.
Shrapnel (fuse cap off)	702mm. (27.6 in.)	20 lbs. 4 oz.
Shrapnel (fuse cap on)	715mm. (28.1 in.)	20 lbs. 10 oz.

(This H.E. shell is the same as that used in the Russian Model 1936 Field Gun, some of which have been captured by the Germans and are being used by them under the name "7.62cm. F.K. 295(r)" and hence is described on Page 43 of "Handbook of enemy Ammunition, "Pamphlet No. 8).)

The greater stowed length of the shrapnel projectile is due to a spun brass protective cap, secured by a threaded brass collar. All projectiles have been factory tested for hardness. The A.P. projectile has a short steel ballistic cap and two deep grooves cut round the shoulder.

<u>7.62 mm.</u>	<u>Where stowed</u>	<u>No. of Mags.</u>
	In turret bulge	16
	Nearside Turret wall (behind gunner)	1
	Offside Pannier wall (behind loader)	4
	Left of Auxiliary Gunner's seat	4
	Left of driver's seat	4
	Under rubber flooring, front of fighting compartment	4
		<u>33</u>
	At guns	2
		<u>35</u>
	Total	<u>35</u> (2275 rounds)



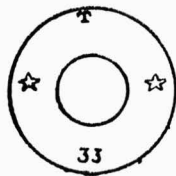
Several types of S.A.A. are included in the magazines, with :-

- * (i) Plain annulus and plain bullet - Ball.
- * (ii) Red annulus and red tipped bullet - Incendiary.
- * (iii) Red annulus and green tipped bullet - Incendiary, with Tracer.
- * (iv) Plain annulus and green tipped bullet - Ball with Tracer.
- * (v) Plain annulus and yellow tipped bullet - Heavy Ball (?A.P.)

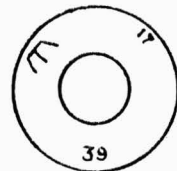
* (This is subject to confirmation by examination)

Overall length of rounds	3.00 ins.
Diameter of base	0.49 ins.
Diameter of rim	0.539 ins.
Diameter of neck	0.34 ins.

Typical base markings



Plain bullet and annulus



Green tipped bullet and red annulus.

The rounds are rimmed, have gilded metal coated bullets and coppered steel cases. The caps are not ringed or stabbed.

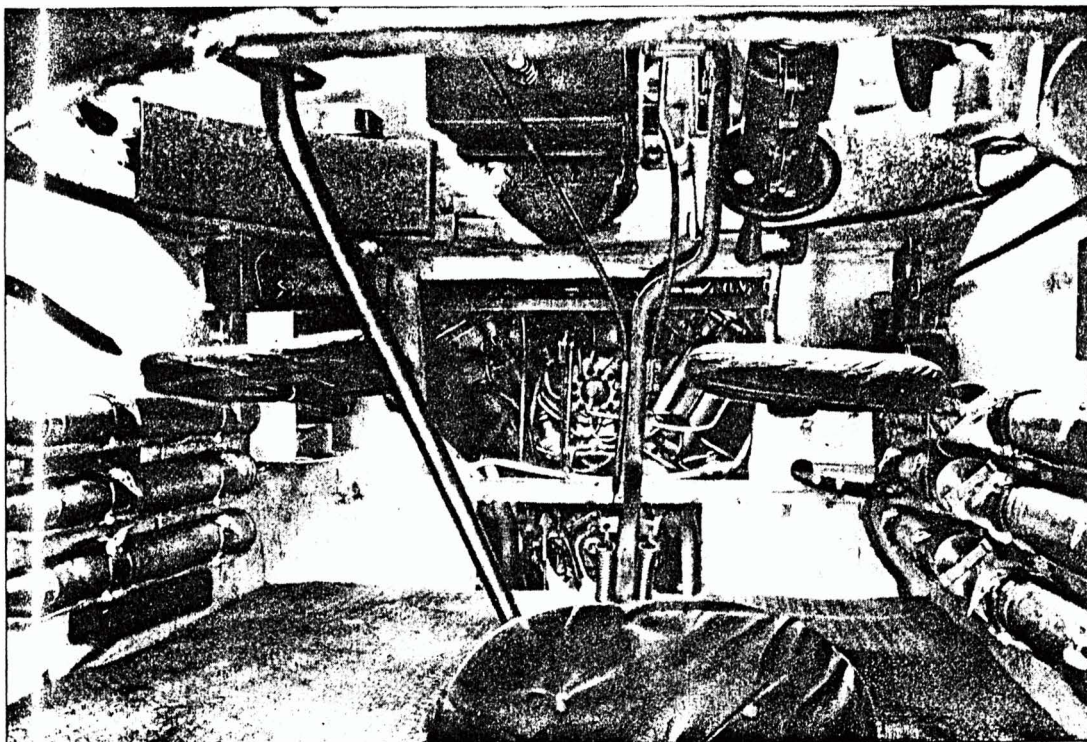
Charge - Three grammes graphited Nitro-cellulose.

GRENADERS

The grenades are of percussion type, egg-shaped with neat segmented cast iron fragmentation cases. There is a vertical drilling down the centre to take the detonator assembly, which carries a ring and split pin, and a handle for holding the striker after removal of the pin. When not primed the central drilling is filled by a long plastic plug of the same length as the detonator, which screws into a thread at the top of the detonator drilling.

Weight of grenade, unprimed with plug	12 ozs.
" " " primed	13 ozs.

The grenades are packed in wooden boxes of 20, and the detonators in small airtight tins of 20. A tin opener is provided, but as this takes deep bites into the metal, care must be taken when opening the tin owing to the danger of setting off the detonators.



6. LEADING DIMENSIONS OF FIGHTING CHAMBER

Floor to bottom of turret ring	750mm. (29.5 ins)
Depth of turret ring	105 mm (4.1 ins)
Top of turret ring to roof	565mm. (22.2 ins)
Headroom in turret	1420mm. (55.8 ins)
Trunnion axis to roof of turret	260mm. (10.2 ins)
Trunnion axis to turret ring	305mm. (12.0 ins)
Trunnion axis to centre of turret	640mm. (25.19ins)
Ground to trunnion axis	1981mm. (78.0 ins)
Distance apart of trunnions	605mm. (23.3 ins)
Axis of bore of 76.2mm. gun above trunnion axis	95mm. (3.7 ins)
Internal diameter of turret ring	1450mm. (57.08ins)

There is no basket or rotating floor and the seats for the commander/gunner and loader are suspended from the turret ring.

7. ACCESS DOORS

TURRET - A large hatch is provided in the turret roof. A dished door, hinged to the front is fitted. The hinges are flush fitting and are welded to the door and bolted to the turret roof.

The door is secured in the open (vertical) position by a spring loaded catch which engages a lug welded to the turret top. This assembly is mounted externally but may be released from inside the door through a circular opening to the right of the hinge. This opening is provided with a B.P. hinged flap which is secured by a spring loaded catch operated by a canvas strap.

Complete closure of the door is retarded by the compression of a spring mounted in a cylinder on the inside of the turret roof. When closed the door is secured by a spring loaded catch. This catch may be released from outside the vehicle by means of a square key.

HULL - The driver is provided with an access hatch in the glacis plate, the door of which is hinged to the rear on a single multi-lug hinge which extends the full width of the door.

A compensating device is fitted consisting of a coil spring in a cylinder, mounted on the superstructure roof, actuated by a piston rod anchored to the door. This assembly retains the door in an approximately horizontal position. A knurled hand bolt locates on the piston rod locking the door in this position. A hand lever integral with the compensating device is provided to pull the door shut against compression of the spring. The door is secured firstly by a light spring loaded catch and then by heavy clamps mounted on 40 mm. diameter screws which pass through and are welded to the door.

The hatch whilst appearing to be satisfactory from an exit and mechanical viewpoint, does nevertheless reduce the high ballistic standard of the glacis plate layout.

The wireless operator is provided with an escape hatch in the belly of the tank. The hatch is situated on the offside of the belly immediately in front of the wireless operator's seat. It is hinged to the front and opens downwards. Two screw clamps secure the door when closed and a spanner is required to release the clamps.

For access to the gearbox and final drive units the whole of the upper tail plate is hinged at its lower edge. Three hinges are fitted with fully floating hinge pins, retained by cotters - this permits easy complete removal of the plate when necessary. The plate is secured by 22 hexagon head set screws to angle section welded to the hull sides and lower tail plate. The upper edge is not secured. A circular aperture of 21 $\frac{1}{2}$ " diameter is provided in the centre of the tail plate for access to the gearbox, steering brake adjustment and electric starter motor. A hinged cover is fitted to this aperture and is secured by seven hexagon headed set screws.

In the centre of the rear superstructure is a rectangular engine hatch measuring 1'7 $\frac{1}{2}$ " x 2'7 $\frac{3}{8}$ ". A flush fitting door is fitted to this hatch. It is hinged to the rear and is secured by a screw clamp operated by a special key from the outside.

8. OBSERVATION AND PISTOL PORTS

Fighting Compartment -

Commander/Gunner	-	1 periscopic dial sight PT 4-7 1 telescopic sight TMRD 1 episcopes 1 pistol port, below episcopes
Loader	-	1 open sight aperture for D.T. M.G. 1 episcopes in right hand turret wall 1 pistol port, below episcopes 1 signal port in turret hatch cover

In addition, there is a pistol port in the removable plate in the rear turret wall.

The episcopes are of simple fixed type, mounted so that they point downwards at approximately 5 degrees to the vertical. They are inserted from below in slots in the thickness of the turret wall, and held in place by springs on the episcopes casings and a hinged flap with a spring catch on the lower end of the slot. An extra armoured cover is welded to the outside of the turret wall. Overall dimensions are :

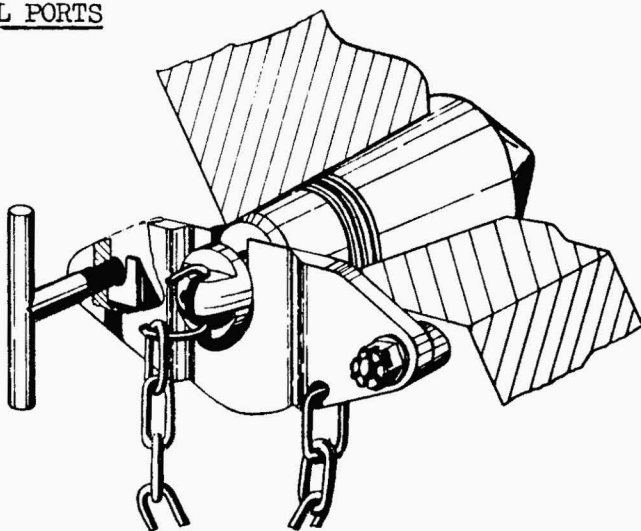
Height	165 mm.
Width	130 mm.
Thickness	36 mm.

The episcopes cases are constructed of sheet tin plate, with soldered joints. The quality of the glass is poor and contains many bubbles and flaws. Visibility when closed down is very limited and is little better when opened up, owing to the restriction of forward vision by the large flap of the turret access hatch.

PISTOL PORTS

The pistol ports are conical apertures of approximately 43mm diameter inside the turret and 71mm. outside the turret, giving an inclusive angle of taper of approximately 14 degrees.

The ports are closed by conical plugs anchored to the inside of the turret wall by a chain. The plugs are each secured in the ports by a pivoted plate with a slot which engages an annular groove in the plug. The plug is removed by a sharp blow.



Forward Compartment Driver - 2 episcopes in front hatch.

These are identical with those previously described and have extra protection welded to the outside of the mounting. They are mounted vertically pointing forward and outward from the keel line at about 5 degrees to the tank's transverse axis and are provided with armoured hoods. The hoods are pivotally mounted and may be closed or adjusted to either of two positions of opening by a hand lever with a spring loaded plunger which engages coincident holes in a quadrant. The eyepieces of both episcopes are protected by a long transparent plastic strip, held in place by the episcopes retaining flap. Its purpose is not clear.

Auxiliary Gunner/Operator - open sight aperture in M.G. mantlet

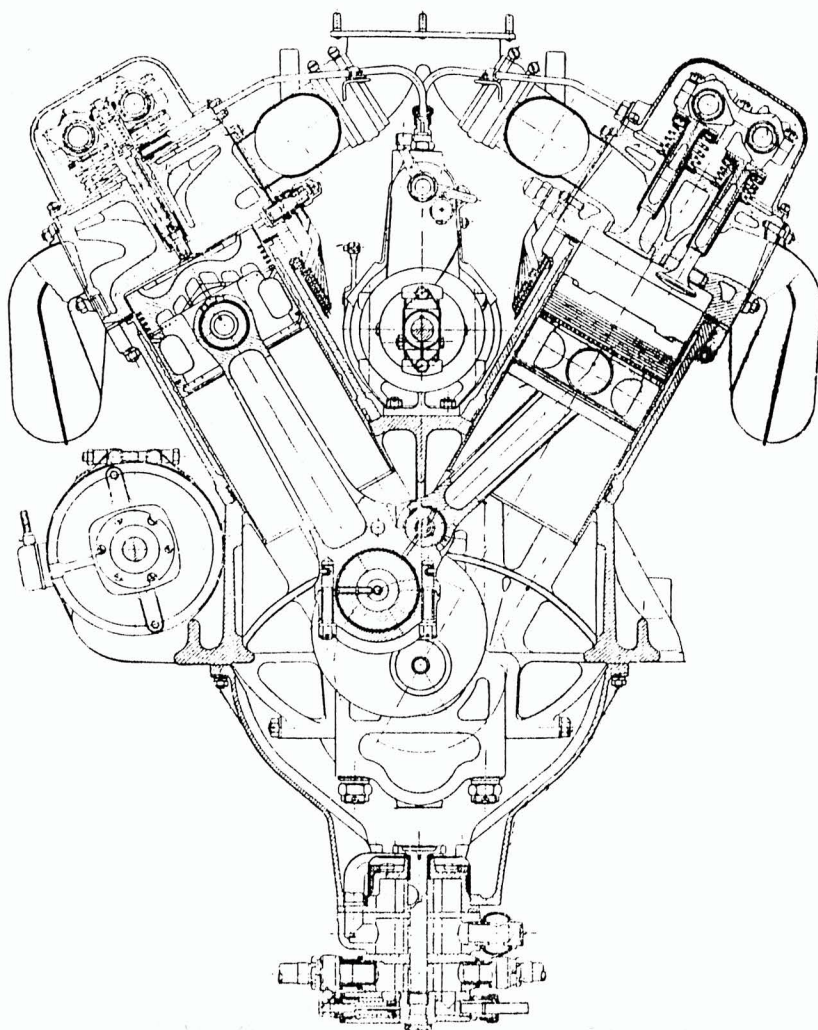
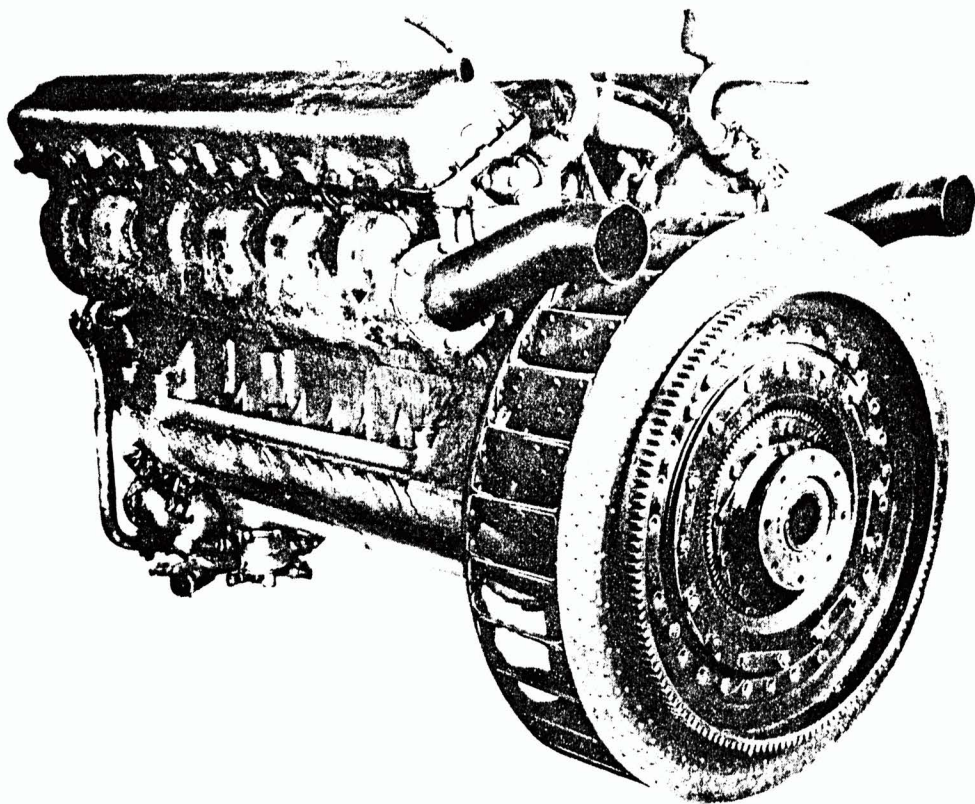
9. SEATING

Seats for the crew are arranged as follows:

COMMANDER/GUNNER - this seat is adjustably mounted on a tubular support, which is itself adjustable for height and rotation in a bracket on the rear nearside of the turret ring. The seat has a longitudinal adjustment on the support. A wide backrest is fitted on the turret ring, and both this and the seat are cushioned.

LOADER - the loader's seat is identical with that for the Commander/Gunner except that it is secured to the offside rear of the turret ring.

DRIVER AND HULL GUNNER - these seats are identical and are mounted on the floor in the front nearside and offside respectively of the forward compartment. They are of armchair type with folding backrests and are not adjustable in any way; the seats, arms and backrests are cushioned.



10. POWER PLANT

ENGINE

TYPE - "V.2". 60 degree V - 12 cylinder. Water cooled C.I.

BORE 150 mm.

STROKE 180 mm. (articulated rods)
186.7 mm. (master rods.)

CAPACITY 38.88 litres

COMPRESSION RATIO 15 : 1 (articulated rods)
15.8 : 1 (master rods)

RATED POWER 500 B.H.P. at 1800 R.P.M.

The engine is situated in a separate compartment at the rear with a radiator and fuel tank on each side.

The design of the engine in general follows established principles embodied in certain well-known in line aero engines and there seems very little doubt that it is basically an aero engine, converted to C.I. and modified for use in A.F.V.'s.

It is of very light construction, the cylinder heads, blocks and crankcase being of aluminium alloy. The blocks are detachable and are fitted with wet liners. The combustion chamber is of open type with the injector nozzle centrally in the head. To gain access to the injectors it is necessary to remove the valve covers. Four vertical valves per cylinder are operated directly by the camshafts. The pistons are of hot pressed aluminium alloy and the connecting rods are articulated of "H" section and machined all over. Copper lead bearings are used in the big ends and mains, and a ball thrust race is located on the driving end of the crankshaft. The crankshaft is supported in eight bearings and is fully machined. No torsional vibration damper is fitted. The crankcase is split along the crankshaft centre line but extends below this level to support side thrust on the main bearings. A bevel on the free end of the crankshaft drives up to the camshafts, injector pump and governor, air distribution valve and dynamo. Driven also from this bevel and located on the sump are the water pump, oil pump and fuel feed pump. The engine is mounted rigidly at four points on longitudinal bearers welded to the hull floor. The mounting is not particularly rigid and is not braced to the hull side plates.

The quality of the workmanship varies very considerably. Whilst the highly stressed parts have a finish comparable with that of British aero engines of moderate output, the sand castings by contrast are exceptionally rough. In spite of this, however, the latter appear to be sound, there being no signs of porosity or blow holes on the machined surfaces. Most of the important bolts and studs are stress relieved and ground, and on a few components the standard of finish is very high. The large number of inspection stamps on certain components is particularly noticeable.

INJECTOR EQUIPMENT

Bosch type of injector equipment is used. The injection pump is a 12 cylinder in-line with 10 mm. diameter plungers; in design it is basically similar to the C.A.V. B.P.E. series pumps with a centrifugal governor incorporated at the rear. It is situated centrally between the cylinder banks and driven through a Bosch type fibre coupling.

The nozzle holders have a very long reach and the leak off goes directly into the valve chamber. Seven hole closed type nozzles with a ~~spacing~~ spray angle of 170 degrees are fitted. A mechanically driven vane pump delivers the fuel through a felt element type filter to the injection pump. On superficial examination, the essential parts appear to be well made but where a high surface finish is not required, the finish is comparatively rough.

COOLING SYSTEM

The centrifugal water pump is situated on the engine sump and is driven at 1.5 x engine speed. Water is drawn from the radiator and delivered to a single inlet at the base of each cylinder block. From the block it passes into the head through a number of small holes below the valves, and is returned to the radiator via a single port in each head. A remote greaser for the pump is mounted in the fighting compartment on the engine bulkhead and is operated by a turnbuckle.

A gilled tube radiator is mounted at each side of the engine compartment - they are inclined towards the top of the engine at an angle of 30 degrees. The header tanks are coupled by a pipe in the centre of which is the filler cap incorporating a pressure relief valve. Steam is taken off the cylinder heads via small diameter relief pipes, one for each bank, which couple the return pipes to the filler "T" piece.

A radial flow fan is mounted on the flywheel and circulates air drawn through louvres at either side of the engine cover plate through the radiator matrices and round the engine. The air is exhausted through external louvres at the rear of the superstructure, having first circulated round the gearbox and steering units. The outlet louvres may be completely closed, or the degree of opening adjusted, by a lever to the left rear of the driver.

LUBRICATION SYSTEM

The triple gear type oil pump is mounted next to the water pump and driven at 1.725 x engine speed. Two scavenge pumps draw oil from each end of the sump and deliver it to two oil tanks. Each tank has a capacity of approximately 50 litres and is situated on either side of the engine between the radiators and hull side plates. There is no oil radiator in the system. The pressure pump delivers oil into the free end of the crankshaft after it has passed through a clearance type filter incorporating a by-pass valve. The filter is very inaccessible and removal of the element presents considerable difficulties.

AIR CLEANER

An oil bath type air cleaner is mounted centrally above the engine. It has a very shallow element of loosely packed steel wire. The standard of workmanship in this component is particularly crude. The cleaner must be removed to obtain access to the fuel injection pump.

EXHAUST SYSTEM

which The exhaust gases from each bank are conveyed via separate manifolds which are pressings from sheet steel. They are manufactured in two halves, welded together.

FUEL SYSTEM

Eight fuel tanks are provided having a total capacity of 610 litres (135 gallons).

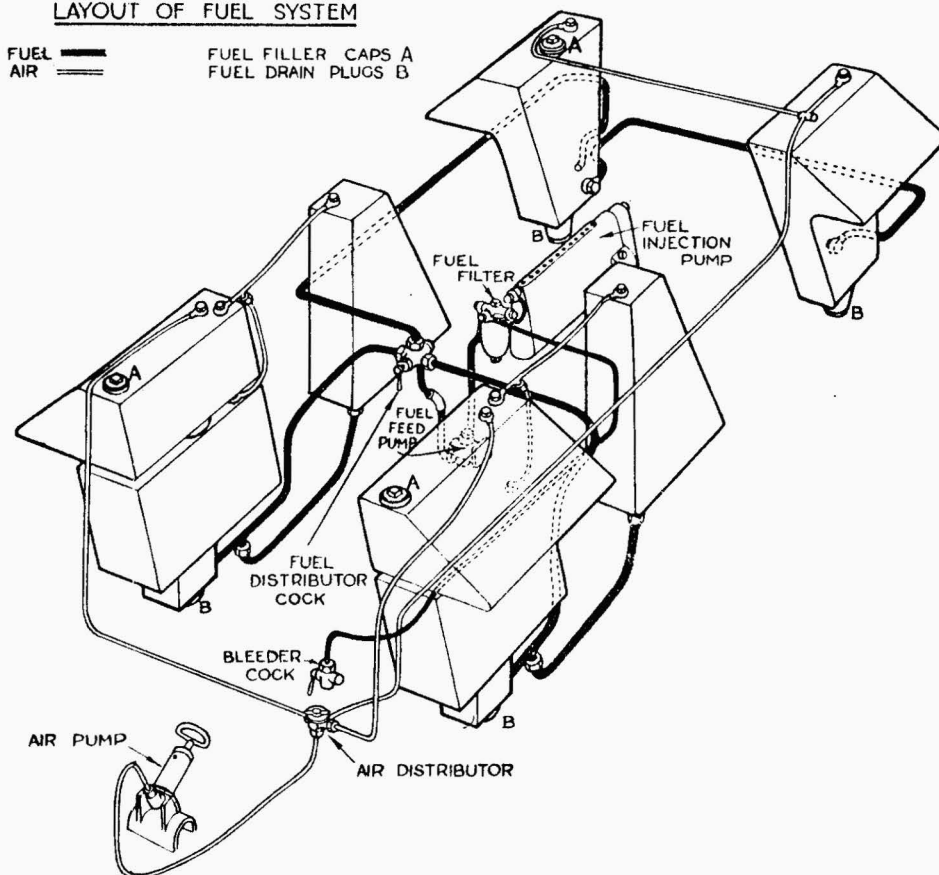
The respective capacity and position of the tanks is as follows:

- One wedge shaped tank above a rectangular tank on each side of the fighting compartment - 150 L each pair - - 300 L.
- One tank at each side of rear compartment over final drive units - 80 L each - - 160 L.
- One tank at each side of engine compartment forward of lubricating oil tank - 75 L each - - 150 L.

A filler cap is provided to each upper forward tank, the lower tanks being fed by gravity from the upper tanks. The central tanks in the fighting compartment are coupled to the forward tanks and have no independent filler caps. The filler caps for the forward tanks are accessible from the top of the hull on removal of B.P. covers, each secured by two hexagon head set screws.

A common filler, situated at the top of the offside tank, is provided for the rear tanks which are coupled. To reach the filler it is necessary first to open the hinged cover over the air louvres at the rear of the vehicle and then to remove a B.P. cover, similar to those for the forward tanks. Removable gauze filters are fitted at each filler. A ring approximately half-way up the filters marks the maximum level to which the tanks may be filled. A composite dipstick is provided in the vehicle equipment to measure the quantity of fuel in the tanks. To ensure that the fuel lines are air free, the air distributor cock, mounted on the floor on the left of the driver has to be turned to one of three positions, i.e. front right tank, front left tank or feed tanks. Pressure is introduced by means of a hand pump situated by the driver's left foot controls. A bleeder cock at the driver's left shoulder which discharges through a funnel shaped orifice to outside the vehicle indicates when the system is correctly primed. When all the air has been excluded from the system, the air distributor valve is turned to a position marked "M.A." and with the valve in this position all tanks are vented to atmosphere. A main fuel cock is mounted in the fighting compartment on the right of the engine bulkhead. It has three positions for fuel tanks and the "OFF" position.

LAYOUT OF FUEL SYSTEM



STARTER EQUIPMENT

The engine may be started by solenoid operated electric starter or compressed air.

- (i) Electric - the electric starter motor is a 24V four pole, series wound, totally enclosed machine. It is mounted in a cradle on top of the gearbox and engages a ring gear on the flywheel.

The pinion is driven by the armature through a multi-plate clutch. It is moved axially into engagement by means of a pivoted forked finger. The finger is actuated by a solenoid mounted alongside the motor. On completion of the starter circuit the solenoid first moves the pinion into engagement, then completes the armature circuit.

The starter motor circuit is completed by a solenoid switch operated by a press switch on the driver's panel. The solenoid lead is connected to the generator positive terminal in the regulator unit. An electrical interlock results which de-energises the solenoid circuit immediately the engine starts, thus dis-engaging the starter pinion, and preventing engagement whilst the engine is running.

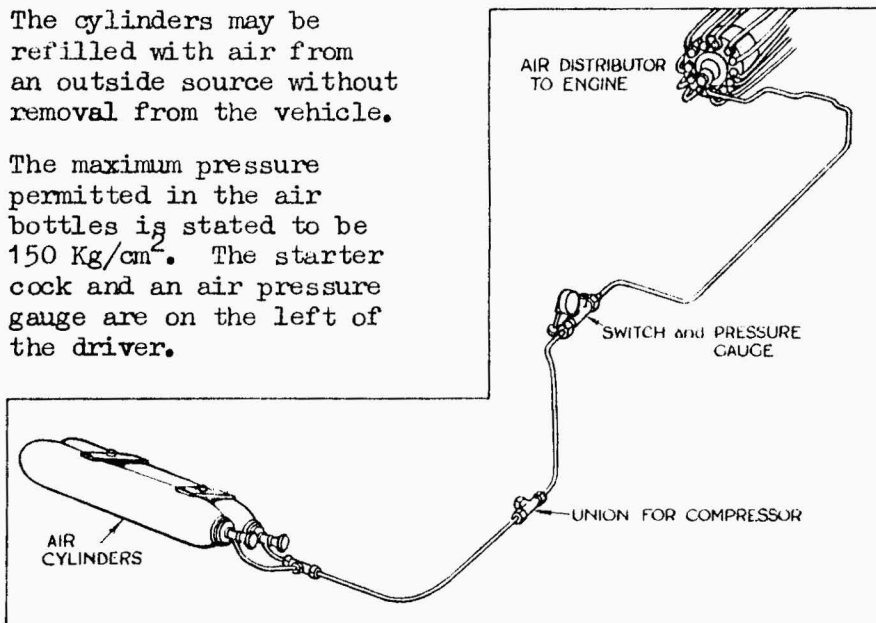
- (ii) Air - the compressed air system is provided for use only as an emergency measure should the electric starter fail.

It consists of an air distributor mounted on the front of the engine which conveys air to the cylinders of each bank, through non-return valves in each cylinder.

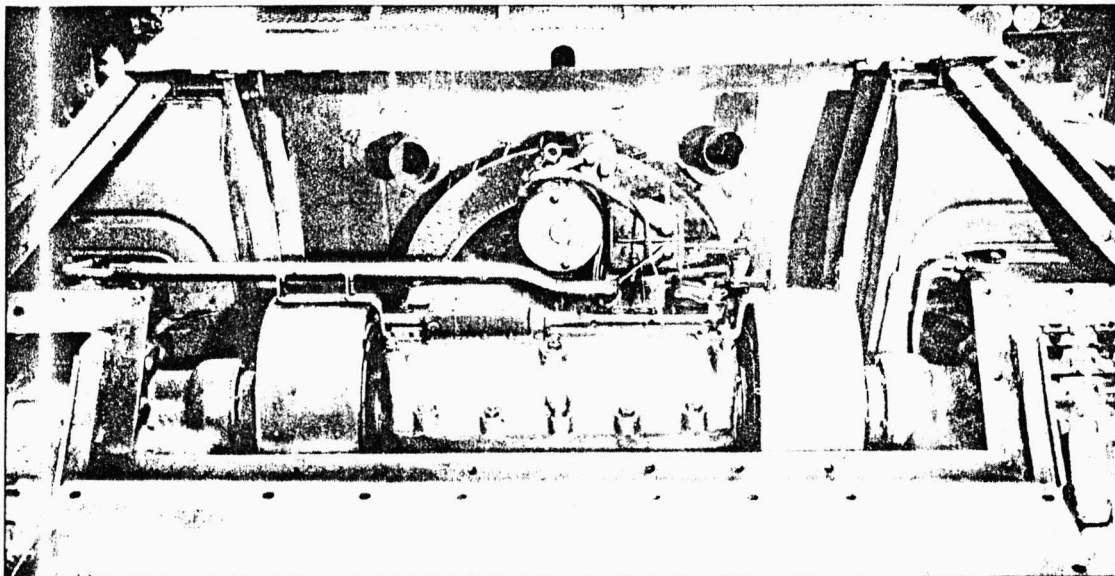
The air is delivered to the distributor from two steel cylinders mounted forward on the floor of the driving compartment.

The cylinders may be refilled with air from an outside source without removal from the vehicle.

The maximum pressure permitted in the air bottles is stated to be 150 Kg/cm². The starter cock and an air pressure gauge are on the left of the driver.



II. TRANSMISSION



The general arrangement of the transmission is shown in the sectional drawing.

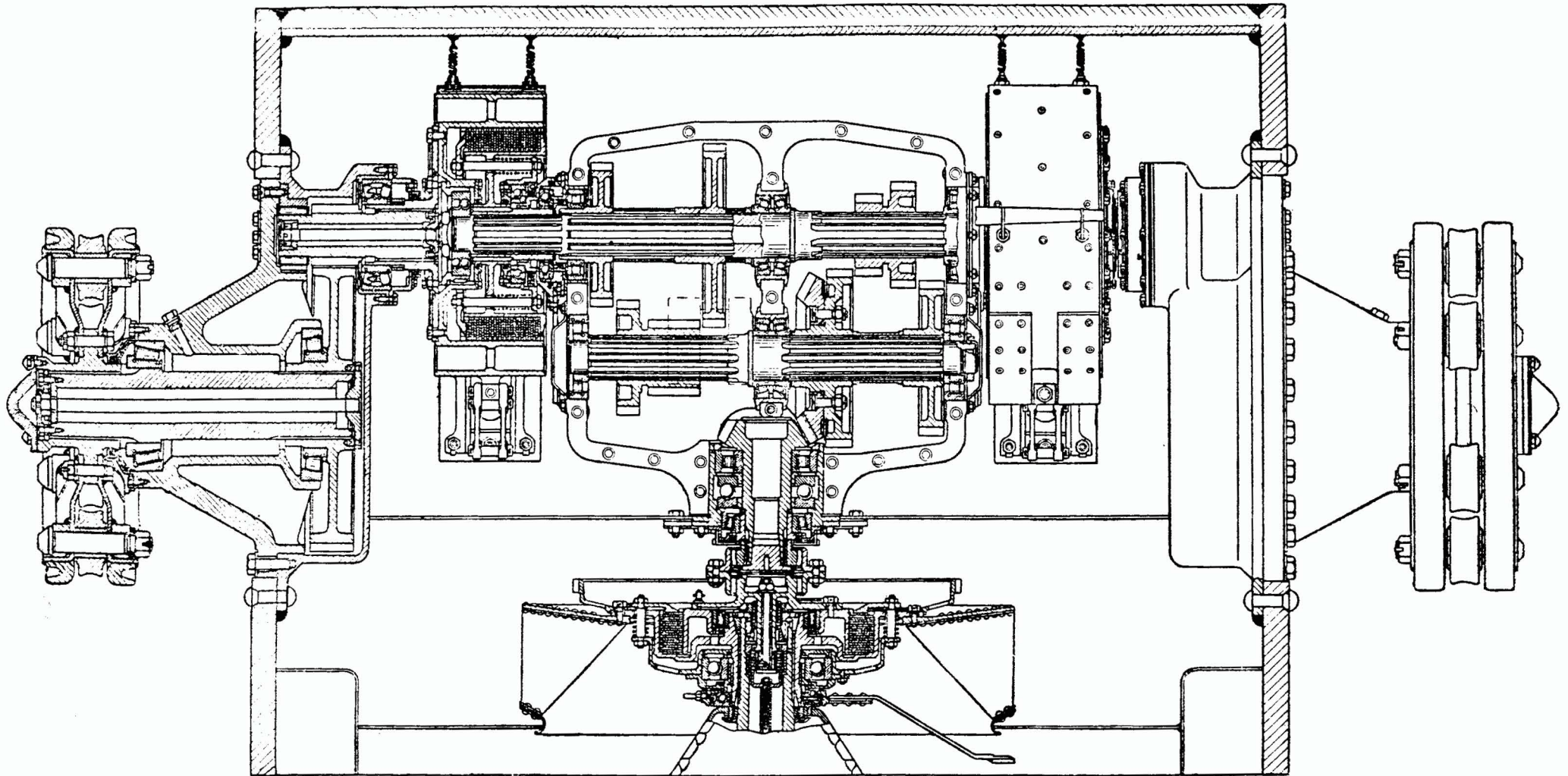
CLUTCH

A multiplate dry clutch is mounted on splines on the end of the crankshaft. The fan and starter ring gear are bolted to the clutch driving member. Eleven driving plates locate in internal splines in the driving member and ten driven plates in external splines on the driven member. The driven member is supported on the driver member by a large single row ball race. A similar ball race carries a cage situated between the clutch plates and the engine to release the spring pressure on the pressure plate and disengage the clutch. The withdrawal mechanism itself consists of a type of ball thrust race situated between the withdrawal cage and the engine. One member of this race is bolted to the crankcase and the other may be rotated by the clutch withdrawal lever. The balls, however, do not run in an annular groove, but each in a separate depression. Thus, when the one member is rotated by the withdrawal lever, the balls ride up these depressions and force the withdrawal cage outwards. Mechanical linkage connects the withdrawal lever with the clutch pedal.

GEARBOX

The drive from the clutch to the gearbox is taken through a splined muff coupling, the splines on the gearbox input being spherical to allow for a certain amount of mal-alignment.

The gearbox itself is a simple four forward and one reverse speed sliding mesh type operated through a linkage from a change speed lever to the right of the driver. The primary shaft is driven at right angles from the input shaft through a pair of spiral bevels. The input shaft is supported on a parallel roller race, a ball thrust race and a taper roller race. Both primary and secondary shafts are supported, at their centre, on double taper roller races and at each end on parallel roller races. First and second gear driving pinions are integral and slide on the primary shaft. Third and fourth gear driven pinions are integral and slide on the secondary shaft. Reverse pinion engage with the first gear pinions. The casing is of cast aluminium split along the centre line of the shafts. A filler cap is provided in the top of the casting. No dipstick is fitted, but the Service Handbook specifies a minimum level of 40mm. No oil pump is fitted, the lubrication being entirely by splash.



A somewhat unusual locking device to prevent the gears jumping out of engagement is incorporated in the change speed mechanism. It consists of spring loaded plungers actuated by balls engaging dimples on the selector control rods, and a rotating circular locking plate, with holes appropriate to each plunger. A trigger on the change speed lever rotates the circular locking plate, thus bringing the plungers into alignment with the holes. Upon engagement of the selected gear the appropriate plunger enters its respective hole and the gear and controls are positively locked. It will be seen that movement of the change speed lever for the selection of any forward speed, necessitates depression of the trigger. To engage reverse gear, the trigger is not operated until the gear is engaged, when it is depressed, and retained in this position by a hinged catch on the change speed lever.

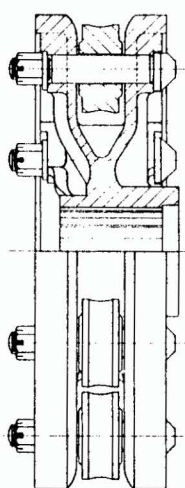
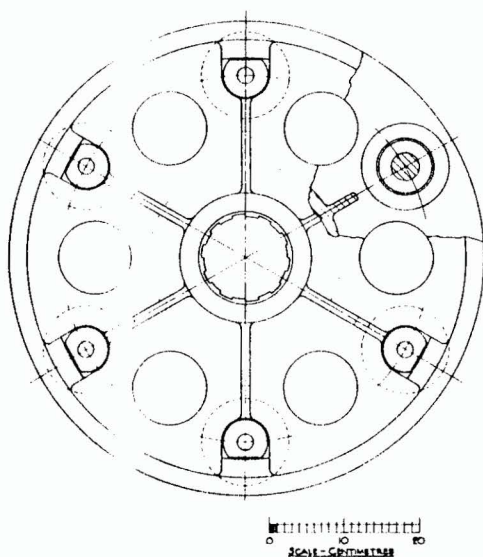
In addition to this device an interlocking of the rectangular section selector rods is effected by the interpositioning of balls between their vertical faces. This arrangement is a safeguard against the engagement of two or more gears at the same time, and is in accordance with orthodox practice. In design the gearbox is extremely simple and straightforward. The finish of the parts is very rough, the surface of the casting being particularly so. The gear profiles have not been ground or processed after heat treatment.

STEERING

The gearbox secondary shaft is extended each side to carry the driving members of the steering clutches. Each clutch consists of fifteen driving and fifteen driven plates, the design being basically similar to that of the main engine clutch with a similar type of withdrawal mechanism operated mechanically by the steering levers. On the driven member of the clutch is a brake drum. External contracting bands with segmental cast iron linings are operated mechanically through toggles and rods by the steering levers. When the brakes are free, the bands are held off the drums by four small tension springs. An interconnected foot pedal operates the same bands on the steering brakes through a transverse compensating shaft. A hand operated retaining watch engaging with the footbrake pedal provides for parking.

12. FINAL DRIVE

The final drive unit consists of a single straight spur reduction gear mounted in armoured housings at each side of the tail of the vehicle. Lubricant is introduced to the units through filler plugs located near the top of the housings, outside the hull side plates.



SPROCKETS

Overall diameter	2' 1"
P. C. D.	1' 7 ³ / ₈ "
Height of centres from ground	2' 0 ³ / ₈ "
No. of rollers	6
Pitch of rollers	9 ⁵ / ₈ "

The centre member and hub consists of a one-piece casting. Two ribbed discs form the wheel, the track horn running between them. The track horns are engaged by rollers mounted between the wheel discs. Six holes are formed in each wheel disc to allow for the clearance of mud and snow.

IDLERS

The twin idler wheel is of one-piece construction, similar in design to the sprockets but without the rollers. Tyres are not fitted.

Diameter of idler	1' 7 ³ / ₄ "
Height of centre of idler from ground	2' 0 ³ / ₈ "

13. SUSPENSION

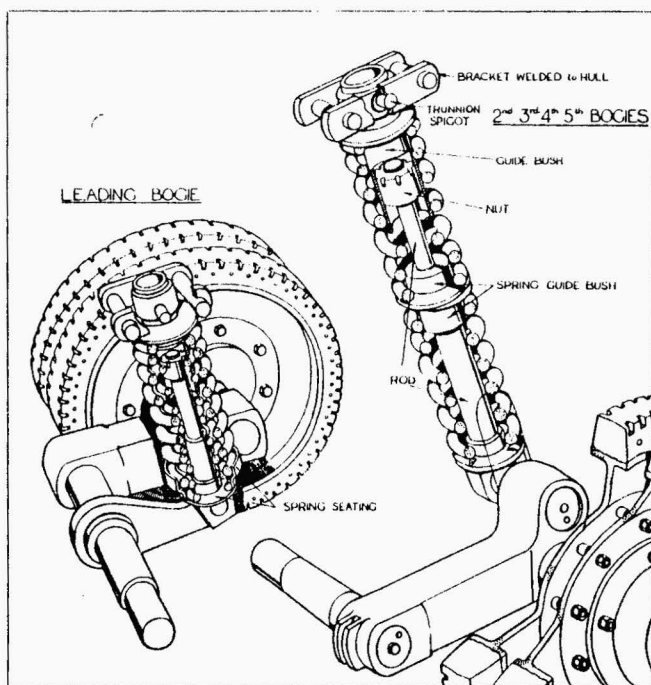
There are five rubber tyred bogie wheels on each side. The three rear wheels are equally spaced at $2'10\frac{1}{4}"$ centres, whilst the two front bogies on each side have $3'0\frac{1}{2}"$ centres and are spaced from the foremost of the three rear bogies at $3'4\frac{1}{2}"$ centres.

The suspension is independent and a large wheel deflection is allowed. Concentric double close coiled springs are used in the case of the leading bogies, whilst the 2nd, 3rd, 4th and 5th bogies have each two single close coiled springs.

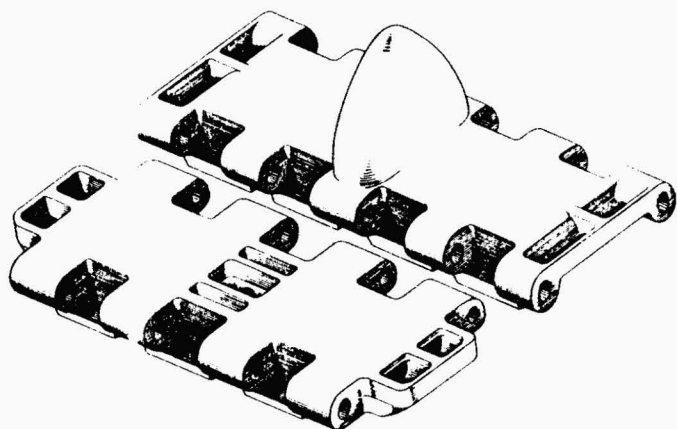
The bogies are mounted on trailing hollow cast steel suspension arms. The suspension arm shafts are carried in plain bearings in the hull. The 2nd, 3rd, 4th and 5th units on each side are each retained laterally by a quadrant guide plate bolted to a boss which is welded to the hull side plate. This guide is engaged by a forked projection on the suspension arm.

The bogie wheels are mounted on ball bearings on parallel stub axles. In the case of all except the leading bogies, a trunnion is mounted in a projection on the suspension arm immediately above the bogie axle which forms the lower anchorage for the spring. The springs are housed in boxed recesses behind the hull side plate.

The leading suspension arm on each side is of different design. The anchorage for the spring consists of an arm keyed to the suspension shaft inside the hull. This arm also serves to prevent lateral movement of the suspension unit. The springs are housed inside the hull and are enclosed.



14. TRACKS



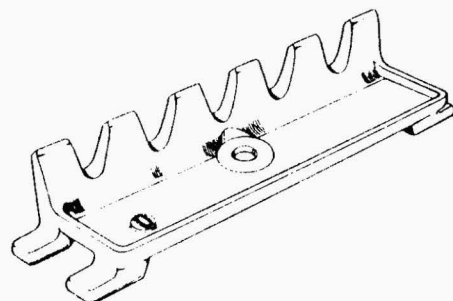
The tracks are of cast manganese steel. Two types of link are used, one with a guide horn and one without. The plain plates are drilled in the centre for the attachment of grousers and on their extremities slots are formed into which tongues at the ends of the grousers locate. The plain and horned tracks are assembled alternately.

Pitch of Shoe
Width of Shoe
Pin Diameter
Weight of Shoe

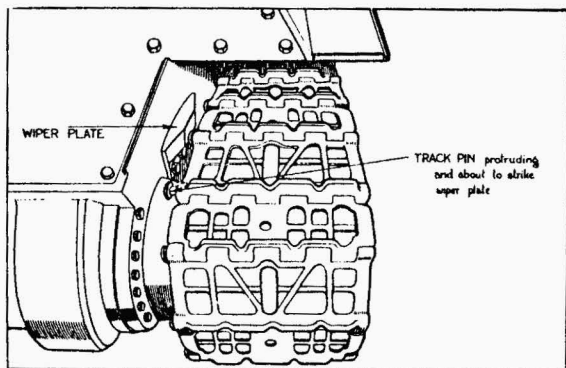
175 mm. ($6\frac{7}{8}"$)
504 mm. ($19\frac{1}{8}"$)
20 mm. ($\frac{7}{8}"$)
28 lbs. plain
37 lbs. horned
 $2\frac{1}{4}$ lbs.

Weight of pin
No. of shoes per track

72

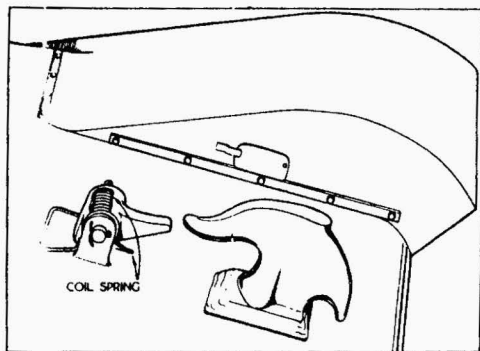
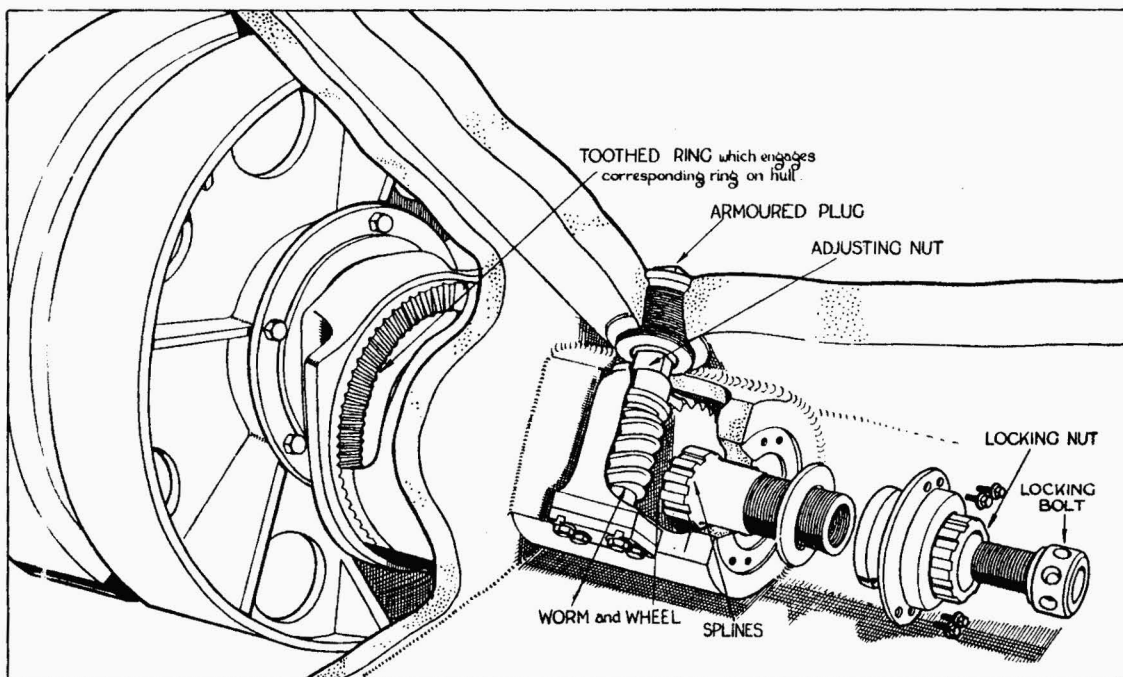


The track pins have round heads at one end and are "hot-cropped" at the open end. The pins themselves have no retention device and are retained by the fitting of bevelled wiper plates welded to the hull sides at the rear of the vehicle. On receipt of the vehicle, however, several pins on each side had slipped out beyond the point at which the wipers are effective. This condition may have been caused by vibration set up during transportation and may not occur when the tracks are under load.



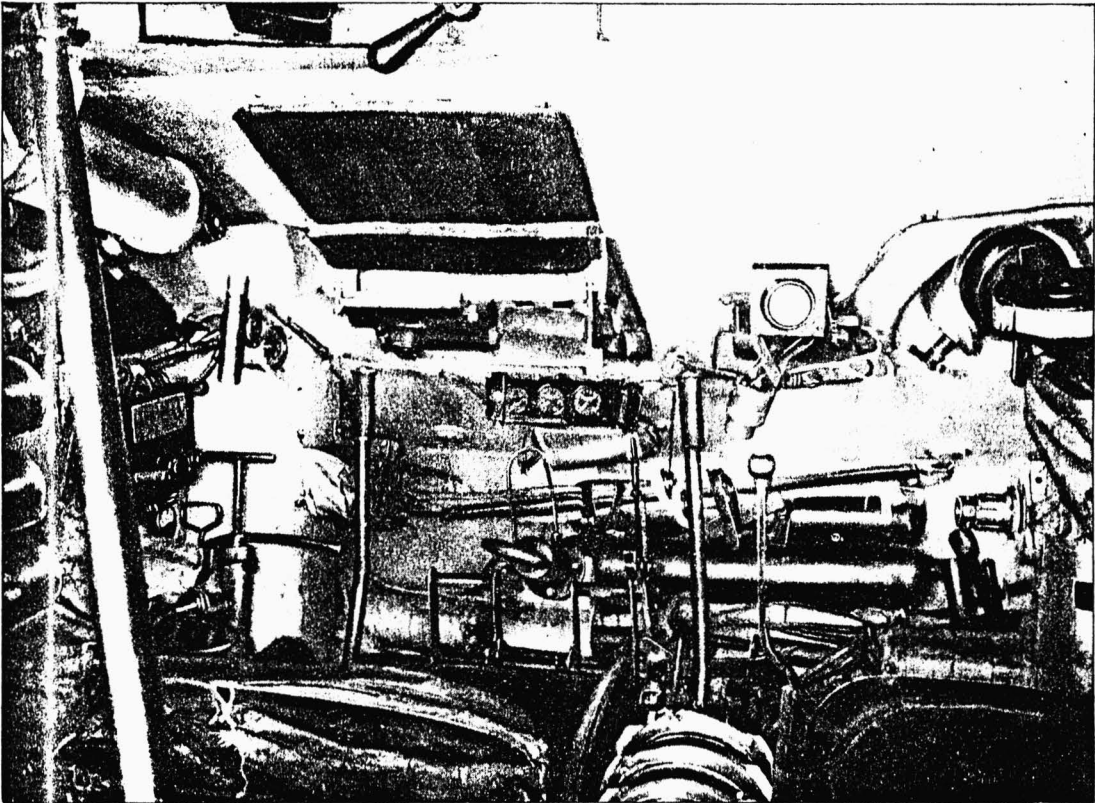
Adjustment of Tracks

Adjustment of the tracks is effected by means of the cranked mounting of the front idler wheels. The shaft of the idler crank is housed in a bracket welded to the hull. A concentric toothed ring is formed on the web of the crank. The teeth on this ring engage teeth on the mounting and the adjustment is made by the loosening of a splined nut which disengages the teeth, and rotation of the shaft by means of a worm and wormwheel. The wormwheel is splined to the shaft and the worm rotates in a mounting on the glacis plate. A square boss protruding through this plate at each side is engaged by the adjusting tool. A lock bolt is provided to ensure the security of the splined nut when the adjustment is complete.



Combined towing and lifting hooks are welded to the glacis plate at each side. These incorporate a spring loaded safety catch to prevent the towing cable from jumping the hook.

Heavy towing eyes are welded to the hull. Two towing cables and shackles are carried on the nearside track guard. Lifting eyes are fitted at three points on the turret roof.



15. DRIVER'S CONTROLS

The driver's controls consist of:

Foot Controls

Clutch pedal - left
Footbrake - centre
Accelerator - right

Hand Controls

Orthodox steering levers - on transverse axis
Locking device for vehicle brakes - right hand operation
Change speed lever - right hand operation
Hand operated air pump for priming fuel system.

16. DRIVER'S INSTRUMENTS

On panel in front of driver:

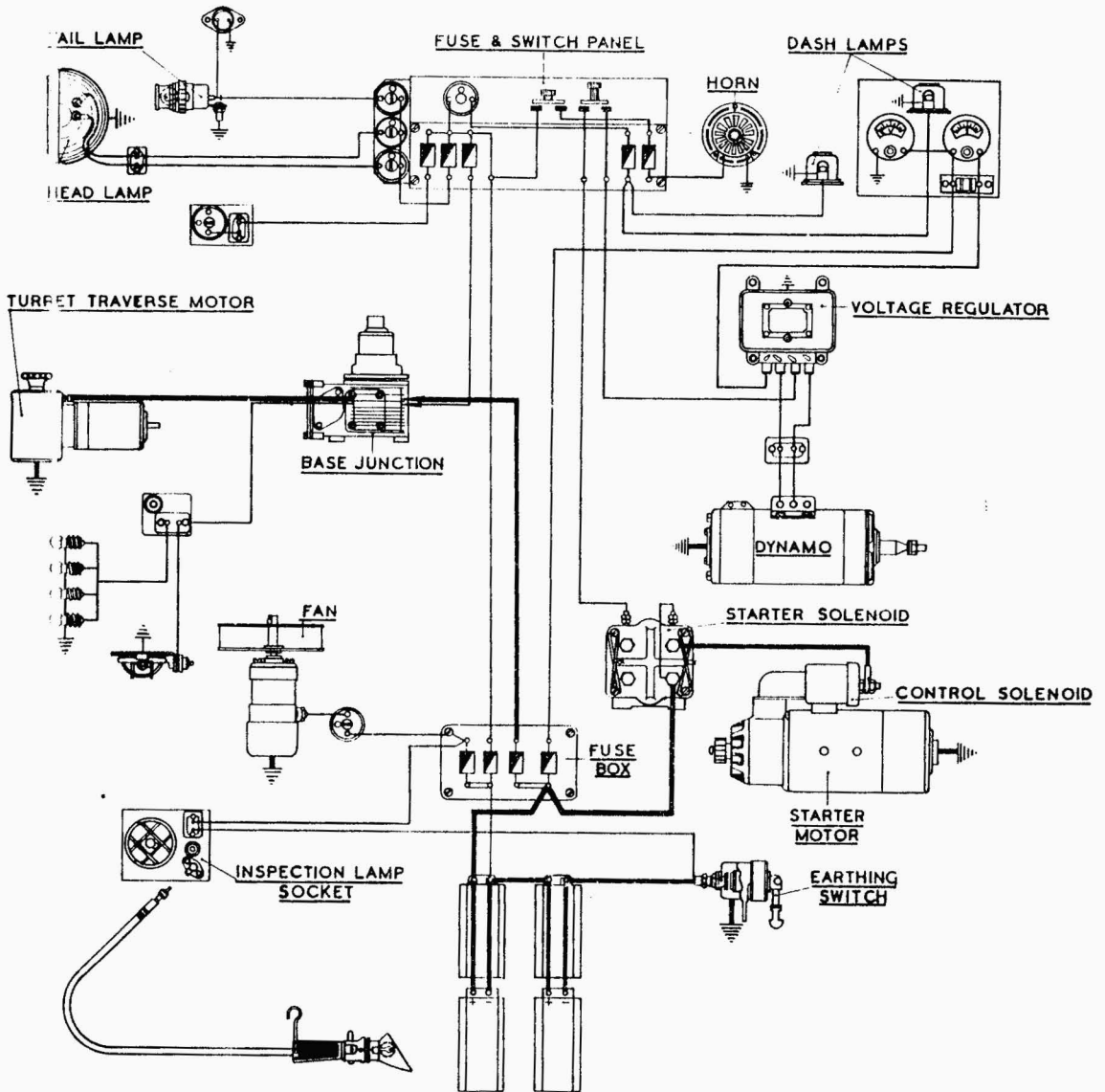
Water temperature gauge graduated 60° - 125°
Oil " " " 0° - 125°
Oil pressure gauge " 6° - 15 Kg/cm^2

On panel on left of driver:

Revolution counter 400 - 3000
Speedometer recording 134 Km.
Ammeter 0 - 50 amps
Voltmeter 0 - 35 volts
Starter switch
Electrical switches.

At air starter valve union:

Air pressure gauge graduated 0 - 250 Kg/cm^2



17. ELECTRICAL EQUIPMENT

The electrical equipment on the vehicle operates at two voltages, 24 volts for the starter motor and the turret traverse motor, and 12 volts for lighting and communication equipment. The wiring is single pole earth with negative earth return, a single pole earth isolating switch being incorporated in the battery earthing lead. The switch is mounted on the hull wall to the right of the wireless operator.

All cables are screened by a braided wire sheath earthed by clamps at each end of the cable runs, and except for a few short lengths all cables are carried in pressed steel ducts bolted to the hull.

The 12 volt services are taken from one bank of accumulators only, when the earthing switch is closed. One internal lamp and an inspection lamp socket have double pole wiring across the terminals of this accumulator and these components are unaffected by the position of the earthing switch.

ACCUMULATORS

Four 12 volt lead acid batteries of about 120 amp/hr. capacity are mounted in the engine compartment in two banks, on either side of the engine. The accumulators are accessible through doors in the bulkhead, and their removal is extremely laborious, much of the fighting compartment stowage having to be removed before the accumulators can be pulled into the fighting compartment for removal through the turret hatch.

GENERATOR

The accumulators are charged by a four pole, shunt wound, totally enclosed generator of 1000 watts output with negative earthed. The generator is mounted on the right of the engine and driven through a slipping clutch.

VOLTAGE REGULATOR

Generator voltage regulation is carried out by a single contact vibrating type voltage regulator maintaining the voltage constant at 30 - 32 volts. The cut-out, closing at an engine speed of 600 - 650 R.P.M. is carried in the same case as the regulator and is of normal design, having two sets of contacts.

The regulator and cut-out are carried in a pressed steel box mounted on the hull wall to the left of the driver. A resistance is also mounted on the regulator insulating base and is presumably the generator field resistance.

The Russian Instruction Book indicates that later models of this type are fitted with a voltage regulator and current limiter, the maximum charging current being limited to 38 - 42 amps.

ELECTRICAL INSTRUMENTS AND CONTROLS

The charging rate and the state of charge of the batteries is indicated by a centre zero, 0 - 50 amps, ammeter and a voltmeter reading 0 - 35V, mounted on a panel to the driver's left. With the earthing switch closed, the voltmeter reads the total voltage of the accumulators, and directions are given in the handbook that the engine shall be cranked over by the starter motor whenever the voltage is being taken. With the earthing switch open and any of the 12V components switched on, the voltmeter will indicate the voltage of the left bank of accumulators.

In addition to the above meters, the control board to the driver's left also carries the switches for the external lighting and panel lights, and the horn and starter switches, with the main fuse panel mounted above the meters. The fuse panel is mounted in a pressed steel case and carries one cartridge type fuse of 50 amps capacity, four of 10 amps capacity and one open fuse of 150 amps capacity. A diagram showing the circuits protected and the size of fuse is carried on the lid of the case, the fuses also being marked with their capacity.

LIGHTING

Internal

The internal lighting in the driver's compartment is confined to festoon lamps with variable aperture for illuminating the various instruments and the wireless sets. The lamps are fitted with S.P.B.C 13V 5W bulbs controlled by tumbler switches adjacent to the fittings.

A board carrying a lamp, a switch and an inspection lamp socket is mounted on the hull wall to the operator's right, and these components are independent of the earthing switch as mentioned above. The lamp is of the totally enclosed bulkhead pattern with an almost hemispherical frosted glass. The intensity cannot be controlled, and there is no shade fitted.

External

External lighting on the vehicle is confined to one headlamp on the nearside track guard and a tail lamp in a recess at the top of the gearbox compartment cover. The headlamp is unscreened and carries one 13V 25W and one 13V 5W bulb controlled from switches on the driver's panel.

ROTARY BASE JUNCTION

The feed to the turret services are taken through a fuse box in the left hand corner of the fighting compartment, containing three cartridge and one wire fuse then through a rotary base junction mounted in the middle of the fighting compartment floor. The slip ring assembly rotates with the turret and consists of three copper rings about $\frac{1}{2}$ " wide. The rings are insulated from each other by fibre rings which project above the surface of the slip ring, an arrangement which, in the case of the small rings, helps to hold the brushes in position on the surface of the ring. Owing to the inaccessibility of the base junction and the fact that the top plate of the case is welded in position it was not possible to determine the method of mounting of the rotating portion. The brush gear is carried on an insulated base screwed to the inside of the case with the incoming leads connected to the terminals accessible through a plate on the side of the case. One square section copper brush bears on each of the large rings, the brushes being carried in insulated holders and spring loaded. The six brushes bearing on the smaller rings are bright steel wire about 14 S.W.G. in the form of hair-pin springs with one leg anchored in an insulating block and the other leg resting against the slip ring, on which it is retained by the projecting insulating ring as mentioned above.

The case of the base junction consists of an iron casting, the fixed portion being held to the turret floor by four bolts. Five inspection plates, with rubber gaskets are provided on the sides of the case. The moving portion of the case is a machined hemisphere which rides in a hemispherical seating in the fixed portion and forms a universal joint. This part of the casing is held in position by a ring welded to the fixed portion and a rubber gasket being held in position by a ring bolted to the fixed portion of the case. A conduit, about $1\frac{1}{4}$ " internal diameter is welded to the top of the moving part of the case, and carries the leads to the turret. The top end of the conduit is carried in a slotted bracket bolted to the turret.

The construction of the base junction is such that it is probably water-tight, but it does not seem possible to strip the unit easily, and its removal from the vehicle would necessitate the removal of the turret wiring at the same time.

The current from the battery is fed to and returned from the turret components by three large slip rings - the top and centre rings carry respectively +24V and +12V. The lower ring is the earth to the turret and hull. These rings are all considerably pitted and show signs of scoring. Six small rings carry the intercommunication circuits and are in fairly good condition.

TURRET CIRCUITS

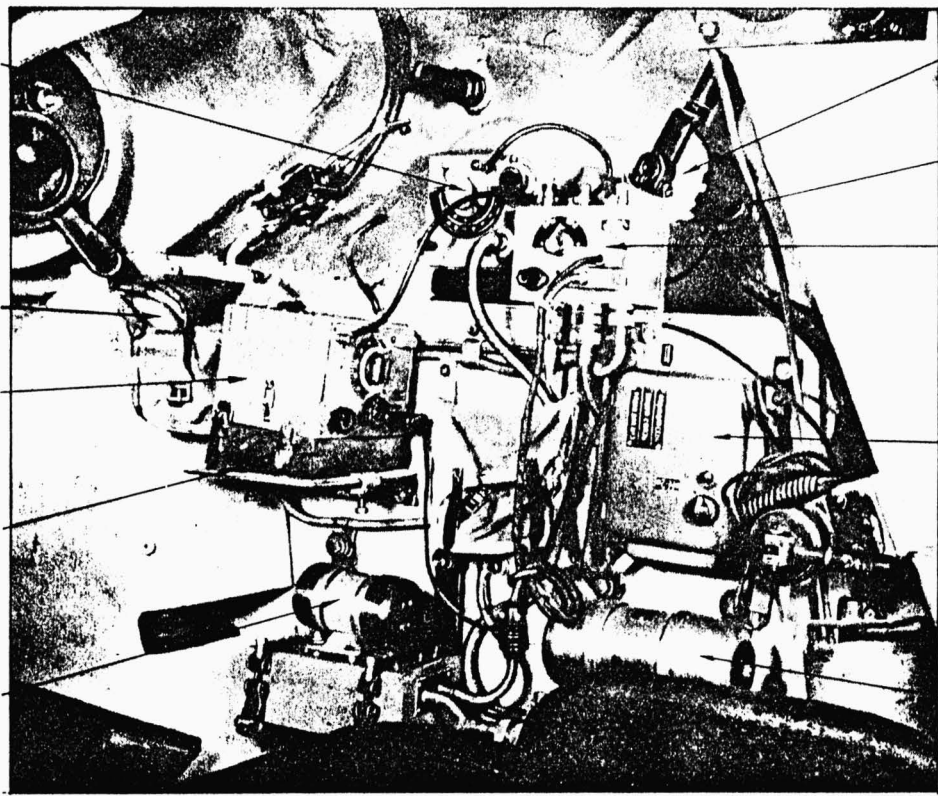
The turret 12V components are confined to one lamp of the bulkhead type described above, mounted in the turret roof to the right and forward of the gun breech, and controlled by a tumbler switch fitted on the same base. Two sockets are fitted for supplying the five lamps illuminating the periscope and telescopic sights. These again are controlled by tumbler switches.

18. WIRELESS AND INTERCOMMUNICATION

The tank is equipped with wireless and intercommunication, the intercommunication system being independent of the wireless and capable of operation with the wireless removed.

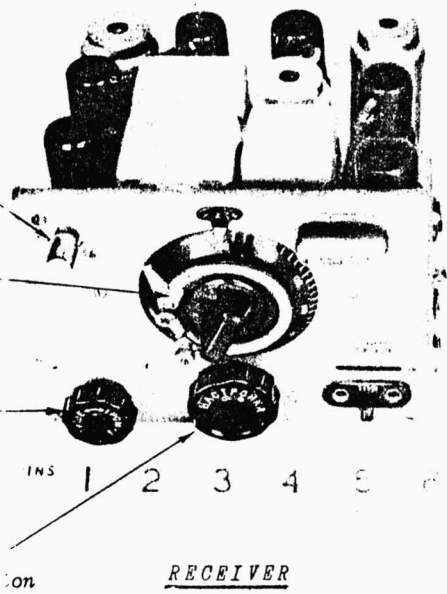
Wireless - the wireless installation consists of a receiver and sender mounted in the pannier to the right of the front gunner together with a control panel which carries the rotary transformer switch. Two sockets are provided in the face of the control box either for direct connection of the headsets and microphone or for connection to the operator's intercommunication box.

Sender
 Bag for Phones & Microphone
 Receiver
 Cushion & absorber
 Receiver Dynamotor

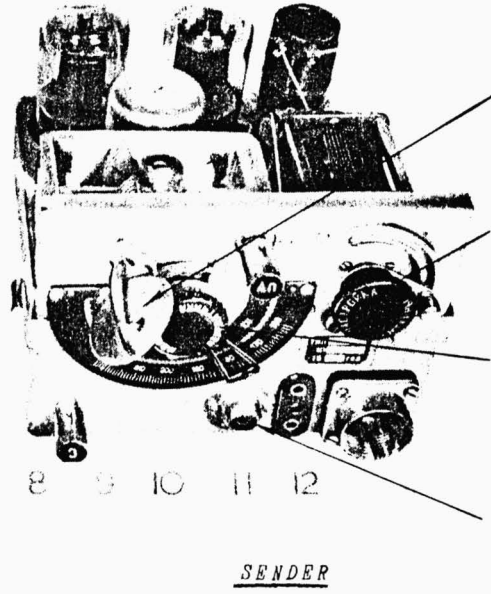


Aerial Lowering Lever
 Aerial Lead-in
 Control Panel
 Intercom Amplifier
 Sender Dynamotor

Antenna
 Flick Device
 Volume
 Slow Motion



RECEIVER



SENDER

Main Tuning Locking Device
 Aerial Tuning
 Main Tuning
 Tuning Lamp

The receiver has only one tuning knob and one volume control. Two flick frequencies are obtainable by adjusting points on the knob. The sender has one tuning knob and a variometer working in conjunction with a tuning lamp.

The two rotary transformers are mounted below the sets and are connected to them and to the control box by braided metal sheathed cables terminating in plugs for engagement with sockets in the various components. The aerial is mounted on an isolated base on the right hand side plate at the front and can be dipped by a lever behind the wireless sets inside the tank.

The intercommunication box is to the operator's right and can be connected to the wireless control box by plugs, in which case the operator's head set and microphone are plugged into the intercommunication box.

The box carries a three-way switch, a push-switch and a lamp. The three-way switch has positions "Set to Self", "Intercom" and "Sets to No. 3", enabling the operator to put the commander on the air. Apart from the operator only the commander and driver are provided with headsets and microphones.

The driver's intercom box is provided with a calling push only and he can speak and hear on the intercom.

The commander's box has a two-way switch, a push switch and an indicator lamp, the two positions of the switch being either "Wireless" or "Intercom".

The headsets consist of two receivers arranged to be carried in the pockets of a crash helmet. The microphone is a high resistance type with wooden mouthpiece and a "press to speak" switch.

The wireless and intercom sets have been examined and tested by the S.R.D.F. who have published a detailed report on construction and performance.

19. MODIFICATIONS

In the course of the examination, certain modifications have been observed between this vehicle and that described in the Russian Handbook. For the purpose of ready reference such variations are tabulated below:

ARMAMENT

76.2 mm. Gun F. 34

The Russian Gun Handbook refers to Models, 1940, 1941 and 1942. It is possible that the Model F. 34 mounted on this vehicle is identical with Model 1942.

SIGHTS

The P T K - 5 sight which is referred to in the Handbook as being mounted in the turret roof door is not fitted.

The Handbook also indicates that a clinometer was fitted to render the telescopic sight TMFD suitable for indirect fire.

No provision is made, however, for the fitting of a clinometer in this vehicle.

ENGINE AND AUXILIARIES

Fuel System

The fuel system installed in the vehicle has considerable differences from that described in the Handbook.

Eight fuel tanks are fitted, an additional tank being mounted at each side of the engine compartment and connected by balance pipes to the lower forward tanks.

The capacity of these additional tanks is approximately 29 gallons giving a total capacity for the eight tanks of 135 gallons.

The compensator tank, bleed tank and fuel pressure gauge have been dispensed with. The bleeder cock, which is piped to a take-off from the top of the main fuel filter now discharges into a funnel-shaped orifice in the second suspension unit housing on the nearside. This considerably reduces the number of fuel lines.

The auxiliary cock in the coupling pipe between the two rear fuel tanks is not fitted. A filler cap is provided only in the offside rear tank and not in both rear tanks as indicated in the handbook. There is no indication of fittings for the carrying of spare fuel on the inclined side plates of the hull.

COOLING SYSTEM

Radiators

The steam valve referred to in the handbook is not fitted in this vehicle.

INSTRUMENT PANEL

The fuel pressure gauge is not fitted. Two thermometers only are installed - one for oil and one for water.

20. LIST OF STOWAGE AND FITTINGS

The following fittings are items of stowage which were received with the vehicle. Particulars of ammunition stowage are given in Para. 5 of this Report.

EXTERNAL

2 Towing Hooks	Rear Plate
2 Track Links	Rear of Track guard, offside
Tool bin for track pins, washers etc.	" " " "
17 Greasers and 2 Horned track links	Centre " " "
1 Shovel	" " " "
1 Web Strap	Front " " "
2 Towing Hooks	Front glacis plate
2 Towing Shackles	In clip on front of track guard, nearside
1 Bin for gun cleaning rod (3 sections)	
Oil (3 Cans), brush and projectile ejector	Track guard, nearside
1 Entrenching tool	Behind above
1 Headlamp	Superstructure side plate, nearside
2 Tow ropes	Rear of track guard, nearside
2 Lifting eyes	Top of turret.

INTERNAL

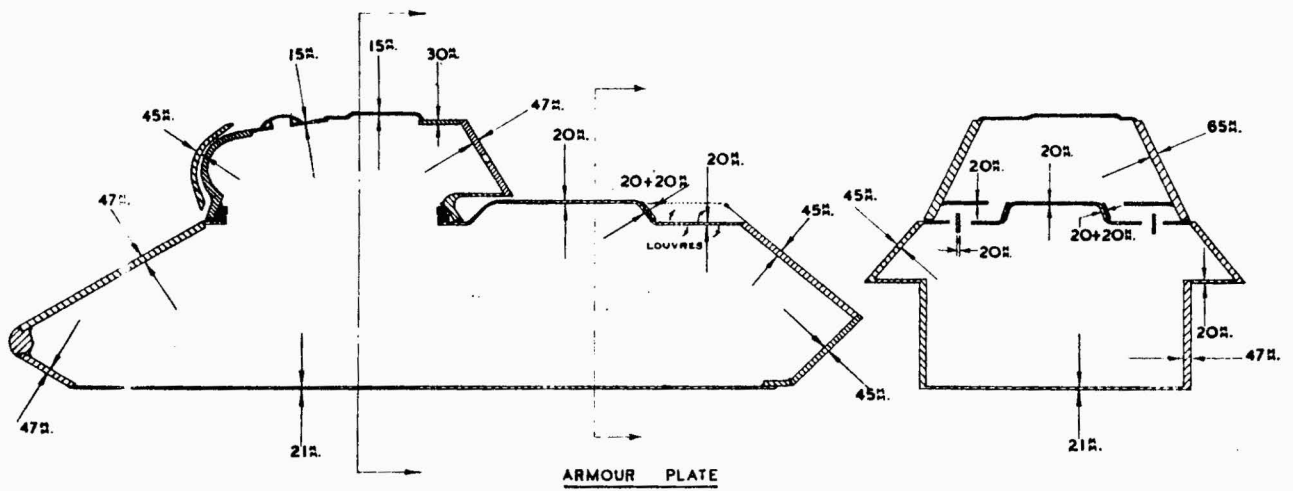
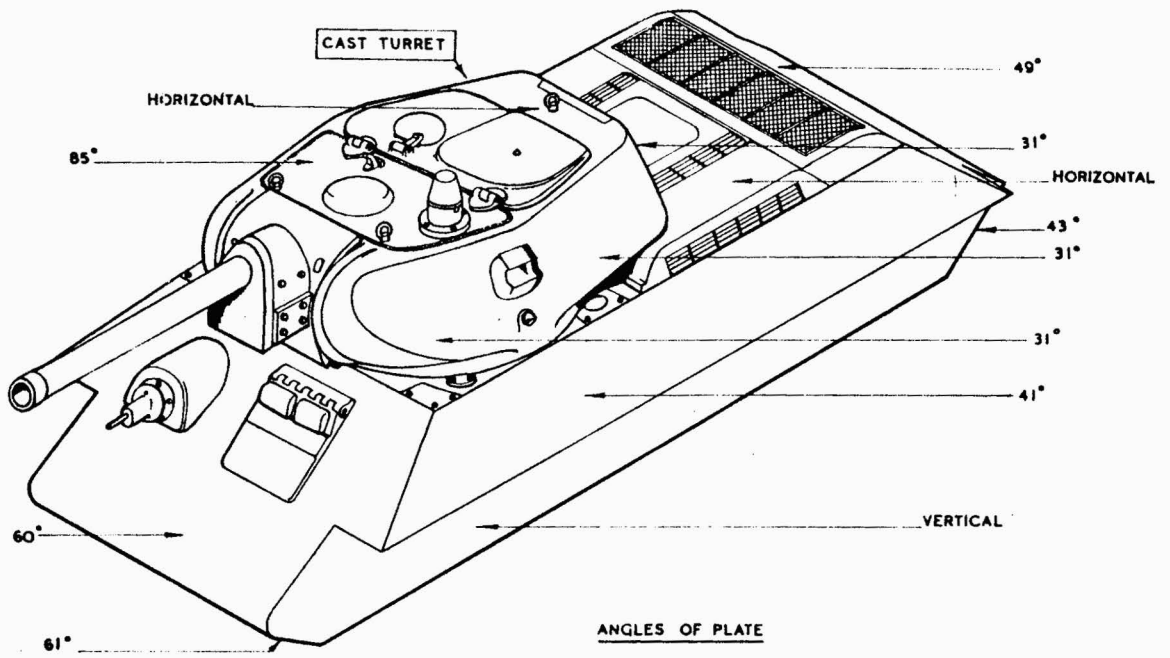
W/T. Head set (Commander)	In canvas satchel, nearside turret wall.
2 Episcopes	Metal strapped box rear of nearside superstructure side wall.
First Aid box, (empty)	Nearside of rear fighting compartment Bulkhead.
2 Episcopes	Metal strapped box rear of offside superstructure side wall.
Water Bottle	In carrier forward on superstructure side wall.
Spare object prism head for periscope	Padded box on forward offside of turret ring.
W/T Set	Offside hull wall, in forward compartment.
2 Headsets (Operator's & Gunner's)	In canvas satchels superstructure side wall
Box containing 4 canvas bags.	Under hull gunner's seat.
Long strap	Offside nose.
2 Straps	Central, above air cylinders.
Log Books etc.	Canvas case, nearside of glacis plate.
Headset (driver's)	In canvas satchel forward on nearside wall.
2 Clips	Forward on nearside hull wall.
Strapped Carrier	Nearside hull wall.
4 Spare episcopes and roll of insulating tape	Nearside hull wall high up under Glacis plate.
Small Clip	On lid

The remainder of the tools, kit, etc., are stowed loose on the floor of the forward compartment and under the driver's seat. It comprises:-

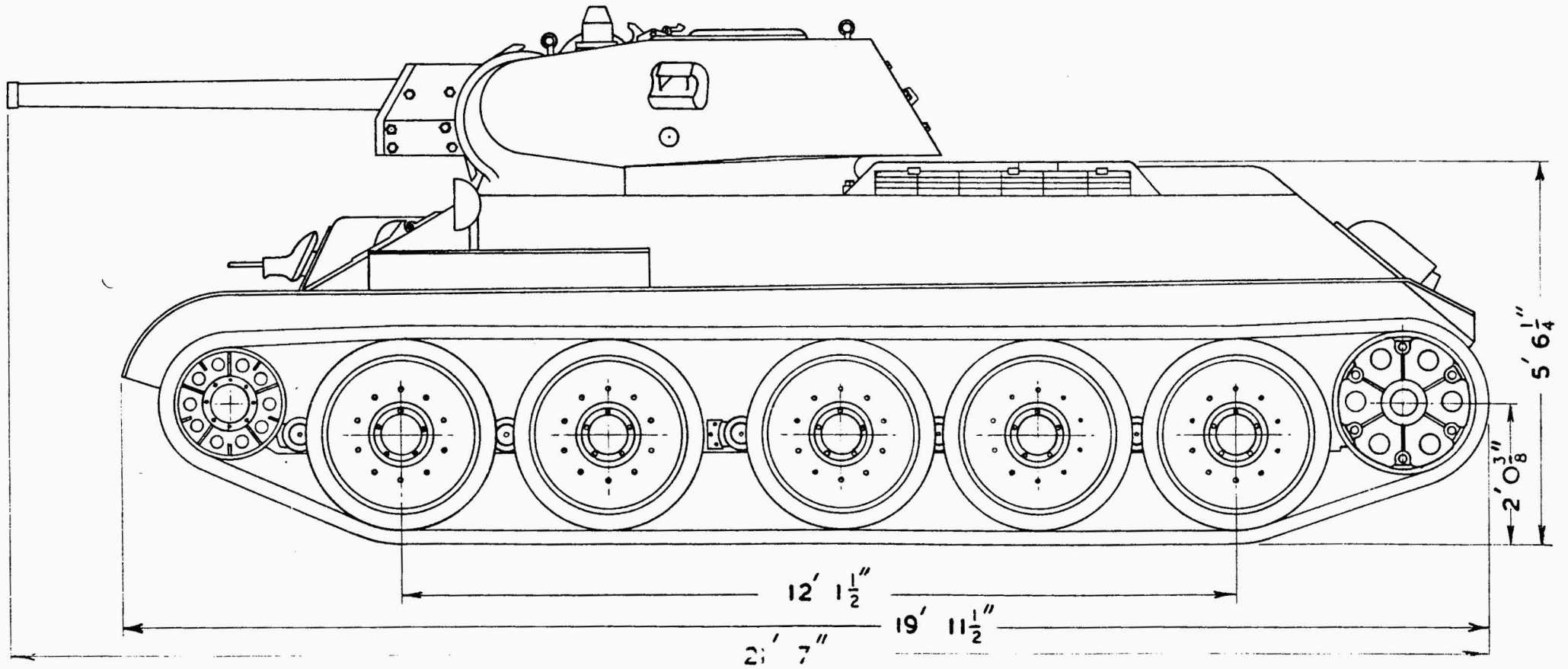
Loading platform for L.M.G. magazines	1.
Spare transparent plastic blocks	2.
Box of spare valves for W/T set	1.
Headsets	3.
Aerial rod (in canvas case) 4 Sections	1.
Wrench and oil pipe adapter (in canvas case)	1.
Canvas Haversacks (worn by crew)	4.
Sledge Hammer	1.
Dipstick (in canvas case)	1.
Inspection lamp (in canvas case)	1.
Hand axe	1.

Spare laminated glass blocks	2.
Box of spare bulbs	1.
Commander's helmet (in canvas case)	1.
Oil can, with fuel funnel, filter and spare nozzles	1.
Canvas water bucket	1.
Canvas map case	1.
Tool holdalls	2.
3' Crowbar	1.
L.M.G. Muzzle covers	1.
" Spare parts envelopes	3.
" bipods and cases	2.
" deflector bags	2.
" breech covers	2.
" tools in case	2.
76.2 mm. gun kit in case	1.
" " set of spares	1.
" " breech cover	1.
Jack knife	1.



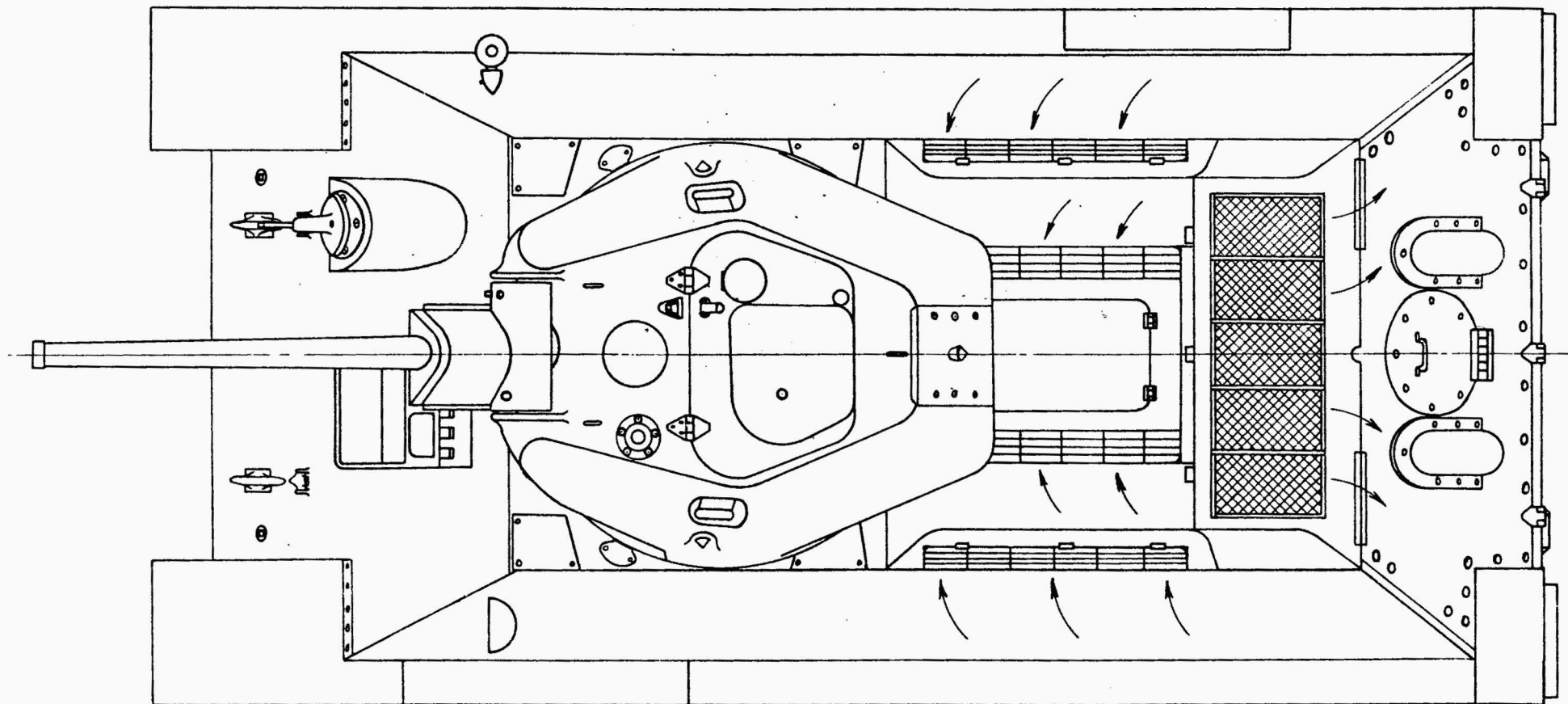


RUSSIAN T. 34.



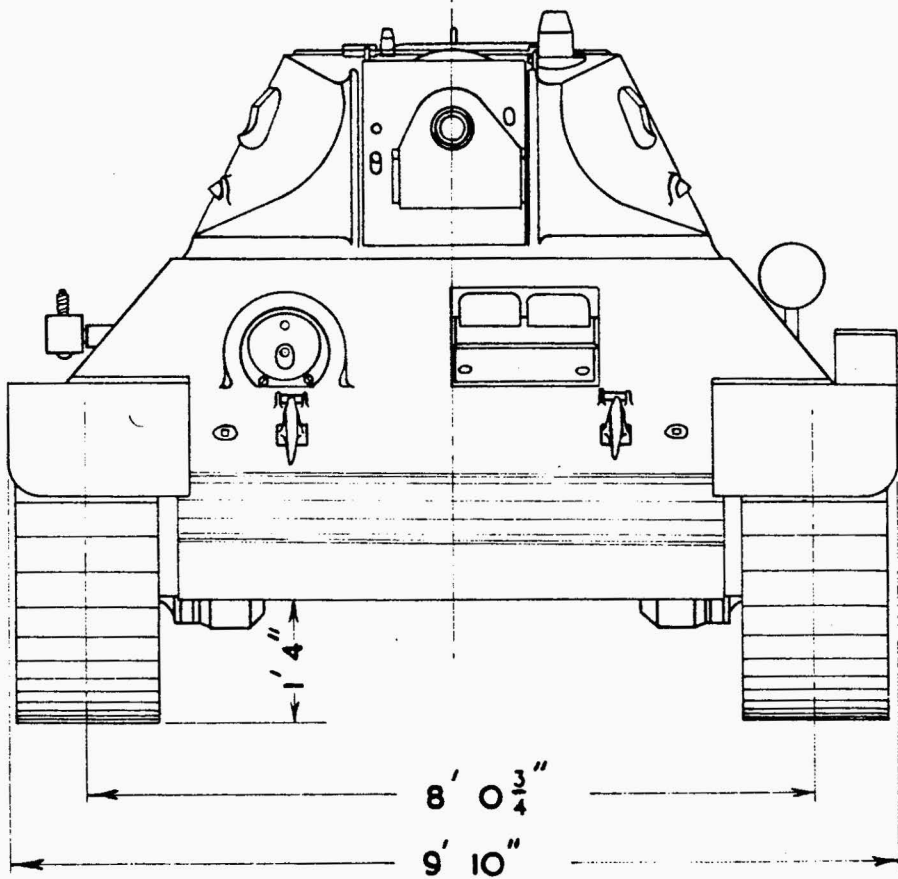
SIDE VIEW.

RUSSIAN T. 34.

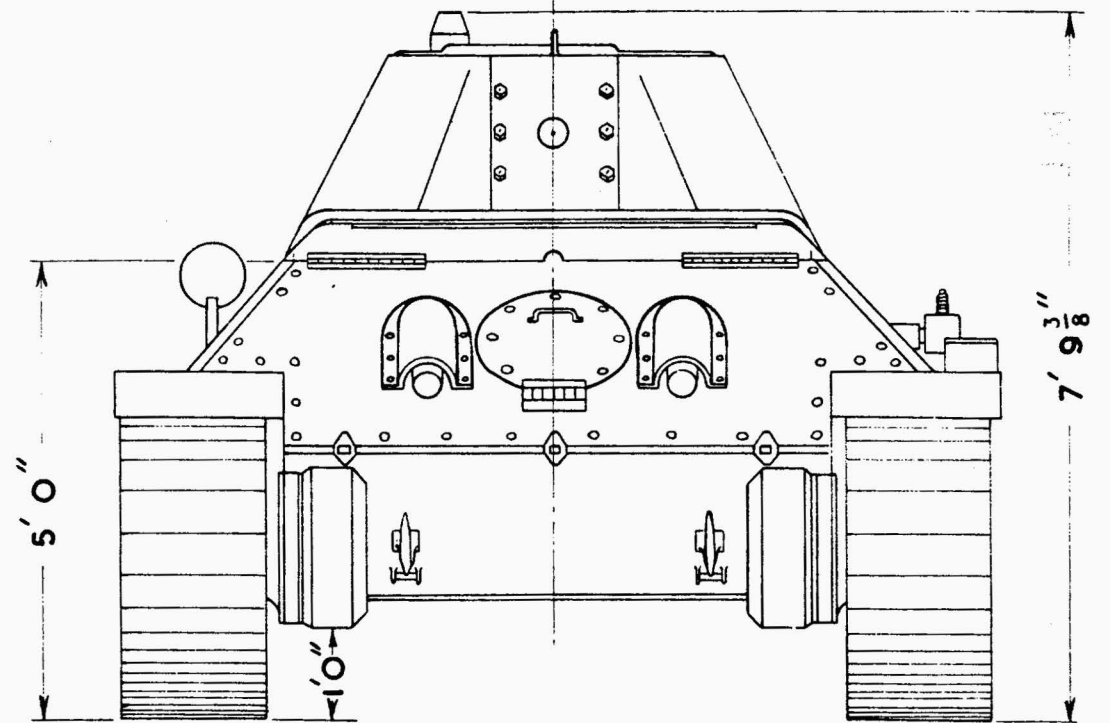


PLAN

RUSSIAN T. 34.



FRONT VIEW



REAR VIEW