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INFORMATION REPORT INFORMATION REPORT

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Att. No. 1 Chapters 1, 2, 6, and 10 of a document entitled "Handbook of the Component Parts and Employment of the T-54 Tank - (Document 'A')." The titles of the available chapters are as follows:

Chapter 1, "General Description of the Tank and its Characteristics", with six drawings.

Chapter 2, "Armored Hull and Turret", with 16 drawings.

Chapter 6, "Running Gear", with 10 drawings; and

Chapter 10, "Particulars Regarding the Use of Tanks in Summer and Winter."

Att. No. 2 A document entitled "Incomplete Russian Handbook - Title Unknown- Subjects: - repairs to (T-54) tank gun - Document 'L'". This provides mainly information on the repair of the breech and of the elevating and compensating mechanisms.

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HANDBOOK

OF

THE COMPONENT PARTS AND EMPLOYMENT

OF THE T 54 TANK

(DOCUMENT "A")

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Chapter 1

General Description of the Tank and its Characteristics

The medium tank T 54 (figs 1, 2 & 3) is a fully tracked battle vehicle possessing a powerful armament, reliable armour protection and a high degree of manoeuvreability. The tank's armament consists of a 100 mm gun and three MGs, including two SGMT machine-guns of 7.62 mm calibre and one anti-aircraft heavy machine-gun DShK of 12.7 mm calibre.

In case of necessity the tank could be equipped with mine clearing blades.

The tank crew consists of four men.

Its main parts are: the armoured hull and turret, armament, power plant and transmission, running gear, electrical system, signals equipment and fire-fighting equipment. The tank contains a maintenance kit of spare parts, instruments and accessories (ZIP).

The tank's hull consists of three sections: the driving compartment, fighting compartment and engine compartment. The driving compartment (fig. 4) is situated in the fore part of the hull. It contains a gear lever and steering clutch controls, linkage, control handles of exhaust louvres, starter button, oil and air pump buttons, instrument panel, battery switch, signal panel of the fire-fighting equipment, portable lamp socket, tank intercommunication system, relay regulator warning lamps to show the barrel of the gun is clear of the tank width, MG, SGMT, driver-mechanic seat, part of maintenance kit, medical chest. The driver's hatch is situated in the hull roof plate over the seat. Two indirect vision devices are fitted in front of the hatch. Torsion bars are situated along the hull floor of the driving compartment and control cables run along the left side. Fuel tanks are fitted to the right of the driving compartment in the fore part of the tank, tank batteries and the basic part of the individual ammunition supply.

The fighting compartment (fig 5) is in the middle of the hull and in the turret. The turret contains the 100 mm gun and the co-axial MG, SGMT, the telescopic sight TSh2-22, vision devices, turret traverse mechanism, wireless-set, three intercommunication devices, part of the ammunition supply and maintenance kit.

The commander's place is in the turret, the roof of which contains his hatch. The loader's hatch is also situated in the turret roof. The anti-aircraft MG is mounted on the turret of the loader's hatch. The fighting compartment contains the following seats: the loader's on the right and the gunner's on the left side of the gun with the commander's behind it. The preheater and the emergency exit hatch are located on the left hand side floor of the tank; extinguishers are situated in the right hand rear corner. On the walls of the turret recess and on the floor of the fighting compartment is part of the ammunition supply. Torsion bars are under the floor of the fighting compartment, and the driving control cables are along the left side wall of the hull.

The engine compartment (fig. 6) is in the rear of the hull and is divided by a partition from the fighting compartment. It contains the engine with air cleaner, gear train housing, main clutch, the gear box, epicyclic steering gear, final drive, fan, middle fuel tanks and lubricating oil tank. An electric starter is mounted on the housing of the gear-train. Water and oil radiators are fitted above the gear box and the steering mechanism. There are louvres in the hull roof plate over the engine, the air cleaner and fan.

In the hull bottom there are a number of hatches for the maintenance of components. Beyond the detachable partition in the engine compartment are situated the fuel supply tap, the fuel pump, lubricating oil pump and a cock to drain fluid from the engine cooling system. Along the bottom are torsion bars.

Attached to the outside of the hull are three fuel tanks, the oil tank, the refueling pump, the maintenance kit, wire cables, a log for recovery, smoke pots,

headlights, lamps, tarpaulin and driver-mechanic's protective hood.

Battle and Technical Characteristics

Type	medium
Battle weight	35.5 - 36 tons
Crew	4 men
Power rating	14.4 - 14.6
Average tank pressure	0.8 - 0.81 Kg per cm^2

Dimensions in mm

Length, gun pointing forward	9000
Length, gun pointing rearward	8485
Length of the hull	6040
Width	3270
Height, without DShK (anti-aircraft machine gun)	2400
With the DShK	2750
Height with DShK in battle position (with maximum angle of elevation)	3830
Width (measured from middle of tracks)	2640
Length of bearing surface	3840
Ground clearance	425
Diameter of turret race	1800

Speed - Km. per hour

Calculated on 1800 engine revolutions per minute:

In gear I	6.78
" " II	14.5
" " III	20.0
" " IV	28.5
" " V	45.0
In reverse gear	6.78

Average speed:	
on dirt road	20 - 25 km.
on metalled road	30 - 33 km.
Maximum speed on metalled road	48 - 50 km.

Fuel consumption per 100 km. in litres:	
on dirt road	280 - 300
on metalled road	180 - 190

Lubricating Oil consumption per 100 km. in litres:	
on dirt road	7 - 11
on metalled road	6 - 8

Rated cruising range (according to quality of fuel) Km.:	
on dirt road	240 - 260
on metalled road	360 - 400

Obstacles to be Overcome

Maximum slope	30°
Maximum angle of tilt	30°
Width of ditch (metres)	2.7
Depth of ford (metres)	1.4
Step (metres)	0.8

/Armament.

Armament. The Gun.

Caliber, in mm	100
Type	D10 - T
Initial velocity, m/sec.	
using armour - piercing tracer shell	895
using anti-personnel fragmentation shell:	
full charge	900
reduced charge	600
Weight in Kg. of:	
an armour-piercing tracer shell	15.88
an anti-personnel fragmentation shell	15.60
a complete projectile (fixed round)	30
tipping parts of the gun without armour	1950
Height of trajectory	1750 mm.
Maximum range of fire in m.:	
using telescopic sight	6900
using clinometer sight	15600
Loading	fixed ammunition
Entire length of barrel, in mm.	5608 (56 calibers)
Breech mechanism	sliding block, semi-automatic, horizontal.
Gun elevating gear	sector (rack) type.
Normal recoil in mm.	490 - 550
Maximum admitted recoil	570 mm.
Amount of fluid in recuperators	4.4 - 4.6 litres
Initial pressure in recuperators	Kg/cm. 53 - 57
Amount of fluid in buffer	6.4 litres.

Machine Guns

Co-axial and fixed

Number	2
Make	SGMT
Calibre mm.	7.62
Initial velocity m/per sec:	
light bullet	865
heavy bullet	800
Maximum range of co-axial MG with the help of sight TSh 2-22, metres	2200
Firing rate, rounds per minute	600 - 700
Maximum (practical) rate	200 - 250
Feed	belt fed
Number of rounds in belt	250

Anti-Aircraft MG

Number	1
Make	DShK
Calibre mm	12.7
Bullets initial velocity m/per sec.	830 - 850
Maximum range using sight, m.	3500
Maximum range of bullet	up to 7000
Rate, rounds per minute	560 - 600
Battle rate, rounds per minute	100
Feed	belt fed
Number of rounds in belt	50

SMG KALASHNIKOV (AK)

Number	1
Make	AK 47
Caliber, mm	7.62
Bullet initial velocity m/per sec.	700
Range, using sight, m.	up to 800
Rate of fire, rounds p.m.	600
Battle rate, rounds p.m.	
of single shot	approx 40
Automatic	90 - 100
Feed	magazine fed
Weight with loaded magazine, Kg	4.79

Signal Pistol

Number	1
Caliber, mm	26

Fire Characteristic of Gun and Co-Axial MG

Traverse	360°
Elevation	+ 17°
Depression	- 4°

Dead Ground, m

for gun	20
for MG	21

Fire Characteristic of Co-Axial MG

Traverse	360°
Elevation	+ 82°
Depression	- 4.5°

Ammunition Battle Supply

for 100 mm gun, rounds	34
for the two SGMT MGs	3000
for the DShK MG	500
KALASHNIKOV automatic	300
Hand grenades F-1	20
Units of Very cartridges	2

Sights and Vision Devices

Gun and Co-Axial MG sight	Telescopic, hinged with interchangeable magnification
Make	TSh 2 - 22
Magnification	x 3.5 and x 7
Field of view	18° and 9°
Anti-aircraft MG sight	Collimating
Make	K - 10T
Longitudinal level	1
Azimuth scale on turret race	1
Vision devices:	
Tank commander's	TPK-1 and 4 periscopes
Gunner's	1 periscope
Driver mechanic's	2 periscopes
Loader's	1 periscope.

Power Plant

Engine

Type	Four cycle, single stage, high speed compression, ignition liquid cooled.
Make	C-54
Maximum power at 2000 revolutions per min in h.p.	520
Maximum torque at 1200-1300 rev/min. Kg	230 ± 10
Number of cylinders	12
Position of cylinders	60° V-engine
Firing order (l indicates left, r indicates right)	11 - 6r - 51 - 2r - 31 - 4r - 61 - 1r - 21 - 5r - 41 - 3r
Cylinder diameter in mm	150
Piston Stoke in mm:	
Left group	180
Right group	186.7

Fuel Supply System

Fuel used	Diesel fuel DL, DZ and DA
Capacity of main fuel tanks, litres made up thus	532
front tanks	217
middle tanks	315
Capacity of external fuel tanks litres	250
Fuel filters	For rough cleaning: gauze: fine: felt, double
Manual fuel pump	Diaphragm mark RNM-1

Air Supply System

Air filter	3-stage with automatic removal of dust
Means of removing dust from dust collectors	Ejectors using exhaust gas energy

Lubrication System

Oil used	MT-16p
(Priming) capacity of lubrication system, litres	82
(Priming) " " oil tank litres	60
Capacity of additional oil tank litres	35
Oil radiator	Tubular
Cooling surface, sq. m.	9
Oil pump	Pinion, 3-section, (one section force pump, two sections evacuating)
Output of pump at 1600 rpm of crankshaft litres/min	62.5
Oil filter	Kimaf ST-3 with two cleaning stages: wire-slit section and cardboard element.
Oil circulation pump (?:MASLOZAKACHIVAYUSHCHY)	Pinion MZN-2 with electric drive

Cooling System

Type	Liquid, closed with forced circulation
(Priming) capacity litres	about 70
Radiator	Tubular
Cooling surface sq. m.	60.5
Water pump	Centrifugal
Fan	"

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Heating System

Type	Liquid with forced circulation
Heater	Force pump with hot tube boiler

Engine Starting System

Main starting system	Electric starter ST-16M
Additional starting system	Compressed air
Number and capacity of cylinders	2 cylinders, 5 litres each

Checking Instruments

Cooling liquid thermometers	2
Oil thermometers	1
" manometers	1
" Tachometers	1

Engine Working Conditions

Temperature of cooling liquid, °C recommended	70-90
permissible for short periods	105
Oil temperature °C recommended	70-90
permissible for short periods	110
" pressure kg/cm² working conditions	6-9
minimum idling speed	not less than 2
rpm of engine crankshaft working	1600-1800
maximum	2000

Power Transmission

Swinging Arm (GITAR)	Pinion step-up gear
Transmission ratio	0.7
Oil used	17T-16p
Amount of oil in housing, litres	6-7
Main clutch	Multi-disc, dry friction
Method of rubbing surfaces	Steel to steel
No. of driving discs	9
" " driven "	8
Drive controlling clutch	mechanical
Gearbox	Constant meshing of pinion teeth with synchro mesh on II, III, IV and V gears
No. of speeds	5 forward, 1 reverse
Transmission ratios: on I gear	60
" II "	2.8
" III"	2.0
" IV "	1.43
" V "	0.9
reverse	6.0
Oil used	17T-16p
Amount of oil in housing, litres	13
Drive to fan	Pinion step up gear with clutch
Radio rpm of crankshaft to rpm of fan	1:1.3
Mechanism for turning tank	Planetary two stage reduction gear.
Transmission ratio	
with clutch engaged	1
with clutch disengaged and turning break engaged	1.42
Interlocking clutches	Multi disc, dry friction steel-on-steel
No. of discs with external tooth	7
" " internal "	6
Brake	Strip, floating with cast iron shoes.

/Drives

Drives for control of mechanisms of turning and stopping brakes	Mechanical
Oil used	Mixture 30% oil UT & 70% oil MT-16p
Amount of oil in each reduction gear, litres	2.5
Slide transmissions	Single stage stepdown reduction gears
Transmission ratio	6.78
Oil used	TSIATIM-208 or mixture 30% UT + 70% MT-16p
Amount of grease in each reduction gear, Kg	4.5

Undercarriage

Engine	Caterpillar with driving wheels in rear position
Caterpillar	Metal, small link, mangle gear
No of track links in each caterpillar (new)	90
Track joints	with steel pins
Width of track mm	580
Pitch of caterpillar mm	137
Weight of one caterpillar Kg	about 1300
Driving wheels	with removable toothed crown wheels
No. of teeth	13
Weight of driving wheel Kg	126
Idlers	Cast with metal rims
Bogies	Double with rubber tyres
No. of bogies	10 (5 on each side)
Weight of bogie, Kg	265
Suspension	Individual, torsion
Elastic element	Torsion bar
Shock absorbers	Hydraulic, connected with balance arms of front and rear rollers
Shock absorber liquid	Alcohol-glycerine mixture (80/10)in accordance with VTU-55 or liquid AZh-170
Quantity of liquid in shock absorber, Kg	1.3-1.5

Electrical Equipment

System	Single wire (except duty lighting)
Supply network voltage, v with engine not working:	24
with engine working:	27-29

Sources of Electric Supply

Accumulator batteries	4
Type	Starter, acid
Mark	6 STEN-140M
Voltage of one battery, v	12
Capacity " " " ah	140
Battery connection	Mixed (parallel groups in series)
Total capacity of batteries, ah	280
Weight of battery with electrolyte Kg	62
Electrical Generator	
Type	DC with parallel excitation.
Mark	G-731
Power, w	1500
Normal voltage	28
Maximum current, a	51-59
Direction of relation of armature	Right, looking from direction of drive
Ratio of rpm of crankshaft to rpm of armature	1:1.75

Relay Regulator	1
Mark	RRT-30
Relay	Back current
Regulator (two)	Vibration type
Current limiter (two)	" "

Electrical Power Consumers

Starter	1
Type	Electrical, DC with series excitation
Mark	ST-16M
Power, h.p.	15
Voltage, v	24
Working current, a	700-800
Rpm corresponding to maximum power	1100
Drive relay	Electro magnetic
Mark	RST-15A
Ratio of No. of teeth of starter pinion and crown wheel of main clutch	1:9.5
Weight of starter, Kg	45
Electrical drive for turret	Regulated by system generator-motor
Mark	EPB-4
Voltage converter	AB-64
Generator voltage, v	Regulated from 0.8 to 18
Power, w	3000
Rpm of armature	3300
Motor for rotating turret	With independent excitation
Mark	MPB-54
Power (on shaft), w	2000
Voltage, v	24
Current required (maximum) a	250
Methods of controlling electric drive:	
by gunner:	by controller KB-4
by tank commander	Command control system with switch button on observation instrument TPK-1
Speed of rotation of turret, degrees per sec: when controlled by gunner	Regulated: minimum 0.1, maximum 10
" " commander	Constant 10
Electric motors	
Combat section fans	Two, MV-42
Force spray burner	One, MV-42
Oil circulating pump	" MN-1
Power, w	175
Voltage, v	24
Current required, a	not more than 18
Electric triggering	
Guns	Remote, with relay RT-9
Machine guns	" with special relay
Auxiliary instruments	
Revolving contact device	VKU-27
Battery switch	VB-404
External starting socket	One for starting engine from external current supply
External charging terminals	Two for charging batteries as above
Electric filters	Two FG-51A and FG 57 AB
Volt-ammeter	One, magneto electric, VA-240 for measuring voltages 0-304 and currents 20-0-60 A.

/Communications

Communications Apparatus

Radio Set	Receiver-Transmitter, Simplex R/T-W/T
Mark	10RT-26E
Range on RT using 4 metre rod aerial, km	Stationery / Travelling
Summer: day	Up to 14 / Up to 11
night	Up to 9 / Up to 7
Winter: day	Up to 20 / Up to 15
night	Up to 9 / Up to 7
with no external interference (on selected wave lengths)	35-40 / 23-25
Supply	From tank network
Voltage, v	26
Current required A: on reception	Up to 4
on transmitting	Up to 9.5
Tank intercomm	TPU-4-47
Location of apparatus: commander	Apparatus No. 2
gunner	" No. 1
driver mechanic	" No. 3
loader	" No. 3

Fire Fighting Equipment

Type of installation	Semi automatic, carbon dioxide
No. of cylinders of carbon dioxide	3
Weight of carbon dioxide in each cylinder Kg	1-8-2
Warning of fire to driver mechanic	Signal lamps and sound signal
No. of thermo electric warning devices	6
Method of bringing installation into action	Push buttons (two: one for driver-mechanic one for loader)
Hand fire extinguisher OV-2	1

Smoke Release Apparatus

Smoke cartridges	Two BDSh-5

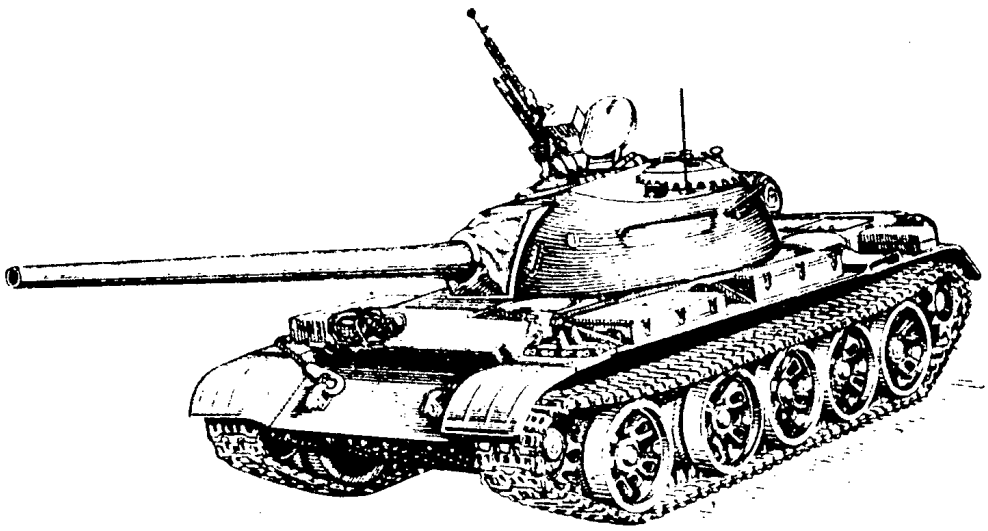

Fig. 1. T-54 Tank (General view)

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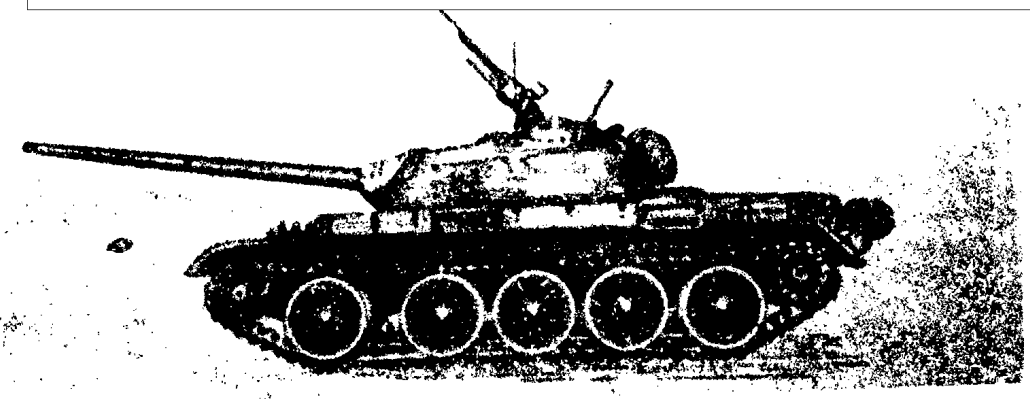

Fig. 2. T-[illegible] Tank (Side view)

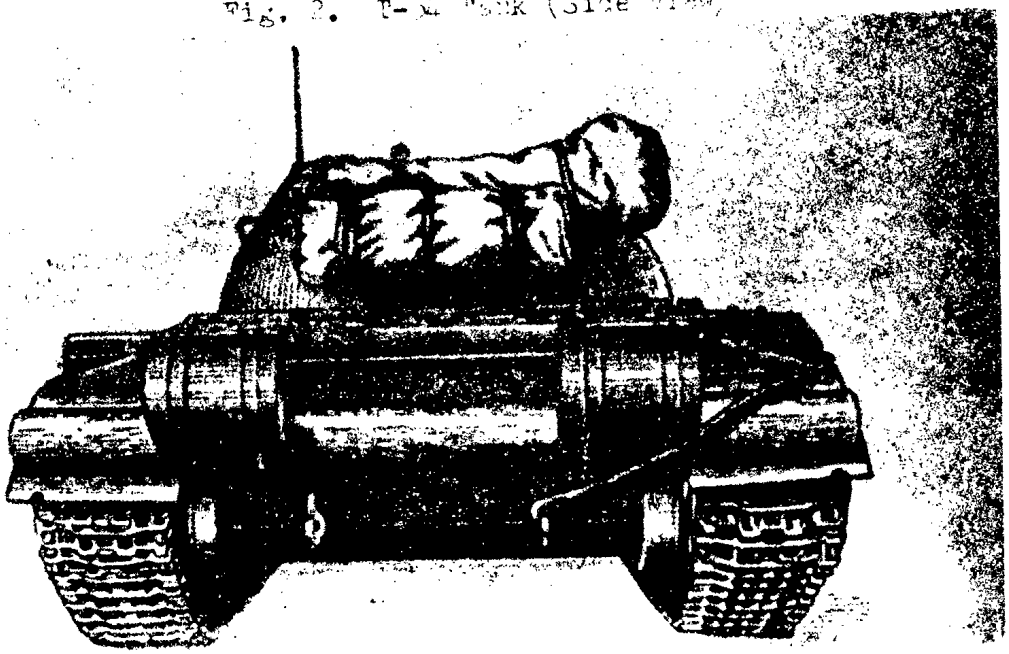

Fig. 3. T-[illegible] Tank (Rear view)

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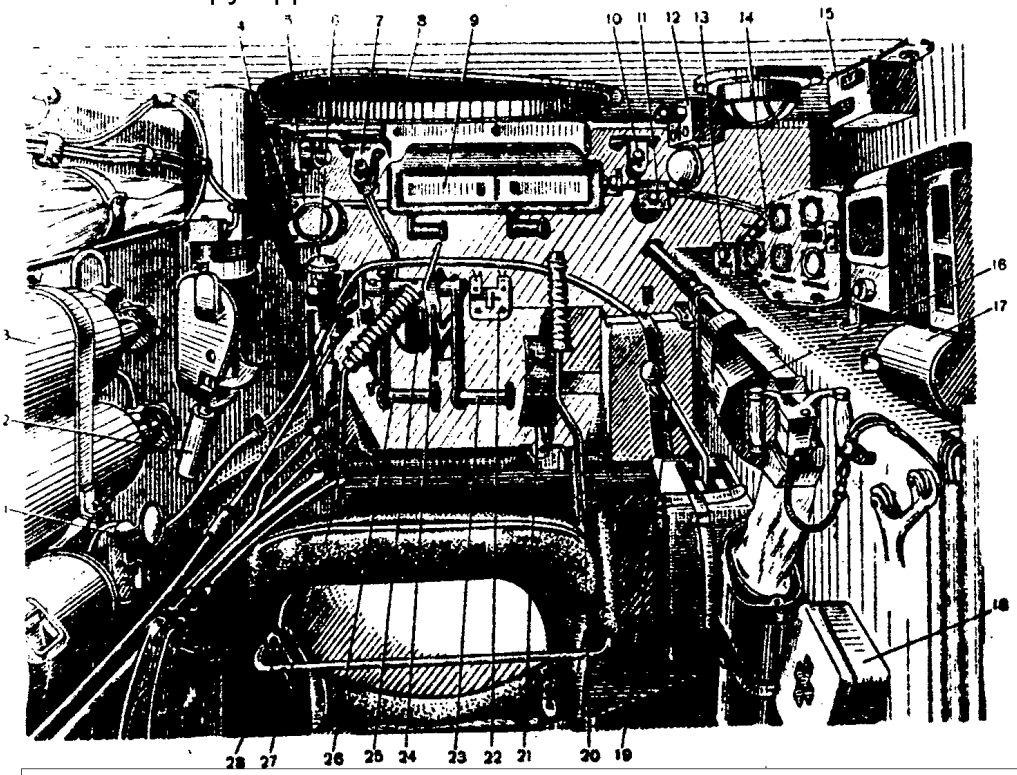

Fig. 4. Drivers Compartment.

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1. Air starting (?) tap.
2. Handle of the closing mechanism of the driver-mechanic's hatch cover.
3. Air tank.
4. Control handle of the outlets of the louvres.
5. Tachometer.
6. Handle of the hand gear/drive (?) of the NK-10 pump.
7. Signal lamp shewing when the gun barrel protudes beyond the limit of the width of the tank.
8. Driver-mechanic's hatch cover.
9. Driver-mechanic's observation fixtures.
10. Signal lamp shewing when the gun barrel protudes beyond the limit of the width of the tank.
11. Button of the lubricating oil pump
12. PPO (?) signal dashboard.
13. Starter button
14. Control instruments dashboard.
15. No. 3 set tank intercom apparatus (driver-mechanic's)
16. Machine gun.
17. Battery switch.
18. Medical chest.
19. Gear lever.
20. Steering and braking control levers.
21. Control pedal of the NK-10 pump.
22. Headlamp terminal switches.
23. Brake pedal.
24. Handle of the brake pedal lock.
25. PPO signal.
26. Main clutch pedal.
27. Steering and braking control levers.
28. Driver-mechanic's seat.

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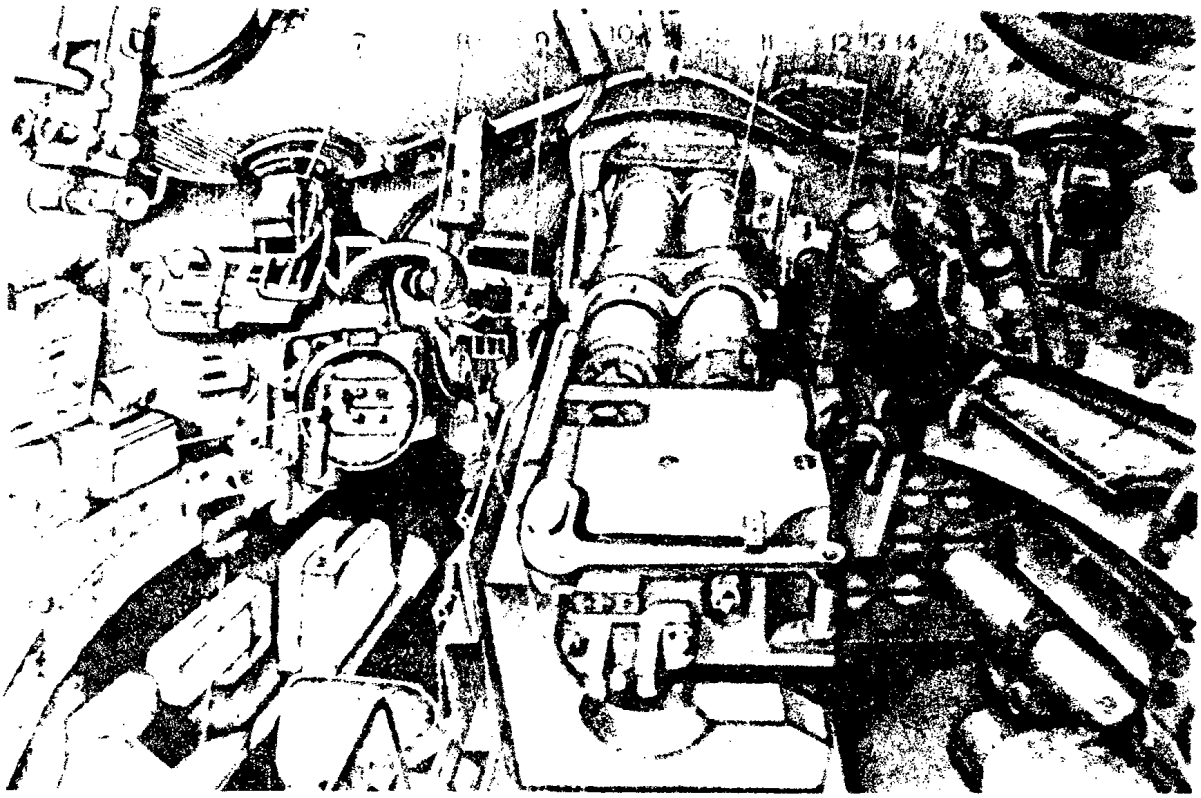

Fig. 5. Fighting Compartment.

1. Turret stop.
2. Turret turning mechanism.
3. Tank intercom transformer.
4. No. 2 set tank intercom apparatus. (Commander).
5. No. 1 set tank intercom apparatus (Gunner).
6. TPK-1 observation instrument.
7. Gunner's observation instrument.
8. TSh2-22 sight.
9. Switch of the electrical trigg[50X1-HUM] of the gun and co-axial machine gun.
10. Gun locked position stop.
11. Gun.
12. Fighting compartment ventilator.
13. Co-axial machine gun.
14. Drinking water canister
15. Loader's observation instrument.
16. No. 3 set tank intercom apparatus (Loader's).
17. Submachine gun.
18. Main stowage of gun ammunition.
19. Loader's seat.
20. Handle of the controller.
21. Handle of the gun elevating mechanism.
22. Longitudinal level.
23. Gunner's seat.
24. Lamp.
25. Tank commander's seat.

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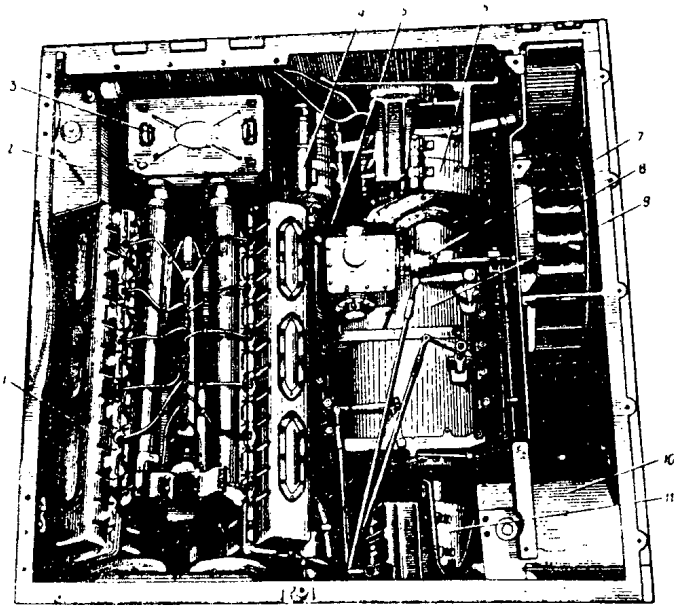

Fig. 6. Power unit.

1. Motor.
2. Central fuel tanks.
3. Air filter.
4. Starter.
5. Main clutch.
6. Turning mechanism.
7. Ventilator drive.
8. Ventilator.
9. Gear box.
10. Oil tank.
11. Turning mechanism.

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The running gear (Fig 156) of the tank consists of the caterpillar drive and suspension.

Caterpillar Drive

The caterpillar drive consists of two caterpillars, two driving wheels, two idler wheels with mechanisms for tightening the caterpillars and ten bogies.

The caterpillar drive provides for longitudinal motion of the tank. It ensures good performance in difficult terrain and good positional manoeuverability.

Caterpillars

The caterpillars are metallic with small links and bobbin meshing. Each caterpillar consists of 90 tracks and an equal number of pins.

The Track (Fig 157) takes the form of a shaped steel casting with two openings for engaging with the teeth of the driving wheel, and a comb preventing the caterpillar from coming off when turning and heeling which also directs the movement of the caterpillar over the bogies and idler.

On the outer surface of the track in contact with the ground are treads which increase the strength of the track and improve the grip of the caterpillar on the ground. The inner surface of the track is smooth on both sides of the comb and forms the track in which the bogies run.

Holes are made in the lugs of the tracks for the pins which link the tracks.

The Pins of the caterpillars have a head at the end nearest the tank body. The head prevents the pin from coming out of the lug outwards. If a pin should come out on the side next the body it is knocked back into position as the caterpillar revolves by the strikers on the cover of the side transmission and on the side plate of the body.

To put on one caterpillar when the other is already in position it is necessary to proceed as follows:

1. Spread out the caterpillar in front of the first supporting roller (the pins should have their heads on the body side and the tracks with 4 lugs ahead.

2. With the first transmission drive the tank on to the caterpillar, guiding the caterpillar with a crowbar till the rear bogie reaches the second last track.

3. By means of the tension mechanism move the idler as far as possible to the rear.

4. Fix a cable to the front track; the other end is passed upwards between the rims of the idler and the bogies winding it on the hub of the driving wheel and making three turns. Brake the tank by placing the control lever on the side with the caterpillar on in the second position.

5. Engage the drive for reverse travel and pull the upper branch of the caterpillar till the front track engages with the driving wheel. The free end of the cable should be pulled to set up the necessary force of friction between the cable and the driving wheel.

6. Disengage the transmission and remove the cable detaching it from the driving wheel and caterpillar.

7. Engage the reverse gear and having pulled the upper branch brake the driving wheel having set the control lever in the second position.

8. Align the eyelets of the tracks and by means of a conical pin join up the track substitute the normal pin for the conical pin

9. By means of the tension mechanism regulate the tension of the caterpillar.

If it is necessary to put on both tracks, haul the tank by towing it on to the tracks laid out on the ground and out them on in succession as described above.

Driving Wheel

The driving wheels are located at the rear. A driving wheel (Fig 158) consists of a hub 1 with two toothed crowns (4). On the outer side of the hub there are openings to prevent the accumulation of mud or snow between the caterpillars and the driving wheel on the side next to the body of the tank the labyrinth packing wheel (2) is pressed into the body of the hub and welded at six points.

The toothed crowns are fixed to the flanges of the hub of the driving wheel by the bolts (3), the crown nuts of these being cottered. The driving wheel is set on splines on the driving shaft of the side drive and is prevented from moving axially by a plug screwed into the buttend of the shaft. This plug is prevented from coming loose by a toothed washer set on the splints of the driving shaft between the hub of the driving wheel and the plug.

Into openings in the toothed washer pass the ends of stop bolts which are screwed into the plug. One of the bolts is locked with a bent washer and the other with wire together with the plug which covers the opening for lubricating the side transmission.

Bogies

The tank has five bogies on each side. The bogies on the left side are set 105 mm further back than those on the right hand side. This non-aerial distribution of the bogies is due to the disposition of the torsion shafts of the suspension.

A bogie (Fig 159) is doubled, with rubber tyres. The disc (8) of the bogie is of steel. Two metal bands (10) with rubber tyres (9) are pressed on and welded to the disc of the bogie.

The bogies are set on the axis on ball and roller bearings. The outer rings of the bearings are pressed into the hub of the disc and the inner rings are freely fitted on the axis of the roller. Bearings have an inset shoulder made with the object of improving the reliability of the bearing under the action of axial loading. Between the internal rings of the bearings is placed the thrust cellar (11). The nut (3) prevents axial displacement of the bogie: it is screwed on to the axis and cottered.

On the inner side of the bogie the hub of the disc is closed by the cover (13) of the labyrinth packing. The cover is fixed with bolts with spring washers and packed with an interlayer with red lead.

On the neck of the axle of the bogie two rubber self adjusting packings (14) are fitted these being held in position on the axis by a retaining ring. The rubber cuffs of the packings are permanently pressed against the cover of the labyrinth packing by spring rings (the rings may be of circular cross section or laminated). The labyrinth ring (15) is pressed against the axis of the bogie and welded to the rocker.

On the outside the hub of the bogie is covered with an armoured cap (2). Under the cap is a cardboard packing (6) with white or red lead. Two of the six threaded holes under the bolts fixing the cap pass into the internal cavity of the hub. They are used for lubricating the bearings. The heads of the belts (5) screwed into the hole (7) are painted red and the hub is thickened at these holes.

Idler wheel

The idler wheel (Fig 160) is of steel cast and reinforced with ribs for strength. Its function is to guide the caterpillar when running and along with the tension mechanism, to change the tension in the caterpillars.

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The idler wheels are at the front. The right and left idler wheels with the tension mechanism are interchangeable.

The idler wheel is mounted on the short axle of the crank (4) on two bearings, a ball bearing and a double-row roller bearing. The outer rings of the bearings have a mobile (free) fit in the hub of the wheel while the inner ring is pressed on to the axis. Between the inner rings of the bearings are fitted the thrust ring (6) and the floating washer (8). The idler wheel is prevented from moving axially by the nut (5) which is cottered.

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On the inner side the hub is covered by the cover (11) of the labyrinth packing. The cover is fixed by bolts (27) with spring washers and packed with an interlayer with red lead. Inside the cover the felt gland (12) and self adjusting rubber gland (10) are placed in annular grooves. Between the cover of the labyrinth packing and the roller bearing is mounted the floating washer (26). The labyrinth ring (13) is pressed on to the axle and is welded to the body of the crank.

On the outside the armoured cap (3) is fixed to the hub of the disc with bolts, and under it is a cardboard interlayer with red lead. If necessary lubricant can be filled into the armoured cap.

Caterpillar Tension Mechanism

The mechanism consists of the crank (4) and two worm pairs.

The axle of the crank is mounted on the bracket (24) which is welded to the body of the tank within the bracket is located the orifice (25) which is one of the supports of the axis of the crank. The second support of the crank is the bracket itself. To reduce friction, between the axis of the crank and the supports two threaded brass bushes (17 and 21) are fitted, the ends of these being rolled out (expended) to prevent movement.

In order to prevent water and mud getting into the tension mechanism, a rubber packing ring (16) is fixed in the orifice.

The rear worm (23) and the worm pinion (18) are used for rotating the crank round its axis this altering the tension of the caterpillar.

The worm pinion (18) is freely fitted on the axle of the crank with splines, enabling the crank to be moved in relation to the pinion.

To hold the crank with the idler wheel in the rear position and take the load off the worm pair on the face of the cheek of the crank, triangular teeth have been made which engage with teeth on the bracket of the body. The hood (14) protects the teeth from mud.

The crank is disengaged by means of the front worm (19) and the worm pinion (22) and for this purpose the latter is fitted on the axle of the crank on a thread. A floating ring (20) is mounted between the worm pinions (18 and 22).

Each worm rotates in two bushes: lower cast-iron bushes (28) pressed into openings in the bracket and upper bronze bushes (30) screwed into the bracket and locked by bolts (29).

The tail-ends of the worms terminate in square heads. Access to the heads is obtained through openings closed by plugs (32). Under the plugs are fitted copper gaskets on the head of the front worm is slipped a stop washer which prevents random rotation of the worm.

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To tighten or loosen the caterpillar it is necessary:

1. To release the turnscrew of the front mud shield from the bracket and raise the cover on its hinges.

2. Unscrew the plug by means of a twist-key and remove the stop washer from the front worm.

3. By relating the front worm disengage the teeth on the crank from those on the bracket.

bracket. Rotate the worm on the right hand guide wheel anticlockwise and that on the left hand guide wheel clockwise.

4. By rotating the rear worm tighten or loosen the caterpillar.

5. By rotating the front worm engage the teeth on the crank with those of the bracket.

6. Loosen the rear worm having turned it slightly in either direction.

7. Replace the stop washer and copper gasket and screw up the plug.

Suspension

The suspension softens impacts and jolts acting on the body of the tank when moving. To damp out rapidly vibrations of the body of the tank caused by passage over irregularities of the terrain or roads and also after surmounting an obstacle, the suspension is equipped with shock absorbers.

The suspension of the tank (Fig 161) is individual and torsional. It includes components connecting the body to the bogies: the torsion shaft (10) the balance arm (2) the balance arm support (11) the stop (9) and the hydraulic shock-absorber (6).

Torsion shaft

The elastic element of the suspension is the torsion shaft (6) (Fig 162) which takes the form of a circular steel rod with a small and a large splined head.

At the end of the torsion shaft with the large head there is a smooth cylindrical surface under a roller bearing. The small head of the torsion shaft is mounted in a splined opening in the bracket (13) welded to the body. The ground part of the large head is connected partly with the balance arm and the smooth cylindrical rests on the roller bearing (7) mounted on the support of the balance arm. The torsion shaft is prevented from moving by the stop ring (5) and the cover (17).

In the end face of the torsion shaft on the side nearest to the large head there is a threaded aperture for removing the shaft.

Since one end of the torsion shaft is rigidly fixed to the body of the tank and the other to the balance arm, when the roller passes over an obstacle the balance arm rotates and twists the torsion shaft. Owing to the twisting of the torsion shaft, jolts and impacts picked up by the body of the tank are softened.

The torsion shafts of all the three balance arms are identical in dimensions but the shafts of the 1st, 2nd, 3rd and 4th left hand balance arms and the 5th right hand balance arm are not interchangeable with the shafts of the 1st, 2nd, 3rd and 4th right hand balance arms and the 5th left hand balance arm.

The cause of the non-interchangeability of the torsion shafts is due to the fact that the shafts have different direction in twisting and they are subjected to twisting in this same direction in the preliminary tests carried out at the factory.

On the face of the heads of the torsion shafts of the 1st, 2nd 3rd and 4th balance arms on the left and the 5th balance arm on the right there is marked the letter "L", and on the remaining shafts the mark "AL".

In order to seal the body of the tank hermetically, the splined heads of the torsion shafts are smeared with a sealing lubricant before mounting (the lubricant consists of 27% kaolin, 27% wax, 12% rosin, 17% gun grease, 12% red ochre and 5% turpentine)

Balance arm and Supports

The balance arm 1 is of stamped steel made in one piece with the axle of the bogie and the axle of the balance arm. It is mounted on two supports. One support

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is the bracket (13) with a bronze bush (14) pressed into a hole in it, the other support being the roller bearing (7) placed in the support (8). The balance arm is prevented from moving longitudinally by a support with a projection which goes into a groove in the limiters (2) screwed by bolts to the balance arm. 50X1-HUM

Between the limiter and the balance arm are placed gaskets (3) and by means of these the position of the bogies (tracks) are adjusted in relation to the driving and idler wheels.

The bush (14) in the bracket is lubricated through an opening covered by the plug (15). To prevent contamination or leakage of the oil glands (10) and (11) are fitted.

The 1st and 5th balance arms differ from the others in having eyelets for connection with the arm of the shock absorber.

The 1st, 2nd, 3rd and 4th balance arms on each side are set in the direction of travel of the tank and the 5th in the reverse direction.

To limit the maximum angle of twist of the torsion shaft, stop (21) is fitted. To cushion the impact of the balance arm against the stop a buffer is placed in the body of the balance arm. This consists of two rubber rings (18) a washer (19) and nut and bolt, (20) (on the 1st and 5th balance arms)

On the outside of each stop a cross is marked for setting the balance arm in relation to the stop with normal angle of twist of the torsion shaft.

To protect the first balance arms from bending under the action of axial loads on the supporting rollers, limiters (8) are welded to the sides of the tank (Fig 161)

Stop (8) (Fig 162) of the balance arm is fixed to the bracket with bolts. In the base of the support fifteen rollers are fitted. On the outer side the rollers are covered by a cover fixed with bolts. The felt packing (4) protects the roller bearing from contamination and the lubricant from running out, the latter being put in during assembly.

Opening (16) in the support is for knocking out the torsion shaft in case of its fracture in use.

Hydraulic shock absorbers

Four hyraulic shock absorbers are fitted on the tank. They are connected with the balance arms of the front and rear supporting rollers.

The hydraulic shock absorbers (Fig 163) consist of a body (1) partition (4) shaft (7) with vanes, a cover (6) and crank (5).

The body of the shock absorber is of pressed steel. Within the body a cylindrical bore is made for fitting the partition and the shaft carrying the vanes. In the end wall of the body is a recess which serves as a support for the shaft carrying the vanes. In the upper part of the body there are two openings. One opening, closed with a plug (15) is used for pouring the fluid into the shock absorber and the opening with the plug 16 is for letting the air out of the shock absorber during filling with fluid. The plug 15 is coloured red.

On the outside of the body of the shock absorber are two flanges with six holes for fixing the shock absorber to the body of the tank.

The partition (1) (Fig 164) takes the form of a steel disc in which there is a recess and a flange with holes on the side next the cover of the shock absorber and on the other side two projections. In each of these projections on the partition there is a dead-end hole, made to increase the capacity of the reservoir chamber which is formed by an annular recess in the partition and cover. In the body of the projections are mounted the spherical valves (3) (Fig 163) which allow fluid to pass from the resevoir chamber to the working chamber. The balls of the valves are prevented from falling out by stop pins (2). 50X1-HUM

The internal bore of the partition serves as the second support for the shaft carrying the vanes. Two annular grooves in the inner bore of the partition collect the liquid drawn through from the working chambers of the shock absorber through the gaps. To draw off the liquid from the grooves to the reserve chamber slanking holes are drilled in the body of the partition opposite each of the annular grooves.

On the cylindrical part of the partition there are milled: a groove a forming a chord and a groove to parallel to the axis of the partition. Channel (a) terminates in a radial piercing hole when the partition is fitted in the body of the shock absorber the grooves coincide with two openings in the upper part of the body of the shock absorber.

Groove (a) is for communication between the reserve chamber and the filling hole and groove (b) for communication between the working chambers and the air-outlet hole.

For sealing the working chambers of the shock absorber, a rubber ring (12) is fitted in the body of the partition; it rests in a circular groove on the outer cylindrical surface of the partition. The partition with the cover (b) is fixed to the body of the shock absorber by bolts (14) which are cottered in pairs with wire. Between the flange of the partition and the body of the shock absorber is placed a pile of cardboard regulating washers with white or red lead. Under the cover is placed a cardboard packing gasket (10).

The shaft (7) is made in one piece with the vanes. In each vane is fitted the working valve (13) which covers two holes drilled in the vane. The flap of the valve is pressed to the vane with a spring. The spring is held on the valve by a locking nut. On the splined end of the shaft carrying the vanes is pressed the lever (5). Hair lines are cut on the end of the shaft and the lever to indicate the position of the lever in relation to the shaft. To remove the lever from the shaft, there are two projections on the lever for gripping with the stripper.

To prevent leakage of the fluid from the shock absorbers and to protect them from dirt, a self adjusting rubber packing (11) and a felt packing (8) are fitted.

The shock absorber works as follows. The blades on the shaft and the projections on the partition divide the volume within the body of the shock absorber into four working chambers (Fig 165).

If the supporting roller is raised in relation to the body, the balance arm rotates the lever of the shock absorber and with it the shaft carrying the vanes. Under the pressure so set up in the chambers A the working valves open and fluid passes through the holes into chambers B (Fig 165a).

If the supporting roller moves downwards relative to the body the vanes rotate in the direction opposite to that described above and pressure is set up in the chambers B. Under the action of this pressure the valves close and the fluid is forced into chambers A through the radial and face gaps between the vanes and the body of the shock absorber (Fig 165b).

The friction of the fluid as it flows through the holes in the working valves and through the gaps between the vanes and the body of the shock absorber sets up a force of resistance under the influence of which the vibrations of the body are damped out.

To reduce the force of shocks acting on the hull when moving i.e. to reduce the jolting of the hull the resistance of the shock absorber when the bogie rises will be less than when it moves downwards since the working valves in the blades let fluid through the holes only when the balance arm is raised.

The first shock absorber on the left is interchangeable with the fifth shock absorbers on the right and the first on the right with the fifth on the left.

When the amount of fluid in the working chambers is reduced, it is made up from the reserve chamber through the holes in the fixed partition, these being closed with ball valves.

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The shock absorber is fixed with bolts to a bracket welded to the body of the tank. Between the flanges on the body of the shock absorber and the bracket a cardboard packing smeared with red lead is placed.

The levers of the shock absorbers are connected with eyelets in the ends of the balance arms by links and two pins which are prevented from falling out by other pins.

To increase reliability chilled steel bushes with rubber packing rings are pressed into the eyelets of the links.

Maintenance of the running gear

At checking examination (at short halts):

- Check the tension of the caterpillars and if necessary correct the tension

- See that there is no leakage from the bogies idler wheels and hydraulic shock absorbers

In technical maintenance No.1

- Clean the running gear of mud (from snow in winter)

- Check by external inspection the state of the parts of the running gear and the correctness of the tracks of the caterpillar

- See that there is no leakage from the bogies idlers and hydraulic shock absorbers; if leakage is occurring, dismantle the shock absorber, replace defective parts assemble and replace it

- Check that there are plugs in the lubrication holes

- Check the tension of the caterpillars and correct it if necessary

In using the tank on sandy terrain or in snow the caterpillars should be loosened so that the upper branch touches the four rear or all five bogies. When surmounting anti-tank obstacles, for travelling on cobbles or roads with hard surfaces or in mountainous country and on activities, the caterpillars should be adjusted so that the upper branch touches the three centre rollers. In use in marshy country the caterpillar tension should be such that the upper branch touch the middle roller only. With user and slackening of the tension of the caterpillars when it becomes impossible to tighten them by the tension mechanism, one track-link should be removed from each caterpillar. After three or four track-links have been taken out of each caterpillar it is recommended that the right driving wheel should be put on the left side and the left wheel on the right and that the caterpillar pins should be replaced by new ones. Running can be continued until three more tracks have been discarded. After removal of 6-7 tracks from each caterpillar and it is no longer possible to tighten the caterpillars they may be replaced.

In technical maintenance No.2 all the work in technical maintenance No.1 should be done and in addition check:-

- the tightness of the bolts on the idler wheels, balance arm supports, bogies, driving wheels and hydraulic shock absorbers, the check is carried out by striking the nuts (bolts) with a hammer and by means of a key check.

- that the nuts (plugs) fixing the driving wheels to the driving shafts of the side transmissions are tight

- the state of the rubber tyres on the bogies.

In technical maintenance No.3 carry out all the work in technical maintenance No.2 and in addition

- top up the bogies with lubricant US. Before topping up unscrew the plugs in both holes in the high (wide) booms of the hubs of the bogies after which top up through the holes which will be found in the lower position till oil runs out from the opposite hole.

- check by external inspection the state of the labyrinth packing of the bogies and idler wheels and also the state of the tension mechanisms; if any fault is found which necessitates dismantling an assembly the bogies, idler wheel or tension mechanism should be dismantled and the defective parts and old lubricant replaced; in re-assembling wash all parts in diesel oil; before replacing bearings they should be liberally smeared with US lubricant; topping up the lubricant in the bogies (idlers) should be carried out after re-assembly.

- check the state of the balance arms, the fixing of the supports of the balance arms and the buffer device (by external inspection)

- lubricate with US lubricant the bush of the balance rod axles (through the holes in the balance arm brackets)

- check the fixing of the hydraulic shock absorbers the state of the connecting pins and bushes of the levers of the shock absorbers and see that there is no leakage of fluid. If the badly-worn replace the pins and bush and where there is leakage of fluid, remove the shock absorber and correct the defect.

Changing of the oil in the bogies, idler wheels and tension mechanisms and of the oil in rollers in the supports of the balance rods takes place after 4000 km or when these assemblies are dismantled.

Topping up the shock absorbers The shock absorbers are topped up with fluid AZN 170 or a mixture (90/10) of alcohol and glycerine (VTU-56) consisting of 90% distilled glycerine of high or first grade (GOST 6824-54) diluted with boiled or distilled water to a concentration of 88% and 10% rectified Ethyl alcohol (GOST 5962-51) with strength 95%. This mixture is supplied made up to units.

To top up the shock absorbers it is necessary to

- desconnect and remove the upper branch of the caterpillar from the rollers

- take off the link connecting the lever of the hydraulic shock absorber to the balance arm

- remove dirt and unscrew plugs (15 and 16) (Fig 163)

- rocking the lever from one extreme position to the other, top up through the topping-up hole by means of a shock absorber syringe; the liquid should be added till it appears from the opening for the escape of air

- screw up the plugs firmly and cotter them

- connect the link on the lever of the hydraulic shock absorber with the balance arm; put back and join up the caterpillars and stretch them.

Possible faults in the running rear

Fault	Indications of fault	Cause	Procedure for detecting and means of remedy
Breakage of bearings; oil leakage	Strong heating of hubs of bogies and idler wheels	Excessive wear on packing; absence of oil and dirt	Remove supporting rollers or guide wheels, check state of packing and bearings; replace defective parts

/Leakage

[redacted]

	Fault	Indications of fault	Cause	Procedure for detecting and means of remedy
	Leakage of fluid from shock absorbers	After long running shock absorbers do not get hot	No liquid in shock absorbers	Remove and dismantle shock absorbers, replace defective parts; top up shock absorbers
(315)	Fracture of torsion shaft	Sharp blows of balance rods against stop	Incorrect setting out. Defect in manufacture of shaft; result of prolonged use.	By raising the bogies in turn with a crowbar find which torsion shaft is broken. Replace torsion shaft and check setting of roller.

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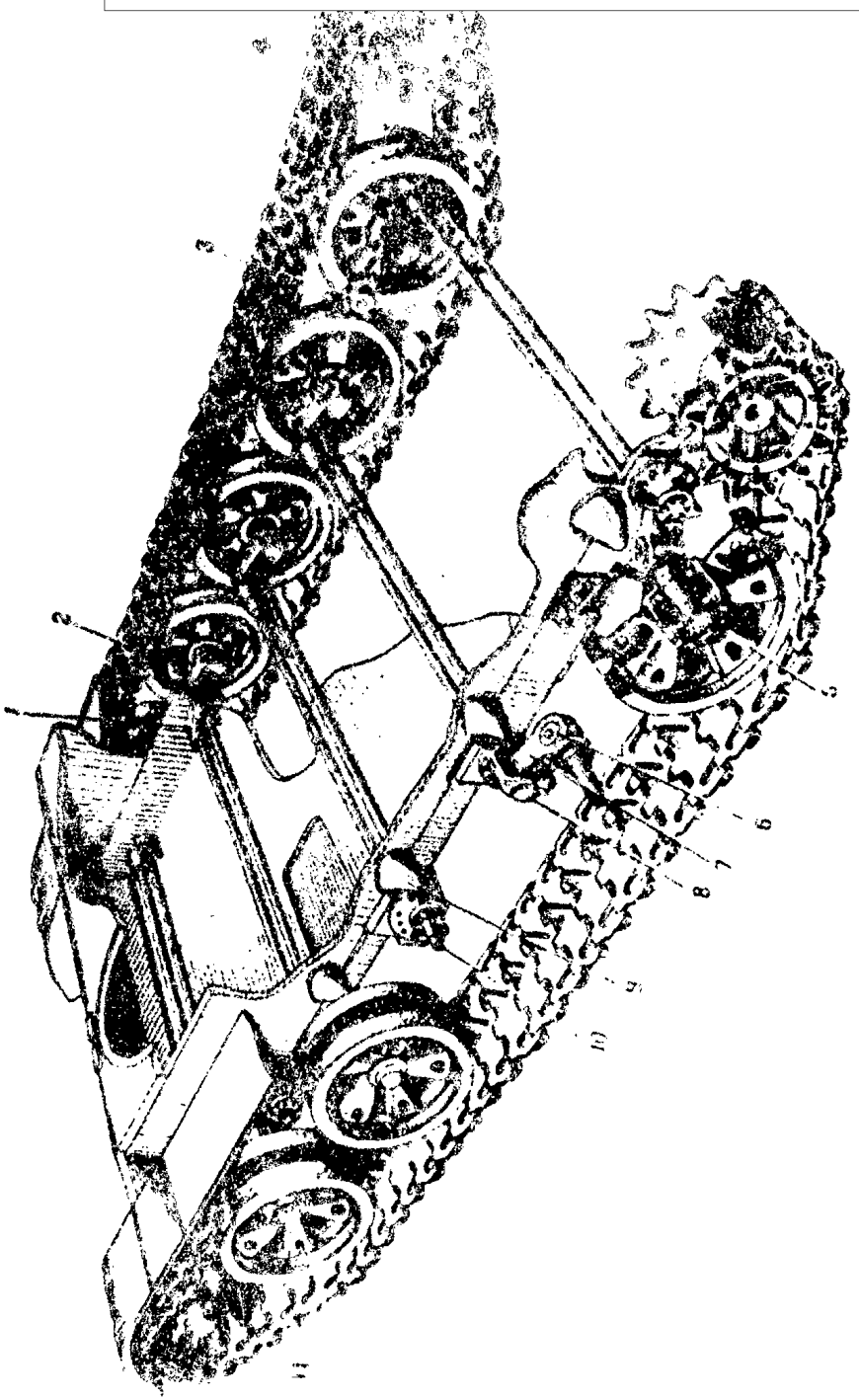

Fig. 156. Running Gear (General View)

1. Balance rod bracket; 2. Caterpillar; 3. Shock absorber; 4. Driving wheel; 5. Bogie; 6. Buffer; 7. Balance arm; 8. Balance arm support; 9. Stop; 10. Torsion rod; 11. Idler wheel.

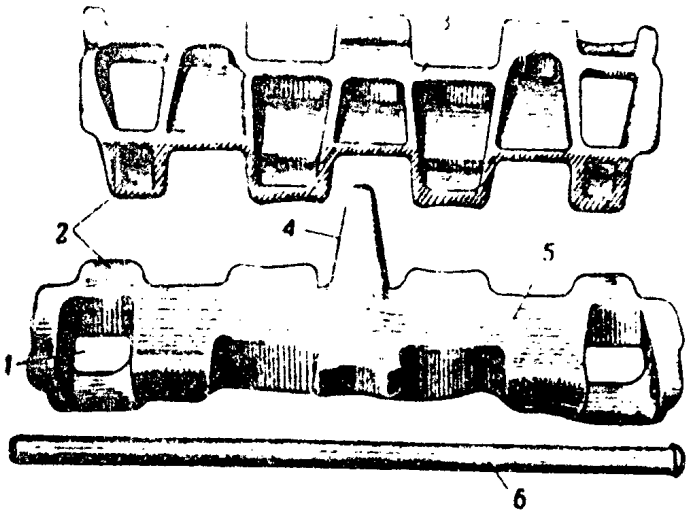

Fig. 157. Track and Pin.

1. Track sprocket hole; 2. Track eyelet; 3. Ground grip; 4. Crest; 5. Running track; 6. Pin.

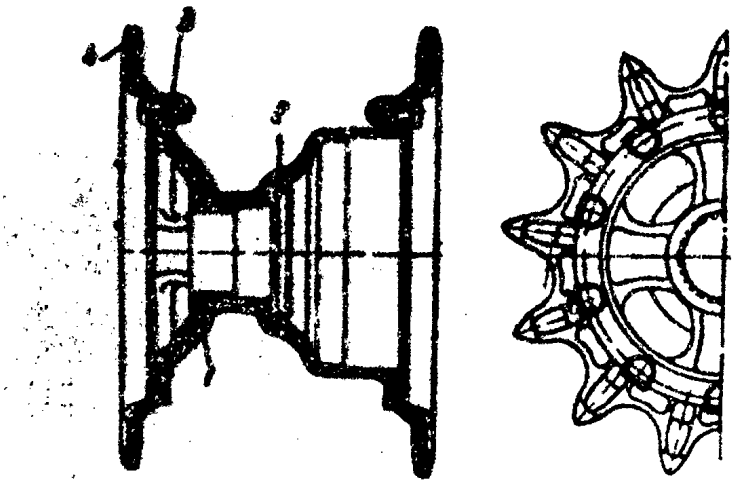

Fig. 158. Driving Wheel (Rack).
1. Hub; 2. Packing ring; 3. Bolt fixing crown;
4. Toothed crown.

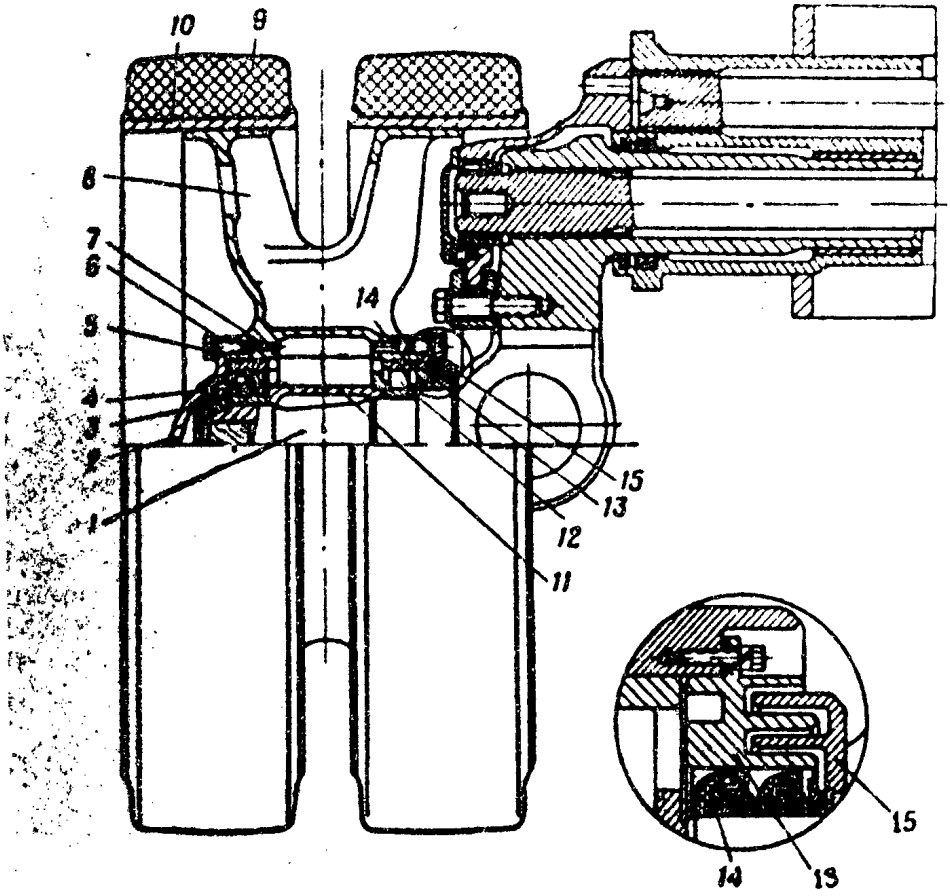

Fig. 159. Bogie.

1. Axis of bogie; 2. Armoured cap; 3. Nut; 4. Ball-bearing; 5. Bolt; 6. Packing; 7. Lubrication hole; 8. Disc of bogie; 9. Tyre; 10. Rim; 11. Distance bush; 12. Roller-bearing; 13. Labyrinth packing cover; 14. Self-adjusting packing; 15. Labyrinth ring.

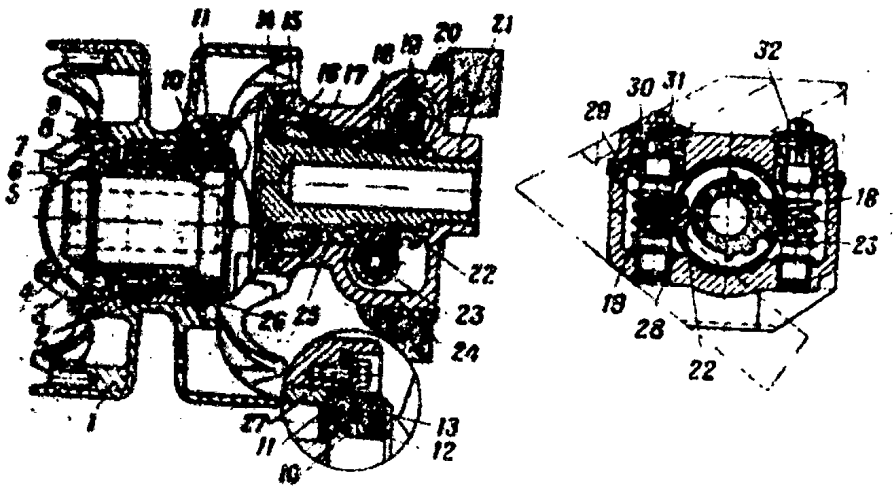

Fig. 160. Idler Wheel.

1. Idler wheel; 2. Roller-bearing; 3. Armoured cap; 4. Crank; 5. Nut; 6. Distance ring; 7. Roller-bearing; 8. Floating washer; 9. Packing; 10. Self-adjusting packing; 11. Cover of labyrinth packing; 12. Felt packing; 13. Labyrinth ring; 14. Visor; 15. Bolt; 16. Packing ring; 17. Split bush; 18. Worm pinion; 19. Front worm; 20. Floating ring; 21. Split bush; 22. Worm pinion; 23. Rear worm; 24. Bracket; 15. Throat; 26. Floating washer. 27. Bolt; 28. Lower bush; 29. Stop bolt; 30. Upper bush; 31. Stop washer; 32. Plug.

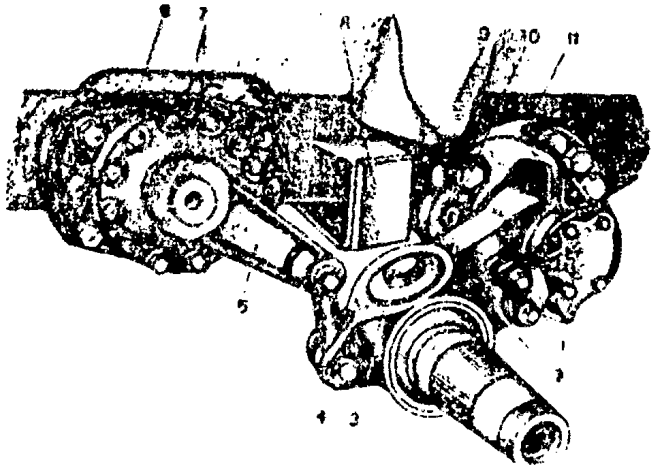

Fig. 151. Balance arm of First Bogie

1. Axial movement limiter of balance arm; 2. Balance arm; 3. Balance arm buffer; 4. Link; 5. Shock absorber lever; 6. Hydraulic shock absorber; 7. Shock absorber filling and air escape hole plugs; 8. Limiter; 9. Stop; 10. Torsion rod; 11. Support.

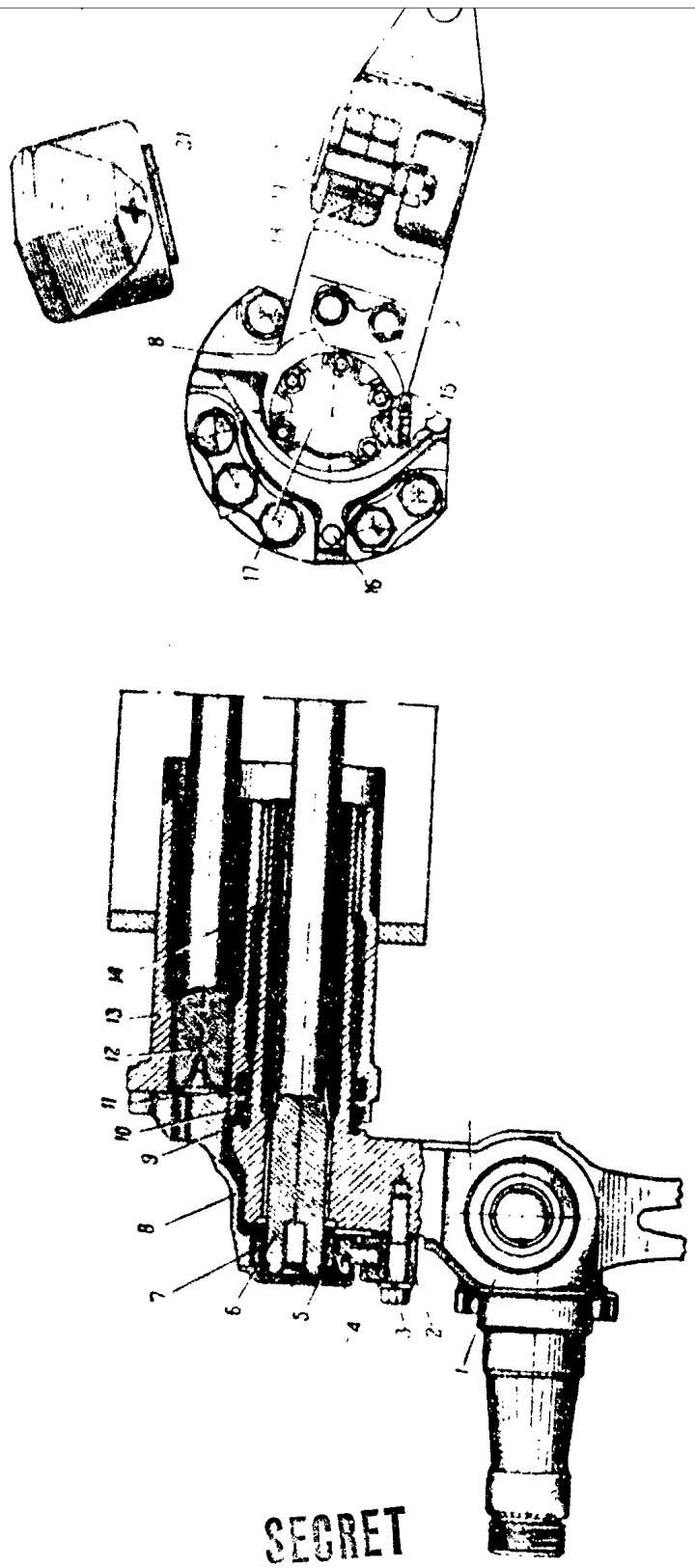

Fig. 162. Balance Arm with Torsion Shaft (left side).

1. Balance arm; 2. Axial movement limiter; 3. Regulating packing; 4, 10 & 11. Felt packing; 5. Stop ring; 6. Torsion rod (balance arm of left side); 7. Roller-bearing; 8. Support; 9. Spring with washer; 12. Torsion rod (balance arm of right side); 13. Balance arm bracket; 14. Bush; 15. Plug; 16. Opening in support; 17. Cover; 18. Rubber ring; 19. Buffer washer; 20. Bolt; 21. Stop.

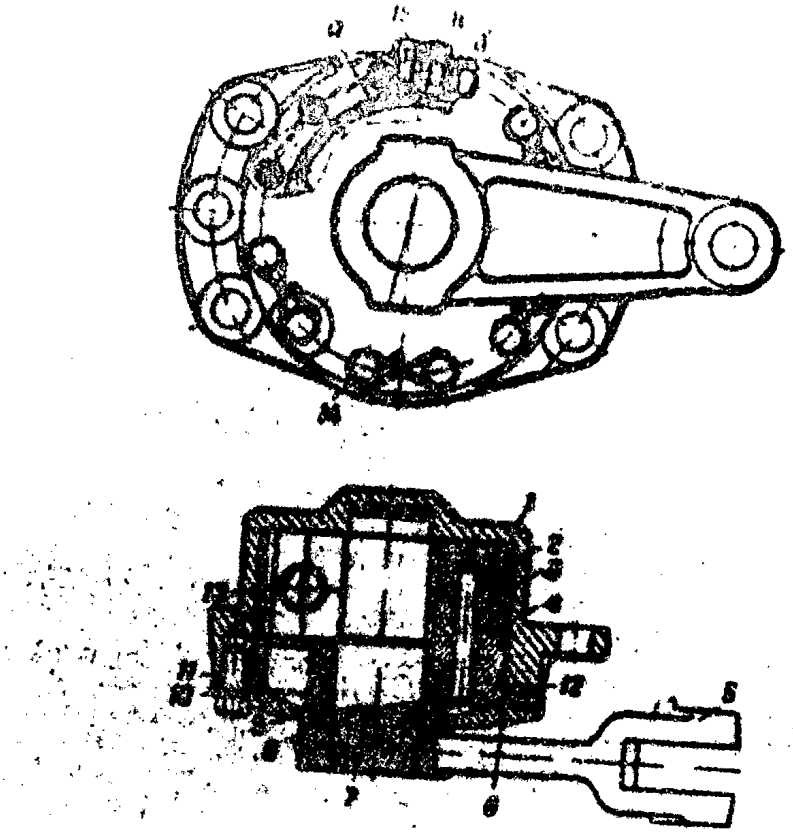

Fig. 163. Shock Absorber.
1. Body; 2. Stop pin; 3. Ball valve; 4. Partition; 5. Lever; 6. Cover; 7. Shaft with vanes; 8. Felt packing; 9. Self-adjusting packing; 10. Sealing packing; 11. Regulating packing; 12. Packing ring; 13. Working valve; 14. Bolt; 15. Plug for topping-up hole; 16. Plug for aor outlet hole; a & b. Grooves in partition.

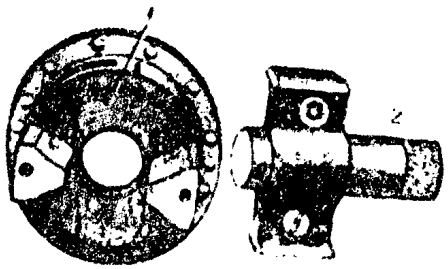

Fig. 164. Parts of Shock Absorber.
1. Partition; 2. Shaft with vanes.

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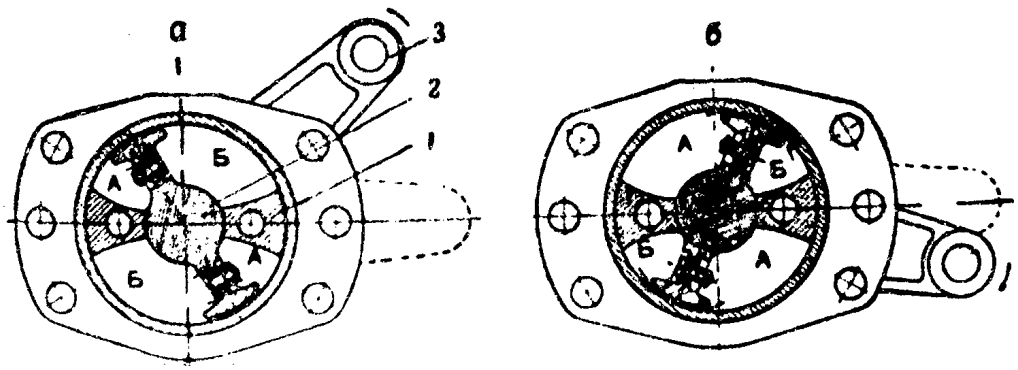

Fig. 165. Working of shock absorber.
1. Partition; 2. Shaft with vanes; 3. Lever; A & B. 50X1-HUM
a. Balance arm rising; b. Balance arm dropping.

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The armoured hull and turret are intended for dispersal of and protection from damage by enemy fire of the crew, armament, ammunition and mechanism of the tank. In addition to this the armoured hull is the skeleton joining in a single whole all the units and mechanisms of the tank, taking all the loads arising from movement, surmounting obstacles and conducting fire from the tank. On the roof of the hull the armoured turret is set on a ball race. The form of the hull and turret provides for the most efficient utilisation of the interior space and for high armour-resistance.

Armoured Hull

The hull of the tank takes the form of a rigid box constructed by welding together armoured sheets. It consists of a forward part, sides, rear, bottom, roof and partitions.

The forward part of the hull (Fig 7) consists of an upper (1) and lower (7) inclined armour plate. On the lower edge of the lower inclined plate a longitudinal cut is made by means of which the plate abuts against the bottom. The plates are welded together and to the bottom, sides and the plate under the turret respectively.

Two towing hooks (6) with spring catches (17) two stands (4) for fixing the board protecting the observation instruments for the driver-mechanic from mud and snow thrown up when the tank is moving and the bracket (16) for fixing lamps, are welded to the upper inclined plate. An aperture (3) is drilled through the central part of this plate for the fire from the hull machine gun.

On the left of the upper inclined plate at the point where it joins the plate under the turret a cut is made into which is welded the base of the drivers-mechanic observation instrument. Brackets are welded to the inner side of the upper inclined plate and the main-clutch and brake pedals are fixed to these and also other small components. In some tank hulls two brackets are welded to the upper part of the upper inclined plate and 8 strips with threaded holes to the lower inclined plate

The eyelets of the cables supporting the two frames are slipped on to the brackets and the brackets of the tow frame are bolted to the strips.

The sides of the hull are vertical armour plates welded to the upper and lower inclined plates of the forward part, the plate supporting the turret, the bottom and stern plates respectively.

In the front part of the hull on the outside of the side plates, the inclined plates of the forward part and the inclined part of the bottom the brackets for the cranks of the bogies are welded. Below five supports (12) of the balance beams of the bogies are welded to each side plate; these limit rotation of the balance beams. Behind each side plate is welded a recoil hammer (13) for driving in the pins of the back when the tank is moving.

To the upper part of the side plates are welded the racks (14) projecting above the tracks and protecting the body and turret from spattering with mud when the tank is moving. On these racks are fixed the external fuel tanks, the oil tank, the ZIP boxes and the towing cables, digging tool and two spare tracks are also stowed there. Above the idlers and driving wheels are arranged hinged mud-guards. In the lowered position the mud-guards are held by torsion springs. To prevent breaking in overcoming obstacles the rear mud-guards are raised and fixed by wing nuts 3 (Fig 8) to the middle rear plate. A semi-circular hole is made in the lower part of the rear mud-guard which is used in laying a towing cable on the rack.

There is also a hole cut in the upper part of the left side plate. From inside a flange is welded to the side plate with openings for fixing an ejector.

For directing exhaust gases the exhaust pipe (13) is welded to the rack above the tracks and the side plate. A flange is welded to the end of the pipe and to this is fixed the attachment for providing for the tank running under water.

Rear portion of hull (Fig 8): This consists of three armour plates: the upper, (1) middle (2) and lower (10). To armour plates 2 and 10 and to the sides are welded the housings of the side transmissions. The outer part of the housing is protected by additional armour welded to the middle and lower rear plates and to the housings.

In the middle plate there is an opening for access to the bolts fixing the fan axle. The opening is closed by the cover (9) which has a rubber seating. On the outside at the side plates the upper and lower brackets (4) are welded to the plate. These are for the straps for fixing a block under the lower brackets and round the spring catches of the towing hooks are welded two strips (11) with openings into which fit the axes of the brackets for fixing smoke dischargers. On the upper part of the sheet are welded at each side two brackets with threaded holes for fixing the brackets of smoke dischargers. In the upper rear plate there are two openings (17) in which are mounted catches holding smoke dischargers.

At the point where the middle and lower rear plates abut two towing hooks (7) are mounted. To the middle plate catches (8) are welded above the towing hooks.

On the lower rear plate (Fig 9) are placed two oval openings closed by covers (3) for access to the stretching release springs of the brake bands of the steering mechanism and for draining off oil from their housings, and also a rectangular aperture closed with a cover (1) under the oil tank for draining off the oil and getting to the filter and draining valve of the oil tank.

Bottom of the body (Fig 9): in cross section this is trough shaped and consists of three armour plates welded together (on some machines the bottom is a single stamping). The front plate of the bottom is welded to the lower inclined plate of the forward part of the body and the rear plate of the bottom to the lower rear plate. The sides of the bottom are welded to the side plates of the body to increase rigidity there are ribs on the bottom.

Along the side plates of the body and to the bottom are welded five brackets (9) (Fig 7) of the balance beam axes and two flanges (11) for fixing shock absorbers.

Under the support of the balancing arm of the first supporting roller a limiter (10) is welded on each side. This is intended to protect the axes of the balancing arms of the first supporting rollers from bending. Below the driver-mechanic's seat there is a hatch in the bottom for an emergency exit for the tank crew. Behind the emergency exit hatch is a hole in the bottom for the escape of the products of combustion of the heating system. This opening is closed by a cover (11).

On the left hand side of the bottom under the engine there is an aperture for access to the oil and water pumps and to the manuel fuel pump.

The opening under the engine is closed by a cover (13) on hinges welded to the bottom. The cover of the opening is fixed to the bottom with bolts.

An opening is cut in the bottom below the main clutch. This opening is closed by the cover (14). Its purpose is for access to the shafts of the drive of the main clutch. In the rear plate of the bottom under the gearbox there is an opening for draining the oil from the gearbox. The opening is closed by the plug 2. In the bottom near the opening under the engine there is an opening (12) for draining off coolant.

In the front plate of the bottom under the front group of fuel tanks there is an opening for draining off fuel. This opening is closed by the plug (8). In the same plate there is an opening (9) for removing water, oil and fuel from the driving compartment.

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In the rear part of the body two blocks are welded to the lower rear plate and the brackets of the gear box are fixed to these with bolts. To the rear sheet of the bottom is welded the base 4 (Fig 10) for fixing the engine together with the front bracket 3 for fixing the gear box and brackets 9 for fixing the swinging arm.

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The floor of the combat compartment covers components welded to the bottom and the torsion bars. It consists of six steel plates to which rubber mats are rivetted. The plates are bolted to brackets welded to the bottom. The torsion bars of the first and second bogies are covered by the plates. They also are fitted to supports welded to the bottom of the body.

The cover of the body (Fig 11) consists of the plate below the turret 4, the removable cover over the engine, the folding cover over the radiator output regulatable louvres and folding-back covers over the ventilator.

The turret plate is welded to the sides and the upper inclined plate of the forward section of the body. It has a large circular opening with a groove in which the shoulder of the turret is set. Holes are drilled for fixing the shoulder in the groove.

In the front portion of the turret plate on the left above the driver-mechanic's seat is an opening with a cover (18) and on the right an opening for fitting the front group of fuel tanks. The opening has a cover (2).

The four openings (3) with bolted covers in the front part of the turret plate are intended for fixing the attachment used in mounting and dismounting the gun.

At the front the turret plate projects beyond the side of the body. The projecting part of the turret plate is protected on both sides with cast or rolled strips welded to the sides and turret plate.

The removable cover over the engine is fixed with bolts to the transverse girder welded to the turret plate, to a longitudinal strip welded to the right side and to two blocks welded to the left side respectively.

To prevent the cover moving stopping strips are welded to the sides of the body. Two large openings in the cover over the engine closed by covers (6 and 15) give access to the engine and air filter. Covers 6 and 15 are fixed on hinges to the cover (16) above the engine.

In the front part of the cover above the engine on the right is an opening for filling the central group of tanks with fuel. The opening is closed by cover 5.

Cover 10 over the radiator rests on the upper edge of the sides of the body and folds back on three hinges welded to the cover above the engine. In the open position the radiator cover is retained by the stop (7). To facilitate opening of the cover two torsion springs (8) are fixed on brackets welded to the cover. The springs are bolted to the brackets.

In the central part of the cover above the radiator are fixed adjustable louvres for letting out heated air. A grill (9) is placed over the louvres.

The cover over the radiator is fixed by five bolts to strips welded to the rear transverse girder. In the centre of this girder is mounted a catch strengthening the fixing of the cover (10, over the radiator. To open the cover it is necessary to open the catch and unscrew the five bolts. In dismantling, the radiator cover is removed with the engine cover.

The rear part of the cover of the hull is placed above the fan and oil-tank. It takes the form of a transverse welded girder fixed with bolts to the side plates and the upper rear plate. Adjustable outlet louvres are fixed at the left of the girder.

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Above the fan on hinges welded to the upper rear plate are fixed two folding covers 18 (Fig 8). In the closed position they rest on the transverse girder and in the open position they rest on the support (19) welded to the upper rear plate. When the tank is moving the open covers are fixed by bolts to the rack. The louvres and covers above the fan are covered by grilles 12 and 14 (Fig 11) on hinges. These grilles prevent foreign bodies from falling into the tank. In the closed position the grilles are fixed by the spring catch (13).

At the joint of the radiator cover (10) and the transverse girder is an opening covered with a cover (11) for filling the cooling system.

There are a number of partitions within the body. The combat compartment is separated by a partition from the power unit (Fig 12). The sections of the partition can be removed. Above they are fixed with catches (2) to the transverse girder welded to the turret plate and below they engage with a support welded to the bottom. On the left of the partition a niche is made. In the upper part of the niche the fan of the combat compartment is fixed on a removable bracket. The lower part of the niche is covered with a removable partition (5) fixed, like the other removable plates by grips and catches. In the bottom left-hand corner of this plate an opening is cut for access to the pump of the heater covered with a sheath.

Through the lower part of the niche access is obtained to the fuel distributor cock, fuel pump, handle of the draining cock of the cooling system and the fuel filter for rough cleaning.

The fan of the cooling system is separated from the units of power transmission by the partition (17 Fig 10) and owing to this the flow of cooling air travels from the inlet louvres through the radiator to the outlet opening.

The upper part of the partition and a plate pressed into contact with the oil tank can be removed. For better sealing, rubber gaskets are fitted to the edges of the partition plates which fit round the band of the fan. In addition to direct a current of cooling air between the ventilator and the rear section an additional partition (18) is fitted.

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Hatches

Driver-mechanics hatch (fig 13) enables the driver-mechanic to board and leave the tank and to observe the ground ahead.

When the tank is on the move with the hatch open above the head of the driver mechanic a special cover may be fitted, equipped with a sight glass with an electric heater, and a wind-screen wiper with hand drive.

Driver Mechanic's Sea

The driver mechanic's seat is on the whole floor in the driving compartment. It is adjustable to high and low positions. The seat is in low position when the tank moves with closed hatch and the high position when the hatch is open.

Main parts of the seat are: (15)

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the base	(10)
frames	(9 and 11)
frame of seat	(4)
frame of back	(13)
cushion	(3)
back	(1)

The cushion and the back are detachable and are fastened by straps. There are two longitude notches on each side of the seats base; these are intended for bolts which fix the bottom of the seat to the base of the hull. At the same time these notches allow regulation of the seat position by moving it backward and forward. Frames 9 and 11 are so placed as to have their cleats cross on the right and left side of the seat. The lower ends of frames 9 and 11 are hinged to the base. The top end of frame 9 is joined by a hinge to the lower part of frame 13; the top axis (7) fits into the notches of the seat frame. A handle (6) is fixed at the end which serves to bring the seat into the high or the low position. The top axis of frames 9 and 11 are connected by two springs (12). These springs serve to bring the seat into high position. When lowering the seat the top axis (7) moves forward into the notches of the seat frame. In order to fix the seat in its lower position one must lower it and turn the handle (6) towards the rear of the tank. In order to bring it into the higher position the handle is turned vertically, the springs contract and lift the seat. To keep the seat fixed in a high position the handle must be turned forward. The inclination of the seat back may be regulated by the notches in the frame and the arc of the handle. Two positions can be obtained. The inclination can also be regulated by fixing the handle into one of the three existing holes in the seat's frame (4). Should one wish to have the driver mechanic seated in a lower position when driving at night and using the vision device the cushion (3) is taken off the seat and fastened to the maintenance kit box behind the seat.

Maintenance of Tank's Hull

When effecting a maintenance inspection the following should be checked: - make sure that hatch covers and axis plate plugs are in their place and well fastened. - that maintenance kit and tank are secure.

When Carrying out Technical Maintenance No. 1:-

Clean and wash hull from outside (remove snow in winter). - Clean inside of dust and dirt. - Check tightness of hatch covers and plugs and also the bolts of the emergency exit hatch. - Check (by way of external inspection) the condition and security of binding of the maintenance kit and tanks. - Check whether the driver mechanic's hatch cover opens easily and whether it is secure when the hatch is open or closed. - Take the driver mechanic's visual devices out of their apertures, clean the apertures of dirt and dust and cover with a thin layer of lubricant. - If necessary clear driver mechanic's periscopes of dust and dirt (and of snow in winter).

When Carrying out Technical Maintenance No. 2:-

Carry out all parts of Technical Maintenance No. 1 and also check:- Maintenance kit and how secure it is inside the tank. - Check the bolts of detachable decking over the engine. Technical Maintenance No. 3 comprises all tasks laid down in Technical Maintenance No. 2, additionally examine and, if necessary, clean and grease the catches of towing hook, locks and hinges of all hatch covers.

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The Turret

The turret is a shaped steel casting. In its fore part there is an embrasure for the mounting of the gun. A frame (16, No. 3) with brackets for fastening the trunnions of the gun cradle is welded to the inside walls of the embrasure and the bottom plate of the turret. From the outside along the walls of the embrasure on the left and right sides protective plates No. 4 are welded these have threaded holes to fasten the canvas cover of the gun. On the right of the embrasure there is an oval slit No. 5 for the co-axial MG and on the left a slit No. 2 for sight. Along the perimeter of these slits a piece which serves to fasten the canvas covers is welded. On the fore and the rear parts of the turret two hooks are welded these are for lifting the turret, by ropes, for repair purposes the roof consisting of two halves welded together is welded to the top of the turret. The right half No. 9 has three round apertures, into one of these the fan is welded, the second has the loader's hatch with the ring mounting and the loader's periscope is fixed in the third. A piece is welded around the fan which serves to fasten the canvas cover. There are also three apertures in the left half of the roof No. 14 these are intended for the commander's turret, the gunner's periscope and the aerial lead of the wireless set. Four hand rails (No. 13) are welded to the turret. Brackets, intended for the anti-aircraft MG, for fitting the searchlight and for use in strapping down the folded tarpaulin are welded at the back of the turret. Behind the loader's hatch there is a securing lock for fixing the anti-aircraft MG. In the lower part of the turret there is a recess to which the bottom plate if welded. In this plate there are apertures for the attachment of the turret race. The turret is set on a ball race in a recess on the hull. On the left interior side of the turret the body of the turret locking device is welded to the bottom plate. Two handles, one for the commander and the other for the gunner are welded to the turret wall. There are also brackets for the stowage of the radio set, the interoommunication system, electric wiring and other tank equipment welded to the walls, roof and bottom plate of the turret. The ball race (No. 17) is a radial thrust ball bearing its rings forming the turret race. This ball bearing race consists of the lower (9) and upper (6) races, balls (7) and separator (8) consisting of separate sections.

The mechanism for rotating the turret is fixed to the upper runner (POGON) of the turret to the left of the gun and is used for rotating the turret by means of an electric motor or by hand. With the object of protecting it from damage the mechanism for rotating the turret is provided with a friction clutch.

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Construction of the mechanism for rotating the turret

The mechanism for rotating the turret (Fig 18) consists of the housing with two covers and a recess for the electric drive, a flywheel with the handle for manual operation, a switching device, a worm and a worm pinion, vertical shaft with reverse pinion, the friction clutch and the electric motor.

The housing (39) takes the form of a shaped (FIGURNY) casting within which are mounted all the main parts of the mechanism. Outside the housing there are feet with holes for fixing the mechanism to the turret. By means of tension bands the electric motor (2) is fixed to the housing. From above the housing is closed with two covers, the lower (54) and the upper (56). On the upper cover is a bracket with holes for fixing it to the body of the turret. On the side of the housing is fixed the recess (GORLINA) 36 for the drive with the cover (6). In the recess is an annular channel in which is fitted the packing (37) which prevents dust entering the recess.

The electrical drive is mounted in the recess. It serves to transmit the rotatory motion of the electric motor to the worm. The drive consists of two cylindrical pinions (7 and 38) the small pinion (7) is fixed on the shaft of the electric motor. The pinion is prevented from rotating on the shaft by a spline. The large pinion (38) is set on the shaft (58) carrying the worm, and can rotate freely on it. The large pinion (38) carries internal teeth which engage with the toothed clutch (26) of the switching apparatus.

The flywheel with its handle are mounted in the drive recess. It consists of a disc (34), handle (18) and cover (20) with counterweight (28) to the handle. Disc (34) is set on a ball bearing on the end of the worm shaft. To the disc is fixed the contact ring (33) of the electric trigger of the pair of machine guns and the axle (15) of the handle. The handle (18) for manned operation is set on the ball bearings (16) of the axle. On the axle carrying the handle there is mounted the press button apparatus for electrical firing of the pair of machine guns. It consists of the push button (19) rod (13) and spring (17). The flywheel rotates freely on the end of the worm shaft.

The switching device is for selection of manual or electrical drive. It is mounted on the handle (18) and on the disc (34) of the flywheel and consists of the key (21) set on the handle by means of lugs, the cursor (9) the cursor ring (10) stop (11) springs (14) crank (31) and toothed clutch (26) which slides on the shaft carrying the worm (58) and joined to the latter by a spline.

The worm (58) with the worm pinion (52) are mounted with the housing (39). The worm is set on two ball bearings and the worm pinion on slots in the upper end of the vertical shaft (57). The worm and worm pinion transmit the rotatory motion to the vertical shaft with pinion (40).

The vertical shaft (57) is set in the housing on two ball bearings. On the ends of the vertical shaft are slots for connecting with the worm pinion (52) and the driving discs of the friction clutch. At the lower end of the vertical shaft is set a pinion (40) which engages with the shaft by means of a frictional clutch. The ends of the vertical shaft are threaded and clamped on both sides with nuts to the housing.

The friction clutch consists of driving and driven discs (46), the spring (48) of the friction plate and a stop collar (50). The driving discs engage by means of internal teeth with the internal slots of the pinion (40). In the lower part of the discs are supported through centreing rings (45 and 47) and the ball bearing on the ring (44). The pinion (40) engages with the teeth of the lower runner of the turret.

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To rotate the turret by hand it is necessary to depress the key on the handle when the ring with the cursor and stop move in the direction of the recess and turn the crank (31). The crank in rotating disengages the toothed clutch(26) fro the large pinion (38) of the drive and engages it with the disc (34) of the flywheel.

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On rotation of the flywheel with the handle the worm will rotate and transmit rotation through the worm pinion and the vertical shaft (57) to the pinion (40) of the turret runners. Pinion (40) running round the teeth of the lower runner will cause the turret to rotate.

If the electric motor (2) is switched on when working by manual drive, the motor shaft and the pinions of the electrical drive will run idle.

To rotate the turret by means of the electric motor (2) the key of the flywheel handle must be released when the stop (11) of the handle with all the parts will return to their original position under the action of the spring (14) and the toothed clutch (26) will again engage with the large pinion (38) of the drive. On switching on the electric motor rotation will be transmitted through the pinions (7 and 38) to the worm and from it through the worm pinion and the vertical shaft to the friction clutch and the runner pinion.

The electric motor is switched on by the sighter by means of the control panel or by the tank commander by means of the command control apparatus.

Turret Stop

The turret stop is located on the bottom plate of the turret to the left of the sighter's seat.

The purpose of the stop is to fix the turret reliably in the proper position taking the load of the turret rotating mechanism.

The stop (Fig 19) consists of the body (1), the stop rod (2), the eyelet (5) lever (10), axles (4 and 5), the roller (9), the lever and the stop fixer. The body of the stopper is welded to the turret plate (22). The eyelet is fixed to the body of the stop by the axis (6) and by means of the axle (4) it is connected to the stop (??). The handle (10), joined to eyelet (5) by means of the roller (9) can occupy two positions, along the eyelet and perpendicular to it. These positions of the lever are fixed by means of the fixer (8) the spring (7) and the openings (11) in the lever.

The fixer of the stop is intended to hold (stop) the rod of the stop in the upper or lower position.

The fixer of the stop consists of the fixer (12) the spring (14) the body (16) nut (13) and handle (15). The body of the fixer is screwed into the body of the stop and locked with nut (13). To protect the stop from dust and grease it is covered with a sheathing (3).

The turret is stopped in two positions: with the gun pointing ahead or pointing astern.

Before setting the turret on the stop it is necessary to turn lever (10) setting it along eyelet (5) and to free the stop rod from the fixer by rotating the handle (15) of the fixer in a clockwise direction into a horizontal position.

To stop the turret it is necessary to raise the lever of the stop mechanism: in this connection for optimum engagement of the bolt of the stop into the recess on the plate under the turret with manual drive of the rotating mechanism, it is easy to rotate the turret to one side or the other (in relation to the divisions of the degree scale 30-00 or 60-00). The stop bolt should then be held by the fixing mechanism for which the handle of the latter is turned upwards. After this the lever (10) by rotating backwards becomes perpendicular to the eyelet (5).

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To release the turret from the stop it is necessary to rotate the handle (15) of the fixing mechanism into the horizontal position, set the lever (10) along the eyelet (5) and press it downwards. After release of the turret it is necessary to fix the stop bolt with refixer in the upper position and the lever (10) is placed perpendicular to the eyelet (5).

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Command Turret

The command turret (Fig 20) is mounted in the left hand half of the cover of the turret. The command turret consists of the base (2) the block (3) with runner (11), the cover (9) of the dome for the tank commander, the ball (bearings ?) (17) and the cage (16). The base is fixed by bolts to the cover of the turret. The block is united to the base by the ball bearing which are placed in the races of the runner and base. The balls are placed in the thrust cage through a hole in the runner which is closed by the plug (24).

Annular grooves are made on both sides of the ball back in the runner and in these are placed the packing rings (25). In the block the cover (9) of the dome is mounted on hinges and has a lock. The lock can be opened from outside by a special key and from inside by a handle. The lock consists of the handle (1) (Fig 21), the fastener (3) a spring (2) and a limiting bolt (5). The handle of the threaded part is screwed into a recess placed in the cover of the dome. A cut is made in the runner into which the tooth tongue of the lock projects. When the cover of the dome is in the closed position the face of the tooth of the handle rests in the face of the recess in the runner. The lock handle in the closed position of the dome cover is held fast by a fixing device. Rotation of the handle is limited by the bolt (5) which is screwed into the washer (4).

To facilitate closing of the lock of the dome a handle is welded to the cover (9) (Fig 20) of the dome.

For the same purpose a handle is also welded to the cover of the loader's dome.

To facilitate opening the cover of the dome a ("bundle torsion") (7) is provided made from plates. For signalling a small dome is made in the dome cover and this is closed by the cover (15). The cover of this small dome can be opened and closed from within the tank.

The TPK-1 observation instrument (14) is located in the command turret, also 4 prismatic appertures (12). The TPK-1 instrument has an armoured cover made in one piece with the block (3).

In front of the inlet window of the instrument is the protective glass (5) and wiper (4). The prisms of the instrument are protected from the outside by the armoured visors (10).

For locking ("stopping") the rotating portion of the command turret the stop (13) is located on the commander's right. To release the turret it is necessary to pull out the stop ring (20) remove it from the slot (19) in the body and turn it at right angles to the slot.

Loader's Cupola

The loader's cupola (Fig 22) is located in the right hand half of the cover of the turret. The base (4) of the cupola is fixed to the cover of the turret by bolts (6). The gun ring of the zenith machine gun is mounted in the base on a ball bearing ("thrust ")

The runner (1) of the gun ring is connected with the base by balls placed in the tracks of the base and runner. The balls (3) of the runner of the gun ring are placed in the cage (14) through an opening made in the right hand side of the runner. The opening is closed by the plug (15). In the runner of the gun ring annular grooves are made on both sides of the back and packing rings (2) are placed in these. In the gun ring the cover (9) of the cupola is mounted on hinges. The cover is provided with rubber packing (12) and a lock (8) of the same design as in

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the cover of the tank commanders dome. From the outside the lock can be opened and closed by the same key as the lock in the cover of the tank commander's cupola. From inside the lock of the cover of the cupola is opened and closed by means of a handle.

The bracket for fixing the zenith machine gun in the fore part is cast in one piece with the gun ring runner; in its rear part are two cast brackets with machined apertures. In these apertures are placed a (bundle torsion) (10) joined to the cover of the dome with hinges. The (torsion) facilitates opening and closing of the cover of the cupola. Rubber buffers (11) are fixed to the same bracket by means of bolts, these absorbing the impact of the cover when opened. In opening and moving the cover to the stop it is stopped automatically by catches located on the hinges of the cover.

Stop (15) located to the left of the fixing bracket of the zenith machine gun locks the gun ring in two positions: when the machine gun is pointing forwards and in the advancing combat position with the stop out of action the gun ring together with the cover can be rotated without meeting any obstacle to any position.

Ventilation Apparatus

To remove from the combat compartment of the tank the powder-gases which accumulate during firing, two ventilators are installed. One of these (an extractor fan) is placed on the partition of the engine compartment on a removable bracket and the second (a blower) is mounted on the body welded to the cover of the turret. The fixing of the electric motor (2) (Fig 23) with a winged (blade) and is carried out by means of the collars (3). The ventilators are covered with protective fabrics. In the marching position to reduce the amount of dust getting in the combat station the ventilators are covered by sheaths.

Seats in the Turret

There are three seats in the turret of the tank (Fig 26). The tank commander's seat and that of the sighter are located on the left of the gun while that of the loader is on the right of the gun.

The tank commander's seat is fixed to the bracket (4) which is fixed to the upper runner of the turret. There are 3 holes in each cheek of the bracket and by means of these the height of the seat is regulated. A pin projects into the hole by which the upper end of the tube (5) is fixed to the bracket, on the lower end of the tube is fixed the cushion (6) of the seat. The position of the cushion of the seat is fixed by means of triangular teeth located on the crown of the tube and on the frame of the seat.

The cushion is fixed by a stop screw (8) screwed into the lower end of the tube. In tightening up the stop screw the teeth on the crown of the tube mesh with those of the base of the cushion. For convenience in maintenance of the combat compartment, the cushion of the seat can be fixed in the lowered position. By means of the cord the seat and the tube can be kept in the raised position.

Gunner's seat. This is placed on the bracket (20) made of tube and fixed by bolts to the bracket (21) of the raising mechanism of the gun. The base (15) of the cushion of the seat is joined by means of the axis (17) to the bracket (4) which is bolted to the bracket (20). In the bracket (14) there are 6 holes giving two horizontal and three vertical positions of the seat.

In the raised position the cushion of the seat is fixed by spring catches (16). By withdrawing the catches from the base (15) the seat folds downwards. At the end of the gunner's seat the bracket is a footrest (12) on which the tank commander rests his foot. In front of the gunner's seat the footrest (19) is fixed to the bracket (20) on which the gunner rests his foot. Footrests (12) and (18) are always kept in the raised position by springs (they stand vertical).

The loader's seat can be removed and is held in grips (22) welded to the partitions of the runners of the turret. It can be set under the loader's cupola or under the loader's observation instrument. The cushion (23) of the seat is

kept in the raised position by springs (standard vertical). When the gun is being fired the loader's seat is removed from the grips and fixed by means of the same grips and catches to the fixed gun screen.

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There are three holes in the cheeks of the bracket (25) arranged vertically and these are required for adjusting the height of the seat. Spring catches go into these holes and are fixed to a runner to which the cushion of the seat is hinged by means of an axle.

Care of the Turret

In check examinations the presence and fixing of the protective shields covering the instruments and parts in the turret are verified, the shields should be in place and only removed in case of necessity and placed inside the tank or in bores on the ledges (in the free space).

In technical maintenance No. 1 - clean the turret inside and outside from dust and mud (and from snow in winter).

- Check the ease of opening and closing and the fit of the covers of the commander's and loader's cupolas and that the locks on the covers are in order; the cupolas should be closed firmly and reliably by the strength of single men and the locks of the covers of the domes should work without sticking.

- Clean for dust (and mud) the contact device of the commander's dome and the mechanism for rotating the turret.

- Check the working of the ventilator (by switching it on)

In technical maintenance No. 2 - carry out all operations of technical maintenance No. 1 and in addition check:

- the correctness and ease of rotation of the commander's turret on the ball bearing and of the dome cover on its hinges; if rotation is stiff wash and lubricate the ball bearing.

In technical maintenance No. 3 - carry out all operations of technical maintenance No. 2 and in addition:

- Examine and if necessary clean and lubricate hinges and locks of cupola covers;

- check reliability of fixing of upper and lower runners of turret and partition.

Washing and Lubrication of Ball Bearings of the Turret, Commander's Cupola and locks of Cupola Covers

For washing and lubricating the ball bearings of the turret it is necessary to:

- unscrew on the upper and lower runners from 4 to 6 bolts diametrically opposite to each other;

- set under the lower openings a vessel to catch the diesel fuel or paraffin required for washing;

- wash the ball bearing by squirting diesel oil or paraffin through the upper opening;

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- set the balls of the lower runner;

- lubricate the ball bearing with TSIAMTIM-201 oil to the amount of 0.5 Kg;

- set the bolts of the upper runner and ("split-pair them")

[redacted]

For washing and lubricating the ball bearing it is necessary:

- to unscrew the plug of the lubrication hole

- put a vessel under the runner or cover the radio apparatus and other parts of the machine with rags to prevent diesel fuel or paraffin on to them.

- wash the ball bearing squirting diesel oil or paraffin through the lubricating aperture.

- let the residual washing liquid drain off and rub the lower part of the cupola dry.

- lubricate ball bearing with lubricant TSIATIM-201 to an amount 0.3 Kg.

- replace the plug.

For cleaning and lubricating the locks it is necessary to:

- dismantle the lock, for which purpose the upper clamping screw is unscrewed after which the lock is unscrewed by the handle.

- wash the parts in diesel fuel and dry with rag.

- wipe the lock recess with rag moistened in the washing liquid after which it is dried.

- lightly grease the parts of the lock with lubricant US and reassemble the lock.

- fill the upper cavity of the lock with lubricant US, through the upper hole.

Possible faults in the body and turret

Fault	Cause of fault	Method of cure
	Faults in the body	
Cover of driver-mechanic's dome does not catch (does not seat)	Protective visor of the dome cover or caster of clamping ring bent	Correct bending of protective visor or collar of clamping ring
Cover of driver-mechanic's dome cannot be raised in released position.	Spring of covering mechanism of dome cover weakened.	Change spring of covering mechanism of dome cover.
Water and dust getting into tank.	1. bolts fixing dome covers at bottom loose.	Tighten bolt fixing covers.

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Defect	Cause of defect	Means of repair
	2. Damage to rubber packing covers of access plates.	Replace access plate packings.
Difficulty in opening cover over radiator.	Cover torsion springs weak.	Replace torsion springs cover over radiator.
	Defects of the turret	
Turret does not turn.	1. The turret is locked. 2. The gun or turret is fouling on objects located on the hull of the tank or inside, in the fighting compartment.	1. Unlock the turret 2. Remove objects that prevent turning of turret.
Strong resistance on the traverse hand wheel.	Dirt or thick grease (in the fixed ring of the turret races.	Clean and grease the fixed ring and gear of the turret races.
Creep of more than 10^{o} when on the move, tilting or turning the tank and also when stationary after switching off the electric power traverse.	Friction coupling of the traverse mechanism has slipped above the setting.	Press the spring of the friction coupling discs. Should this not help, strip it and wash discs. Faulty discs should be replaced.
The turret hatch covers open with great difficulty.	Torsion (spring) is broken or weak.	Change the torsion spring.
Commander's cupola or the AAMG mounting turns stiffly.	Dirt in the ball bearing race.	Clean and lubricate the ball bearing race.
Commander's hatch cover does not lock in open position.	The catch is either broken loose or dirty.	Replace spring clean and lubricate catch.
Locks of the hatch covers open by themselves.	Spring of the lock stop is either weak or dirty.	Replace stop spring clean stop parts.

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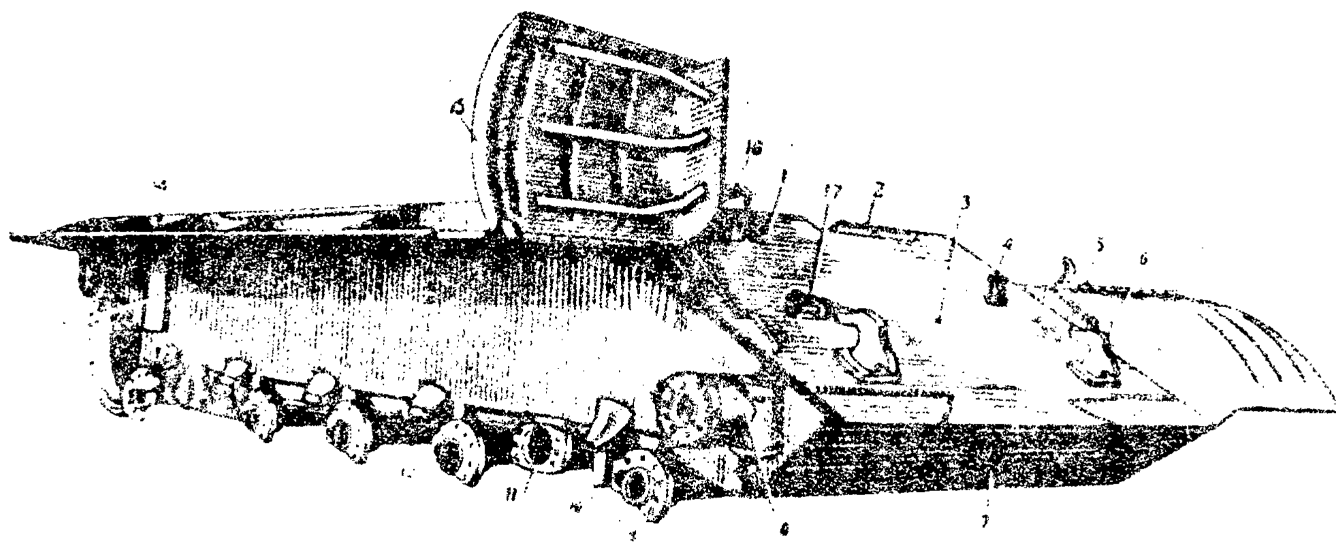

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Fig. 7. Hull (Forward Part)

1: upper inclined plate; 2: cover for drivers observation apperatus; 3: opening for hull machine gun; 4: support for fixing board; 5: spring of front folding mud shield; 6: towing hook; 7: lower inclined plate; 8: bracket for crank of idler; 9: bracket of axis of balance [illegible]; 10: limiter; 11: flanges for fixing shock absorbers; 12: balance rod stop; 13: track-pin-hammer; 14: shelf; 15: front hinged mudguard; 16: lamp bracket; 17: towing [illegible]

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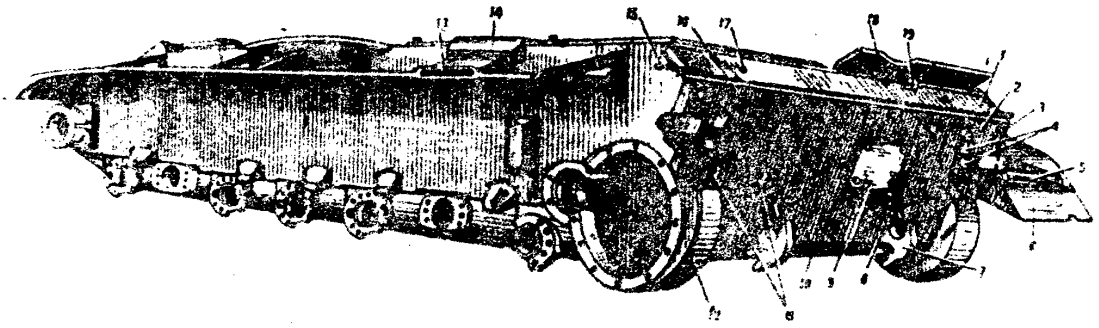

Fig. 1. Hull (Rear Part)

1: upper rear plate; 2: middle rear plate; 3: wing nut; 4: brackets for ribbons for fixing leg; 5: spring of rear mudguard; 6: rear guard; 7: towing hook; 8: towing hook catch; 9: covering of opening; 10: lower rear plate; 11: strips; 12: armoured housing of side transmissions; 13: exhaust pipe; 14: armour protection; 15: bracket for fixing rear light; 16: pins; 17: opening for fitting catch; 18: hinged cover; 19: support.

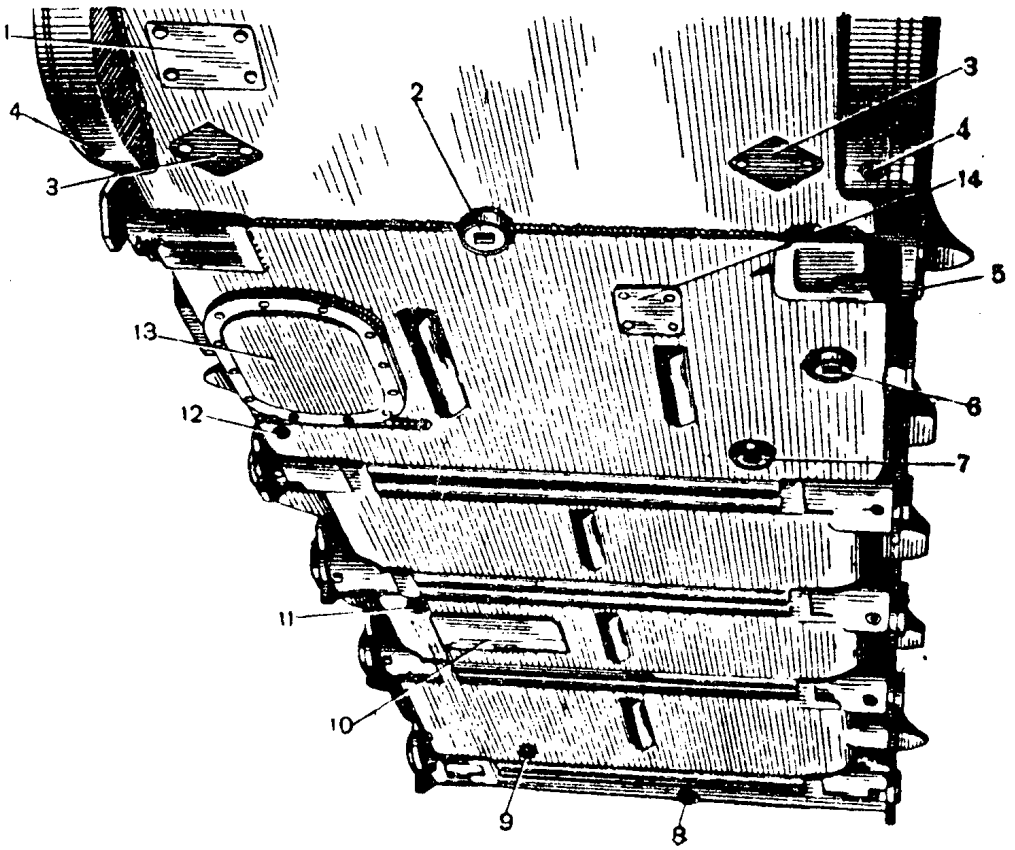

Fig. 9. Hull (Bottom)

1: cover of hole for running oil from oil tank; 2: plug of opening for draining oil from gearbox: 3: covers for holes for access to the springs of the brake bands and draining of the oil from the steering mechanism; 4: plugs of openings for draining oil from side transmissions; 5: plug of opening for lubricating axis of balance arm; 6: plug of opening for draining oil from swinging arm; 7: plug of opening for draining fuel from the tanks of the central group; 8: plug for draining fuel from the tanks of the forward group; 9: opening for removing water oil and fuel from the driving compartment; 10: cover of opening of emergency unit; 11: cover of opening for removal of products of combustion from heating system; 12: [illegible] for draining off codent; 13: cover of opening below engine; 14: cover of [illegible] for access to pull rods of drive of mid[illegible]

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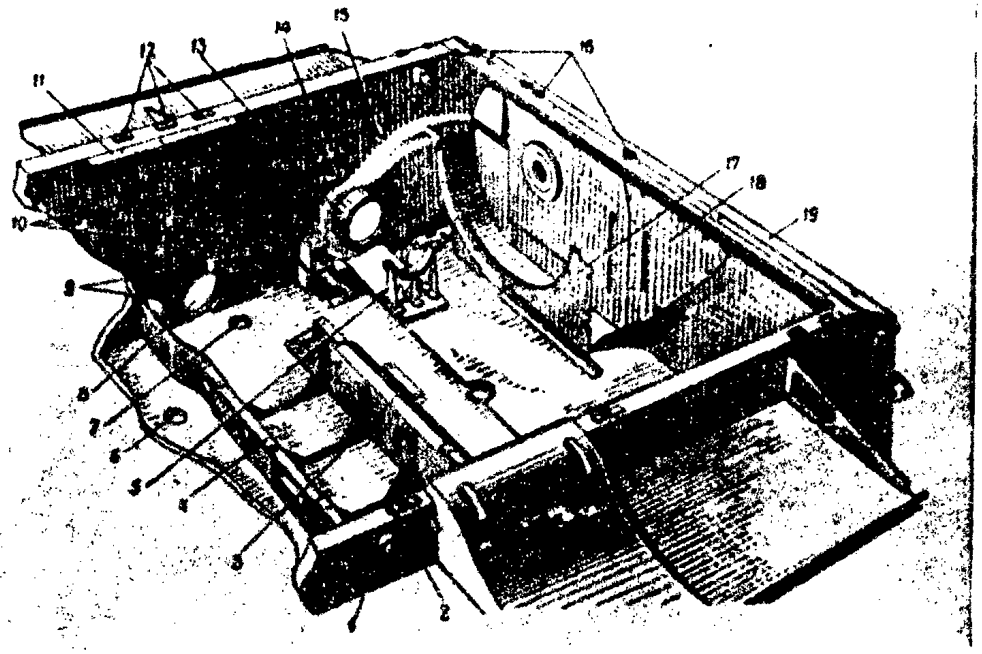

Fig. 10. Hull (Engine Compartment)

1: Body of TPU rosetts; 2: block for fitting cover over engine; 3 & 5: brackets for fixing gear box; 4: seating for fixing motor; 6: opening for draining fuel from central group of tanks; 7: opening for draining oil from swinging arm; 8: opening for fitting shock absorbers; 9: brackets for fixing swinging arm; 10: blocks for fixing air filter; 11: longitudimal strip for fixing engine cover; 12: stop strips; 13: housing of side transmission; 14: block for fixing brackets for brake bands; 15: blocks for fixing brackets for tension springs of brake bands; 16: hinges for fixing hinged covers; 17 and 18: ventelation partitions; 19: upper rear plate.

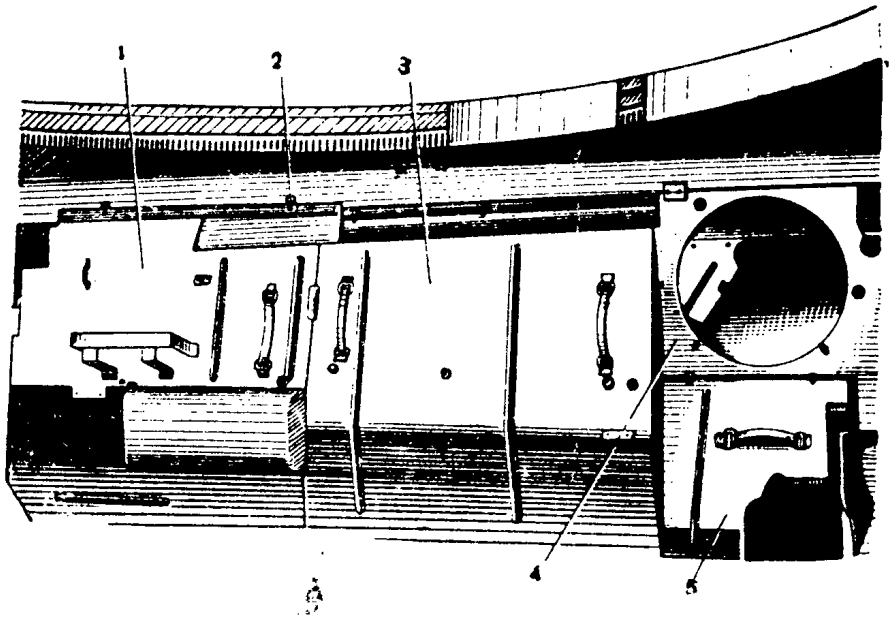

Fig. 12. Partition of Power Compartment.

1: right hand part of partition; 2: catch; 3: left-hand part of partition; 4: partition niche plate; 5: removable partition.

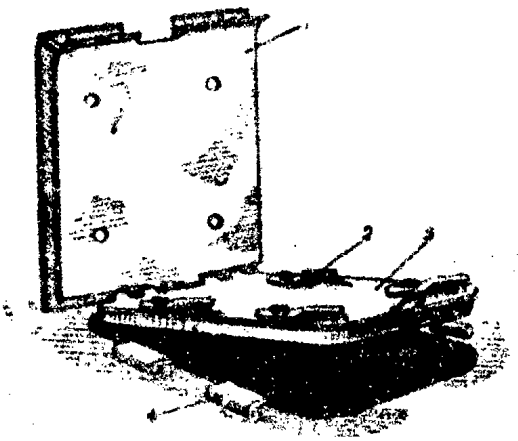

Figure 14 - Emergency Exit Hatch

1. Plate with cover.
2. Release catch.
3. Hatch cover.
4. Clamp.

The emergency exit hatch is behind the driver mechanic's seat in the bottom of the hull. Its cover (3) opens inward on hinges. It is closed by means of four release catches (2) which fit into clamps (4). The clamps are welded to the bottom on either side of the hatch. To seal tightly, the cover is fitted with rubber packing. The hatch cover has a plate covered with rubber. To open the hatch one lifts the plate and turns the catches to release them from the clamps.

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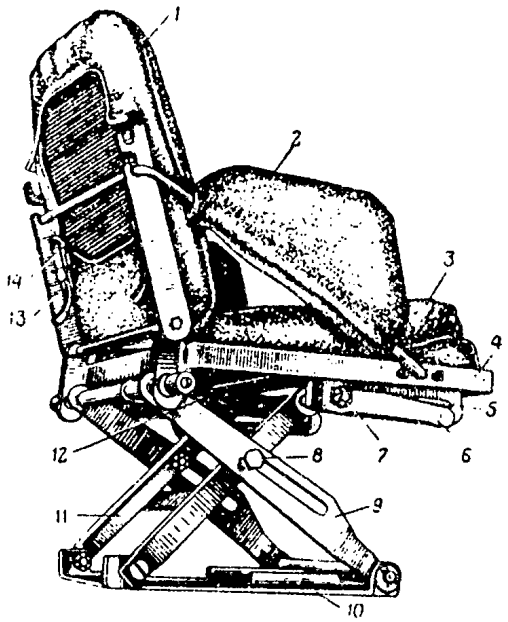

Fig. 15. Driver Mechanic's seat.

1. Back rest; 2. Arm rest; 3. Cushion; 4. Seat frame; 5. Frame adjusting slits; 6. Locking lever; 7. Frame axis; 8. Hinge; 9. Frame; 10. Base. 11. Frame; 12. Adjusting spring; 13. Back rest frame; 14. Belt.

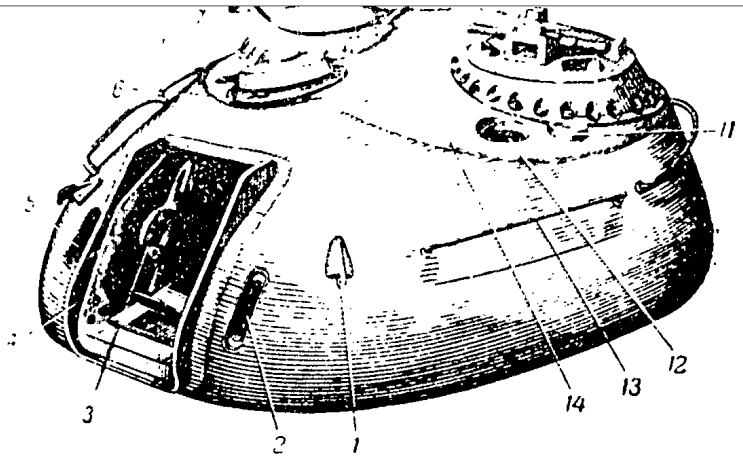

Fig. 16. The Turret.

1. Hook; 2. Sight aperture; 3. Trunnion frame; 4. Protective plate; 5. MG slit; 6. Threaded hole for mantlet cover; 7. Fan seating; 8. Loader's hatch cover; 9. Right half of roof; 10. Commander's turret; 11. Aerial mount; 12. Aperture for fixing anti-aircraft MG; 13. Hand rail; 14. Left half of roof; 15. Aperture for fixing loader's periscope.

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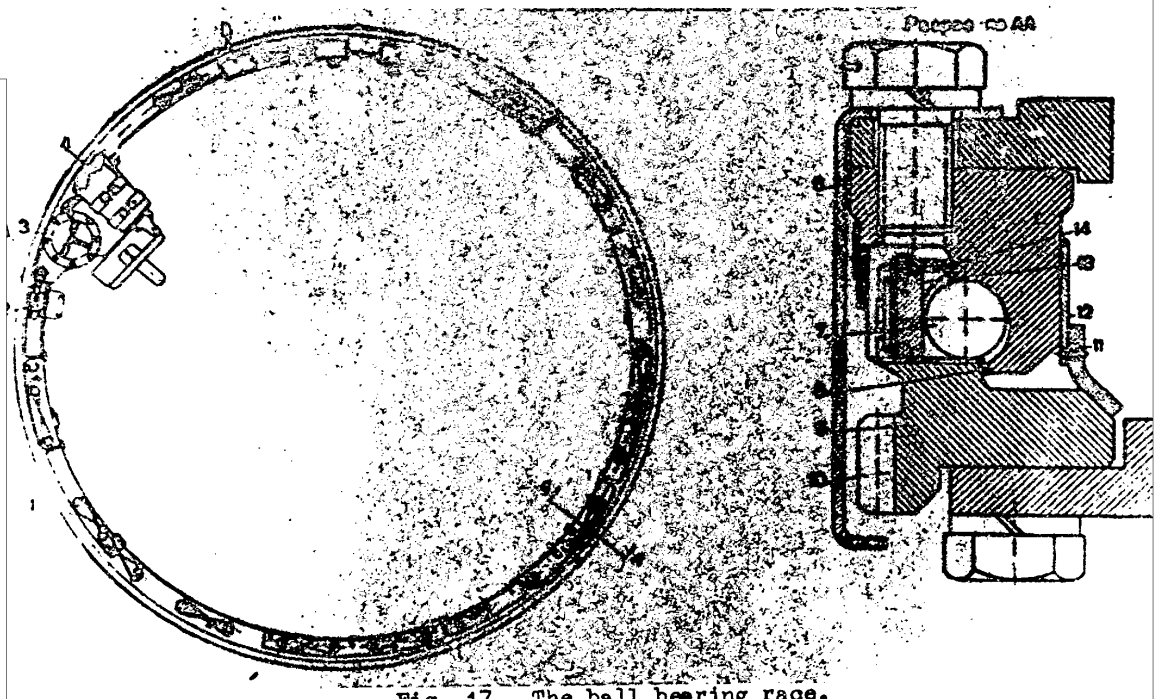

Fig. 17. The ball bearing race.

1. Bolt; 2. Cramps for traverse indicator; 3. Traverse mechanism; 4. Electric motor; 5. Limiting stop; 6. Upper race; 7. Ball bearing; 8. Separator; 9. Lower race; 10. Fixed ring of turret race; 11. Felt belt; 12. Ring; 13. Plug; 14. Ring.

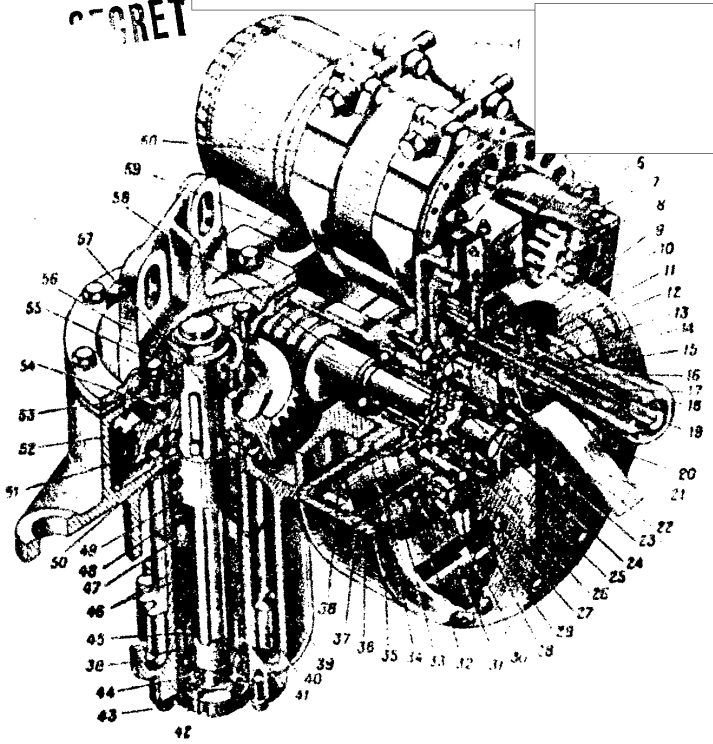

Fig. 18. Turret rotating mechanism.

1. Tension bolts.
2. Electric motor.
3. Insulation block.
4. Brush of interlocking circuit of electric drive of turret.
5. Brush of machine gun electric trigger circuit.
6. Cover.
7. Pinion of electric motor.
8. Flywheel stop.
9. Cursor.
10. Cursor ring.
11. Stop.
12. Pin.
13. Contact rod of machine gun electric trigger.
14. Stop spring.
15. Axle of handle.
16. Balls.
17. Push button spring.
18. Handle for manual drive.
19. Machine gun electric trigger button.
20. Flywheel housing.
21. Key.
22. Flywheel cover.
23. Stop ring.
24. Spline.
25. Slotted bush.
26. Toothed clutch of switching device.
27. Turret electric drive interlocking rod.
28. Counterweight.
29. Bush.
30. Contact screw.
31. Crank lever.
32. Textolit ring.
33. Contact ring for machine gun electric trigger.
34. Disc.
35. Interlocking contact ring of electric drive of turret.
36. Tube.
37. Packing.
38. Large driving pinion.
39. Housing.
40. Turret runner pinion.
41. Centering ring.
42. Lock washer.
43. Hood.
44. Ring of lower bearing of vertical shaft.
45. Centering ring.
46. Driving and driven discs.
47. Centering ring.
48. Friction clutch spring.
49. Bush of lower stuffing box.
50. Stop ring.
51. Stuffing boxes ring.
52. Worm pinion.
53. Washer.
54. Lower cover of housing.
55. Plate.
56. Upper housing cover.
57. Vertical shaft.
58. Worm.
59. Pin.
60. Tension strip.

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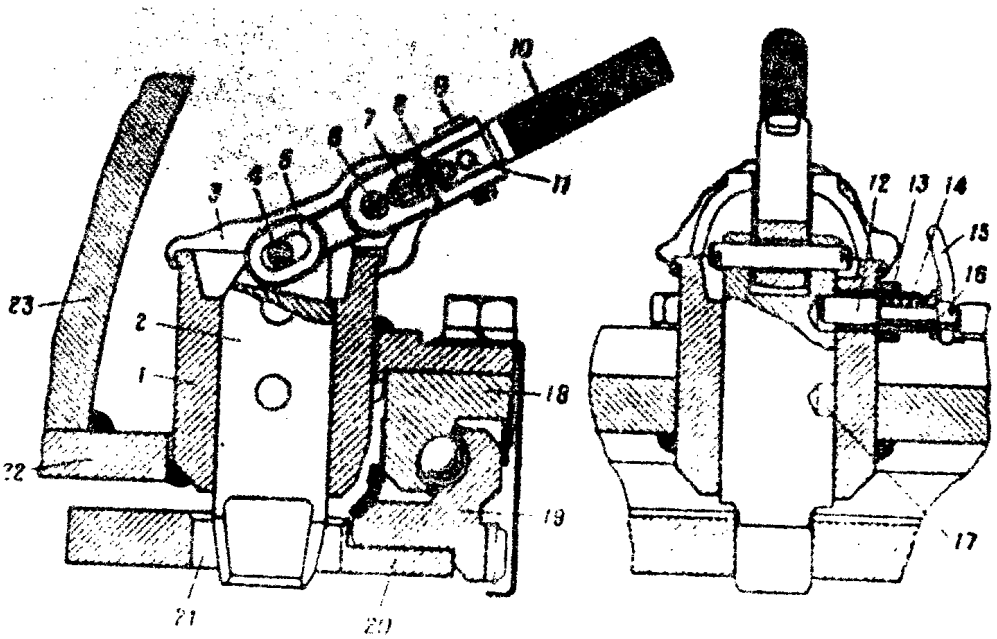

Fig. 19. Turret Stop.

1. Body of stop.
2. Stop.
3. Cover.
4. Axle of stop.
5. Eyelet.
6. Eyelet axle.
7. Spring of lever detent.
8. Lever detent.
9. Roller.
10. Lever.
11. Opening for detent.
12. Stop for detent.
13. Washer.
14. Detent spring.
15. Detent handle.
16. Body of detent.
17. Opening for detent.
18. Upper runner.
19. Lower runner.
20. Bottom plate of turret.
21. Recess for stop.
22. Plate under turret.
23. Turret.

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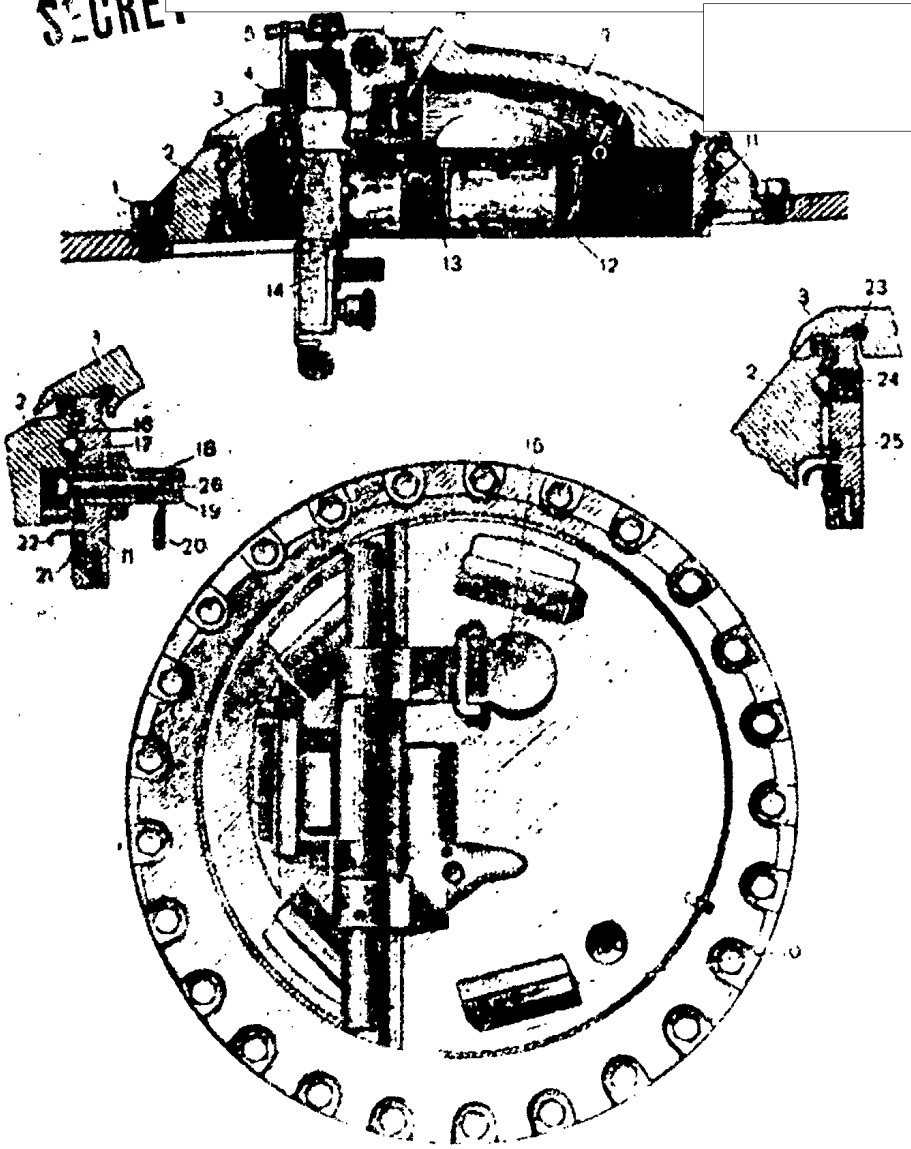

Fig. 20. Commander's Turret

1. Bolt.
2. Base.
3. Block of turret.
4. Glass wiper.
5. Protecting glass.
6. Buffer.
7. Bundle torsion.
8. Glass wiper handle.
9. Cover of commander's dome.
10. Visor of observation instrument.
11. Runner.
12. Prismatic observation instruments.
13. Turret stop.
14. TPK-1 observation instrument.
15. Cover of dome for signalling.
16. Cage.
17. Ball.
18. Stop spring.
19. Body of stop.
20. Stop ring.
21. Contact ring of command control.
22. Shield.
23. Packing ring.
24. Plug.
25. Packing ring.
26. Stop rod.

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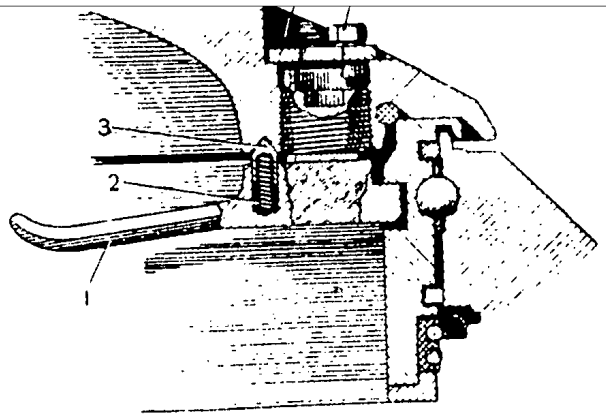

Fig. 21. Lock of covers of turret doors.

1. Handle.
2. Detent spring.
3. Detent.
4. Washer.
5. Limiting bolt.

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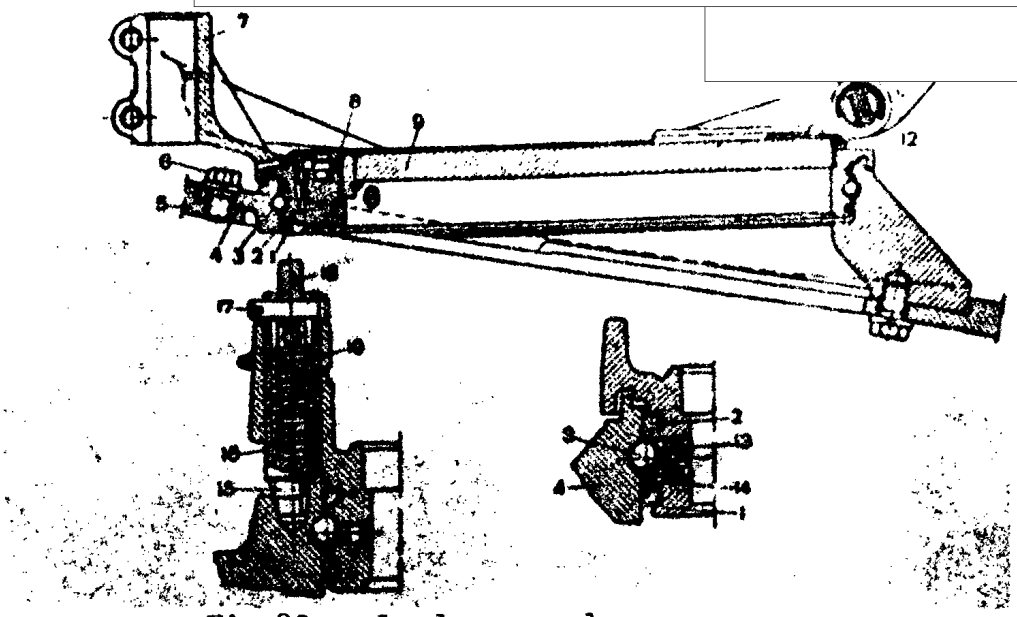

Fig 22. Loaders cupola.

1. Runner.
2. Packing ring.
3. Ball.
4. Base.
5. Cover of turret.
6. Bolt.
7. Bracket.
8. Lock.
9. Cover of cupola.
10. Bundle torsion.
11. Buffer.
12. Rubber packing.
13. Plug.
14. Cage.
15. Stop.
16. Stop spring.
17. Roller.
18. Knob.
19. Stop cylinder.

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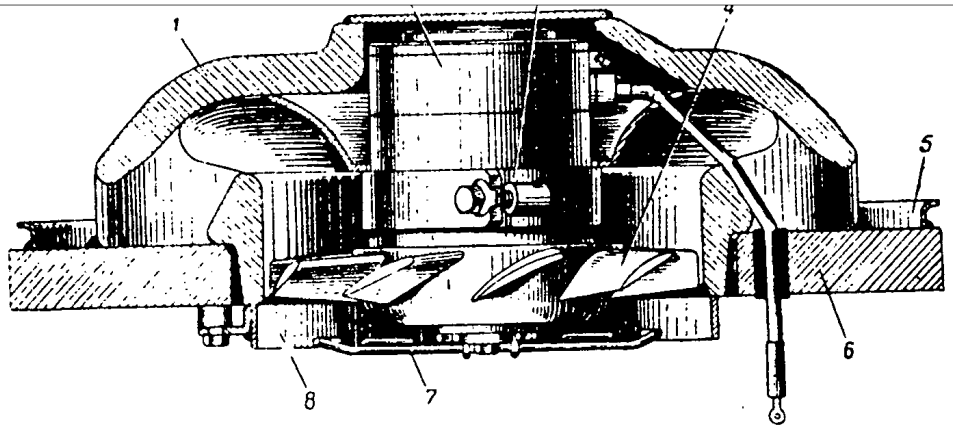

Fig 23. Force Fan.

1. Ventilator body.
2. Electric motor.
3. Motor fixing collar.
4. Fan Vanes.
5. Shell.
6. Turret cover.
7. Grille.
8. Collar.

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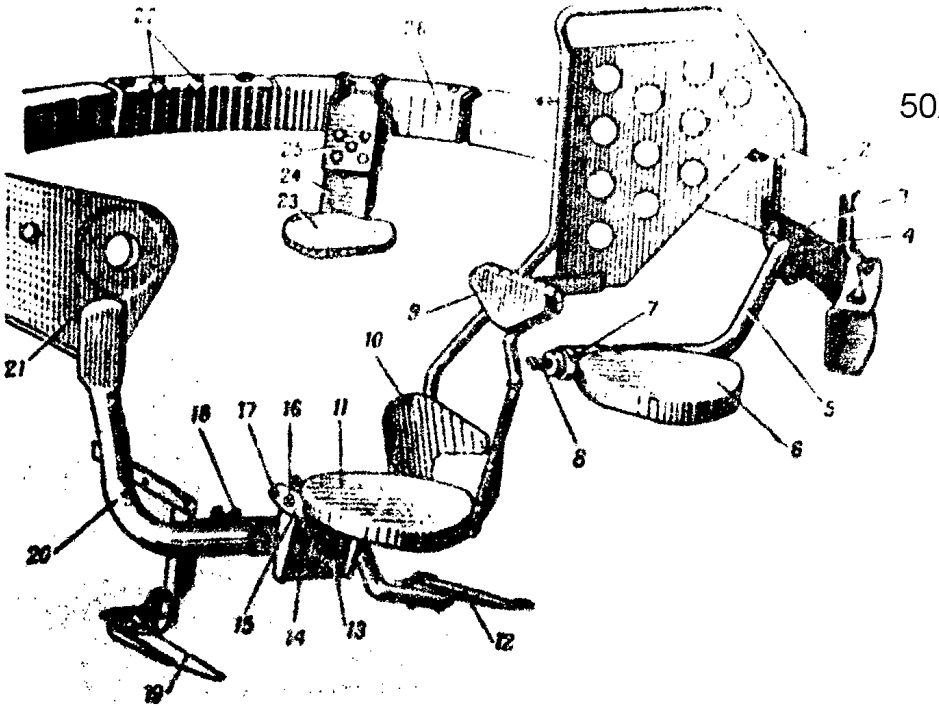

Fig 24. Seats in the Turret.

1. Gun shield.
2. Back of tank commander's seat.
3. Holes for adjusting Height of seat.
4. Bracket.
5. Tube.
6. Cushion of tank commander's seat.
7. Frame of seat.
8. Clamping screw.
9. Back of sighter's seat.
10. Bracket.
11. Cushion of sighter's seat.
12. Tank commander's foot rest.
13. Holes for adjusting in vertical and horizontal position.
14. Detent bracket.
15. Base of cushion.
16. Spring catch.
17. Seat Axis.
18. Bracket for stowing back of sighter's seat.
19. Sighter's foot rest.
20. Bracket of sighter's seat.
21. Bracket of gun raising mechanism.
22. Grips for loader's seat.
23. Cushion of loader's seat.
24. Runner.
25. Housing of turret runners.

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Subject:- repairs to (T-54) tank gun

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DETECTION OF DEFECTS AND REPAIR OF THE BREECH

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Breech not opening by hand

Press upwards on the 02-27 handle knob and turn the handle Sb 02-2 to open the breech into the extreme rear position. Then the 02-21 handle stop should engage behind the shoulder of the 02-32 closing mechanism. Turning the Sb 02-2 handle forward, try to open the breech.

Reasons for the fault.

Jamming of the breech wedge as a result of bulging of the shell case

Press upwards on the 02-27 handle knob and turn the handle Sb 02-2 to open the breech into the extreme rear position, then turning the handle forward and simultaneously striking with a hammer along the wooden arm, set on to the leading tray, open the breech.

Extract the jammed shell case using the Sb 41-302 extractor or eject by means of the discharger from the muzzle part.

Check the clearance between the breech face of the tube of the barrel and the front face of the slide, to do which insert into the chamber a shell case which has been checked for defects, and which has a flange of 6.5 mm thickness, and close the breech; the breech wedge should not reach the 02-11 sear of the wedge stop.

If no shell case which has been checked for defects is available insert into the chamber a spent case (with a non-protruding case), having first of all measured the thickness of its flange, then close the breech and using a clearance gauge, measure the clearance between the breech face of the tube of the barrel and the surface of the shell case flange.

The total dimension of the thickness of the shell case flange and the clearance, measured with the clearance gauge, should not be greater than 6.5 mm.

If the breech closes with the checked shell case inserted into the chamber (the clearance between the breech face of the barrel tube and the front face of the slide greater than 6.5 mm), set the face on to the wedge (chart 3).

Fracture or settling of the A51230-10 spring (diagram 1)

Press upwards on the 02-27 handle knob and turn the Sb 02-2 handle to open the breech to the extreme rear position. When this is done the 02-21 handle catch should, under the influence of the spring, engage the 02-32 lever stop of the closing mechanism and clamp tightly with its top to the surface of the lever step.

If the 02-21 catch does not engage the lever stop and does not clamp tightly with its lip to the surface of the lever stop, replace the spring with one prepared according to chart 4.

Jamming of the 02-18 piston in the seat of the 02-21 handle catch as a result of bending of the piston rod (with guns of the first issue, diagram 1)

Knock out the 02-90 catch axis from the 02-25 handle, take off the 02-21 catch and extract 02-18 piston.

Check whether the piston rod is curved.

If there is bending straighten the piston. If after this the piston is jammed, replace the piston with one prepared according to Appendix 1, sketch 131 or in the case of bending of the rod replace the piston (Appendix 1, sketch 131) and press the bush into the 02-21 handle catch (sketch 5).

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Contortion or chipping of the tip of the 02-21 handle catch (1 on diagram 1)

Knock out the 02-90 catch axis from the 02-25 handle and take off the catch.

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Weld on to the catch tip a layer of metal 3-4 mm thick with an E50A 4 mm electrode and process (sketch 6).

Put the catch in place, press the 02-90 axis into the handle and punch the axis in three places from both sides.

Assemble the breech and check how it opens. 50X1-HUM

When turning the Sb 02-2 handle forward up to the moment when the handle is stopped on the breech ring by the 02-28 rod the 02-21 catch should withdraw freely out of the coupling with the 02-32 lever stop of the closing mechanism.

If the 02-21 catch does not withdraw freely from the coupling with the lever stop, it is permissable to file the surface A of the lip of the catch, retaining the shape of the lip (cp. sketch 6).

Projection of the 02-13 clamp beyond the surface of the breech recess of the breech ring as a result of a fracture or settling of the A51230 spring of the clamp (diagram 1)

Withdraw the breech block wedge from the recess in the breech ring.

Clamp some sort of rod on to the end of the 02-60 firing lever and release.

Under the influence of the spring the firing lever should return sharply to its initial position; when this is done the end of the 02-13 clamp should not project beyond the surface of the breech recess in the breech ring.

If the firing lever does not return to its initial position and the end of the clamp projects beyond the surface of the breech recess in the breech ring, then replace the spring (Appendix 1).

Breech opened by hand with difficulty

Press upwards on the 02-27 handle knob and turn the Sb 02-2 handle to open the breech to the extreme rear position, then turn the Sb 02-2 handle sharply forward to its limit, open the breech.

Reasons for defect:

Fracture of the 02-30 crankshaft roller (diagram 1)

Replace the 02-30 crankshaft roller and the 02-31 roller stop (chart 5).

Dents or holes in the 02-33 socket (diagram 1). Smooth the dents without heating

Drill or punch out the dents and round off the edge of the hole, if dismantling of the mechanism is impossible.

Weld apertures in the socket with a E42 ∅ 4 mm electrode and trim.

Projection of the heads of the 02-10 screws beyond the surface of the breech block wedge as a result of working loose spontaneously

Tighten the screws to the limit, punch each screw in two places and trim it flush with the surface of the wedge.

Cuts and scratches on the bearing surfaces of the breech block wedge and the recess for the wedge in the breech ring

Withdraw the wedge and with a scraper or smooth-cut file remove the raised metal on the wedge and in the recess of the breech ring for the wedge.

/Scratches

Scratches on the bearing surfaces of the 02-29 crankshaft and the recess for the crankshaft in the breech ring (2 on diagram 1) 50X1-HUM

Withdraw the crankshaft and with a scraper or smooth-cut file remove the raised metal on the crankshaft and in the recess of the breech ring for the crankshaft.

Sb02-2 handle for opening the breech not retained by the 02-28 rod

With one hand raise the 02-25 handles to the limit and, supporting it in this position, with the other hand try to turn the S602-2 handle back without pressing upwards on the 02-27 handle knob; the handle should not turn.

Reasons for defect:

Fracture or settling of the 02-23 knob spring (diagram 1)

Turn the Sb02-2 handle to open the breech into the rear position. Press upwards on the 02-27 handle knob and release. Under the influence of the spring the knob should return sharply to its initial position.

If the knob does not return to its initial position, replace it with one prepared according to chart 4.

Presence of a 2.5 mm champfer on the lower end of the 02-28 rod (on guns of the first issue; 3 on diagram 1)

Knock out the A51041-13 pin and withdraw the 02-28 rod.

Weld a layer of metal on to the lower end of the rod using the E50A ϕ 3 mm electrode and trim (sketch 7).

Place the rod in place, press in the A51041 pin and punch it from both sides, then trim the ends of the pin.

Champfering on the breech ring milled under an angle of 30° (on guns of the first issue; 4 on diagram 1)

Weld a layer of metal on to the champfer with a E50A ϕ 4 mm electrode and trim the champfer under an angle of 35° (sketch 8).

Breech block wedge not retained in the extreme left position

Open the breech by hand and check whether the extractor hooks retain the breech clock wedge in the extreme left position.

Reasons for defect:

Fracture of the hooks of the 02-87 upper and 02-88 extractors (5 on diagram 1)

Replace the extractors (Appendix 1).

Fracture or settling of the 02-77 springs of the extractors (diagram 1)

Press upwards on the 02-27 handle knob and turn the Sb 02-2 to open the breech into the extreme rear position. Then turn the handle forward so that between the 02-80 step and the surface to the rear part of the 02-21 catch there is a clearance of 3-4 mm, and, retaining the handle in this position, press on the clamp of the 02-87 upper extractor with some kind of rod and turn release. Then press on the clamp of the lower 02-88 extractor and release. The 02-77 springs should press the extractors sharply against the 02-9 extractor cams.

If the extractors do not press against the cams replace the 02-77 springs with some prepared according to chart 4.

/Contortion

Contortion of the adjoining surfaces of the shoulders of the upper 02-87 and the lower 02-88 extractors and the steps of the 02-9 cams of the extractors (8 on diagram 1)

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Replace the extractors and the extractor cams (Appendix 1). Fit the 02-9 cams in pairs so that the difference in measurement A on the right and the left is no more than 0.1 mm.

Adjustment of the cam in the measurement A is permissable with the preservation of the lower part of the cam (sketch 9).

Cavities on the surface of the shoulder of the 02-32 lever of the opening mechanism (7 on diagram 1)

Weld on to the surface of the shoulder of the lever a layer of metal, using the E70 ∅ 4 mm electrode, and trim it (sketch 10).

Contortion or shipping of the tip of the 02-21 catch of the handle (8 on diagram 1)

Cp. "Breech note opening by hand".

Inadequate tightening by the 02-77 springs of the extractors against the extractor cams as a result of increased depth of the ∅ 11 mm aperture in the 02-76 sleeves (in guns of the first issue; diagram 1)

The depth of the ∅ 11 mm aperture in the 02-76 sleeve in guns of the first issue equals 24 mm, and in guns of the last issue the depth of the aperture is decreased to 22 mm.

If after eliminating defects 1-5 the breech block wedge will not stay in the extreme left position, replace the 02-76 sleeve with one prepared according to Appendix 1, sketch 132.

Breech does not close after Loading

Put a good shell-case in the chamber of the barrel. Then the breech block wedge should open; i.e. up to the 02-11 catch stop.

The shell-case (on loading the opening of the breech is checked) should have no wicks in the flange, or hollows and protuberance of the primer cap beyond the shear of the flange of the shell-case.

Causes of defect:

Settling or fracture of the 02-35 closing spring (diagram 1)

Adjust the tightened closing spring by means of the 02-89 adjusting nut.

If after adjustment the breech does not close (the wedge does not go up to the 02-11 catch stop) or the spring its broken, change the spring (Appendix 1).

The normal height of the spring in its free position is 361 ± 15 mm.

Hollows or holes in the 02-33 socket (diagram 1)

Cp. "Breech opening by hand with difficulty", para 2.

02-10 screw heads projecting above the surface of the breech block wedge as a result of coming loose (diagram 1)

Cp. "Breech opening by hand with difficulty", para 3.

Breech not opening Automatically

Check the opening of the breech by firing or artifical recoil of the barrel.

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On the run out of the barrel the breech should open and the wedge should be in the extreme left position.

When producing an artificial recoil it is essential:

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- to elevate the tipping parts of the gun 2-3;
- to unscrew the 08-38 plug (diagram 3) from the recoil brake cylinder and in its place screw in a connecting pipe, prepared according to sketch 11; to the other end of the connecting pipe join the hose of the air cylinder.
- to gently turn on the tap of the cylinder; then the barrel will start to recoil;
- to turn off the tap of the cylinder, when the barrel has recoiled 300-310 mm;
- to secure the recoiled barrel by a wooden rod ∅ 50 mm, length 300-310 mm, placed between the face of the lower end of the recuperator and the face of the coupling of the barrel; iron ferrules with rounded edges are fitted to the ends of the rod;
- to disconnect the cylinder hose from the connecting pipe;
- to gently knock out the rod, at which the barrel should recoil; when knocking out the rod, take care not to injure the hand when the barrel recoil
- unscrew the connecting pipe from the cylinder of the recoil brake;
- after the air is forced from the brake cylinder, check the amount of fluid in the recoil brake and replace the 08-38 plug.

Causes of defect:

(Detection of defects, after having recoiled the barrel).

Fracture or settling of the 30-5 spring (diagram 4)

Press on the 30-51 catch from below and release. Under the influence of the spring the catch should return sharply to its original position.

If the catch does not return to its original position replace the spring by one prepared according to chart 4.

Contortion of edge of the tooth of the 30-51 catch and the 30-52 stop, as a result of which the 30-58 plunger does not detain the catch (9 on diagram 4)

Trim the dents on the edge of the tooth of the catch and on the edge of the stop (sketch 12), taking off the minimum layer of metal.

If there are deep dents on the edge of the tooth of the catch removed the welded joint, connecting the 30-26 pin to the 30-51 catch, knock out the pin and remove the 30-27 roller.

Remove the bevel edge on the 30-26 pin (sketch 13).

Weld on to the edge of the tooth of the catch a layer of metal with an E70 ∅ 4 mm electrodge and then trim (sketch 14).

Assemble the opening mechanism (without the 30-26 pin and 30-27 roller) and, producing an artificial recoil, with the aid of a clearance gauge check on the assembled gun how the surfaces of the tooth of the catch and the step adjoin at height to (cp. diagram 4); it should be impossible to insert a 0.05 mm clearance gauge.

To ensure that the surfaces adjoin it is permissable to file the tooth of the catch down to size.

After final adjustment take off the catch and process the catch locally, thermally - the temperature for hardening is 850°C and for tempering 450-500°C with cooling in oil. Then put the roller in position, press in the pin, weld it to the catch with an E42 ∅ 5 mm electrode (sketch 15) and assemble the opening mechanism.

Jamming of the 30-6 socket in the aperture of the 09.170 arm of the catch (diagram 4)

Trim the dents on the socket.

Dents in the surface of the 30-58 plunger and in the semi-automatic 30-61 cam as a result of which the breech block does not open completely and closes straight-away. (10 on diagram 4).

Trim the dents in the surface of the plunger.

Weld a layer of metal with an E70 ∅ 4 mm electrode on to one 30-61 semi-automati cam and trim (sketch 16).

Adjust the semi-automatic cam so that clearance "a" (cf. diagram 1) between the cam and the surface of the plunger when the breech is closed is no less than 1.5 mm, and clearance "b" between the cam and the side surface of the plunger when the breech block wedge is in the extreme left position, and when the extractor cams press against the extractor shoulders as far as possible, is within the limits 0.5-1.5 mm.

Measure clearance "a" up to recoil, and clearance "b" on run-out of the barrel, when the breech is closed and the 30.58 plunger is in an extreme rear position.

To measure clearance "b" it is essential to:

- press upwards on the 02-27 knob (diagram 1) of the handle and turn back the Sb 02-2 handle so far that the 02-21 catch of the handle engages the shoulder of the 02-32 lever of the closing mechanism;
- turn the Sb 02-2 handle forward so far that the breech block wedge is transposed into the extreme left position and, holding back the handle, measure clearance "b".

Measure clearances "a" and "b" with a clearance gauge.

After adjusting the cam check the opening of the breech at the counter-recoil of the barrel and execute local thermal processing of the cam with a hardening temperature of 850°C and a tempering temperature of 450-500°C with cooling in oil.

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30-58 Plunger Returns Sluggishly to its initial position after automatic opening of the breech

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Reasons for fault:

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Catching of the 30-55 spring on the lower surface of the breech ring (with guns of the first issue; diag. 4).

With a clearance gauge measure clearance "e" between the lower surface of the breech ring and the coils of the spring; the clearance should be not less than 0.5mm.

If clearance "e" is less than 0.5mm trim the lower surface of the breech ring in the place where it meets the spring with a scraper or file.

Fracture or settling of the 30-55 spring (diag. 4). The normal weight of the spring in the free position is 244 ± 10mm.

Change the unserviceable spring (Appendix 1).

Firing pin not cocking

Open and close the breech. Using a metal rule check whether the firing pin protrudes beyond the face of the breech block wedge; the firing pin should not protrude beyond the face of the wedge.

Reasons for fault:

Fracture or settling of the A51230-13 spring (diag. 1).

Withdraw the breech block wedge from the recess of the breech ring. Cock the A51605 firing pins by a turn of the lever of the 02-5 axis of the sear; then the 02-3 catch of the sear should shift sharply into the extreme position. If the sear catch does not move into its extreme position replace the spring (Appendix 1).

Contortion of the adjoining edges of the 02.4 sear of the firing pin and the 02-3 stop of the sear. (11 or diag 1).

Using an E70 ⌀ 4mm electrode weld a layer of metal 3-4mm thick on to the edge of the firing pin sear and the edge of the sear stop and trimming (sketches 17 and 18).

After welding and trimming execute local thermal treatment with a hardening temperature of 850 C and a tempering temperature of 450° - 500°C with cooling in oil.

Dents on the side surfaces of the end of the 02-3 stop of the sear and grooves in the breech block wedge (12 on diag. 1).

Trim the raised metal.

Spontaneous Release of the Firing Pin

Perform a check in the following order:-

- open the breech;
- close the breech, bring the 10-207 handle (diag. 2) sharply back into the extreme left position;
- check whether the firing pin is released. To do this insert a metal straight edge (a ruler will do) into the gap between the face of the wedge and the shear of the tube and ensure that the striker pin does not protrude beyond the face of the breech.

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- effect a release of the firing pin, at which the characteristic click of the release should be heard.

Perform the above-mentioned check no less than five times. 50X1-HUM

Spontaneous release of the firing pin when the breech is closing is not permissible.

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Reasons for fault:

Fracture or settling of the A51230-13 Spring (Diag. 1).

Cf "Firing pin not cocking", para.1.

Contortion of the adjoining edges of the 02-4 sear of the firing pin and the 02-3 catch of the sear (13 on diag.1).

Cf. "Firing pin not cocking", para.2.

Firing Pin not being released

Open and close the breech.

Effect a release of the firing pin using the electrical or the mechanical trigger and determine from the sound whether the firing pin has been released. After this check, using a metal rule whether the striking pin protrudes beyond the face of the breech block: the striking pin should protrude beyond the face of the wedge.

Reasons for fault:

Cf. "Detecting defects and repair of the trigger mechanism, safety device and cradle," faults -

"Electrical trigger not working" paras.1-5 and "Mechanical trigger not working," paras.1-2 and in addition:

Fracture of 02-7 firing pin spring (A51230-103, diag.1)

Replace spring (Appendix 1).

NOTE. With guns of the latter issue the dimensions of the A51230-103 firing pin spring are modified. The new spring is given the number 02-7. When replacing unserviceable springs in guns of the first and latter issues use an 02-7 spring.

Shell Case not Extracted

Reasons for fault:

Fracture of the hooks of the upper 02-87 and lower 02-88 extractors (14 on diag.1)

Replace the extractors (Appendix 1).

Dilation of the shell case

Extract the shell case from the chamber of the barrel using an Sb41-302 hand extractor or force it from the muzzle end using a bell rammer.

Contortion of the adjoining surfaces of the shoulders of the upper 02.87 and lower 02.88 extractors and of the catches of the 02-9 cams of the extractors (15 on diag. 1).

Cf. "Breech block wedge not retained in the extreme left position", para.3.

Misfires

Reasons for fault:

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Primer cup screwed in too deeply or incorrectly.

If the primer cup is screwed in too deeply, unscrew it so far that it is flush with the bottom of the shellcase. If after this there is a misfire with

/the

depth of the depression in the primer cup greater than 0.6mm, replace the primer cup.

In the firing mechanism

Fracture, bending or settling of the A51605 striker pin (diag. 1). 50X1-HUM

Withdraw the breech block wedge from the recess of the breech ring, inspect the striker pin and measure, using the official A52415-1 gauge, how far it comes out beyond in the face of the wedge.

The normal distance should be from 2 to 2.38mm.

Replace the unserviceable firing pin by the spare or by one prepared according to Appendix 1, sketch 133.

Fracture or settling of the 02-7 firing spring (A51230-103 (diag. 1).

If no fracture can be detected, fit a serviceable spring in place of the one being checked and check whether the primer cup fractures.

Fracture of the primer cup when the newly fitted serviceable spring has been fitted indicates settling of the spring being tested.

If there is no serviceable spring available settling of the spring is determined by its height.

The height in the free position should be:

02-7 springs - not less than 69mm, A51230-103 - not less than 71mm.

In the event of fracture or settling replace the 02-7 (A51230-103) spring with an 02-7 spring (Appendix 1).

In the operating mechanism

Eccentricity of the impact of the A51604-3 firing pin (diag.1).

Check the position of the firing pin dent on the primer cup, for which:

- unscrew the detonated primer cup from the shell case;
- unscrew the anvil and bush from the primer cup;
- correct the dent on the primer cup by blows along the knock-out rod, fitted into the recess of the primer cup, after which trim the end of the cup;
- screw the primer cup into the aperture of the shell case;
- place the shell case in the chamber of the barrel and close the breech;
- applying power of the arm to shell tray of the breech block wedge, move the wedge as far as possible to the left and effect the release of the firing pin;
- open the breech, turn the shell case through 180° and close the breech;
- again applying the power of the arm to the shell tray of the breech block wedge, move the wedge as far to the left as possible and effect the release of the firing pin;
- withdraw the shell case from the chamber and measure distance A between the contours of the dents of the striker pin (sketch 1[illegible]) 50X1-HUM

Distance A should be not greater than 6.5mm.

If distance A is greater than 6.5 mm replace the 02-30 roller of the crank and the 02-31 stop of the roller (chart 5) and clear the roller groove in the wedge, taking off the minimum layer of metal.

The maximum permissible breadth of the groove is 35 mm.

In the closing mechanism

Fracture or settling of the 02-35 closing spring (diag. 1.)

Open and close the breech. Mark the position of the breech block wedge by a line, which is drawn on the lower guiding surface of the wedge recess of the breech ring along the end of the breech block wedge (on the shell tray side). Then, turning the S 02-2 handle to open the breech into the extreme rear position, trg to move the breech block wedge to the closing side.

After this draw a second line on the lower grinding surface of the wedge recess.

Deviation of the lines indicates settling of the closing spring.

If there is a deviation of the lines adjust the tightening of the spring by the C2-89 adjusting nut. If even after this adjustment the breech block wedge does not reach the second line on closing, replace the spring (Appendix 1).

If there is fracturing of the spring, replace it also.

02-11 Catch of the stop does not retain the breech block wedge in the closed position

Reasons for fault:

Fracture or settling of the A51230-16 spring (diag. 1).

Open the breech, press upwards on the 02-11 catch of the stop and release. The catch should spring sharply back into its initial position under the influence of the spring.

If the catch does not return to its initial position, replace the spring by one prepared according to chart 4.

Jamming of the 02-11 catch of the stop in the recess of the breech ring, caused by dents on the surface of the catch or bending of the shaft (16 on diag. 1).

If there are any dents on the surface of the catch trim the raised metal. Check by the paint if the surface of the stop catch and the surface of the groove of the wedge adjoin.

Straighten the catch if the shaft of the stop catch is bent.

Holes and Gaps in the Outer Cylinder of The Recuperator

Small holes in the outer cylinder of the recuperator are permissible if there are no splits and if the holes do not interfere with the assembly of the recuperator, or the withdrawal and installation of the recuperator in the recesses of the cradle.

Weld up gaps up to 15 mm, and those greater than 15 mm but not greater than 80 x 80 mm seal with a plate.

Holes which interfere with the assembly of the recuperator and also the withdrawal and installation of the recuperator in the recesses of the cradle should be eliminated by cutting out the damaged parts and sealing them with plates.

If the dimensions of the gaps are greater than those shewn above, replace the recuperator (Appendix 1).

Detection of Defects and Repair of the Elevating and compensating Mechanism.

The sealing of holes in cylinders is only permitted in wartime.

Stiff movement of the Elevating Mechanism

Set the hinged shield in the action position and suspend a 0.5 Kg weight on the rear side of the shield.

Check the working of the elevating mechanism, adding angles of elevation to the tipping part of the gun from - 5° to + 18°.

The mechanism should work smoothly. The pull on the handle of the hand-wheel to set it in motion should be not greater than 6 Kg.

After measuring the pull take off the weight hung on the rear side of the shield.

Reasons for fault:

In the engagement of the teeth of the rack and the spindle from the elevating mechanism cog wheel.

Scratches, nicks and dents on the teeth of the 21 - 416 spindle from the cog wheel and on the teeth of the 09 - 175 rack of the elevating mechanism (diagram 5).

Trim the raised metal.

In the mechanism of the worm gear

21 - 209 worm clamped tightly by the 21 - 421 nut (diagram 5).

Take off the 21 - 422 stop wire and unscrew the A51066 - 7 screw (A51066 - 136).

Test the turning of the hand-wheel, at the same time unscrewing and screwing up the 21 - 421 nut.

By means of the 21 - 421 nut adjust the turning of the worm so that the hand-wheel turns lightly and the worm has no axial looseness.

/After

After finishing this adjustment stop the 21 - 421 plug with the A51066 - 7 screw (A51066 - 136) and the 21 - 422 wire.

Clamping of the 113 - 12 spring not adjusted on the compensating mechanism which is being adjusted.

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Unscrew the 113 - 15 lock nut up to the stop into the end of the 113 - 11 shaft.

By slackening or tightening the 113 - 14 clamping nut, adjust one tightness of the 113 - 12 spring so that when the angle of elevation of the barrel is increased or decreased the elevating mechanism works smoothly, and the pull exerted on the fly-wheel of the mechanism to set it in motion is not more than 6 Kg.

After adjustment screw the 113 - 15 locking nut fully into the clamping nut and measure the distance "a" between the fall of the locking nut and the fall of the end of the rod; the distance "a" should be between the limits 0 - 35 mm.

If adjustment of the compensating mechanism is not successful (in the absence of faults 1, 2, 5 and 6), and also if the 113 - 12 spring is fractured, replace the spring (Appendix 1).

Fracture or settling of the 113 - 19 (113 - 10) spring in the unadjusted compensating mechanism (diagram 6).

The normal height of the spring in its free position is as follows:

113 - 19 springs in guns of the latter issue 347^{+8}_{-4} mm and springs (113 - 10) in guns of the first issue - 414 ± 24 mm.

Replace the unserviceable spring (Appendix 1).

In the coupling of the cradle with the trunnions.

Fracture of the 17 - 71 needle of the trunnions (diagram 5).

With the trunnions from the bracket of the turret of the tank. Dismantle the trunnions; when doing this ensure that the needle bearings are not scattered.

If there are any fractures or splits on the needles replace the needles (Appendix 1).

Dents from the 17 - 71 needles on the 17 - 71 needles on the 17 - 80 or 17 - 84 left trunnion collar and the right 17 - 82 or 17 - 85 collar in guns of the last issue or (17 - 80) in guns of the first issue and on the internal surface of the 17 - 70 sleeve (20 on diagram 5).

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If after eliminating the defects, shewn in paragraphs 1-4 the power exerted on the handle of the hand-wheel of the elevating mechanism to set it in motion is greater than 6 kg replace the left Sb 17-17 and the right Sb 17-18 trunnions in guns of the last issue or Sb 17-15 trunnions in guns of the 50X1-HUM ue (Appendix 1).

Increased Full Vertical Unsteadiness of the Tipping Part of the Gun

Manipulating the elevating mechanism of the weapon, bring the barrel to the horizontal.

Press upwards from below on the muzzle end of the barrel employing a pressure of about 25 kg and supporting the barrel in this position, using the handle of the 10-63 worm of the spirit level bring the bubble of the spirit level to the middle and note the reading of the level. Then press down on the muzzle end of the barrel from above with the same pressure and supporting the barrel in this position once again bring the spirit level bubble to the middle and note the reading.

The difference between the readings of spirit level shows the size of the full vertical unsteadiness in units.

Make this check every 50 mils up to the maximum angle of elevation.

A full vertical unsteadiness greater than 6 mils is not permitted.

Reasons for fault:-

Increased clearance (greater than 1.2 mm) between the adjoining teeth of the 09.175 rack of the elevating mechanism and the teeth of the 21.416 shaft from the cog wheel (diag. 5).

Measure the clearance between the teeth of the rack and the teeth of the shaft from the cog-wheel at several angles of elevating for winch:-

- insert between the teeth (along the length of the tooth) a lead plate of gauge 2 x 6 mm and length 60 mm;
- turning the flywheel of the elevating mechanism, compress the plate and withdraw it;
- measure the minimum thickness of the plate at both ends: the thickness of the plate shews the size of the clearance between the teeth.

The clearance should be uniform along the whole length of the tooth and should be no greater than 1.2 mm.

An unequal clearance between the teeth indicates bending of the bracket of the tank.

In the case of negligible bending of the bracket of the tank and a clearance between the teeth no greater than 1.2 mm eliminate the bending of the teeth when they engage the cog-wheel with the rack by fixing a strip of any kind of steel up to 1.5 mm thick between the housing of the elevating mechanism and the bracket of the tank, held in place by bolts. The strip should be held by not less than two bolts.

After fixing the strip check how the teeth of the cog-wheel engage the teeth of the rack by taking impressions of the teeth on a strip of paper 50X1-HUM passed between the teeth.

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A clearance up to 1.4 mm may be allowed if the clearance where the teeth of the 21-118 rim of the worm gear meet the thread of the 21-209 worm is no greater than 2.0 mm and the clearances in the remaining couplings, affecting the vertical unsteadiness of the tipping part of the gun, are normal. 50X1-HUM

The total length of the impressions of each tooth on the paper should be not less than 42 mm.

If the total length of the impressions is less than 42 mm scrape the teeth of the rack and the shaft.

If fixing the strip does not succeed in eliminating the bending in the engaging of the teeth, and also if the clearance is greater than 1.2 mm do as follows.

In the case of unequal clearance in the engaging of the gears straighten the bracket of the tank when it has been heated.

To eliminate possible bending of the teeth after straightening the bracket of the tank it is permissable to fix under the housing of the elevating mechanism a strip of any kind of steel up to 1.5 mm thick.

After fixing the strip check how the teeth engage by taking impressions on a piece of paper, as shewn above, and also check the deviation of the end of the tooth of the shaft from the cog-wheel in relation to the tooth of the rack; a deviation greater than 8 mm is not permissable.

In the case of a uniform clearance in the engaging of the gears greater than 1.2 mm adjust the engaging of the teeth using an old cam sleeve or using a new cam sleeve (chart 16), or by moving the rack of the elevating mechanism (chart 17).

Axial unsteadiness of the 21-209 worm (diag 5)

Check whether there is any axial unsteadiness of the worm. No unsteadiness is permissable.

If there is any unsteadiness tighten the 21-421 nut so that the worm has no axial unsteadiness and the hand-wheel turns easily.

After adjusting stop the 21-421 nut by the A 51066-7 (A51066-136) screw.

Heat using a gas torch, and 21-422 wire.

Wear of the apertures of the 21-35 and the 21-410 sleeves, of the journal of the 21-416 shaft from the cog-wheel and of the external cylindrical surface of the 21-412 clamping sleeve (diag 5).

Dismantle the elevating mechanism.

Measure the diameters of the apertures of the sleeves, the diameter of the journal of the shaft from the cog-wheel and external diameter of the clamping sleeve.

The difference in diameters in each junction should be not greater than 0.5 mm. 50X1-HUM

If the difference is greater than 0.5 mm replace the sleeves (chart 18).

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Wear of the level surfaces of the 21-418 rim of the worm gear (diag 5).

Dismantle the elevating mechanism.

Remove the lubricating oil from the level surfaces of the friction cone and the worm gear rim and rub them dry.

Check by paint how the level surfaces adjoin; the adjoining should be not less than 70%, and the imprint of the paint should be spread evenly along the whole surface.

If the level surfaces adjoin less than 70%, and the imprint of the paint is spread unevenly, then rub the friction cone with GOI paste along the rim of the worm gear.

After abrasion assemble the elevating mechanism without the 21-413 cap and check the moment of the friction apparatus on to the 21-416 shaft from the cog-wheel.

The moment on to the shaft from the cog-wheel should be M = 34000 + + 2000 kg/cm^2.

In order to check the moment:-

- fix the elevating mechanism on the stand (Appendix 12):
- put on to the teeth of the 21-416 shaft from the cog-wheel the special key (Appendix 13) in such a way that the handle of the key is in the horizontal position;
- put on to the handle of the key a pipe, and on to the end part of the pipe at distance "l" from the centre of the 21-416 shaft; from the cog-wheel suspend a weight "Q", creating moment $M1=Ql+Mo = 34000$ kg/cm^2, where Mo = moment from the weight of the key handle and the pipe.

Under the influence of the moment M, the shaft from the cog-wheel should not turn. If the shaft from the cog-wheel turns tighten the friction cone, screwing up the 21-409 nut sufficiently, so that at moment M, the shaft from the cog-wheel does not turn.

Then once again set the key with the pipe in the horizontal position and create moment $M_2=Ql+M_o = 36000$ kg/cm^2 (or $M2=QL,+M_o = 3600$ kg/cm^2).

Moment M_2 may be created at the expence of a variation of weight Q or distance L.

Under the influence of moment M_2 the shaft from the cog-wheel should turn.

If the shaft does not turn, slacken the clamping of the friction cone, unscrewing the 21-409 nut sufficiently so that at moment M_2 the shaft turns.

After this once again perform a check at moment M_1.

After checking and regulating the moment on to the shaft from the cog-wheel check the position of the line on the 21-409 nut in relation to the line on the external surface of the 21-412 clamping sleeve. If the lines do not correspond, then remove the line on the nut and draw a new one of depth and breadth 0.5mm against the line on the external surface of the clamping sleeve. Fill in the line with red lacquer.

Replace the 21-413 cap and set the elevating mechanism in plac 50X1-HUM

Fracture of the teeth of the 09-175 Rack of the Elevating Mechanism and the teeth of the 21-416 shaft from the cog-wheel

In the case of a tooth of the rack fracturing to no more than half the length of the tooth weld on to the damaged tooth a layer of metal, using an E50A ⌀ 4 mm electrode, and trim it according to a template prepared according to a profile of a serviceable tooth.

In the case of fracture of a tooth of the rack to more than half the length of the tooth or [redacted] 50X1-HUM

Increased Play of the Elevating Mechanism

(greater than $\frac{1}{2}$ turn of the fly-wheel)

Fix a wire indicator (arrow) on the [illegible] end of the elevating mechanism, so that its end is by the rim of the elevating mechanism hand-wheel.

Depress the barrel 1-2°.

Pick out the play of the elevating mechanism by a turn of the fly-wheel in the "elevation" direction, at the same time bringing the top of the central square of the telescopic jointed sight into the point of the mark.

Mark the position of the hand-wheel according to the indicator by a line on the external surface of the rim.

Turning the fly-wheel slowly back in the opposite direction up to the moment when the top of the central square of the sight moves away from the point of the mark, once more mark by a line according to the indicator the second position of the hand-wheel.

The angular deviation of the line on the rim of the hand-wheel gives the size of the play of the mechanism; the play should be not greater than a $\frac{1}{2}$ turn of the hand-wheel.

Reasons for fault:

Cf. "Increased full vertical unsteadiness of the tipping part 6 of the weapon", paragraphs 1-6 and in addition:-

Unsteadiness of the hand-wheel on the 21-209 worm (diag 5).

Check whether there is any unsteadiness of the hand-wheel on the worm.

Unsteadiness is not permitted.

If the hand-wheel is unsteady trim the key grooves of the A51910-253 boss and the worm, taking off the minimum layer of metal possible; prepare an A51050-21 dowel according to Appendix 1, sketch 149 and fit it in so that there is no unsteadiness of the hand-wheel on the worm.

Elevating Mechanism Yields on Discharge

This is determined from the documents accompanying the weapon from the military unit which sent the gun for repair, or from the information given by the personnel bringing it.

The elevating mechanism should not yield on discharge.

Any knocking down of the laying after discharge greater than 1 mil is not permissable.

Reasons for fault:-

21-419 friction cone loosely clamped by the 21-409 nut (diag 5)

Unscrew the three A51061-8 screws and withdraw the 21-413 cap.

Clamp the friction cone, screwing up the 21-409 nut; in this case a deviation of the line on the 21-409 nut in relation to the line on the external surface of the 21-412 clamping sleeve is permitted if it is no greater than $\frac{3}{4}$ of a turn of the nut.

If after clamping the friction cone the elevating mechanism yields on discharge, dismantle it, examine the 21-420 plate springs and with a depth gauge measure height A of each spring (sketch 31).

Height A of a spring should be not less than 10.1 mm.

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In the case of settling or fracture of a spring replace it (Appendix 1).

Wear of the apertures of the 21-6 sleeves and the journals of the 21-209 worm (diag 5).

Measure the diameters of the apertures of the sleeves and the di[redacted] 50X1-HUM
of the journals of the worm.

The difference in diameters in each junction should be not greate[redacted] 50X1-HUM
0.6 mm.

If the difference is greater than 0.6 mm replace the sleeves (Appendix 1, sketch 148).

After pressing the 21-6 sleeves into the 21-214 housing and the 21-208 sleeve cut in the sleeves a groove for lubrication (sketches 27 and 28).

To eliminate possible catching of the worm journals in the sleeves (after pressing in) it is permissable to scrape the outer surface of the sleeves.

When replacing the 21-6 sleeve in the 21-208 sleeve in guns of the first issue do as follows:-

- cut a groove on the external surface of the 21-208 sleeve (Cf. sketch 28);
- press the 21-6 sleeve into the 21-208 sleeve;
- cut a thread M8 x 1.25 in the 21-214 housing (sketch 29);
- prepare an A51064-3 screw (appendix 1, sketch 150);
- stop the 21-208 sleeve with the A51064-3 screw.

Wear of the grooves in the junction of the 21-419 friction cone and the 21-417 bearing flange with the 21-416 shaft from the cog-wheel (diag 5).

Measure the breadth of the grooves of the friction cone, the bearing flange and the shaft from the cog-wheel.

The difference in dimensions in each junction should be not greater than 0.5 mm.

With a difference greater than 0.5mm trim the grooves in the friction cone and the bearing flange, weld on to all the groove shoulders (on one side) of the cog-wheel shaft a 2.3 mm layer of metal with an E50A ⌀ 4 mm electrode and trim them on both sides (sketch 30).

Wear in the joining of the teeth of the 21-418 rim of the worm gear with the thread of the 21-209 worm (diag 5).

Measure the thickness of the teeth of the worm gear rim at a distance of 4.6 mm from the top of the teeth and the thickness of the thread of the worm at a distance of 4.5 mm from the top of the thread.

The difference between the spacing of the 14.13 mm thread and the sum of the thickness of the tooth of the worm gear rim and the thickness of the thread of the worm should be not greater than 1.2 mm.

With a difference greater than 1.2 mm replace the Sb 21-55 worm gear.

A clearance of up to 2.0 mm may be permitted, if the clearance in the linking of the teeth of the 09-175 rack with the teeth of the 21-416 shaft from the cog-wheel is not greater than 1.4 mm, and the clearances in the remaining linkings, affecting the vertical unsteadiness of the tipping part of the gun, are normal.and the worm (Appendix 1). After assembling the elevating mechanism check the moment of the friction apparatus on to the 21-416 shaft from the cog-wheel (cf "Elevating mechanism yields on discharge", paragraph 2).

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Particulars regarding the use of tanks

Taking into account particulars for the use of tanks under various conditions following rules are given in this manual to insure keeping the tank in a proper condition.

Getting tank ready for use in summer.

In order to get tank ready in summer one has to apply technical maintenance No. 2 or 3 and additionally :-

- clean armament and its mounting, eliminate noticed faults and replace winter lubricant by summer type.

- fill fuel system with summer fuel.

- drain cooling system of anti-freeze mixture; and flush the system with hot water; in case the engine has run hot one must flush the cooling system with a mixture of 1 Kg. of soda and ½ Kg. of kerosene per 10 litres of water;

- switch off preheater from the cooling system;

- clean preheater cooler from fouling.

Way of cleaning cooling system

- fill the cooling system with the mixture as per above; start engine, let it work for 10 - 15 min. then leave mixture in the system for some 10 - 12 hours.

- start engine again, let it warm up, then stop it.

- drain mixture and flush system with clean water.

- fill cooling system with clean sweet water.

It is forbidden to flush the cooling system with caustic soda for it might damage the bakelite surface.

In case of necessity radiator surface could be cleaned with a brush then radiator blown through with compressed air.

In order to avoid radiator's surface getting dirty, latter should be kept dry, no water spilt and any leakages stopped.

Particular rules to be observed when using tank in high temperature and in air filled with dust.

High air temperature brings up heating of tank components, increased use of water of the cooling system and of electrolite in the batteries, it also worsens working conditions of the crew.

Dust (sand) penetrating inside the tank and settling on its parts worsens cooling conditions and stiffens working of traversing and elevating hand wheels and also of control pedals and levers.

Dusty air lowers considerably visibility through observation devices, especially when moving in a column.

In order to obtain tanks normal work in high temperatures and in dusty air it is essential:-

1. To watch carefully thermometers, not to allow engine overheating. In order to prevent overheating the cooling system should be filled to capacity, radiator surface clean and the sealing of the engine compartment in good order.

2. At short halts the heating of the running gear and the final drive should be checked, in order not to admit engine overheating. Particular attention should be given to the heating of fourth and fifth road wheels. In case of an overheating of one of the road wheels - ascertain its reason and if necessary disassemble and replace the faulty parts. In case of considerable overheating of road wheel-rubber rims one should drive at reduced speed.

3. In order to prevent dust getting in, tank should be refuelled with the help of a fuel pump. Before removing plugs of fuel tanks and points of lubrication these should be thoroughly cleaned. Holes in fuel tank plugs must be cleaned, even washed, to give access of air to the tanks.

   All fuel and lubricants containers must be well closed..

4. All servicing of filters and air-cleaner should be carried out indoors. When these are removed, all openings in the body of the filter and tubes must be well closed to prevent dust penetration. Air-cleaner magazine should be flushed 2 - 3 times, each time changing the fluid. For a more thorough cleaning the magazine should be blown through with compressed air.

5. During the move lubricants should be removed from parts subject to friction (such as gear quadrant, race teeth, traversing and elevating gear, hatch hinges, louvres, hinges etc.) as it collects dust and this leads to stiffening up of the parts.

6. When there is a considerable increase in the work of control pedals and levers these hinges and bearings, should be cleaned and washed with fuel.

7. Every 5 - 6 days the level of electrolite in batteries should be checked, dust and dirt removed, plug holes cleaned, distilled water added, battery cover rubbed with a clean cloth.

Particular features of using tanks in bad ground conditions

Natural obstacles such as rivers, lakes and marshes and also much softer ground due to rains and spring slush considerably reduce tanks' speed and manoeuvreability.

The state of roads in early spring and during the period of rains affect in the first place tank running gear bearings due to penetration of water, slush and sand. Dirt and sand wear out the running gear bearings. It is therefore essential not to admit any defect in the fastening of labyrinth packing covers, supporting bearings and adjusting idler wheels.

Negotiating difficult particularly waterlogged sections of roads leads to considerable overloading of components of the transmission and of the engine, consequently to their overheating.

The maintenance of a tank during period of bad roads is more difficult and requires more time.

In order to ensure correct tank use one should ease track tension.

/Preparing

Preparing tank to negotiate a ford

Before negotiating a ford up to 1.4 in. deep it is essential:

- to check belly access plates.
- to shut driver-mechanic's hatch. Att. to CS B 3,645,324
- to put on gun and MG muzzle covers.
- to insert rubber plug in apertures for the hull MG in the upper glacis plate.
- to check track tension and if necessary adjust.
- check the storage and security of the tow rope; free ends of which are fastened to the turret.

After the crossing, it is essential to make sure there is no water in the hull. Should there be any water in it, the tank is put on an inclined plane and water drained through access plates.

Preparing to use tanks in winter.

When acting in cold weather it is essential to carry out technical servicing No. 2 and No. 3 and additionally:

- to refuel the tanks with winter fuel instead of summer fuel, then start engine and drain remaining summer fuel from pipes, filters and feed ramp;
- clean dirt from controlling openings of engine block;
- check heating system;
- connect preheater with the system, turning the handle so as to make visible inscription "VKO" ("on") looking on it from above;
- check state of radiators;
- drain water from the system, hoses and their connections;
- fill cooling system with anti-freeze.

  If cooling system will not be re-filled it is essential to turn the crankshaft two or three times without fuel;
- to pump in 5 - 6 litres of anti-freeze through radiator opening;
- drain this anti-freeze; leave open drain cock, opening and radiator opening while the tank is stationary.
- check condition of tarpaulin and "heating carpet".

Characteristics of using tanks in temperatures below Zero.

It takes a longer time to start tank engine in low temperatures and danger arises that damage might be done to the engine, (bearings might run, or engine seize) when starting it, should one not observe rules in preparing it, this would also complicate crew's work.

In order to simplify engine starting and creating normal conditions of work after having started it, engine should be heated up with the help of a "forced feed pre-heater", placed in the tank.

To avoid possible damage to components of the power transmission and running gear (in temperatures - 30°centigrade or more) one must start on 2nd gear, switching on epicyclic gear train .

Use of pre-heater.

Pre-heater is used to heat engine before starting it when air temperature is below 5°C.

When using pre-heater tank must be placed on horizontal plane. An inclination of 7°might be admitted. Pre-heater can work on electrical or hand gear. When working on hand gear the handle should be fitted and then turned making 60 - 70 revolutions per minute. In order to reduce effort on the handle the electrical belt drive should be removed.

To start pre-heater

- open bottom access plate intended to let out exhaust gases; in order to achieve it, unscrew the nut of the plate's cover until it touches handle, press it as far as possible and turn access plate cover through 180°.
- replace handle of pre-heater hand gear;
- connect fuel pump with any group of fuel tanks fill pre-heater and engine fuel pumps by way of hand pump;
- switch on batteries;
- switch on spiral heater plug and about 1 minute later begin slowly to turn hand gear in reverse direction without checking handle's move;
- after ignition of mixture reverse immediately direction of turning of handle, switch on electric pump gear and quickly take off hand gear handle.

When warmed up and pre-heater works well (that is when fuel in engine can ignite without heater plug) switch off heater plug and continue system's warming up. Pre-heater's normal working is characterized by intensive rise in temperature of cooling fluid and smokeless exhaust gases leaving pre-heater.

If the resistance on the handle is great and turning is difficult or impossible it is essential to turn shaft of the electric motor and of the injector pump for several revolutions by hand, using the driving belt. If this is impossible remove the belt,operate pre-heater by hand and let it work 10 - 15 minutes after which replace the belt and start electric motor.

In order to reduce resistance in turning the handle one may pour into the cavity of the pre-heater injector pump 25 - 30 gr. of diesel fuel (in case air temperature is below - 30°C.).

Should the pre-heater refuse to start or work irregularly all air should be let out of its fuel pump turning air plug 3 - 5 times in order

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to make fuel flow [redacted] tightly screwed up.

After pre-heater has stopped working fan should be switched on for 1-2 minutes in order to clear air of exhaust gases. Access plate should then be closed, valves being screwed tightly and axis handle turned upwards.

Order in which engine should be warmed up in low temperature

Before starting the engine it is essential to have an inspection of the tank; any defects should be corrected and the engine warmed up.

It is strictly forbidden to start a cold engine in a temperature below 5°C (i.e. without using the pre-heater).

When fitting the cooling system with anti-freeze and the lubricating system with oil, the engine should be warmed up in the following way:

- batteries should be placed in the tank;
- tarpaulin removed on the left side in order to let exhaust gas out of pre-heater and engine;
- pre-heater started and engine warmed up to anti-freeze temperature reaching 80° - 90° C. (according to panel thermometer); temperature in system might be allowed to rise up to 90° - 100° C while pre-heater is working
- the lubricating pump switched on for a short period of 3--5seconds in order to obtain an oil pressure not less than 3 Kg./1 sq. cm.; pre-heater switched off and engine started as explained in Chapter 13.

In case the required pressure had not been obtained at first attempt it should be repeated. The pump might be switched on for up to six times with intervals of 15 - 20 sec. Should the required oil pressure not been obtained even after six attempts, start pre-heater and repeat warming up of the engine until anti-freeze temperature has reached 95° - 100°C. when pre-heater should be stopped, oil pressure brought up to 3 Kg./1 sq. cm. by means of the oil pump and engine started. In case even this procedure should not give the required pressure, allow a 10 minute pause and then switch on pre-heater and repeat the warming up and starting of engine.

If the oil pump's gears refuse to turn due to thick oil it is forbidden to keep pump switched on for more than 5 seconds as it might lead to the burning out of the windings of the electric motor.

When the oil pump functions it is not advisable to have it switched on for more than 10 sec. as it might lead to a large amount of oil being pumped from the oil tank to the engine crankcase.

When tank cooling system is filled with water (which is allowed in exceptional cases if there is no anti-freeze available) one should prepare to start engine in the following way:

- batteries should be placed in the tank;
- make sure that anti-freeze drain cock is open;
- pour water of 90° - 95°C through radiator nozzle and as soon as hot water will flow out of drain cock, close it and pour in another 30 - 50 litres of hot water;
- start pre-heater and fill cooling system up to normal level;

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- screw up plugs of radiator opening and of drain cock;
- warm [redacted]

/How to

How to warm up tank in field conditions

It is with pre-heater's help that the tank is kept ready to move after prolonged halts (should these be necessary) in wintry weather. In this case anti-freeze and oil are not drained.

To keep the tank ready to move the following conditions must be observed:

- choose a sheltered horizontal plane to be occupied by the tank;
- close all hatches and louvres;
- cover all louvres with carpets ?
- cover tank with tarpaulin and put some snow on the edges of the tarpaulin where it touches the ground;
- observe regularly, according to panel thermometer, the temperature of anti-freeze in the system;
- should its temperature fall to 35° - 40° C. remove tarpaulin on the left side to allow exhaust gases out of pre-heater and have it started;
- warm up engine up to antifreeze temperature of 95° - 100°C. and switch off pre-heater;
- cover tanks left side with tarpaulin.

For the duration of the halt whenever the anti-freeze temperature falls to 35° - 40°C the warming up of the tank should be carried out as per above.

Temperature should be watched by means of the instrument panel thermometer.

In cases where the cooling system has been filled with water the following measures must be taken to keep the tank in readiness:

- warm it up as explained earlier;
- switch on pre-heater every 30 minutes and bring water temperature up to 95° - 100°, when this is reached switch it off.

When the engine is being warmed up with the aid of the pre-heater the hand gear should be used as a precautionary measure against the batteries going flat.

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