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ТАНК Т-90М
Руководство по эксплуатации
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188М.РЭ
188М.РЭ1
188М.РЭ2

~~Утвержден 188М.РЭ.ЛУ~~

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TANK T-90M

Manual

Part 1. Description and operation of the tank

188M.R E

Content

This operating manual (hereinafter referred to as the manual) is the main document in accordance with which the T -90M tank (hereinafter referred to as the tank) must be operated. The guide consists of three parts.

The first part of the manual contains the main tactical and technical characteristics of the tank, a description of the purpose, design and operating principles of the tank's systems and mechanisms.

The second part of the manual contains information on the rules of operation of the tank and its components, including maintenance, storage and transportation.

The third part of the manual (album of drawings) contains illustrations that explain and supplement the text of the first and second parts of the manual.

During the operation of the tank, along with this manual, it is necessary to use the operational documentation supplied with the tank, according to the list of operational documents 188M.VE.

Persons who have been trained in the operation and maintenance of the tank are allowed to work on the tank.

1 General description of the tank

1.1 Purpose and composition of the tank

The T-90M tank is a tracked combat vehicle with powerful weapons, reliable armor protection and high maneuverability.

The tank has a crew of three people: commander, gunner and driver.

General views of the tank are presented in Figures 1.1 and 1.2 .

The tank is armed with a 125-mm smoothbore cannon, stabilized in the horizontal and vertical guidance planes, a 7.62-mm machine gun coaxial with the cannon, and a 12.7-mm machine gun as part of a remote machine gun installation (hereinafter referred to as the RPU).

The tank is equipped with an automated multispectral fire control system, as well as an automatic loader, ensuring a high combat rate of fire for the gun.

The DPU is designed to combat stationary and moving targets: tank-dangerous manpower and lightly armored vehicles.

The tank is equipped with:

– power plant with V-92S2F engine;

– automatic gear shift system (hereinafter referred to as AMS);

– driver mechanic display complex (hereinafter referred to as DKMV), which generates recommendations for the driver mechanic to prevent emergency situations;

– a diesel generator set (hereinafter referred to as the DGS), designed to provide the tank with electricity when operating in the parking lot;

– pre-heater with automated control with a delayed start timer, protection against loss or overheating of coolant and an open position sensor for the heater exhaust flap;

– external video surveillance system (hereinafter referred to as SNV);

– a unified software and hardware complex that ensures the integration of the tank into the automated control system for combined arms and supporting military formations at the tactical level (hereinafter referred to as the ASUV TZ);

– a set of removable-modular all-aspect protection, increasing the tank's protection against armor-piercing and cumulative weapons;

– an automatic system for setting curtains (hereinafter referred to as the SPS), designed to interfere with the control systems of anti-tank weapons with laser target designators and rangefinders;

– a system that protects the crew and equipment inside the tank from weapons of mass destruction (hereinafter referred to as WMD). The system protects against the following damaging factors:

- exposure to shock waves and penetrating radiation during a nuclear explosion;
- radioactive dust when the tank moves through radioactively contaminated areas;
- poisonous and bacterial agents;

– a fire-fighting equipment system (hereinafter referred to as FPE), designed to extinguish fires inside and outside the tank;

– thermoelectric air conditioner (hereinafter referred to as TEC), which ensures the creation of improved microclimate parameters in the habitable compartments of the tank at elevated ambient temperatures.

The tank has radar protection due to the installation of shields, as well as protection from detection in the visible and thermal wavelength range due to deforming (camouflage) painting and installation of thermal protection elements. In addition, the tank is protected from the effects of napalm-type fire mixtures.

The tank is equipped with: equipment for underwater driving (hereinafter referred to as OPVT), designed to overcome fords and water obstacles along the bottom; self-digging equipment designed for excerpts of trenches, and thermal smoke equipment (hereinafter - TDA) for setting up smoke screens.

In addition, the tank is equipped with:

– an active defense complex to combat cumulative anti-tank weapons;

– generator of jamming signals to suppress radio control channels for mine-explosive devices;

– radio absorbing kit;

– track-mine trawl for making passages in minefields;

– up to three additional barrels of fuel.

The tank includes a single set of spare parts, tools and accessories. According to the arrangement of mechanisms and equipment inside, the tank is divided into three compartments: the control compartment, the fighting compartment and the engine and transmission compartment.

1.1.1 Department of Management

The control compartment is located in the bow of the hull and is limited by:

– on the right - the right bow fuel tank and the right tank;

– on the left - the left bow fuel tank, the driver's shield and a rack with batteries with electrical equipment installed above the batteries;

– at the rear - local protection of the rotating conveyor of the automatic loader at the bottom and a turret ring guard at the top.

In the control compartment at the driver's workplace there is a seat 42 adjustable in height and in the longitudinal direction (Figure 1.3), which provides the driver with a "combat" and "traveling" seating position.

In front of the seat on the bottom of the body there are:
– fuel pedal 41;
– stopping brake pedal 45;
– rod 13 of the stop brake pedal latch;
– clutch pedal 46.

To the right of the seat are:
– right steering control lever 36 with an upshift button;
– voter 35 transfers;
– handle 34 for blinds drive;
– ventilation control box 28 KUV11-6-1S;
– automatic machine AKS -74U pos. 31, mounted in a rack on the right pillar of the driver's seat;
– optical sensor OD1 -1C pos. 11 PPO systems on a bracket;
– box 29 for stowing the TVN-5 device in the non-working position; on the box for TVN-5 there is space for stowing a bag for F-1 grenades;
– glass temperature regulator 37 of the prism observation device TNPO -168V;
– blocks of the WMD protection system on the right bow fuel tank: sensor 30 and measuring panel 26 of the PKUZ -1A instrument complex; control and alarm panel P13 pos. 25 and automation unit B13-1S pos. 32 systems 3ETs13 - 1;
– air bleed fitting 33.

To the left of the seat are:
– left turn control lever 49 with a braking button;
– handle 50 for manual fuel supply with engine stop mechanism 48;
– in rack 60 there are four rechargeable batteries, covered with easily removable casings 58. Above them there is a relay-regulator P15M-4S pos. 7 , starter switching unit BKS pos. 2 , switch block BC , battery protection block 4, external power socket 3, external start socket 5 and external start connector;
– pouch 57 with magazines for the AKS 74U assault rifle , mounted on an easily removable -battery casing ;
– tool box 56, placed on a support to the left of the driver's seat. The support is located on the bottom;
– optical sensor OD1 -1C pos. 11 software systems;
– driver's panel 8 with the driver's APU, which displays information about the operation of the engine and transmission systems, the speed of the tank, an image of the terrain received from a rear-view television camera, information coming from the orientation system and other information.

On the driver's panel there is a battery switch, controls for starting the engine and other electrical systems of the tank.

Installed under the driver's shield :
– fuel distribution valve 51;
– electric fuel priming pump pos. 52 (hereinafter - BCN);
– handle of manual fuel pump pos. 53;
– valve 55 for releasing air from the fuel system;
– coarse filter 54.

A prismatic observation device TNPO-168V pos. is installed in the shaft of the upper armor plate. 14. The spare prismatic observation device TNPO -168V is placed in a case and secured in rack 6 to the left of the driver's mechanics. The rack is attached to the left pillar of the driver's seat and to the turret plate.

To the left of the TNPO 168V prism observation device -there is a traffic alarm panel 9 with switches for the gear selector locking device and the turn indicator.

To the right of the observation device are located:
– remote TV display pos. 24;
– filling neck 19 of the GPO system tank, closed with a plug;
– air system pressure gauge 20;
– air bleed valve 40;
– electro-pneumatic valve 23 of the engine air starting system;
– air intake device 27 (VZU) with a cyclone of the PKUZ-1A instrument complex;
– valve 18 with a valve for the gas flow system.

Under the TNPO 168V prism observation device -in the bow of the control compartment there are installed:
– driver's panel lighting panel 1;
– fan 15 with fan switch 16;
– two cylinders 39 for compressed air in the racks;

– a fluid tank for the GPO system of the driver's observation device with a hose for draining the fluid, at the end of which there is a fitting with a plug 47;

– fitting 12 for connecting the hose of the driver's protective cap.

At the left side of the hull, between the rack with batteries and the local VT protection , the following are installed:

– mounted on a rack with batteries – coordination and control unit BSU pos. 59, above it there is a computer 61 orientation system;

– tank weapon stabilizer power amplifier 62, traffic alarm box, high-speed cylinder 2B of the PPO system;

– on the roof of the building there is a lighting panel 1.

On the local protection of the rotating conveyor, behind the driver's seat, the following are attached:

– first aid kit case "AB";

– manual freon fire extinguisher.

On the right side of the hull, between the right tank and the local VT protection , there is a rack for the PCP kit, as well as cylinder 1B of the PPO system.

The management department is equipped with:

– driver's hatch located in the middle part of the front turret plate, above the driver's seat. The hatch is closed with a lid 17 using a screw closing (opening) mechanism 21, equipped with a handle 38 for emergency opening of the hatch cover;

– an emergency exit hatch located in the bottom of the hull behind the driver's seat. The hatch is closed with a lid 44. An infantry shovel in a case is attached to the emergency exit hatch cover.

At the back of the driver's hatch, on the front sheet of the hull roof, there are mounted a lighting shield 1, an MSNC interface unit (from the hardware-software complex AVSKU), a plug socket 22 for connecting a portable lamp and a lampshade 10 PMV-71 emergency lighting.

1.1.2 Combat compartment

The fighting compartment is located in the middle part of the tank and is separated by a partition from the MTO.

The design and layout of the tank ensures the transition of crew members from the combat compartment to the control compartment and back.

The following are installed in the tank turret :

– weapons complex, including:

- 125 mm smoothbore gun 2A46M -5–01 or 2A46M5P01;
- a coaxial 7.62 mm 6P7K machine gun;
- DPU with a 12.7 mm machine gun, modernized 6P49;
- OMS, STV, DPU control system and automatic loader;

– software and hardware complex;

– curtain installation system;

– surveillance equipment;

– GPO system of observation and aiming devices;

– anti-fragmentation screens (on the internal surfaces of the tower);

– electrical equipment and other systems.

To the right of gun 46 is the commander's workplace (Figure 1.4), on which the following units of systems and complexes, ammunition, spare parts and other equipment are installed:

– on the right side of the gun cradle 46 there is a coaxial 7.62 mm machine gun 42 and a cartridge case catcher 26, in the guides of which a magazine 27 with a belt for the 7.62 mm machine gun is fixed;

– in the roof of the tower above seat 34 is the base 5 of the commander's hatch. The hatch is closed with a cover 9, which is fixed with a stopper in the open position and a lock handle 47 in the closed position. At the base of the commander's hatch, seven TNP4E-06 prismatic observation devices are installed, pos. 4, eight direction indicators 6, manhole cover position sensor 49 and pressure gauge 50;

– in front on the roof of the tower - gun position sensor 44, electromechanical gun stopper 31, linear acceleration sensor 3, lamp 2 with a switch, handrail 45, video viewing device 8 and signal lamp PPO pos. 7;

– on the roof of the tower (behind the hatch) - interface unit 54 MS 1 of the AVSKU software and hardware complex, commander's panoramic sight 48 (PKP), roll and pitch sensor 70, bracket on which the PMV-71 canopy pos. 53, lamp 2 with switch, circuit breaker KAZ/GShS pos. 51 and headlight switch 52 with digital attachment;

– on the front wall of the tower - lamp 2 with a switch, direction indicator adapter, distribution panel 43 right, distribution panel 19 with circuit breakers in the radio equipment and control panel circuits, GPO switch pos. 21 commander's observation and aiming devices, PKP control panel 10, multifunctional PMF-3.2 panel 11 from UARMk, commander's console PK-90 pos. 18, PDT control panel 14, cooling unit 20 of the thermoelectric air conditioner, unit 26 of the PRMD transceiver of the R-168MRA radio station and the GPO distribution valve of the commander's observation and aiming devices with handle 23;

– on the right side of the tower - switch 13 video images of the external video surveillance system, pipelines 12 thermoelectric air conditioner, device MT10M-21 pos. 15, anti-fragmentation screen 16, loading console 76 PZ185-3S, VKU unit pos. 72 R-168MRA radios, HF key pos. 75 for capsule bushings, connector 79 for connecting the suppression equipment console, block 73 for controlling the PKP stabilization system, block 74 of the computer system from the UARMk, as well as blocks of the AVSKU software and hardware complex: control and indication block 17 PUDL, two sources 80 of secondary power supply IP50V- 12-AB, TKOM block pos. 77, BShM block pos. 81 and unit 82 for pairing the MSNC;

– on the rear wall of the tower - STV control unit 65, PKP engine control unit 60 and DPU power amplifier;

– in the tower niche (behind the seat) - radio station R-168-25U-2 pos. 71; frequency separating device pos. 62 R-168BSHPA antennas, MSVKU interface unit 63 of the AVSKU software-hardware complex, rammer 56, cassette lifting mechanism 57, on the right side of the bracket there are elements of the MPC manual drive, namely: handle 64 with a key, chain drive, locking disk, latch 58, lever 61, drive to the electromagnetic stopper;

– on the bottom sheet and ball support (pursuit) 22 of the tower - a footrest 24 and a lifting mechanism 28, on which a seat 34 with a backrest 66 and a guard 41 is attached;

– on VT flooring :

- in front of the seat - footrest 35 with a base, floor 29, handle 31 for manual drive to the VT stopper , magazine 27 with a belt for a 7.62 mm machine gun and an AKS-74U assault rifle, pos. 25 per rack;
- under the seat - a pouch 32 with magazines for the AKS-74U assault rifle, two bags 30 with F-1 grenades, a signal pistol in a holster pos. 67 and two cartridge belts 33 with cartridges for a signal pistol;
- behind the seat are two 27 magazines with belts for a 7.62 mm machine gun;
- in the niche of the VT flooring – control unit BU185-3S pos. 36.

On the left side of the turret there is a gunner's workplace (Figure 1.5), on which the following units of systems and complexes, ammunition, spare parts and other equipment are installed:

– to the left of the gun there is an actuator cylinder 16 and a bracket on which a seat 38 with a backrest 77, a gunner's guard 19 with a movable shield 23, a drive device for connecting the VT deck with the turret and a footrest are attached;

– in the turret roof above seat 38 is the base of the 4th gunner's hatch. The gunner's hatch is closed by a cover 5, in which there is a hatch for installing an air supply pipe (when overcoming water obstacles along the bottom), closed by a cover 9. The hatch cover 5 in the open position is fixed by the stopper handle 15 and in the closed position is locked by the lock handle 64;

– in front on the roof of the turret - gunner's multi-channel sight 7 (MPM), drive rods 3 and 8, respectively, of the left and right protection covers of the PNM, backup television sight (PDT) pos. 12, rod 11 of the PDT protection flap stopper drive, tank 10 of the GPO system of observation and aiming devices in the turret with two dispensers mounted on it, two prismatic observation devices TP4E-06 pos. 2, sensor 6 for the position of the hatch cover, the console on which the guidance console 20 is mounted, the control panel for the control system and the AZ pos. 14 and handrail 15;

– on the roof of the tower (to the left of the hatch) - a TNP-165A prism observation device, pos. 67;

– on the roof of the tower (behind the hatch) - lampshade PMV-71 pos. 65, a gearbox with an electric motor that drives the cover 57 of the pallet ejection hatch, on the body of which a lamp 52 with a switch is attached;

– on the front wall of the tower - cooling unit 56 of the thermoelectric air conditioner, distribution valve GPO pos. 18 observation and aiming devices for the gunner, a bracket on which the lifting mechanism 24 guns, an angle limiter 21 and a reduction device are mounted;

– on the left side of the tower - video viewing device 54, PNM control panel 51, PDT control panel 49, GPO switch pos. 48 observation and aiming devices for the gunner, control and indication unit 53 PUN of the AVSKU hardware and software complex, MT10M device pos. 50, distribution panel 68 left, panel 69 with a circuit breaker for thermoelectric air conditioner circuits, product 450B pos. 71, computer unit 70 and digital image processing unit 66;

– on the rear wall of the tower - block BTSHU-1-2B1 pos. 63 and control unit 60 of the remote machine gun control system;

– in the tower niche (behind the seat) – side level 74; unit 75 for controlling the PNM stabilization system; UVI block pos. 73; THPT cable, closed with plug EPR11WR pos. 78; distribution box 76 KR185-3S, on the mounting bracket of which the video signal switching unit 62 and the electronic unit are fixed;

– on the MPK bracket there is a rod 59 for locking the gun in the "stowed" position in the rack, on which the rammer 82 is additionally secured in two clips;

– on the bottom sheet of the tower there is a plug socket 82 for connecting a portable lamp and an OPVT flashlight;

– on the tower chase - voltage frequency regulator RCHN –3/3, tower position sensor 42, tower stopper 45 and a manual tower rotation mechanism 41 with an azimuth indicator 46, in the housing of which two lamps 44 are located. A switch 44 of the azimuth indicator lamps is attached to the MPB;

– on VT flooring :

- in front of the seat – polik 20;
- under the seat - a magazine with a belt for a 7.62 mm machine gun and a protection block 25;
- behind the seat there is a spare prism observation device TNP4E-06, an AKS-74U assault rifle in a case pos. 17, pouch 53 with magazines for the AKS-74U assault rifle and tank 49 for drinking water;

- in the niche of the VT flooring there is a backup power supply PDT, an F-5 radio interference filter, a UVI docking device, an air tank and a gearbox with a filter for the GPO system of tower surveillance devices .

On the left sheet of the gun fence there is a handle 22 for releasing the bolt wedge and re-cocking the striker, a handle 25 for manual release and a base 17 for attaching the side level.

On the right side of the gun guard there is a recoil indicator and a manual release locking mechanism. At the bottom of both sheets of the cannon fencing, flanges are welded for installing a device for rolling out the cannon from the turret. On the base of the gun guard there are balancing weights, a trigger mechanism, a power supply unit 26, a sensor unit, a PT-800 voltage converter and a frame drive for the pallet removal mechanism.

In the middle part of the body there is a rotating conveyor for the automatic loader. The conveyor bowl contains a manual drive VT , an electromechanical drive with a cassette position sensor and a stopper VT.

At the bottom, under the VT flooring , there is a rotating contact device VKU-1, in the central hole of which there is a rotating air device (hereinafter referred to as VVU) for supplying air to the tower's GPO system.

In the middle part of the turret roof there is a support for installing the gun locking rod in the “stowed” position.

At the MTO partition there are:

– on the bottom there is a rack in which eight charges are fixed;

– on the roof of the hull there are two lamps, racks for storing eight shells, protected by anti-fragmentation screens, and an electromechanical turret rotation mechanism with an actuator electric motor (on the left side).

An engine heater with a crew compartment heater is installed in a protective casing between the rack and the starboard side. A filter-ventilation unit (hereinafter referred to as the FVU) and control mechanisms for the supercharger valves are located above the heater.

Behind the retrofitted rack on the left side, on the bottom, there is a water pump, the water discharge pipe of which is connected to a hatch on the turret plate. On the MTO partition, at the top left, there is an OPVT valve, and at the bottom there is a hatch for the flow of water from the MTO to the fighting compartment (when overcoming water obstacles along the bottom), which have a lever-cable drive from the drive rod to the OPVT covers.

The fighting compartment contains eight optical sensors OD1-1S of the PPO system: four on the left side, one on the right side, one on the rear roof sheet and one on a rack in the supercharger area.

Suspension torsion shafts run along the bottom of the body, and cables and rods for control drives run along the sides.

1.1.3 Engine compartment

The MTO is located in the rear of the tank hull.

The MTO houses:

– engine and components of its servicing systems;

– transmission unit with hydraulic control;

– fire extinguishing aerosol generators GOA-19 and temperature sensors of the PPO system.

The MTO layout is made with a transverse engine position, shifted to the left side.

An input gearbox is installed along the starboard side, transmitting torque from the engine to the gearboxes. Between the left side of the hull and the engine there is a device for releasing exhaust gases from the engine cylinders.

The starter-generator is installed on a separate engine foundation bracket. The bevel gearbox of the fan drive is mounted on a bracket located on the bottom of the tank. In special crankcases, on the left and right, there are gearboxes assembled with final drives. Each gearbox has a distribution mechanism.

On the rear plate of the hull there is a cooling system fan, an inlet guide vane and two GOA-19 generators of the PPO system.

The MTO is covered by a roof, consisting of a roof over the engine and a roof over the transmission. A rack containing water and oil radiators is attached to the roof above the transmission.

1.1.4 Outside the tank

Located outside the tank :

– on the bow of the hull:
- universal dynamic protection of modular type;
- two tow hooks;
- headlight with blackout attachment;
- headlight with infrared filter;
- sound signal;
- side lights (two front, two side);
- electrical connector for recharging batteries with low currents (on the housing of the left front parking light);
- equipment for self-digging;
- equipment for installing attachments;

– on the stern plate of the hull:
- two tow hooks with spring latches;

- two tow ropes;
- spurs for attaching the tank to a railway platform;
- brackets for installing and fastening barrels of the fuel supply system;
- a cover covering the hole for access to the fan clutch;
- Rear View Camera;
- spare tracks;
- brackets for attaching the third fuel barrel;

– on the right fender:
- front (folding) flap and rear mud flap;
- side screens;
- side panel and lattice screens;
- additional screens (installed in combat conditions);
- external fuel tanks included in the general fuel supply system;
- log for self-pulling;
- right rear marker light;

– on the left fender:
- front (folding) shield;
- side screens;
- side panel and lattice screens;
- additional screens (installed in combat conditions);
- three boxes for spare parts;
- crowbar on the third spare parts box;
- external oil tank;
- diesel generator set in an armored compartment, on the housing of which the left rear marker lamp is fixed;

– on the tank turret:
- VDZ blocks and module-type universal dynamic protection containers;
- lattice screens;
- anti-location shields;
- fine and coarse laser light indicator heads;
- System 902 launchers;
- DPU;
- a magazine with a belt for a 12.7 mm DPU machine gun (placed on the DPU machine);
- antenna module ZhS;
- a housing on which are installed: DV-E wind sensor , air temperature sensor, additional subscriber block, three START television cameras (No. 1, No. 3 and No. 4), a headlight with a digital attachment and a side lamp;
- START television camera (No. 2) - mounted on the starboard side;
- antenna R-168BShPA;
- SK-B antenna;
- container and expansion tank of thermoelectric air conditioner;
- aft module with ammunition for the gun - in a non-mechanized stowage. Attached to the aft module are: a protective cap for the driver and a basket in which a tarpaulin, two ropes and three packages with antenna rods are placed (one package is the main one, the other two are spare).

1.2 Technical characteristics of the tank

1.2.1 Total information

Weight of tank with ammunition and crew, t	51 $^{+2\%}$
Crew, people	3
Specific power, kW/ t	16.2
Average specific ground pressure, кгс/см^2, no more	1.04

1.2.2 Main dimensions [1)]

[1)] Dimensions are for reference only.

Tank length, mm :	
– with the gun forward	9830
– with a gun back	9690
Length of the housing along the strap for attaching the rubber mud flap to the folding flap and the diesel generator compartment, mm	7075
Width, mm :	
– on lattice screens (in stowed position)	4080
– on lattice screens (in working position)	3960
– on lattice screens (in stowed position) and logs	4150
– by tracks	3370
Height, mm , no more:	
– on the roof of the tower	2225
– by wind sensor	3180
Track width (distance between the middle of the tracks), mm	2790
Ground clearance (based on stamping of the front part of the bottom), mm	404
Length of track support surface, mm	4290

1.2.3 Travel speeds

Average speed, km /h:	
– along a dirt road	from 35 to 45
– along the highway	o t 3 5 to 50
Maximum speed on the highway, km/h, not less	60

1.2.4 Fuel and oil consumption . fuel range

Fuel consumption per 100 km, l:	
– along a dirt road	from 300 to 500
– along the highway	285
Oil consumption per 100 km on a dirt road, l	from 6 to 10
Fuel range with additional barrels excluding diesel generator set operation, km:	
– along a dirt road	from 345 to 520
– along the highway	up to 550

1.2.5 Obstacles to be overcome

Maximum lift angle	thirty°
Maximum roll angle	25°
Ditch width, m , no more	2.8
Wall height, m , no more	0.85
Ford depth (without preliminary preparation of the tank), m , no more	1.2
Fording depth (with preliminary preparation of the tank for 20 minutes), m , no more	1.8
Water barriers (on the bottom with OPVT) at a current speed of up to 1.5 m/ s :	
– width, m , no more	1000
– depth, m , no more	5

1.2.6 Engine

Brand	V-92S2F
Type	four-stroke, multi-fuel diesel engine, liquid-cooled and supercharged by a turbocharger
Number of cylinders, pcs.	12
Cylinder arrangement	V-shaped
Maximum power, kW (hp)	831 (1130)
Maximum torque at n = 2000 rpm when operating on diesel fuel N ·m (kgf ·m)	4521 (461)
Maximum engine speed, rpm	2300
Minimum stable crankshaft speed idle speed	from 800 to 950

Cylinder operating order	1l, 6p, 5l, 2p, 3l, 4l, 6l, 1p, 2l, 5p, 4l, 3p
Dry engine weight, kg , no more	1100

1.2.7 Fuel supply system

Capacity of the system with three barrels with a capacity of 200 l l	17 7 5
Capacity of internal fuel tanks, l	63 8
Capacity of external fuel tanks, l	537

1.2.8 Air supply system

Air purifier type	two-stage , with ejection removal of dust from the dust collector
Number of cassettes, pcs.	2

1.2.9 Lubrication system

Type	circulation, combined
Filling capacity of the system, l	78
Filling capacity of tanks, l :	
– main	27
– additional	38
– spare external	19

1.2.10 Cooling system

Type	liquid , closed, with forced circulation of coolant and blowing air through the radiators with a fan
System capacity, l	90
Fan type	centrifugal

1.2.11 Heating system

Type	with liquid heater
Heater type	nozzle, programmable
Maximum fuel consumption, l /h	7.5

1.2.12 Starting system

Main	air
Additional	electric , starter-generator and combined

1.2.13 Air system

Operating pressure,кгс/см^2	from 120 to 160
Compressor brand	AK150SV-Yu
Compressor type	piston , three-stage two-cylinder, air cooled
Number of cylinders, pcs.	2
Cylinder capacity, l	5

1.2.14 Transmission installation

Type	mechanical with input gearbox, two gearboxes, coaxial final drives

1.2.14.1 Input reducer

Type	step-up gear reducer with drives for the compressor, starter-generator and cooling system fan
Weight, kg	303.6

1.2.14.2 Transmission

Type	planetary, hydraulically controlled
Quantity, pcs.	2
Number of gears	7 - forward, 1 - backward
Control drive	mechanical with hydraulic gear shift and automatic gear shift system
Brake drive	mechanical with pneumatic braking
Weight of gearboxes assembled with final drive, kg :	
– left	754
– right	745

1.2.14.3 Final drive

Type	planetary
Quantity, pcs.	2
Weight, kg	224.8

1.2.14.4 Transmission hydraulic system

Type	unified , providing lubrication, cooling and transmission control
Total system capacity, l	57
Tank filling capacity, l	42

1.2.15 Chassis

1.2.15.1 Mover

Type	tracked , with rear drive wheels

1.2.15.2 Caterpillar

Type	metal, with a parallel rubber-metal hinge and lantern engagement, providing the ability to install asphalt shoes
Number of tracks in each caterpillar, pcs.	81
Track width, mm	580
Engagement pitch, mm	164
Weight of one track, kg	15.5
Weight of one caterpillar, kg , no more	1863

1.2.15.3 Drive wheel

Type	with removable crowns
Number of crowns on one wheel	2
Number of ring teeth	12
Drive wheel weight, kg	229.8

1.2.15.4 Guide wheel

Type	double-disc welded
Quantity, pcs	2
Weight of guide wheel with crank, kg	20 8

1.2.15.5 Track roller

Type	double-disc with solid rubber tires, with external shock absorption
Quantity, pcs	12
Weight of the support roller, kg , no more	159

1.2.15.6 Support roller

Type	single disc with internal shock absorption
Quantity, pcs	6
Weight of support roller, kg	31

1.2.15.7 Suspension system

Type	individual torsion bar with shock absorbers
Number of pendants, pcs.	12
Shock absorbers	hydraulic vane
Location	on the suspensions of the 1st, 2nd and 6th road wheels
Number of shock absorbers, pcs.	6
Weight of filled hydraulic shock absorber, kg	66.6

1.2.16 Armament

1.2.16.1 A gun

Index	2A46M-5-01 or 2A46M-5P-01
Type	smoothbore
Caliber, mm	125
Types of projectiles used	armor- piercing sub-caliber, cumulative, high-explosive fragmentation, fragmentation type with remote detonation along the trajectory, guided missile
Loading	separate automatic loader or manually
Method of firing a shot	galvanic ignition, electric release and manual mechanical release
Rollback length, mm :	
– normal	from 260 to 300
– ultimate	310
Amount of fluid in two rollback brakes, l	7.2
Amount of liquid in the knurl, l	0.3
Initial pressure in the knurl, kgf/cm ^{2}	59 $^{+3}$
Estimated firing range of a high-explosive fragmentation projectile using side level (with preparation of firing position), m	12000

Weight of the swinging part of the gun without armor and stabilizer units, kg	2500

1.2.16.2 Coaxial 7.62 mm tank machine gun

Index	6P7K
Caliber, mm	7.62
Rate of fire, rounds per minute	from 700 to 800
Sighting range, m	1500
Method of firing a shot	electric or manual
Cocking method	manual
Machine gun power	tape
Machine gun weight (without sliders), kg	10.5
Location	on the right side of the cannon
Number of cartridges in a box, pcs.	400

1.2.16.3 Remote machine gun installation

Index	6P49
Caliber, mm	12.7
Rate of fire, shot/min:	
– big	200
– small	100
Sighting range, m	2000
Method of firing a shot	remote electric trigger
Cocking method	manual
Machine gun power	tape
Number of cartridges in a box, pcs.	300
Machine gun weight (with electric trigger), kg	26.9
Installation location	on the tower on the right, behind
Pointing (firing) angles in the horizontal plane:	
– left	74°
– right	242°
Pointing (firing) angles in the vertical plane:	
– reduction	10°
– elevation	45°

1.2.16.4 Automatic AKS-74U

Caliber, mm	5.45
Quantity, pcs.	3
Weight with loaded magazine, kg	3.0

1.2.16.5 Flare gun

Caliber, mm	26
Quantity, pcs.	1
Weight, kg	0.9

1.2.17 Ammunition

Shots for the gun, pcs., including:	40
– ready for use in the automatic loader	22
– in the aft module on the tower	10
Cartridges for 7.62 mm machine gun, pcs.	2000
Cartridges for 12.7 mm machine gun, pcs.	300
Cartridges for the machine gun, pcs.	360
Cartridges for signal pistol, pcs.	12

F-1 hand grenades, pcs.	10

1.2.18 Automatic loader

Type	electromechanical , with constant charging angle
Capacity of VT , shots	22
Duration of loading one shot, s , no more	8
Delivery of shots to the gun's charging chamber	separate

1.2.19 Electrical equipment

1.2.19.1 Power supply system

Type	DC, single-wire with minus current source on the tank body and two-wire for emergency consumers
On-board voltage, V	from 22.5 to 28.5
On-board network voltage when the engine is running, V	27.5±1
On-board network protection	fuses and circuit breakers

1.2.19.2 Rechargeable batteries

Brand	12ST-85RM
Type	starter, lead o- acid
Total battery capacity, Ah	340
Quantity, pcs	4
Weight of one battery with electrolyte, kg	67

1.2.19.3 Starter-generator

Brand	SG-18-1S
Generator mode:	
– power, kWt	18
– rated voltage, V	27.5±1
Starter mode:	
– power, kWt	20.5
– rated voltage, V	48
Weight, kg	78

1.2.19.4 Driver display system

Brand	DCMV
Type	electronic, providing control, monitoring of functioning, operational technical diagnostics of the power plant, transmission, on-board network

1.2.19.5 Auxiliary diesel generator set

Brand	DGU10
Operating mode	long-term, at least 24 hours

engine's type	four-stroke liquid-cooled diesel
Rated power, kW, not less	10
Rated voltage, V	27.5±1
Fuel	from the tank fuel system
Fuel consumption at rated power, l /h, no more	4.6
Fuel reserve	tank fuel reserve
Engine oil	oil grades used for the main engine
Oil consumption, l /h	0.03

1.2.20 Software and hardware complex

1.2.20.1 Unified automated commander workstation

Brand	UARMk-01
PMF screen diagonal size, mm	213
PMF touch screen mode	provided

1.2.20.2 Communication complex

Operating frequency ranges via external communication network, MHz:	
– meter (MV)	from 30 to 108
– decimeter (UHF 1)	from 390 to 440
– decimeter (UHF 2)	from 1500 to 1750
– Wi - Fi	from 2400 to 2500
Communication range when transmitting/receiving voice information in conditions of moderately rough terrain in the microwave range, km, not less:	
– in the “FChS”, “FChDS” mode	20
– in the “FChS-TM”, “AS”, “PPRF” modes	17
Communication range when receiving/transmitting voice information in open areas in UHF 1 range in modes “KFCh-A”, “KFCh-C”, “PPRCh”, km, not less	15
Communication range when exchanging data protected by CIPF, in conditions of moderately rough terrain in the MV range at speeds up to 16 kbit/s, km, no less	17
range when exchanging data protected by CIPF , in conditions of direct optical visibility in the UHF 2 range at speeds up to 11 Mbit/s, km, no less	5
range when exchanging data via Wi-Fi at speeds up to 5 Mbit/s, m , not less	100
Number of subscribers who simultaneously may be in the intercom network	up to 4

1.2.20.3 Orientation system

Type	combined (satellite navigation equipment and autonomous inertial navigation)
Root mean square relative error of determination coordinates of the tank in offline mode while moving over moderately rough terrain in a range of geographical latitudes (0 °± 70 °) , lasting up to 7 hours, % of the distance traveled, no more	1

Root mean square error of determination
in integrated mode with radio visibility
at least four satellites of the GLONASS radio navigation system:

– tank coordinates:

● in the parking lot, m , no more 10

● in motion, m , no more 20

– tank height:

● in the parking lot, m , no more 20

● in motion, m , no more ..... thirty

Error in determining the initial directional angle
longitudinal axis of the tank, no more ..... ±0.5 °

Error in holding the current directional angle
longitudinal axis of the tank for 1 hour of movement, no more ..... ±0.2 °

1.2.21 Observation devices

1.2.21.1 Commander's observation devices

Brand TNP4E-06

Type ..... prismatic , periscopic, heated, with built-in glass temperature controller

Quantity, pcs 7

Weight (nominal), kg 3.2

1.2.21.2 Gunner's observation devices

Brand TNP4E-06

Quantity, pcs 2

Brand TNP-165A

Quantity, pcs 1

1.2.21.3 Outdoor video surveillance system

Brand START-2

Type ..... television , all-round view, with video information displayed on the commander’s APU

1.2.21.3.1 TV camera

Brand ..... TVKT-95N or TKV-1-95

Type ..... low-level , black and white, with automatic heating of the protective glass

Quantity, pcs 4

1.2.21.3.2 Video switcher

Brand ..... KVI

Quantity, pcs 1

Weight (nominal), kg 3

1.2.21.4 Driver monitoring device

Brand TNPO-168V

Type ..... prismatic, periscopic, heated

Quantity, pcs 1

1.2.21.5 Driver's night monitoring device

Brand TVN-5

Type ..... electro-optical periscope

Line of sight:	
– vertically, no less	26°
– horizontally, no less	33°
Vision range, m :	
– in active mode (when illuminated by infrared light)	80
– in passive mode (with natural night illumination (4±1) • 10^{-3} lux)	180

1.2.21.6 TV rear view camera

Brand	TVKT-65N or TKV-1-65
Type	low level, monochrome
Line of sight:	
– vertically, no less	40
– horizontally, no less	65
Quantity, pcs.	1

1.2.21.7 Infrared light source

Brand	FG 125
Type	headlight with infrared filter

1.2.22 Habitability facilities

1.2.22.1 Air conditioner

Brand	KTE-VT-1.6-27-02
Type	thermoelectric with local supply of cooled air
Number of cooling blocks, pcs.	2
Continuous operation time, h	24
Volume of refilled liquid, l	13

1.2.22.2 Heater

Type	Liquid type, included in the engine cooling system

1.2.23 Curtain setting system

1.2.23.1 Grenade launch system

Brand	902
Caliber, mm	81
Number of launchers, pcs.	12
Range of installation of the curtain, m :	
– 3D17 grenade	from 50 to 80
– grenade 3D6, 3D6M	from 110 to 200
Smoke screen dimensions, m , not less with one 3D17 grenade 3 s after the shot:	
– width	15
– height	10
one 3D6, 3D6M grenade 10^{+5} s after falling on the ground:	
– average width	27

– average height	8
Working spectral range of the smoke screen, microns :	
– 3D17 grenade	from 0.4 to 14.0
– 3D6 grenade	from 0.4 to 0.8
– 3D6M grenade	from 0.4 to 14.0

1.2.24 Means of camouflage

1.2.24.1 A set of visibility reduction means

Brand	"Cape" type, IMZHV.169.500.000
Set weight, kg	125

1.2.24.2 Deformation coating

Type	three-color deformation dyeing
Coating material	enamel XC-5146

1.2.24.3 Smoke exhaust system

Type	thermal smoke equipment
Duration of continuous action, min	5
Average fuel consumption, l /min	5

1.2.25 Defense system against weapons of mass destruction

Type	collective, providing protection for the crew and internal equipment of the tank from the effects of shock waves and radioactive substances, as well as protection for the crew from penetrating radiation of a nuclear explosion and gamma radiation from radioactively contaminated areas, toxic substances and bacterial agents
System sensor	instrument complex PKUZ -1A
Control equipment for actuators	3ETs13-1
System activation method	automatic and manual
Source of overpressure and air purification products	filter-ventilation unit with filter-absorber type FPT-100B

1.2.26 Fire-fighting equipment

Type	automatic, double action for each compartment
Operating mode	automatic, semi-automatic, emergency and additional
Number of cylinders in the habitable compartment, pcs.	2
Number of fire extinguishing aerosol generators in MTO GOA-19, pcs.	2
Type of fire extinguishing composition of cylinders	freon 13B1
Manual freon fire extinguisher, pcs.	2
Number of optical sensors, pcs.	10
Number of temperature sensors, pcs.	5

1.2.27 Underwater Driving Equipment

Type	built-in , with preparation of the tank to overcome a water obstacle

Method of preparing a tank to overcome a water obstacle	sealing of the hull and tower with installation of removable equipment
Means for ensuring the preservation of a given direction when overcoming a water obstacle.....	orientation system
Installation time of the removable part of the OPVT, min, no more	20
Water pumping system	one pump with a capacity of 100 l/min at a back pressure of 4 kPa (4 m w.c.) . with t .)
Weight of the removable part of the OPVT kit, kg.....	40

1.2.28 Equipment for self-digging

Type.....	built-in bulldozer
Blade width, mm ……	2140
Time to excavate a trench measuring 10^{+2}x4,5^{+1}x1,2$^{+0,3}$m, min, no more:	
– on sandy loam and sandy soil	15
– on soil with vegetation and clay.....	40
Transfer time, min, no more:	
– from traveling to working position	2
– from working to traveling position	5
Total operating time of the tank in a section of trenches, hours, no more	25
Weight of removable part, kg.....	201

1.2.29 Equipment for making passages in minefields

Brand	KMT-8
Type.....	knife track mine trawl
Brand	EMT
Type.....	electromagnetic attachment for mine trawls

2 Description and operation of the tank components

2.1 Power point

The power plant is designed to convert fuel combustion energy into mechanical energy of rotation of the engine crankshaft.

The power plant includes:
– engine;
– fuel system;
– air supply and exhaust system with turbocharger;
– Lubrication system;
– cooling and heating system;
– intake air heating system;
– air launch system;
– crankcase ventilation system (breathing).

The tank is equipped with a four-stroke V-shaped 12-cylinder diesel engine V-92S2F, liquid-cooled with direct fuel injection, multi-fuel, supercharged from a turbocharger.

The engine is installed in the tank's MTO perpendicular to its longitudinal axis on a foundation welded to the bottom. The engine feet are attached to the foundation with eight bolts and nuts. The first left bolt and nut are elongated . Gaskets of various thicknesses can be installed under the paws, with the help of which the toe of the engine crankshaft is centered with the drive gear of the input gearbox.

The engine consists of the following mechanisms:
– crank mechanism;
– gas distribution mechanism;
– gear mechanism.

2.1.1 crank mechanism

The crank mechanism consists of the following components: crankcase, cylinder blocks, crankshaft, connecting rods and pistons.

2.1.1.1 Carter

The crankcase, together with the blocks installed on it, makes up the power frame of the engine, which perceives internal and external forces acting on the engine. All engine units and components are installed on the crankcase.

The crankcase consists of two parts: the lower half of the crankcase and the upper half of the crankcase, the parting plane of which passes through the axis of the crankshaft.

The upper half of the crankcase is cast from aluminum alloy and consists of the following components: side longitudinal walls; upper shelves on which the cylinder blocks are installed; front and back walls; eight transverse partitions that serve as main supports of the crankshaft.

On the upper inclined shelves there are holes for cylinder liners, and anchor pins are screwed into the transverse partitions, tightening the block and the head with the crankcase.

The side longitudinal walls form a closed cavity through which coolant supplied from the heater flows to warm the main bearings when starting the engine in cold weather.

The lower half of the crankcase is cast from aluminum alloy and is a sump. On the transmission side there are platforms with centering holes on which an oil pump, a water pump, and a gear pump for the crankcase ventilation system are installed.

The trough-shaped crankcase oil sump is covered with an oil catch plate and has two oil sumps connected by pipes to the pump-out sections of the oil pump. The oil collection part of the crankcase has double walls that form a cavity through which coolant flows, supplied by the tank heater through the upper crankcase. Coolant warms up the oil in the crankcase before starting the engine in cold weather. More details about the crankcase are described in the technical description of the 92S2F RE engine, part 1.

2.1.1.2 Cylinder block

The engine has two cylinder blocks.

The cylinder block consists of the following components:
– aluminum jacket of 9 (Figure 2.1) cylinders with an individual supply of coolant to each cylinder and with its flow along the block through holes in the partitions of the jacket;
– six cast iron liners 8 cylinders;
– heads 14 blocks made of aluminum alloy;
– 2 head covers;
– intake 6 and exhaust manifolds;
– bimetallic rings 7 sealing the gas joint;
– pipes 11 for inlet and 15 for coolant outlet.

2.1.1.3 Crankshaft

The crankshaft is made of high quality steel. The shaft has six elbows (cranks) located in three planes at an angle of 120°.

In each plane there are two elbows, equally distant from the middle of the shaft.

There are a total of six connecting rods and eight main journals on the crankshaft. The seventh main journal is made elongated to accommodate an angular contact bearing. The crankshaft cheeks are round in shape.

The connecting rod and main journals have cavities inside, connected by holes. Through these holes and cavities, oil is supplied from the shank side through jets in the journals to lubricate the main and connecting rod bearings.

On the power take-off side, a drive gear to the fuel pump and air distributor is installed and secured with tight-fitting bolts on the shaft flange. An oil squeegee ring and a thrust bushing with two seal rings are also installed there. The end of the shaft has an internal thread for tightening and securing the connection coupling with the input gearbox to the cones with a special nut.

At the opposite end of the crankshaft there is a bevel gear that drives the transmission mechanism.

2.1.1.4 Connecting rod group

The connecting rod group consists of main and trailing connecting rods. The main connecting rods are installed in the left block, the trailing connecting rods - in the right block. The main connecting rods, the lower heads of which are detachable, are connected to the crankshaft.

2.1.1.5 Piston

The oval-barrel-shaped piston made of aluminum alloy is made with a reinforced bottom and has three annular grooves. Two oil scraper rings are installed in the lower groove. Trapezoidal compression piston rings made of high-strength steel.

2.1.2 Gear mechanism

The gear mechanism serves to transmit rotation from the crankshaft to the camshafts of the gas distribution mechanism and the engine-servicing units.

Consists of the following components:

– crankshaft bevel gear, transmission side for drive;
– inclined rollers of camshafts of the gas distribution mechanism;
– tachometer sensor drive;
– lower vertical transmission to water and oil pumps;
– transmissions to the fuel priming pump and the pump of the crankcase ventilation system;
– spur gear on the toe side of the crankshaft to drive the high pressure fuel pump and air distributor.

A gear pump for the engine lubrication system is installed on the lower crankcase, driven by a spring roller from the transmission gear to the fuel priming pump.

2.1.3 Gas distribution mechanism

The gas distribution mechanism is mounted on the heads of 14 (Figure 2.1) blocks. For each cylinder in the cylinder head, two intake valves 4 and two exhaust valves 18 are installed. Each valve is pressed to the seat by a large 16 and a small 17 spring. The valves are driven by camshafts 3 inlet and 1 exhaust.

2.1.4 Turbocharger

The turbocharger is designed to supply air to the engine cylinders with excess pressure, which increases engine power and ensures reliable operation in high altitude conditions.

The turbocharger is a single-stage centrifugal compressor driven by a radial-axial turbine driven by engine exhaust gases.

The turbocharger consists of the following components: compressor housing 19 (Figure 2.2), inlet pipe 1, vane diffuser 5, oscillating bushing 14, rotating bushing 15, thrust bearing 7, turbine housing 17, insert 16, nozzle apparatus 10; rotor consisting of the following parts: turbine wheel 12 with shaft 4, heel 8, ring holder 21, compressor wheel 22 secured to the shaft with nut 2 and washer 3.

The compressor housing 19 and the turbine housing 17 are connected by bolts 18.

The oscillating sleeve 14 is stopped from axial movement by a stopper 9, through which oil is supplied to the rotor shaft, heel 8 and thrust bearing. The oil that has leaked through the gaps from the oil cavity A through a special cast channel is drained into the oil channel of the receiver 20, on which the turbocharger is mounted.

Split rings 13 seal the oil cavity from the gas and air cavities.

The turbocharger is cooled only by oil supplied from the central supply pipeline.

The oil is drained from the turbocharger through the receiver into the upper crankcase on the transmission side.

The gaps between the compressor pipe and the wheel, as well as the turbine wheel and the nozzle apparatus, are regulated by gaskets 6 and 11. Air is supplied to pipe 1 from the air cleaner through the air supply pipe 4 (figure) located between the blocks.

Compressed air from the housing with the volute enters the receiver 20 (Figure 2.2) and through the tee 23, in which the intake air heater is installed, is supplied to the intake manifolds. Exhaust gases from the exhaust manifolds are supplied to the gas turbine through gas lines with bellows compensators, which are connected with special clamps.

A more detailed description of the design and operation of the engine is set out in the technical description for the engine, 92S2F RE, part 1, supplied with the tank.

2.1.5 Heating system

The heating system is used to warm up the engine and its servicing systems before starting the engine.

The power plant heating system includes heater 17 (Figure 2.4), coils 3 of the main engine oil tank and 8 of the oil tank of the hydraulic control and lubrication system of the transmission, heated cavities of engine components, water jackets of oil pumps 1 and pipelines.

Heater 14 (Figure 2.5) consists of boiler 5 (Figure 2.6); heater 9 (Figure 2.5); a supercharger including an electric motor 5, a water pump 7, a fan 6 and a fuel pump 1; injectors 23; filter 24; solenoid valve 8; candles 20 and 22; bypass valve 2 and pipelines with air release valve 21. The heater is installed in the fighting compartment on the starboard side on the bottom of the tank. The heater is attached by the paw to the bracket on the bottom and with bolt 12 to the end of the outlet pipe.

The heater boiler consists of head 1 (Figure 2.6) and boiler 5, connected to each other. A heat-resistant gasket 3 is installed between the flanges.

Boiler 5 consists of an outer casing 8, a boiler block 9 (made of stamped plates assembled in pairs in sections). The channels in the sections and the cavity between the casing and the boiler represent a path for the circulation of coolant. A screen 4 is provided to disperse gases. The heated liquid is supplied and discharged through pipes 11 and 6.

Boiler head 1 is a device for preparing, igniting and burning the fuel mixture. Bonks 2 and 15 are used for installing glow plugs and igniting fuel. The internal cavity of the boiler head forms the combustion chamber. Fuel heating during operation of the heater is carried out in tube 13 from the heated wall of housing 12.

The supercharger is designed to supply fuel and air to the combustion chamber of the heater, as well as to ensure circulation of coolant through the heated lines of the power plant. It consists of an electric motor and a centrifugal liquid pump, a centrifugal fan and a gear fuel pump mounted on its shaft. The supercharger is mounted on a bracket welded to the boiler head.

The centrifugal type injector is designed to supply atomized fuel into the combustion chamber. It is installed in the threaded hole of the boiler combustion chamber. The nozzle consists of body 3 (Figure 2.7), valve 1, swirler 8 with filter, sleeve 4, spring 5, nozzle 9, union nut 10, nut 7, gasket 2 and washer 6.

Injector valve 1 is designed to prevent fuel from flowing from the fuel supply pipes through the injector into the combustion chamber.

Electromagnetic valve 8 (Figure 2.5) is designed to remotely control the supply and shutdown of fuel supply to the heater nozzle. The valve operation is controlled from the driver's seat.

Air release valve 21 is installed in the fuel pump route and is designed to remove air from the heater fuel system without depressurizing it.

Glow plugs are installed in the threaded holes of the combustion chamber and are designed to heat the fuel and ignite the combustible mixture in the combustion chamber when starting the boiler. After starting the heater, the spark plugs are switched off.

The coolant presence sensor 10, installed in a glass at the outlet of the heater boiler, is designed to send a signal to automatically turn off the electromagnetic valve 8 when the coolant in the system overheats or the flow of coolant through the heater decreases, as well as to block the start of the heater in the absence of coolant. Temperature receivers 13 and 15 are designed to control the temperature of the coolant at the inlet and outlet of the heater. If there is no difference in coolant temperature between the inlet to the heater and the outlet from the heater, the heater is switched off. Breaker 26 is designed to turn off the heater when its boiler overheats. The exhaust gas temperature sensor 11 of the heater is installed in the exhaust pipe.

To prevent contact with hot parts, the heater is placed in a protective casing 17.

Sensor 1 (Figure 2.8) is designed to monitor the position of the exhaust hatch cover 3. DKMV blocks the start of the heater with the hatch closed. In addition, when the hatch is open and the engine is running, the information "CLOSE HEATER EXHAUST HATCH" is displayed on the driver's APU screen. When you unscrew the bolt 4 of the heater hatch 3 cover, the rod 2 moves and the sensor 1 is activated. The signal from the sensor enters the DCMV. Heating system operation

When the heating system is operating, fuel through a strainer 24 (Figure 2.5) enters the fuel pump 1 of the heater, the solenoid valve 8 and the nozzle 23 of the heater, which supplies it in atomized form into the combustion chamber of the boiler. In the combustion chamber, fuel, mixing with air supplied by fan 6 of the supercharger, forms a combustible mixture, which, when burned, heats the liquid circulating in the liquid path of the heater boiler. The heated liquid is supplied by the water pump 7 of the heater through the heater 9 through pipelines to the engine 11 (Figure 2.6), into the housings of the oil pumps 1, coils 3 and 8 of the oil tanks, heats them and returns to the heater. Spark plugs 20 (Figure) and 22 are turned on when the heater is started. Spark plug 20 preheats the fuel supplied to the injector, and spark plug 22 ignites the air-fuel mixture.

2.1.6 Engine lubrication system

The lubrication system is circulation, combined. It is designed to accommodate a transportable supply of oil and supply it under pressure to the rubbing parts of the engine in order to reduce their wear and remove heat from them.

The engine lubrication system includes the main oil tank 7 (Figure 2.9), additional oil tank 8, two oil radiators 5, engine oil pump 17, MAF oil filter pos. 1, centrifugal oil purifier MC-1 pos. 2, oil pump MZN-2 pos. 14, pressure indicator 15, temperature receivers 12 and 16 and pipelines.

The tank has three oil tanks: main, additional and external. The main and additional tanks are included in the lubrication system and serve to store the oil necessary for engine operation. The external tank is used to store and

transport the transported oil supply. The main and additional tanks contain 65 liters of oil (27 and 38 liters, respectively) out of 78 liters of filling capacity of the entire lubrication system. The amount of oil in the tanks (20 l), at which engine starting is prohibited, is distributed among the tanks in this way: 16 l - in the main oil tank and 4 l - in the additional oil tank. The filling capacity of the external tank is 30 l.

2.1.6.1 Lubrication system operation

When the engine is running, the pressure section of the oil pump 17 (Figure 2.9) of the engine takes oil through the intake filter 13 from the main oil tank 7 and supplies it under pressure through the MAF oil filter pos. 1 to the cover of the central oil supply, from where it flows to the rubbing parts of the engine. In this case, part of the oil is sent through a branch pipe from the main line to the turbocharger to lubricate the rotor bearings.

Part of the oil when leaving the MAF oil filter pos. 1, is supplied through a pipeline to lubricate the fuel pump drive bearings and to ensure the operation of the automatic clutch of the high-pressure fuel pump drive, as well as for additional oil supply to the eighth journal of the crankshaft through the fuel pump drive housing and channels in the crankcase.

From the cavity of the central supply, the main part of the oil enters the crankshaft and provides lubrication of the main and connecting rod bearings.

Part of the oil from the central supply cavity through three channels in the central supply cover through jets in the crankcase holes is supplied under pressure to lubricate the bearings of the upper and lower vertical transmission rollers, the pump drive, the inclined roller gears and the tachometer sensor drive.

From the inclined roller gear bearings, through holes in the crankcase, oil flows through two tubes to the block heads to lubricate the gas distribution mechanism.

Oil flows from the head through the casings of the inclined rollers and two holes in the anchor wells into the crankcase.

Oil flowing through the gaps between the crankshaft journals and bearing shells is sprayed onto the cylinder walls, gets inside the pistons and through the holes in the upper head of the connecting rods goes to lubricate the piston pins.

The oil collected in the front and rear oil sumps of the lower crankcase is pumped out by sections of the engine oil pump 17 and supplied through a pipeline through oil coolers 5 to the main oil tank 7. At low temperatures, oil from the engine to the main oil tank 7 can pass through the bypass valve 6 of the main oil tank. tank 7, bypassing oil radiators 5.

Part of the oil from the pumping sections of the engine oil pump 17 under pressure is supplied to the centrifugal oil purifier MTs-1 pos. 2, where it is cleaned of mechanical impurities and then drained into the engine crankcase.

When the oil pump 14 is operating, oil from the main oil tank 7 is supplied directly to the central oil supply cover, bypassing the MAF oil filter pos. 1.

Not all the oil filled into the oil tanks is involved in the work, but only that which is in the main oil tank 7. As oil is consumed, the oil from the additional oil tank 8 enters the main one.

Open type lubrication system. Communication with the atmosphere is carried out through drainage pipelines, a drain pipe from the centrifugal cleaner MC-1, pos. 2 into the engine crankcase 3. The engine crankcase is connected to the atmosphere through the oil separator of the crankcase ventilation system.

The operation of the lubrication system is monitored by the DKMV using data from the pressure indicator 15 and temperature receivers 12, 16.

Pressure indicator 15 is located on the left gearbox housing and is connected by a hose to the central oil supply cover. One temperature receiver 16 is installed in the pump-out line in the pipeline connecting the pump-out sections of the engine oil pump 17 with the bypass valve 6 on the main oil tank 7. The second temperature receiver 12 is installed in the intake filter 13 of the main oil tank 7.

2.1.6.2 Oil tanks

The main oil tank is installed in the engine-transmission compartment between the fan drive bracket and the input gearbox. It is welded from stamped steel sheets. To protect against corrosion, the inside and outside of the tank is varnished. To warm up the oil before starting the engine, a coil 4 is installed inside the main tank (Figure 2.10), which is included in the heating system with outlet pipes 8 and 12 for the supply of heating fluid.

The engine oil pump or the MZN-2 pump takes oil from the zone of the tank that is most heated by the coil through a pipe welded into the filter housing 14 and an oil intake filter 15 with a temperature receiver located in the lower part of the tank. Access to the filter is through hatch 17 (Figure 2.11). Through flange 10 (Figure 2.10), in the upper part, oil, cooled in the radiators after pumping it out of the engine crankcase, is drained into the tank. A bypass valve 9 is installed on top of the tank, protecting oil radiators from destruction as their internal resistance increases. The valve opens at a pressure of 4.3 to 5 $кгс/см^2$and the oil is drained into the tank, bypassing the radiators.

Through flange 17, in the lower part, oil from the additional oil tank enters the tank through a pipeline. Through fitting 3, in the upper part, the tank is connected by a drainage pipeline to the additional oil tank. A drain valve 6 is installed at the bottom of the tank.

The additional oil tank is installed in the aft part of the engine compartment on the starboard side. It is welded from extruded aluminum sheets. The outer surface of the tank is painted.

On the front wall of the additional oil tank, flange 9 is welded (Figure 2.12) for connecting the drain tube from the main oil tank and flange 8 for connecting the drain tube from the additional oil tank to the engine. In the upper part of the tank there is a filling neck 5, which is closed by a plug 6 with a rubber sealing gasket 7. At the bottom of the tank there is a check valve, which consists of a housing 11 welded into the tank with a ball 13 freely moving in it. Oil flows

from the refill tank into the main tank through the valve body 11, to which a pipe with sleeve 12 is welded for connecting the pipeline.

The check valve prevents oil from flowing from the main tank to the secondary tank when the tank is moving uphill.

The external oil tank is mounted on the left fender above the outlet pipe. The tank is welded from extruded aluminum sheets. The outer surface of the tank is painted.

A filler neck flange is welded on the top sheet of the tank, limiting the amount of oil to be filled. The filling neck is closed with a plug with a sealing gasket.

The oil in the tank is heated from the engine exhaust pipe.

2.1.6.3 Oil radiators

Oil coolers are designed to cool the oil leaving the engine. The engine lubrication system includes two radiators of similar design, connected in series and located in the radiator rack above the water radiators on the right.

The aluminum plate-and-tape type single-pass radiator consists of a core, front and rear collectors. The collectors are welded to the core. A pipe for connecting the radiators to each other is welded into the rear manifold; a flange is welded into the front manifold for supplying hot oil from the engine (right radiator) or discharging cooled oil from the radiators to the main oil tank (left radiator).

2.1.6.4 Oil pump MZN-2

The MZN-2 gear-type oil pump driven by an electric motor is designed to supply oil from the main oil tank to the cover of the central engine oil supply before starting it. The pump is installed under the bevel gear bracket of the cooling system fan drive . The pump consists of the following components: sealed electric motor 7 (Figure 2.13), housing 6, cover 2, drive gear 13, driven gear 1, oil seal 4, coupling 5 and ball pressure reducing valve. The pump housing is secured to the electric motor housing with four pins, and the drive gear 13 is connected to the motor shaft 8 by a coupling 5. The walls of the pump housing 6 are hollow for fluid circulation to heat the oil in the pump when the engine heating system is operating. For connection to the heating system, the housing has a pipe 3 for supplying and a pipe 11 for discharging the heating liquid.

The pump cover is attached to the housing with four bolts, two of which are tight.

The pressure in cavity A is limited by a pressure reducing valve; as the pressure increases, the oil is transferred to cavity B.

2.1.6.5 Engine oil pump

Gear type engine oil pump. It has three pairs of gears, forming one pumping and two pumping sections located in a common housing.

The main parts of the pump: housing 1 (Figure 2.14), cover 4, driving 6, and driven 7 gears of the discharge section, driving 8 and driven 9 pumping section gears, three gears 3 actuators, pressure reducing valve 5 in the discharge line, ball valve 11 in the pumping line and casing 2.

The oil pump is installed on the lower crankcase of the engine and is centered in the bore of the crankcase flange by a cylindrical housing belt. The oil pump is driven by spring roller 13, which is driven by the engine crankshaft and fits into the splines of the drive gear. 6 discharge section.

The injection section takes oil from the main tank and supplies it through the MAF filter and pipelines to the engine, turbocharger and fuel injection pump.

Pressure reducing valve 5 in the discharge line is designed to maintain oil pressure from 5 to 14 $кгс/см^2$at the engine inlet.

Ball valve 11 in the pump-out line of the oil pump maintains the required oil pressure at the inlet to the MC oil centrifugal cleaner. It is installed on a fitting that drains oil from the pumping sections of the oil pump.

When the engine is running, most of the oil (70 to 80%) from the pump sections passes through the ball valve fitting to the radiators or oil tank. Since the bypass hole B in the ball valve body is of small diameter, a pressure is created in the oil line supplying oil to the MTs-1 centrifugal cleaner, the value of which is limited by spring 12. The spring is adjusted to the valve opening pressure of 6 $кгс/см^2$. If the pressure in the ball valve body reaches 6 $кгс/см^2$, the valve opens and some of the oil is additionally passed through the fitting to the radiators or into the tank.

2.1.6.6 MAF oil filter

The MAF slotted wire oil filter is designed to clean the oil from resins, coke and mechanical impurities before supplying it to the rubbing parts of the engine. It is installed in the area of the drive coupling to the engine fuel pump and is attached to a bracket welded to the MTO bulkhead.

The filter consists of a housing 4 (Figure 2.15), a cover 2, three filter sections 5, 6 and 7, a hollow rod 8, a reducing valve 10 and a shut-off valve 16.

Housing 4 is a cast aluminum alloy glass with two bosses in the bottom, into the holes of which a fitting is screwed 13 and shut-off valve.

The oil line from the pressure section of the oil pump is connected to fitting 13, and the oil lines that drain oil from the filter to the central oil supply cover, the fuel pump drive clutch and the engine turbocharger are connected to the shut-off valve. The ball shut-off valve prevents oil from flowing from the filter into the crankcase when the engine is not running.

A blind nut 12 with an internal thread is pressed into the central hole of the housing, into which a hollow rod is screwed 8 with a centering sleeve welded to it 17, attached to the bottom of the housing glass with bolts. On the other side, the rod has an internal thread into which a coupling bolt is screwed 1 with a knob that presses the cover to the filter housing. The joint between the housing and the lid is sealed with a rubber ring 3.

A spring and a cup are installed in the inner bore of the cover, which are kept from falling out by a locking ring. A spring presses the bushings of the filter sections against each other through the cup. The filter sections are steel corrugated glasses with brass wire of a special profile wound on them, forming conical slots between the bushings with a width of 0.04 to 0.09 mm. Double bottoms are soldered to the corrugated glasses, into which bushings with holes are soldered to drain purified oil from the cavity formed by the corrugations of the glass and the wound wire into the cavity of the rod.

When the oil pump operates, oil from its discharge section enters the filter housing through the inlet fitting and fills the internal volume around the filter sections. After passing through the filter sections, the oil enters the cavity of the rod, passes through the drilling in the housing, presses out the shut-off valve ball and enters through pipelines into the central supply cover, to the turbocharger and the engine fuel pump drive clutch.

If the filter sections are excessively clogged or the oil is not warmed up enough, when the filter resistance is from 4.7 to 5.8 $кгс/см^2$, the pressure reducing valve opens, the oil, bypassing the filter sections, enters the cavity of the rod and is supplied uncleaned to the engine.

2.1.6.7 Centrifugal oil purifier MC-1

Centrifugal oil purifier MC-1 is used as a filter for fine purification of oil from mechanical impurities and resinous inclusions. It is installed in the MTO on the right side of the NK-13M fuel pump drive and is attached to the bracket with two tapes. The bracket is attached with four bolts to the middle beam of the MTO.

The centrifugal oil purifier consists of a housing 8 (Figure 2.16), a cover 3, a rotor, a rod 7, a bolt 1 and a drain pipe 11.

Filter housing 8 is cast from aluminum alloy. In the central boss of the housing, a rod 7 is secured with a blind nut, in the lower part of which there are channels for the passage of oil. A bolt 1 with a knob is screwed into the upper part of the rod, tightening the filter cover and the housing. The joint between the bolt and the filter cover is sealed with a copper ring, and the joint between the filter cover and the housing is sealed with a rubber ring 18.

A rotor is mounted on the rod, which consists of a rotor body 14, a rotor cover 16, a bushing 19, two steel tubes 17 and a coupling nut 5. A bushing 19 is screwed onto the protruding central part of the rotor body and secured with two screws, onto which a nut 5 is screwed, tightening the cover 16 and rotor housing 14. The joint of the nut 5 with the rotor cover is sealed with an aluminum gasket 6, and the joint of the rotor cover with the housing with a rubber gasket 15. In the lower part of the rotor housing 14, two nozzles are screwed in from the outside 22 with holes diameter 2 mm. The lower part of the rotor rests on the heel 13 of the rod, and its upward movement is limited by the sleeve 20 and spring 21, installed in the filter cover and held there by a locking ring 4 from falling out.

The drain pipe 11 is attached to the filter body with pins 10. The joint between them is sealed with a paronite gasket 9.

Oil under pressure enters the rotor through channels in the filter housing and rod, passes through the tubes and is thrown out of the nozzles in opposite directions, creating, due to the reactive action of the jet, a torque that spins the rotor along with the oil to a rotation speed of approximately 5500 to 6000 rpm during normal engine operating conditions. Under the influence of centrifugal forces, impurities in the oil that have a high density (specific gravity) are thrown towards the wall of the rotor cover and deposited on it in a dense layer. The purified oil is drained through the pipe into the engine crankcase.

The MC-1 filter is connected parallel to the main pumping line, and from 20 to 30% of the total flow of pumped oil passes through it. The quantity and pressure of the pumped oil is limited by a ball valve installed at the outlet of the pumping sections of the engine oil pump.

2.1.7 Cooling system

The cooling system is designed to maintain engine temperature within acceptable limits.

The cooling system is liquid, closed type, with forced circulation of coolant. The filling capacity of the system is 90 l. The working fluid is water with a three-component anti-corrosion additive or low-freezing coolant. The brands of low-freezing liquids used are indicated in 188M.R.E (Part 2).

The cooling system includes radiators 4 (Figure 2.4) and 7, expansion tank 16 with steam-air valve 13, additional tank 12, engine water pump 10, engine cylinder cooling jackets, thermometer receiver 2, coolant drain valve 9, pipelines, fan 5, as well as entrance and exit blinds on the MTO roof.

2.1.7.1 Cooling system operation

When the engine is running, coolant circulation is carried out by water pump 10 (Figure 2.4) of the engine. From the water pump, coolant flows into the cylinder jackets and block heads.

Leaving the engine, the heated coolant branches into three streams:

– the main flow through the pipeline enters radiators 4 and 7, from where it is taken by the engine water pump 10;

– the second flow branches in two directions:

- first - to coils 3 of the main engine oil tank and 8 tank of the hydraulic control and transmission lubrication system, as well as to oil pumps 1;
- the second - to the heater 17 and the water pump 10;

– the third flow circulates through the drainage-compensation circuit from the engine heads and the left water radiator 7 into the expansion tank 16, from which it enters the water pump through the additional tank 12.

The drainage-compensation circuit is designed to prevent steam formation and disruption of the coolant circulation by the water pump. The coolant temperature is controlled by the DKMV complex. Receiver 2 of the thermometer is installed in the pipeline that drains liquid from the engine head, the readings are displayed on the driver's APU.

Air circulation in the air path of the cooling system is carried out by fan 5. Air is sucked in by the fan through the inlet louvers, passes through oil and water radiators and is thrown out through the outlet louvres. The fan drive is turned on and off by the DKMV complex in automatic mode. It is possible to force the fan to constantly operate.

2.1.7.2 Water radiators

The engine cooling system includes two radiators of similar design, located together with oil radiators in a radiator rack mounted below on the roof of the engine compartment. The radiators in the rack are attached to brackets 1 (Figure 2.43) and paw 8 through rubber shock absorbers.

The radiator is aluminum, plate-and-band type, single-pass, solder-welded design, consists of a core 4, front 3 and rear 10 collectors.

The radiator core is a set of aluminum plates and strips that form channels for the passage of coolant and air. Collectors are welded to the radiator core.

The front manifolds have 2 pipes with flanges. A pipeline that supplies coolant from the engine is connected to the left radiator pipe, and a pipeline that drains coolant from the radiators to the water pump is connected to the right radiator pipe. The collectors have handles 9 for transporting the radiator. On the rear manifold of the left radiator there is a filling neck 6, closed by a plug with a gasket, and a pipe 7 for removing steam and air from the radiators into the expansion tank during operation of the cooling system and for releasing air during refueling. Pipe 5 connects the left radiator to the right one.

2.1.7.3 Cooling system expansion tank

The expansion and additional tanks serve as a reservoir for coolant that expands when heated, to collect and condense steam removed from cylinder blocks and radiators, to replenish the natural loss of coolant (due to evaporation) in the system during long-term operation. The capacity of the expansion tank is 5 l, the additional tank is 8 l.

The expansion tank is installed in the MTO and is bolted to the bonks welded to the MTO bulkhead and to the elbow on the left side. The tank is located at the same height as the highest point of the engine head, washed by coolant.

The expansion tank consists of sidewalls 17 (Figure 2.17) and 18, partitions 2, steam outlet pipes 1 and 15, pipe 14 with a flange, barrel 19, flange 7, into which a steam-air valve 8 with gasket 10, filter 13 and spring 12 is installed. 1 and 15 have nipples to which couplings for quick-release connections of steam pipelines are connected.

The steam outlet pipe from the engine on the gear mechanism side is connected to branch pipe 15; pipelines to the refill tank are connected to branch pipe 14 with a flange and bonnet 19. Coolant is filled through the filler neck 4. The neck is closed with plug 6 with gasket 5. A coolant level sensor is installed in flange 3.

2.1.7.4 Cooling system refill tank

The expansion and additional tanks serve as a reservoir for coolant that expands when heated, to collect and condense steam removed from cylinder blocks and radiators, to replenish the natural loss of coolant (due to evaporation) in the system during long-term operation. The capacity of the expansion tank is 5 l, the additional tank is 8 l.

The additional tank is installed under the expansion tank and is attached to the MTO partition through rubber shock absorbers on the feet. The tank consists of sidewalls 6 (Figure 2.18) and 7, partitions 3, intake pipe 5, pipes 1, 2 and 4. Pipes from the expansion tank are connected to pipes 2 and 4, and a pipe from the engine water pump is connected to intake pipe 5. Coolant is drained from the tanks through drain pipe 1.

2.1.7.5 Steam valve

The steam-air valve is used to maintain a certain pressure of coolant vapor or air in the cooling system. It is installed in the threaded hole of the expansion tank and consists of a housing 10 (Figure 2.19), a steam valve 11, a gasket 6, a mesh 8, a plate 1 with an adjusting screw 3, an air valve 7, cups 2 and 5, springs 12 and 13 and retaining rings 4 and 9.

The screens protect the valve from contamination. The steam-air valve is closed with a lid 9 (Figure 2.17), and communication with the atmosphere occurs through hole A in flange 7.

The steam valve is adjusted to excess pressure (3.2 ±0.1) $кгс/см^2$. The air valve is adjusted to vacuum (0.08 ±0.06) $кгс/см^2$.

2.1.7.6 Water pump

The engine is equipped with a centrifugal type water pump . It is designed to create continuous forced circulation of coolant in the cooling system.

The pump is installed on the right side of the lower engine crankcase on the gear side. The pump is driven from the engine crankshaft.

The pump consists of the following components:
– housing 3 (Figure 2.20);
– bell 7 of the water pump;
– roller 6;
– impellers 8;
– ball bearings 13;
– spline bushing 1;
– spacer sleeve 4;
– self-tightening cuff 11;
– metal-graphite washer 9;
– gland corrugation 5;
– springs 10.

The pump housing 3 is made of aluminum alloy. A fitting 12 is screwed into the boss, onto which a valve for draining coolant from the engine cooling and heating system is installed. There is a control hole in the pump housing A , liquid leakage from which indicates a malfunction in the pump.

Liquid is taken from the radiators through socket 7. Through pipe 14, coolant is supplied to the jackets of the engine blocks, and through hole B to the heater.

2.1.7.7 Fan

The tank is equipped with a centrifugal fan, which serves to create a flow of cooling air through oil and water radiators. It is made of aluminum alloy and is located at the rear of the hull.

The fan consists of a disk, rim and blades riveted to the disk and rim.

The fan is bolted to the fan hub. To increase efficiency, the fan is placed in a special volute, and at the entrance to the fan an input guide vane is installed, secured with bolts and nuts 5 (Figure 2.21) through a sleeve 4 and adjusting washers 2 on strip 1 mounted on the front wall of the cochlea. To avoid dismantling of bushings and adjusting washers, they are installed on thickly ground zinc white MA-011-1.

The fan is driven by a drive that is controlled by the DCMV depending on the following conditions:

– switches off when the coolant temperature is less than plus 80 °C and the engine oil temperature is less than plus 90 °C;

– turns on when the coolant temperature is more than plus 85 °C or the engine oil temperature is more than plus 95 °C;

– turns off for no more than 30 s when coolant and oil temperatures are below critical and the fuel pedal is pressed all the way.

2.1.7.8 Blinds

The tank is equipped with entrance and exit shutters.

The shutters are designed to maintain the required temperature conditions of the engine due to the cooling air sucked in by the fan through the radiators (input shutters), as well as to protect the MTO units from combat damage (input and output shutters).

The entrance blinds are mounted in the roof above the transmission and consist of fixed upper 15 (Figure 2.15) and lower 13 shutters.

The exit blinds are built into a beam located at the rear of the removable roof above the MTO. They consist of two movable 17 and two fixed 16 valves, separated by three transverse ribs.

The position of the movable leaves of the exit blinds is set by the blind drive. To prevent foreign objects from entering the MTO, protective nets are installed above the entrance and exit blinds.

The blind drive consists of a drive link 1 with a lever, a spring 3, a blind drive mechanism 4, a coupling bolt 5, forks 8 , a driver 9, two-arm levers 12, a driver 18, a roller 20 and rods. The shutter drive lever has several fixed positions. The lever is released from the fixed position by pressing the handle from above. A strip 21 with an inscription indicating the direction of movement of the handle for opening and closing the blinds is attached to the bracket of the blinds drive.

The blind drive mechanism 4 is designed for emergency closing of the blinds upon commands of the defense system against weapons of mass destruction. After passing the indicated commands, it is necessary to engage the shutter drive mechanism 4, for which the slide lever 1 must be moved all the way towards the rear of the tank (the shutters are closed).

2.1.8 Fuel supply system

The fuel supply system is designed to accommodate the transportable fuel supply, clean it and supply it to the cylinders of the main engine and the diesel generator set engine.

The fuel supply system includes:

– internal 1 (Figure 2.23), 5, 27 tanks;
– external 3, 6, 7, 9, 12 tanks;
– expansion tank 10;
– fuel distribution valve 30;
– valve 8 for shutting off external tanks;

– coarse 25 and fine 13 filters
– manual fuel priming pump RNM-1 pos. 28 (hereinafter referred to as RNM);
– engine fuel pump 20;
– electric fuel priming pump pos. 29;
– Diesel engine fuel pump pos. 23;
– high pressure fuel pump 19;
– injectors 17;
– fuel valves:
- float 11;
- air release pos. 32;
- electromagnetic KET 01 pos. 22;
- reverse 21;
- bypass 24;

– drain fitting 31 for pumping out fuel with an electric pump;
– electrical capacitive fuel level meters 26;
– sensor 33 for the presence of water in the fuel;
– high 18 and low pressure pipelines.

Using special equipment 15, two or three standard barrels 16 with a capacity of 200 liters can be connected to the fuel supply system. Two barrels are installed on brackets fixed to the rear hull plate, the third barrel is installed on a bracket above the diesel generator compartment.

The tank is equipped with a multi-fuel engine that can be operated on diesel fuel (primary), TS-1, T-2 and RT fuels.

2.1.8.1 Fuel system operation

When the BCN or RNM is operating, fuel passes from the left bow tank 27 (Figure 2.23) through the electric drive pump, fuel distribution valve 30, RNM pump, coarse fuel filter 25, engine fuel priming pump 20, fine fuel filter 13 and high-pressure fuel pump 19 , displaces air, which, together with the fuel, is discharged back into the left bow tank through the air release valve 32.

When the engine is running, fuel is taken by the engine fuel priming pump from the left bow tank, in which a vacuum is created. Under the influence of vacuum, fuel flows into this tank from the right bow 1 and right 5 tanks. A decrease in the fuel level in these tanks also leads to the formation of a vacuum in them, under the influence of which fuel comes from the first external tank, etc. Thus, the last of the connected tanks (the left barrel or the fifth external tank) is produced first, through which, as production progresses, the system is filled with atmospheric air entering through the float valve 11, expansion tank 10 and tap 8 shutdown of external tanks.

When the diesel generator set is operating, fuel is taken by the fuel pump 23 of the diesel generator set engine from the left bow tank 27 and supplied through the bypass valve 24 to the fuel equipment of the diesel engine generator set. Excess fuel is discharged through check valve 21 and air release valve 32 into the left bow tank.

Filling the internal tanks with fuel is carried out through the filler neck of the right tank 5, when unscrewing the cap of which, a hole opens to release air when refueling from the left bow tank. From the right bow and right tanks, air exits directly through the filler neck. With external tanks 3, 6, 7, 9, 12 turned off, after filling the right tank, the expansion tank will be filled with fuel.

During the process of filling the internal tanks, fuel begins to flow into the left bow tank only after 400 liters of fuel have been filled into the remaining tanks. Therefore, after complete exhaustion, if there is less fuel for refueling, it is necessary to fill directly into the left bow tank from 90 to 100 liters of fuel through the drain fitting to ensure engine starting and subsequent exhaustion from the remaining internal tanks.

After filling the internal tanks, fill the external ones, starting from the first tank 3, each through its own filling neck. Fill the barrels connected to the system last , starting from the right.

2.1.8.2 Fuel tanks

Fuel tanks are used to store and transport fuel in a tank. Fuel tanks are divided into internal and external. The fuel tanks are connected to each other by pipelines in series.

The internal tanks are welded from stamped steel sheets and coated with bakelite varnish inside and outside to protect against corrosion.

The external tanks are welded from extruded aluminum sheets and painted on the outside.

All tanks have baffles inside, which are designed to increase the rigidity and strength of the tanks, as well as to reduce fuel sloshing in the tank.

The internal tanks are equipped with special protective covers and installed in the tank body.

2.1.8.2.1 Left bow tank

The left bow tank is installed in the bow of the tank hull to the left of the driver's seat. Fuel is taken from the left bow tank to power the engine.

There is a welded pipe in the upper part of the tank, which connects to the filling neck of the right tank and serves to release air when refueling; At the bottom of the tank, an inlet tube is welded to connect the tank with the right bow tank and a flange to which the BCP is attached. Inside the tank, the cut of the tube is 200 mm above the bottom, which prevents fuel from flowing into the right group of tanks when filling a small amount directly into the left bow tank and ensures that if any other tank is damaged, the remaining fuel in it is from 90 to 100 liters, sufficient for the movement of the tank within 1 hour.

A valve for draining fuel from the tank is installed in the bottom of the tank. A flange is welded in the upper part of the side wall, into which an electric capacitive fuel meter sensor is installed, and in the lower part there are bolts for attaching the bracket for fuel devices.

2.1.8.2.2 Right bow tank

The right bow tank is installed in the bow of the tank hull, to the right of the driver's seat.

At the top of the tank there is a welded pipe that connects to the pipe on the right tank. An intake pipe connected to the left bow tank and a pipe for connection to the right tank are welded at the bottom of the tank. On the tank walls there are welded bolts for fastening electrical equipment.

2.1.8.2.3 Right tank

The right tank is installed in the bow of the tank hull behind the right bow tank, to the right of the driver's seat.

At the top of the tank there is a welded filler neck flange, into which is welded a tube for releasing air from the left bow tank when filling it and a pipe for connecting to the right bow tank. A flange is welded to the rear of the tank for installing a fuel meter sensor. At the bottom of the tank there is a welded pipe for connection to the right bow tank and a pipe for connection to the external fuel tanks.

At the bottom of the tank there is a valve for draining fuel and a fitting for installing a water presence sensor.

2.1.8.2.4 External fuel tanks

External fuel tanks are installed on the right fender and secured with tension bands. The fifth tank is additionally attached to the rear edge of the shelf with a clamping bar and a fork. The tanks are connected to each other by hoses. The inlet and outlet tubes are located inside the tanks in such a way that if one of them is damaged, fuel leakage from the others is prevented. A filler neck flange is welded into the upper part of each tank, into which a plug with a rubber gasket is screwed. The tanks have handles for transportation. The inlet tube of the fifth tank ends with an adapter for connecting barrels.

During production, fuel is taken into the internal group of tanks from the first external tank, which, as production progresses, is filled with fuel flowing from subsequent external tanks. Thus, first of all, the last, fifth tank is exhausted (emptied), which is connected to the atmosphere through an adapter for connecting barrels, a shut-off valve for external tanks, an expansion tank and a float valve.

2.1.8.2.5 Expansion tank

The expansion tank is a compensating capacity of the fuel supply system, into which, when the system is fully charged, fuel flows during thermal expansion. The capacity of the expansion tank is 12 liters. It is installed in the MTO on the bottom under the air cleaner.

The fuel entering the expansion tank is always produced first.

The inlet tube of the tank is connected to the float valve, the outlet - to the shut-off valve of the external fuel tanks.

2.1.8.3 Equipment for connecting barrels to the fuel supply system

The equipment is designed to connect tank-mounted drums to the fuel system. The equipment allows you to connect two or three barrels.

The equipment consists of three necks 28 (Figure 2.24), which, using fittings 23 with o-rings 25 and rubber gaskets 26, and clamps 27, are installed on the flanges 24 of the necks of barrels 1. An intake tube 22 and a connecting pipe 31 are welded into the neck body. the neck hole is fitted with a plug 29 with a gasket 30.

The equipment is connected to the adapter 21 of the fifth external tank 10 through a gasket 20 with bolts 18. The flange 19 and the necks are connected to each other by hoses with protective spring braids installed on them. The neck of the left barrel is connected to the neck of the middle barrel using union connections with union nuts 2 and 4. This allows you to disconnect the neck of the left barrel and connect two barrels to the fuel supply system, while the drain hose 3 and the fuel hose 6 are connected to each other using an adapter 32 , located in a single set of spare parts for the tank.

2.1.8.4 Fuel distribution valve

The plug-type fuel distribution valve is designed to connect fuel tanks to the engine fuel priming pump and disconnect fuel tanks from it, as well as to connect tanks to the drain fitting if it is necessary to pump out fuel from the central station.

The valve consists of a valve body 6 (Figure 2.25), a valve plug 11, a spring 8, a nut 10, a rubber seal 9 and a handle 1 with an arrow marked on it.

There are three holes in the valve body into which pipe 5 is welded for connection to the BCP, pipe 2 for connection to the RPM and pipe 4 for connection to the drain fitting for pumping out fuel from the BCP.

The faucet handle is installed in one of three positions:

– TANK ENABLED (arrow directed to the rear of the tank) - in this position, consistent production of fuel from all tanks of the fuel system is ensured;

– PUMPING OUT (arrow pointing up) - in this position, when the cylinder is turned on, through the drain fitting and the drain hose connected to it, fuel is pumped out from the system tanks to another tank or any container;

– TANK CLOSED (arrow pointing down) - in this position, all tanks are disconnected from the engine fuel supply system.

The tap handle positions are indicated on a plate attached to the left bow tank forward of the tap.

2.1.8.5 Shut-off valve for external fuel tanks

The shut-off valve for external fuel tanks is mounted on a rack for placing charges on the starboard side of the tank.

The valve consists of a body 7 (Figure 2.26), a flange 2, a plug 4, a handle 1 with an arrow marked on it, a spring 9, a gasket 3, an oil seal 10.

The valve body has holes into which pipes are welded:

– pipe 8 - for supplying fuel from the first external fuel tank;

– pipe 6 - for intake of atmospheric air from the expansion tank;

– pipe 5 - for supplying air to the adapter of the fifth external fuel tank.

Through hole A in the plug, the tap communicates with the right tank. The tap handle has two positions:

– ON - in this position, the external fuel tanks are connected to the internal ones, and fuel from the first external tank flows into the right tank through pipe 8 and the hole And in the tap plug; pipes 5 and 6 are connected to each other, and air from the expansion tank enters the fifth external fuel tank (or left barrel);

– OFF - in this position, the external fuel tanks are disconnected from the internal ones; pipe 6 is connected to hole A in the plug, and atmospheric air enters the right tank.

2.1.8.6 Coarse fuel filter

The coarse fuel filter is used to pre-clean fuel from mechanical impurities. It is installed in the control compartment on the fuel gauge bracket.

The filter consists of the following components: glass 9 (Figure 2.27), cover 1, filter sections 10, 11 and 12; springs 6. The lid is secured with a nut 2 screwed onto a bolt 5 welded to the bottom of the glass. The connectors of the lid with the glass and with the filter sections are sealed with a felt gasket 4 and a paronite gasket 13. The lid has two threaded holes to which the inlet and outlet pipelines are connected.

The fuel enters the cavity between the walls of the glass and the filter sections through the inlet pipeline, passes through the sections and through the outlet pipeline goes to the engine fuel priming pump.

2.1.8.7 Fine fuel filters

Fine fuel filters are attached to brackets installed on the toe side of the crankshaft.

Filters serve for final purification of fuel from mechanical impurities before it enters the NK-13M high-pressure fuel pump.

The filter includes: glass 1 (Figure 2.28) with a filter element and a lid 2. A tie rod 15 is screwed into the bottom of each glass, passing through the central hole of the filter element.

The filter element consists of the following parts: pressure flanges 16, cardboard filter plates 17, spacer inlet 18 and outlet 19 rings and a metal mesh 20 covered with a nylon cover 21. The glasses, complete with filter elements, are tightly pressed through gaskets 9 and 10 to the lid using 15 tie rods and 6 nuts.

The lid has three parallel horizontal channels. Through channel A, through the rotary angle 8, fuel is supplied to the cavity of the glass, and through channel B (through the rotary angle 5), the filtered fuel is discharged to the NK-13M pump. The middle channel is designed to drain fuel through the rotary angle 3 to the PVV valve. Air and fuel vapor can be released through valve 32 (Figure 2.23) air release into the left bow tank. The filter plates and spacer rings are glued together to form an integral filter element.

2.1.8.8 Electrically driven fuel priming pump

An electric fuel priming pump (FCP) is designed to pump fuel through the fuel system in order to fill the pipelines with fuel and remove air and steam plugs before starting the engine, as well as to pump fuel out of the system through the drain fitting.

The BCP is installed on the flange of the left bow tank. The inlet and safety screen of the pump are located inside the tank, and the housing and electric motor are located on the outside of the tank.

The BCP consists of a centrifugal pump and an electric motor mounted in one unit.

2.1.8.9 Manual fuel priming pump

The manual fuel priming pump (PHP) is a backup fuel priming device and is used primarily in case of malfunctions in the operation of the electric drive pump. It serves to fill the supply line with fuel before starting the engine. The pump is installed on a bracket with fuel devices.

The diaphragm type pump consists of a body, a cover, a diaphragm, a foot valve, a discharge valve, a bypass valve and a hand drive. The pump creates a pressure from 1 to 1.3 $кгс/см^2$.

The cover is bolted to the pump housing. The axis of the manual pump drive is installed in the cover bosses. A membrane made of petrol and oil resistant rubber is installed under the cover. The middle part of the membrane is connected to the drive arm by means of a nut and two metal plates installed on both sides of the membrane.

The pump drive consists of a handle, a lever and a driver. The handle is connected to the lever by teeth, tightened with a bolt.

When the handle is moved to its extreme positions, the membrane bends under the action of the driver. When the membrane bends towards the cover, a vacuum is created in the internal cavity of the pump, under the influence of which fuel from the tanks through the electric drive pump and the fuel distribution valve enters the suction pipe of the pump, opens the intake valve and fills the internal cavity of the pump. When the membrane bends in the opposite direction, pressure is created in the internal cavity of the pump, under the influence of which the intake valve closes, the discharge valve opens and fuel flows through the coarse filter, the engine fuel priming pump and the fine filter to the high pressure pump. As the system fills with fuel, the pressure in it increases. When the pressure reaches from 1 to 1.3 $кгс/см^2$The bypass valve opens and fuel is transferred from the discharge cavity to the suction cavity.

When the engine is running, fuel is supplied to the high pressure pump by the engine fuel priming pump. In this case, the intake and discharge valves of the PNM pump are open under the influence of vacuum created in the supply pipeline by the engine fuel priming pump.

2.1.8.10 Electric fuel pump DGU

The electric fuel pump of the diesel generator set is designed to supply fuel and create excess pressure in the fuel line of the diesel engine of the diesel generator set. It is installed on the side wall of the charge rack in the area of the water pump of the OPVT system.

Flow-through pump, roller type.

2.1.8.11 Engine fuel priming pump

The engine fuel priming pump is designed to create fuel pressure at the inlet of the fine filter in front of the high-pressure fuel pump, which prevents the formation of vapor locks in the fuel system.

The pump is mounted on the lower half of the crankcase and is driven by the engine crankshaft. It is mounted on the gear pump of the crankcase ventilation system.

The fuel pressure created by the pump ensures the operation of the valve for the automatic drainage of sludge from the air system.

2.1.8.12 High pressure fuel pump

The NK-13M high-pressure fuel pump doses fuel to ensure the appropriate engine operating mode and supplies it to the injectors at a certain point in the operating cycle.

Multi-fuel plunger type pump. The amount of fuel supplied is adjusted by turning the plunger. The pump has 12 plunger pairs (according to the number of engine cylinders). Plunger diameter 13 mm, plunger stroke 10 mm.

The pump is located in the camber of the engine cylinder blocks and is mounted on its upper crankcase, at an angle of 17 °towards the left cylinder block.

The pump consists of the following parts: pump housing 7 (Figure 2.29), cam roller 16, pushers 14, fuel supply sections, rack 11, ring gears 13 and speed controller with regulator cover 1.

Oil supply to the pump from the engine lubrication system is carried out using a tube from the pump drive coupling, fitting 15 and hole F for oil supply in the pump housing. Hole F for oil supply is located in the pusher guide and oil is supplied inside the fuel pump housing. The fuel pump uses a flow lubrication system.

Through the holes And for oil to enter the regulator in the walls of the pump housing and regulator, oil enters the regulator, from where it is drained directly into the engine crankcase through fitting 9. The protrusion of fitting 9 into the internal cavity of the regulator determines the required oil level in the regulator body for its normal operation.

To reduce the degree of oil dilution by fuel that has leaked through the gaps between the plunger and the sleeve, the plunger sleeve is equipped with an annular groove B and hole B for draining the leaked fuel into the suction cavity D (low pressure cavity). Regulator cover 1 is installed without drain and control plugs.

In order to equalize the operating modes of the cylinders in the pump, differentiated adjustment of the fuel supply sections has been introduced according to the angle of the start of supply and the magnitude of the cyclic fuel supply.

Adjusting screws 4 on the regulator body 5 are intended for adjusting the pump at the manufacturer. These screws are sealed to eliminate the possibility of reconfiguring the pump during operation.

To reduce the temperature of the pump, reduce vaporization in the fuel and achieve better and more uniform (across sections) filling of the pump elements, fuel is supplied to the pump from both sides and removed from the middle part of the pump housing. This scheme of connecting the fuel pump to the engine fuel system, in the presence of a

constant flow of fuel through the air release valve, also ensures a more complete removal of fuel and air vapors from the pump channel.

The pump is equipped with an all-mode regulator with a built-in power limiting mechanism (hereinafter referred to as PTO), which limits the fuel supply at the command of the driver's display complex.

The all-mode regulator is used to automatically maintain crankshaft speeds under changing engine loads. Makes it easier for the driver to maintain speed at all ranges of engine operation. The executive PTO, at the command of the driver's display complex, reduces the fuel supply to the cylinders.

The pump is equipped with an axle box 8 for connecting a closed-type coupling of the fuel pump drive.

2.1.8.13 Fuel pump drive clutch

The fuel pump drive clutch is designed to connect the drive shaft to the cam shaft of the fuel pump and to adjust the angle at which fuel supply begins by changing the position of the pump shaft relative to the drive shaft.

The engine is equipped with an automatic clutch that drives the fuel pump of a closed type.

The fuel pump drive is located on the upper crankcase on the toe side of the engine crankshaft and is designed to transmit rotation from the crankshaft through the gear block to the fuel advance coupling 4 (Figure 2.30), connected by splines to the splined sleeve 10 of the fuel pump drive.

The fuel pump drive housing is closed by a cover 1 with an air distributor 2 installed on it, supplying air to the engine cylinders during air start.

The angle of the start of fuel supply to the top dead center of the piston of the sixth left cylinder in the compression stroke installed on a new engine is indicated in the engine passport.

A more detailed description of the high pressure fuel pump is given in 92S2F RE part 1.

2.1.8.14 Nozzle

The closed-type drainless injector is designed to supply atomized fuel into the combustion chamber of the engine.

The nozzle consists of a nozzle body 14 (Figure 2.31), with nozzle parts and spacers 11 installed in it. A high-pressure tube 1 is attached to the nozzle body 14 with a pressure fitting 6 to supply fuel from the NK-13M pump to the nozzle. In the nozzle body 14 there is a rod 13, a spring 15 and a nut 17. The nozzle nut 12 is used to secure the spacer 11 and the nozzle to the end of the nozzle body 14. The atomizer consists of a nozzle body 10 and a needle 9. A ball check valve is used in the spacer 11 to relieve the cavity above the needle 9 from fuel leaking through the gaps into the atomizer.

The gap between the block head cover 3 and the end of the thrust ring 8 should be from 0.5 to 1.5 mm.

2.1.8.15 Air release valve

The air release valve is designed to remove air and fuel vapors from the high-pressure pump, fine filters and pipelines both before starting the main engine, when turning on the BCP or the operation of the pilot pump, and during operation of the main engine, as well as to remove air from the fuel system of the diesel generator set engine .

The valve is installed on a bracket with fuel devices and consists of a body 1 (Figure 2.32), a rod 3 with a gasket 2 installed on it, a mesh 4, a spring 5, a nut 7, a solenoid valve 8, a diaphragm 10, a plug 11, a bushing 13, a button 15 , keys 18.

Two pipes are welded to the valve body, connecting the valve to the high-pressure pump and the left bow tank (pipes 19 and 9, respectively).

Rod 3 has a radial hole A with a diameter of 1.1 mm. This hole ensures constant pumping of fuel through the cavity of the high-pressure fuel pump and fine filters when the main engine is running in an amount of 50^{+20} l/h. Fuel pumping is created by the engine fuel priming pump and maintains the thermal state of the high-pressure pump cavities at a level that prevents the formation of steam bubbles in the fuel.

When you press the key, the button and the rod move, compressing the spring; the rod moves away from the end of the body, along which the seal occurs, and ensures communication between the inlet and outlet cavities of the valve through a larger flow area. In this position of the button, the system is pumped with the RPM or BCN before starting the engine.

After releasing the key, the spring presses the rod with the gasket to the end of the body and the valve cavities communicate with each other only through hole A.

When the diesel generator set control panel is turned on, the electromagnetic valve 8 opens and, through a bypass channel, ensures communication between the inlet and outlet cavities of the valve through a larger flow area, which creates the necessary pumping of fuel through the cavity of the high-pressure fuel pump and the fuel filter of the diesel generator set engine during its operation.

2.1.8.16 Float valve

The float valve ensures the flow of atmospheric air into the fuel tanks during fuel depletion and prevents fuel from leaking out during thermal expansion through the openings A (Figure 2.33) of the valve connecting the system to the atmosphere. It is mounted on the MTO partition beam next to the MAF filter.

The valve consists of a body 6 and a plug 10 with hole B. A glass 5 is soldered into the plug, inside which a float 7 with a shut-off needle 8 is placed.

After filling the expansion tank, fuel flows through tube 4 into the valve body and into the glass, while the float floats up and closes hole B with a shut-off needle , preventing fuel from leaking out of the system.

2.1.8.17 Solenoid valve KET 01

The electromagnetic valve KET 01 is designed to connect the fuel line of the diesel generator set to the fuel supply system. It is installed on the fuel supply pipeline to the engine booster pump, passing through the rib of the engine-transmission compartment bulkhead.

The valve consists of a body, a coil, a core with a rubber valve, and a spring.

The valve is constantly in the closed position and opens only when the diesel generator control panel is turned on.

2.1.8.18 Check Valve

The check valve is designed to isolate the fuel drain lines from the diesel generator set and the main engine. It is installed in the engine-transmission compartment on the left side in the area of the engine-transmission compartment bulkhead on the drain pipeline.

The valve consists of a body 1 (Figure), balls 2, 9, springs 3, 8, sealing rings 4, 6, screw 5 and fitting 7.

When the main engine is operating, under the influence of pressure created by the engine fuel priming pump, ball 9, compressing the spring, opens the channel, and air with excess fuel from the main engine enters the drain pipeline, through which the air release valve is discharged into the left bow tank, while the drain the engine line of the diesel generator set is blocked by ball 2. When the diesel generator set is operating, under the influence of the pressure created by the fuel pump of the diesel generator set, ball 2, compressing spring 3, opens the channel, and air with excess fuel from the diesel generator set enters the drain pipeline, through which through the air release valve they are discharged into the left bow tank, while the drain line of the main engine is blocked by ball 9.

2.1.8.19 Bypass valve

The bypass valve is designed to maintain operating excess pressure in the fuel line of a diesel engine DGU. It is installed on a bracket fixed to the charge rack in the area where the water pump of the OPVT system is located.

The valve consists of a body 6 (Figure 2.35), a ball 5, a spring 4, an o-ring 2 and a screw 1. The opening pressure of the valve is set by adjusting washers 3

When the pressure in the fuel line of the diesel generator set engine reaches from 2.3 to 2.8, кгс/см^{2}the ball, compressing the spring, opens the bypass channel, and part of the fuel is transferred to the input of the fuel pump of the diesel generator set.

2.1.8.20 Fuel drain fitting

The fuel drain fitting is used to pump fuel out of the tank tanks using an electric drive pump.

The fitting is installed in the control compartment on a bracket with fuel devices and consists of a housing with a pipe, a plug and gaskets. The fitting is connected through a pipe to the fuel distribution valve.

2.1.8.21 Fuel filling device

Fuel tanks in the absence of stationary refueling facilities (fuel dispensers, special refueling units, etc.) or fuel tankers should be refueled with a small-sized MZA-3 refueling unit located in a single spare parts kit for the tank.

The MZA-3 set includes pump 2 (Figure 2.36) assembled with an electric motor and cable, hose 1 with a dispensing valve and three extension cords (No. 1, 2, 3) pos. 3 suction pipes.

The pump assembly with the electric motor consists of the following parts: extension No. 1 pos. 3 with a check valve 5 and a strainer 6 installed in it, an o-ring 7, an axial pump 8, a housing 9, an electric motor 12, a handle 13 with a switch placed on it.

An oil seal 10 is installed in the housing on the electric motor side. To check the serviceability of the oil seal, there is a control hole plugged with a screw 11.

Using adapter 4, found in a single spare parts kit for the tank, the hose with the dispensing valve of the MZA-3 unit is connected to the hose for filling the left bow tank when it is completely depleted.

The pump of the unit is not self-priming, therefore, before starting work, it is necessary that the fuel level reaches the level of the pump impeller or is higher than it. To do this, it is necessary to fill the suction pipe by lowering it into a container with the appropriate level of fuel or by pouring fuel into the pipe through a check valve, for which the unit must first be turned upside down. After the unit returns to its operating position, the valve will hold the filled fuel.

ATTENTION:

IT IS PROHIBITED TO PUMP GASOLINE AND OTHER FLAMMABLE LIQUIDS WITH THE MZA-3 UNIT!

2.1.9 Engine air supply system

The engine air supply system is designed to clean air and supply it to the engine cylinders.

The engine power system includes the following components: air cleaner 6 (Figure 2.3), air supply pipe 4, turbocharger 10, intake manifolds 5; pipe 1 left and pipe 8 right for suctioning dust from the dust collector of the air cleaner; automatic valves left 3 and right 9; indicator 26 SDU-1A-0.12 of the maximum resistance of the air cleaner, sensor 16 of exhaust gas temperature.

2.1.9.1 Air purifier

The tank is equipped with a two-stage air cleaner with automatic dust removal from the dust collector. The air cleaner is installed in the MTO on the starboard side and is secured with straps 29 through rubber shock absorbers 28 on two brackets 27 on the MTO bulkhead and a removable bracket on the starboard side.

The air purifier consists of the following main parts: a body, two cassettes and a cover.

The air cleaner body is a welded structure consisting of a head, a cyclone apparatus and a dust collector.

The cyclone apparatus is assembled from individual cyclones. Together with the dust collector, it represents the first stage of cleaning. To prevent foreign objects from entering the inlet pipes of the cyclones, nets and shields are installed around the cyclone apparatus.

In head 1 (Figure 2.37) of the air purifier, two cassettes are placed one above the other: lower 5 and upper 4. To distinguish the cassettes, they have the inscriptions LOWER, UPPER and are installed with these inscriptions towards the pipe 7. The cassettes constitute the second stage of cleaning. Each cassette consists of a body and a shell with meshes. The cassette body is filled with wire with different densities for different cassettes. To prevent the suction of unpurified air, felt gaskets 6, 8 and 9 are installed between the upper grill of the cyclone apparatus and the lower cassette, between the cassettes, as well as between the head and the air cleaner cover. Felt gaskets 8 and 9 are sealed through the cassette bodies with beams 3.

The air cleaner head has a hollow bonnet for connecting a fitting with a hose 25, going to the signaling device SDU-1A-0.12 pos. 26 (Figure 2.3). In the dust collector 10 (Figure 2.38), dust collected by cyclones is deposited, which, under the influence of the vacuum created in the exhaust pipes through the dust suction pipes 9, is thrown out along with the exhaust gases. The dust suction pipes 9 are connected to the dust collector nozzles by union nuts 30 (Figure 2.3) and sealed with rubber gaskets 32. The union nuts are held against arbitrary unscrewing by stoppers 31 installed on the dust collector nozzles.

2.1.9.2 Limit resistance alarm

Signaling device SDU-1A-0.12 pos. 26 (Figure 2.3) is a vacuum sensor, when triggered, the inscription “SERVICE IN ” is displayed on the DKMV display, signaling that the maximum contamination of the air cleaner 6 has been reached.

The operating principle of the alarm is based on the effect of atmospheric pressure on an elastic sensitive element, the deformation of which leads to the closure of contacts inside the alarm. The alarm is installed on the air cleaner, under the dust collector. The vacuum cavity is connected by a hose 25 to the air cleaner head, in which, as the cassettes become dusty, the vacuum increases during engine operation. The discharge cavity of the sensing element is connected to the atmosphere. When the maximum resistance is reached, the contact of the signaling device closes, and the inscription “SERVICE IN ” is displayed on the DKMV display.

2.1.9.3 Air purifier operation

Air enters the air cleaner through air intake louvres in the roof above the engine and through radiators.

To prevent excessive heating of the air and the associated loss of engine power, shields are installed on the starboard side and the cyclone apparatus on the radiator side.

Dusty air, under the influence of the vacuum created by the engine, enters at high speed into the inlet pipes of the cyclones 11 (Figure 2.38) of the air cleaner, where it receives a spiral-shaped rotational movement. Under the influence of centrifugal force, the heaviest dust particles are thrown towards the walls of the cyclones, lose speed and are deposited in the dust collector 10. From the dust collector, under the influence of the vacuum created by the exhaust gases, part of the air with dust through the dust suction pipes 9 enters the exhaust pipe 5, where it is mixed with the exhaust gases and released into the atmosphere.

The cyclone device (the first stage of purification) provides preliminary air purification from dust by 99.7 %. After passing sequentially through the lower and upper cassettes, which are the second stage of cleaning, the air purified to 99.83% from the air cleaner head through pipe 3 enters the air supply pipe 4, the engine turbocharger and then through the intake manifolds into the engine cylinders.

2.1.10 Exhaust gas release device

The device is designed to remove exhaust gases from engine cylinders into the atmosphere and includes the following components:

– two exhaust manifolds 8 (Figure 2.39);

– turbocharger 6 ;

– compensator consisting of the following parts:

- inner sleeve 3;
- outer sleeve 2;
- sealing rings 11;

– exhaust pipe 1 on the shelf above the track.

Exhaust manifolds 8 are attached with flanges using studs and nuts to the engine block heads. Copper-asbestos gaskets are installed between the flanges and the block head with the rolled side facing the engine head.

The compensator is designed to compensate for the movements of the exhaust pipe of the turbocharger relative to the pipe flange fixed on board. It consists of outer 2 and inner 3 bushings installed with annular gap A , which is sealed with four o-rings 11.

Gas lines serve to remove exhaust gases from the engine manifolds to the turbocharger and ejector on board, as well as remove dust from the air cleaner dust collector.

Exhaust gases, leaving the internal sleeve 14 (Figure 2.3) of the compensator at high speed, create a vacuum in the ejector 12, under the influence of which from the dust collector of the air cleaner through the suction pipes, dust along with air enters the ejector, which is also an exhaust pipe and is thrown out along with the exhaust gases. gases into the atmosphere.

When installing OPVT valves on the exhaust pipe of the exhaust gas system, excess pressure is created in the ejector, and the dust removal circuit from the air cleaner dust collector stops functioning. To prevent exhaust gases from entering the MTO, and then through the open OPVT valve into the fighting compartment and control compartment of the tank, valves 9 are installed in the dust suction route.

2.1.11 Crankcase ventilation system

The crankcase ventilation system is designed to remove gases that penetrate from the cylinders into the crankcase during engine operation. At the same time, the pressure inside the crankcase increases, which can lead to oil being squeezed out through the joints in the crankcase and through the crankshaft seal.

The system consists of the following components:

– an oil separator located in the camber between the fuel pump and the right cylinder block, and secured to the intake manifold mounting studs;

– pipelines supplying crankcase gases to the oil separator from the toe and gear side;

– oil pipeline connecting the oil separator to the bilge pump installed on the left side of the lower half of the crankcase under the engine fuel priming pump. A flexible hose 1 is connected to the drainage pipeline for removing crankcase gases (Figure 2.40), which drains crankcase gases into the tank's MTO through tank 2, in which oil vapor condenses. To drain oil condensate from tank 2 there is a plug valve 3.

2.1.12 Intake air heating system

The inlet air heating system (hereinafter referred to as IA) is designed to ensure a cold start of the engine in winter conditions and reduce the time it takes to prepare the tank for emergency exit.

PVV operates under the control of DCMV.

Heating is carried out at the time of start-up, and for some time after the engine starts operating with hot gases from the combustion of fuel supplied to the spark plugs along with air from the air system to the tee, and then to the intake manifolds.

The PVV system consists of the following assembly units:

– intake air heater;

– electric air valve EK-48;

– gearbox IL611-150-25K;

– connecting pipelines of fuel and air systems.

The electric air valve and reducer are installed on the air cleaner bracket.

The intake air heater is designed to supply and ignite the air-fuel mixture and heat the air intake by the engine with hot gases.

The heater is attached to the air supply receiver from the turbocharger to the intake manifolds.

The heater consists of the following components: tee 1 (Figure 2.41) of the supercharger, nozzles 10, glow plugs 9, fuel supply fitting 4 (channel D) and air supply fitting 2 from the air system (channel B).

In the air supply fitting 2 and in the fuel supply fitting 4, mesh filters 3 are installed for additional purification of the supplied fuel and air.

A piston-nozzle 7 is installed in the air supply fitting 2, which reduces the pressure of the supplied air and the rod 6 moves the piston 5. Fuel with air through the fuel channels enters the combustion chamber 8 through the heater nozzles 10, where it is ignited by glow plugs.

DKMV ensures the operation of the engine starting program with PVV, as well as displaying information on the execution of the next actions when starting the engine. DKMV ensures accounting of the number of authorized launches from the air explosive (number of authorized launches - 20), and when they are exhausted - the number of emergency launches used (number of emergency launches - 10). DCMV is located to the left of the driver.

2.1.12.1 Operation of the PVV system

When starting the engine using the PVV, perform the following steps:

– turn on the BCN;

– turn on the “COMBO” switch;

– open air cylinders;

– On DKMV in dialogue mode, select START WITH PVV. Confirm that the “COMBINED” switch is turned on – the APU will display the message “CONFIRM STARTING WITH PVV KN. CHOICE";

– press and release the SELECT button - the driver’s APU will display the engine oil pressure scale and the engine start cycle timer with PPV. After 1 minute, the engine MZ will turn on. In 2 min on the driver’s APU the message “PRESS THE STARTER BUTTON” will be displayed, and the value of the oil pressure for engine lubrication must be at least 2 $кгс/см^2$;

– press the STARTER button - the inscription “PRESS THE STARTER BUTTON” should go out on the driver’s APU, and the electric air valve EK-48 and the electromagnet EM-74M for pumping oil from the gearbox will turn on, and the engine crankshaft will begin to rotate. The air, coming from the air cylinders through the reducers RT-160-70, RT-160-25 and the electric air valve EK-48, enters the heater of the PVV system and, acting on the piston-nozzle 7 (Figure 2.41), pushes the piston 5 through the rod 6 and enters through channels for mixing with fuel. In this case, the fuel, mixing with air, enters the nozzles 10. After 4^{+1}pressing the STARTER button, the message “START THE ENGINE WITH THE FUEL PEDAL” should appear. Only then start the engine by pressing the fuel pedal.

After completing the program for starting the engine with PVV, it is necessary to turn off the MCP and turn off the “COMBO” switch.

2.2 Transmission installation

The mechanical transmission unit with hydraulic control consists of an input gearbox and two gearboxes, structurally combined with final drives.

The transmission unit is designed:

– to transmit torque from the engine crankshaft to the drive wheels;

– to change the speed of the tank and the traction forces on the drive wheels in a wider range than can be done by changing the engine crankshaft speed;

– for starting, making turns, braking, providing reverse gear and keeping the tank in a braked state on ascents and descents;

– to disconnect the engine from the drive wheels when idling and during start-up, as well as when changing gears.

The transmission unit provides seven gears for forward movement and one gear for reverse movement, turning the tank in each gear and braking. Additionally, the transmission unit provides a kinematic connection between the starter-generator armature and the engine crankshaft and transmits torque to the air compressor and to the engine cooling system fan.

2.2.1 Operation of the transmission unit

The torque developed by the engine is transmitted to the input gearbox, where it is reduced, and then to the gearboxes. To transmit torque from the input gearbox to the drive wheels, it is necessary to include two brake clutches or a brake and locking clutch or two locking clutches in both gearboxes. Engaging the brake clutch stops one of the elements of the planetary gear, while engaging the locking clutch locks the epicycle and the sun gear into one unit. In this case, the torque is transmitted through the planetary gears - to the driven shafts and then through the BR - to the drive wheels of the tank.

Depending on the gear engaged (various combinations of operation of the planetary gears), the torque required for movement on the drive wheels and the traction force of the caterpillar drive are provided.

Additionally, when transmitting torque to the gearboxes, rotation is transmitted to the hydraulic coupling of the fan drive, to the air compressor drive, to the starter-generator drive and to the oil pump for pumping oil out of the input gearbox housing. The listed components are located in the input gear housing and form a single unit with it.

The operation of the transmission unit is controlled using control drives and a hydraulic system.

2.2.2 Input reducer

The input gearbox is a gear overdrive designed to transmit torque from the engine to the gearboxes - left and right, to the cooling system fan, to the air compressor and to the starter-generator (in generator mode). It is located along the right side of the tank and is installed on two yokes of bracket 9 (Figure 3.1) and two brackets 6. In the yokes, the input gearbox is secured with marks 11; Legs 5 of the input gearbox are bolted to brackets 6. The bolts are an assembly unit consisting of a bolt 20, a stud 21, a washer 19 and a nut 18.

The input gearbox consists of a housing 8, gears 1, 4, 7, 10. In addition, a drive to the compressor 9 (Figure 3.2), a drive to the starter-generator, a drive to the fan, and a pump 10 with a drive to it are mounted on the input gearbox. The input gearbox is lubricated under pressure from the hydraulic system of the transmission unit. Oil is supplied through fitting 5 through channels in the top cover 6 and crankcase 8 (Figure 3.1) into channels B and C for lubrication of the drive gear bearings and through pipeline 3 (Figure 3.2) to the sprayer for lubrication of other gears and bearings of the input gearbox. Oil from the crankcase cavity 8 (Figure 3.1) is pumped out by pump 10 (Figure 3.2).

To transmit torque from the engine to the input gearbox, shaft 3 is used (Figure 3.1), which with one gear enters the splines of drive gear 1, the other into gear coupling 15, connected by bolts 12 to coupling 14, fixed to the toe of the crankshaft 13 of the engine. The bolts are secured with wire. To unload the bolts 12, two crackers 16 are installed in the slots of the couplings 14 and 15, protected from falling out by brackets 17.

To limit the axial movement of shaft 3 and soften impacts, two rubber buffers 2 are used.

The transmission of rotation from the input gearbox to the right gearbox is carried out through shaft 9 (Figure 3.3), which is connected to the driven gear 13 of the input gearbox and the drive gear 10 of the right gearbox; to the left gearbox - through two gear couplings 3 and shaft 5. The axial movement of gear couplings 3 and shafts 5 and 9 is limited by half rings 2 and rubber buffers 12, 14, 16. The half rings are locked by spring rings 1. The casing 4 is sealed with rubber rings 6 and 15, The seal of the input gearbox and the right gearbox in the liners 8 of the yoke 7 is carried out with rubber rings 11.

On the input gearbox housing there is an expansion tank 2 (Figure 3.2), designed for condensation of oil vapors coming from the cavity of the input gearbox through the holes. Expansion tank 2 is connected through fitting 1 to the breather of the hydraulic system of the transmission unit.

2.2.2.1 Air compressor drive

The compressor drive is designed to transmit rotation from the engine crankshaft to compressor 5 (Figure 3.4). The drive is located on the drive unit of the input gearbox, the compressor 5 is attached to the gearbox housing 3 with studs 7 and nuts 6. To improve the cooling of the compressor, a casing 7 is installed (Figure 3.2), creating a directed air flow.

The drive consists of an elastic coupling and a step-up gearbox. Drive clutch 10 (Figure 3.4), connected by bolts 12 to the drive gear of the input gearbox, transmits rotation through spring-loaded liners 11 to driven clutch 2 and then through a splined connection to the drive gear 4 gearboxes. driven gear 9 of the gearbox has splines with which the shank 8 of the compressor engages.

The compressor is lubricated through channels A and B of the crankcase under pressure from the common lubrication system. Filter 1 is installed to clean the oil.

Oil is drained from crankcase 3 of the compressor drive through pipeline 8 (Figure 3.2) into the crankcase of the input gearbox.

2.2.2.2 Cooling fan drive

The fan drive is designed to transmit rotation from the engine to fan 18 (Figure 3.5) of the cooling system.

The drive consists of the following components:

– a step-up gearbox with a fluid coupling, mounted in the input gearbox housing 27;

– bevel gear 25;

– fan support 7 with a pyromechanism for emergency stopping of the fan in the event of a fire in the mechanical equipment installed on the tank hull;

– two cardan shafts 29.5.

The fluid coupling is designed to smoothly turn the fan on and off, as well as to reduce dynamic loads in the drive when the engine speed changes sharply.

The fluid coupling consists of a pump 3 (Figure 3.6) and a turbine 9 wheels. The pump wheel is connected to the crankshaft of the tank engine using gears 1, 2, 4, and the turbine wheel is connected to the output shaft 8 of the input gearbox.

The drive is lubricated from the hydraulic system of the transmission unit. Oil is supplied through pipeline 3 (Figure 3.2) to the sprinkler.

The bevel gearbox 25 (Figure 3.5) is designed to transmit rotation from the input gearbox 27 to the fan 18 at an angle of 90°. The bevel gearbox is secured with marks 1 on bracket 22. The gearbox is lubricated under pressure through pipeline 23 and filter housing 24. A filter is installed in filter housing 24. The oil from the bevel gear housing is drained into housing 4 (Figure 3.3) of the shaft connecting the input gearbox to the left gearbox.

Cardan shafts 5 (Figure 3.5), 29 are designed to transmit rotation from the input gearbox 27 to the bevel gearbox 25 and from the bevel gearbox 25 to the fan hub 9.

The fan support consists of a support 7, fixed with bolts 11 on the rear plate of the tank body, a fan hub 9, on which the fan 18 is mounted, a cylinder 4 (Figure 3.8), connected to the pressure plate by 2 pins with springs 8, and a squib 6 with a contact device 5.

When the engine is running, the torque from the engine is transmitted through gears 1 (Figure 3.6), 2, 4 of the input gearbox to the pump wheel 3 of the fluid coupling. Torque from the pump wheel is transmitted to the turbine wheel 9 of the fluid coupling under the influence of the kinetic energy of the oil flow. The fluid coupling cavity is filled and fed with oil from the hydraulic system of the transmission unit through channel A.

From the turbine wheel 9 through the driveshaft 29 (Figure 3.5), torque is transmitted to the gears of the bevel gear 25, and from them through the driveshaft 5 to the hub 9 of the fan 18.

If a fire occurs in the MTO and an emergency stop of the engine, the fluid coupling cavities are emptied and the fan loses its kinematic connection with the engine, continuing to rotate by inertia. If a fire occurs in the MTO, the signal from the PPO system is received through contact device 5 (Figure 3.8) to the squib 6. The squib is triggered, and the pressure of the powder gases enters cavity A , affecting cylinder 4, connected by pins to pressure plate 2. Cylinder 4, moving under the influence of the pressure of the powder gases, it pushes pressure plate 2 through the studs, pressing it against the friction surface of disk 1. Pressure disk 2, pressing against the friction surface of disk 1, creates a braking friction torque, under the influence of which the fan stops.

After the fan stops, the powder gases leave cavity A , and the pressure plate with the cylinder under the action of springs 9 returns to its original position. The fan drive becomes ready for operation again.

Bearings 10 and 11 are replenished with lubricant through a channel closed with plug 7.

2.2.2.3 Starter-generator drive

The starter-generator drive is designed to transmit rotation from the starter-generator to the engine, when operating in starter mode, and to transmit rotation from the engine to the starter-generator, when operating in generator mode.

The drive is located on the input gearbox and is mounted in two housings 16 (Figure 3.9) and 19. It consists of a drive gear 10 mounted on the splines of the drive shaft 12; an elastic coupling 13, the driving parts of which are connected by splines to the drive shaft 12, and the driven parts are connected by splines to the pump wheels of the fluid coupling 15; driven shaft 14, on the splines of which the turbine wheels of the fluid coupling and the sun gear 20 of the planetary gear sit; booster 8 and torsion bar 3. The movement of the torsion bar is limited by rubber buffers 2.

2.2.2.3.1 Drive operation in starter mode

When you press the STARTER button, the MZN for starting the engine from the tug is turned on. The MZN takes oil from the tank and through the distributor valve 9 supplies it through the channels to the booster 8. Under the influence of oil pressure, the booster 8 moves, compresses the return spring 5 and moves the gear coupling 6 through the bearing 7. The gear coupling 6 moves along the screw splines of the drive shaft 12 and engages with the teeth of the 4th planetary gear carrier.

To prevent the gear coupling 6 from sticking into the teeth of the planetary gear carrier 4, simultaneously with pressing the STARTER button, a reduced voltage is supplied to the SG. The SG shaft begins to rotate and through the torsion bar 3 and gears 21 begins to rotate the driven shaft 14 with the sun gear 20 and the 4 planetary gear drive through the satellites.

Under oil pressure, the gear coupling 6 continues to move, and at the end of the stroke, the copier 24 pushes out the ball 23, which acts on the buttons of the D-20 sensors, pos. 22. When the buttons are pressed, the tug start MZ is disabled. Further, after a number of conditions are met, a voltage of 48 V is applied to the SG , at which the starter develops full power. Since the planetary gear carrier 4 and the gear clutch 6 are engaged , the drive shaft 12 and the drive gear 10 begin to rotate, and through the main row of gears of the input gearbox, the rotation is transmitted to the engine crankshaft. As soon as the engine starts, the gear coupling 6 begins to rotate at a higher speed than the planetary gear carrier 4 and becomes the driver. As a result, an axial force arises in the engagement of the screw splines, screwing the gear coupling 6 along the screw splines of the drive shaft 12 to its original position, separating the starter-generator shaft and the engine crankshaft. Booster 8, under the action of gear coupling 6 and return spring 5, also returns to its original position. Oil from the booster cavity flows through a special hole and through the bypass valve of the distributor valve into housing 19 and from there through channel B into the housing 11 of the input gearbox. The drive is prepared for operation in generator mode

2.2.2.3.2 Generator mode operation

When the engine is running, the injection pump creates pressure in the hydraulic system of the transmission unit, and oil enters the cover 18 of the fluid coupling housing, and then through the adapter tube 17 into the cavity of the driven shaft 14 to fill the fluid coupling 15 and lubricate the drive.

After filling the fluid coupling, rotation through the drive gear 10, elastic coupling 13, fluid coupling, driven shaft 14, gears 21 and torsion bar 3 is transmitted to the shaft of the starter-generator 1.

2.2.3 Gearboxes

Gearboxes (Gearboxes) - mechanical planetary with hydraulic control are designed to change the speed of movement and traction forces on the drive wheels, braking, disconnecting the engine from the drive wheels and turning the tank.

The gearboxes are installed in crankcases 23 (Figure 3.10), welded into the rear part of the tank hull on the left and right sides, and attached to the flanges of these crankcases with bolts 18. A gasket 19 is installed between the crankcase and the rear flange of the gearbox. An O-ring is installed between the crankcase and the front flange of the gearbox 24. The drive shafts 28 of the gearbox are connected to the driven gear of the input gearbox; the right gearbox shaft - gear 10 (Figure 3.3) and shaft 9, and the left gearbox shaft - gear couplings 3, shaft 5 and gear 17.

The CP includes:

– four planetary gears - I, II, III, IV;

– six planetary gear control elements - friction clutches $\Phi_1, \Phi_2, \Phi_3, \Phi_4, \Phi_5$ и Φ_6;

– device for mechanically engaging clutches Φ_4 и Φ_5;

– drive to oil pumps.

All gearbox operating modes are ensured by turning on and off certain combinations of clutches using control drives. The combination of engaged clutches and planetary gears involved in power transmission in this mode is shown in Table 1.

Table 1

CP operating mode	Engaged clutch	Planetary gear involved in power transmission
Neutral	Φ_4	-
1	Φ_4, Φ_3	III, IV
2	Φ_6, Φ_4	II, IV

CP operating mode	Engaged clutch	Planetary gear involved in power transmission
3	Φ_6, Φ_3	II , III , IV
4	Φ_1, Φ_4	I , II , IV
5	Φ_1, Φ_3	I , II , III , IV
6	Φ_2, Φ_4	IV
7	Φ_2, Φ_3	Direct transmission, rows blocked
Reverse	Φ_5, Φ_3	III, IV
Braking	Φ_5, Φ_4	IV

Friction clutches Φ_1, Φ_4, Φ_5 и $\Phi_6$provide braking of the planetary gear elements, and clutches Φ_2 и $\Phi_3$provide their blocking.

Each clutch consists of a package of steel and metal-ceramic friction discs, a booster sealed with rubber cuffs, and a spring release device. The clutch is activated by oil supplied under pressure into the booster cavity from mechanism 1 (Figure 3.10) for distributing the hydraulic control system through channels A in the body parts. When the clutches are turned on, Φ_2, Φ_3oil from the housing parts is supplied to the rotating boosters through mechanical seals 12 and 32. The clutches are turned off by removing the oil pressure in the booster cavity. After the oil pressure is removed, the booster is returned to its original position by a spring squeezing device. To ensure clear shutdown of the rotating clutch boosters, Φ_2, Φ_3devices are designed consisting of unloading rings 8 and balls 14 that balance the centrifugal pressure of the oil in the booster. When the clutches are turned off, guaranteed gaps between the friction disks are ensured.

Along with hydraulic control Φ_5 и Φ_4, the clutches that provide tank braking are activated from the stopping brake pedal and the braking device through a mechanical drive and a ball activation mechanism, consisting of engagement rings 3 and 5 and balls 4 and 6. To ensure force closure in the ball mechanism with a hydraulic turning on the clutchesΦ_5 и Φ_4 serves as a tracking device consisting of springs 37, stops 36 and 38, acting on pins 39 pressed into the inclusion rings 5.

Composition of gearbox planetary gears:

– Row I - sun gear 27, three satellites 29;

– Row II - sun gear 30, three satellites 33, epicycle 35;

– III - sun gear 31, integral with the drive shaft 28, three satellites 2, epicycle 17;

– Row IV - sun gear 13, four satellites 15, epicycle 16, carrier 9.

In the first planetary gear, the function of the epicycle is performed by the sun gear of the second row. Rows I, II and III have a common carrier 34. The satellites 33 of the II planetary gear have wide teeth and are meshed with the sun gear 30, the epicycle 35, as well as the satellites 29 of the I planetary gear.

Structurally, all gearbox parts are combined into assembly units:

– front flange 26 with clutch Φ_1 and drive - to the pumps;

– sun gear 27 I planetary gear - with clutch F_2 ;

– drum 21 - with clutches F_5 and F_6 , and a ball mechanism for engaging the clutch F_5 (the drum has a platform for installing a distribution mechanism);

– rear flange 7 - with clutches F_3 and F_4 , IV planetary gear, driven shaft 10, ball mechanism for engaging clutch F_4 ;

– drove 34 I, II , III planetary gears - with a drive shaft 28, sun gear 30, satellites 2, 29 and 33, epicycles 16, 17 and 35.

The front flange 26, drum 21 and rear flange 7 are fastened together with bolts 20 and 22 and form the gearbox housing.

To lubricate and cool the parts of the gearbox and final drive, oil under pressure is supplied from the hydraulic system of the transmission unit to channel B of the rear flange 7, in which it is divided into two streams:

– the first flow through the horizontal hole in the rear flange, drum 21 and front flange 26 is supplied to lubricate the friction discs of the F_1 , F_6 and $F_{5\ clutches}$;

– the second flow through the radial channel in the rear flange enters the internal cavities of the driven 10 and driving 28 shafts and then through the holes in the shafts to the bearings, gears, friction disks, and to lubricate the final drive parts.

The place where the oil is supplied to the driven shaft 10 is sealed with rings 11. After lubricating and cooling the parts, the oil flows into the cavity of the gearbox crankcase 23 and is pumped through channel B by pump 25 into the hydraulic system tank of the transmission unit through the filter.

The left and right gearboxes are structurally identical, with the difference that a pressure oil pump is installed on the front flange of the left gearbox along with the scavenge pump; The gears installed on the drive shaft of the left gearbox are slightly longer than those on the right.

2.2.4 Final drive

The final drive (hereinafter referred to as BR) is designed to transmit torque from the gearbox driven shaft to the drive wheel of the caterpillar propulsion unit. The BR is a single-stage planetary gearbox that reduces the rotation

speed and increases the torque. The BR is connected to the gearbox with screws, forming an assembly unit installed on the tank.

The BR consists of the following main parts:
– cover 1 (Figure 3.11), in which the epicycle teeth are made;
– four satellites 2;
– carrier 8, the splined shank of which is designed to install the drive wheel.
The BR sun gear is integral with the gearbox driven shaft.

The BR gears and roller bearings of the satellites are lubricated and cooled by oil coming from the hydraulic system of the transmission unit through the driven shaft of the gearbox. After cooling and lubrication, the oil flows through the holes in the rear flange of the gearbox into the gearbox housing and is pumped out by a pump into the tank through a filter.

Bearings 4, 5 BR are lubricated with grease, which is filled into the carrier cavity and supplied to the bearings through channel A.

The cavity of the bearings 4, 5 is sealed with cuffs 3 and 6, an o-ring 10, an oil seal 7 and a cover 9 pressed into the carrier. The listed seals prevent mutual flow and mixing of oil and grease, the ejection of lubricant outward, and the entry of dust and dirt into the ballast.

2.2.5 Transmission unit hydraulic system

The hydraulic system of the transmission unit is designed for:
– storage of transportable oil reserves;
– oil purification;
– supplying oil under pressure to the hydraulic control of gearboxes and to lubricate all transmission units;
– cooling of transmission parts;
– pumping out oil from gearbox housings and input gearboxes during operation and before long-term parking of the tank;
– replenishing the hydraulic coupling of the starter-generator drive with oil under pressure;
– ensuring engine starting with an electric starter and from a tug.

The hydraulic system consists of the following main components:
– distribution mechanisms 19 (Figure 3.12) and 44;
– oil tank 6 and radiator 1;
– valve device 2 with spools 3, 4, 48 and electromagnet 31;
– oil filter 32 of the pumping line with bypass valves 37 and 47;
– injection pump 38;
– pumps, gearbox pos. 22 and 39;
– pump 14 VR;
– hydrocyclone filter 45;
– oil pump MZN-2 pos. 8 transmissions;
– valve-distributor 9 with electromagnet 26
– spool box 34 with electromagnet 33;
– pressure indicator receiver 17 for measuring the lubricant pressure of the transmission unit;
– connecting pipelines.

All hydraulic system components are located in the MTO. The oil pressure in the hydraulic control line is not controlled during operation. If it is necessary to check and adjust the hydraulic control pressure, hoses from the device for measuring pressure are connected to the right and left distribution mechanisms; for this purpose, the distribution mechanisms have threaded holes that are plugged during operation.

2.2.5.1 Operation of the hydraulic system of the transmission unit

2.2.5.1.1 Operation of the hydraulic system to lubricate units

When the engine is running, oil from the oil tank 6 (Figure 3.12) is supplied by the injection pump 38 to the hydrocyclone filter 45. The oil purified in the hydrocyclone is supplied through pipelines to the left 44 and right 19 distribution mechanisms, as well as into the cavity G (Figure 3.14) of the valve device. Spool 3, under oil pressure, moves in the axial direction, compresses the springs and opens the passage of oil into cavity E. The opening pressure of this spool, and, consequently, the pressure it maintains at the entrance to the distribution mechanisms, is determined by the force of its springs and is adjusted by screw 4 in the range from 17 to 18.5 $кгс/см^2$. Under the same pressure, oil flows through the jet to feed the fluid coupling 16 (Figure 3.12) of the starter-generator drive.

From cavity E (Figure 3.14), oil flows through hole D to lubricate all transmission units. The lubrication spool 6 maintains a pressure in cavity E of 2 to 2.5 $кгс/см^2$. When the pressure is more than 2.5, $кгс/см^2$the lubrication valve 6 is lowered, compressing the spring, and part of the oil is drained from cavity E into the tank.

The pressure in the lubrication system is regulated by screw 7.

After lubricating the transmission units, the oil accumulates in the lower part of the gearbox housings and the input gearbox, from where it is supplied by pumps 14 (Figure 3.12), 22 and 39 to the oil filter 32 of the pump-out line. The oil purified in the filter passes through the radiator, cools and drains into the tank.

Bypass valves 37 and 47 protect the pumping line pipelines from destruction in case of filter contamination or when cold oil is pumped through the filter and radiator. In this case, the pressure in the pumping line increases, and the valves, opening, allow oil to flow directly into the tank, bypassing the filter and radiator.

The operation of the hydraulic system of the transmission unit (in terms of monitoring the pressure on the gearbox lubricant) during operation is controlled by the DKMV. If necessary, you can display a scale on the driver's APU with information about the pressure on the gearbox lubricant. The pressure must correspond to that specified in the subsection "Monitoring the operation of power and transmission units" 188M.R E1 . If information is given out, STOP. LOW TRANSMISSION OIL PRESSURE in the AVSKU and on the driver's APU, follow the subsection "Possible malfunctions of the transmission unit and methods for eliminating them."

Adjust the pressure on the lubricant using screw 7 (Figure 3.14) of the valve device.

2.2.5.1.2 Operation of the hydraulic system when starting the engine with a starter - generator

To start the engine with a starter-generator, the START FROM TOWSHIP switch on the driver's panel must be set to the OFF position.

When starting the engine with the starter-generator, after pressing the STARTER button, the electric oil pump pos. 8 (Figure 3.12) oil is supplied from tank 6, through valve-distributor 9, into the starter-generator drive booster, ensuring its activation. After starting the engine, the booster returns to its original position, squeezing oil out of the booster cavity through the nozzle. The oil is drained into the input gearbox housing.

2.2.5.1.3 Operation of the hydraulic system when starting the engine from a tug

To start the engine from a tug, you need to turn on the required gear on the selector and set the START FROM TUG switch to the ON position , while in the distributor valve, electromagnet 4 (Figure 3.15) moves spool 2 to its extreme position.

While towing the tank, the driver presses the MZN START FROM TUG button on the driver's panel. In this case, the electric oil pump pos. 8 (Figure 3.12), and oil from tank 6 comes under pressure through distributor valve 9 to the left 44 and right 19 distribution mechanisms, and through them to the gearbox boosters corresponding to the engaged gear. Boosters ensure that the gearbox clutches are engaged, and torque is transmitted from the drive wheels through the final drives, gearbox and input gearbox to the engine, ensuring cranking of the crankshaft and starting the engine.

After starting the engine, it is necessary to turn off the electric oil pump by releasing the TOW START button MZN, and set the TOW START switch to the OFF position .

2.2.5.1.4 Operation of the hydraulic system when pumping oil from transmission units

Oil circulation in the hydraulic system stops when the engine stops. At the same time, about 20 liters of oil remain in the gearbox and gearbox crankcases. During subsequent engine starts, this oil provides additional resistance to turning the crankshaft. It especially increases in winter. To make engine starting easier and reduce the load on the starter, oil from the gearbox and gearbox crankcases is pumped into the transmission oil tank before long-term parking in winter conditions. When the OIL PUMPING FROM Gearbox switch is turned on, electromagnet 5 (Figure 3.14) of the valve device is activated. The electromagnet moves spool 1, which connects cavity D of the valve body to the tank. When the engine is running, the oil supplied by the injection pump is drained directly into the tank, bypassing the lubrication line. The KP and BP bilge pumps pump out the remaining oil in the crankcases through the bleed-out line filter and the radiator into the tank.

2.2.5.2 Distribution Mechanisms

Distribution mechanisms are the hydraulic part of the control drives and are designed to change the oil pressure and direct its flow to the corresponding gearbox clutch boosters depending on the specified positions of the gear shift drive, rotation drives and clutch drive.

The tank has two distribution mechanisms - left and right. Each of them is installed on the corresponding gearbox and attached to it with four 25 bolts (Figure 3.13).

The left and right distribution mechanisms are similar in design and principle of operation. The right distribution mechanism differs from the left one in the presence of gear shift lever 5.

The distribution mechanism consists of the following main components and parts:

– crankcase 7 with covers 6 and bushings 41 and 35;
– 8th turn bushings;
– plugs 9;
– fist 17 gears with gear 18 and dial 19;
– fist 2 turns with lever 15;

– carrier 3 on axle 4;
– a shaft 14 with a toothed sector 16, a fork lever 11, a pressure increase lever 10 and a clutch sleeve 13;
– pressure regulator spool 34 with spring 33;
– adjusting sleeve 28 with plate 31 and return springs 29, 30;
– locking spool 38 with spring 37;
– spools 39 and 40 for increasing pressure.

The distribution mechanism housing 7 is a cast iron casting, the mating surface of which is used for installation on the gearbox drum 24. The gap between the distribution mechanism housing and the gearbox housing welded into the tank body, pos. 23 is sealed with ring 22. Six channels extend onto the mating surface of the crankcase $А_1$oil supply to the gearbox clutch boosters.

There are threaded holes on the front wall of the crankcase $Д_1$and $И_1$(Figure 3.13 sheet 2). Through the hole $Д_1$Oil is supplied to the distribution mechanism from the hydraulic system of the transmission unit, and $И_1$a hose from the pressure gauge of the device for measuring pressure in the hydraulic control system is connected to the hole.

There are holes on the rear wall of the crankcase $Б_1$and $В_1$for connecting pipelines connecting the left and right distribution mechanisms.

The side surfaces of the crankcase are covered with aluminum covers 6 (Figure 3.13 sheet 1). The covers have holes for installing shaft supports 14, knuckle supports 2 and 17. The crankcase has a bore in which a sleeve 8 with plug 9 is located. In the body of the crankcase and on its mating surface there are channels for supplying oil to the gearbox clutch boosters and spools.

In the upper cavity of the crankcase, a shaft 14 is mounted on bearings, with which a gear sector 16 is rigidly connected. A fork lever 11 and a lever are mounted on the shaft on needle bearings 10 increase in pressure.

A lever 5 is rigidly fixed to the shaft shank of the right distribution mechanism, connected through a system of rods and levers to the gear selector lever.

The shafts 14 of the left and right distribution mechanisms are rigidly connected to each other by an adapter shaft.

Plug 9 serves as a distribution valve, providing oil supply to the corresponding gearbox clutch boosters and draining oil from the remaining boosters, depending on the position of the gear selector lever.

The cork inside is hollow. The internal cavity of the plug is connected to the outer surface by through holes I (Figure 3.13 sheet 1), through which oil is supplied into it, and through grooves Ш , which ensure the flow of oil through the corresponding holes in the rotation sleeve 8 to the clutch booster channels.

On the outer surface of the plug there are blind grooves L that extend to the ends of the plug. Oil from the boosters of the switched off clutches is drained through these grooves.

At the end of the plug there is a groove U (Figure 3.13, sheet 1), which serves to drive the plug from the gear knuckle. The gear knuckle 17, with its protrusion E, engages with the groove U of the plug 9 and, with the help of the gear 18 attached to it and the gear sector 16, rotates the plug when changing gears. A dial 19 is installed on the shank of the fist 17 , on which there are marks corresponding to the gears being engaged. Two recesses of the fist serve to enter the locking spool 38 when engaging 1st gear and reverse gear.

The rotation sleeve 8 is designed to engage a lower gear in the gearbox when the corresponding control lever is moved to the final position.

On the outer surface of the bushing there are:
– through channel $Г_1$(Figure 3.13 sheet 2) supplying oil to plug 9;
– blind groove $Ж_1$, through which the holes $В_1$in the crankcase are connected to the drain or to the hydraulic control pressure line, depending on the position of the control levers;
– grooves $К_1$, supplying oil from plug 9 to the gearbox clutch booster channels;
– ring groove $Е_1$with three through holes for draining oil from the clutch booster $Ф_3$when the control lever is moved to the extreme position when the selector lever is set to the neutral position.

When the sleeve 8 is turned, the channels of the boosters engaged in a given gear communicate with the drain, and oil is supplied to the boosters of the clutches that include a gear lowered by one step.

At the end of the rotation sleeve there is a tenon M, which fits into the groove of the carrier 3, and the tenon of the carrier fits into the groove H (Figure sheet 1) of the fist 2.

Pressure regulator spool 34 provides a change in pressure at the inlet to the clutch boosters depending on the position of the controls.

The spool 34 is located in the sleeve 35, which has three cavities separated by partitions.

Oil from the system is supplied under pressure $17^{+1,5}$ $кгс/см^2$into the lower cavity $М_1$(Figure 3.13 sheet 1) of bushing 35 . The middle cavity C is connected to the cavity of plug 9, and the upper cavity F is connected to the crankcase through the drain hole.

Spool 34 is cylindrical in shape with a collar in the upper part and an annular groove in the middle. In the upper part of the spool there is a blind hole in which the spring 33 is located, and in the lower part there is a hole drilled that communicates with the annular groove through a transverse hole.

The upper end of the spring 33 rests against the screw 36, rigidly connected to the plate 31. The shank of the plate fits into the hole of the adjusting sleeve 28. Return springs 29 and 30 are installed between the plate and the adjusting sleeve. The installation force of the return springs is greater than the force of the spring 33 of the spool 34. Therefore plate 31 is pressed downwards until it stops (until the nut stops at the end of sleeve 28).

Under the lower end of the plate there are crackers 32 of the fork lever 11.

When the fork lever is turned, the crackers lift the plate, compressing the springs 29 and 30. In this case, the spring 33 is expanded, and the force with which it acts on the spool 34 smoothly decreases to zero.

In the absence of pressure in the cavity $М_1$(Figure 3.13, sheet 1) of the sleeve 35, the spool 34, under the action of the spring 33, occupies the lowest position (until the spool shoulder stops at the end of the sleeve (Figure 3.13, sheet 2). In this case, the middle center (Figure 3.13, sheet 1) and the bottom $М_1$the sleeve cavities are interconnected and isolated from the upper (drain) cavity F.

When pressure is applied to the cavity, $М_1$oil enters the cavity of the center and clutch boosters, as well as through the holes in the spool 34 into the cavity under the spool. In this case, a force arises, under the influence of which the spool rises, compressing the spring 33. The flow area of the gap connecting the lower and middle cavities of the bushing decreases, the pressure in the middle cavity of the bushing decreases and, consequently, a pressure is established in the clutch boosters, determined by the spring force 33 (Figure 3.13 sheet 1). This force can be changed by screwing in the bushing 28 in the crankcase. The position of the bushing is selected during adjustment so that in the middle cavity C bushings 35 and in the gearbox boosters, pressure was provided from 10 to 11.5 $кгс/см^2$at the initial position of the control levers and clutch pedal. In this case, the selector lever should be in neutral position or 2nd - 7th gears.

Fork lever 11 is mounted on needle bearings on shaft 14. Bearing 1 fixed to the lever is located in the fist hole 2 turns at the beginning of its shaped profile P (Figure 3.13 sheet 1), and the crackers 32 attached to the fork are slightly below the plate 31. At the end of the fork lever there is a protrusion P (Figure 3.13 sheet 1), which engages with the protrusion C of the clutch bushing. When the fork lever is turned, the nuts 32 lift the plate 31, compressing the springs 29 and 30, while the spring 33 expands and the spool 34 rises, blocking the oil exit from the cavity $М_1$(Figure 3.13 sheet 1) of the sleeve 35 and connecting the middle cavity C with the drain cavity F (Figure 3.13 sheet 1). The oil displaced from the gearbox clutch boosters by the springs of the squeezing devices is drained through the channels in the crankcase, the grooves of the rotation sleeve and plug, the cavities of the C and F sleeve 35 into the crankcase.

The pressure increasing lever 10 is mounted on needle bearings on a shaft 14. A rod 20 and a spring 21 are installed in the lever.

The lever is designed to increase pressure in the gearbox clutch boosters in 1st gear and reverse gear, as well as on the side of the running caterpillar when turning the tank.

In the initial position, the lever 10 is pressed by the spring 26 until it stops against the pressure increase spool 40. When oil is supplied to the cavity under one of the pressure increase spools, the spool 40 rises, turning the lever 10, pressing it against the adjusting screw 42, while the rod 20 rests against the stop T (Figure 3.13 sheet 1) of the fork lever, the nuts 32 rest against the collar of the spool 34 , and the spring force is added to the spring force 33 21.

The pressure in the cavity C (Figure 3.13 sheet 1) of the bushing 35 and in the gearbox clutch boosters increases to a value from 16 to 18 $кгс/см^2$, depending on the angle of rotation of the lever 10 and is regulated by screw 42. When the screw is screwed in, the stroke of the lever decreases and the pressure decreases accordingly. When the screw is removed, the pressure increases.

Pressure to spool 39 when engaging 1st gear and reverse gear is supplied through locking spool 38.

When the tank is rotated, pressure is supplied to spool 40 through the hole $Б_1$from the groove $Ж_1$(Figure 3.13 sheet 2) on the bushing of the distribution mechanism on the side of the lagging track. For this purpose, the holes $Б_1$Both $В_1$the left and right distribution mechanisms are connected to each other by pipelines.

Knuckle 2 is designed to rotate bushing 8 and fork lever 11 when squeezing the control levers. The steering knuckle is mounted on bearings in the cover 6.

On the shank of the steering knuckle, a lever 15 is mounted on splines, connected by a drive to the control lever.

The shaped profile P (Figure 3.13 sheet 1) of the fist ensures that when the fist is turned, first a rapid rise of the fork lever, and then its smooth lowering to its original position.

This ensures a quick release of pressure in the boosters at the beginning of squeezing the control lever, and then a smooth increase in pressure to the initial value.

The profile of the shaped groove H of the fist is chosen such that at a small angle of rotation of the fist, the carrier 3 and the associated bushing 8 rotate at the angle required to engage a lower gear. With further rotation of the fist, the carrier spike slides along the groove H of the fist, which in this section is made along a circular arc.

Locking spool 38 opens the clutch booster filling channel $Ф_5$only in 1st gear and reverse gear.

The spool 38 is installed in the crankcase hole and is pressed against the cam 17 by a spring 37. In 1st gear and reverse gear, the spool head is aligned with one of the two recesses on the cam 17 (Figure 3.13 sheet 1), and the spool moves towards the cam, opening the oil supply channel to the clutch booster $Ф_5$. When the remaining gears and neutral are engaged, the oil supply channel to the clutch booster $Ф_5$is closed, and the drain from the booster is open through an additional channel in the crankcase.

In this position of spool 38, the oil supply channel under spool 39 simultaneously opens and increases the pressure in the boosters in 1st gear and reverse gear.

In other gears, the cavity under spool 39 is connected to the drain.

Clutch bushing 13 is installed on the shaft. When the clutch pedal is depressed, the clutch bushings of the left and right distribution mechanisms simultaneously rotate and the protrusions C (Figure 3.13 sheet 1) turn the fork levers 11 (Figure 3.13 sheet 1), and the pressure in the clutch boosters is reduced to zero.

2.2.5.3 Oil tank

The oil tank is designed to accommodate the amount of oil required for the operation of the hydraulic system. It also ensures foam suppression, oil settling during operation and oil heating before starting the engine in winter. The tank holds 42 liters of oil out of approximately 57 liters of filling capacity for the entire system.

The tank is welded from stamped steel sheets. On the top surface of the tank there are welded a filler neck pipe and a barrel with a hole for connecting pipeline 27 (Figure 3.12 of the drainage system.

Inside the tank there is a coil through which fluid circulates from the engine cooling and heating system, and an intake strainer 7 through which oil is drawn in by a pressure or oil pump.

A drain ball valve is installed at the bottom of the tank.

A valve device and a filter for the pumping line are attached to the outside of the tank.

2.2.5.4 Pressure pump

The injection pump is designed to supply oil under pressure into the hydraulic system of the transmission unit. The gear pump is installed on the front flange of the left gearbox. The pump is driven from the input shaft of the left gearbox through a gear system. The pump has a ball relief valve. The discharge channel of the injection pump is connected to a hydrocyclone through a channel in the front flange of the gearbox.

2.2.5.5 Hydrocyclone

The hydrocyclone is designed to clean oil from mechanical impurities. From the hydrocyclone, oil flows through a tee to the left and right distribution mechanisms, the valve device and the steering control hydraulic cylinders.

2.2.5.6 Valve device

The valve device is designed to maintain a constant pressure of 17 to 18.5 $кгс/см^2$in the hydraulic control line and a pressure of 2 to 2.5 $кгс/см^2$in the lubrication line, and to regulate these pressures.

The valve device is installed on the oil tank of the transmission unit and consists of housing 2 (Figure 3.14), high-pressure spool 3, lubrication spool 6, drain spool 1, electromagnet 5 and parts that ensure the operation of the spools.

The high-pressure spool maintains constant pressure in the oil supply line to the distribution mechanisms and through the jet in the feed line for the fluid coupling of the starter-generator drive. This pressure is adjusted using screw 4.

The oil coming from the injection pump through hole B into cavity D presses spool 3 and through the windows in it enters cavity E, and from it through hole D into the lubrication line. Constant oil pressure in the lubrication line is maintained by spool 6. As the pressure increases, spool 6 is lowered, and the oil is drained into the tank through the windows in the spool; the pressure is regulated by screw 7, acting on the spring of spool 6.

Drain valve 1 is designed to stop the supply of oil to lubrication and control when pumping oil from the crankcases of transmission units.

When electromagnet 5 is turned on, spool 1 moves, connecting cavity G with the tank through windows B. Oil supplied by the injection pump is drained from cavity G through windows in spool 1 and drain windows B into the tank. In this case, the pressure in cavity G drops, spool 3 blocks the passage of oil from cavity G to cavity E , and no oil is supplied to lubricate the units.

When the electromagnet is turned off, spool 1 returns to its original position by a spring.

Through hole D, oil under a pressure of 2 to 2.5 $кгс/см^2$is supplied through pipelines to lubricate the gearbox, BP and bevel gear of the fan drive.

2.2.5.7 Oil recovery pumps

Oil recovery gear pumps are designed to pump oil out of gearbox housings and input gearboxes. They are attached to the input gearbox and the front flanges of the gearbox.

The pumps supply oil to filter 32 (Figure 3.12) of the pumping line.

2.2.5.8 Pump-out line filter

The bleeder line filter is installed on the transmission oil tank. It consists of a housing mounted on the tank and a removable filter element 35.

Oil enters the filter through the screw hole and is supplied to the filter element through the channels available in the housing.

The filter element consists of a cover 6 (Figure 3.16) with a rod 8, a protective mesh 4 and a set of filter sections 3.

The filter section is a frame on which a brass mesh with small cells is attached.

The sections are assembled onto a rod 8 and secured with a nut 2. The nut is locked with a ring 1. The oil flows to the outer surface of the filter sections, passes through them and the holes in the rod into the internal cavity of the cover and then through windows A and channels in the filter housing it flows to the filter outlet fitting. Mechanical particles present in the oil are retained by the meshes of the filter sections. The connector of the filter element and the housing, as well as the jumper separating the inlet and outlet cavities of the filter housing, are sealed with rubber rings 5. For ease of removing the filter element from the housing, there is a handle 7.

A ball bypass valve is designed to bypass oil into the tank if the filter is clogged.

2.2.5.9 Oil radiator

The oil cooler is designed to cool the oil pumped out from the gearbox and input gearbox. It is installed in the radiator rack on the left and is designed in the same way as the engine lubrication system radiator, differing from it in the configuration of the connecting pipes.

2.2.5.10 Oil pump

The transmission oil pump MZN-2 is designed to ensure engine starting with an electric starter, as well as from a tug. The pump takes oil from the tank and supplies it through a pipeline to the distributor valve.

is similar in design to the MZN-2 engine lubrication system and is installed under the fan drive bevel gear bracket.

2.2.5.11 Distributor tap

Distributor valve 9 (Figure 3.12) is designed to supply oil from the oil pump MZN-2 pos. 8 to the starter-generator drive booster when starting the engine with a starter or to the gearbox boosters through distribution mechanisms when starting the engine from a tug. The distributor valve is installed on the starter-generator drive housing.

The distributor valve consists of a housing 3 (Figure 3.15), an electromagnet 4, a spring 1, a spool 2, a bypass valve 6 and a check valve 5. When installing the TOW START switch . on the driver's panel in the OFF position, oil from the oil pump goes to the SG drive booster, and when set to the ON position, the electromagnet rod 4 moves the spool 2 to the extreme position, and the oil flows through the check valve 5 into the pipeline to the distribution mechanisms.

2.2.5.12 Spool box for controlling the hydraulic coupling of the fan drive

Oil from the transmission control hydraulic system is supplied to fitting 12 (Figure 3.7) and, accordingly, to channel D. Channel E is connected through fitting 6 and the pipeline to channel A (Figure 3.6) for feeding fluid coupling 23 (Figure 3.12) of the fan drive. Channel G is connected to the drain into the casing 20 (Figure 3.5) of the transmission load shaft.

When electromagnet 5 is turned off (Figure 3.7), spool 3 is in the extreme right position under the force of spring 2, channels D and E are connected and oil flows to the fluid coupling of the fan drive, respectively, the fan is turned on.

When the electromagnet 5 is turned on, the spool 3, under the action of the electromagnet rod 5, moves to the extreme left position, oil is not supplied from channel D to channel E, channel E is connected to the drain into the transmission load shaft housing. Oil does not flow to the fan drive fluid coupling, the fluid coupling is emptied through drainage channel B (Figure 3.6) and the fan is turned off.

To force the fan to be turned off, the spool box design has a valve 8 (Figure 3.7), which is forcibly moved to the extreme left position by the stop 10. To force the fan to be turned off, it is necessary to loosen the nut 11 and rotate the stop 10 counterclockwise to move it to the extreme right position. Valve 8, under the action of spring 7, moves to the right and oil will not be supplied from channel D to channel E, and accordingly the fan will not turn on.

2.2.5.13 Drainage system

The drainage system is designed to equalize the air pressure in the gearbox crankcases, the gearbox crankcase and the oil tank, as well as to connect the system to the atmosphere. The crankcases of the right gearbox and VR communicate with each other through the gaps of the coupling, and with the crankcase of the left gearbox through the gap between the shaft and its casing. The upper cavity of the oil tank communicates with the casing cavity through pipeline 27 (Figure 3.12) of the drainage system.

The VR crankcase communicates with the atmosphere through breather 25.

2.3 Control drives

Tank control drives provide:
– separation and connection of drive and driven shafts of gearboxes;
– shifting gear in gearbox;
– tank rotation control;
– tank braking;
– high pressure fuel pump control.
Control drives consist of mechanical and hydraulic parts.

The mechanical part of the drive includes:
– gearbox release drive (clutch drive);
– gear shift drive;
– rotation control drive;
– stopping brake drive;
– fuel pump control drive.

The hydraulic part of the drive includes distribution mechanisms, which are part of the hydraulic control and lubrication system of the transmission.

2.3.1 Stopping brake drive

The stopping brake drive is mechanical, directly acting with a braking device - designed to activate the brake when braking a tank in motion, when overcoming obstacles, at stops, as well as to keep the tank in a braked state on ascents, descents, railway platforms and in other necessary cases .

The drive consists of a pedal 13 (Figure 3.17) of the stopping brake mounted on the pedal shaft, a front transverse shaft 1, a longitudinal composite rod 3, a return spring 6, a servomechanism 4 with an equalizing device, a rear transverse shaft 10, rods 8 and 11, latches 14 with thrust 12, fastening and installation parts.

The pedal is installed in the control compartment on the bottom in front of the driver's seat and is connected through a system of rods and levers to a cam-type servo mechanism located on the right side of the tank in the power compartment. The servomechanism is connected by rods 8 and 11 to the drives of the clutch engagement mechanisms $\Phi_4$and $\Phi_5$the left and right gearboxes.

To hold the pedal pressed for a long time, it is necessary to move the latch using rod 12 until the pedal stop enters the latch tooth 14. To unlock the pedal, you must press it, and the latch, under the action of the return spring located on rod 12, will disengage with the pedal stop and returns to its original position. When the pedal is released, the drive, under the action of the clutch release springs and return spring 6, will return to its original position.

The servo mechanism is designed to reduce the pedal force required for braking.

The servomechanism consists of a fist 1 (Figure 3.18) with an arrow-pointer 3 and a leash 9 with a balancer 5, installed in the servomechanism housing on needle bearings. The initial position of the fist is fixed with the limiting bolt 2 of the initial position.

When you press the brake pedal, the driver roller, rolling along the profile of the fist, provides different drive ratios.

A parallelogram-type equalizing device, mounted together with a servomechanism, ensures uniform tightening of the brake clutch discs in both gearboxes, which is necessary for simultaneous braking of both tank tracks.

The equalizing device consists of a balancer 5, a two-arm lever 4, a rod 8 and a lever 7 with an equalizer arrow 6. A double-arm lever mounted on needle bearings in the upper head of the balancer is connected at one end to the rod of the right gearbox, and at the other end through rod 8 to lever 7, which is connected to the rod of the left gearbox through the rear transverse shaft, which has a bearing support in the balancer.

When you press the brake pedal, due to the permissible difference in the forces of the release springs and the thickness of the disc packs in of the left and right gearboxes, the beginning of their tightening, and, consequently, the beginning of an increase in efforts in each gearbox will not be simultaneous. In this case, the gearbox rod, to which a greater force is applied, for example Γ_1, will stop, and the gearbox rod, to which a smaller force is applied Γ_2, will move due to the rotation of the double-arm lever until the forces on $\Gamma_1$both $\Gamma_2$rods are equalized, after which compression of the brake clutch disc packs in both gearboxes, and, consequently, braking will be uniform.

Drives of clutch engagement mechanisms $\Phi_4$andΦ_5 The left and right gearboxes are slightly different from each other. The right gearbox drive consists of a rod 1 (Figure 3.19) and a double-arm lever 4 with a balancer 7, installed in the gearbox housing.

The rod outlet from the gearbox housing is sealed with a rubber ring 2 and a spherical seal with a ring 3.

Double-arm lever 4 is installed in the crankcase on an axis 11 on needle bearings 13. The axis is held from falling out by a stopper 12 welded to the crankcase and a plug 10 screwed into the crankcase.

A balancer 7 is installed in the lever 4 on needle bearings 8, which ensures the distribution of forces P_1(Figure 3.18) and P_2between the racks 6 (Figure 3.19) of the drive mechanism for engaging the clutches $\Phi_4$and Φ_5. The balancer is held in the lever by a ball stopper 9 to prevent it from falling out.

Rod 1 with lever 4 is connected by axis 5 with a nut. To reduce friction, a spherical bearing is installed in the rod.

The drive of the clutch engagement mechanism $\Phi_4$and $\Phi_5$the left gearbox consists of rod 1 (Figure 3.20), lever 2, shaft 9, lever 5 with balancer 4. Shaft 9 is installed in the left gearbox housing on needle bearings 8.

At the end of the shaft 9 coming out of the crankcase, lever 2 is secured to the splines with a bolt. At the other end of the shaft, lever 5 is secured to the splines with a lock nut 11. The shaft seal as it exits the gearbox housing is ensured by rubber rings 7.

The shaft 9 is held against axial movement by a ring 10 and a stop 12 mounted in a cover 13 fixed in the tank body.

A balancer 4 is installed in lever 5 on needle bearings. Otherwise, the drive device is similar to the drive device of the right gearbox.

When you press the brake pedal, the force is transmitted through a system of rods and levers and a servo mechanism to the stops of the racks of the movable rings of the clutch engagement mechanisms $\Phi_4$and Φ_5. The clutches, when engaged, stop the driven shafts of the gearboxes and, consequently, the drive wheels of the tank. The simultaneous braking of the right and left caterpillar tracks is ensured by an equalizing device for the brake drive and balancers of the clutch $\Phi_4$and clutch engagement mechanisms Φ_5.

The gear ratio from the brake pedal to the activation mechanism changes according to the profile of the servomechanism fist and increases by an order of magnitude by the time the disks begin to compress, when the gaps between the disks are minimal.

2.3.2 Gearbox release drive (clutch drive)

The clutch drive is designed to disconnect and connect the drive and driven shafts of the gearboxes and ensure smooth starting of the tank.

The drive consists of the following components:
– pedal 23 (Figure 3.21), mounted on the front transverse shaft;
– longitudinal composite thrust 20;
– rear transverse shaft 19 with a return spring;
– located on the left gearbox housing;
– inclined rod 18 with quick-release tip;
– cross shaft 15 of the clutch connecting the distribution mechanisms, fasteners and installation parts.

The pedal is installed in the tank control compartment to the left of the stopping brake pedal. A bracket is welded to the bottom in front of the pedal, into which a persistent adjusting bolt 22 is screwed.

To disconnect the drive and driven shafts of the gearbox, it is necessary to press the clutch pedal 23 all the way to the adjusting bolt 22. The movement from the pedal through a system of rods and levers is transmitted to the shaft 15 with bushings 29 of the clutch shaft, which, using adjusting bolts 25, turn the clutch bushings of the distribution mechanisms. In this case, in the distribution mechanisms of both gearboxes, the channels of all boosters are connected to the drain, the clutches are turned off, and torque is not transmitted from the engine through the gearbox to the drive wheels.

To connect the drive and driven shafts of the gearbox, it is necessary to remove your foot from the pedal, and the pedal will return to its original position under the action of the drive return spring.

2.3.3 Fuel pump control drive

The drive is designed to change the amount of fuel supplied to the engine cylinders by acting on the rack of the high pressure fuel pump.

The drive is controlled by a pedal located to the right of the stopping brake pedal and a handle located to the left of the driver's seat.

The drive consists of a fuel supply pedal 2 (Figure 3.22), mounted on the pedal shaft with an adjusting bolt 1, an engine stop mechanism 3, a fuel supply manual drive 5 with levers 17, 19 and a manual fuel supply handle 20, a front transverse shaft 6, a longitudinal rod 7, a leash 9, a return spring 8, a rod with a quick-release tip 10, a double-arm lever 11 mounted on the engine, an inclined rod 12, a rod 13 with an elastic link connected to the regulator lever 14, fasteners and installation parts.

The engine stopping mechanism is connected simultaneously to the front transverse shaft 6 and the lever 17 mounted on the axis of the gear sector 16 of the manual fuel supply drive 5. Such a device provides independent control of the drive from the fuel supply pedal 2 and from the manual fuel supply handle 20.

When you press the pedal, the pedal shaft rotates and, through the MOD, a system of rods and levers, transmits movement to the fuel pump rack, increasing the fuel supply. The hand drive handle remains stationary. When the force is removed from the pedal, the return spring 8, together with the regulator springs, returns the pedal and the regulator lever to their original position.

When the manual fuel supply handle 20 moves forward, the handle pin 18 moves the lever 17, the rod 15 and the MOD, acting on the regulator lever 14. In this case, pedal 2 also moves.

A manual drive is usually used when setting the minimum stable engine crankshaft speed.

To ensure ease of use, the manual fuel supply handle 20 has a fixed position corresponding to the minimum engine speed. This position is ensured by the pin 18 resting on the spring-loaded lever 19 when moving the handle forward. Further movement of the handle forward to set a higher rotation speed is possible by moving lever 19 forward.

The position of the manual fuel supply handle 20 relative to the gear sector 16 of the manual drive is fixed with a spring-loaded latch. To move the handle, you must press it from top to bottom, and the latch disengages with the gear sector, allowing the handle to move.

The fuel pump control drive is equipped with an engine stop mechanism 3, which is designed to automatically stop the engine in the event of a fire in the MTO, the receipt of command "A" from the PKUZ-1A instrument system, the reverse start of the engine when the tank rolls back from a slope with the forward gear engaged, and also when pressing the ENGINE EMERGENCY STOP button on the right switchboard of the tower. It consists of a body 22, a tip 21 connected to the drive lever, balls 23, a spring-loaded lock 24 and an electromagnet 26.

Usually the MOD works like a rigid rod. When voltage is applied to the electromagnet 26, the armature 25 of the electromagnet retracts the lock 24, releasing the balls 23, which separate the tip 21 and the housing 22 MOD. Under the action of the return spring 8 of the drive and the regulator springs, the regulator lever 14 returns to its original position, the fuel supply stops, and the engine stops.

To connect the MOD, it is necessary to move the handle 20 for manual fuel supply to the rearmost position and push the pedal 2 towards you until the tip 21 is locked with lock 24, install the dustproof cover 4 on the MOD body.

The fuel pedal position sensor is located in the left pedal shaft support. It outputs a signal to the electronic unit to control the electric motor of the gear shift mechanism depending on the position of the fuel pedal during automatic gear shifting.

On the fuel pedal 2 there is an electric sensor that allows the electric air valves of the braking device to operate only after removing the foot from the fuel pedal.

2.3.4 Tank rotation control drive

The rotation control drive consists of a right gearbox control drive and a left gearbox control drive.

Both parts of the drive are similar in design. Each part includes a control lever 1 (Figure 3.21), mounted on the front transverse shaft; longitudinal composite rod 6 with side knuckle 5; rear transverse shaft 12 located on the distribution mechanism housing; rod 13 connecting shaft 12 to lever 14 of the distribution mechanism.

The control levers are located to the left and right of the driver's seat.

Stops 8 are welded on the longitudinal rods, which, resting against the limiting bolts 7 of the initial position and the adjusting bolts 9 of the final position, limit the travel of the rods. The limiting bolts 7 of the initial position are secured to brackets welded on board. In the fighting compartment, longitudinal rods are connected to side knuckles 5, mounted on the sides of the tank, which are designed to create a uniformly increasing force on the control levers and return the drive to its original position.

Steering actuators operate as follows:

– when the control lever is moved to the rearmost position, the movement through the system of rods and levers is transmitted to the lever 14 of the distribution mechanism. The lever 14 of the distribution mechanism, through the fist and the carrier of the distribution mechanism, turns the rotation sleeve and engages a gear reduced by one step in the corresponding gearbox. To prevent slipping of the clutch discs of the gearbox located on the side of the running track, increased pressure is transmitted to the clutch boosters of this gearbox, which is set by the distribution mechanism of the lagging side;

– when both control levers are moved to the rearmost position, a gear reduced by one step is activated in both gearboxes and the tank will move straight at a reduced speed. Therefore, you should not use the control levers to stop the tank, since it can only stop when moving in 1st gear or reverse gear;

– When the control lever is released under the action of the side knuckle spring, all drive parts return to their original position, while the driver needs to bring the control lever to its original position.

2.3.5 Gear shift drive

The drive provides gear shifting in the gearbox in manual and automatic modes. It consists of a gear selector with a shift mechanism and gear shift lever 3 (Figure 3.21), longitudinal composite rod 4, rear transverse shaft 33, connecting distribution mechanisms, fasteners and installation parts through adapter shafts 35 and couplings 28.

When changing gears, the movement from gear shift lever 3 through a system of rods and levers is transmitted to the lever of the right distribution mechanism. When turning the lever and the rear transverse shaft 33, the plugs of the right and left distribution mechanisms simultaneously turn, ensuring the flow of oil through the corresponding channels to the gearbox clutch boosters of the engaged gear.

The gear selector is installed in the control compartment to the right of the driver's seat and consists of the following components:

– housing 2 (Figure 3.23) with a built-in electric gear shift mechanism;
– gear shift lever 5 with return spring;
– levers 4 and 11;
– combs 1 with grooves for fixing the gear shift lever;
– latch 6 with a return spring;
– electromagnet 7 of the locking device for the electromechanical locking of the gear shift lever;
– locking 12 gear selector from the parking brake latch
– neutral sensor 13;
– sensor 3 levers;
– parts that ensure fastening and interaction of selector parts.

Lock 6 eliminates the possibility of inconsistent transition from higher gears to lower gears and does not allow engaging reverse gear without first setting the gear shift lever to the neutral position. The lock does not interfere with shifting from low to high gears.

The locking device eliminates the possibility of moving the gear shift lever from 7th to 6th, from 6th to 5th and from 5th to 4th gears when the engine crankshaft speed is higher than permissible and consists of an electromagnet 7, a pawl 8 with a return spring 9 and a spring-loaded latch 10. When a signal is received, the electromagnet is triggered, its armature engages the pawl 8 with the latch 10. Downshifting is blocked.

Neutral sensor 13 is designed to block engine starting when the gear is engaged. In the neutral position of the selector lever 5, the sensor rod is released - the blocking is disabled.

Sensor 3 of the gear shift lever is designed to block the system of the gear shift process in automatic mode, when changing gears by a mechanic-driver. When the gear shift lever is removed from the comb fixing groove, lever 4 releases the sensor rod - the automatic transmission system is locked.

2.3.5.1 Locking the gear selector from the brake pedal latch

The lock prevents the tank from moving when it is braked, since engaging the gear is possible only after removing the brake pedal from the latch, and installing the brake pedal on the latch is possible only after setting the gear shift lever to the neutral position.

When the pedal 13 (Figure 3.17) of the stopping brake is placed on the latch 14, the rod 12 through the cable 15 turns the locking lever 12 (Figure 3.23) of the gear selector. If the gear shift lever 5 is set to the neutral position, the gear shift mechanism is blocked and prevents the possibility of changing gears.

To ensure that the gear is engaged, it is necessary to remove the brake pedal from the latch, and the gear shift mechanism will be unlocked.

If the gear selector lever 5 is in the gear engaged position, then placing the brake pedal on the latch becomes impossible.

2.3.5.2 Automatic gear shift system

The automatic gear shift system (hereinafter referred to as AMS) is designed to automatically control gear shifting from first to seventh up and from seventh to first down, depending on road conditions, engine load, tank speed and the driver's actions to control the movement.

To operate the AMS system, the following is used:

– gear selector, with built-in gear shift mechanism, reversible electric motor, shift cycle sensor gears, gear number sensor;

– fuel pedal position sensor;

– initial position sensors for rotation drives;

– engine tachometer sensor;

– tank speed sensor;

– coolant temperature sensor;

– gear lever position sensor;

– valve device solenoid.

The automatic gear shift system works as follows.

DKMV, depending on the information provided by the sensors, analyzes the position of the steering control levers, fuel pedals, engine crankshaft speed, tank speed, engine coolant temperature and, according to the underlying algorithm, controls the electric motor of the gear shift mechanism, ensuring the optimal one for the given conditions movement selection of gear number.

When a gear shift command is issued, voltage is applied to the gear shift motor. The mechanism, which is a reduction gearbox with a cam device, ensures that the gear shift handle is removed from the comb groove, the handle is shifted to "up" or "down" gear, and the handle is inserted into the comb groove. Next, based on a signal from the cycle sensor, voltage is removed from the electric motor.

Simultaneously with the removal of the gear shift lever from the fixing groove of the comb, while the lever is moving into the next groove, the electronic unit issues a signal to the electromagnet of the oil drain spool in the valve device to break the flow of power from the engine to the drive wheels.

DCMV (in terms of implementation of control algorithms) provides:

– automatic shifting of step transmission gears from first to seventh and back, depending on the speed of the object, the degree of engine load and the position of the fuel pedal;

– prohibition of engaging higher gears when the coolant temperature is higher than the maximum permissible;

– prohibition of engaging higher gears when turning the tank (the steering control levers are not in their original position);

– prohibition of engaging lower gears when turning the tank (the steering control levers are not in their original position). This blocking is removed when the engine crankshaft speed is less than (850±50) rpm ;

– forced engagement of lower gears when the coolant temperature rises above the maximum permissible, which ensures more intensive operation of the cooling system fan and protects the engine from overheating;

– prohibition of gear shifting (both up and down) when the shift lever is disengaged from the comb grooves manually.

During the operation of the automatic transmission, the optimal operating mode of the engine and transmission is ensured, and there is automatic protection against engine overheating. When the automatic transmission is turned off, all mechanical connections of the manual gear shift drive are completely preserved.

The automatic transmission is switched on by a switch located on the housing of the switching mechanism. When the automatic control system is initially turned on, there is a two-second delay required for all system elements to enter operating mode.

Neutral, 1st gear and 3rd gear are engaged manually by the driver.

2.3.6 Braking device

The braking device in the stopping brake drive is designed to reduce the speed of the tank without pressing the stopping brake pedal with your foot and to move the pedal to a more convenient position for use.

The braking device consists of a booster 9 (Figure 3.17), acting on the balancer 7 of the servomechanism; an electric sensor built into the fuel pedal; braking buttons built into the left control lever; two series-connected electric air valves supplying air from the air system through pipelines to the booster.

To reduce wear on the gearbox friction discs, an electric sensor allows the electro-pneumatic valves to operate when the brake button is pressed only after removing your foot from the fuel pedal.

When you press the braking button (your foot is removed from the fuel pedal), the electric air valves are activated and air under a pressure of 70 kgf $см^2$is supplied to the booster. The booster rod, through the balancer, equalizer levers, gearbox rods and clutch activation mechanisms, compresses the clutch discs with constant force $\Phi_4$andΦ_5 both gearboxes, providing braking for the tank.

The booster develops the force necessary for braking at an air pressure in the tank's air system of at least 70 kgf/ $см^2$.

At the same time, the booster rod, through the rod 5 of the servomechanism, ensures that the brake pedal 13 moves forward. The brake pedal, moving to the nose of the tank, is set to a more convenient position for use.

When the brake button is released, the electric air valves release air from the booster into the atmosphere. The influence of the booster rod on the balancer of the servomechanism stops, and the stopping brake drive returns to its original position.

In 2nd and 3rd gears, the brake pedal may not move to a more comfortable position.

2.4 Tank body

The hull is designed to accommodate and protect the crew, weapons complex, ammunition, units and mechanisms of the tank from being hit by enemy fire.

The body is a rigid box welded from armor plates of various thicknesses, on which are installed:

– removable roof over the engine compartment;
– driver's hatch and hatches for access to tank components;
– shelves above the tracks;
– welding in the bow, on the sides, bottom, roof, stern for installing units and equipment of the tank inside and outside the hull;
– dynamic protection (DZ) on the bow of the hull;
– screen protection (side and lattice screens);
– anti-fragmentation screens inside the housing.

The main parts of the body are:

– nasal node;
– sides;
– rear axle;
– bottom;
– roof;
– chassis brackets;
– engine compartment partition;
– fan baffle.

2.4.1 Engine compartment partition

The engine-transmission compartment partition, separating the engine-transmission compartment from the combat compartment, is welded to the transverse beam, sides and bottom. It consists of ribs 6 (Figure 4.1) and 7, welded together and welded to the bottom, and two stamped sheets 1 and 2. On the left sheet 2 of the partition there is a hatch with a cover 3, consisting of two parts. The cover contains a valve for supplying air to the engine in underwater driving mode. When the left side of the cover is removed, access to the left exhaust manifold, left ejection valve and engine mounting bolts is provided. When the right side of the cover is removed, access to the left engine exhaust manifold, left ejection pipe and engine mounting bolts is provided. On the right sheet 1 of the partition there are holes for the passage of air system pipelines.

On the right and left (at the sides) in the partition there are holes through which guides 4, 5, 8, 9 pass with pressed-in bushings in which the control drive rods move. All connections have seals that provide the partition with the required tightness.

In the left rib 6 there are rectangular and round cutouts for the passage of cables from the fighting compartment to the engine-transmission compartment , two holes for the passage of fuel system pipelines, as well as a cutout for a hatch for the flow of water from the engine-transmission compartment to the combat compartment during underwater driving. The rib 7 has a cutout for the heater pipe.

2.4.2 Fan baffle

The fan baffle is made in the form of a spiral casing with removable partitions 5 (Figure 4.2) and removable rubber sectors 4. The main purpose of the fan baffle is to form an air flow to the output louvers in order to ensure a given air flow through the radiators of the cooling and lubrication system of the engine and transmission unit.

2.4.3 Nasal node

The bow assembly of the hull consists of an upper frontal part 26 (Figure 4.3) and a lower nose sheet 30, inclined and welded together at an angle, as well as with the front roof sheet, sides and bottom.

The upper frontal part (hereinafter referred to as the VLD) contains front and back sheets, between which the filler is installed. There are 23 marker lights welded to the front sheet on each side of the body; tubes 27 for supplying cables to headlights and side lights; tubes 22 for supplying cables to the electromagnetic trawl; Bolts 24, 25 for attaching the removable remote control module. At the junction of the front sheet of the VLD with the front sheet of the roof along the axis of the tank, a cutout is made into which a shaft is welded for installing the driver's observation device. The top of the shaft is closed with a visor welded to the shaft.

On the lower sheet of the bow, strips 29 are welded on the outside for attaching attachments (mine trawls), as well as towing hooks 28 for installing towing brackets.

2.4.4 Boards

Sides 6, 10 are vertical armor plates, in the upper part of which protective turret strips are welded to increase the internal volume of the hull and install the turret. In the lower part there are cutouts for installing brackets for 4 hydraulic shock absorbers (two in the front and one in the rear). At the rear of the left side there is a welded plate 12, to which a pipe for exhausting engine exhaust gases is welded.

Brackets 1 for guide wheels are welded to the sides and inclined sheets of the bow assembly. Welded to each side are brackets 5 for support rollers, 9 bumpers that protect the shelves from impacts from the tracks, 19 bumpers to prevent the tracks from moving towards the hull, 3 balancer stops limiting the rotation of the balancers, 8 booms for installing brackets for locking the tracks when transporting the tank.

2.4.5 Rear axle

The rear axle of the hull consists of a stern plate 14, a stern bottom plate 18, and gearbox housings 20, which are welded to the side plates and the rear bottom plate. On the right side, in the upper part, in the stern sheet there is a fitting 17 for draining the sludge from the moisture-oil separator. Brackets 15 for fastening additional barrels of the fuel system are welded in the upper part of the stern sheet. In the central part of the stern sheet along the axis of the tank there is a hole for installing a fan support. The hole is closed with an armored cover secured with five bolts. Two towing hooks 16 with spring latches are welded at the bottom of the stern sheet. The towing hooks have through holes for rigid coupling when towing the tank.

2.4.6 Bottom

The bottom of the hull 21 is trough-shaped and consists of three stamped parts. To increase rigidity and place the torsion bars of the chassis in the bottom, longitudinal and transverse stampings are made. The front sheet of the bottom has a deep stamping to accommodate the driver's seat. Behind the driver's seat in the front sheet there is a cutout with a welded flange for the crew emergency exit hatch. The rear bottom sheet has cutouts for installing service hatches for the engine and transmission compartment units. On the left and right sides, brackets for 2 balance beams are welded into the bottom. The bottom and sides are connected by its upper bent part (redan).

) of the starter-generator is welded to the bottom . The sub-engine foundation contains the front 10 and rear 8 sidewalls of the foundation, reinforced with stiffeners. On the sidewalls there are four strips with machined areas and engine mounting holes. The front supports 1 and 2 of the input gearbox are welded to the right gearbox housing and the rear side of the engine foundation. The right gearbox housing has a bracket 3 on the bottom with two yokes for attaching the rear support of the input gearbox. Between the rear side of the engine foundation and the fan baffle, a bracket 7 is welded to the bottom for attaching the removable bracket 6 of the fan drive bevel gear.

2.4.7 Roof

The hull roof consists of front and rear armor plates welded together and welded to the sides, the upper frontal part of the hull and the engine bulkhead bracket.

On the roof, strips 11 (Figure 4.3) for protecting the tower ring and energy-absorbing modules 7 for reinforcing the roof are welded.

The front roof sheet contains:

– hole for installing the driver's hatch;
– hole for access to the fuel meter sensor;
– hole for installing the junction box of attachments;
– opening for filling internal fuel tanks;
– a hole with a bore and holes for fastening the turret linear device;
– hole for the VZU of the PKUZ 1A instrument complex.

There is a hole in the rear roof sheet on the left side for the release of water by the OPVT pump.

2.4.8 Chassis brackets

The chassis chassis brackets include: twelve brackets 2 (Figure 4.3) balancers (six on each side), six brackets 5 support rollers (three on each side), four bumpers 9 tracks (two on each side), six stops 3 balancers (three on each side on the 1st, 2nd and 6th suspensions), four brackets 4 shock absorbers (two on each side in front). On each side of the gearbox flanges there is one bore with holes for mounting shock absorbers.

The balancer brackets are cast, welded to the bottom and sides and are used for installing the balancers of the road wheels and torsion bars of the chassis. The support roller brackets are stamped and are used for installing support rollers. The shock absorber brackets are stamped-welded and are used for installing hydraulic shock absorbers.

2.4.9 Shelves over tracks

The shelves above the tracks are welded to the sides and serve to install the equipment placed on them, fuel tanks, spare parts boxes and built-in continuous protection (hereinafter referred to as NRZ).

The shelves contain ribs welded to the sides, shelf sheets and outer bulwarks. The shelf sheets are reinforced at the bottom with longitudinal stiffening ribs made from angles. Folding panels 4 are attached to the shelves at the front (Figure 4.4), 16.

In the bow part of the fenders, above the guide wheels, there are compartments 2, 6 for the built-in NRZ, as well as covers 3 for access to the track tension mechanism. The compartments are structurally divided into two parts. Modules of the built-in NRZ are placed in the compartments and secured with bolts. Cover 3 is installed in the guide and secured with a bolt.

In the aft part of the fenders, side flaps 5, 15 and rear right flap 1 are installed.

The left fender shelf contains an armored compartment 12 of the diesel generator unit and an exhaust pipe 14. The compartment is equipped with welds for installing a diesel generator in it.

The compartment is closed on top with a lid 8. The lid is sealed with a rubber gasket of rectangular cross-section and secured with bolts. Cover 8 has a hatch 7 for air intake from the diesel generator set cooling system and a hatch 9 for maintenance, which are closed with latches and sealed with rubber gaskets.

On the rear wall of the compartment there is a hatch 10 for the exit of exhaust gases and maintenance, the hinged cover of which is sealed with a rubber gasket and closed with bolts.

On the side wall of the compartment there is a hatch 13 for the air outlet of the diesel generator engine cooling system, which is closed with bolts and sealed with a rubber gasket.

On the niche of the compartment in the stern area there is a hatch for access to the relay-regulator fuse, the screw plug 18 of which is sealed with a rubber gasket.

On the side walls of the compartment there are threaded holes for draining water, into which plugs 11 are installed and sealed with aluminum washers. There is also a hatch 17 at the bottom of the compartment for TO , the cover of which is sealed with a rubber gasket of rectangular cross-section and secured with bolts.

The exhaust pipe 14 serves to release engine exhaust gases and contains an internal pipe and an external armored fence.

On the flange of the exhaust pipe there is a pipe 5 (Figure 4.5) with a shield 1. The pipe 5 is attached to the exhaust pipe using hinged bolts 7 with nuts 6. Shield 1 is installed on pipe 5 using brackets 2, 3 and fixed with latches 4. Shield 1, as well as heat shields 5 (Figure 4.4) are designed to reduce thermal radiation.

2.4.10 Tank hull hatches

For boarding and egress of crew members, refueling the tank, as well as for access to the units and components of the tank during maintenance work, hatches and plugs are located in the hull. The manhole covers are sealed with round or rectangular rubber gaskets.

The location of the hull hatches is shown in Figure 2.11 .

2.4.10.1 Engine hatch

Hatch 22 under the engine is made in the bottom of the hull in front of the left final drive housing. The hatch is closed with a hinged lid. The hatch cover is sealed with a rubber gasket and secured to the bottom with bolts. The cover has a cover 21 for access to the plug for draining liquid from the engine cooling system, which is closed with a threaded cover with a locking bolt.

2.4.10.2 Driver's hatch

The driver's hatch is located in the middle part of the front roof of the hull above the driver's seat and is closed with a hatch cover using a closing (opening) mechanism that allows you to close and open the cover from the inside and outside.

Cover 6 (Figure 4.6) of the hatch in the closed position (see B-B) rests on the supporting surface of the roof and is sealed with a rubber cord 5. The position of the cover above the hatch opening when closing is ensured by strip 3 on the cover and guide strips 4 on the roof of the housing. In the open, rotated and lowered position (see A-A), the hatch cover rests on the support bracket 1 and bracket 2 on the top sheet of the nose and the roof.

In the outer glass 15 on balls 22 there is a glass 18 with a handle with a guide key 42 and a lever handle 39 installed on it. When turning the lever handle, through the guide key 42, the glass with the handle turns the rod 13 with

the hatch cover. The lever handle has a spring-loaded stop 40 that locks the cover when it is in the over-the-hatch position and in the open, rotated position.

Inside the rod 13, a nut 24 is installed on the splines, connected to the screw 17 with a thread. The nut is connected to the rod by a locking mechanism. The locking mechanism consists of the following components: balls 46 installed in the holes of the nut and in the groove of the rod, a bushing 45 with a groove and a spring 47. In the initial position, the bushing under the action of the spring locks the balls in the groove of the rod and holds the spring 16 installed between sleeve 48 nuts and sleeve 12 rod.

The screw 17 is connected by a polyhedron to the handle 27 of the screw and rests on the balls 33 of the nut 34 and is pressed against the cup with the handle through a thrust washer 35 with adjusting rings. The screw is connected with a square shank to the key 9. When the screw is rotated by the screw handle or by the key, the nut 24 with rod 13 with the hatch cover moves until the sleeve 37 stops at the end of the guide key 42. The screw handle is fixed in the closed position of the cover by a spring-loaded lock 25 with a button 26. Inside the screw there is a rod 30 with a stop 43 and a spring 44, and on the screw handle there is a lever 29 with an emergency handle 28 for opening the hatch cover. In the initial position, the handle fixes the lever.

When the hatch is closed and if it is necessary to urgently leave the tank, the closing (opening) mechanism allows you to raise the hatch cover in emergency mode. To do this, you need to turn handle 28 all the way from the original position (see B) and sharply press it down until the emergency lifting mode is activated (see E). In this case, the rod 30 moves the sleeve 45 through the stop 43 until the sleeve groove aligns with the balls 46, the balls are squeezed out of the groove of the rod and disconnect it from the nut 24. Under the action of the spring 16, the manhole cover with the rod rises up until it stops. After releasing the handle 28, the rod with the stop under the action of the spring 44 returns to its original position.

Restoring the initial state of the closing (opening) mechanism after an emergency lifting of the hatch cover is carried out by rotating the handle 27 of the screw clockwise. In this case, the nut 24 with balls 46 moves upward and compresses the spring 16. When the balls are aligned with the groove of the rod, under the action of the spring 47, the sleeve 45, with the conical surface of the groove, squeezes the balls into the groove of the rod and locks them, connecting the nut to the rod.

To prevent injury to the driver when the turret is rotated by an electric drive when the hatch is open, the closing (opening) mechanism is equipped with a locking device. The blocking is carried out by sensor 21 installed on the outer glass 15. When the hatch cover 6 is lifted, the rod 13 with the conical surface of the groove pushes out the balls 19 and 20, which act on the microswitch of the sensor that opens the circuit for turning on the electric drive of the tower.

2.4.10.3 Emergency exit hatch

The emergency exit hatch is located in the bottom of the hull behind the driver's seat and is closed with a hatch cover. The lid opens outwards and, if necessary, is separated from the body.

cover 20 (Figure 4.7) in the closed position (see A-A) rests on the supporting surface of the flange 23 in the bottom and is sealed with a rubber gasket 18. The hatch cover with hinges 21, axles 22, axles 9 with sealing rings 8 is installed in the holes of the flange with spring washers 10 and screwed clamps 11. The closed position of the cover into the hatch opening is ensured by guide bolts 7. It is locked with locking bolts 5 left and 17 right until they stop in the squares 6, mounted on axles 19 with washers 14, nuts 15 and cotter pins 4. Clamps and locking bolts in in the closed position they are locked together with wire 3. Brackets 1 are designed for fastening spare parts .

2.4.10.4 Roof over the power compartment

The roof over the power compartment consists of the following components:

– roofs 3 (Figure 4.9) above the power plant;

– roof 7 above the transmission unit with entrance shutters, in the rack of which radiators for the engine cooling and lubrication system and the hydraulic system of the transmission unit are installed;

– beams 10 with exit blinds.

The roofs over the power plant and over the transmission are hinged together with hinges. At the joint between the roofs there is a sealing rubber gasket, and under the joint there is a support beam attached to the sides with bolts.

Along the perimeter, the roof above the power compartment has sealing rubber gaskets and is attached to the body with bolts 2 and bolts 1. On the left side of the roof above the power plant in the area of the exhaust pipe, a fabric-asbestos seal is installed, and also during normal operation, plugs 14 are installed instead of bolts. When driving, instead of plugs, bolts 2 with a special coating are installed, located in a single set of spare parts for the tank.

A rack with water and oil radiators is attached from below to the roof above the transmission with bolts 9. On the right side under the roof above the transmission there is a lifting device. Stopper 5 ensures a fixed position in the open state of the roof above the power unit, as well as the roof above the transmission unit without radiators.

When working in the power compartment with the roof raised, complete with radiators, for safety reasons, a support rod 5 is installed under the roof (Figure 4.10), the threaded shank of which is inserted into the stop, and the tapered end into the eye hole. When the roofs above the power plant and above the transmission are opened simultaneously, the support rod 5 is also installed under the roof above the power plant on the left side.

The lifting device ensures that the roof with attached radiators is lifted with the effort of two people to a fixed position.

The lifting device consists of an external torsion bar 1 located above the junction of the roofs above the engine and transmission; stop 9, mounted on the guide bar 11 of the radiator rack; lever 2 with roller; supports 6 internal torsion bars eleven; support arm 4; pressure bolt 3, located on the left side of the beam with exit blinds and latches 10.

Video clip 12 levers 2 when closing or opening the roof above the transmission rolls along a guide bar 11. In the open position of the roof, the lifting mechanism is locked with a latch 10, and is removed from the stopper by hitting this latch with the rod from below.

2.4.11 Driver's seat

The driver's seat is installed on a plate 15 (Figure 4.8), which is rigidly secured using two racks 2 to the roof of the tank hull with bolts 3. The left rack is secured with quick-release bolts. Two pins 14, welded to the bottom, fit freely into the holes of the plate 15 and prevent the seat from moving in the longitudinal and transverse directions.

The design of the seat provides adjustment in height and along the tank body to install it in a position convenient for the driver relative to the controls.

The seat consists of a cushion 18, a backrest 1, an arm 20 and a lever mechanism with a torsion bar.

Axles 7 are welded to the frame of the pillow 18 in the front part on both sides for installing the arm 20. In the rear part of the frame there are two brackets 5, to which the backrest 1 is attached. The connection of the backrest 1 and the arm 20 with the frame of the cushion 18 is hinged and quick-release. Two strips 4, each having three cutouts, are welded to the back 1. With the help of these cutouts and the bow 20, the tilt of the backrest is adjusted.

Two guide strips are welded to the bottom frame of the cushion 18, which move in the grooves of the base 6. The locking of the cushion 18 along the body in six positions is ensured by grooves on the right strip and a spring-loaded locking lever 17.

The pillow frame 18 is hingedly connected to the brackets of the plate 15 through a frame 12 with a built-in torsion bar and the torsion bar arms 13. The frame 12 is through a roller. 9 and cam bushings and clamps installed at its ends 11 rests on two gear racks 10. Locking the seat in the upper and intermediate positions is ensured by pressing the cam bushings of the clamps 11 to the gear racks 10.

2.5 Tank tower

2.5.1 General structure of the tower

The turret is a welded structure made of rolled armor plates and is designed to accommodate weapons and equipment for the fighting compartment, as well as to ensure weapons guidance in the horizontal plane.

In front of the turret there is an embrasure for installing a cannon. In the embrasure there are two bores “A” (Figure 6.1), into which the gun is installed with clips placed on the cradle axles.

Arc-shaped cheeks 19, 22 are welded to the side surfaces of the embrasure, which, in combination with grooves in the movable armor of the gun, form a labyrinth that prevents lead splashes (fragments) from penetrating into the turret and reduces the impact of the shock wave.

To attach the outer protective cover of the gun, a groove 21 is welded on top of the embrasure, and a groove 20 with a drain hole is welded below the embrasure.

To the right of the gun embrasure in the turret there is an embrasure “B” for a coaxial 7.62 mm machine gun with a shell 23 for attaching the machine gun case.

Hooks 16, 27, 38, 50 are welded in the front part and on the sides of the tower to grip the tower with cables during its installation and dismantling.

In the right half of the turret roof there is welded the base of the commander's hatch with a cover 36, the base 1 for a remote machine gun mount and the commander's sight with its protection, the housing 2 of the pressure seal, the brackets 35 for fastening the protection of the DPU drive.

The following are welded into the left half of the turret roof: the base of the gunner's hatch with cover 53; flange 10 for installing a gunner's sight; flange 12 of the sight-backup; shafts 5, 9 for installation of gunner observation devices; stand 3 for mounting headlights, side lights, television cameras, outside air temperature sensor; bracket 4 for TWO; flange 48 for antenna installation; bracket 7 for satellite dish; bracket 8 launchers, housing 6 for protecting the rough head of the TShU.

At the rear of the tower roof there is a flange 45 for the pallet ejection hatch, a control platform 44 for installing the quadrant, and an installation hatch 43.

In the front part of the tower roof and on top of the frontal part, booms 11, 28 are welded for fastening dynamic roof protection containers.

On the front part of the turret there are welded booms 13, 14, 29 and brackets 15, 18, 24, 26, 30, 57 for fastening explosive reactive armor containers, as well as booms 17, 25 for attaching housings for protecting precision TShU heads.

In the rear part of the tower, brackets 40, 42, 46, 47 are welded for attaching the aft module.

On the left side of the turret are welded: a bracket for 55 launchers of the 902 system; brackets 49, 56 for installing a frame on which dynamic protection blocks and containers are mounted; brackets KAZ 52, 54. In the lower part, on the bottom sheet, a copier 51 for driving the OPVT covers is welded.

Welded on the right side of the turret are: a bracket for 34 launchers; KAZ brackets pos. 33; brackets 31, 39 for installing a frame on which dynamic protection blocks and containers are mounted; housing 37 for protecting the head of the rough TSU; bracket 41 air conditioner.

On the front part of the tower, on the left and right sides, bonnets 32, 58 are welded for fastening cable routes.

On the inside of the turret, anti-fragmentation screens are installed on the sides, roof, and front sheets, providing protection for the crew and internal equipment from secondary fragments when the armor is damaged.

2.5.2 Aft module

The aft module is designed to accommodate additional ammunition and protect it from bullets and shrapnel.

The aft module consists of a housing 10 (Figure 6.2), which is a welded box-shaped structure divided into three compartments. Each compartment has racks for storing ammunition. Access to the compartments is provided through hatches located at the top of the module. Hatch covers 4, 6, 7 are hingedly connected to the module, have a rubber seal around the perimeter (gasket 11) and are secured with clamps 8 with bolts 9.

The following components are located outside the module:

– hinges 1, 5 for fastening the basket, on which lattice screens are installed for additional protection of the aft module and turret from RPGs;

– metal panels 14, which are fastened with bolts 13 to the bonks welded to the body 10.

At the bottom of the module there is a hole for draining condensate. The hole is closed with plug 12.

The aft module is attached to the tower with bolts 2 together with shock absorbers 3.

To reduce the amount of condensate formed in the compartments of the hull 10, the aft module has a ventilation system consisting of two through holes located in the upper and lower parts of the hull 10. The holes are closed with screw plugs 15, 17 with a rubber seal (gaskets 16, 18), which are connected between is an axis 19 that ensures synchronous opening and closing of the holes. The open state of screw plugs 15, 17 is determined by the indicator surface F , painted red (red color is visible - OPEN, red color is not visible - CLOSED).

ATTENTION:

OPEN AND CLOSE SCREW PLUG 15 BY MANUAL ONLY!

IT IS PROHIBITED TO USE KEYS AND OTHER TOOLS TO OPEN AND CLOSE SCREW PLUG 15!

2.5.3 Running device and tower seal

The ball support of the tower (shoulder straps) consists of the lower 1 (Figure 6.3) and the upper 7 shoulder straps, balls 14 and spacer springs 13, laid in the running tracks of the shoulder straps. Balls 14 and springs 13 are placed through a hole in the rear part of the upper strap 7, which is closed with a plug 12.

The lower shoulder strap 1 is attached with bolts 11 to the turret plate of the hull. The joint of the lower shoulder strap 1 with the turret plate is sealed with a rubber ring 2. The lower shoulder strap 1 has a gear ring with which the gears of the manual turret rotation mechanism mesh.

The upper shoulder strap 7 is attached with bolts 6 through shock-absorbing bushings 5 to the bottom sheet of the tower, in the rear part of which there is a hollow bonnet with a plug 15, intended for filling the ball bearing with lubricant. The upper shoulder strap 7 has a gear ring, with which the gears of the electromechanical turret rotation mechanism mesh.

A ball bearing seal is attached to the lower strap 1 with bolts 10, which consists of a metal ring frame 9 and a felt tape 8. The felt tape 8 is secured to the frame with staples. Between the bottom sheet of the tower and the lower shoulder strap 1, in the groove of the shoulder strap, a sealing rubber cuff 4 is installed, tightened with a nylon ring 3.

2.5.4 Tower stopper

The turret stopper consists of a housing 6 (Figure 6.4), a stopper 7, a screw 5, a handle 9 and a sprocket 10. The stopper 7 is installed in the housing 6 and has a toothed comb for engagement with the teeth of the lower shoulder strap. A screw 5 is screwed into the stopper 7, onto which the handle 9 is movably mounted and the sprocket 10 is fixed. The handle 9 houses a latch 4 with a spring 3 for turning the sprocket 10. The latch 4 is connected to the cap 1 with a rivet 2. The letters “Z” are printed on the cap - locked and “O” - unstopped.

On the shield 15, fixed to the body 6 with bolts 8, the letters “Z” and “O” are also marked and there is a slot in which an indicator 14 is placed, indicating whether the tower is locked or unlocked.

A locking device is installed on housing 6, which prevents the drive from being turned on when the tower is locked. The locking device consists of a switch 11 and a rod 13 with a spring 12. When the tower is locked, the switch contacts are open.

2.5.5 Tower hatches

2.5.5.1 Commander's hatch

The commander's hatch is designed to provide entry and exit for the commander from the tank, protecting him from damage from above and is located on the right side of the turret roof.

The commander's hatch consists of a cover 7 (Figure 6.5) and a casing 6, secured with screws 5. The hatch cover has an annular groove for installing a sealing rubber cord 10.

To ensure opening, the hatch cover has a torsion bar, consisting of bushings 14, 16 and steel plates of the torsion bar 13. The twist angle of the torsion bar is ensured using screws 15. In the open position, the cover with its eyes rests on rubber buffers 12, installed on the roof of the tower using bolts 11, and is held in this position by the hatch stopper.

The hatch stopper is designed to lock it in the open position and is installed above the hatch cover 7 at the front. The hatch stopper consists of a stopper 17, which holds the hatch cover 7 during locking using a tooth located on its left eye, teeth 2, screw 18, spring 19, bushing 3, screw 4 and handle 1 of the stopper.

In the closed position, the hatch cover 7 is secured by a lock 8, which operates using a handle 20, a screw 9, a latch 21, a spring 22 and a button 23.

To prevent the DPU from operating when the hatch cover is open, a sensor is installed under the turret roof at the rear left. Its operation is ensured by rod 24, spring 25 and bushing 26.

2.5.5.2 Gunner's hatch

The gunner's hatch is designed to provide entry and exit for the gunner from the tank, protecting him from damage from above, and is located on the roof of the turret on the left side. The gunner's hatch consists of hatch cover 4 (Figure 6.6) , hatch lock 7 (for locking hatch cover 4 in the closed position), stopper 8 (for locking hatch cover 4 in the open position). To facilitate opening of the hatch cover 4, a steel plate torsion bar 2 is installed in its hinges and the eye of the hatch base 1. In the open position, the hatch cover 4 rests on a rubber buffer 3.

The hatch lock 7 consists of a body with a spring-loaded handle 9, a limit bar 10 and a limit bolt 5. The hatch lock 7 in the closed position is fixed by a bar 10 placed behind the stop 11. From the outside, the hatch lock 7 is opened and closed with a key for opening hatches.

In the middle part of the hatch cover 4 there is a hatch for installing an air supply pipe for underwater driving of the tank. The hatch is closed by a hatch cover 14, connected to the hatch cover 4 by an axis 12 and sealed with a rubber cord 13. The hatch cover 14 is closed from the inside with a lock 16, which is secured in the closed position with a screw 15.

2.5.6 Turret rotation mechanisms

2.5.6.1 Electromechanical turret rotation mechanism

The electromechanical mechanism 1 (Figure 6.7) for turning the tower (hereinafter - EMPB) is designed to transmit torque from the electric motor to the ring gear 2 of the upper ring of the tower in all operating modes of the GN STV drive.

The EMPB is installed on booms 5 and 6, welded to the inner surface of the roof of the tank hull, on the left side, near the MTO partition, above the rack. The mechanism is secured with bolts 3 and 7 with shock absorbers to the bonnets and bolt 11 through spherical washers 12, 13 and 15 to the adjustable stop 16. Bonk 6 is the axis about which the EMPB can rotate with bolt 11 turned out and bolts 3 and 7 loosened. With spacers 14 adjustment of the radial clearance in the gear engagement of the output gear and ring gear 2 is ensured. Using shims 10, the height position of the EMPB is adjusted.

EMPB is a three-stage reduction gearbox with spur-cut spur gears, on which electric motor 9 of the GN STV drive is installed.

The drive gear of the first stage of the gearbox is manufactured integrally with the electric motor shaft 9. The driven gear is also the supporting half-coupling of the cam safety clutch 8. The cam clutch is designed to protect the drive elements from damage when excessive dynamic moments occur on the side of the tank turret when the STV is operating.

To reduce the angular play in the gear train, the teeth of the output gears 18 and 19, which are in mesh with the ring gear 2, are pressed against the adjacent side surfaces of the ring gear teeth using a spring 17. To fix the relative angular position of the teeth of the gears 18 and 19 during dismantling - when installing the EMPB, locking bolts 4 are used (from a single spare parts for the tank), which are screwed into threaded holes in the crankcase and the conical part fits into the cavities of the gear wheels.

2.5.6.2 Manual turret rotation mechanism

The manual turret rotation mechanism (hereinafter referred to as RMPB) is designed to rotate the turret manually and hold it when the STV GN drive is turned off.

The RMPB is located in front to the left of the gunner's position and is attached with bolts 2 (Figure 6.8) with shock absorbers to the bottom plate of the turret through the shoulder strap, with bolt 12 to bracket 3 and bolt 4 through spherical washers 7 and 8 to the adjustable stop 9. Bolt 12 is the axis relative to which The RMPB can turn with bolt 4 turned out and the tightening of bolts 2 loosened. Gaskets 6 ensure adjustment of the radial clearance in the gear engagement of the output gear and ring gear 1. Using spacers 13 and 22, the position of the RMPB in height is adjusted.

RMPB is a combined two-stage reduction gearbox with an irreversible worm gear and spur gears. A flywheel 19 with a handle is installed on the worm 18. The flywheel contains a contact device for supplying power to the electric trigger of the coaxial machine gun using button 20.

The mechanism is equipped with a controlled friction safety clutch 11, designed to disable the worm gear when the STV GN drive is turned on and protect against gear breakage during overloads. The friction clutch is turned off by electromagnet 15.

To reduce the angular play in the gear train, the teeth of the output gears 16 and 17, which are in mesh with the ring gear 1, are pressed against the adjacent side surfaces of the ring gear teeth using a spring 10. To fix the relative angular position of the teeth of the gears 16 and 17 during dismantling - when installing the RMPB, locking bolts 5 are used (from a single spare parts for the tank), which are screwed into threaded holes in the crankcase and the conical part fits into the cavities of the gear wheels.

An azimuth indicator 21 is installed on the RMPB. The azimuth indicator is designed to determine the rotation angles of the turret relative to the tank hull.

The azimuth indicator has two scales: a coarse reading scale 27 and a corresponding rough reading arrow 23 in the form of a tower outline, and a fine reading scale 25 and a corresponding fine reading arrow 26.

Rough and fine scales are printed on the glass, which has the outline of the tank chassis in plan. There are four red marks 24 on the scale , indicating the extreme positions of the gun in the dimensions of the tank hull. The coarse scale has 60 divisions with a division value of 1-00, the fine scale has 100 divisions with a division value of 0-01.

With the help of gears, the coarse and fine arrows of the azimuthal indicator are connected to the ring gear 1 of the shoulder strap. With one 360° rotation of the tower, the fine counting arrow makes 60 revolutions, and the coarse counting arrow makes one revolution.

The azimuth indicator is set in such a way that the position of the gun forward corresponds to the position of the 30-00 arrows.

2.5.6.3 Operation of turret rotation mechanisms

When the STV GN drive is turned on, the electromagnet 15 (Figure 6.8) through the rod 14 turns off the friction clutch 11. The torque from the electric motor 9 (Figure 6.7), in accordance with the STV control signals, is transmitted through the EMPB gearbox to the gear ring 2 of the upper ring of the tower, ensuring rotation or holding a tower. When the STV GN drive is turned off, friction clutch 11 (Figure 6.8) is turned on. The torque from the flywheel handle 19 is transmitted through the RMPB gearbox to the gear ring of the lower (fixed) ring of the tower, ensuring rotation of the tower.

2.5.7 Crew seats in turret

2.5.7.1 Commander's seat

The commander's seat is mounted on bracket 24 (Figure 6.9) with the carriage of lifting mechanism 1, secured to the turret ring with bolts 2 and 3.

The seat includes a lifting mechanism 1 that regulates the height of the seat, a backrest 6, a guard 8 and a seat cushion 9.

The lifting mechanism 1 consists of a pipe 35, a bracket 24 with a carriage, an insert 32 with rollers 33, bushings 30 with rings 28, balls 29, a stopper 25 with a spring 23, a lever 38, covers 39 and 40. Bolts 27 installed in bushings 30, protect the balls 29 from getting into the holes of the pipe 35. The bracket 24 with the carriage is locked relative to the pipe 35 by a spring-loaded stopper 25 under the action of the lever 38. To facilitate lifting the seat, a cup 34 with a spring 37 is installed in the pipe 35.

The guard 8, through the support 41 with a nut 44, is hinged on the seat cushion 9 and is fixed with a handle 7. The gap between the swinging parts of the gun and the guard 8, which ensures the safety of the commander, is set with bolts 43, 45 and nuts 42, 46.

The removable backrest 6 consists of a backrest 10, a frame 11, levers 14, 19, a spring 18, an axle 17, bolts 13, 15. When adjusting the backrest 6 in angle, it rotates on a roller 20 installed in the grooves of the seat cushion brackets 9 and is fixed with using the lock rods 16 in one of three positions.

A step is installed on the turret roof in the area of the commander's hatch for easy entry and exit of the commander.

ATTENTION:

TO PROTECT THE COMMANDER'S FEET FROM THE SWINGING PARTS OF THE GUN, A QUICK-RELEASE FOLDING FOOTREST IS INSTALLED ON THE VT FLOORING!

2.5.7.2 Gunner's seat

The gunner's seat is mounted on bracket 1 (Figure 6.10), secured to the turret ring with bolts 6 and the gun lifting mechanism bracket with bolts 11, 12.

The seat includes a bracket 1, a guard 2, bolted 3 to the tower roof bracket and bracket 1, a shield 4, a backrest 5, a seat cushion 9 and a folding footrest 14 mounted on an axis 10. A ball 15 with a spring 13 is designed to fix the footrest 14 in extreme positions.

The seat is adjusted in tilt using bolt 21, in height and in the longitudinal direction by moving bracket 7, secured with bolts 8 to bracket 1.

The removable backrest 5 consists of a backrest 16, a frame 17, levers 20, 26, a spring 25, an axle 24, bolts 19, 23. When adjusting the backrest 5 inclination, it rotates on a roller 28 installed in the grooves of the seat cushion 9 brackets and is fixed with using the lock rods 27 in one of two positions.

2.6 Dynamic protection complex

2.6.1 Dynamic housing protection

The dynamic protection complex is designed to provide additional protection to the tank hull from cumulative weapons and armor-piercing sub-caliber projectiles. When a cumulative weapon or an armor-piercing sabot projectile interacts with sections or blocks of dynamic protection, the cumulative jet or core, penetrating into the dynamic protection elements, causes detonation of the explosive charge, as a result of which the armor-piercing effect of the cumulative jet or the core of the armor-piercing sabot projectile is significantly reduced.

Dynamic hull protection is located on the upper bow sheet and along the sides on the side screens.

4S23 products are used as dynamic protection elements (hereinafter referred to as the ERA element) on the tank .

Dynamic protection on the nose of the hull is a removable module consisting of 12 sections arranged in two rows. The sections contain pallets 1 (Figure 6.11), 6 with DZ elements pos. 2. The module is installed on booms welded on the top sheet of the nose, and secured with bolts 8 and washers through bushings - shock absorbers 9.

The side projection of the tank hull is protected by dynamic protection screens and lattice screens. In conditions of mass use of RPGs, the protection of side projections can be increased through the use of additional screens.

The side screens are located along the fenders. All side screens are fastened with bolts 3 (Figure 6.12) with spring washers to strips 12, which in turn are attached to the bulwarks with bolts 13 with spring washers. The screens are connected to each other by hinges 2 with axis 1.

To service the chassis, the screens are rotated on the two hinges 11 on them, having previously unscrewed the bolts 3, and are fixed in the tilted position with the axis 1 removed from the hinges 2 connecting the screens to each other.

Each screen consists of two layers of rubber-fabric plate 5, front covers 4 and 6, located on the front side of the plates on the top and bottom of them, and back covers 8 and 10. Each of the plates 5 has cutouts into which the remote control elements pos. 7. The entire set of plates and covers are tightened around the perimeter with bolts 9.

The principle of operation of screens with remote sensing is similar to the action of remote sensing on VLD.

The tank is not equipped with remote sensing elements at the manufacturer's factory.

The lattice screens are attached to the bulwarks and the diesel generator compartment on the left shelf with 14 bolts and washers. The lattice screen provides protection against cumulative weapons such as RPGs.

2.6.2 Dynamic tower defense

Dynamic protection of a tank turret consists of the following components:

– 12 removable frontal containers 1-4 (Figure 6.13);

– 12 removable containers 5 - 7 roofs;

– 22 removable onboard containers 41-44, 55-57.

Containers 2-7, 41-43, 55, 56 contain remote sensing elements pos. eleven.

Frontal container 1 consists of an upper cassette and a removable box 38 with packages 32-35 installed in it. Frontal containers 2, 4 consist of upper and lower cassettes located at an angle to each other. The frontal containers 3 consist only of a lower cassette. The frontal containers are attached to the turret with bolts 31, as well as bolts 15, 18, 29 together with cone shock absorbers 16 and nuts 17.

Cassettes are welded boxes having cavities into which pallets 12, 20 are inserted with elements of remote protection pos. laid in them in one layer. 11. The pallets have Shch elements for pressing the pallets. The lower cassettes from the front end, the upper cassettes from the rear end are closed with covers 10, 13, 19, 21, 28, which are secured with bolts 9, 14.

Roof containers 5-7 consist of bodies 25, 27, 38, covers 24, 26, 37 and are attached with bolts 23 to bonks welded to the tower. In housings 25, 27, DS elements pos. are placed in one layer. 59 and plates 60, 61, 62, 63, into housing 38 - in two layers with partial overlap and rotation in relation to the other element of the remote control pos. 59 and plates 64, 65.

Onboard containers 41, 42, 43, 55, 56 are welded boxes into which pallets 45, 49, 51, 54 are inserted with DZ elements, pos. 11. The pallets have Y elements for pressing the pallets. The top side containers 41, 42, 43, 55, 56 are closed with lids 47, 50, 52, 53, which are secured with bolts 46.

Onboard containers 41, 43, 55, 56 are attached to frames installed on the right and left sides of the tower with bolts 48 and frame elements. Onboard containers 42 are attached to the frames with bolts 48.

Onboard containers 44, 57 are welded boxes with combined filling. Onboard containers 44, 57 are attached to the frames with bolts 58.

2.6.3 Additional protection

Additional tank protection consists of the following components:

– additional housing screens (Figure 6.14);

– additional tower screens (Figure 6.15);

– tower mesh screens.

Additional hull and turret screens are designed to increase the tank's protection from the side projections. DZ 4S20 or 4S22 elements are used as dynamic protection elements in additional housing screens. Additional turret screens use DZ 4S24 elements.

Additional screens are installed in anticipation of hostilities in populated areas, as well as in conditions of massive use of hand-held anti-tank grenade launchers.

On the march, additional screens are designed for a range of up to 200 km, with an average speed of about 30 km/h in all weather conditions

The container for additional turret protection is a fabric cover 1 (Figure 6.15) , equipped with front and rear inserts 7, side inserts 2, 3 and bottom insert 5. Starting from the dynamic protection element, elements DZ 4S24 pos. 6 and gaskets 4, fixed with ties in the upper part. From above, the container is closed successively with the side, front and back walls of the case, which are secured with paired ties and a textile fastener.

Case 1 contains nine DZ 4S24 elements and eight gaskets. The total number of DZ 4S24 elements installed in containers for additional turret protection is 162 pcs.

A set of equipped containers is secured to the brackets using straps and buckles sewn to the case.

Mesh screens (Figure 6.15 , sheet 3) are networks woven from polyamide cord, the nodes of which contain metal elements. The upper parts of the net are placed on the mounting strips. Mesh screens are installed around the perimeter of the tower and are attached to the frontal containers of the remote control, the left radar shield, brackets 15 and 23 and mesh screens.

Additional protection is included in a single non-transportable spare parts item.

2.7 A set of visibility reduction means

The tank is prepared for installation of the IMZHV.169.500.000 visibility reduction system, designed to reduce the likelihood of its detection and targeting of high-precision weapons.

2.8 Chassis

2.8.1 Crawler mover

2.8.1.1 Track roller

The tank has six road wheels installed on each side. Due to the misaligned location of the torsion shafts, the starboard side support rollers are shifted toward the stern by 112 mm relative to the left side rollers. The double-disc support roller, with external rubber tires, consists of two stamped aluminum alloy disks 1 (Figure 5.1), pressed onto the hub 34 and fastened with bolts 35 and nuts. To protect aluminum discs from wear by track ridges, a steel flange 2 is pressed into each disc.

The roller is mounted on rolling bearings. The first and sixth support rollers, being the most loaded, are mounted on a ball bearing 32 and two roller bearings 26. The remaining rollers are mounted on one ball and one roller bearing each. A spacer sleeve 28 is installed between the ball bearing and roller bearings.

The first and sixth support rollers have the STRENGTH distinctive mark stamped on the outer disk of the roller.

The support roller is held against axial displacement by a nut 29, which is screwed onto the balancer axis and secured with a folding pin 30.

On the board side, the roller hub is closed by a labyrinth seal cover 43. The cover is attached to the hub with six bolts with spring washers and sealed with an auto-sealant gasket or a cardboard gasket installed on whitewash. Two rubber cuffs 46 are installed on the neck of the balancer axis. The edges of the cuffs are constantly pressed against the labyrinth seal cover by plate springs 45. The labyrinth seal cover 43 and the labyrinth ring 44 form a labyrinth seal. The labyrinth ring is pressed onto the balancer axis and welded to it.

From the outside, the support roller hub is closed with a cover 31. The cover is sealed with an auto-sealant - a gasket or cardboard gasket installed on whitewash. Two of the six holes for the cover mounting bolts 31 communicate with the inner cavity of the hub and are intended for lubrication of the bearings. A distinctive sign of lubrication holes is the presence of a spherical boss on the roller disk opposite one of them. The roller hub is filled with grease.

The first and sixth road wheels, if necessary, are allowed to be installed on the second, third, fourth and fifth suspensions.

2.8.1.2 Drive wheel

The drive wheel is designed to transmit torque from the final drive shaft to the caterpillar and consists of disk 1 (Figure 5.2) of the drive wheel and two crowns 5. The crowns are attached to the disc flanges with bolts 6 and nuts 2. The conical surface of the nuts mates with the conical surface of the crown. Nut tightening torque 540^{+60}N ·m (54^{+6} кгс · м).

A limiting disc 3 is welded to the drive wheel disk, preventing the track from running off. On the final drive side, labyrinth ring 4 is welded to the disk.

The crowns of the drive wheel have twelve teeth each and are installed on the disk so that the base teeth, which have a distinctive mark (tide) A in the tooth recess, are located one against the other.

The drive wheel is installed on the final drive shaft on splines and two split cones 9 and 10 and secured with a plug 8, which is locked with a toothed washer 7. Plug tightening torque 4000^{+500}N ·m (400^{+50} кгс · м). There is a hole in the plug B for lubrication of the final drive.

The outer cone 9 has threaded holes designed to press it out when removing the drive wheel.

The drive wheels are interchangeable with each other only when complete with cones.

2.8.1.3 Caterpillar

Caterpillar designed to transfer forces acting from the drive wheel and road wheels of the tank to the supporting surface.

The tank is equipped with lantern tracks with parallel rubber-metal hinges. If necessary, additional asphalt shoes can be installed on the caterpillar during operation.

The caterpillar consists of 81 tracks 1 (Figure 5.3).

The track assembly consists of two stamped steel links B , connected to each other by two tubular pins 2.

The pin is a rubber-coated pipe with flats L on both sides. The pins are oriented pressed into the eye holes of the track links using a special lubricant. The orientation of the pins during pressing ensures that the adjacent track plates rotate by 15° in the assembled track.

The extreme parts of the tracks are connected to each other by brackets 3, which are put on the ends of the fingers of adjacent tracks and secured with bolts 8 and wedges 4. The tightening torque of the bolts 8 is 450^{+50}N·m (45^{+5}kgf·m). Bolts 8 are locked by mating the conical surfaces of the bolt headrest and the hole in the bracket.

In the middle part, the tracks are connected using shoes 5 and ridges 7, which are installed in the openings between the track links on the fingers and connected to each other by bolts 6. The tightening torque of bolts 6 is 750^{+50}N·m (75^{+5}kgf·m). Bolts 6 are locked by local compression of the flanges under the bolt heads into the splines E of the ridge.

Holes M, located in the central part of the track link plates, are used for attaching removable asphalt shoes.

2.8.1.4 Support roller

The support rollers are designed to support the upper branch of the caterpillar from sagging.

The tank has six support rollers, three on each side.

The roller type is single-disc, with internal shock absorption.

The support roller consists of a hub 1 (Figure 5.4) with a pressed rubber tire 2 and a steel rim 11, a bracket 6 and a sealing cover 4. The hub is mounted on the bracket on three rolling bearings: two roller 15 and one ball 3; The bearings are secured with a nut 12, which is kept from being unscrewed by a locking bolt 14.

Bracket 6 has a radial hole A designed to supply lubricant to the working edges of the cuffs.

The sealing cover 4 is attached to the hub with ten bolts 9. Three cuffs 5 are pressed into the cover using sealant, the edges of which are pressed against the surface of the bracket by spring rings. A rubber ring 10 is installed in the recess of the cover. Sealing cover 4 and ring 8 labyrinths form a labyrinth seal. Ring 8 of the labyrinth is pressed onto the bracket axis and welded to it.

The support roller is filled with oil to the level of the lower edge of the filling hole in the hub. The hole is closed with plug 13 with a sealing cone. Plug tightening torque 100^{+20}N ·m (10^{+2} кгс · м).

The support roller is secured with four bevel bolts. Bolt tightening torque 1500^{+200}N ·m (150^{+20} кгс · м). Special washers are installed under the bolts. The support rollers are interchangeable with the rollers of previously produced tanks, to ensure this, a lower middle hole is made in the flange of the bracket 6.

2.8.1.5 Asphalt shoes

Asphalt walking shoes (AHB) pos. 2 (Figure 5.16) are designed to prevent the destruction of asphalt road surfaces by the caterpillar lugs. ACB is a reinforced product made of polymer material and consists of reinforcement 3 and a polymer mass 4.

The ACB is installed in all tracks and secured to the track with bolt 1, similar in design to the bolt for fastening the track bracket, while the shank A of the reinforcement rests on the rib of the track track. The tightening torque of bolt 1 is 45^{+5} kgf·m. The bolt is locked by mating the bolt head and the hole in the track along the conical surface.

The ACB kit includes asphalt shoes, mounting bolts and a special key.

2.8.2 Suspension system

The suspension system is designed to soften shocks and shocks and dampen vibrations of the tank body when driving over uneven terrain.

The suspension system includes suspensions, hydraulic shock absorbers and stops.

Suspension - individual, torsion bar. The number of pendants is twelve. The suspension consists of a torsion shaft and a balancer assembly.

Hydraulic shock absorbers are installed on the first, second and sixth suspensions.

Stops for the first, second and sixth suspensions are welded to the sides of the tank hull.

2.8.2.1 Torsion shaft

Torsion shaft 20 (Figure 5.1) is an elastic suspension element and is a round steel rod with large and small splined heads. At the end of the torsion shaft on the side of the large head there is a threaded hole for its removal and installation, as well as fastening the cover with bolt 3. Bolt tightening torque 125^{+25}N ·m ($12{,}5^{+2{,}5}$ кгс · м).

The torsion shaft is connected to the balancer by splines of the large head, and by splines of the small head to the bushing 13 balancer of the opposite side.

The torsion shaft is held against longitudinal displacement by a spring ring 6 and a cover 5.

Since one end of the torsion shaft is fixed in a fixed bushing, and the other end in a movable balancer, when the roller hits uneven surfaces and the balancer turns, the torsion shaft twists, dampening the energy of shocks and impacts affecting the tank body.

The port side torsion shafts are not interchangeable with the starboard side shafts. Therefore, at the ends of both heads of the torsion shafts, intended for installation on the left side, there is a mark L, and on the starboard side there is a mark PR.

The torsion shaft rod is wrapped with insulating tape, protecting its surface from damage. In order to protect the sixth pair of torsion bars from becoming clogged with dirt, they are covered with special protective covers, and a rubber cuff is additionally installed on the sixth right torsion bar.

2.8.2.2 Balance

The assembled balancer is a unit consisting of a balancer 27 (Figure 5.1), a sleeve 13, a spacer sleeve 15 and a bearing race 17.

Stamped steel balancer. There is a splined hole in the balancer axis for securing the large head of the torsion shaft 20.

Labyrinth rings 44 and 7 and a scraper 4 are welded to the balancer. The scraper is designed to clean the track roller disk from the bead side from dirt.

Pins 36 are pressed into the balancers of the first, second and sixth suspensions, intended for connecting them with hydraulic shock absorbers. The balancer rotates in the sleeve 13 and race 17 of the bearing on needle bearings 18. The balancer is held against axial movement by balls 12.

Bushing 13 has a splined hole for securing the small head of the torsion shaft of the opposite side. The bushing flange has four holes for bolts 24 for fastening the bushing to the balancer bracket 21 and two threaded holes for pressing out the balancer. The pressing holes are closed with threaded plugs. A plug 9 is pressed into the bushing flange, which has a hole for knocking out the torsion shaft of the opposite side in the event of its breakdown during operation. For sealing purposes, this hole is closed with a rubber plug 11.

The bearing race 17 is secured to the balancer by a spacer ring 39 and three sectors 40. The bearings are sealed by labyrinth rings 7 and 8, rubber cuffs 38 and 41 with leaf springs 45 and rubber o-rings 14, 16 and 19. The cuffs are held by spring rings 37 and 42.

The assembled balancer is installed in the mounting sockets of bracket 21, welded into the body. Using a sleeve 13, the balancer assembly is attached to the bracket with four bolts 24 with a conical head, which are locked with special lock washers 25. The lower front bolts of the first suspensions have elongated heads and are installed with protective washers that protect the bolt heads from damage during movement.

Bolt tightening torque 1500^{+200}N ·m (150^{+20} кгс · м).

To ensure alignment of the rollers along the track, adjusting shims 10 are installed between the bushing flanges and the balancer bracket.

The tank hull has stops for the first, second and sixth suspensions. The stops limit the twist angles of the torsion bar shafts and the rotation angles of the hydraulic shock absorber blades.

The alignment of torsion shafts to the twist angle when replacing balancers or torsion shafts is made using cross-shaped marks marked on the stops. Markers for the exhibition of torsion shafts of the third, fourth and fifth suspensions are applied to the sides.

Lubrication of the suspension needle bearings is carried out through a hole in the balancer bracket, closed with plug 22. Each balancer is filled with 150^{+50}grams of grease.

Interchangeability of the balancer is possible only on one side between the first, second and sixth, as well as between the third, fourth and fifth suspensions. The balancers of the right and left sides differ only in the installation of scrapers.

The balancers of the first, second and sixth suspensions differ from the balancers of the third, fourth and fifth suspensions in the presence of hydraulic shock absorber pins and the width of the journal for the roller bearing on the roller axis.

In case of extreme necessity, it is allowed to install the corresponding balancers of the starboard side on the left side, and vice versa, as well as installing the balancers of the first, second and sixth suspensions instead of the balancers of the third, fourth and fifth suspensions.

2.8.2.3 Hydraulic shock absorber

The shock absorber is designed to dampen body vibrations and partially absorb the energy of shocks and impacts acting on the road wheels when driving over uneven surfaces.

The tank is equipped with six double-acting lever-blade hydraulic shock absorbers. They are installed in accordance with the markings on the levers:

– “1, 2, 3 LION” - for the first, second and sixth left pendants;

– “1, 2 PR ” - for the first and second right suspensions;

– “3 PR ” - on the sixth right suspension.

The shock absorber is attached to the body with four bolts, locked with folding washers. Bolt tightening torque (1300 ± 50) N ·m ((130 ± 5) kgf ·m).

The shock absorber consists of a body 2 (Figure 5.5), a partition 11, a blade 12, a lever 7 with an axis and a pin, and a cover 15.

The blade is supported by a needle bearing 14 and a bronze bushing 6. The blade is connected by splines to the axis of the lever, which is secured against axial displacement by a plug 5.

The partition assembly with the cover, lever and blade is installed in the body and secured with bolts 8. The joint between the partition and the body is sealed with rubber rings 9.

Two protrusions E of the partition and a blade divide the internal volume of the shock absorber into two pairs of working chambers G and D. Through holes F in the blade and the lever axis, these chambers are connected in pairs to equalize the pressure in them when the blade rotates. One valve device is installed in the projections E of the partition, each of which consists of a valve 19, an adjusting shim 21, a spring 20 and valve cups 18 and 22.

The partition flange and the inner surface of the cover form a compensation chamber K , which serves to collect working fluid flowing from the working chambers through the gaps between parts, and replenish the working chambers with liquid through poppet valves 10. The joint between the partition and the lid is sealed with a rubber ring 16.

The shock absorber arm is sealed by four rubber cuffs 25.

To reduce uncontrolled leaks between the working chambers and the compensation chamber, the following sealing elements are installed in the shock absorber:

– bronze pads 23 in the grooves of the blade;

– bronze inserts 3 in the projections of the partition;

– steel spring rings 4 at the ends of the blade;

– rubber ring 13 between the axis and the blade.

To allow air to escape when filling the shock absorber with liquid, a threaded hole is made in the partition flange, which is closed after filling with a ball 17 and a screw 1.

The shock absorber is connected to the balancer 7 (Figure 5.6) by rod 6 and two hinges, upper and lower. Each hinge consists of an outer bushing 1 and an inner bushing 2 and locking parts. The hinge bushings are interchangeable.

The parts of the upper hinge are secured to pin 3 of the hydraulic shock absorber lever with a cover 5 and two bolts 4. The tightening torque of the bolts is 100^{+20}N ·m (10^{+2} кгс · м). The lower hinge parts are secured to the balancer pin 9 with a washer 10, a cover 11 and two bolts 8. The tightening torque of the bolts $60^{+20}$is N ·m (6^{+2} кгс · м). After tightening, the threads of bolts 8 are riveted through holes B in washer 10.

The rod is installed so that the non-stamped side faces the balancer to ensure maximum clearance between the rod and the balancer.

2.8.2.4 Operation of hydraulic shock absorber

When hitting an uneven surface, the support roller rises relative to the tank body, the balancer rotates and, through a rod, turns the shock absorber lever upward (straight stroke). When the track roller moves down relative to the tank body, the shock absorber lever turns down (reverse).

Damping of body vibrations occurs under the influence of resistance force, which occurs when fluid flows from working chambers B (Figure 5.7) into chambers D during forward stroke and from working chambers G into chambers B during reverse stroke of the shock absorber lever.

2.8.3 Track tension mechanism

2.8.3.1 Guide wheel

The guide wheels are designed to hold the track in the contour when it is rewinding, and together with the tension mechanisms - to change the tension force of the track. The location of the guide wheels is front.

guide wheel 1 (Figure 5.8) consists of two cast disks welded together. It is installed on the crank axis 18, on two bearings: ball 24 and double-row roller 19.

The guide wheel is mounted on the crank against axial movements with a plug 20, which is secured with a bolt 23.

On the inside, the wheel hub is closed by a labyrinth cover 17. The cover is attached to the guide wheel with 2 bolts, locking spring washers, and is sealed with a cardboard gasket installed on the auto-sealant gasket. Inside the cover there is a felt gland 44 and a rubber self-clamping cuff 45 with two working edges.

From the outside, a cover 21 is attached to the disk hub with bolts 25, which is sealed with a cardboard gasket installed on the auto-sealant gasket. Two of the ten threaded holes for the cover mounting bolts communicate with the internal cavity of the hub. They are designed for filling bearings with lubricant and are made in two diametrically located thickenings of the hub.

The guide wheels are interchangeable.

2.8.3.2 Track tension mechanism

The track tensioning mechanism is single-worm, with globoidal gearing. The worm pair directly perceives the forces acting on the guide wheel.

The track tension mechanism consists of a crank 18 (Figure 5.8), a worm wheel 32 and a worm 31.

On the crank axis there is a neck 6, a spacer sleeve 7 and a worm wheel on the splines. A sealing rubber ring is installed between the ends of the neck and the crank 3.

The worm wheel is pressed to the spacer sleeve with a nut 8, secured with a cotter pin eleven.

The crank is mounted on two supports. One support is the mounting hole in the bracket, the second is the mounting hole in the neck. Brass inserts are installed in both mounting holes 4 and 9.

The neck is attached to the bracket with bolts 5. Two top bolts 5 a limiter is attached to the neck 15, which together with two stops welded to the crank cheek 16 limits the angle of rotation of the crank, which prevents the worm from disengaging with the worm wheel when the tracks are tensioned. When installing (replacing) a worm wheel, the mark above the spline cavity of the wheel should be aligned with the mark on the end of the crank, marked LEV . - for the left crank and right. - for the right one.

The supports of the worm 31 are a sleeve 30, pressed into the bracket 10, and a support 33, attached to the bracket with bolts 34. The worm has a threaded hole in the lower part, into which a locking screw 28 is screwed.

The locking screw is sealed with a rubber ring 29 installed in the recess of the worm, and the worm is sealed with a rubber ring 27 installed in the recess of the bracket and pressed together with the cover 26 with screws to the sleeve 30.

When installing the crank into the bracket, flat B of the worm wheel should face the direction of the worm. After installing the crank, the worm must be engaged with the worm wheel by turning the crank and rotating the worm.

Before installing the crank on the tank, 1 to 1.5 kg of lubricant is placed in the internal cavity of the bracket.

The tension and loosening of the caterpillar is carried out by turning the worm after unlocking it with the locking screw 28.

2.8.3.3 Drives to the speed sensor and tachogenerator

The drives to the speed sensor and tachogenerator are located in the bores of the cranks of the guide wheels.

The right crank contains a tachogenerator and a drive to it, the left one contains a drive and a speed sensor.

Each drive consists of a pin 22 (Figure 5.8), pressed into the guide wheel cover, a flexible shaft 37 and a gearbox. Shanks B of the flexible shafts fit into the grooves of the pins and are held in split nuts 38 by cones 40 and union nuts 35. The split nuts are locked with bolts 36, and the union nuts and bolts 36 with retaining rings 39.

The gearbox 13 with a speed sensor is installed in the bore of the crank axis and is kept from turning by a stopper 12 installed in the groove of the sleeve 14 , which , in turn, is kept from turning by a cotter pin 11.

Gearbox 41 with a tachogenerator is also installed in the bore of the crank axis and is held from turning by pin 42.

Both gearboxes are held against axial movement by aluminum bushings 14, 43 and cotter pins 11.

Rotation from the guide wheel to the speed sensor and to the tachogenerator is transmitted by fingers through flexible shafts and gearboxes.

To prevent lubricant from getting from the bearing assembly of the guide wheel into the internal cavity of the crank, the pin is sealed with a rubber cuff 46 installed in plug 20.

2.9 Weapon complex

2.9.1 Combat Kit

For firing from a tank gun, separate-loading artillery shots with a partially burning cartridge case and guided shots can be used:

– 3VBM11 with an armor-piercing sub-caliber projectile 3BM26;
– 3VBM13 with an armor-piercing sabot projectile 3BM32;
– 3VBM17 with an armor-piercing sub-caliber projectile 3BM42;
– 3VBM20 with an armor-piercing sabot projectile 3BM48;
– 3VBM22 with 3BM59 armor-piercing sabot projectile;
– 3VBM23 with an armor-piercing sabot projectile 3BM60;
– 3BBK10 with a cumulative projectile 3BK14M (3BK14);
– 3BBK16 with a cumulative projectile 3BK18M (3BK18);
– 3VSh7 with a 3Sh7 projectile with ready-made lethal elements;
– 3VOF22 with high-explosive fragmentation projectile 3OF19;
– 3VOF36 with high-explosive fragmentation projectile 3OF26;
– 3VOF128 with a high-explosive fragmentation projectile 3OF82;
– 3VP6 with a practical armor-piercing sabot projectile 3P31;
– 3VP5 with a practical cumulative projectile 3P11;
– 3VP24 with a practical high-explosive fragmentation projectile 3P23;
– ZUBK14 or ZUBK20 with a 9M119 or 9M119M guided missile;
– ZUBK14F with a 9M119F guided missile.

As part of artillery shots, the main propellant charges 4Zh40 or 4Zh52 are used, with the exception of shots:
– 3VBM11, 3VBM13, 3VBM20 and 3VBM17, which are equipped with a 4Zh63 charge;
– rounds 3VBM22 and 3VBM23, which are equipped with a charge of 4Zh96.
The 9M119 and 9M119M guided missiles have a cumulative warhead and are painted in a khaki color.
The 9M119F guided missile has a high-explosive warhead and a sand-colored warhead.
The guided missile rounds include a 9X949 propellant.
Markings are applied to projectiles, charges and ammunition closures. The markings of the various shots are shown in Figures 7.1; 7.2; 7.3; 7.4.

The marking is intended:
– to determine whether the shots correspond to the caliber and type of tank gun (shells and charges are marked with the inscription “125 - D81”);
– for storing shells in a tank complete with their own charges;
– to distinguish shots by type;
– to equip the tank's ammunition rack with shots appropriate to the fire mission.
To avoid confusion with charges 4Zh40 and 4Zh52, a distinctive white and red stripe is applied on the side surface of charges 4Zh63 and 4Zh96, respectively.
In the middle part of the burning cylinder of armor-piercing sub-caliber projectiles 3BM59 and 3BM60 there is a distinctive red stripe.
Shells and charges, sealed in canisters and cases, are supplied in wooden or metal boxes designed for storing and transporting shots. Before stowing ammunition in a tank, it is necessary to check the condition of the stowage, then inspect the shots, remove dirt and grease from them, and sort them by markings and weight marks.
Guided missile rounds are supplied in wooden boxes with a lid designed for storing and transporting the rounds. Before stowing rounds in the tank, it is necessary to check the condition of the stowage, and then inspect the rounds for defects, play at the joints of the rocket, and remove dirt, grease and moisture from them.
A more detailed description of the artillery rounds used is set out in the technical description and operating instructions for the 2A46.TO 1 gun . Part 3. Ammunition, guided missiles - in technical descriptions and operating instructions.

2.9.2 A gun

The gun is designed:
– to combat tanks, self-propelled guns and other armored enemy targets;
– to suppress and destroy enemy fire weapons and manpower;
– for the destruction of wood-earth, brick and reinforced concrete structures.
The gun is mounted in the tank turret on axles that have bearings with cages.
The gun trunnion clips are fixed in the turret using wedge devices.
The front embrasure of the turret is covered with an armored mask, which is bolted to the cradle. The outside of the armored mask is covered with a cover. Behind the armored mask there is an internal cover for sealing the turret embrasure. A multi-layer protective casing is installed on top of the armored mask and the outer cover.
The elevation angle of the gun is limited by a bar fixed in the upper part of the embrasure, against which the armored mask rests, and the angle of descent is limited by a stop welded to the turret roof, against which the gun cradle rests.
The gun is balanced by weights attached to the fence, or by rings installed on the front end of the gun receiver.
The gun is aimed at the target by the handles of the gunner's or commander's sight control panel with the weapon stabilizer turned on, as well as manually by the flywheels of the gun's lifting mechanism and the turret rotation mechanism.
To lock the gun “in the field” there is a rod, which at one end can be installed in the eye bore on the roof of the turret, and at the other end it is attached to a bracket on the breech of the gun. In the stowed position, the gun is mounted on the lower hole of the rod, when transported by rail - on the upper holes of the rod.

Main parts of the gun:
– trunk;
– thermal protective casing;
– semi-automatic shutter;
– recoil devices;
– cradle;
– guard with a trigger mechanism;
– lifting mechanism.
The design, purpose and operation of the gun are described in detail in the technical description and operating instructions for the 2A46M.T O , 2A46M.TO1 gun.

2.9.3 Machine gun coaxial with cannon

The coaxial 7.62 mm machine gun is designed to combat stationary and moving tank-dangerous manpower and unarmored vehicles at ranges of up to 1500 m and is located in the tank turret on a bracket attached to the cradle and the gun fence on the right side.

The coaxial machine gun is aimed at the target using the same mechanisms or control panel as the cannon. The machine gun's trigger mechanism is powered by an electric trigger connected to the tank's control system.

The design, purpose and operation of the coaxial machine gun are described in detail in the operating manual 6P7K.00.000 TO.

The machine gun installation consists of :

– bracket 16 (Figure 9.1);
– frames 17;
– front slider 4 and rear slider 18;
– guide tray 25;
– upper catcher 24 and lower catcher 26;
– horizontal screw 20;
– front rack 3 and rear rack 19 and machine gun embrasure seal with gas outlet 11.

Frame 17 with sliders is installed on bracket 16 using the front racks 3 and back racks 19. Front strut 3 fits into the vertical cylindrical hole of the bracket and is secured with a nut and locknut. The rear post 19 fits into the hole of the horizontal screw 20 and is secured with two bushings 21. The horizontal screw 20 is installed in the eyes of the bracket 16 and is attached to it with bushings 22. The rear post 19 and the horizontal screw 20 in combination with the bushings 21 and 22 screwed onto them constitute the alignment mechanism . Bushings 21, 22 have ten divisions along the circumference for ease of work when aligning the machine gun.

At the ends of the frame 17 there are two platforms with guides for the front slider 4 and the rear slider 18. A pin for installing a machine gun is attached to each slider on a chain. The chain fastening screw on the rear slider serves to limit the rearward movement of the slider. On the front slide 4 there is a shock absorber that softens shocks when the machine gun rolls back and forth during firing. The shock absorber consists of a front spring 5, a rear spring 2, a screw with a nut and a lock nut.

The upper catcher 24, attached to the machine gun bracket 16, serves to direct spent cartridges and tapes into the lower catcher 26, which is a collection of spent cartridges and tapes. The lower catcher 26 is quick-detachable, consists of a metal casing and a canvas bag containing 20 pieces of tape (25 links each) and 500 spent cartridges. It is attached to the gun with a front stopper 13 and a rear stopper 15.

Box 14 is installed in the guides of the lower catcher 26 and is held by a spring loop.

A quick-release guide tray 25 is attached to the right side of the bracket 16 and serves to feed the tape into the receiving window of the machine gun.

The ball seal of the machine gun embrasure is installed on the machine gun barrel and serves to prevent shock waves, radioactive dust and lead splashes from penetrating into the turret. It consists of bushings 6 and 7, spring 8 and hinge 9. Gas outlet 11 is installed on the barrel of the machine gun and forms a channel between the gas machine gun tube 12 and bushing 6 to remove powder gases to the outside of the tank.

The cover 10 is secured with quick-release wing screws outside the embrasure part of the turret and is designed to protect against dirt and seal the embrasure machine gun during underwater driving.

2.9.4 Remote machine gun installation

A remote machine gun mount (RMG) with a 12.7 mm 6P49 machine gun is designed to combat stationary and moving targets: tank-dangerous manpower and lightly armored vehicles at ranges of up to 2000 m.

The control panel is located on the roof of the tower, on the right, behind the commander's hatch. The axis of rotation of the installation turret coincides with the axis of rotation of the panoramic sight (Figure 9.2).

The DPU consists of a rotary turret 7 and a machine 1 installed on it.

Turret 7 is designed to aim the remote control unit along the horizon. The turret includes a base 5, a support 6, a running device 8, a GN gearbox pos. 2, GN position sensor gearbox pos. 3 and electromagnetic stopper GN pos. 4.

The base 5 is fixedly fixed on the tower flange and serves to accommodate the GN gearbox pos. 2, GN position sensor gearbox pos. 3, electromagnetic stopper GN pos. 4 and running device 8.

GN gearbox pos. 2 electromechanical, designed to point the remote control along the horizon. The output gear of the gearbox meshes with the movable gear ring.

Reducer of the GN position sensor pos. 3 is designed to transmit rotation from the gear ring to the DPU position sensor along the GN, which generates an electrical signal about the angular position of the DPU turret. The output gear of the gearbox meshes with the gear ring.

GN stopper pos. 4 is designed to lock the DPU horizontally. In the locked position, the stopper axis enters the locking hole made in a gear chase. The GN stopper has a shaft with a hole for a turret key for manually unlocking the DPU turret.

The running device 8 is a single-row ball bearing. The stationary part of the running device is fixed to the base 5. A support 6 is fixed to the movable gear rung of the running device, which serves to accommodate the machine 1 DPU.

The DPU machine (Figure 9.3) is mounted on the rotating part of the DPU turret and includes:

– rack 15;

– cradle 22 with machine gun 3;
– VN gearbox pos. 14;
– electromagnetic stopper VN pos. 18;
– HV position sensor pos. 13;
– power system;
– protective covers.

The rack 15 is fixed to the turret support and serves to accommodate the cradle with a machine gun, the HV gearbox, the HV stopper and the HV position sensor.

The cradle 22 is installed by means of trunnion assemblies on the rack 15 and is intended to accommodate the machine gun 3 and aim it in a vertical plane. The cradle is equipped with a shock absorber 23, a cocking mechanism 21, a gear sector of the HV drive, and a hole for locking along the HV, limit stops and guide grooves for installing a machine gun.

Machine gun 3 is installed in the guide grooves of the cradle and secured to it through the shock absorber rod with pin 25. The design, purpose and operation of the 6P49MT machine gun are described in detail in the operating manual 6P49MT.00.000 RE.

The shock absorber 23 is mounted on the cradle and serves to dampen the recoil energy of the machine gun when firing.

The cocking mechanism 21 of the machine gun consists of a cable with a handle 20, a carriage 24 with a roller and a return spring. The carriage serves to connect the cable drive to the reloading rod of the machine gun.

HV gearbox pos. 14 is installed on the rack 15 and provides guidance of the machine gun in the vertical plane. The output gear of the HV gearbox engages with the gear sector of the cradle.

Electromagnetic stopper VN pos. 18 with a lever system is fixed to the rack 15 and serves to lock the DPU cradle in the stowed position and the reloading position. In the locked position, the axis 17 enters one of the locking holes made in the vertical wall of the cradle. The 19-sl lever is used for manually unlocking the cradle.

HV position sensor pos. 13 is installed on the left trunnion assembly of the DPU machine and serves to generate an electrical signal about the angular position of the cradle.

The power supply system includes a bracket 5, a magazine 4, a tape feeder 6, a receiving tray 1 and a link outlet 12.

Bracket 5 is installed on the rotating part of the DPU turret and serves to secure the magazine 4 and tape feed 6.

The magazine 4 is fixed to the bracket 5 by a locking axis 7 and is designed to accommodate the ammunition for the machine gun. The magazine consists of a box with a horizontal partition and a hinged lid. In the closed position, the lid is secured with lock 2.

The tape feed 6 is fixed to the bracket 5 and serves to supply the cartridge tape from the magazine to the receiving tray 1.

Receiving tray 1 is fixed to the cradle and serves to direct the cartridge belt into the receiving window of the machine gun.

The link outlet 12 is fixed on the cradle and serves to remove the spent cartridge strip from the area of the moving parts of the installation.

Protective covers 9, 10, 11, 16 are designed to protect the DPU from dirt.

The casing 11 of the machine gun is folding and is designed to quickly eliminate delays and reloading. In the working position, the casing is fixed on the cradle with screw 8.

2.9.4.1.1 Flexible cable DPU

The DPU flexible cable is designed to transmit on-board network voltage and electrical signals between the DPU and the DPU control equipment.

The flexible cable is laid between the movable support of the DPU machine, the rim with rollers and the fixed casing. When the DPU machine is rotated, the flexible cable moves along a rim with rollers. The flexible cable is covered with two shields on top. The shields are bolted to the support of the DPU machine.

2.9.5 Weapon stabilizer

2.9.5.1 Purpose of STV

STV is intended for:

– stabilization in two planes of the gun and the coaxial machine gun when firing from a place and on the move according to signals from the PNM (in the “MAIN” mode) or the control panel (in the “DOUBLE” mode) ;

– practicing the gun and turret's aiming angles and lateral lead based on signals from the warhead in the "MAIN" and "DOUBLE" modes;

– automatic holding of the cannon, coaxial machine gun and PDT aiming line in a stabilized position in two planes when firing from a place and on the move in the “DOUBLE” mode;

– aiming a stabilized cannon and a coaxial machine gun in two planes with a smooth change in the aiming speed;

– turret transfer (pointing the turret at the highest possible speed);

– target designation from the tank commander to the gunner (coordination of the turret and gun with the PKP aiming line);

– bringing the gun to the loading angle and holding it in this position for the duration of loading;

– aligning the gun with the line of sight after loading is completed;

– emergency rotation of the turret by the driver from the EMERGENCY TURN CAP button on the driver's control panel;

– hydraulic locking of the gun when it rebounds from the upper or lower stops at an absolute speed of more than 7 °/ s ;

– hydraulic locking of the gun after firing for the duration of rollback;

– control of the electromagnet of the turret rotation mechanism (switching between manual turret pointing and automatic turret pointing by the GN STV drive).

2.9.5.2 Stabilizer design and placement of its components

The tank weapon stabilizer (hereinafter referred to as STV) consists of an electro-hydraulic drive that stabilizes and points the cannon and coaxial machine gun in the vertical plane (VN drive), an electromechanical drive that stabilizes and points the turret along with the cannon and coaxial machine gun in the horizontal plane (GN drive) and support equipment performing drive control functions.

Composition and placement of the hydraulic drive (VN STV drive):

– power supply installation - in the tower, under the cannon on the bottom sheet of the fence;

– executive cylinder - in the turret, to the left of the gun in front of the PDT;

– hydraulic installation kit (hydraulic hoses) - in the tower, connects the supply unit and the actuator cylinder;

– pressure sensors (2 pcs.) are located directly in the executive cylinder.

Composition and placement of the GN STV drive:

– power amplifier - in the chassis, on the left side in the area of the batteries;

– executive engine (electric motor) - in the chassis, in the electromechanical mechanism for turning the turret on the left side.

Composition and placement of support equipment:

– control unit - in the turret, behind the commander;

– sensor block - in the turret, under the cannon on the bottom sheet of the fence;

– linear acceleration sensor - on the roof of the turret, to the right of the gun in front of the commander's hatch.

– electrical installation kit (electrical harnesses) - in the turret and chassis, connects the stabilizer equipment to each other and to the tank equipment;

– the actuation device is in the turret, to the left of the gun on the fence, in front of the lifting mechanism;

– limiter - in the turret, to the left of the gun on the fence, above the handle of the lifting mechanism.

N o t e - the electromagnet of the turret rotation mechanism is not included in the STV, but is controlled by signals from the STV BU. Electromagnet 15 (Figure 6.8) MPB is located in the tower on the housing of the manual MPB.

2.9.5.3 Operating principle of the weapon stabilizer

The principle of operation of the STV in the “MAIN” and “DOUBLE” modes is based on constant compensation (in real time) in two planes of mismatch between the stabilized line of sight of the PNM (PKP) and the gun (turret), taking into account the ballistic corrections generated by the BV.

In the “MAIN” and “DOUBLE” modes, the gun and turret are aimed by aiming the PNM (PKP) line of sight using signals from the guidance console (commander’s console) and compensating for the mismatch between the stabilized PNM (PKP) aiming line and the gun (turret). The turret transfer is ensured when a sign of transfer and a transfer direction appear from the warhead, generated by signals from the guidance console (commander's console).

The principle of operation of the weapons stabilizer in the “DUBLER” mode is based on compensation of disturbing influences based on signals from the sensor unit.

In the “DOUBLE” mode, guidance of the gun and turret is carried out due to the direct guidance of the gun and turret using signals from the guidance console (commander’s console), and if the level of signals from the GN reaches a threshold (close to the maximum) value, then the transfer of the turret is activated.

Bringing the gun to the loading angle and holding it in this position for the duration of loading is carried out according to signals from AZ and actuator.

2.9.5.4 Locking the drives of the main and high voltage weapons stabilizer during operation of the fire control system

To ensure safe operation of the crew and normal operation of the stabilizer, locking of the GN and HV drives is provided.

Automatic shutdown of the GN drive is carried out in the following cases:

– when the tower is locked - to prevent overload of the GN drive;

– with the driver's hatch open - to avoid injury to the driver when turning the turret;

– when setting the AVT - RUCH toggle switch on the control panel of the control system and AZ or on the loading panel to the RUCH position;

– when the HV actuator motor is overloaded, for example, as a result of prolonged work on a steep slope. In this case, the unloading circuit is activated, as a result of which the power of the GN drive is limited for a period of time of no more than 1 minute. When the unloading scheme is in effect, the turret may not rotate in the direction of raising the gun barrel; spontaneous rotation of the turret in the direction of lowering the gun barrel is possible. When the unloading scheme ceases, the tower jerks back to the position agreed with the PNM (PKP). If the overload is not removed, the unloading circuit may operate again.

The HV drive provides for hydraulic locking of the gun onto the turret in the following cases:

– after the shot for the duration of the rollback;

– when the gun rebounds from the turret stops with an angular velocity of more than 7 ˚/ s in order to avoid repeated collisions of the gun with the stops;

– when the mechanical lift lever is in an intermediate position;

– when the frame of the CBM and the grip of the MPC are not completely lowered ;

– when the gun is stopped by an electric machine stopper;

– when the gun is braking as it moves from top to bottom at a speed of more than 7˚/ s ;

– when the STAB toggle switch is turned off on the control panel of the control system and AZ;

– with the driver's hatch open - to avoid injury to the driver with the gun when aiming.

2.9.6 Automatic loader

Automatic loader (hereinafter referred to as AZ) is an electromechanical complex designed for automatic loading of a gun.

A Z consists of the following main assembly units:

– rotating conveyor;

– cassette lifting mechanism;

– tray removal mechanism;

– rammer;

– docking device (from the UVI);

– electric machine gun stopper;

– control unit;

– distribution box;

– control panel;

– loading console;

– electrical installation kit.

2.9.6.1 Operation of the automatic loader

2.9.6.1.1 Operation of indicators for the presence of type and number of shots

By setting the shot type switch on the SLA and AZ launchers to positions B, K, O, U, R , C, the presence of shot types loaded into the VT is determined. If the selected type of shot is loaded into the VT, then the indicator “THERE IS A TYPE” pos. 6 (Figure 9.5) lights up.

The number of shots of the selected type loaded into the VT is determined by indicator 5 (Figure 9.6) by setting the shot type switch on the PZ to positions B, K, O, U, R , S.

2.9.6.1.2 Operating principle A 3

automatic charging cycle begins by pressing the ON button. AZ on PU AZ or AZ Platoon on the PK-90 (when the “DOUBLE” mode is turned on) with shots loaded into the VT, and the VT begins to rotate. When a cassette with the selected type of shot approaches the release window, the VT slows down and stops. Simultaneously with the rotation of the VT, the gun is brought to the loading angle and locked with an electric machine stopper. Simultaneously with the braking of the VT , with the gun locked by an electric machine stopper, the CBM frame rises. After the VT stops , with the CBM frame raised (or moving upward), the cartridge with the shot rises to the projectile dispensing line and is locked in this position.

If the gun is loaded by type P or C , then the cassette in front of the projectile dispensing line stops and is locked on the line of transmitting flight time to the projectile by a docking device. Then the housing with the docking device funnel extends, docks with the projectile, the flight time is transferred to the projectile, after which the housing with the funnel returns to its original position. After the flight time is transferred to the projectile, the cassette rises to the projectile dispensing line and is locked in this position.

After this, the rammer chain sends the projectile into the gun chamber and the rammer chain returns to its original position. At the same time, at the end of the projectile delivery, the ejection hatch cover opens, the pallet is thrown out and the hatch cover is closed, and the number of shots on the PZ indicator decreases by one. Then the cassette is lowered and locked on the charge delivery line. After locking the cassette, the charge is sent into the gun chamber, the

gun bolt wedge is closed, and the rammer circuit returns to its original position. The empty cassette and frame are returned to the lower position, and the gun is removed from the stopper and brought to a position consistent with the aiming line. The loading cycle is completed, the gun is ready to fire a shot.

The cyclogram of the AZ operation is shown in the figure .

2.9.6.2 Composition of the automatic loader

2.9.6.2.1 Rotating conveyor

The rotating conveyor serves to place shots and deliver them to the dispensing window. It is installed on the bottom of the tank hull and consists of the following components: frame 15 (Figure 9.8), electromechanical drive, flooring 12, closing mechanism for the dispensing window with shutters, stopper, manual drive, linear device, cassettes 21 and local protection.

2.9.6.2.2 Frame

The frame is used to accommodate 22 cassettes and is a welded structure consisting of outer and inner rings with racks and supports connected to each other by pipes.

The frame is bolted to the upper shoulder strap of the VT running device and rests on five support rollers 16 installed on the bottom of the body.

Removable protective shields are attached to the frame, designed to reduce the temperature impact on the ammunition rack in the event of ignition of flammable substances on the bottom of the tank.

2.9.6.2.3 Running device

The running device is designed to ensure rotation of the VT and is the main support of the conveyor.

The running device consists of a glass 20 with balls placed in raceways, an upper strap 18 with a gear ring and a lower strap 19.

There is one hole in the glass, and in the upper strap there are 22 holes for fixing the VT frame with a stopper.

To prevent the entry of dust and dirt, the holes in the upper strap are sealed with a rubber gasket with a clamp.

The lower shoulder strap is fixedly fixed to the bottom. The glass is connected to the tower by a driving device.

In the locked position (the VT stopper rod is extended), the deck and the cup are interlocked with the VT frame and rotate together with the tower relative to the lower shoulder strap.

When the VT is extended, the VT frame rotates relative to the glass on the balls.

2.9.6.2.4 Electromechanical drive

The electromechanical drive is designed to rotate the VT and is located on the conveyor bowl. The drive is a four-stage helical gearbox with a spring safety link and an electric motor.

The lower output gear of the gearbox meshes with the ring gear of the upper ring, and the upper gear transmits rotation to the cassette position sensor shaft, which is mounted on the gearbox housing.

2.9.6.2.5 Cassette

The cassette is used to accommodate a shot of any type and consists of the following components: tray 13 (Figure 9.9) and pipe 1 welded together; spring-loaded latches 3, 4, 7, 9, 12 and a roller 6 for opening the latches.

The tray and cassette tube, together with the tray located on the breech of the gun, form a guiding surface when sending the projectile and charge.

The charge is placed in the pipe and is kept from moving by a latch 12 and a bar 10.

The tray has latches 3, 4, 7, 9 for fixing and holding projectiles:

– latch 3 - for a guided projectile;

– latch 4 - for high-explosive fragmentation projectile;

– latch 7 - for a cumulative projectile;

– latch 9 - for an armor-piercing sabot projectile.

Plank 11 together with latches holds the projectile in the pipe.

The cassettes are installed in the conveyor between the racks and frame supports and are kept from moving by guide bars.

2 hooks are welded to the cassette pipe, with which the cassette is held using a gripper when lifting and lowering.

The latches are installed so that when loaded they allow the projectile and charge to pass through and secure them in the cassette.

To remove the projectile, you need to open the latches by turning the roller by hand by lever 8, and to remove the charge, open the latch 12. These operations are performed by crew members from the commander and gunner's position.

Latches 3, 4, 7, 9 during A3 operation are opened by roller 6 when lever 5 runs against the stop on the inside of the left guide of the MPK, and latch 12 - when it runs against the stop of the right guide.

2.9.6.2.6 Flooring

The flooring covers the conveyor and serves as the floor of the fighting compartment. It is a welded structure consisting of a ring and stamped sheets with a window for dispensing cassettes.

The flooring is bolted to the glass. Additional support for it is provided by supporting rollers 13 (Figure 9.8) mounted on the supports of the VT frame .

To level the flooring in height relative to the supporting rollers (at the VT dispensing window), the flooring is connected to the MPC bracket with two ties.

2.9.6.2.7 Stopper VT

The VT stopper is designed to lock the VT frame relative to the tower in a step equal to 1/22 of a circle (according to the number of cassettes), which ensures the position of the cassette in the dispensing window to engage it with the MPC gripper.

The stopper is located inside the sleeve of the running device and constantly, under the action of a spring, stops the upper shoulder strap with the frame relative to the cup with the flooring. To unlock the VT, the stopper is actuated by an electromagnet or a manual drive.

To dampen the energy of inertial masses that arise when stopping the VT, there is a stopper buffer in the glass.

To prevent dust from entering through the hole in the glass, the stopper rod is sealed with a rubber cuff.

2.9.6.2.8 the VT dispensing window

the VT dispensing window is designed to protect the conveyor from foreign objects getting into it.

It is located in the VT dispensing window and consists of two spring-loaded flaps with levers. In the initial position, the MPC grip presses the valve levers and closes the VT dispensing window .

When the gripper moves upward, the arms become vertical under the action of springs and remain in this position until the gripper returns to its original position. The doors close under the action of the gripper when it returns to its original position.

2.9.6.2.9 Manual drive VT

VT manual drive is designed to rotate the conveyor manually after it has been unlocked by a manual drive to the stopper. It consists of a manual drive to the VT stopper and a manual drive VT.

The manual drive to the VT stopper is placed on the VT flooring and consists of a manual drive handle 9 and a cable 10. The cable is fixed at one end to the handle, the other end is led through a guide tube and rollers to the VT stopper lever and is constantly under tension using a spring.

The VT manual drive is located on the conveyor cup next to the handle 9 of the manual drive to the VT stopper and consists of the following components: a handle, a ratchet mechanism and a bevel gear, the output gear of which is meshed with the ring gear of the upper ring.

2.9.6.2.10 Local VT protection

Local VT protection is designed to protect ammunition stored in mechanized stowage.

It consists of front 17, left 14 and right 22 fences attached to the bottom of the tank hull. There is a removable sheet on the right guard in the heater area.

2.9.6.2.11 Cassette position sensor

The cassette position sensor (rotating transformer) provides information for braking and stopping the VT .

The sensor is installed on the VT drive gearbox .

2.9.6.2.12 Cassette lifting mechanism

The cassette lifting mechanism serves to bring the cassettes to the dispensing or loading line and then return them to their original position.

The MPC is attached to two brackets welded to the rear part of the tower, and consists of the following main components: bracket 6 (Figure 9.10) for lifting cassettes, gripper 12, two chains 7, gearbox 4, manual drive, locking device and contact device 3.

2.9.6.2.13 Cassette lifting bracket

The cassette lifting bracket is a welded structure of two guides. There are grooves in the guides of the bracket along which the grip 12 moves with chains 7 on rollers. The cassette moves in the guide bars 8, 9 10, 22.

The following stops are installed inside the MPC bracket:

– on the left guide there is a stop 11 for opening the latches holding the projectile;

– on the right guide there is a stop 21 for opening the latch that holds the charge.

At the bottom of the bracket, support strips 14 are welded to support the grip.

2.9.6.2.14 Capture

The grip consists of the following components: body 3 (Figure 9.11) with hooks 6, clamp 7, two earrings 2, stops 9, shield 10, cams 1, springs 8 and axis 5.

The gripper, when moving upward, picks up the cassette with hooks and holds it with cams pressed by springs. When the gripper moves downwards, the cams release the cassette after the clamp stops in the support bars 14 (figure) of the MPK bracket and the springs are compressed. Axis 5 (Figure 9.11) serves to lift the pallet stop when the gripper approaches the delivery line.

To move the gripper, there are two open-type plate bushing-roller chains in the guide grooves of the MPC bracket. The chains are moved by gear sprockets.

2.9.6.2.15 Gearbox

Gearbox 4 (Figure 9.10) - three-stage, with spur-cut cylindrical wheels of external gearing, with a spring safety link and two drive sprockets.

The gearbox is driven by a reversible electric motor 1.

2.9.6.2.16 Locking device

The locking device is located on the output shaft of the gearbox and consists of an electromagnetic stopper 5 and a locking disk 20. The electromagnetic stopper, entering under the action of a spring into the grooves of the locking disk, fixes the gripper with the cassette in one of five positions:

– initial (the grip in the lower position does not hold the cassette, while free rotation of the VT is ensured);
– on the information transmission line;
– on the loading line with VT shots;
– on the projectile delivery line;
– on the charge delivery line.

2.9.6.2.17 Contact device

The contact device is built into the gearbox housing and ensures the operation of microswitches to turn on and off the electromagnetic stopper of the locking device and issue signals to the A3 control circuit .

2.9.6.2.18 Drive to contact device

The drive to the contact device is made from the output shaft of the gearbox by a pair of cylindrical spur wheels. The copier is installed on the gear.

During operation, the copier protrusions press on the corresponding microswitches.

2.9.6.2.19 Manual drive MPK

The MPC manual drive is located on the right side of the MPC bracket. It consists of the following components: handle 15 with a key, chain drive 17, locking disk 16, lock 19, lever 18, drive 2 to the electromagnetic stopper.

The handle with the key has two positions: initial and working. In the initial position, the handle locks into one of the holes in the locking disc. In the working position (with the key pressed), the handle lock is retracted.

The locking disc is fixedly fixed on the MPC bracket.

2.9.6.2.20 Rammer

Rammer 1 (Figure 9.8) is designed to send shot elements into the gun chamber. It is installed on the bottom sheet at the rear of the tower and consists of a gearbox with a reversible electric motor, a chain and a volute.

2.9.6.2.21 Rammer gearbox

The rammer gearbox is two-stage, with cylindrical wheels of external gearing, with a safety disc friction clutch and a drive sprocket.

The slipping torque of the clutch is regulated by a nut located under the cover on the left side. The gearbox has a square shank for installing a device for measuring the slipping torque of the rammer clutch.

A pusher type chain consists of internal and external links, axles and rollers hinged to each other. The chain links are made with one-way rotation on the axes. The front links are of a locking type, so when they exit the crankcase they form a rigid rod, which ensures that the elements of the shot are sent into the gun chamber.

On the first link of the chain, spring-loaded flaps with vulcanized corrugated rubber on the front side are hinged on axles.

In the initial position, the chain is placed in the volute and fixed in the crankcase with a spring-loaded clamp.

To prevent the chain from disengaging with the sprocket in the absence of a shot, the cassette is equipped with an idle speed limiter on the last link of the chain, which is a link with a smaller pitch than the other links, which ensures that the chain is locked.

The contact device activates microswitches to issue signals to the control circuit A3 and is located in the crankcase cavity. The drive to the contact device is made from the output shaft of the gearbox by a pair of cylindrical

spur wheels. The copier is made together with the gear. During operation, the copier protrusions press on the corresponding microswitches.

2.9.6.2.22 Pallet removal mechanism

The sump removal mechanism (hereinafter referred to as the CBM) is designed to catch the extracted sump and remove it from the tank.

The CBM consists of a catcher, a catcher drive, a stop 4 (Figure 9.8) of the pallet, an ejection hatch 3 and a drive for the ejection hatch cover.

2.9.6.2.23 Catcher

The catcher is designed to catch the pallet extracted from the gun and consists of a frame 7, hinged on the gun guard; trap 6 with holding trays, hooks and plate torsion bars located in the pipe and an electromagnetic stopper 5 CBM attached to it.

With the torsion bars cocked in the initial position of the frame, the hooks are held by a rod that is connected to the gun guard.

Electromagnetic stopper 5 is designed to hold the hooks during the process of lifting the frame before throwing and releasing them to remove the pallet through the ejection hatch.

2.9.6.2.24 Drive to catcher

The drive to the catcher consists of a worm gearbox with a rack, a torsion bar that acts as a delivery link, and levers with a rod.

There is a contact device in the gearbox housing. The drive to the contact device is carried out from the gearbox shaft by a pair of cylindrical spur wheels.

The driven gear is integral with the copying disk on which the copiers are installed. During operation, the copiers press the corresponding microswitches, ensuring their operation and issuing signals to the control circuit A3 for raising and lowering the frame.

2.9.6.2.25 Pallet stop

The tray stop is designed to hold the tray in the catcher after extraction. It is hinged to the gun guard. An electric button is installed in the pallet stop, signaling the presence of a pallet in the catcher.

In the initial position, the pallet stop is fixed by a stopper installed on the CBM frame. The tray stop can be raised manually by pulling the stopper by the ring.

2.9.6.2.26 Ejection hatch and drive to it

The ejection hatch and the drive to it are designed to ensure ejection of the pallet from the tank and ventilation of the fighting compartment after a shot. The hatch cover is hinged on the roof of the tower and connected to a worm gear through a system of levers.

The gearbox is mounted on brackets welded into the tower.

2.9.6.2.27 Electromechanical gun stopper

The electromechanical gun stopper is designed to reliably hold the gun at the loading angle. The electromechanical stopper is mounted on a bracket in front of the turret roof on the right side of the gun.

The stopper is driven by a reversible electric motor through a three-stage reduction gearbox and a spring clutch. Inside the case there is a copier with microswitches. For manual removal of the gun from the stop, there is a square shank on its body. The shank key is attached to the stop body.

2.9.6.2.28 Loading panel PZ185-3S

The PZ185-3S loading console is designed to control A3 in semi-automatic loading and unloading mode, manual loading and displaying the amount of ammunition loaded into the VT. It is installed on the right side of the tower.

The loading console contains:

– indicator 1 (Figure 9.6) AZ readiness for operation (color of light - yellow);
– indicator 2 of AZ operation in MANUAL mode (illumination color - red);
– STOP indicator VT pos. 3 (glow color - green);
– indicator 4 of the presence of a pallet in the CBM catcher (glow color - red);
– indicator 5 of the presence of the type of ammunition loaded into the VT;
– switch 6 types of ammunition;
– button 7 for turning on AZ;
– toggle switch 8 for switching on operating modes AZ (AVT - RUCH);
– toggle switch 9 for turning on the unloading and loading modes AZ (UNLOADING - LOADING);
– Toggle switch 10 for CBM control (FRAME EMISSION - EXIT).

2.9.6.2.29 Control panel of control system and AZ

The FCS and AZ control panel is designed to turn on the fire control system, turn on the stabilized control of the PNM and STV, select the type of shots and type of weapon, turn on the automatic loader and indicate the state of the FMS and the automatic loader mechanisms. It is located in the turret directly in front of the gunner, above the guidance console.

On the control panel of the control system and AZ there are:

– indicator "SUO" pos. 1 (Figure 9.5);

– "STAB" indicator pos. 2;

– toggle switch " AVT - MANUAL" pos. 3 (switching AZ operating modes. “ AVT ” - automatic, “MANUAL” - manual);

– indicator “THERE IS A TYPE” pos. 6;

– indicator "PALLET" pos. 5;

– "AZ READY" indicator pos. 4;

– switch 7 types of shots and types of weapons;

– ON button AZ" pos. 8;

– "MANUAL" indicator pos. 9;

– toggle switch "STAB" pos. 10;

– toggle switch "SUO" pos. eleven.

2.10 Fire control system

2.10.1 Purpose and composition of the fire control system

The tank is equipped with an automated multispectral fire control system that provides the following main functions:

– 24-hour detection, recognition and destruction of targets through the gunner's multi-channel sight (MCM) and the commander's panoramic sight (PKP);

– effective targeted shooting by a gunner from a cannon (including a guided missile) or a coaxial machine gun, day and night, from a standstill and on the move;

– effective targeted shooting by the commander from a cannon or a coaxial machine gun, day and night, from a standstill and on the move;

– high-precision stabilization of the aiming lines of PNM, PKP and main weapons for effective shooting on the move;

– all-round visibility of the terrain by the commander, regardless of the gunner, through the use of the commander's panoramic sight (PKP) with the ability to measure range with a laser rangefinder;

– automatic preparation of initial data for firing from a cannon, coaxial machine gun and remote-controlled machine gun installation (RCM) due to automatic accounting of all meteorological and ballistic characteristics, including roll and pitch, target angular velocity, own speed, gun barrel bending, atmospheric pressure, air and ammunition temperature, barrel bore wear, barrel bending, etc.;

– automatic preparation of initial data for effective firing of ammunition with remote detonation;

– effective destruction by the commander of tank-dangerous manpower, including during active maneuvering of the tank, regardless of the gunner, through the use of a dual-plane stabilization control system;

– simultaneous and independent automatic tracking of targets through PNM and PKP;

– automated target designation from the commander to the gunner with automatic setting of the parameters of the PNM channel TP (range to target, field of view, focusing, etc.), in accordance with the current parameters of the PKP channel TP, and automatic capture of a target accompanied by the commander in the field of view of the PNM TP channel;

– automatic coordination of the PKP field of view with the direction or landmark chosen by the commander using an electronic map of the area on the multifunctional commander’s panel (from the PTC);

– automatic coordination of the aiming line of the PKP and DPU (with the DPU turned on) to the target area observed by the commander through the commander’s observation device;

– prompt selection of the commander’s prism observation device(s), through which the target at which the PKP is aimed will be visually observed;

– conducting targeted shooting, including on the move, in emergency mode (if the fire control system fails) from the gunner's and commander's workstations through a backup television sight (PDT);

– conducting targeted shooting from the gunner's position using manual drives and mechanisms in the partial or complete absence of power supply to the control system equipment from the tank's on-board network;

– adjusting the aiming line of the PKP or rotating the turret along the GN according to commands from the SPZ.

The diagram of the main functional relationships of the control system equipment is shown in Figure 8.1 .

2.10.2 Placing the fire control system equipment in the tank

Multichannel gunner's sight (MPM) pos. 7 (Figure 1.5) is installed in the turret in the gunner’s position to the left of the PDT.

The PNM consists of block 1 (Figure 8.2) for stabilizing the gunner's multi-channel sight and block 2 for sighting and rangefinder with a thermal imaging camera, pos. 16.

Block 75 (Figure 1.5) of the PNM control unit (CU PNM) is installed on a bracket next to the computer unit (behind the gunner’s seat).

Commander's panoramic sight (PKP) pos. 4 8 (Figure 1.4) is installed in the turret behind the commander.

The control panel is structurally an optical-electronic unit, which consists of an adapter block 10 (Figure 8.3), a mirror block 3, and a driving rotating contact device 21. The sighting and rangefinder unit with a thermal imaging camera is located in the internal parts of the optical-electronic unit .

Block 73 (Figure 1.4) control panel (PKP control unit) is installed on the right side of the tower (behind the commander’s seat) .

The engine control unit is installed in the rear part of the turret (on the rear wall of the turret) directly next to the block near the STV control panel (behind the commander's seat) .

Duplicate television sight (PDT) pos. 12 (Figure 1.5) is installed in the turret to the left of the gun (to the right of the PNM). Drive 14 (Figure 8.4) is mechanically connected to module 1 of the PDT and the gun. The drive has a mechanism 31 for vertical alignment of the PDT.

The backup power supply is installed on the deck of the rotating conveyor under the gun (in the bow of the turret).

Panel 49 (Figure 1.5) for controlling the gunner's PDT is installed on a bracket on the left side of the turret under the APU and Pn-PNM.

Panel 14 (Figure 1.4) for controlling the commander's PDT is installed on a bracket on the right side of the turret above the commander's console.

Block 70 (Figure 1.5) of the computer is installed on the left side of the turret under the BTsOI (behind the gunner’s seat).

The air temperature sensor is installed outside the tower on the wind sensor rack.

The meteorological sensor is installed on the flooring of the rotating conveyor at the commander's place directly next to the window for issuing cassettes.

Panel 10 (Figure 1.4) control panel is installed on a bracket on the right side of the tower under the commander's APU.

Panel 51 (Figure 1.5) of the PNM control is installed on a bracket on the left side of the turret under the gunner’s APU.

indicators 6 (Figure 1.4) are installed in the commander's hatch directly next to the commander's observation devices.

The direction indicator adapter is installed at the commander's position in the forward part of the turret.

Video viewing device (VSU) pos. 8 (Figure 1.4) of the commander is installed on a bracket on the roof of the tower above the Pn-PKP.

Multifunctional panel 11 (Figure 1.4) is installed to the right of the commander’s APU.

Video viewing device (VSU) pos. 54 (Figure 1.5) gunner is mounted on a bracket on the left side of the turret.

The wind sensor is installed outside the turret on a stand in the area of the gunner's hatch.

Sensor 70 (Figure 1.4) roll and pitch is installed on the roof of the turret (behind the gunner's seat) between the STV control unit and the MPK.

N o t e - The placement of equipment not listed in this section (DI, STV, SU DPU, BTsOI, BKVS, DPP, PN , PK, BZ, DPB, PT-800, RFN3/3, etc.) is described in the relevant sections.

2.10.3 Fire control system operating modes

The fire control system ensures independent operation from the commander's and gunner's workstations in the following modes:

– for the commander:

- "OBSERVATION" mode ("OBSERVATION");
- "DPU" mode;
- “DOUBLE” mode;
- "Double" mode;
- “TARGETING” modes;

– for the gunner *:*

- “OBSERVATION” mode;
- BASIC mode;
- "Double" mode.

2.10.3.1 “OBSERVATION” mode

The “OBSERVATION” mode is intended for the commander to maintain a 360-degree view of the terrain, detect and recognize targets at any time of the day, and measure the range to targets (using the control panel).

After turning on the fire control system in the “OBSERVATION” mode, the commander has the opportunity to:

– work with the BV menu;

– bring the PKP field of view to the selected sighting direction through the commander’s prism observation devices using direction indicators;

– conduct a survey of the area and search for targets in the near zone through the surveillance TV channel of the control panel (taking into account the limitations of visibility of the stationary control center) or through the strategic offensive weapon;

– conduct a survey of the area and search for targets through the main TV or TP channels of the control panel (taking into account the limitations of visibility of the fixed control center) or through the strategic offensive weapons;

– measure the range to targets using the LD PKP;

– use the functions of improving the quality of video images of TV channels of the control panel;

– capture targets for automatic tracking;

– instantly turn on the combat mode from the commander’s seat (turn on the “DPU” mode).

After turning on the fire control system in the “OBSERVATION” mode, the gunner has the ability to:

– work with the BV menu;

– direct the line of sight of the PNM using the manual drives of the gun and turret (by tracking the PNM over the position of the gun);

– monitor the area through the PNM TP channel;

– monitor the terrain through the PNM sighting channel;

– measure the range to targets using LD ISM;

– instantly switch the control system into combat mode from the gunner’s position, into the “MAIN” mode.

2.10.3.2 "DPU" mode

The “DPU” mode is the “OBSERVATION” mode with the DPU turned on, which, in addition to the capabilities of the “OBSERVATION” mode, ensures firing from the DPU from the commander’s position.

2.10.3.3 "DOUBLE" mode

The “DOUBLE” mode is intended for duplicate control from the commander’s position when it is impossible to work from the gunner’s position. In the “DOUBLE” mode, detection and recognition of targets is ensured at any time of the day, measurement of range to targets, firing from a cannon and coaxial machine gun from the commander’s position (using PKP) with all types of ammunition except guided missiles.

2.10.3.4 BASIC mode

The “MAIN” mode is intended for detection and recognition of targets by the gunner at any time of the day, measuring the range to targets when firing from a cannon and coaxial machine gun from the gunner’s position (using the PNM). When the gunner is working in the “MAIN” mode, the commander can work in the “OBSERVATION” or “DPU” modes. Operation in the “ MAIN ” mode via the PSM is also possible when the control panel is switched off.

2.10.3.5 "Double" mode

The “DOUBLE” mode is designed to provide the possibility of targeted shooting (using PDT) from a cannon and coaxial machine gun in the event that it is impossible to use the main sights and other equipment of the fire control system, including in the absence of power supply voltage from the tank’s on-board network. If there is power and serviceable STV drives, working with the PDT in the “DOUBLE” mode is possible from the gunner’s position and the commander’s position. In the absence of power or faulty STV drives, operation with the PDT in the “DOUBLE” mode is only possible from the gunner’s position using the manual drives of the gun and turret. If there is no power, work from the commander's position is blocked (when the PDT is turned on from the commander's position, the video image will be displayed only on the gunner's APU).

2.10.3.6 Targeting modes

The fire control system, together with the tank equipment, provides the following target designation modes:

– target designation by the commander to the gunner (in the absence of automatic target tracking), which ensures coordination of the turret and gun (the PNM sighting line) with the PKP sighting line, which remains motionless in space;

– target designation by the commander to the gunner during automatic target tracking through the PKP TP channel and automatic target reacquisition through the PNM TP channel. In this mode, coordination of the ISM line of sight with the control panel line of sight is ensured, which remains motionless in space. In the process of matching the sighting lines of the control panel and the ISM, the TP parameters of the IMS channel (field of view, focusing, etc.) are automatically set in accordance with the current parameters of the TP channel of the control panel. After the line of sight of the ISM and PKP is coordinated, the target is automatically reacquired in the TP channel of the ISM. If the commander has acquired a target for automatic tracking automatically when measuring the range or measured the range after manual acquisition, then the range measured by the commander is transmitted to the gunner automatically;

– bringing the control panel along the GN (field of view of the control panel) to the commander's prism observation device, through which the commander observes the target, by pressing a button on the corresponding direction indicator, including when the control system is operating in the " DOUBLE " mode ;

– targeting the source of laser treatment , i.e. bringing the control panel along the GN (field of view of the control panel) to the radiation source .

N o t e - In the process of target designation to the commander's observation devices and target designation to the source of laser radiation, the field of view of the control panel is automatically brought to the zero position in the VN plane and a wide field of view of the television or thermal imaging channels of the control panel is automatically established ;

– target designation (automatic coordination of the PKP field of view) with the direction or landmark chosen by the commander using an electronic map of the area on the multifunctional commander's panel.

2.10.4 Multi-channel gunner's sight

The gunner's multi-channel sight (hereinafter referred to as the MCM) with a thermal imaging camera provides:

– overview of the area, detection and recognition of targets at any time of the day;

– stabilization of the field of view in two planes;

– aiming and holding the central aiming mark (CRM) on the target according to signals from the guidance console;

– measuring the range to the target with a laser rangefinder;

– formation of a laser control channel (LCC) for firing guided missiles;

– generation of control and information signals to ensure collaboration with the equipment of the fire control system and other equipment of the tank;

– display in the field of view of the sighting channel and on the screens of the APU information about operating modes, type of ammunition, ready-to-fire signal, measured range value;

– automatic input of aiming angles and lateral lead into the weapon stabilizer drives (together with the control system equipment);

– alignment of the central sighting mark of the sighting channel of the sight relative to the gun barrel (according to the index on the optical block);

– built-in alignment of laser channels relative to the sighting channel;

– alignment of the TP channel relative to the sighting channel.

The PNM includes:

– block 2 (Figure 8.2) sighting and rangefinder (hereinafter referred to as BVD);

– thermal imaging camera pos. 16 (hereinafter - TK);

– unit 1 for stabilizing the gunner's multi-channel sight;

– PNM stabilization system control unit.

2.10.4.1 Sighting and rangefinder unit

The sighting and rangefinder unit (hereinafter referred to as the BVD) is a cast housing in which elements of the sighting, thermal imaging and laser channels of the PNM are installed with elements for their alignment.

On the front panel of the BVD, which is also the front control panel of the PNM, the following control and indication elements are located:

– handle 8 (“  ”) for turning on and off the light filter in the sighting channel;

– button 9 (“  ”) to turn off the “EXCESS” mode, turn off the laser control channel and return the pankratic to its original state when working with type U. Designed to turn off the radiation of the LCU and return the pankratic mechanism to its original state when firing a guided missile (type of ammunition “U” "), or turning off the "EXCESS" mode immediately before firing a guided missile (used if necessary);

– button 10 to turn on the illumination of the reticle and save the value of the parameter being changed (“  ”);

– button 11 “MENU ” (“  ”);

– buttons 12, 13 for manually entering the range and changing the digital value ("  ", " ");

– button 14 (“  ”) for switching the multiplicity of the viewing channel;

– readiness indicators of the main PNM systems:

- indicator 21 of readiness for operation of the laser range finder;
- indicator 22 of readiness for operation of the computer unit;
- indicator 23 of the turned on heating mode of the protective glass and eyepiece. Turning on (off) the heating of the PHM is carried out using the PHM control panel;
- indicator 24 of readiness for operation of the stabilization and control system;
- indicator 25 for turning on the “AUTOMATIC” mode (independent mirror stabilization mode). The mode is turned on by the “STAB” toggle switch on the control panel of the control system and AZ;
- indicator 26 of readiness of the laser control channel;

– screw 20 for switching built-in alignment modes. The screw has three fixed positions:

- "  " (" OFF " - middle position");
- "  "(SVK");
- "  " ("DU").

Setting screw 20 to the “ OFF ” position puts the PNM into operating (operational) mode (turns off the built-in alignment mode). Setting screw 20 to the “  ” (“ SVK ”) position turns on the mode of built-in alignment of the sighting channel relative to the gun according to the superscript on the optical block.

Before installing screw 20 to the “  ” (“ SVK ”) position, you must make sure that the gun wedge is open. To ensure focusing and ensure observation of the index on the optical block, the BVD is equipped with optical components, which, when screw 20 is moved to the “  ” (“ SVK ”) position, are installed in the working position. When the HV stabilizer drive is turned on, the gun is automatically brought to the loading angle and locked with an electromechanical stopper, after which the PNM mirror rotates. An image of the superscript on the optical block should appear in the eyepiece. With the HV stabilizer drive turned off, it is necessary to bring the gun using a mechanical lift to lock at the loading angle, check for the presence of play and set the mechanical lift handle to the middle play position.

Setting the screw to the “  ” (“DU”) position turns on the mode of built-in alignment of the LCU relative to the sighting channel (with the selected type of ammunition “U”) or the mode of alignment of the rangefinder channel relative to the sighting channel;

– the screws of the rangefinder channel alignment mechanism "  " are located to the right of the indicators (alignment screw 3 ("  ") of the laser rangefinder horizontally and alignment screw 4 ("  ") of the laser rangefinder vertically);

– the screws of the laser control channel alignment mechanism (socket 15 with vertical and horizontal alignment screws) are located on the lower plane of the BVD.

In addition, on the BVD there are :

– drying indicator 5 of the sighting-rangefinder unit, located above the sighting eyepiece channel behind the forehead 18;

– alignment key 17 and forehead protector 18, which are removable elements of the BVD. The foreheadplate is positioned and secured using lever 6 of the foreheadplate latch;

– eyepiece 7, providing observation of the terrain through the sighting channel at magnifications of “4 ˣ” or “12 ˣ”.

2.10.4.2 Contents of service information in the field of view of the sighting channel

In the operating mode of the control system “MAIN”, the fields of view of the sighting channel at magnification “4 ˣ” and “12 ˣ” contain the following elements:

– central aiming mark 1 (Figure 8.5);

– horizontal strokes 2;

– alignment strokes 3 and 4 LKU;

– indicator 5 of firing circuit readiness (green);

– indicator 6 of the range to the target in meters (four digits);

– indicator 7 indicator of lack of readiness of the LCU and emergency absence of radiation from the LCU (red). The indicator flashes when there is no radiation from the LCU after firing a guided missile or lights up continuously when the LCU is not ready;

– symbol 8 for the presence of automatic target tracking;

– indicator 9 modes “DOUBLE” and “TARGETING” (yellow);

– indicator 10 of the selected type of ammunition and type of weapon.

N o t e - When setting the PNM (with the BVD menu on), indicators 6 and 10 display the designation of the adjustable parameter and the adjustment value.

2.10.4.3 Gunner's thermal imaging camera

The thermal imaging camera is designed to convert thermal radiation into a standard television signal. The main element of the PNM thermal imaging channel is the thermal imaging camera pos. 16 (Figure 8.2), installed in the BVD.

Thermal imaging camera TPK-K (hereinafter referred to as TPK-K) is a sealed rectangular housing.

In TPK-K the desiccant is located on the side surface of TPK-K pos. 27 (Figure 8.2), access to which is provided through the front panel of the PNM.

TPK-K operates in the spectral range from 3 to 5 microns.

2.10.4.4 Contents of service information in a wide field of view of the thermal imaging channel

After the TC enters the operating mode or after switching from the UPL to the ShPZ, the APU screens display corner marks 2 (Figure 8.6a) of the UPL boundaries, and window 1 indicating the status and operability of the stabilization and control system (hereinafter referred to as the SCS), in which, depending on status of the control system, the following information can be displayed:

– “SSU OFF ” - SSU is turned off;

– “SSU ON” - SSU is turned on and ready for operation;

– “SSU” - SSU is preparing for work;

– “SSU OSH 1 ” - no AC voltage;

– “SSU OSH 2 ” - no gyromotor current;

– “SSU OSH3” - the two-plane gyroscopic sensor is not ready;

– “SSU OSH 4 ” - constant voltage of the BS is less than permissible;

– “SSU OSH5” - failure of the arrester in the emergency hospital;

– “SSU OSH 6 ” - no coordination with weapons.

2.10.4.5 Contents of service information in a narrow field of view and in a narrow field of view with electronic magnification of the thermal imaging channel

In the UPD and in the UPD with electronic magnification, the following are displayed on the APU screens:

– sighting mark 5 (Figure 8.7b);

– window 1 (Figure 8.7a) indicating readiness to fire (if ready, the message GOT is displayed);

– window 2 indicating the type of ammunition and type of weapon (the selected type is displayed: B, K, O, P , U, R, S);

– window 3 indicating the range to the target (the measured or manually entered range is displayed). When you simultaneously press the "+" and "– " buttons on the front panel of the BVD, the range is reset and the message "SBR" is displayed in the display window and in the field of view of the sighting channel. In the absence of a reflected rangefinder signal (in case of a miss), "- - - -" is displayed in the display window and in the field of view of the sighting channel;

– window 4 indicating the operating mode of the control system ("OSN" - "MAIN" mode; "DBL" - "DOUBLE" mode; "LOADING" mode - loading the DPU; "TSU" - "TARGET DESIGNATION").

2.10.4.6 PNM stabilization block

The multi-channel sight stabilization unit (hereinafter referred to as the BSMP) provides stabilization and guidance in two planes of the fields of view of the sighting and thermal imaging channels of the MSM. A drying cartridge with silica gel is located in the upper part of the stabilization block.

2.10.4.7 PNM stabilization system control unit

The PNM control unit provides control of the stabilization system, as well as electrical coupling with other elements of the control system. The PNM control unit, based on commands from the control system, switches the operating modes of the control system, controls the operation of gyroscopic elements, and controls the drives of the mirror and arrester of the emergency medical vehicle.

On the side of the PNM control unit cover, fuses are located under plugs 1 (Figure 8.8), 10, 11. The designation of the fuses and their ratings are indicated on the PNM control unit cover. To access the fuses, you need to unscrew the plugs. In addition, emergency indicators, voltage presence indicators and SSU status indicators are built into the cover (see pos. 2-9).

2.10.4.8 Purpose of indicators on the PNM control unit

The indicators on the cover of the PNM control unit are designed to display the following information:

– indicator 2 " ⚠ " ("EMERGENCY") – lights up if the built-in control of the control system does not normally pass (emergency situations, breaks in cables, etc.);

– indicator 3 " ~ " failure in the HV and GN sensor circuits – lights up when fuse 11 under the plug in the HV and GN sensor circuits blows;

– phase presence indicators 4 ("1 ~ ", "2~", "3~") – light up when the corresponding fuses blow;

– indicator 5 of lack of power from the on-board network when the "+27V" fuse blows;

– indicator 6 " ⟷ " ("GN ERROR IS NORMAL") lights up if the GN error is normal (the mismatch between the BSMP mirror and the tower is no more than the permissible value);

– indicator 7 " ↕ " ("VV ERROR IS NORMAL") lights up if the VV error is normal (the mismatch between the BSMP mirror and the gun is no more than the permissible value);

– indicator 8 "GYROSCOPE HEATING IS ON" lights up when the heating of the small-sized gyroscope in the emergency hospital is turned on. There is no indicator mark on the cover;

– voltage presence indicators 9 ("+15V", "-15V", "+5V", "+30V") light up when there is power from the corresponding secondary power sources.

2.10.4.9 Assignment of fuses on the PNM control unit

Fuses "1~", "2~", "3~" are designed to protect AC power circuits.

Fuse 10 under the plug in the "+27V" power circuit is designed to protect the DC power circuit.

Fuse 11 " ~ " under the plug in the HV and GN sensor circuits is designed to protect the power supply circuits of the BSMP angle sensors for HV and GN.

2.10.4.10 Installation of a multi-channel gunner's sight

The gunner's multi-channel PNM sight is installed on the turret to the left of the PDT backup sight.

The lower flange 3 (Figure 8.9) is installed in the bore of the turret flange on the gasket 7 and is attached to it with bolts 4 with washers 5 and 6. On the lower flange from below, screws 30 with washers 31 are attached to the sighting-rangefinder block 8 with the TC. On top of the lower flange, with 3 screws 32 and washers 31, the upper flange 10 is attached with the sight stabilization block 1 installed on it. Stabilization block 1 is secured to the upper flange with bolts 11 and washers 12.

To protect the stabilization unit from bullets and fragments, protection 2 is installed, which is attached to the turret flange with bolts 24 and washers 25. To protect the exit window of the sight, spring-loaded covers 13 and 14 are installed on the protection. The left cover 14 protects the thermal imaging channel, the right cover 13 protects the sighting channel, rangefinder channels and laser control channel. Plugs 27 and 28 are installed in the inspection slots of the

covers, secured with captive bolts. When working with the sight, depending on the tasks performed and working conditions, either the plugs are removed or the covers are opened.

Opening and closing of protective covers is carried out using two manual mechanisms 9 for opening the cover. To open the right cover 13, a manual cover opening mechanism 9 is used, located on the right side of the PMU; to open the left cover 14, a manual cover opening mechanism 9, located on the left side of the PMU, is used. The shafts 18 and 20 of the mechanisms rotate freely in the bushings 17. On each shaft, a lever 26 and a sector 19 are secured with nuts 21 and washers 22 and 23. Drives 35 are mounted on brackets to the left and right of the sighting-rangefinder block 8 and secured with bolts 37 with strips 39 and washers 38. The drive consists of the following components: a base 36, a rod 33 and a slider 40 connected by a cable to sector 19. To fix the protective cover in the closed position, there is an L-shaped groove in the drive housing in which the slider screw 34 moves.

Adjustment of the fit of the covers to the protection body in the closed position is ensured by screws 15 with nuts 16.

2.10.5 Commander's panoramic sight

The commander's panoramic sight (hereinafter referred to as the PKP) with a thermal imaging camera provides:

– all-round view of the area (with the remote control switched on), detection and recognition of targets at any time of the day;

– all-round view of the area in the near zone (with the remote control switched on), using an overview television channel;

– stabilization of the field of view in two planes when working with the main channels (when working with an overview television channel, stabilization of the field of view is ensured in the GN plane);

– aiming and holding the aiming mark on the target according to signals from the commander’s console;

– measuring the range to the target with a laser rangefinder;

– generation of control and information signals to ensure collaboration with the equipment of the fire control system and other equipment of the tank;

– display on the APU screens information about operating modes, type of ammunition, ready-to-fire signal, measured range value;

– automatic input of aiming angles and lateral lead into the drives of the weapon stabilizer and remote control;

– alignment of the sighting mark of a television channel in various operating modes of the fire control system (for firing from the commander’s position from a cannon, a coaxial machine gun and a remote-controlled machine gun mount);

– reconciliation of the main television channel according to the index on the optical block;

– built-in alignment of the laser rangefinder relative to the control panel television channel;

– alignment of the thermal imaging channel with respect to the control panel television channel.

The PCP includes:

– optical-electronic unit;

– control unit for the PKP stabilization system (Figure 8.10);

– engine control unit PKP GN (Figure 5.32);

– thermal imaging camera.

2.10.5.1 Optical-electronic unit

The optical-electronic unit is the main unit of the control panel, consisting of an adapter block 10 (Figure 8.3), a mirror block 3, and a driving rotating contact device 21. The sighting and rangefinder unit is located in the inner parts of the optical-electronic unit.

The sighting and rangefinder unit contains elements of television, thermal imaging, laser channels of the control panel and elements of built-in alignment.

At the bottom of the optical-electronic block there are: a drying indicator with silica gel; valve closed with a plug and electrical connectors.

The mirror block is designed to stabilize and guide the control panel's field of view in the vertical plane. At the top of the mirror block there is a desiccant with silica gel and two valves closed with plugs.

The driving rotating contact device (hereinafter - PVKU) is designed to transmit electrical circuits between the fixed and moving parts of the control panel. The driven rotating contact device ensures stabilization and guidance of the control panel's field of view in the horizontal plane.

The transition block is designed for joining various elements into a single optical-electronic block.

2.10.5.2 PKP stabilization system control unit

The PKP stabilization system control unit (hereinafter referred to as the PKP CU) provides control of the PKP stabilization system, as well as electrical coupling with the BV and other elements of the control system. The appearance of the control panel control unit is shown in Figure 8.10 .

2.10.5.3 The engine control unit

The engine control unit (hereinafter referred to as the ECU) provides stabilization and guidance of the control panel field of view in the horizontal plane (engine control PVKU) based on signals from the control panel control unit. Fuse 2 is located on the ECU (Figure 8.11). To access the fuse, you must unscrew the plug.

2.10.5.4 Commander's thermal imaging camera

The main element of the thermal imaging channel of the control panel is the thermal imaging camera. The thermal imaging camera is installed in the BVD of the optical-electronic control panel unit and is designed to convert radiation in the spectral range from 3 to 5 microns into a standard television signal.

Switching from a wide field of view to a narrow field of view and vice versa is carried out by optical elements in the TC lens. Switching between narrow field of view and narrow field of view with electronic zoom is achieved electronically.

2.10.5.5 Service information when working with the control panel
2.10.5.6 Contents of service information in a wide field of view of the television and thermal imaging channels of the control panel (except for the “DOUBLE” mode).

When monitoring through the control panel, with the control panel turned on or off, and there are no malfunctions of the stabilization and control system (hereinafter referred to as SCS) of the control panel, in the wide field of view of the television and TP channels of the control panel, the following are displayed on the APU screens:

– window 1 (Figure 8.12) indicating the readiness of the DPU for firing (when the DPU is turned off, the “GOT” indication is absent);

– window 2 indicating the type of ammunition and type of weapon (when working with the DPU, “P” is displayed, when the DPU is turned off, it is absent);

– window 3 indicating the range to the target (the measured or manually entered range is displayed. When you simultaneously press buttons 10 (Figure 8.13), 21 (“ ⇦ ”, “ ⇨ ”) on the Pn-control panel, the range is reset and the SBR message is displayed in the display window; in the absence of a reflected rangefinder signal (in case of a miss), “- - - -” is displayed in the display window);

– window 4 (Figure 8.12) indicating the operation mode of the control system (“NABL” - observation mode through the control panel; “DPU” - “DPU” mode; “LOADING” - “DPU” loading mode; “TSU” - “TARGET DESIGNATION”);

– window 5 indicating the status and performance of the stabilization and control system;

– aiming sign 6 (not present in the OPC, but displayed when working in the SPC);

– corner marks 7 boundaries of a narrow field of view (absent in the OPZ, are displayed when working in the SPD);

– electronic azimuth indicator 8 (pictogram of the relative position of the turret, hull and PKP aiming line).

In window 5 indicating the status and performance of the control system, depending on the state of the control system, the following information can be displayed:

– “SSU OFF ” - SSU is turned off;

– “SSU ON” - SSU is turned on and ready for operation;

– “SSU” - SSU is preparing for work;

– “SSU OSH 1 ” - no AC voltage;

– “SSU OSH 2 ” - no gyromotor current;

– “SSU OSH3” - the two-plane gyroscopic sensor (DGD) is not ready;

– “SSU OSH 4 ” - there is no exchange between the control panel boards (the “MU” board with the “POS” board);

– “SSU OSH5” - there is no exchange between the PKP boards (the “MU” board with the “PKR” board);

– “SSU OSH 6 ” - there is no exchange between the PKP boards (the “PKR” boards with the “PC” board);

– “SSU OSH 7 ” - there is no exchange between the PKP board and the BV (the “MU” board with the BV).

N o t e – When loading the DPU (LOADING mode), there is no indication of the readiness of the DPU for firing, the type of ammunition and the type of weapon.

2.10.5.7 Contents of service information in a wide field of view of the television and thermal imaging channels of the control panel when the control system is operating in the “DOUBLE” mode

When the “DOUBLE” mode is turned on and when a wide field of view of the television and thermal imaging (after the TC enters the mode) channels of the control panel is selected, the following are displayed on the APU screens: corner marks 2 (Figure 8.6b) of the boundaries of the UPD; electronic azimuth indicator 3 (pictogram of the relative position of the turret, hull and PKP aiming line) and window 1 indicating the status and performance of the control system.

In window 1 indicating the status and performance of the control system in the “DOUBLE” mode, information is displayed both in a wide field of view of the television and thermal imaging channels of the control panel when working with the control panel. The messages displayed in window 1 and their explanation are shown above.

Content of service information in a narrow field of view and in a narrow field of view with electronic magnification of the television and thermal imaging channels of the control panel

In the UPD and in the UPD with electronic zoom, the following are displayed on the APU screens:

– window 1 (Figure 8.7a) indicating readiness to fire (if ready, the message “GOT” is displayed);

– window 2 indicating the type of ammunition and type of weapon (the selected type is displayed: B, K, O, P , R, S; when working with the DPU, “P” is displayed; when working in the “NABL” mode, there is no indication);

– window 3 indicating the range to the target (the measured or manually entered range is displayed. When you simultaneously press buttons 10 (Figure 8.13), 21 (“ ⇦ ”, “ ⇨ ”) on the Pn-control panel, the range is reset and the SBR message is displayed in the display window; in the absence of a reflected rangefinder signal (in case of a miss), “- - - -” is displayed in the display window);

– window 4 indicating the operating mode of the control system (“NABL” - “OBSERVATION” mode; “DBL” - “DOUBLE” mode; “DPU” - “DPU” mode; “LOADING” - “LOADING DPU” mode; “TSU” - “TARGET DESIGNATION”) ");

– sighting mark 5 (Figure 8.7b);

– electronic azimuth indicator 6 (pictogram of the relative position of the turret, hull and PKP aiming line).

Elements of an electronic azimuth indicator (pictograms of the relative positions of the turret, hull and PKP aiming line).

The electronic azimuth indicator (pictogram of the relative position of the turret, hull and PKP aiming line) is designed to visually display the relative position of the turret, hull and PKP aiming line, as well as to numerically display the position of the turret relative to the hull.

The electronic azimuth indicator is displayed in the top right image from the control panel (on top of the television and thermal images from the control panel). During the process of switching on the control panel and on-board digital display, the electronic azimuth indicator is missing.

The electronic azimuth indicator consists of the following elements:

– bow part 1 (Figure 8.14) of the tank hull;

– tower 2 with a cannon;

– sector 3 position of the PKP aiming line along the GN;

– 4 tank hull;

– least significant digit 5 is the value of the position of the tower relative to the hull (analogous to the precise scale of the azimuth indicator);

– the most significant digit 6 is the value of the position of the tower relative to the hull (analogous to the rough scale of the azimuth indicator).

2.10.5.8 Installation of commander's panoramic sight

The commander's panoramic sight is installed in the rear of the turret behind the commander's seat.

Flange 19 (Figure 8.3) is installed on the tower flange and secured to it with bolts 17 and washers 18. Drive rotating contact device pos. 21 is installed in the flange bore on gasket 20 and secured with bolts 14 with washers 15 and 16. An adapter block 10 is attached to the rotating part of the PVKU with bolts 11 and washers 12 and 13. The mirror block 3 is attached to the adapter block with bolts 4 and washers 5 and 6.

To protect the mirror block from bullets and fragments, protection 2 is installed, which is attached to the adapter block with bolts 22 and washers 23. The openings in the protection for fasteners are protected by segments 7, secured to it with bolts 8 and washers 9. Cover 1, installed in the grooves of the protection, serves to protect the sight's entrance window from dust.

2.10.6 Television double sight

The television backup sight (hereinafter referred to as PDT) is designed for firing from a cannon with all types of ammunition, except for guided missiles, as well as for firing from a machine gun coaxial with the cannon. The PDT is designed to operate from the gunner's or commander's position in the event of malfunctions of the main sights (PNM or PKP) and other equipment that do not allow targeted shooting in the "MAIN" and "DOUBLE" control system modes.

PDT provides:

– overview of the area, detection and recognition of targets during daylight hours and at dusk;

– tracking the field of view behind the gun;

– range measurement using the “base-on-target” method;

– display on the APU screens information about operating modes, type of ammunition, ready-to-fire signal, measured range value;

– displaying the aiming mark or scale of a coaxial machine gun on the APU screens;

– solving ballistic problems and automatically entering aiming angles and lateral lead into the position of the aiming mark;

– performing the above functions while operating from an autonomous power source in case of emergency disconnection from the tank’s on-board network.

2.10.6.1 PDT module

The PDT module is an optical-electronic unit with a flange designed for mounting the module on an object. The PDT module has a support on which a drive with an alignment mechanism is mounted and is a monoblock structure in which elements of the optical circuit and elements that generate a television signal for transmission to the control system equipment are installed.

On the body of the PDT module there are electrical connectors X 1 (for connection to the backup power supply) and X2 (for connection to the tank equipment). The following components are located in the upper part of the PDT module: desiccant with silica gel; valve closed with a plug and process electrical connector.

2.10.6.2 Drive and alignment mechanism

The drive and alignment mechanism is a hinged lever mechanism mounted on the lower support of the PDT module and on the mating plane of the gun, providing a kinematic connection between the mirror block of the PDT module and the gun.

2.10.6.3 PDT control panel

PDT control panels (hereinafter referred to as Mon-PDT) are located at the gunner's and commander's workstations and are used to control the PDT.

The following controls and indications of the PDT are located on the Mon-PDT:

– toggle switch 2 (Figure 8.15), designed to turn on and off the PDT, located under cover 1. The cover prevents unauthorized access to the toggle switch and prevents accidental activation of the PDT to preserve the charge of the PDT battery;

– indicator 3 of the on state of the motor vehicle (“ ”);

– indicator 4 for turning on PDT heating;

– button 5 for turning on the PDT heating (“ ”);

– button 7 to turn on the menu and enter parameters (“ ”). The button is intended to activate the PDT menu, select options in the PDT menu, enter parameters and activate the scale for firing from a coaxial machine gun.

N o t e – Operational activation of the scale is intended to reduce time, for a situation where it was planned to fire from a cannon (one of the artillery types was selected), but suddenly there was a need to defeat tank-dangerous enemy personnel from a coaxial machine gun (for example, when a grenade launcher suddenly appeared in the field of view of a grenade launcher) . In normal situations, to fire a coaxial machine gun, you need to set type P on the control panel of the control system and AZ or on the PC;

– buttons 6 and 8 for changing parameters (" ", " ") .

2.10.6.4 Backup power supply

The backup power supply unit (hereinafter referred to as the BPR) is installed on a bracket fixed to the VT deck (under the hoses from the supply unit to the actuator cylinder).

The BPR ensures autonomous operation with the PDT in the absence of supply voltage to the tank's on-board network.

Structurally, the BPR is made in the form of a monoblock structure, the main load-bearing element of which is the metal body 5 (Figure 8.16).

On the front panel 6 there are:

– indicator 1 “ ” (“BATTERY”), indicating that the PDT is operating on battery power;

– indicator 2 “+27 V ”, signaling the operation of the PDT from the tank’s on-board network;

– fuse 4.

On the end side of the BPR there is an electrical connector 3 for connection to the PDT module.

The BPR contains a battery module consisting of non-renewable batteries that provide the necessary power to operate with the PDT.

ATTENTION:

AFTER THE BPR IS DISCHARGED, IT IS NECESSARY TO REPLACE THE BATTERY MODULE IN THE BPR OR COMPLETELY REPLACE THE BPR!

2.10.6.5 Operating modes of PDT

The following operating modes of the PDT are distinguished:

– work with PDT from the gunner's position in the presence of power from the on-board network;

– work with the PDT from the commander's seat (only if there is power from the on-board network);

– work with PDT from the gunner's position in the absence of power from the on-board electrical network.

2.10.6.6 Working with PDT from the gunner's position in the presence of power from the on-board electrical network

When the PDT is turned on with toggle switch 2 (“ ”) (Figure 8.15) on the gunner's Pn-PDT the following is provided:

– display of video information from the PDT on the screens of both APUs;

– measuring range using the “base on target” method, turning the heating on/off, working with the PDT menu using the Mon-PDT gunner;

– selection of the type of ballistics used by the PDT to calculate corrections using the control panel of the control system and AZ;

– constant lighting of the PDT indicator on the gunner's Mon-PDT and blinking of the PDT indicator on the commander's Mon-PDT;

– display of the NAV indication on both screens of the APU, which means working with the PDT from the gunner's position.

2.10.6.7 Working with PDT from the commander's seat (only with power from the on-board network)

When the PDT is turned on with toggle switch 2 on the commander's Mon-PDT, the following is provided:

– display of video information from the PDT on the screens of both APUs;

– measuring range using the “base on target” method, turning the heating on/off, working with the PDT menu using the commander's Mon-PDT;

– selecting the type of ballistics used by the PDT to calculate corrections using a PC;

– constant lighting of the PDT indicator on the commander's Mon-PDT and blinking of the PDT indicator on the gunner's Mon-PDT;

– display of the PTO indication on the screens of the APU, indicating work with the PDT from the commander's seat.

N o t e s

1 Flashing of the “PDT” indicator on Mon-PDT indicates that the PDT is turned on, and the control of the control system in the “DUBLER” mode is carried out from another place.

2 If there is an on-board network of the tank and the PDT is turned on, from the gunner's place and from the commander's place, control of the control system in the “DUBLER” mode is carried out from the commander's place (priority is with the commander).

If there is power from the on-board electrical network and the STV is operational (with the STV drives turned on), the field of view of the PDT (guns and turrets) is guided from the PC.

2.10.6.8 Working with PDT from the gunner's position (in the absence of power from the on-board electrical network)

In the case of the PDT operating from a battery (in the absence of voltage from the tank's on-board power supply to the PDT) for a period of no more than 40 minutes (depending on the state of charge of the BPR battery module), an autonomous mode of operation of the PDT is ensured.

This mode provides:

– display of video information from the PDT on the screen of the gunner's APU;

– working with the PDT menu using Mon-PDT;

– selection of the type of ballistics used by the PDT to calculate corrections using the control panel of the control system and AZ;

– range measurement using the “base-on-target” method;

– constant lighting of the PDT indicator on Mon-PDT;

– displaying the NAV RUCH indication on the gunner's APU screen;

– Possibility to turn heating on/off. To turn on the heating, on the Mon-PDT you need to press and hold the button 5 for turning on the heating of the SDT until the indicator 4 for turning on the heating for the SDT lights up.

ATTENTION:

WHEN THE HEATING IS TURNED ON, THE OPERATING TIME OF THE PDT IN AUTONOMOUS MODE IS REDUCED. TURN ON THE PDT HEATING ONLY IN CASE OF EMERGENCY!

2.10.6.9 Contents of service information in the field of view of PDT

After the PDT is turned on and enters the mode, the following is displayed on the APU screens:

– sighting mark 5 (Figure 8.17) when selecting all types of ballistics except P ;

– scale 13 for firing from a coaxial machine gun. The scale appears when you select the ballistics type P or quickly activate the scale when one of the artillery types is selected;

– window 3 indicating readiness to fire (if ready, the message “READY” is displayed);

– window 4 indicating the type of ammunition and type of weapon (the selected type is displayed: B, K, O, P , R, S). When selecting type U, there is no indication;

– window 6 indicating the range to the target (the manually entered range is displayed). When resetting the range, simultaneously pressing buttons 6 (Figure 8.15) and 8 for changing parameters on Mon-PDT, the message “SBR” is displayed in window 6 (Figure 8.17) indicating the range to the target;

– window 7 indicating the operating mode of the fire control system (“NAV” - when working with the PDT at the gunner’s place; “COM” - when working with the PDT at the commander’s place; “NAV RUCH” - when working with the PDT from the battery at the gunner’s place);

– pictogram 2 of PDT operation from BPR. When the PDT is operating from a battery (from the BPR), an icon is displayed, the number shows the level of the remaining charge as a percentage (when fully charged, the number is not displayed). When the PDT is operating from the tank's on-board network, the indicated icon is not displayed.

Note - After turning on the PDT , a test image in the form of horizontal stripes of varying brightness is displayed on the APU screen for no more than 10 s .

2.10.6.10 Installing a backup sight

A television sight-backup PDT, and a drive with an alignment mechanism, is installed on the turret to the left of the gun.

PDT module pos. 1 (Figure 8.4) is installed in the bore of the turret flange on gasket 2 and secured to it with bolts 3 with washers 4 and 5. Trim 13 of drive 14 is installed on the gun cradle bracket and secured with bolts 11 and 12. The drive is connected to the output shank of the sight and ensures synchronization transferring swing angles from the gun to the head mirror of the sight. Under the cover 15 on the drive there is a vertical alignment mechanism 31, which is a split housing 32 with a worm 30 and a fixing screw 29. To protect the mirror unit from bullets and fragments, protection 6 is installed, which is attached to the sight flange with bolts 23 and washers 24. To protect the output The sight window is protected by a spring-loaded shutter 16. The shutter is fixed in the closed position and opened using an opening mechanism consisting of a stopper 27, a lever 28, a stopper drive 10 and a cable 8. The stopper 27 is installed in the sleeve 26 and secured with a nut 25. The lever 28 is secured to the stopper shaft 19 with a nut 20 with washers 21 and 22. The stopper drive 10 is installed on the tower bracket and secured with bolts 33 with washers 34. The cable 8 is secured at one end to the ring 9 of the drive rod, and at the other end to the stopper ring 7. Adjustment of the fit of the sash to the protection body in the closed position (gap B) is ensured by screw 17 with nut 18.

2.10.7 Commander's console PK-90

2.10.7.1 Purpose of the commander's console

The commander's console PK-90 (hereinafter - PC) as part of the control system is designed for the commander to perform the following functions:

– guidance of the line of sight of the PKP (PDT) depending on the control system mode using lever 1 (Figure 8.18) guidance control ;

– turning on the control panel using the control panel toggle switch pos. 7 - turning on the DPU with the DPU toggle switch pos. 6;

– a shot from a cannon, a coaxial PKT or a DPU, depending on the control system mode, using button 1 1 firing from the selected weapon ;

– loading the gun in the “DOUBLE” mode with button 12 or switching the rate of fire of the DPU when working in the “DPU” mode;

– setting the operating mode of the control system using a 4- mode switch and selecting the type of ballistics ;

– selecting the type of ballistics for use in the “DOUBLE” mode using switch 4;

– range measurement via the control panel with button 10;

– capture and reset of automatic target tracking with button 9;

– target designation to the gunner with button 16.

On the front panel of the PC there is a control panel indicator (green) pos. 8 and DPU indicator (yellow) pos. 5 to display the states of the corresponding systems.

The control panel indicator signals the readiness of the control system for operation using the control panel (constant light), the preparation of the control system for operation or its malfunction (flashing).

The DPU indicator signals that the DPU Control System is ready for operation (constant light), that the DPU Control System is preparing for operation or that it is malfunctioning (flashing).

The PC also has the DZ START and TSU-LI buttons for controlling the SDR. The purpose of the DZ and TsU-LI START buttons and the procedure for working with the SPZ are given in the subsection “Curtain setting system” 188MRE1.

2.10.7.2 Placement and structure of the commander's console

The PC is an electronic unit in a dust-splash-proof design, which is installed on the right side of the tower under the PMF.

The housing 13 of the block is an assembly of several rectangular modules. The modules are united by an adapter plate 14 for mounting in the tank.

On the front panel and side surfaces of the PC there are controls (buttons, toggle switches, switches, etc.) and status indicators of the tank systems. On the back side of the PC there is an electrical connector XP 1 for connecting the PC to the tank equipment.

2.10.8 Pointing console (PN)

2.10.8.1 Purpose of the guidance console

The guidance console as part of the control system is designed for the gunner to perform the following functions:

– guidance of the PNM sighting line in the OMS “MAIN” mode, the STV drives (PDT sighting line) in the “DUBLER-N” mode by rotating handles 5 (Figure 8.19), 7 around the horizontal axis and rotating the control panel housing 6 around the vertical axis;

– firing a cannon with button 3;

– range measurement via PNM button 4;

– capture and reset of automatic target tracking with button 8;

– shot from a paired PKT with a button located on the left handle 7 under the index finger.

2.10.8.2 Placement and design of the guidance console

The PN is installed at the gunner's workplace under the PNM and is a dust-splash-proof block, inside of which there are potentiometers for generating guidance signals and buttons that generate the corresponding electrical signals when pressed.

To connect the PN to the tank equipment, an electrical connector 1 is located on the flexible cable 2.

On the body 6 of the remote control there are handles that rotate around a horizontal axis.

By turning the handles from a neutral position relative to the horizontal axis, the gunner sets the vertical alignment of the line of sight. The speed of aiming the line of sight depends on the angle of rotation of the handles (the larger the angle, the higher the speed). By turning the handles (the lower part of the handles away from the gunner), the gunner sets the line of sight to move upward; turning the handles in the opposite direction sets the line of sight to move down.

The remote control housing 6 rotates relative to the fixed flange 9 (around a vertical axis).

By rotating the control panel body relative to the vertical axis, the gunner sets the horizontal alignment of the line of sight. The speed of aiming the line of sight depends on the angle of rotation of the body (the larger the angle, the higher the speed). By rotating the PN body (the right handle on the gunner), the gunner sets the line of sight to move to the right, and the opposite direction of rotation of the body sets the line of sight to move to the left.

The design of the PN provides a zone for switching on the horizontal transfer speed. This zone is located in a small range of rotation angles of the remote control body, close to the maximum . When this zone is reached, an increase in the moment of resistance to rotation of the body is tactilely felt due to the activation of the elastic element. With further rotation of the hull, the transfer speed of the turret is activated. The horizontal transfer speed activation zone is limited by a rigid stop that blocks further rotation of the PN housing.

2.10.9 Commander and gunner video viewing devices

Video viewing devices (hereinafter - VSU) of the gunner and commander are designed to reproduce a black-and-white image on screen 2 (Figure) generated by the PNM, PKP, PDT and external video surveillance system. To adjust the contrast, brightness and sharpness of the image, the following are located on the APU:

– key 5 to increase the parameter value;

– key 4 to decrease the parameter value;

– key 3 for selecting an adjustable parameter (“contrast-brightness-sharpness”).

The type of service information when adjusting contrast, brightness and sharpness is shown in Figure 8.20 .

The APU is powered from the tank's on-board network.

The APU is turned on by an external signal from the BKVS or an external video surveillance system (commander’s APU).

N o t e – At low ambient temperatures, there may be a delay (no more than 6 minutes) from the moment an external switching signal is sent to the APU until an image appears on its screen.

On the rear panel of the APU there is an electrical connector to which the on-board network voltage, video signal, and power-on signal are supplied.

2.10.10 Interface and correction equipment

Interface and correction equipment (ASVP) provides:

– coupling of various equipment into a single fire control system using electrical signals and the formation of operating modes of the fire control system;

– calculation of total corrections taking into account various factors and ensuring their automatic input into the drives of the stabilizer of tank weapons and control units;

– control of the gunner's multi-channel sight, control of the commander's panoramic sight, control of the BV technological menu, display of service information;

– generation of information (values) about current meteorological and topographical conditions;

– target designation to the commander's observation device and indication of the position of the control panel in the horizontal plane relative to the commander's hatch;

– interaction with other equipment of the tank's control system.

The interface and correction equipment includes:

– computer block;

– direction indicating equipment;

– PNM and PKP control panels;

– meteorological sensors.

2.10.10.1 Computer block (CB)

The BV provides automatic generation of aiming angles and lateral lead. Aiming and lateral lead angles are developed simultaneously and independently for the main (cannon), auxiliary (coaxial machine gun) and additional weapons (DPU).

To solve ballistic problems, the BV processes signals coming from sensors and data entered manually.

When calculating aiming and lead angles, the following are taken into account: meteorological and ballistic factors:

– range to target;

– tank's own speed;

– the position of the turret relative to the tank body;

– target angular velocity;

– type and individual properties of ammunition;

– bore wear;

– deviation of the initial velocity of the projectile;

– parallax;

– signals from sensors that determine firing conditions (turret roll and pitch, charge temperature, outside air temperature, atmospheric pressure, lateral component of wind speed, barrel bending);

– position of the control panel relative to the tower.

For the operation of the OMS, BV provides:

– organization of operating modes of the control system, including switching of analog control signals from the PNM and control panel and transmission of analog signals to the vertical guidance drives STV and DPU (depending on the operating mode of the control system);

– tracking, taking into account the total angles of aiming and lateral lead, the vertical and horizontal guidance drives of the STV and DPU behind the aiming lines of the PNM and PKP or, vice versa (with the STV drives turned off);

– interaction of the BV with other ASVP equipment;

– interaction with the control system equipment and other tank equipment;

– management and interaction with the PNM and the control panel, including to ensure, together with the control center, simultaneous and independent automatic tracking of targets through the PNM and the control panel;

– organization of target designation modes, including automated target designation, together with the on-board control center, from the commander to the gunner;

– generation of control signals for the firing circuits of a cannon and coaxial machine gun, including in the "DUBLER" mode when the propellant is de-energized (turned off);

– generating the supply voltage for sensors, processing and converting (if necessary) signals from these sensors;

– generation and processing of the necessary signals for the operation of the automatic loader;

– functioning of the BV menu. To control the BV menu, use the control panel control panel or the PNM control panel;

– mode of built-in control of the main functions of the BW (software loading, testing the external data bus, testing the file system, checking the functioning of information exchanges).

2.10.10.2 Direction indicating equipment

Direction indicating equipment is intended:

– to quickly bring the PKP aiming line to the target area observed through the commander's prism observation device;

– for the prompt selection of the commander's prism observation device(s), through which the target at which the PKP is aimed will be visually observed.

The direction indicating equipment includes:

– direction indicator (8 pcs.);

– direction indicator adapter.

2.10.10.3 Direction indicator

The direction indicator is a flat rectangular case; in the central part of the front panel of the case there is a button, directly in which the light indicator is located.

The direction indicators are located directly next to the commander's prismatic observation devices, which ensures an unmistakable determination of their belonging to the corresponding commander's prismatic observation device. The "backward" direction indicator is installed in the rear part of the commander's hatch and does not belong to any of the commander's observation devices (the number of direction indicators is one more than the number of commander's observation devices).

2.10.10.4 Direction Sign Adapter

The direction indicator adapter is a rectangular body, on one of the surfaces of which there are eight electrical connectors for connecting direction indicators and an electrical connector for connecting to the computer unit. Near the electrical connectors there are their numbers and directional arrows, designed to correctly connect the direction indicators to the direction indicator adapter.

Direction indicating equipment provides:

– indication of the position of the PKP aiming line in the GN plane relative to the commander's prism observation devices located in the commander's hatch, due to the lighting of the LEDs on the corresponding direction indicators. When the PKP's aiming line is between the commander's observation devices, the LEDs light up on two adjacent direction indicators;

– bringing the PKP aiming line to the commander's prism observation device, through which the commander observes the target. Target designation is performed by pressing a button on the direction indicator located directly next to the commander's observation device, through which the commander observes the target.

When you press the button on the direction indicator again, while the control panel's aiming line is moving, further movement stops (emergency stop).

In the process of moving the PKP aiming line and pressing a button on any other direction indicator, the PKP aiming line is brought to the prism observation device, next to which the pointer button was pressed for the last time.

When you press and hold the button on the direction indicator, the PKP aiming line is adjusted and remains in a position consistent with the commander's observation device, regardless of external influences (turret rotation and tank hull rotation);

– bringing the PKP line of sight to the commander's observation device when the control system is operating in the "Double" mode. When you press and hold the button on the direction indicator, the turret is automatically brought to the line of sight of the corresponding commander's observation device (the turret rotates along with the commander's hatch to the required angle, providing observation through the control panel of the background target situation previously observed through the commander's observation device). When the button on the direction indicator is released while the tower is moving, further movement of the tower stops (emergency stop).

ATTENTION:

IN THE PROCESS OF TARGET DESIGNATION, THE AIMING LINE OF THE CONTROL PANEL IS AUTOMATICALLY BROUGHT TO THE ZERO POSITION IN THE HIGH-VOLTAGE PLANE AND A WIDE FIELD OF VIEW OF THE TELEVISION OR THERMAL ISON CHANNELS OF THE CONTROL PANEL IS AUTOMATICALLY ESTABLISHED!

2.10.10.5 PNM and control panel control panels

The PNM control panel (hereinafter referred to as Pn-PNM) is intended for :

– control of the thermal imaging channel of the PNM (switching on/off, switching to standby mode, adjusting focus, adjusting gain, switching image polarity, switching fields of view);

– control and navigation through the menu of the PNM thermal imaging channel;

– controlling the BV menu from the gunner's seat to configure the BV, control the basic parameters of the BV, enter data, as well as select automatic or manual modes for taking into account meteorological and ballistic factors (turning on or off the corresponding sensors);
– control (on/off) of PNM heating;
– indication that the PNM heating is turned on.

The following elements, controls and indications are located on the Pn-PNM:
– protective bracket 1 (Figure 8.21) toggle switch for turning on the TP of the PNM channel;
– toggle switch 2 for turning on the TP channel PNM;
– buttons 3, 5, 11, 14 " ⇧ ", " ⇩ ", " ⇦ ", " ⇨ " for navigation and changing values (modes);
– button 4 “ ” (“MENU/ENTER”) is used to enter the TP menu of the PNM channel. To enter the TP menu of the PNM channel, you must press and hold the “ ” (“MENU/ENTER”) button for at least 3 seconds. The menu is displayed on the APU;
– button 6 “ ” for selecting focus adjustment of the TP channel of the ISM channel;
– button 7 “ ” switches the polarity of the TP channel ISM;
– button 8 " " to increase the zoom (reduce the viewing angle) and button 9 " " to decrease the zoom (increase the viewing angle). The buttons are used to switch the fields of view of the TP channel of the ISM;
– button 10 " " for selecting gain control. Used to enable the mode for adjusting the image contrast of the TP channel of the ISM;
– button 12 “ ” for turning on the PNM heating;
– indicator 13 for turning on the PNM heating.

The control panel control panel (Pn-PKP) is intended for :
– switching between TV and TP channels of the control panel;
– PKP TV channel control (focus adjustment, field of view switching);
– control of the TP channel of the control panel (turning on/off, switching to standby mode, adjusting focus, adjusting gain, switching image polarity, switching fields of view);
– manual range entry and reset;
– control and navigation through the control panel menu;
– control and navigation through the TP menu of the control panel channel;
– control of the BV technological menu from the commander’s seat to configure the BV, control the main parameters of the BV, enter data, as well as select automatic or manual modes for accounting for meteorological and ballistic factors (turning on or off the corresponding sensors);
– turning on the mode for displaying a thermal imaging image from the PNM at the commander’s place;
– control of digital image processing of the PKP television channel;
– control (on/off) of the control panel heating;
– indication that the control panel heating is turned on;
– indication of readiness of the stabilization and control system;
– indication that the laser rangefinder is ready;
– indication of the selected (active) control panel channel and the readiness of TV or TP channels of the control panel.

The control panel control panel (Pn-PKP) contains the following elements, controls and indications :
– protective bracket 1 (Figure) of the toggle switch for turning on the TP of the PNM channel;
– toggle switch 2 for turning on the TP channel of the control panel;
– buttons 3, 10, 18, 21 " ⇧ ", " ⇩ ", " ⇦ ", " ⇨ " for navigation and changing values (modes);
– indicator 4 “ ” of the state of the stabilization and control system (SCS) of the control panel. The indicator lights up when the control control system is ready, the indicator does not light up when the control panel control system enters mode or when the control panel control system is malfunctioning;

– indicator 5 “  ” readiness of the laser rangefinder (hereinafter referred to as LD) of the control panel. The indicator lights up when the LD is ready for operation;

– button 6 “  ” to select the display of the TP channel of the ISM channel. When you press and hold the TP button, the image from the PNM is displayed on the commander’s APU;

– indicator 7 “  ” readiness for operation of the control panel TP channel and signaling the selection of the control panel TP channel. The indicator lights up when the control panel TP channel is selected, flashes when the control panel TP channel enters the mode after it is turned on, even if the control panel television channel is selected;

– button 8 “  ” for selecting control panel channels (television/thermal imaging) Using this button, you can switch between the TV and TP channels of the control panel;

– indicator 9 “  ” readiness of the control panel TV channel and signaling the selection of the control panel TV channel. The indicator lights up when selecting the TV channel of the control panel;

– button 11 “  ” for selecting focus adjustment of the TP channel of the control panel;

– button 12 “  ” switches the polarity of the TP channel of the control panel;

– button 13 "  " to increase the zoom (reduce the viewing angle) and button 14 "  " to decrease the zoom (increase the viewing angle). The buttons are used to switch the fields of view of TV and TP channels of the control panel;

– button 15 “  ” for selecting gain control is used to enable the mode for adjusting the image contrast of the TP channel of the control panel;

– button 16 "  " for adjusting digital image processing. When pressed, the method of processing the image of the TV channel of the control panel changes;

– button 17 “  ” to turn on the control panel heating;

– indicator 19 for switching on the control panel heating;

– button 20 “  ” (“MENU/ENTER”) is used to enter the control panel menu.

To enter the control panel menu, press the “  ” (“MENU/ENTER”) button. To enter the control panel TP channel menu, you must press and hold the “  ” (“MENU/ENTER”) button for at least 3 seconds. Menus are displayed on the APU.

2.10.10.6 Meteorological sensors

Meteorological sensors are designed to measure meteorological factors (air temperature, atmospheric pressure and charge temperature).

The set of meteorological sensors includes the following sensors:

– meteorological sensor (DM);

– air temperature sensor (ATS).

The meteorological sensor is designed to measure charge temperature and atmospheric pressure. On the DM body there are receiving openings that are connected by a system of channels to a sensitive element that measures atmospheric pressure. The temperature measurement element is located inside the DM directly on the body.

The meteorological sensor is installed in close proximity to the charges (on the floor of the rotating conveyor).

The air temperature sensor is designed to measure the outside air temperature.

The air temperature sensor is installed outside the tank on the wind sensor rack.

2.10.11 Digital image processing unit

2.10.11.1 image processing unit

The digital image processing unit (DIP) is designed to solve the following main tasks:

– increasing the efficiency of shooting at moving targets;

– increasing the search characteristics of the control panel due to visual improvement of video images from the control panel TV channel;

– reducing the time from the moment the target is detected by the commander until it is hit by the gunner (BTSOI together with the control system ensures the transfer of automatic target tracking from the commander to the gunner).

BCOI provides:

– formation of a sign of readiness to capture a target observed on the APU for auto tracking;

– capture of the selected target for auto tracking;

– automatic tracking of a captured target due to automatic continuous holding of the PNM aiming line (PKP) on its image;

– manual retargeting - changing the aiming point of the PNM (or PKP) relative to the center of the captured target by the guidance console without interrupting the auto-tracking process;

– automatic tracking of the predicted position of a captured target when its image is briefly blocked by external obstacles.

2.10.11.2 Placement and general arrangement BTsOI

The BCOI is a sealed electronic unit, which is installed on the left side of the turret above the BV (behind the gunner's seat).

On the front panel 2 (Figure 8.23) there are indicators 3 and 5 of the unit's serviceability, the state of the power supply and switching circuits, electrical connectors 4, and grounding terminal 6. Plugs are installed on process electrical connectors X2 , X6, X10.

2.10.11.3 Controls used when working with BTsOI

When the gunner is working with the BCOI, the auto tracking capture/reset button (CAPTURE) pos. 8 (Figure), located on the left handle of the PN under the thumb for manual target acquisition or resetting auto tracking.

When the commander works with the control center, the following controls are used:

– auto tracking capture/reset button (CAPTURE) pos. 9 (Figure 8.19) on a PC for manual target acquisition or resetting auto tracking;

– target designation button (TS) to the gunner pos. 16 on a PC to transfer automatic target tracking to the gunner;

– button for adjusting digital image processing pos. 16 (Figure 8.13) on Pn-PKP to change the video image conversion method.

2.10.11.4 Operation of the digital video processing unit

The activation of the BCOI occurs automatically when the OMS is turned on. After switching on and entering the BCOI mode, it can be used simultaneously by the commander and gunner.

MAIN ", " MAIN-OBSERVATION " operating modes of the control system and to the commander in the "Observation", "DPU" and " DOUBLE " operating modes of the control system .

The selection of a target to capture is carried out when observing through :

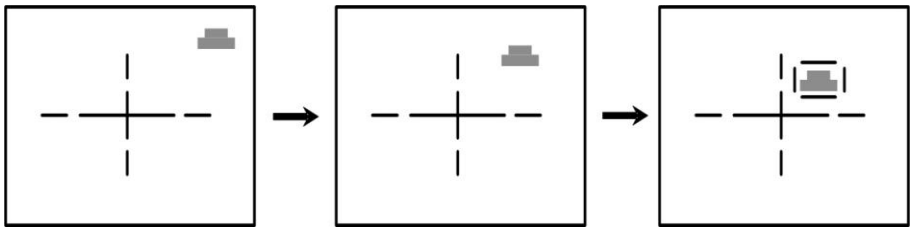
– TP channel PNM in UPZ or UPZ×2 when operating the control system in any mode;

– TV or TP channel of the PKP in ShPZ, UPZ or UPZ×2 when operating the control system in the " OBSERVATION " and "DPU" modes;

– TV or TP channel of the PKP in UPZ or UPZ×2 when operating the control system in the " DOUBLE " mode.

2.10.11.5 "MANUAL ASSISTANCE" mode

When pointing the crosshair of the TP channel PNM (TV or TP PKP channel) at the target area using the PN (PC), if the selected target meets the capture criteria (in size and contrast level), the BCOI forms a frame ready for capture in the field of view of the channel being used target (from two vertical and two horizontal lines located around the target, see figure below). The presence of a frame of readiness to capture a target signals that this target can be captured by the BCOI with a high probability. If the frame of readiness for capture is not formed, then the capture of this target by the BCOI is impossible.

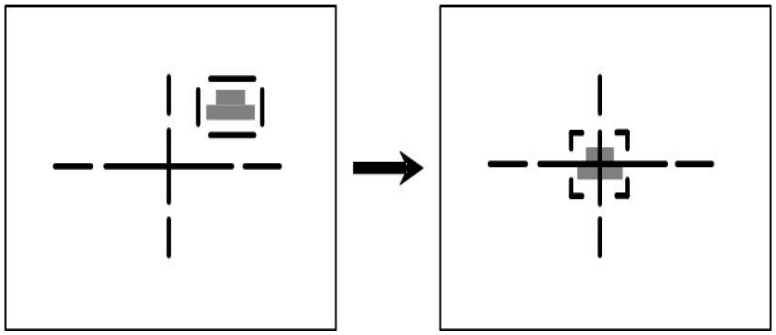


If there is a frame ready for capture, the BCOI ensures that the target is captured for automatic tracking when you press the CAPTURE button on the PN (PC).

Target acquisition is possible when selecting any type of shot.

2.10.11.6 “AUTOMATIC TRACK” mode

After locking on a target, the on-board sensor switches to the “ AUTOMATIC TRACKING ” mode and forms an automatic tracking frame in the field of view of the corresponding ISM channel (PKP) in the form of four corners located around the target image, while ensuring that the aiming mark is kept at the center of the target (see the figure below).



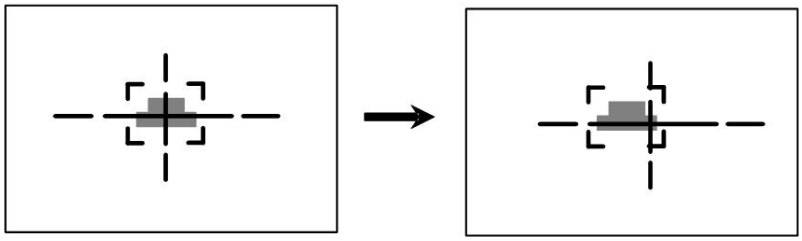
In addition, for additional indication of the “ AUTOMATIC TRACKING ” mode, a symbol for the presence of automatic target tracking 8 is displayed in the ISM optical channel (Figure).

In the “ AUTOMATIC TRACKING ” mode, the BCOI continuously processes the video image of the background target environment, determines the current coordinates of the captured target relative to the crosshair of the aiming mark, and using these current coordinates generates control signals for the position of the field of view of the PNM (PKP).

During the auto-tracking process, the possibility of manual additional targeting using PN (PC) is provided.

2.10.11.7 MANUAL AIM” mode

During manual additional targeting, the gunner or commander, without interrupting the auto-tracking of the captured target, points the crosshair of the aiming symbol at the desired aiming point, using the PN (when the control system is operating in the “ MAIN ” mode) or the PC (when the control system is operating in the “ OBSERVATION ”, “DPU” or " DOUBLE ")



2.10.11.8 “TARGETING WITH AUTOMATIC TARGET RECAPTURE” mode

The “ TARGET DESIGNATION WITH AUTOMATIC TARGET REACQUISITION ” mode is organized when the fire control system is operating in the “ MAIN-DPU ” or “ MAIN-OBSERVATION ” mode to reduce the preparation time for a shot through the PNM by performing part of the gunner’s functions (target acquisition for auto-tracking and range measurements) by the commander.

The procedure for operating in the “ TARGET DESIGNATION WITH AUTOMATIC TARGET REACQUISITION ” mode using the BCOI:

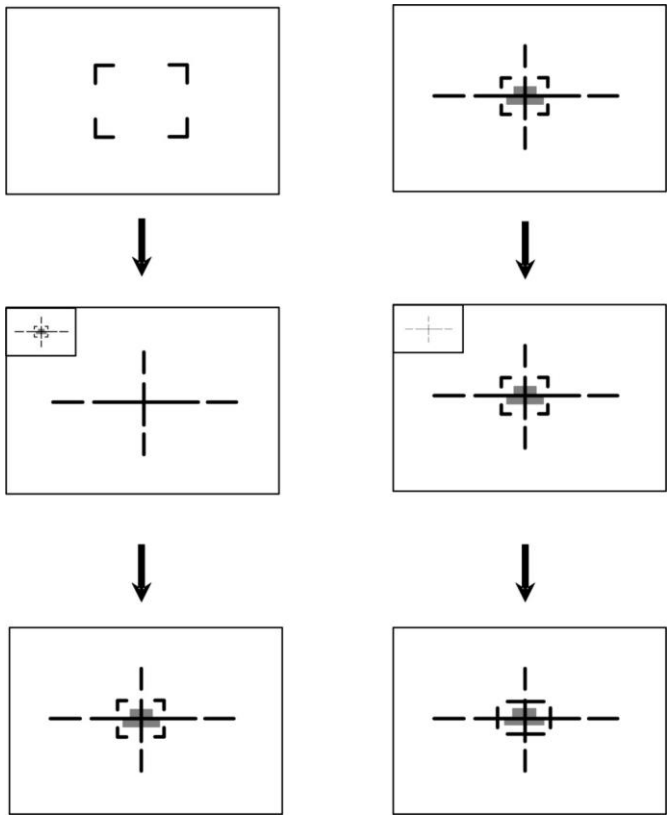
– the commander, working with the TP channel of the PKP, performs target acquisition and, if necessary, measures the range to the target (when the control system is operating in the “ MAIN-DPU ” mode);

– the commander presses the target designation button for the gunner (TsU) pos. 16 (Figure) on the PC and holds it until the line of sight of the PNM and the line of sight of the control panel are aligned. To visually observe the target designation process, during the entire period of holding the control center button, the field of view of the TP channel of the PNM is displayed in the upper left corner of the commander’s APU screen, and the field of view of the TP channel of the PKP is displayed in the upper left corner of the gunner’s APU screen (see the figure below). In the process of combining the sighting lines of the control panel and the ISM, the parameters of the TP channel of the IMS (range to the target, field of view, focusing, etc.) are automatically set in accordance with the current parameters of the TP channel of the control panel. After combining the sight lines of the PNM and PKP, automatic target re-acquisition is ensured in the PNM TP channel and, in case of successful acquisition, an automatic transition to the “ MANUAL TRACKING ” mode in the PKP TP channel.

N o t e s

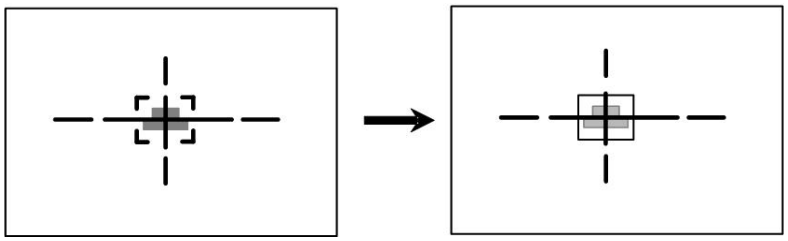
1 The range measured by the commander is transmitted to the gunner in the “ TARGET DESIGNATION WITH AUTOMATIC TARGET REACQUISITION ” mode, if the commander measured the range after acquiring the target for auto tracking.

2 If , due to external factors preventing the formation of a frame of readiness for capture, the commander is unable to capture the target, then the transfer of the detected target to the gunner can be carried out in the “ TARGET DESIGNATION ” mode without automatic recapture.



2.10.11.9 “INERTIAL FOLLOWING” mode

When the target is blocked by external obstacles or when the contrast is significantly reduced, the BCOI automatically switches from the “ AUTOMATIC TRACKING ” mode to the “ INERTIAL TRACKING ” mode with the formation of a frame in the form of a solid rectangle (see the figure below).



When operating in the “ INERTIAL TRACKING ” mode, the BCOI provides automatic tracking of the predicted position of the captured target according to the parameters recorded at the time of interruption of optical communication with the target (characteristics of the target image, speed and direction of its movement are remembered).

In the “ INERTIAL TRACKING ” mode, the BCOI continuously searches for a target in the expanded screen area, and when optical communication with the target is restored, it reacquires the target and switches to the “AUTO TRACKING” mode.

N o t e - When the BCOI is in the “ INERTIAL TRACKING ” mode for more than 5 s, it automatically switches to the “ MANUAL TRACKING ” mode.

2.10.11.10 Reset auto tracking

When operating in the " AUTOMATIC" MODES ACCOMPANIMENT " and " INERTIAL TRACKING » provides the ability to force auto-tracking reset by pressing the CAPTURE button pos. 8 (Figure 8.18) on PN or by pressing the CAPTURE button pos. 9 (Figure) on a PC, and also automatically after firing from a cannon (any type of shot, except a guided missile).

After the launch of a guided missile, the BCOI briefly (for the duration of the video image exposure in the field of view of the TP channel) switches to the “ INERTIAL TRACKING ” mode, after which it automatically reacquires the target and continues its auto-tracking.

In addition, when the BCOI operates in the “ AUTOMATIC TRACKING ” and “ INERTIAL” MODES TRACKING » resetting target auto-tracking in the ISM TP channel is automatically performed in the following cases:

– when switching fields of view of the TP channel of the PNM (with an increase in the angular dimensions of the field of view);

– when switching the control system from the “ MAIN ” mode to the “ DOUBLE ” mode and when performing “TARGET DESIGNATION”.

Automatic target tracking in the TV and TP channels of the control panel is automatically reset in the following cases:

– when switching the fields of view of the TV or TP channel of the control panel (with an increase in the angular dimensions of the field of view);

– when switching between TV and TP channels of the control panel;

– after completion of target designation using the BCOI in the event of successful automatic re-acquisition of the target in the PNM TP channel (only for the PKP TP channel).

2.10.11.11 Function for improving the visual perception of video images

To improve the visual perception of the video image, the commander of the BCOI implements digital processing of the television image in three ways, based on algorithms for converting the original image from the PKP TV channel. A description of the video processing methods used is given in the table . By default, the digital processing function is disabled. Digital video processing is turned on by briefly pressing the digital image processing (DIP) adjustment button, pos. 16 (Figure 8.13) on Pn-PKP.

Consecutive change of the digital processing method is performed by briefly pressing the COI button on the Pn-PKP. When the COI button is held down for more than 1 s, digital video processing is turned off.

When changing the digital processing method in the upper part of the commander’s APU screen in the window pos. 1 (Figure 8.24) indicating the selected method of video image processing, the “VI” indication with the code of the selected method is displayed for a short time.

table 2

Video processing method	Impact on the original image	Recommended conditions of use
VI 0	Absent	-

Video processing method	Impact on the original image	Recommended conditions of use
VI 1	Enhancing contrast in low-contrast areas	Fog, haze, snow, rain
VI 2	Increased detail	Insufficient contrast in the original image
VI 3	Improved visibility in dimly lit or overexposed areas	Uneven illumination of the area

ATTENTION!

WHEN DIGITAL PROCESSING IS TURNED ON, AUTOMATIC TARGET TRACKING IS BLOCKED!

2.10.12 Video signal switching unit

2.10.12.1 Purpose of the video signal switching unit

The video signal switching unit (hereinafter referred to as BKVS) is designed to perform the following functions:

– reception of analog video signals from the PNM, PKP, PDT, BCOI and the television cold sighting tube (hereinafter referred to as TCPT) , switching of received analog video signals to the BCOI, gunner's APU and commander's APU in various operating modes of the control system;

– switching power supply and switching signals for the gunner's APU, commander's APU and on-board control unit in various operating modes of the control system.

2.10.12.2 Placement and arrangement of BKVS

BKVS is a sealed electronic unit, which is installed on a bracket in the rear part of the turret directly next to the control unit (behind the gunner's seat).

Housing 1 (Figure 8.25) of the block has a rectangular shape with cooling fins and lugs 2 for fastening. On the front panel of block 3 there are electrical connectors for connecting the BKVS to the tank equipment, an electrical connector for connecting the THPT via the THPT cable, as well as a technological electrical connector for video recording.

On the side face of the BKVS housing there is a grounding terminal 5.

The BKVS is fastened with bolts through flanges 2 with shock absorbers.

On the front panel there is an indicator of 4 operating modes, displaying the operating mode of the BKVS in accordance with Table 3 .

Table 3

Operating mode	State of indicator " V1 "	
	Glow color	Type of glow
"AUTONOM"	Green	Flashing at 1 Hz
"BASIC"	Green	Constant glow
"DUBLER"	Green	Flashing at 2 Hz
BKVS malfunction	Green	Flashing, three long flashes, then three short flashes

2.10.12.3 BKVS operating modes

Activation and selection of the BKVS operating mode is provided automatically when the control system is turned on and does not require participation from the crew.

The rules for switching video signals in all operating modes of the control system are described in Table 4.

Table 4

Operating mode of the control system	VSU-N	VSU-K
"MAIN" from the gunner's position	PNM	PNM*
"MAIN" from the gunner's position and "OBSERVATION" from the commander's position	PNM	PKP
"OBSERVATION" ("DPU") from the commander's seat**	-	PKP
"DOUBLE"	PKP	PKP
"DOUBLE" from the gunner's position	PDT	PDT
"DOUBLE" from the gunner's position***	PDT	-
"DOUBLE" from the commander's seat	PDT	PDT
"DOUBLE" from the commander's seat***	PDT	-
"DOUBLE" from the gunner's and commander's positions simultaneously	PDT	PDT
"DOUBLE" from the gunner's and commander's positions at the same time***	PDT	-
* When the control panel is turned off. ** When PSM is turned off. *** When the PDT operates from an autonomous power source (BPS). N o t e s 1 PNM - video from TP channel PNM. 2 PKP - video from TV or TP channel PKP.		

2.10.13 Bend sensor

The bending sensor is designed to automatically measure the bending of the trunk in the HV and GN planes, outputting the value and direction of the bending of the trunk to the calculator unit.

The bend sensor consists of a measuring unit 2 (Figure 8.26), installed on the gun protection B , and an optical unit 1, installed on the muzzle of the gun barrel (in the area of the barrel cut).

The measuring unit is intended for :

– forming a beam (radiation) and transmitting it to the reflector of the optical unit;

– determining the center of the beam reflected from the optical block;

– calculating the actual value of the trunk bending in the VN and GN planes and its direction;

– output of digital data to the computer block;

– control of the protective cover drive.

The optical unit is designed to reflect the beam into the photodetector of the measuring unit. The angle of reflection of the beam (radiation) depends on the bending of the barrel.

In the front part of the measuring unit there is an optical eyepiece, which is closed with a protective cover in the off position. The protective cover is opened by an electromechanical drive while the barrel bending is being measured according to commands from the calculator unit. There is a desiccant on the top surface of the measuring unit, and electrical connectors and their fastening elements are located on the back.

The optical block is structurally an optical element (a corner reflector with a spherical front edge) fixed in a bracket, which is rigidly fixed to the muzzle of the gun barrel (in the area of the barrel cut).

Measuring unit 2 (Figure 8.26) is attached to plate 3 with four bolts 4 and adjusting screws 12 with nuts 10. Plate 3 is fastened with nuts 11 on studs G, pressed into protection B of the gun. Adjusting washers 5 are installed under the supports of the measuring block.

Optical unit 1 is installed on the muzzle of the gun barrel and consists of a housing 6 with a reflector and a clamp 7 with two coupling bolts 9.

The housing 6 with the reflector and the clamp 7 are installed between the two front annular collars D on the gun barrel, and two protrusions on the housing 6 with the reflector fit into grooves made in the annular collars. Rubber pads 8 are installed on the clamp 7, which absorb loads when shooting. For alignment using the SVK, the index E is made on the housing 6 with the reflector.

2.10.14 Wind sensor

The wind sensor is designed to measure the lateral component of wind speed and convert its value into an electrical signal for output to the computer unit.

The wind sensor consists of a fairing and a block of sensitive elements.

The fairing is designed to perceive air flow and is a body, the upper part of which has the shape of an ellipse with holes. Each hole is connected by a system of channels to a block of sensitive elements.

The block of sensitive elements is structurally composed of two membrane-capacitive sensitive elements installed in a housing and closed with two covers. The lids are opened remotely based on signals from the computer unit.

2.10.15 Roll and pitch sensor

The roll and pitch sensor (DCT) is designed to measure the roll angle of the gun trunnion axis and the pitch angle of the turret (the angle of inclination of the turret in the direction “towards the bow” or “towards the stern”) relative to the plane of the “true” horizon. The measured roll and pitch angles are converted by the DCT into electrical signals and output to the computer unit. These signals are used by the computer when calculating ballistic corrections.

DKT is a gyroscopic type meter, in which rotating transformers are used as sensors for the angle of deviation of the gyroscope axis from the vertical.

The DKT consists of the following functional units: a three-degree gyroscopic device, a system for correcting the position of the gyroscope axis and rotating transformers.

The roll and pitch sensor is structurally composed of a cubic-shaped body and pins connected to the body through shock absorbers. The studs are designed for fastening and adjusting the VCT in the tank. An electrical connector is located on one of the side surfaces of the VCT.

The VCT is powered by three-phase AC voltage.

When the VCT is operating, the gyroscope axis position correction system constantly orients the gyroscope rotor rotation axis in space so that it is directed strictly vertically. Rotating transformers connected to the gyroscope frames and the DCT housing record the angles of deflection of the housing relative to the frames and generate electrical signals, the amplitude of which is proportional to the angles. The DKT sends these signals to the computer block for use in calculating ballistic corrections.

2.10.16 Gun Position Sensor (GPS)

The gun position sensor is designed to generate an electrical signal corresponding to the gun's elevation angle in the vertical plane. The signal from the sensor enters the computer unit and is used to ensure that the gun tracks the position of the stabilized aiming line of the PNM and PKP in the vertical plane, to develop ballistic corrections for the target elevation angle to ensure accurate shooting, as well as to form zones where firing from the DPU is prohibited.

Sensor 1 (Figure 8.27) of the gun position is installed in the turret above the PKTM machine gun and is attached to the turret bracket with bolts 2.

The gun position sensor is connected to the gun by a parallelogram drive 3, secured to it with bolts 4.

2.10.17 Tower position sensor

The tower position sensor (hereinafter referred to as TPS) is designed to generate a digital signal corresponding to the angle of rotation of the tower in the horizontal plane.

The DPB is connected to the digital CAN interface of the control system. Information from the DPB (turret rotation angle) is used by various tank systems (for example, the rotation angle of the BV turret is used to calculate ballistic tasks).

The turret position sensor is installed on the upper chase of the turret behind the manual MPB. The DPB is a two-stage gear reducer with a digital electromechanical position sensor installed inside. The output gear of the gearbox meshes with the ring gear of the outer ring of the tower. The gear ratio of the DPB gearbox provides one revolution of the digital electromechanical position sensor shaft for one revolution of the tower.

2.10.18 Sensors for the open position of the gunner's and commander's hatches

Sensors for the open position of the gunner's and commander's hatches are designed to generate electrical signals for the state of the gunner's and commander's hatches (open or closed). The main element of the sensors is the limit switch. Electrical signals from the sensors are sent to the DPU control unit to block the firing circuits of the DPU machine gun and prevent the DPU from colliding with the commander’s hatch (when the commander’s hatch is open).

The sensors are located in the turret directly next to the gunner's hatch and commander's hatch. The position of the sensors ensures the movement of the drive element of the limit switch when the hatch is closed, and guaranteed operation of the limit switch when the hatch is closed (generating an electrical signal about the closed state of the hatch).

2.10.19 Converter PT-800 with RCHN 3/3 regulator

The PT-800 converter with the RCHN-3/3 regulator is designed to generate an alternating three-phase voltage of 36 V with a frequency of 400 Hz to power the equipment of the fire control system and the curtain installation system.

The PT-800 converter is an electrical machine converter that converts direct current into alternating current. Stabilization of the output voltage and frequency is provided by the voltage and frequency regulator unit RCHN-3/3.

The PT-800 converter is installed on the lower surface of the gun breech. The RCHN-3/3 regulator is installed on the turret chase under the gun.

2.10.20 Protection block

The protection unit is designed to protect the electrical circuits of the AC fire control system equipment from short circuits with light signaling of blown fuses located in the unit.

The protection unit is installed on the VT deck in the gunner's position closer to the left side of the turret.

The panel with fuses and indicators is normally closed with a protective cover 2 (Figure 8.28), which is fixed to the housing 1 of the unit with screws 3 securing the protective cover.

On the protective cover 2 there is a marking of the fuses (serial number and fuse rating) and there are windows 5 through which the status of the fuse fault LEDs 8 can be monitored.

The serial number of the LED corresponds to the marking of the fuse, for example, the lighting of LED “1” corresponds to the failure of fuse “PR 1 ”.

To replace the fuse, with the control system de-energized, unscrew the screws securing the protective cover, remove protective cover 2 and replace the fuse. The new fuse must correspond to the rated value (for example, when replacing a “PR10” fuse, a fuse with a rated value of “2A” must be installed).

To replace failed fuses, fuses from a single set of spare parts for the tank are used.

To replace fuses “PR1-PR2” you need to: unscrew cap 6 above the fuse, replace the fuse and screw on the cap. To replace fuses “PR3-PR10” you need to: press on the fuse holder 7 and turn it counterclockwise, remove the fuse holder, replace the fuse and install the fuse holder in place.

After replacing the fuses, it is necessary to install the protective cover 2 in place and secure it with screws 3 securing the protective cover.

Purpose of fuses and their nominal values :

– fuses “PR 1 ” and “PR2”, with a nominal value of “10A”, protect the circuits of the gunner’s multi-channel sight, the commander’s panoramic sight and the computer unit;

– fuses “PR3” and “PR 4 ”, with a nominal value of “5A”, protect the stabilizer circuits of tank weapons;

– fuses “PR5” and “PR 6 ”, with a rated value of “5A”, protect the circuits of the remote machine gun mount control system;

– fuses “PR 7 ” and “PR8”, with a nominal value of “5A”, protect the roll and pitch sensor circuits;

– fuses “PR 9 ” and “PR10”, with a rated value of “2A”, protect the circuits of the curtain installation system.

2.10.21 Time interval setter

The time interval setter (hereinafter referred to as TSI) is designed to prepare an electronic remote contact fuse of type P or C projectiles for detonation at a given point in the flight path.

The UVI consists of a UVI block and a docking device.

The UVI block (Figure 8.29) is designed to convert signals from the computer block and transmit them to the transmitting device 6 (Figure 9.4) to prepare the electronic remote contact fuse of type P or C projectiles for detonation at a given point in the flight path. The movement of the docking device is controlled by the automatic loader equipment. The UVI unit is installed on the chase behind the gunner's seat. On the front surface of the UVI unit there are indicators NETWORK, UNIT, REMOTE. Electrical connectors and a pin for connecting a negative jumper are installed on the side surface of the block .

The docking device (Figure 9.4) is designed to transmit information to the electronic remote contact fuse about the flight time to the target. The docking device is installed on the VT deck .

The UVI does not have controls in its design and is used in conjunction with the control system and AZ of the tank.

The operation of the equipment is described in paragraph 2.9.6.1of this manual.

2.10.22 Electric triggers of cannons and machine guns

2.10.22.1 Purpose and description

Electric triggers of cannons and machine guns are designed for remote firing using electrical firing circuits implemented in the tank.

Electrical firing circuits are designed to remotely activate elements of the trigger mechanisms of guns and machine guns. Power to the electrical firing circuits is supplied from the tank's on-board network. Electrical firing circuits provide voltage supply to the galvanic impact bushing of the shot charge and to the electromagnet of the gun's percussion trigger mechanism, as well as supply voltage to the electromagnets of the trigger mechanisms of the coaxial machine gun and the DPU machine gun to fire a shot.

2.10.22.2 Composition and placement of elements of firing chains

Elements of the firing chains of the cannon and the coaxial machine gun are located:

– on the cannon;
– on a coaxial machine gun;
– V AZ control unit;
– in the control unit computer block;
– in the gunner's guidance console;
– in the commander's console PK-90, in the loading console (hereinafter - PZ) and the control console (hereinafter - PU OMS and AZ);
– in the distribution boards of the tower.

Elements of the firing circuits of the DPU machine gun are located:

– on a DPU machine gun;
– in the DPU control unit;
– in the commander's console PK-90;
– in the right switchboard of the tower.

The electrical firing circuits of the gun begin to function at the following positions of the controls and the positions of the gun and AZ mechanisms:

– with EL AZR turned on . DESCENT on the left and right distribution panels of the tower;
– installation of switches AUT. - MANUAL. on the PU SLA and AZ and PZ in the AVT position;
– supercharger turned on ;
– when the gun wedge is closed and the gun is in full roll;
– at the initial position of all automatic loader mechanisms.

When firing with the weapon stabilizer and computer unit turned on, the firing circuits are activated only when the gun is in the shot authorization zone (SZZ). The electrical firing circuits of the coaxial machine gun begin to function in the following position of the controls:

– with EL AZR turned on . DESCENT on the left and right distribution panels of the tower;
– installation of switches AUT. - MANUAL. on the PU SLA and AZ and PZ in the AVT position;
– supercharger turned on .

The AZ control unit contains electronic circuit elements that block the firing circuits of the cannon and coaxial machine gun in manual mode, allowing the gun to be fired only when the gun wedge is closed and the gun is fully rolled up, with the initial position of the AZ mechanisms, and supplying voltage to the power relay contacts of the control unit computer unit.

To ensure the supply of voltage to the galvanic circuit of the gun and to the electromagnet of the trigger firing mechanism of the gun, as well as to turn on the trigger mechanism of the coaxial machine gun for firing from the gun-

ner's guidance console and the PK-90 commander's console, the following elements are placed in the control unit computer block:

– elements of the formation of air defense missiles in the “MAIN” and “DOUBLE” modes, ensuring a shot only in the agreed position of the aiming line and the gun barrel (coaxial machine gun);

– elements for switching firing circuits depending on the operating mode of the fire control system, including to ensure a shot in the “DOUBLE” mode;

– a power relay that supplies voltage to the galvanic circuit of the gun and to the electromagnet of the gun trigger mechanism;

– a power relay that ensures that the trigger mechanism of a coaxial machine gun is activated to fire a shot.

In the handles of the gunner's guidance console there is a button to fire from a cannon (under the right index finger) and a button to fire from a coaxial machine gun (under the left index finger). Signals from the buttons of the guidance panel enter the computer block.

The PK-90 commander's remote control contains a button to fire the selected weapon. Depending on the operating mode of the control system and pressing the firing button from the selected weapon, the PK-90 commander’s console generates a signal to fire from a cannon, or a coaxial machine gun, or a DPU machine gun. The PK-90 commander's console contains elements that block simultaneous firing from a cannon and machine guns.

When the fire control system is operating in the “DOUBLE” mode, the firing circuits are controlled by the computer using signals from the type selection switch located on the PK-90 remote control. In this case, if the switch is set to any of the positions B, O, K, P or C , then the gun firing circuits are activated. If the type selection switch is set to position P , then the firing circuits of the coaxial machine gun are activated.

When the fire control system is operating in the “DPU” mode, the firing circuits from the DPU machine gun are activated when the type selection switch is set to the NABL position.

For firing from a cannon and coaxial machine gun in emergency situations when the stabilizer is not working or the computer unit in the tank is not working, additional firing buttons are provided:

– on the handle of the lifting mechanism there is a MO-Kn1 button for firing a cannon;

– At the end of the handle of the turret rotation mechanism there is an MPB-Kn1 button for firing from a coaxial machine gun.

The gun has a galvanic impact mechanism, which serves to fire a shot by supplying voltage to the electric igniter of the galvanic impact capsule charge sleeve with simultaneous activation of the electric trigger to mechanically break the galvanic impact sleeve of the artillery shot charge, as well as to supply voltage to the inductor sleeve of the 9X949 guided missile propellant.

The readiness of a cannon or coaxial machine gun for firing is indicated by the green “Ready” indicator - in the field of view of the PNM and the GOT message on the screens of the Armed Forces of Ukraine.

The electric trigger of the DPU machine gun is triggered only when the AZR EL is turned on. DESCENT on the right switchboard of the turret and the closed hatches of the driver, gunner and commander mechanics. When at least one of these hatches is opened, the operation of the electric release is blocked by the tank equipment to ensure the safety of the crew.

The DPU control unit contains:

– elements of the electronic circuit for the formation of air defense missiles, allowing a shot only in the agreed position of the PKP aiming line and the machine gun barrel;

– elements of an electronic circuit for blocking fire when the driver's, gunner's and commander's hatches are open;

– elements of the electronic circuit for blocking firing circuits when the remote control is in the firing zone of a gun, antennas, etc.

When the fire control system is operating in the “DPU” mode and the firing button from the selected weapon is pressed, the firing signal from the DPU machine gun from the PK-90 commander’s console is sent to the DPU control unit.

The readiness of the DPU machine gun to fire is indicated by the presence of the GOT message on the commander’s APU screen.

2.11 Remote machine gun control system

2.11.1 Purpose of the DPU control system

The control system for a remote machine gun mount (hereinafter referred to as the DPU Control System) is designed to conduct effective fire from a DPU machine gun on the move and from a place.

DPU control system is intended for:

– stabilization of the control panel in two planes from a place and on the move according to signals from the control panel ;

– testing the DPU aiming angles and lateral lead based on signals from the BV;

– guidance of a stabilized remote control unit in two planes with a smooth change in the guidance speed due to tracking the PKP aiming line;

– transfer of DPU;

– ensuring the resumption of tracking of the DPU in the horizontal plane behind the aiming line of the control panel, when the DPU leaves the zone of mechanical stops (from the dead “zone”);

– blocking the collision of DPU drives with mechanical stops;

– ensuring the electric trigger of the DPU machine gun, taking into account the shot authorization zone and blocking the firing circuits of the DPU machine gun in situations where firing from the DPU machine gun poses a danger to the crew or can damage the tank (the gun is in the firing zone, the antennas are in the firing zone, the wind sensor is in the firing zone shelling, hatches open, etc.);

– ensuring switching the rate of fire;

– ensuring queue cut-off;

– ensuring loading of the DPU (installation and locking of the DPU in the loading position of the DPU);

– control of electromagnetic stoppers.

2.11.2 Composition of the DPU control system and placement of its components in the tank

The DPU control system includes the following equipment:

– control unit (hereinafter - CU DPU) - in the niche of the tower, behind the MPK;

– power amplifier (hereinafter - PA DPU) - in the niche of the tower, behind the MPK;

– vertical guidance electric motor (hereinafter referred to as ED VN DPU) - on the DPU machine, on the left rack;

– horizontal guidance electric motor (hereinafter referred to as the GN DPU ED) - on the DPU support, on the GN drive gearbox housing;

– absolute angular velocity sensor DPU in the VN plane (hereinafter referred to as DUS VN DPU) - on the DPU cradle to the right of the machine gun;

– absolute angular velocity sensor DPU in the plane GN (hereinafter - DUS GN DPU) - on the rotating shoulder strap of the DPU machine;

– DPU position sensor in the HV plane - on the DPU machine, in the trunnion assembly of the left rack;

– DPU position sensor in the GN plane - on the DPU support;

– electrical installation kit (electrical harnesses) - in the turret and at the control center, connects the control center equipment to each other and to the tank equipment.

– electromagnetic stoppers DPU (hereinafter referred to as EMS VN DPU and EMS GN DPU), EMS VN DPU is located on the right rack of the DPU machine, EMS GN DPU is located on the DPU support.

2.11.3 Operating principle of DPU control system

The operating principle of the DPU control system is based on constant compensation (in real time) in two planes of mismatch between the stabilized aiming line of the PKP and DPU, taking into account the ballistic corrections generated by the BV.

Aiming the control panel is carried out by directing the aiming line of the control panel based on signals from the commander's console and compensating for the mismatch between the stabilized aiming line of the control panel and the control panel, including when transferring the control panel.

Installation of the DPU in the stowed position, loading position and locking of the DPU in these positions is carried out by means of the DPU control system according to commands from the commander’s console, taking into account the signals received from the DPU position sensors along the HV and GN.

The transfer of the DPU along the GN from one edge of the guidance zone to the other, to ensure the resumption of tracking of the DPU along the GN, is carried out by means of the DPU control system, taking into account the position of the control panel along the GN relative to the edges of the guidance zone.

Blocking the collision of the DPU drives with mechanical stops is carried out by means of the DPU control system based on signals from the DPU position sensors along the HV and GN.

2.11.4 Control of shooting and reloading of the DPU machine gun

When the control system is operating in the DPU mode (when the mode selection and ballistics switch on the PC is in the NABL position and the DPU toggle switch is on on the PC), the DPU control provides voltage to the electric trigger of the DPU machine gun (firing from the DPU machine gun) when firing button 11 is pressed (Figure 8.18). from the selected weapon on the commander's console.

The DPU control system provides voltage supply to the electric trigger of the DPU machine gun when the following conditions are met :

– the DPU drives are in the shot resolution zone, and the pointing speed of the DPU drives does not exceed the threshold value;

– there are no blocking of the DPU firing circuits.

To save ammunition , the DPU control system provides for switching the rate of fire and forcibly interrupting the burst. A forced interruption of the queue occurs approximately 3 seconds after pressing the firing button 11 from the selected weapon on the commander's remote control . Switching the rate of fire from high to small or reverse is carried out by pressing button 12 for loading the gun/switching the rate of fire of the DPU once on the commander’s remote control .

When a high rate is selected (200 shots/min), “P 2 ” is displayed in the window indicating the type of ammunition and type of weapon; when a low rate is selected (100 shots/min), “P1” is displayed. After turning on the DPU, a high rate of fire (“P 2 ”) is set by default .

For the convenience of reloading the DPU machine gun, a DPU loading mode is provided. Enabling the DPU loading mode is possible when the control system is operating in the DPU mode (when switch 4 for selecting modes and ballistics on the PC is in the NABL position and the DPU toggle switch is on on the PC). To enable DPU boot mode switch 4 selection of modes and ballistics on the PC must be set to the LOAD position. DPU. After switching on the DPU loading mode, the DPU drives rotate to the loading position and are locked in this position. After locking the drives in the loading position, the commander needs to open the hatch and perform the necessary actions. To turn off the DPU loading mode and switch to the normal operating mode (DPU mode), you need to close the commander’s hatch and set switch 4 selecting modes and ballistics on the PC to the NABL position.

2.11.5 Blocking the firing and cocking circuits of the DPU control system during operation of the control system

To ensure safe operation of the crew with the remote control system, the remote control control unit provides interlocking firing circuits.

The DPU firing circuits are blocked in the following cases:
– DPU mode is turned off;
– AZR EL is switched off . S START on ShchRP;
– the commander's hatch is open;
– The gunner's hatch is open;
– The driver's hatch is open;
– The DPU is in the ammunition loading position (in the DPU loading mode);
– when the following elements are in the line of fire of the DPU:
- guns (taking into account its pumping in the range of vertical guidance angles);
- radio station antennas (taking into account its possible deviation from the wind, from the rotation of the tower, from the movement of the tank, etc.);
- data transmission equipment antennas;
- wind sensor and START cameras.

ATTENTION:

WHEN THE MACHINE GUN BELT IS NOT COMPLETELY USED UP, THE MACHINE GUN REMAINS CHARGED AND NOT ON SAFETY. IF THERE IS A STRONG MECHANICAL IMPACT ON THE MACHINE GUN BODY, SPONTANEOUS DESCENT OF THE COCKED BOLT FRAME OF THE MACHINE GUN AND FIRING OF A SHOT IS POSSIBLE, REGARDLESS OF THE BLOCKAGES FORMED BY THE DPU CONTROL SYSTEM. IN THIS CASE, YOU MUST BE EXTRA VIGILANT WHEN LEAVING THE TANK AND WHEN WORKING OUTSIDE!

2.12 Tank electrical equipment

The electrical equipment of the tank can be divided into the following groups:
– sources of electrical energy;
– consumers of electrical energy;
– electrical on-board network;
– auxiliary electrical equipment.
The electrical connection diagram for the electrical equipment of the housing is shown in Figure 10.1 .
The electrical connection diagram for the electrical equipment of the tower is shown in Figure 10.2 .

2.12.1 Sources of electrical energy

The sources of electricity in the tank are the battery and the starter-generator operating in generator mode.

2.12.1.1 Electricity consumers

Consumers of electrical energy are:
– weapons complex devices;
– starter-generator operating in starter mode;
– electric motors of pumps and fans;

– software and hardware complex;
– collective protection system devices (protection against weapons of mass destruction and fire);
– lighting and alarm devices.

Lighting and signaling devices include headlights, front, side and rear marker lamps, lampshades, lamps, portable lamps, sound signals, and warning lamps.

Tank lighting is divided into external, internal and duty.

2.12.1.2 Electrical on-board network

The electrical on-board network is made according to a single-wire circuit, with the exception of emergency circuits (emergency lighting, OPVT pump and emergency sockets). The “negative” wire is the tank body.

^{2} (permissible current up to 10 A) is laid from the control department to the MTO . Its ends are laid in the wire route on the inclined sheet of the nose above the driver's shield (wire No. 98, Figure 10.1) and in the wire route on the input gearbox (wire No. 108).

2.12.1.3 Auxiliary electrical equipment

Auxiliary electrical equipment devices are:
– rotating contact device;
– driver shield;
– distribution boards;
– switches, switches, buttons;
– AZR type circuit breakers, fuses, adapter blocks, electrical connectors.

2.12.2 Electrical equipment of the engine-transmission unit

The following are installed in the engine-transmission compartment :
– starter-generator - on the bracket of the engine foundation;
– tachometer sensor - on the engine;
– coolant thermometer receiver - in the cooling system pipeline;
– oil thermometer receiver - on the oil pumping pipeline from the engine;
– the receiver of the oil thermometer in the tank is in the intake filter of the main engine oil tank;
– thermocouple cold junction thermometer receiver - on the left side;
– thermocouple - in the exhaust manifold;
– receiver of the cold junction thermometer of the heater thermocouple - on the starboard side;
– heater thermocouple - in the exhaust manifold of the heater;
– heater hatch sensor - on the right balancer bracket;
– engine oil pressure receiver and left turn sensor - on the left gearbox housing;
– pressure receiver in the transmission lubrication system and right turn sensor - on the right gearbox housing;
– electric motors for oil pumps starting from the tug and engine - on the bottom under the bevel gear bracket;
– air cleaner contamination indicator - on the air cleaner body;
– PTO electromagnet - on the moisture-oil separator bracket;
– cooling system fan drive control electromagnet - on the left on the fan guard;
– oil drain electromagnet - on the valve device;
– TDA electromagnet - on the engine;
– the electromagnet of the distributor valve and the D-20 sensors of the starter-generator drive are on the input gearbox.

2.12.2.1 Starter-generator

The SG-18-1S starter-generator is a direct current electric machine with parallel excitation in generator mode and mixed excitation in starter mode.

The starter-generator is installed in the MTO on a cushion mounted on a bracket of the engine foundation, and is attached to it with two clamps. A shield is installed on top of it to protect the engine exhaust manifold from thermal radiation.

Cooling of the starter-generator is provided by:

– centrifugal fans installed on the armature shaft of the starter-generator. The housing has windows for cooling air inlet and a tube with a hose for connecting a source of compressed air used to remove dust from the starter-generator during maintenance;

– air passing through air intake 8 (Figure 10.3), which is forced into it by the engine cooling system fan. Air for cooling the starter-generator is taken from the radiator rack and enters the inertial grille 3 and air intake 8. The grille and air intake are fastened with bolts 2 to the middle beam of the MTO.

The grille is made in the form of a welded one-piece box with plates welded inside, which divide the air flow into two routes: clean and dust. The finishing line is connected to the inlet window of the starter-generator using hoses 4 and pipe 5. The dust path ends with a window through which the separated dust is sucked off by a fan of the engine cooling system. The air intake 8 is connected by a sleeve 7 to the flaps 6 on the starter-generator housing. At the en-

trance to the grille 3 and the air intake 8, corrugated rubber seals 1 with meshes are installed. When the roof over the transmission is closed, seals 1 are pressed against the windows of the radiator rack.

2.12.3 Placing elements inside the case

2.12.3.1 Arrangement of elements in the control compartment

The control department has:

– four rechargeable batteries (hereinafter referred to as AB), covered with easily removable casings in the rack to the left of the driver's seat;

– starter switching unit, switch unit, relay regulator, external power socket, external start socket - above the batteries;

– battery protection unit - to the left of the driver;

– driver shield - on the left fuel tank;

– driver's panel lighting lamp;

– individual driver's fan;

– gear selector lighting lamp;

– selector lock switch, turn signal switch - on one bracket, to the left of the driver's observation device;

– remote display - to the right of the driver's observation device;

– electro-pneumatic engine air start valve - to the right of the driver's observation device;

– electric motor, shift cycle and gear number sensors, gear selector locking electromagnet, neutral sensor and gear lever sensor - on the gear selector housing;

– lighting fixture for the PKUZ-1A instrument complex - on the right, in the installation compartment of the PKUZ-1A instrument complex;

– glass temperature regulator for the driver's observation device - on the windshield, in the area of the right bow tank;

– sensor for blocking the stabilizer drive and launching smoke grenades from the driver's hatch - on the outer glass of the closing mechanism;

– two fuel meters - in the left bow tank and the right tank;

– Emergency lamp and power socket – on top, behind the driver's seat;

– speed sensor - in the crank of the left guide wheel;

– tachogenerator - in the crank of the right guide wheel ;

– braking sensor - on the fuel pedal;

– brake button - in the left turn lever;

– the up gear shift button is in the right turn lever;

– The brake switch is located in the stop brake transverse shaft support.

2.12.3.2 Placement of elements in the fighting compartment

The following are installed in the fighting compartment :

– two lamps for illuminating the ammunition rack - near the MTO partition;

– lighting fixture - on the left behind the AB rack;

– electric motor of the OPVT water pump - on the bottom, behind the middle tank rack on the left side;

– electric motors of the heater and heater;

– coolant level sensor - in the heater heater;

– rotating contact device - in the center, on the bottom of the housing;

– heater control unit - on the MTO partition, near the heater;

– BSU coordination and control unit – on the left, on the AB rack;

– electropneumatic valves - in the right rear corner;

– traffic alarm box - on the left side.

2.12.4 Placing elements outside the housing

The following are installed outside the tank hull:

– two front (with a green filter), two side (with a yellow filter) and two rear (with a red filter) side lights;

– headlight with blackout attachment - on the bow, on the left;

– headlight with infrared filter - on the bow, on the right;

– sound signal - on the right headlight guard;

– left rear marker light;

– The electrical connector for recharging batteries with low currents is on the housing of the left front parking light.

2.12.4.1 Headlights

The tank is equipped with three headlights: a FG 127 visible light headlight with a blackout device; headlight FG 126 visible light and a source of infrared light (headlight FG 125 with infrared filter).

The infrared light source (hereinafter referred to as the IR illuminator) is turned on by the HEADLIGHTS-RIGHT switch located on the driver's panel.

The FG 126 headlight is equipped with a digital attachment with a red light filter, a set of numbers from “0” to “9” of which is located in a single set of spare parts for the tank. The headlight is turned on using the HEADLIGHT switch located behind the commander on the roof of the turret.

The FG 127 headlight provides three blackout modes: “Darkening”, “Partial dimming” and “Full illumination”.

Dimming is ensured when the cover of the blackout device (hereinafter referred to as SMU) is closed and the LIGHT LIGHT switch is in the M position.

Partial dimming is ensured when the SMU cover is closed and position B. LIGHT of the HEADLIGHTS-LEFT switch.

Full illumination is provided when the SMU cover is open and position B. LIGHT OF THE HEADLIGHTS-LEFT switch.

2.12.4.2 Marker lights

Marker lights GST-64 indicate the dimensions of the tank.

The tank has seven side lights (two front, two side, two rear on the hull and one on the rear turret). The front side lights have a green filter, the side lights have a yellow filter, and the rear lights have a red filter.

The side lights are turned on by the ALL-REAR switch , and the brightness of their glow is determined by the position of the B. LIGHT - M. LIGHT switch.

Sound signal

The tank is equipped with an electric sound signal located on the right headlight guard. The signal is activated by a button on the driver's dashboard.

2.12.4.3 Road signaling

Road alarms are designed to signal a tank's maneuver (turning or braking) by flashing the side lamps. The electrical circuit diagram of the road alarm is shown in the figure .

The traffic signaling system includes front, side and rear marker lights, a traffic signaling box, a remote display and switches.

The KDS1-2S box is installed on the left side. It ensures that the lamps blink when the turn signal is turned on, when the tank is braking and when the engine is running.

The operation of the turn signal and the activation of braking signals is monitored by the indicators of the remote TV display located to the right of the driver’s observation device.

The traffic alarm is turned on and controlled by the following switches:

– turn signal switch located to the left of the driver's observation device. The switch turns on the flashing lamps:

- left group of side lights - when turning left;
- right group of side lights - when turning right;

– a braking switch installed in the support of the transverse shaft of the stopping brake and ensuring that when the tank is braking, the tail lamps, including the lamp on the turret, blink. When the parking brake pedal is pressed, the turn signal stops and when the pedal is released, it continues to sound unless the turn signal is turned off;

– ALL-REAR parking light switch , located on the driver's panel and ensuring the operation of all side lights or only the rear ones, including the side light on the tower;

– switch for blackout mode of side lights B.SVET - M.SVET, located on the driver's panel and providing switching of side lights from high to low light.

2.12.5 Driver display system

The driver's display system (hereinafter referred to as DKMV) is designed to monitor the operation of the power plant and transmission.

The composition of the DCMV includes:

– Driver's APU;

– coordination and control unit;

– remote TV scoreboard;

– control button block (hereinafter referred to as BCU);

– heater control unit.

The driver's APU is installed on the driver's panel and is designed to display current and emergency information, as well as video images from the external video surveillance system.

The coordination and control unit is installed on the left on the AB rack and is designed to process information and issue control commands to actuators.

The remote TV display is located to the right of the driver’s observation device and is designed to display operational information. The brightness of the indicators automatically changes depending on the light level. If necessary, the brightness of the indicators can be changed manually by pressing the “ ☼” button on the BCU. After going through the preset brightness levels of the indicators, the switch to the automatic brightness change mode occurs again.

The BKU is installed on the driver's panel and is designed to control the DCMV - menu navigation, changing information windows, manually changing the brightness of the remote TV display indicators.

The heater control unit is installed on the MTO partition near the heater and is designed to control the heater.

DKMV displays on the APU screen the main operational parameters in the form of scales, for which the following sensors are used:

– shunt IIIA-540, designed to measure the charging current and voltage of the on-board network;

– P-1 thermometer receivers are designed to measure the temperature of engine oil and coolant;

– ID-2 pressure receivers are designed to measure oil pressure. The transmission lubrication system uses a receiver with a measurement range from 0 to 7 кгс/см^2, and the engine lubrication system uses a measurement range from 0 to 15 кгс/см^2;

– tachometer sensor D-4, designed to measure engine crankshaft speed;

– the DSMU speed sensor is installed in the left guide wheel and is designed to measure the speed of movement and count the distance traveled by the tank;

– IT3-1C fuel meters are designed to monitor the amount of fuel in the left bow tank and right tanks.

When starting the engine with the starter, the image on the driver's APU may briefly go dark.

2.12.5.1 Functions implemented in DKMV

The following functions are implemented in DKMV:

– continuous monitoring of the operating parameters of the power plant, transmission and heater;

– continuous self-monitoring and monitoring of the technical condition (serviceability) of sensors and actuators interfaced with the DCMV accurate to the unit;

– cooling system fan fluid coupling control;

– storage in the non-volatile memory of the DKMV data on the distance traveled by the tank and engine operating hours;

– control of automatic gear shifting (hereinafter referred to as AMS). The design and operation of the AMS system is discussed in more detail in paragraph 3.27.7.2.1 of this manual (Part 2);

– protection of the engine from starting in the opposite direction when the tank rolls back in the event of a failed attempt to overcome the rise. The sensor is a standard tachometer sensor. The executive body for protection is the engine stopping mechanism;

– heater control. The procedure for using the heater is described in more detail in 188M.R E1 (part 2);

– control of the PVV system. The use of the PVV system is described in more detail in 188M.R E1 (Part 2);

– settings for DCM and parameters of individual components, combined in the KTS menu item (technical condition monitoring);

– display on the driver's APU of the current parameter values, as well as emergency, warning and other text messages

– displaying information from the orientation system on the driver's APU.

The DCMV functions are controlled using the driver's mechanic's control unit and APU.

2.12.5.2 Working with the DKMV menu

During normal operation of the power and transmission units, as well as the heater, the main screen with graphic scales is displayed on the driver's APU screen, allowing you to quickly monitor the most important current parameters - engine oil pressure and temperature, oil pressure for transmission lubrication and coolant temperature.

If necessary, the driver can view the current parameter values on the APU using the " ⬆" and " ⬇" buttons on the BCU, or the INF button. on the driver's panel. When you stop using the " ⬆" and " ⬇" buttons on the BKU, or the INF button, an automatic return to the main screen with graphic scales occurs. If necessary, any parameters can be "fixed" on the APU screen using the SELECT button. The "fixation" is released using the " ⬆" or " ⬇" button on the BCU.

To enter the DKMV menu, you must press the MENU button on the BCU. The cursor is moved through the menu using the " ⬆" or " ⬇" buttons on the BCU. To select a menu item, press the SELECT button. To exit the menu, press the MENU button or select EXIT and press the SELECT button.

The structure of the DKMV menu is shown in Table 5.

Table 5

DKMV menu items			Note
Level 1	**Level 2**	**Level 3**	
EXIT	-	-	
HEATER	EXIT	-	
	SINGLE ENTRY	EXIT	The use of the heater is described in 188M.R.E. , part 2
		SINGLE ENTRY	
		HEATING OD	
		PURGE	
	DELAY 00H 00M	-	
	START/STOP	-	

DKMV menu items			Note
Level 1	Level 2	Level 3	
START WITH PVV	-	-	Starting an engine with PVV is set out in 188M.R E , part 2
SETTINGS	EXIT	-	
	SELECTION OF COOLANT TYPE	EXIT	The type of coolant used in the cooling system is necessary to correctly control the thermal state of the engine
		WATER	
		ANTIFREEZE	
KTS	EXIT	-	
	LEVEL GAUGES	-	Before filling the internal tanks with fuel, confirm that there is no fuel in the tanks, and after full refueling, confirm that the tanks are full
	APP SETTING	-	Consistently establish and confirm the appropriate positions of the fuel pedal and gear selector, guided by the instructions on the driver's APU
	LANGUAGE	EXIT	
		ENGLISH	Not used during operation
		RUSSIAN	
	DISCLAIMERS	-	Unreviewed failures detected since the last time the DKMV was turned on are listed. Unreviewed faults are stored in the DKMV memory until they are displayed on the APU screen or until the power is turned off

2.12.5.3 KTS menu item (technical condition monitoring)

The KTS (technical condition monitoring) menu item contains DKMV functions, which are intended for setting up the sensors of the automatic transmission system, calibrating fuel level meters, changing the language for displaying information, and also for reading unviewed faults.

Configuring the sensors of the automatic transmission system and calibrating the fuel level meters is necessary only if the left or right fuel meter, the gear selector with a gear number sensor installed in it, or the fuel pedal with a sensor are replaced.

Entering the CTS menu is only possible when the engine is turned off and the tank is stopped.

2.12.5.4 Alarm, engine and heater protection

The alarm, engine protection and heater protection functions are implemented in the DKMV software and are intended for the following purposes:

– alarms about fire, stalled tank, low pressure and low temperature of engine oil, high temperature of coolant, high temperature of engine exhaust gases, critical engine speed, low transmission oil pressure, presence of water in fuel;

– engine start blocking at low pressure and low engine oil temperature;

– blocking the start of the heater or stopping its operation at high temperatures or loss of coolant;

– limiting the power removed from the engine at high engine exhaust gas temperatures or when the coolant or engine oil is overheated;

– the absence of coolant circulation at engine speeds of more than 900 rpm and coolant temperature of more than plus 20 °C.

The alarm, engine and heater protection functions are shown in Table 6.

If the values of the monitored parameters reach the maximum permissible value (emergency situation), a one-time voice message is issued to the driver's head phones, information about the emergency parameter is displayed on the APU , the " " scale marker (if available) ⚠ flashes , and the " ▼" indicator flashes on the remote display. .

If a malfunction (failure) of sensors or actuators is detected, information is displayed on the driver's APU in accordance with 188M.R E1 (part 2), and the " ⚠" indicator flashes on the remote display.

In such cases, it is necessary to follow the instructions and recommendations issued by the DCMV. If there is information that has not been viewed, the " ≫ " symbol flashes in the lower right corner of the driver's APU .

All faults that have not been viewed are stored in the DKMV memory until the power is turned off .

Table 6

Event	DCMV actions	Information on the driver's APU
Signal from the fire protection system about a fire in the front or rear compartments	-	"FIRE IN THE FRONT COMPARTMENT" (in case of a fire in the PO), "FIRE IN THE REAR COMPARTMENT" (in case of a fire in the AOR)
Signal "A" from PKUZ	-	"RADIATION"

Event	DCMV actions	Information on the driver's APU
Signal "ORB" from PKUZ	-	"POISONIC SUBSTANCES"
Pressing the stopping brake pedal and the tank speed is less than 5 km/h	-	BRAKE
The pressure in the engine lubrication system is less than 2 kgf/cm ^{2} and the engine is running	-	Marker " ▼" of the PRESSURE scale. OIL (engine) in flashing mode and additionally the message: "LOW ENGINE OIL PRESSURE"
The oil temperature in the engine oil tank is below plus 3 °C	Blocks engine start	Marker " ▼" of the TEMPERA scale. OIL (engine) in flashing mode and additionally the message: "START-ING THE ENGINE IS IMPOSSIBLE. HEAT THE COOLANT"
When trying to start the engine, the pressure in the engine lubrication system is less than 2 kgf/cm ^{2} and the oil temperature in the engine oil tank is less than plus 35 °C	Blocks engine start	-
The coolant temperature is more than plus 100 °C and the ANTIFREEZE coolant type selected on the DKMV and more than plus 125 °C with the WATER coolant type selected	-	Marker " ▼" of the TEMPERA scale. Coolant in flashing mode
Exhaust gas temperature more than plus 650 °C	-	Marker " ▼" of the TEMPERA scale. VG in flashing mode
Engine speed more than 2300 rpm	-	The marker " ▼" of the REV.O D scale is in flashing mode and additionally the message: BRAKE! HIGH RPM
The pressure in the transmission lubrication system is less than 1.5 kgf/cm ^{2} for a time of more than 10 s and the engine speed is more than 1600 rpm	-	Marker " ▼" of the PRESSURE scale. OIL (transmission), in flashing mode and additional message: LOW TRANSMISSION OIL PRESSURE.
Receiving a signal about the presence of water in the right tank	-	WATER IN FUEL
The coolant temperature is more than plus 105 °C when operating on antifreeze and more than plus 125 °C when operating on water, as well as in the absence of coolant	Blocks the start of the heater or stops its operation (turns off the fuel supply solenoid valve)	-
One of the parameters is greater than the specified limit value within 15 minutes: - coolant temperature more than plus 100 °C when operating on antifreeze; - coolant temperature more than plus 125 °C when working on water; - engine oil temperature is more than plus 125 °C ; - engine exhaust gas temperature is more than plus 650 °C	Includes PTO	LOWER GEAR WORKS MOM
If one of the parameters is greater than the specified limit value within 10 s: - coolant temperature more than plus 110 °C when operating on antifreeze; - coolant temperature more than plus 130 °C when working on water; - engine oil temperature is more than plus 130 °C ; - engine exhaust gas temperature is more than plus 680 °C	Includes PTO	LOWER GEAR WORKS MOM
If there is a signal from the minimum pressure difference sensor between the inlet and outlet of the water pump within 1 second, the engine speed is more than 900 rpm and the coolant temperature is above plus 20 ° C	-	NO COOLANT BLENDING. THE MOD WILL WORK IN 10 sec (includes a timer from 10 to 0 sec)
When the signal from the minimum pressure difference sensor between the inlet and outlet of the water pump is maintained for 10 s, the engine speed is more than 900 rpm and the coolant temperature is above plus 20 ° C	Stops the engine (turns on MOD)	MOD WORKED. NO COOLANT BLENDING

Event	DCMV actions	Information on the driver's APU
Rotating the engine crankshaft in the opposite direction	Stops the engine (turns on MOD)	-

2.12.6 Consumer power supply and electric engine start system

The system is designed to electrically start the engine, provide electricity to consumers and recharge the battery. The system consists of two main circuits:

– charging circuit and power supply circuits for electrical energy consumers;
– starting the engine.

The charging circuit and consumer power supply circuit includes:

– starter-generator (in generator mode);
– relay-regulator;
– battery protection unit;
– shunt;
– rechargeable batteries (hereinafter - AB).

The engine starting circuit includes:

– rechargeable batteries;
– coordination and control unit (hereinafter - BSU);
– starter-generator (in starter mode);
– starter switching unit (hereinafter referred to as BKS);
– switch block;
– electrical connector for external start.

2.12.6.1 Design and principle of operation of the main parts

2.12.6.1.1 Relay-regulator R15M-4S

The R15M-4S relay-regulator is designed to automatically connect and disconnect the starter-generator in generator mode from the electrical equipment network, to maintain the generator voltage from 26.5 to 28.5 V , to suppress high-frequency radio interference created by the starter-generator.

The relay regulator is installed on the bracket to the left of the driver and is connected to the on-board network by power terminals “+B” and “+I” and an electrical connector.

The relay-regulator has a filter designed to suppress high-frequency radio interference created by the voltage regulator and the starter-generator in generator mode. The filter consists of a high-current choke and two pass capacitors.

2.12.6.1.2 Electric filter

The F-5 electric filter is designed to protect radio equipment from interference that occurs during the operation of electrical equipment.

U-shaped inductive-capacitive filter . It consists of a housing, a choke, two pass-through capacitors and two shielded terminals.

The filter is fixed on the VT flooring .

2.12.6.1.3 Starter switching unit

The starter switching unit (Figure 10.5) performs the following functions:

– connects the battery to the tank's on-board network;
– controls engine start;
– controls the external engine start mode;
– disconnects the excitation winding of the starter-generator while pumping oil from the gearboxes;
– controls the engine preservation mode;
– provides information about the operation and condition of the actuators and batteries during startup, engine conservation, and also in power supply mode.

In engine start control mode, the BKS unit provides:

– start-up after creating the required pressure in the engine lubrication system;
– three-stage starter;
– monitoring the operation of the oil pump after starting the engine for approximately 10 s.

The BKS unit provides a starter start, a combined start (together with an air start) and a start in the PVV mode (with heating of the intake air). Information about the state of the actuators and batteries is displayed on the end surface of the block in the form of light indicators lighting up.

2.12.6.1.4 Switch block

The switch block is designed to connect to the tank's on-board network the electric motors MZN of the engine and MZN of launch from a tugboat, electric air braking valves, an electromagnet for the oil pumping valve from the gearboxes and coordination of electrical signals for manual and automatic control.

2.12.6.1.5 Sensors D-20

D-20 sensors in the engine starting system with a starter-generator are designed to control the complete engagement of the starter-generator drive and the input gearbox.

The sensors are located in the engine-transmission compartment of the tank and installed on the starter-generator drive housing.

2.12.6.2 Operation of the electrical circuit in generator mode

When the engine is running due to the residual magnetic flux, the generator is self-excited and its output voltage increases.

The starter-generator is connected to the on-board network by a relay-regulator contactor. If the voltage at the starter-generator armature is less than at the battery, then the contactor is de-energized. If the voltage on the armature of the starter-generator becomes greater than on the battery by (0,6±0,4) V, then the contactor is triggered and with its contacts connects the armature circuit of the starter-generator to the battery.

Subsequently, the relay-regulator automatically sets the excitation current of the starter-generator, at which the voltage of the starter-generator is maintained within the limits specified when setting it up.

When the engine speed decreases, the generator voltage becomes less than the battery voltage, and reverse current flows through the relay-regulator. With a reverse current of 15 to 50 A, the contactor is de-energized and, with its contacts, disconnects the armature circuit of the starter-generator from the battery.

To automatically turn off the relay-regulator in case of overvoltage in the excitation winding, a voltage protection circuit with a fuse is designed .

The relay-regulator protection circuit is connected in parallel to the excitation winding of the starter-generator. If, when the excitation winding is shorted to the armature circuit of the starter-generator or when one of the elements of the relay-regulator fails, an uncontrolled increase in the output voltage of the starter-generator occurs, the protection circuit is triggered and the relay-regulator fuse blows, and the relay-regulator is disconnected from the on-board network.

Protection of the on-board network and relay-regulator from polarity reversal of the starter-generator is provided by a built-in diode. When the starter-generator is self-excited in reverse polarity, the fuse burns out through the diode, operating, in this case, in the forward direction, after which the relay-regulator is de-energized, and the starter-generator is not excited.

2.12.6.3 Operation of the electrical circuit when starting the engine with the starter

The circuit is ready to operate to start the engine with the starter after setting the gear selector to the neutral position and turning on the battery switch.

When you press the STARTER button on the driver's panel, the electric motor MZN of the engine is turned on, which creates pressure in the engine lubrication system.

When creating oil pressure in the central line of the engine more than 2 $кгс/см^2$and provided that the oil temperature in the engine oil tank is more than plus 5 °C, the start blocking in the DCMV is disabled.

After which the tug's electric motor is switched on. The tug's MZN electric motor creates pressure in the starter-generator drive booster, ensuring preload and engagement of the drive.

After (2.5 ±0.5) s, the relay-regulator is disconnected from the excitation winding and the anchor circuit of the starter-generator.

The battery voltage is supplied through a starting current-limiting resistor to the starter winding of the starter-generator. The armature begins to rotate slowly at a voltage of about 3 V for a time of 0.4 to 0.8 s, i.e. until the end of the first stage of start-up. In this case, the battery voltage is supplied to the excitation winding of the starter-generator, which increases the torque of the starter-generator at the first stage of starting.

When the starter-generator drive is fully engaged, the contacts of the D-20 sensors on the input gearbox are closed, and the tug's MZ is switched off.

At the end of the time delay, the battery voltage is supplied to the starter-generator bypassing the starting resistance (second starting stage).

When the voltage on the starter-generator is more than 17 V or after about 5 s after turning on the second stage of engine starting, the BCS switches the battery from a parallel connection to a parallel-series connection, and a voltage of 48 V is supplied to the winding of the starter-generator (third stage of starting).

The starter-generator, developing full power on the shaft, ensures the engine starts.

After releasing the STARTER button, the relay-regulator is connected to the starter-generator , the starter-generator switches to generator mode, the BCS switches the battery to a parallel connection.

After approximately 10 s, the electric motor of the engine MZN is switched off.

2.12.6.4 Starting the engine with air and combined methods

Starting the engine with air and in a combined way is possible with the gear selector lever in neutral.

When the COMBINED switch is in the off position and the EPK button is pressed, voltage is supplied to the air release electro-pneumatic valve, which supplies compressed air to start the engine.

When the COMBINED switch is in the on position, the STARTER button is pressed and simultaneously with the third stage of engine starting, voltage is supplied to the air release electro-pneumatic valve. There is a combined engine start with a starter and air.

2.12.7 Rechargeable batteries

The tank is equipped with four lead-acid batteries of type 12ST-85RM with a rated voltage of 24 V. For connection, there are output terminals on the front wall of the battery, covered with protective covers.

ABs are placed in baskets and secured in them with coupling bolts. Baskets with batteries are installed in the rack to the left of the driver.

It is possible to install batteries on a tank with a rated voltage of 12 V.

Battery with a rated voltage of 24 V in the tank are connected in parallel, with a nominal voltage of 12 V - in pairs - series-parallel. When starting the engine with the starter, they are switched by the starter switching unit (hereinafter - BKS) to a voltage of 48 V. A voltage of 48 V is supplied to the starter winding of the starter-generator, the remaining consumers remain connected only to two batteries connected in parallel, i.e. for voltage 24 V.

On the casing covering the relay-regulator and the BCS, there is a plate with a connection diagram for the battery, a diagram for connecting wires when starting the engine of your tank from another tank or from the buffer group of the battery (Figure) .

2.12.8 Distribution and protection systems

Electrical equipment distribution and protection systems include:

– rotating contact device;
– driver shield;
– distribution boards;
– switches, switches, buttons;
– AZR type circuit breakers, fuses, adapter blocks, electrical connectors.

2.12.8.1 Rotating contact device

A rotating contact device provides connection between the electrical circuits of the housing and the tower.

The rotating contact device is installed as a fixed part on the bottom of the tank hull so that the axis of rotation is aligned with the axis of rotation of the turret. The moving part of the VKU is connected through a leash to the flooring of the rotating conveyor of the automatic loader and rotates together with the turret.

2.12.8.2 Driver shield

The driver's shield (Figure 10.7) is intended:

– for placement of controls for individual electrical equipment devices;
– for distributing electrical energy through consumer circuits in the tank body and protecting them from short circuits.

The driver's panel contains circuit breakers, switches, switches, buttons, the driver's APU and other devices. The shield is installed on the left bow tank and is included in the tank's electrical circuit with electrical connectors.

The following devices are installed on the left panel of the driver's panel:

– AB switch, VIDEO button, INF button, sound signal button - in the first (top) row;
– The driver's APU is in the second row;
– block of control buttons BKU - in the third row;
– switch for the electric motor of the BCN and the TDA system, switch for heating the fighting compartment, switch for the blackout mode of side lights, switch for side lights, switch for lighting the driver's panel and gear selector, switch for the headlight FG 127, switch for the headlight FG 125 - in the fourth row;
– valve device solenoid switch, VENT switch. CO , tug start switch, COMBINED switch, SPECIAL switch (under the cover) - in the bottom row.

On the circuit breaker panel (right side of the driver’s panel) there are: a button to turn on the oil pump for starting the engine from a tugboat (under the cover); engine oil pump activation button, starter button (under the cover); EPC button; emergency turret rotation button; two circuit breakers of the AZR type, acting as switches for the TDA electromagnet and the OPVT water pump (under the bracket) and circuit breakers acting as fuses (under the hinged covers). There are signs on the inside of the covers indicating in which circuit the AZR is installed . The plate attached to the outside of the cover indicates the procedure for checking the 3ETs13-1 system.

At AZR B 4 (supercharger control) and B17 (supercharger) strips are installed that protect the AZR from manual shutdown.

Behind the driver's shield there are resistors in the circuits of the driver's shield lighting lamps, the gear selector and the FG 127 headlight.

2.12.8.3 Battery protection unit

The battery protection unit (hereinafter referred to as the BPA) is located to the left of the driver. It is equipped with four fuses and a shunt IIIA-540 (Figure 10.8). On the cover covering the BZA there is a plate with the location diagram and fuse ratings.

2.12.8.4 Distribution boards

2.12.8.5 Right distribution panel

The right distribution panel (Figure) is installed in front of the commander. On the shield there are :

– ten network protection circuit breakers, seven of which are fuses, and three (PKP, A Z UPR., PKP GN) are fuses-switches;

– PPO button (under the cover);

– button to call the commander of the driver;

– engine emergency stop button (under the cover).

The circuit breakers are closed with brackets and must be in the on position when operating the tank.

2.12.8.6 Distribution panel

The distribution panel is installed in front of the commander. The panel contains three network protection circuit breakers in the radio equipment and control panel circuits.

2.12.8.7 Left distribution panel

The left distribution panel (Figure 10.10) is installed to the left of the gunner. On the shield there are :

– ten network protection circuit breakers, of which seven are fuses, and three circuit breakers (PNM, SPZ and EL. DESCENT) - fuses-switches;

– PPO button (under the cover);

– switch SUPERCHARGER - EL. DESCENT;

– toggle switch for emergency activation of electric triggers (under the cover).

When operating the tank, the circuit breakers must be in the on position.

To the left of the gunner there is a panel with a circuit breaker in the air conditioner circuit.

2.12.8.8 External trigger socket

The external start socket is designed to connect wires when starting the engine from another similar tank or from a special installation equipped with batteries and starting equipment.

The external starting socket is installed above the batteries. It has three sockets: “48+”, SG, and “–”. The “48+” and SG sockets are connected by a plug that supplies 48 V voltage from the BCS to the starter-generator.

2.12.8.9 External power socket

The external power socket ("BS+" socket) is installed above the batteries and is intended for connecting a wire when powering the tank from an external power source.

2.12.8.10 Network protection circuit breakers

To protect consumers and electrical circuits from overload and short circuit on the tank, circuit breakers of the AZR type are used, which are a switch combined with an automatic fuse.

2.12.9 Interior lighting and alarm

Internal lighting and alarm are provided by:

– emergency lighting lamps designed for general lighting in the tank (one installed in the control compartment and two in the tank turret);

– casement lanterns designed for local lighting. Lanterns installed:

- three - in the control compartment for lighting the driver's panel, gear selector and PKUZ-1A instrument complex. The lighting of the driver's panel and gear selector is dual-mode. Low light is provided by introducing a resistor into the lamp circuit. The selected mode is activated by the LIGHTING switch on the driver's panel;
- three - in the fighting compartment for lighting ammunition racks and a heater;
- six - in the turret for illuminating the turret compartments, the installation site for the 7.62 mm machine gun;

– PPO signal lamp signaling a fire;

– a remote display located in the control compartment to the right of the driver’s observation device. On the remote display there are indicators signaling a fire, the issuance of commands “O”, “P”, “A”, the presence of emergency situations and malfunctions, the gun going beyond the tank’s envelope to the right or left, a turn, a stalled tank, the headlights and side lights are on, the current speed of the tank and the engine speed.

2.12.9.1 Emergency lighting

The emergency lighting is made according to a two-wire circuit; it can be used without turning on the battery switch. The positive and negative circuits are protected by circuit breakers located on the driver's panel (AZR-V13, AZR-V21). The emergency lighting network includes three lamps and two plug sockets, to which portable lamps, a small-sized refueling unit, a glass heater for the driver's protective cap and an OPVT signal light are connected.

2.12.10 Auxiliary diesel generator set

The diesel generator set is a source of direct current electricity to ensure the operation of the electrical equipment of the tank when parked, when the main engine is not running.

Diesel generator set DGU10 (Figure 10.11) consists of the following parts:

– Kohler diesel engine KDW 1003 6 liquid cooled, with electric starter, muffler, preheating system, air ducts, liquid-oil heat exchanger and water pump;

– generator SG - 10-1C pos. 32;

– relay-regulator R10TMU-1S pos. 9;

– engine cooling system with radiator 1, electric fan 51 and coolant heating unit pos. 49;

– fuel system;

– subframe;

– control panel 14 diesel generator set.

The engine, generator, cooling system, fuel system, control panel and subframe are combined into a monoblock installed in an armored compartment on the left fender of the tank. The diesel generator set is installed on brackets welded in the diesel generator compartment.

The compartment is closed at the top with a lid 8 (Figure 4.4.) . The cover is sealed with a rectangular rubber gasket and bolted to the compartment flange. In the cover 8 there is a hatch 7 for air intake of the cooling system of the diesel generator set, cooling the generator and power supply to the engine, and a hatch 9 for carrying out maintenance, which are closed with bolts and sealed with rubber gaskets.

On the rear wall of the compartment there is a hatch 10 for air outlet from the compartment, removal of exhaust gases, control of the diesel generator set and maintenance, the hinged cover of which is sealed with a rubber gasket and closed with a seal.

On the side wall of the compartment there is a hatch 13 for the air outlet of the diesel generator engine cooling system, which is closed with bolts and sealed with a rubber gasket.

The compartment wall has a threaded hole for draining water into which a captive bolt with a sealing gasket is installed. Also at the bottom of the compartment there is a hatch 17 for maintenance, the cover of which is sealed with a rubber gasket of rectangular cross-section and bolted to the compartment flange.

Remote control 14 (Figure 10.11) for controlling the diesel generator set is installed in the rear part of the compartment.

Antifreeze is used as a coolant in the engine cooling system. Cooling of radiator 1 of the cooling system, as well as purging of the armored compartment, is provided by electric fan 51.

The diesel generator set uses fuel from the left bow tank of the tank. The operation of the diesel generator set is ensured if there is fuel in this tank.

2.12.11 Tower electrical equipment

On the outside of the tower there is a headlight with a digital attachment, a side light with a red filter and a wind sensor on a stand at the rear.

Installed inside the tower:

– azimuth indicator lamps - in the indicator body;

– distribution panel - in front of the commander;

– control unit BTSHU-1-2B1 - behind the gunner;

– PPO signal light - ahead of the commander;

– left switchboard - to the left of the gunner;

– two lighting fixtures for the left and left front compartments of the tower - on the wall of the tower;

– the lighting fixture for the left rear compartment of the turret is on a bracket mounted on the ejection hatch cover gearbox;

– OPVT socket - on the turret plate on the left of the gunner's seat;

– filter F-5 - on the VT flooring ;

– right switchboard - in front of the commander;

– left canopy - behind the gunner on the roof of the turret;

– lighting fixture for the coaxial machine gun - in front of the commander;

– right lamp, turret rear light switch, rear turret lighting lamp - behind the commander on the turret roof;

– The tower's top lighting fixture is in front of the commander on the roof of the tower.

2.13 Software and hardware complex

2.13.1 Purpose and composition of the PTC

The software and hardware complex (hereinafter referred to as the PTK) is designed to organize communications and automated control of units, individual tanks in the battalion-company-platoon-tank link, attached to motorized rifle units operating on foot; solving information, calculation and telecommunications problems as part of an automated control system for combined arms and supporting military formations in the automated control system of the TZ in a time scale close to real.

The PTK provides solutions to complex tasks of operational-tactical and information interaction, with operational control of regular and attached units and individual tanks, as well as interaction with supporting units and higher command.

The PTK as part of the tank provides solutions to the following main tasks:

– automated collection, processing, documentation in electronic form and storage of information using built-in memory devices UARMk;

– manual entry of information into the PTC database;

– formation and display of the operational-tactical situation (location of targets, own tank, subordinate and assigned objects, operational-tactical situation data) on an electronic terrain map (ECM);

– automated generation and transmission to a higher commander of information about the current condition and position of the tank in accordance with established regulations or upon request;

– generation and display of forms of formalized documents;

– formation of external target designation by automated application of reconnoitered targets (by range and directional angle) on the ECM and automatic transmission of their coordinates to subordinate tanks;

– automatic reception of external target designation from a superior commander with display on the ECM of targets set for destruction, for the tank commander to make a decision to carry out a fire mission, taking into account the importance of the targets and for turning the commander's sight on the target;

– generation and display of informal alphanumeric documents;

– mapping areas of concentrated fire onto the ECM and transmitting this data to subordinate tanks;

– formation of commands to control the maneuver of the tank - heading commands (indicating the destination and plotting the route of movement of one's own tank with display on the ECM);

– drawing landmarks on the ECM and transmitting them to subordinate tanks.

– binding the PTK to a single time according to satellite navigation equipment or at the command of a senior commander:

– automated input of initial, configuration and other necessary information, including using technological software and hardware tools;

– automated monitoring of the technical condition of the hardware and control system with indication of detected failures;

– storage of setup data (radio station settings, key information , ECM, etc.) when the power supply is turned off;

– protection from unauthorized access to information and combat control (identification of users, differentiation of access to information of different categories of users, the ability to change passwords, blocking access in case of unauthorized access);

– issuance of audible warning signals to the crew headsets from the SPZ and DKMV;

– formation of radio networks MB (from 30 to 108 MHz) and UHF 1 (from 390 to 440 MHz) ranges for voice communication and data exchange with the same type of equipment from the software and hardware of automated control systems, backbone broadband data exchange networks in the UHF2 range (from 1.5 up to 1.75 GHz), as well as wireless (broadband) access of wearable control equipment of interacting motorized rifle units at a frequency of 2.4 GHz;

– exchange of data using a means of cryptographic information protection (hereinafter referred to as CIPF), product 450B and voice messages using the built-in CIPF of the radio station R -16825U2;

– internal communication between crew members;

– work using training electronic computers and databases, including in training mode;

– control of operating modes of radio stations R-168-25U-2 and R-168MRA, in full, including input of radio data, using PUDL;

– SDR management.

Interblock connections of the PTC are shown in the electrical connection diagram in the figure .

The PTC includes:

– unified automated workstation for commander UARMk-01 (hereinafter referred to as UARMk);

– complex of communication means (hereinafter - KSS);

– orientation system (hereinafter referred to as SO);

– software package PTK;

– cable set;

– subscriber communicator AK-3.5 (one communicator for 10 tanks);
– charger UZM-4-1 (one device for 10 tanks).

When studying the design of the PTK, one should additionally be guided by the operational documentation for the PTK and its components included in the set of operational documentation for the tank.

2.13.2 PTC operation

Before use, the following initial data necessary for its operation in the TK automated control system network are entered into the PTC:

– in UARMk - ECM, operational-tactical situation, telecommunication setup data and other data necessary for working in the TZ automated control system network;
– in product 450B - key information;
– in a radio station – radio data.

The initial data is entered by specialists from the communications department using the AK-3.5 subscriber communicator and other special equipment they have.

To prevent unauthorized access to the control system of the PTC and to the information stored in it, when the PTC is turned on, the operator is registered. The registration procedure consists of entering a user name and a password set by a specialist in the communications department.

After turning on the PTC and registering the operator, automatic self-diagnosis of the PTC is performed, the results of which are stored in the PTC memory. The panel screen of the multifunctional PMF-3.2 (hereinafter referred to as the PMF) displays the main window with the ECM and the operational-tactical situation plotted on it. During operation, the orientation system (hereinafter referred to as SO) constantly determines the current location of the tank (coordinates and its directional angle) and the current time, which are sent to the UARMK. The crew, through AVSKU, conducts negotiations over the internal network and carries out external voice radio communications through radio stations.

Work in the TZ automated control system network, including department management, is carried out interactively as follows. The tank commander at the PMF generates requests for subordinate tanks based on their location, fuel reserves, ammunition, technical condition, etc. The request in the form of information packets from UARMk through AVSKU arrives at the 450B equipment, where it is encrypted and transmitted through AVSKU to one of the radio stations, which transmits it to the ASUV TZ network, and the fastest radio station in the given conditions is automatically selected. Over the network, the request arrives at the radio station of the subordinate tank, from which it is transmitted via AVSKU to the 450B equipment, where it is decrypted and transmitted through AVSKU to UARMk. UARMk automatically or with the participation of the commander of a subordinate tank generates a response to the request and sends it back. Upon receiving responses from subordinate tanks, the UARMk of the tank that sent the requests displays the results of processing the responses on the PMF screen. If necessary, to obtain additional information, the tank commander conducts additional negotiations with the crews of subordinate tanks or with a higher commander, using radio stations in open or masked speech modes. In addition, the commander from the TZ automated control system network receives information about changes in the tactical situation and orders from a higher commander. Using the information received and the current tactical situation presented on the ECM, the commander makes a decision, forms an order and transmits it to the commanders of subordinate tanks and, based on responses from subordinates, monitors its execution. Thus, the department is managed using the hardware and software.

A more detailed description of the operation of the PTK components is given in the description of the PTK components, as well as in the operational documentation for the PTK and its components supplied with the tank.

2.13.3 Unified commander's workplace

2.13.3.1 Purpose and composition of UARMk

The unified automated commander's workstation UARMk-01 (hereinafter referred to as UARMk) is designed to solve the problems of automating the main processes of control and information exchange within the TZ automated control system network and interaction with tank systems, as well as the management of CO and KSS from the PTK and SPZ.

UARMK includes:
– computing unit (hereinafter - BV);
– multifunctional panel PMF-3.2 (hereinafter referred to as PMF);
– software package;
– set of mounting parts (cable).

2.13.3.1.1 Computing unit

The computing unit (hereinafter referred to as the BV) is designed to perform the main computing functions of the UARMk and the functions of managing interaction with other components of both the UARMk itself and the hardware and control system and the special protection system. The BV is made in the form of a monoblock with four shock absorbers designed to mount it in the tank. On the front surface of the propellant there are fins for cooling and electrical connectors for connecting it to the tank systems and components of the PTC. On the side wall there is a grounding terminal for connecting a “negative” jumper.

Purpose of electrical connectors:
– PIT/CAN – for connecting:
- to the onboard power supply;
- to the CO (to the computer), via the CAN interface;
- to the control system (BTsOI block) via the CAN interface;
- to the SPZ (block BTSHU-1-2B1) via the CAN interface.

In addition, this electrical connector sends a signal to the CO calculator to turn on the CO ;
– X3 – for connection to AVSKU (TKOM unit) via Ethernet interface;
– X 4 – for connecting to the PMF via LVDS and RS-232 interfaces.
In a tank, the BV is installed at the rear of the turret behind the commander.

2.13.3.1.2 Multifunctional panel

Multifunctional panel PMF-3.2 (hereinafter referred to as PMF) is intended for :
– turning on/off UARMk;
– displaying video information coming from the BV on the screen;
– management of the functioning of UARMk, SPZ and PTK.
Structurally, the PMF is made in the form of a monoblock with four shock absorbers. On the front surface there are controls and a touch screen, and on the rear surface there are connectors for connecting cables and a ground terminal for connecting a “negative” jumper.

Purpose of electrical connectors:
– X 1 – for connection to the on-board power supply;
– X 2 and X3 – for connection to the BV.
In the tank, the PMF is installed in the turret at the commander's workplace on the front right.
The appearance of the PMF, controls and their purpose are shown in the figure .

2.13.3.1.3 Software

The software (hereinafter referred to as the software) ensures the functioning of the UARMk.

The software includes :
– set of system and test software BV;
– general BV software;
– technological software;
– software ARMK-01.
The software is installed in UARMk at the manufacturer.
If necessary, in the event of software failures, the software can be reinstalled by a communications department specialist using his special equipment.

2.13.3.1.4 Kit of mounting parts

The installation kit includes a BV-PMF cable, designed to connect the BV and PMF in the tank.

2.13.4 Communication complex

The communications complex (hereinafter referred to as the CSS) is designed to provide internal communication between members of the tank crew, as well as for voice radio communication in the MV, UHF 1 ranges and data exchange via radio channels in the MV, UHF 2 ranges and via a broadband Wi-Fi access line.

The KSS as part of the tank provides:
– transmission/reception of voice information via a radio channel in the HF range, both when the tank is parked and while the tank is moving;
– transmission/reception of voice information via a radio channel in the UHF 1 band, both when the tank is parked and while the tank is moving;
– exchange of data between UARMk via a radio channel protected by cryptographic protection means of the 450B product in the MV range, both when the tank is parked and while the tank is moving;
– exchange of data between UARMk via a radio channel protected by cryptographic protection means of the 450B product in the UHF 2 range, both when the tank is parked and while the tank is moving;
– exchange of data between the UARMk and the soldier’s unified wearable kit via a Wi-Fi broadband radio channel protected by cryptographic protection means of the 450B product, both when the tank is parked and while the tank is moving under conditions of direct optical visibility;
– internal communication between three crew members and an additional subscriber connected to the additional subscriber block.

The composition of the KSS includes:
– radio station R -16825U2 version 04 (hereinafter - R -16825U2);
– antenna R -168BShPA;
– radio station R -168MRA;

– antenna SK -B;
– software and hardware complex AVSKU;
– product 450B;
– device MT10M-21 (4 pcs.);
– MT10M-05 device with cord L=10 m (one for 10 tanks);
– tank headset TSH-4M-L-01-003 (4 pcs.);
– tank headset TSH-4M-Z-01-003 (4 pcs.);
– cable set;
– subscriber communicator (AK-3.5).

2.13.4.1 Radio station R-168-25U-2

The radio station is a digital multi-channel VHF radio station, designed for open or masked radio communication and for data transmission at any time of the year and day in conditions of moderately rugged (when operating in the HF range) and open (when operating in the 1st UHF range) terrain.

The radio station provides two-way radio communication when parked and on the move, both with the same type of radio station and with other radio stations that are compatible in the operating frequency range, type of modulation and operating modes. With radio stations of the same type, search-free communication and untuned communication is ensured on any channel, on any interference-free frequency range, and in any set mode.

The radio station provides simultaneous independent operation in two frequency ranges:

– from 30 to 108 MHz with a frequency tuning step of 25 kHz, output power of 40 W - MV range (transceiver PP 2);

– from 390 to 440 MHz with a frequency tuning step of 25 kHz, with a frequency spacing between channels of 50 kHz, output power of 30 W - UHF 1 range (transceiver PP1).

The radio station provides the following main operating modes through the PP 2 transceiver in the MV frequency range:

– fixed frequency – simplex (“FFS”). When operating in this mode, reception and transmission are carried out on one AFB;

– fixed frequency – dual-frequency simplex (“DFDS”). When operating in this mode, reception is carried out on one charger, and transmission is carried out on another charger;

– scanning reception (“SP”) in the “PSF” mode. This mode is used to sequentially bypass up to eight RFBs with automatic scanning stop when receiving a tone call from a correspondent, the connection with which was interrupted for any reason;

– fixed frequency – simplex with technical masking of transmitted information (“FChS-TM”);

– duty reception (“DP”). Used when working for a long time on reception, while preventing unauthorized switching of the radio station to transmit mode;

– software (pseudo-random) tuning of the operating frequency (“PRFC”) for a group of 8, 16, 32, 64, 128 or 256 AFs with a speed of 100 jumps per second and the ability to receive a tone call from radio stations operating on a fixed AF;

– adaptive communication (“AC”). When operating in this mode, there is an automatic selection of one or two AFBs, the best according to the results of the analysis of the interference situation, from a group of up to eight AFBs and the ability to receive a tone call from a radio station operating on a fixed AFB.

The radio station provides the following main operating modes through the PP 1 transceiver in the UHF1 frequency range:

– analogue at a fixed frequency (“KFCh-A”). In the “KFCh-A” mode, open analog speech information is received and transmitted;

– digital cryptographically secure on a fixed frequency (“KFC-Ts”). In the “KFC-Ts” mode, the radio station provides operational communication on two frequencies (the main channel and the commander’s channel) without switching the channel;

– digital with software (pseudorandom) tuning of the operating frequency (“PRFC”). In the frequency hopping mode, digital information is received and transmitted with programmatic (pseudo-random) frequency tuning in a group of up to 256 frequency frequencies at a speed of 240 jumps per second;

– scanning at pre-prepared frequencies (up to 10 RF frequencies).

The radio station in the tank operates through a frequency-separation device UCHR to the R -168BShPA antenna.

ATTENTION:

WHEN OPERATING THE RADIO STATION R -16825U2 IN THE FREQUENCY RANGE FROM 80 TO 108 MHZ, A POSSIBLE REDUCTION IN THE COMMUNICATION RANGE DUE TO THE FEATURES OF OPERATING THE RADIO STATION ON THE R -168BSHPA ANTENNA!

The radio station provides round-the-clock operation with a ratio of transmission time to reception time of 1:5 (with continuous operation for transmission no more than 3 minutes). The operating time in the “RECEIVE” mode is not limited.

2 transceiver at frequencies free from interference, when conducting radio communications in moderately rough terrain, provides the communication ranges indicated in tables 7 and 8 .

Table 7

Radio operating mode	Communication range when working with PP 2 , depending on the set power level on the VUFUS-25 unit	
	MSH.S - 8 W	MSH.P - 40 W
“FChS”, “FChDS”, km, not less	10	20
“FChS-TM”, “AS”, “PPRF”, data transmission, km , not less	8	17

Table 8

Radio operating mode	Communication range when working with PP 2 , depending on the set power level (POWER) on the PP2 transceiver of the radio station, connected bypassing the power amplifier on the VUFUS-25 unit		
	POWER N - 0.125 W	POWER .S - 1.5 W	POWER .P - 5 W
“FChS”, “FChDS” km, not less	1	5	10
“FChS-TM”, “AS”, “PPRF”, data transmission, km , not less	1	3	8

The radio station, when operating from the PP 1 transceiver at frequencies free from interference, when conducting radio communications in open areas, provides a communication range of 15 km at increased power and 8 km at the rated power installed on the PP1 transceiver.

The given communication ranges are provided provided there is no radio interference at the frequencies used.

The radio station R -16825U2 includes:

– filtering, amplification and coupling device VUFUS-25 with a shock-absorbing frame;
– transceiver R-168-5UT-2;
– transceiver 5UV 400;
– wired connection;
– cable connection;
– spare parts kit

The radio station has a block design with a high degree of unification, which expands its operational capabilities and ensures ease of maintenance and repair. The R-168-5UT-2 and 5UV 400 transceivers with controls and indications on the front panel are installed in a special container of the VUFUS-25 unit and connected to it with wire and cable connections supplied with the radio station.

In the tank, the radio station is controlled from the PMF -PTK panel or from the control and indication unit PUDL of the AVSKU complex. It is also possible to control the radio station from the front panels of the transceivers, when the control blocking is disabled in the menu item of the PUDL block. The procedure for disabling control blocking is set out in the operating manuals for PTK ITNYA.469679.004-02 RE and for the hardware and software complex AVSKU ITNYA.468369.048-36 RE, supplied with the tank.

The radio station with a shock-absorbing frame is installed on booms that are welded to the bottom plate of the turret in the rear part behind the commander’s seat.

Access to the POWER toggle switch for turning on the radio is difficult, so it must always be in the ON position.

The appearance of the radio station, the location of electrical connectors, controls and indications, and their purpose are shown in the figure .

2.13.4.2 Radio station R-168MRA

The R -168MRA radio station (hereinafter referred to as MRA) as part of the tank ensures the organization of high-speed, cryptographically protected with the help of the 450B product, UHF 2nd band radio data transmission networks in the TZ automated control system networks.

MPA provides:

– automatic transmission and reception of digital information;
– automatic relay and routing of information;
– automatic organization of radio networks;
– automatic entry into a working radio network;

– automatic control of one's own performance;
– adaptive change in data transmission rate depending on the interference environment.

The MPA as part of the tank provides communication range both when the tank is parked and while the tank is moving under conditions of direct optical visibility with a data transfer rate of no more than 11 Mbit/ s at a distance of at least 5 km.

The MPA includes:
– PRMD transceiver unit (hereinafter referred to as the PRMD unit);
– input switching device block (hereinafter referred to as the VKU block);
– spare parts kit

The PRMD block is designed for receiving and transmitting radio signals, generating and exchanging packet information. The PRMD block is structurally designed as a finished product in an aluminum alloy housing. The top panel of the case has a ribbed surface.

Connectors are located on the front panel:
– LAN – for connecting to the VKU unit via the Ethernet interface;
– ANT – for connecting the HF cable from the SK-B antenna;
– POWER – for connecting the power cable from the VKU unit.

To protect against mechanical impacts in the tank, the PRMD unit is attached to the tank hull through a shock-absorbing frame.

The VKU unit is designed to filter power from the tank's on-board network, protect against surge voltages, and protect power and Ethernet circuits from lightning. Structurally, the VKU unit is designed as an autonomous structure.

The block contains :
– LAN connector 2 – for connection to the PRMD unit via the Ethernet interface ;
– LAN connector 1 – for connecting to the MSVKU interface unit of the AVSKU hardware and software complex via the Ethernet interface;
– BS connector – for connecting to the tank's on-board network;
– PIT connector – for connecting the power cable from the PRMD unit;
– NETWORK indicator. The indicator light indicates the presence of power to the BS;
– fuse holder;
– ground terminal;
– PIT power switch.

The MRA in the tank works with the SK-B antenna.

The PRMD unit with a shock-absorbing frame is installed to the right of the commander. The shock-absorbing frame of the PRMD block is fixed to two brackets, which are welded to the bottom sheet of the tower.

The VKU unit is installed on booms that are welded to the right side of the tower. The tank commander is provided with access to the power switch and visual control of the NETWORK indicator.

The MPA is controlled from the PMF-PTK panel or from the control and indication unit PUDL of the AVSKU complex.

2.13.4.3 Antenna R-168BSHPA

168BShPA antenna (hereinafter -referred to as BSPA) is a broadband whip antenna with a frequency separating device (hereinafter referred to as FSD), which ensures simultaneous operation of the antenna in two frequency ranges: from 30 to 88 MHz and from 390 to 440 MHz, and provides reception and transmission radio signal of a working radio station R -16825U2 when the tank is parked and in motion.

ATTENTION:

WHEN OPERATING THE RADIO STATION R -16825U2 IN THE FREQUENCY RANGE FROM 80 TO 108 MHZ, A POSSIBLE REDUCTION IN THE COMMUNICATION RANGE DUE TO THE FEATURES OF OPERATING THE RADIO STATION ON THE R -168BSHPA ANTENNA!

Structurally, the BAS consists of a base, a stand and a pin, connected to each other using threaded connections. At the bottom of the base there is an RF electrical connector for connecting the cable connection from the HRM.

Structurally, the HRM is made in the form of a monoblock with two shock absorbers. On the side surfaces of the block there are connectors for connecting cable connections:
– ANT 1 and ANT2 – for connection to the radio station R -168-25U-2;
– OUTPUT – for connection to the base of the BLAS.

The UAS is mounted on a flange welded to the outer surface of the turret behind the gunner's hatch.

The HRM is installed behind the commander's seat on a special bracket, which is mounted on bonks welded to the bottom plate of the turret.

2.13.4.4 Hardware and software complex AVSKU

The hardware and software complex AVSKU (hereinafter referred to as AVSKU) as part of the tank provides:

– automatic monitoring of the performance of the CSS (when turned on and periodically) and monitoring of the performance of the CSS at the request of the subscriber;

– internal telephone communication between crew members (commander, gunner, driver), as well as with an additional subscriber who is connected to the additional subscriber block (hereinafter referred to as the CDA);

– internal circular two-way communication between all members of the tank crew at the initiative of any subscriber, except for an additional subscriber;

– the commander and gunner have access to external communication via a voice channel through any transceiver of the R -16825U2 radio station;

– provision by the commander of the driver's access to external communication via a voice channel through any transceiver of the R -16825U2 radio station;

– data transmission through the radio station R -16825U2 in the MV range using cryptographic protection means for the 450B product;

– data transmission through the radio station R -168MRA in the UHF 2 range using cryptographic protection means (products 450B);

– data transmission through a high-speed Wi-Fi access point (MSVKU unit) using cryptographic protection tools (450B products);

– generation and display on the PUDL block of incoming information about the state of communication channels;

– generation and display on the PUN block of information about the occupancy of communication channels;

– display on the PUDL of the operating mode of any radio station and the current state of any radio communication channel, including those used by other subscribers;

– the ability for the commander to control the R -16825U2 radio station, the R168MRA radio station and the MSVKU unit from the PUDL unit in full, including entering RD and configuration data;

– the possibility of radio reception (in listening mode) by the commander from the transceivers of the radio station R -16825U2 while in the internal communication network;

– provision by the commander of radio reception (in listening mode) from one of the transceivers of the R -16825U2 radio station to the gunner and driver while they are simultaneously in the internal communication network;

– the ability to listen to the driver's voice messages from the DKMV complex;

– the ability for all subscribers to listen to signals from the BTSHU -1 -2B1 unit;

– listening to the tone call signal received by the transceivers of the radio station R -16825U2;

– sending a tone call to external subscribers through the transceivers of the radio station R -16825U2.

AVSKU includes:

– control and indication unit PUDL (hereinafter referred to as the PUDL block);

– control and indication unit PUN (hereinafter referred to as the PUN block);

– two secondary power supplies IP50V-12-AB;

– interface block MS 1 ;

– MSVKU interface unit;

– two MSNC interface blocks;

– TCOM unit;

– BShM block;

– single set of spare parts.

2.13.4.4.1 Control and display unit PUDL

The control and indication unit PUDL provides the commander with:

– internal two-way telephone communication with the crew and an additional subscriber;

– control of radio stations R -16825U2, R168MRA and the MSVKU unit in full;

– manual input of radio data into the transceivers of the radio station R -16825U2;

– input of radio data into the R -168MRA radio station;

– entering setup data into the MSVKU block;

– access to external communication via any of the transceivers of the radio station R -16825U2;

– the ability to send a tone call through the transceivers of the radio station R -16825U2;

– the ability to receive a tone call, when working in an intercom network, from the transceivers of the radio station R -16825U2, with listening to the signal in the headset phones and the presence of an indication on the front panel of the unit;

– when working with PP 2 of the radio station R -16825U2 in the “FChS” mode, switch to the “FChS-TM” mode and back;

– the ability to turn on/off the noise suppressor when working with PP 2 of the R -16825U2 radio station;

– the ability to listen to PP 1 and PP2 of the radio station R -16825U2 while on the internal communication network;

– the ability to switch the driver to external communication via any of the transceivers of the radio station R -16825U2;

– the ability to switch the driver and gunner to the mode of listening to signals received by the transceivers of the radio station R -16825U2, while simultaneously being on the internal communication network;

– the ability to perform AVSKU control.

Structurally, the PUDL block is made in the form of a monoblock with three shock absorbers. The front panel contains controls and indications, and on the bottom plane there are connectors for connecting electrical harnesses.

The PUDL block is installed on booms welded to the right side of the turret.

The appearance of the PUDL unit, the location of electrical connectors, controls and indications, and their purpose are shown in the figure .

2.13.4.4.2 Control and indication unit PUN

The control and display unit PUN provides the gunner with internal communication, as well as access to external communication through both transceivers of the R -16825U2 radio station.

Structurally, the PUN block is made in the form of a monoblock with three shock absorbers. The front panel contains controls and indications, and on the bottom plane there are connectors for connecting electrical harnesses.

The PUN block is installed on booms welded to the left side of the tower.

The appearance of the PUN block, the location of electrical connectors, controls and indications, and their purpose are shown in the figure .

2.13.4.4.3 Secondary power supply IP50V-12-AB

The secondary power supply IP50V-12-AB (hereinafter referred to as BP) is designed to power the AVSKU complex with stabilized DC voltage.

The connectors are located on the power supply:

– 12 V – for connection to the PIT connector on the BShM and TKOM units;

– 27 V – for connection to the tank's BS.

There are indicators on the power supply:

– "PIT", the glow of which indicates the presence of the input voltage of the tank's BS;

– "+12 V ", the glow of which indicates the presence of a stabilized output voltage.

BP provides:

– power supply of units of the AVSKU complex with stabilized voltage ($12 \pm 1{,}2$) V ;

– protection against power supply in reverse polarity.

AVSKU has two power supply units. The first block, BP(1), provides stabilized voltage power to the TKOM block. The second block, BP(2), provides a stabilized voltage supply to the BShM block. The TKOM and BShM blocks provide stabilized voltage power to the remaining AVSKU blocks and the 450B product.

The power supply unit (1) is installed on bonnets welded to the right side of the turret.

The BP(2) block is installed on booms welded to the right side of the turret, in its aft part.

2.13.4.4.4 Interface block MS 1

Interface block MS 1 (hereinafter referred to as block MS1) provides connection of the circuits of the radio station R -16825U2 to the interface block MSVKU and reduction of signals from the radio station to a single type of signal AVSKU (Ethernet).

Structurally, the MS 1 block is made in the form of a monoblock with two shock absorbers, on the lower plane of which the connectors are located:

– RS 1 and RS2 – for connection to the radio station R -16825U2;

– LAN – for connecting to the MSVKU unit via the Ethernet interface.

Block MC 1 is installed on booms welded to the roof of the turret behind the commander's seat.

2.13.4.4.5 MSVKU interface block

The MSVKU unit ensures data exchange via a wireless Wi-Fi interface with a unified wearable kit for a soldier.

The following connectors are located on the MSVKU block:

– LAN 1 - LAN4 – for connecting tank units. On the tank, LAN 1 – LAN3 connectors are enabled, LAN4 connector is not enabled. The VKU unit from the R 168MRA radio station is connected -to LAN connector 1 . The MC1 unit is connected to LAN connector 2 . The BShM unit is connected to the LAN3 connector;

– PIT – for connection to the BShM unit, from which a stabilized supply voltage is supplied;

– VKU – for connecting the SK-B antenna.

The MSVKU block has indicators:

– "LAN 1 " - "LAN4". The flashing light of the “LAN 1 ” indicator indicates the presence of a connection between the MSVKU unit and the VKU unit of the R -168MRA radio station via the Ethernet interface. The blinking light of the “LAN 2 ” indicator indicates the presence of a connection between the MSVKU block and the MC1 block via the Ethernet interface. The flashing light of the “LAN3” indicator indicates the presence of a connection between the MSVKU unit and the BShM unit via the Ethernet interface;

– "VKU." If the single indicator is lit, then communication has been established with connected external devices via the Wi-Fi wireless interface. If the single indicator blinks, then a search for external devices is taking place;

– “PIT”, the glow of which indicates the presence of supply voltage.

The MSVKU block is installed on bonks, which are welded to the right MPC bracket.

2.13.4.4.6 MSNC interface block

As part of the AVSKU, there are two MSNC interfacing blocks (hereinafter referred to as the MSNC(1) and MSNC(2) blocks, respectively).

The MSNC(1) block provides:

– connecting an additional subscriber through the KDA to the tank’s internal telephone network;

– listening by all subscribers connected to the tank's internal communication network to signals from the BTSHU-1-2B1 unit.

The MSNC(2) block provides:

– connection of the driver, both to the internal telephone network of the tank and to the external telephone radio network through the radio station R -16825U2. The connection of the driver to the internal or external communication network is performed by the tank commander from the PUDL unit;

– listening by all subscribers of the internal telephone network of the tank to warning signals from the PKUZ-1A complex via the circular intercom network;

– only the driver can listen to voice messages from the DKMV complex.

Structurally, the MSNC block is made in the form of a monoblock with two shock absorbers, on the side planes of which there are connectors LF, MTG 1 , MTG2, MTG3, BAS/GO/TSHU, and on the front plane there is a PIT indicator, the glow of which indicates the presence of supply voltage.

On the MSNCh(1) block, the PUDL block is connected to the LF connector, the KDA is connected to the MTG3 connector , and the BTSHU-1-2B1 block is connected to the BAS/GO/TSHU connector. Connectors MTG 1 , MTG2 are not used.

On the second MSNC block, the PUN block is connected to the LF connector through the rotating contact device VKU-1, the driver's MT10M device is connected to the MTG 1 connector , and the PKUZ-1A and DKMV complexes are connected to the BAS/GO/TSH connector. Connectors MTG 2 and MTG3 are not used.

The MSNC unit (1) is installed behind the commander’s seat on bonks that are welded to the right side of the turret, in its rear part.

The MSNC(2) block is installed in the tank body behind the driver’s seat on a special bracket, which is mounted on bonks welded to the turret plate.

2.13.4.4.7 TKOM block

The TKOM unit in the tank provides:

– transmission of digital signals;

– dynamic allocation of IP addresses to the AK communicator, to the BV block from the UARMk and to the 450B product;

– automatic setting of the date and time required for the operation of the 450B product;

– transmission of power circuits from the power supply unit (1) to the 450B product.

The following connectors are located on the TKOM block:

– LAN 1 - LAN4 – for connecting tank units. On the tank, LAN 1 and LAN3 connectors are enabled, LAN2 and LAN4 connectors are not enabled. The BV unit from the UARMk is connected to the LAN3 connector. The subscriber communicator AK 3.5 (hereinafter referred to as AK) is temporarily connected to the LAN connector 1 to enter the initial data into the PTC;-

– VVS 1 - VVS4 – for connecting units and terminal devices. On the tank, only the VVS 1 connector is used ; the VVS2 – VVS4 connectors are not used. Product 450B is connected to connector VVS 1 ;

– PIT – for connection to the power supply unit (1), from which a stabilized supply voltage is supplied.

On the front plane of the case there are indicators “LAN 1 ” - “LAN4”, “VVS1” - “VVS4” and “PIT”. The flashing light of the “LAN3” indicator indicates the presence of a connection between the TKOM unit and the BV unit via the Ethernet interface. When connecting the subscriber communicator to the LAN connector 1 , the blinking light of the LAN1 indicator indicates the presence of a connection between the TKOM unit and the subscriber communicator via the Ethernet interface. The flashing light of the “VVS 1 ” indicator indicates the presence of a connection between the TKOM unit and the 450B product via the Ethernet interface. The glow of the “PIT” indicator indicates the presence of supply voltage. The indicators “LAN 1 ”, “LAN2”, “LAN4”, “VVS2” - “VVS4” are not used.

The TKOM block is installed on bolts securing the BP block (1) to the bonnets welded to the right side of the turret.

2.13.4.4.8 BShM block

The BShM block in the tank provides:

– transmission of digital signals;

– routing of information packets based on IP addresses;

– transmission of power circuits from the BP(2) block to the PUDL, PUN and MSVKU blocks.

The following connectors are located on the BShM block:

– LAN 1 - LAN4 – for connecting tank units and terminal devices. The MSVKU unit is connected to LAN connector 1 . The LAN 2 connector is connected to the PUDL unit. The 450B product is connected to the LAN3 connector. The PUN block is connected to the LAN connector 4 ;

– VVS 1 - VVS4 is not used on the tank;

– PIT – for connection to the power supply unit (2), from which a stabilized supply voltage is supplied.

On the front plane of the case there are indicators “LAN 1 ” - “LAN4”, “VVS1” - “VVS4” and “PIT”. The flashing light of the “LAN 1 ” indicator indicates the presence of a connection between the BShM unit and the MSVKU unit via the Ethernet interface. The flashing light of the “LAN 2 ” indicator indicates the presence of a connection between the BShM unit and the PUDL unit via the Ethernet interface. The flashing light of the “LAN3” indicator indicates the presence of a connection between the BShM unit and the 450B product via the Ethernet interface. The flashing light of the “LAN 4 ” indicator indicates the presence of a connection between the BShM unit and the PUN unit via the Ethernet interface. The glow of the “PIT” indicator indicates the presence of supply voltage. The indicators “VVS 1 ” - “VVS4” are not used.

The BShM block is installed on bolts that secure the BP(2) block to the bonnets welded to the right side of the turret, in its aft part.

2.13.4.4.9 Device MT10M

The MT10M device is intended for :

– amplification of speech signals from the laryngophones of headsets and their transmission to AVSKU;

– amplification of speech signals from AVSKU and transmission of them to headset phones;

– generating the signals “Exit to the radio station” and “Circular call” and transmitting them to AVSKU.

Structurally, the MT10M device is a sealed housing, on the surface of which the following controls and connectors are located:

– VOLUME buttons to set the required volume level;

– PRD button - to switch the R-168-25U-2 radio station to transmit mode;

– CALL button - for a circular call to a subscriber who is on external radio communication;

– connector – for connecting a headset.

Reception and transmission of speech over the intercom network is provided without pressing buttons on the MT10M device.

The MT10M device has several versions, which differ in the length and design of the cord. The tank is equipped with four MT10M devices with twisted cords and one MT10M device with a cord length of 10 m.

Three MT10M devices with twisted cords are located at the workplaces of the driver, gunner and commander and are connected to the MSNC, PUN and PUDL units, respectively.

One MT10M device with a twisted cord is placed in an individual spare parts kit for the tank and is used to connect a subscriber located outside the tank to the KDA block located on a stand welded outside the turret, behind the gunner's hatch.

The MT10M device with a cord length of 10 m is placed in an individual spare parts kit for the tank and is used in emergency situations when the tank overcomes a water obstacle or during tank maintenance. Every tenth tank is equipped with the MT10M device with a cord length of 10 m.

2.13.4.4.10 Headset TSh-4M

The TSh-4M headset is designed for internal and external communication of the crew, to protect the head from impacts on tank structural elements, to protect against the influence of external noise and climatic factors.

A helmet is a headdress that covers the entire surface of the head except the face. The headset GVSh-T-13-01 is built into the headset.

The headset includes:

– laryngophone LEM-5 – 2 pcs.;

– telephone TED-4 (or telephones KED-3E or TDK-5) – 2 pcs.;

– cord with connector.

The headset is connected to the MT10M device using a connector.

The appearance of the TSh-4M headset, the location of the structural elements, and their purpose are shown in the figure .

The tank is equipped with four summer headset and four winter headset. Headsets used seasonally are placed in the tank. Headsets not used for the season are stored in the unit's warehouse.

2.13.4.4.11 Antenna SK-B

The SK-B antenna is designed to work with the R-168MRA radio station and the MSVKU unit of the AVSKU hardware and software complex. The antenna provides simultaneous reception and transmission of electromagnetic radiation in the UHF frequency range is from 1.5 to 1.75 GHz and from 2.400 to 2.474 GHz. On the lower plane of the antenna there are connectors X1 and X2 for connecting RF cables. The antenna is a single, non-separable structure and is installed on the flange of the bracket, which is bolted to the right side of the aft module.

2.13.4.4.12 Product 450B with plug ITNYA.468242.058

Product 450B is intended for cryptographic protection of information in radio data exchange networks of automated control system TK. The plug ITNYA.468242.058 is intended for emergency erasure of key information in the 450B product.

Product 450B with plug ITNYA.468242.058 provides:

– exchange of information with UARMk with an exchange speed of no more than 100 Mbit/ s via the Ethernet interface;

– exchange of information with AVSKU at a speed of no more than 100 Mbit/ s via the Ethernet interface;

– input/output of key information at a speed of 9.6 kbit/ s ;

– automatic search and registration in the network of the AVSKU complex;

– encryption of transmitted information coming from UARMk and transmitted through radio stations R -16825U2, R168MRA and the MSVKU unit;

– decryption of received information from radio stations R -16825U2, R168MRA, MSVKU unit and transmission of decrypted information to UARMk;

– emergency erasure of key information .

Structurally, product 450B is made in the form of a monoblock with two shock absorbers. The 450B product contains the following connectors:

– OOD – for connection to the TKOM unit of the AVSKU complex;

– APD – for connection to the BShM unit of the AVSKU complex;

– POWER SUPPLY – for connection to the TKOM unit of the AVSKU complex, from which a stabilized supply voltage is supplied;

– PU – for connecting the plug ITNYA.468242.058. The plug is permanently connected to the connector of the 450B product and is intended for emergency erasure of key information. A cap is screwed into the end of the plug; when unscrewed, the key information in the 450B product is erased. The cap has a paper seal, which is destroyed when the cap is unscrewed from the plug.

ATTENTION:

WHEN KEY INFORMATION IS ERASED FROM THE MEMORY OF THE 450B PRODUCT, THE OPERATION OF THE PTK IN THE ASUV TZ NETWORK IS IMPOSSIBLE!

On the side surface of the block there are single indicators “POWER”, the glow of which indicates the presence of supply voltage, and “EMERGENCY”, the continuous light of which indicates a malfunction of the unit, and the intermittent light occurs when key information is entered.

When entering key information into the 450B product, the AK -3.5 subscriber communicator is connected to the PU connector instead of the plug through the ITNYA.685919.655 wire connection (available in a single spare parts kit for the tank).

Product 450B with cap ITNYA.468242.058 is installed on bonks welded on the side of the turret, to the left of the gunner.

2.13.5 Orientation system

The orientation system (hereinafter - SO) is designed for continuous automatic determination and issuance in UARMk:

– coordinates of the moving tank's location;

– initial and current directional angles of the tank;

– directional angle to the destination;

– the angle between the direction to the destination and the longitudinal axis of the tank;

– angle of a given direction;

– angles of longitudinal and transverse inclination of the tank;

– distance to destination;

– uniform time signals.

This information is necessary to solve problems of orientation and interaction, as well as to indicate the location of the tank on an electronic topographic map of the area. Information is generated provided that the initial coordinates, the initial directional angle of the tank and the coordinates of the destination point are entered into the system.

CO ensures operation with specified characteristics in the latitude range from 70° N. up to 70º S at any time of the day, in any road and weather conditions.

The composition of the CO includes:
– self-orienting gyroscopic heading guidance system (hereinafter referred to as SSGKKU);
– calculator;
– mechanical universal speed sensor (hereinafter referred to as DSMU);
– satellite navigation equipment 14Ts821SZh (hereinafter referred to as ASN) consisting of:
- electronic PI unit;
- antenna module ZhS;
- set of HF cables.

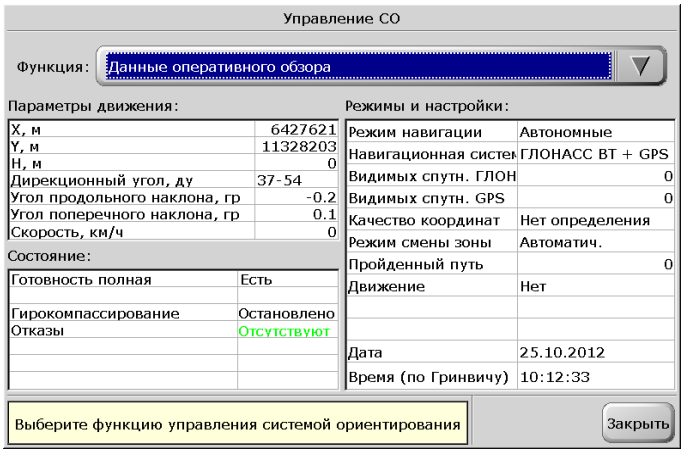
The commander's panoramic PKP sight is used as a sighting device to orient the tank along a given landmark. The angles are reported based on the readings of the azimuth indicator and the position sensor of the control panel mirror unit.

The equipment devices are connected to each other by cable assemblies in accordance with Figure 11.1.

The electronic PI ASN unit is located in the tank turret behind the gunner's seat on a bracket. The ZhS ASN antenna module is installed outside the turret on a bracket located to the left of the gunner's hatch. The SSGKKU is located in the tank hull on the bottom on the left side behind the gunner. The computer is installed on the battery bracket. The mechanical universal speed sensor is installed in the crank of the left guide wheel.

The management of the CO is carried out from the PMF UARMk. Navigation and other information necessary when solving the current task of management, maintenance and monitoring is displayed on the PMF screen. Information is displayed in the form of a menu presented with lists of tasks, data and failures. Using PMF, it is possible to select, run and cancel tasks, select and edit data, view failures and operational messages.

The appearance of the orientation system control dialog box on the PMF screen in the " CO Control " mode is shown below.



At the top of the dialog box there is a "Function" drop-down list, consisting of the following lines:
– operational review data;
– setting the method for determining coordinates and ASN mode;
– setting the KU mode and controlling the direction of movement;
– setting initial coordinates;
– setting the initial directional angle;
– setting the time according to ASN data;
– overcoming water obstacles;
– correction of coordinates using control points.

CO management functions is displayed in the drop-down menu when you touch the ▼ icon.

CO operation messages are displayed at the bottom of the dialog box .

The dialog box of the "Operational Review Data" function displays motion parameters, operating modes of the CO and ACH, as well as the status of the CO .

In the dialog box of the function "Setting the method for determining coordinates and the ASN mode", the operating modes of the orientation system, satellite navigation equipment and the zone change mode are set.

In the dialog boxes of the function "Setting the steering mode and controlling the direction of movement", the operating mode of the heading indicator is set, and the value of the angle of the given direction and the coordinates of the destination are entered.

In the dialog boxes of the functions “Setting initial coordinates”, “Setting initial directional angle”, the method for determining and setting the initial coordinates and the initial directional angle of the tank is set.

In the dialog box of the “Setting time according to ASN data” function, the system time is set according to ASN data.

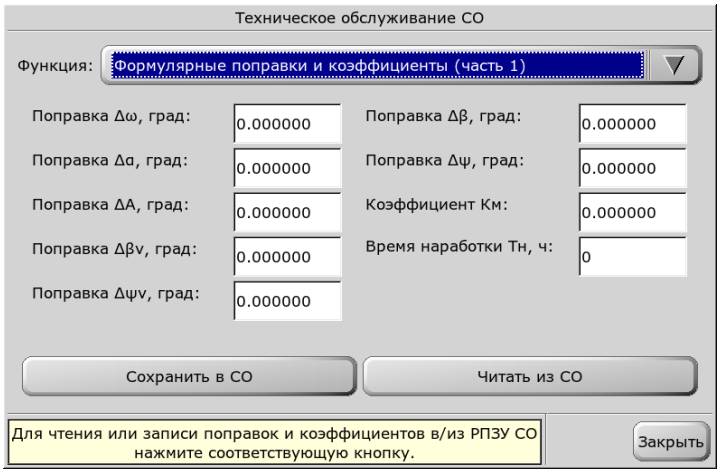
In the dialog boxes of the “Overcoming Water Obstacles” function, the data for performing this function is set and the coordinates are corrected according to the anchored point.

In the dialog box of the “Coordinate correction by control points” function, the data for performing this function is set and the coordinates are corrected by the control point.

A menu item is selected by touching the PMF touch screen in the area where the corresponding controls are displayed.

To return to the previous menu, use the “Close” key.

The view of the CO maintenance dialog box on the PMF screen in the “ CO Maintenance ” mode is shown below.



CO Maintenance ” dialog box there is a “Function” drop-down list, consisting of the following lines:

– formulary amendments and coefficients;

– CO calibration ;

– determination of corrections $\Delta\beta_v$, $\Delta\psi_v$;

– determination of the amendment ΔA ;

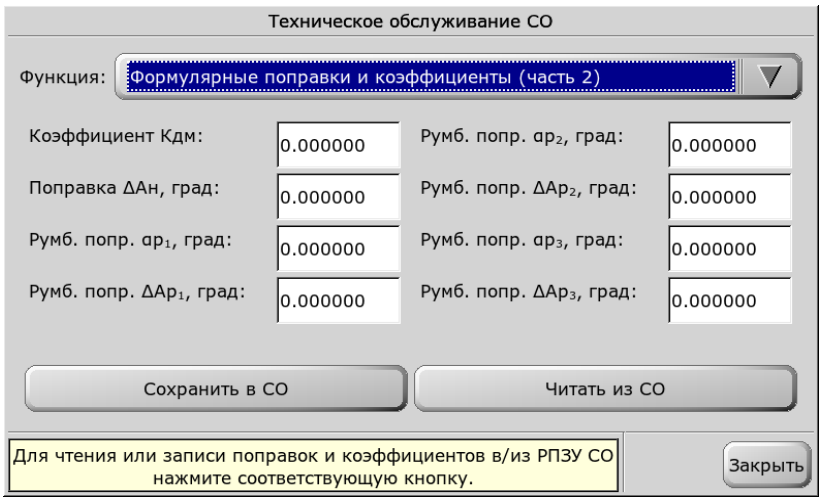
– determining the correction for the gyroscope’s own drift $\Delta\omega$;

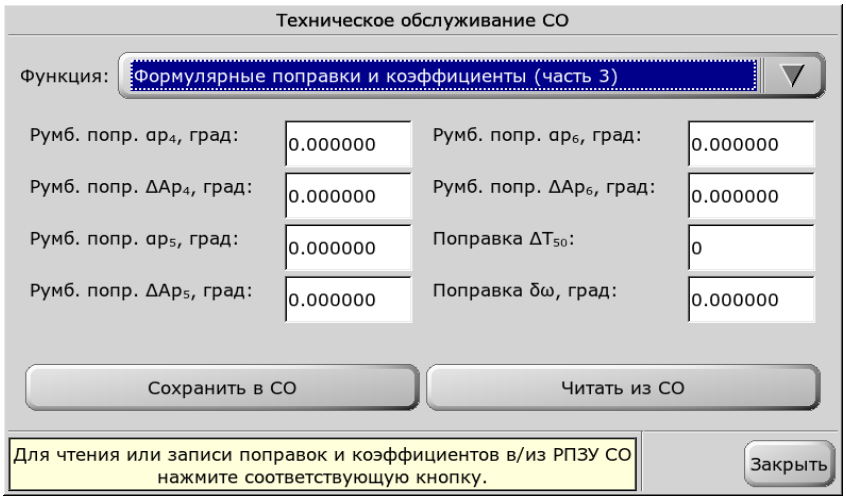
– input of technological data.

CO MOT functions is displayed in the drop-down menu when you touch the ▼ icon.

At the bottom of the dialog box, the corresponding messages about the operation of the orientation system are displayed.

In the dialog boxes of the “Formula corrections and coefficients” function (part 1, part 2, part 3) the values of formula corrections and coefficients determined during maintenance are displayed, as well as the “Save to CO”, “Read from CO” keys for saving their values in the storage device and displayed in a dialog box. The Formula Adjustments and Coefficients dialog boxes are shown below.





, data is set to determine the correction for the displacement of the longitudinal axis of the tank $\Delta\alpha$and the path correction coefficient $K_{M.}$

In the dialog boxes of the function “Definition of corrections $\Delta\beta_v$, $\Delta\psi_v$”, data are set to perform this function and determine corrections to the longitudinal and transverse inclination angle of the tank.

In the dialog boxes of the “Definition of correction ΔA ” function, the data for performing this function and determining the azimuthal correction are set.

In the dialog boxes of the function “Determining the correction for the gyroscope’s own drift”, a command is specified to perform the measurement of the correction Δω.

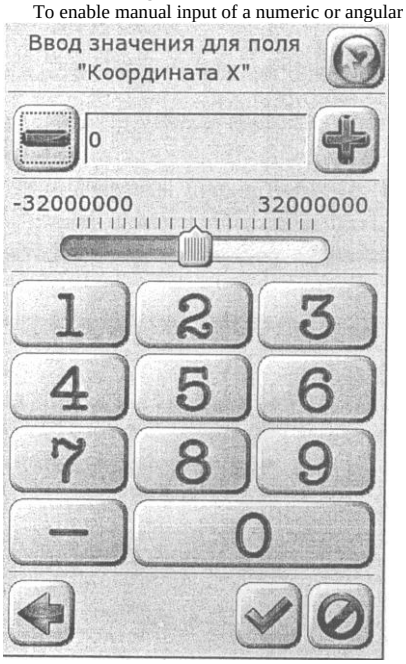
During the execution of CO commands transmitted by the operator, the corresponding controls are blocked. If the software refuses to execute commands, a corresponding message is displayed in the dialog box.

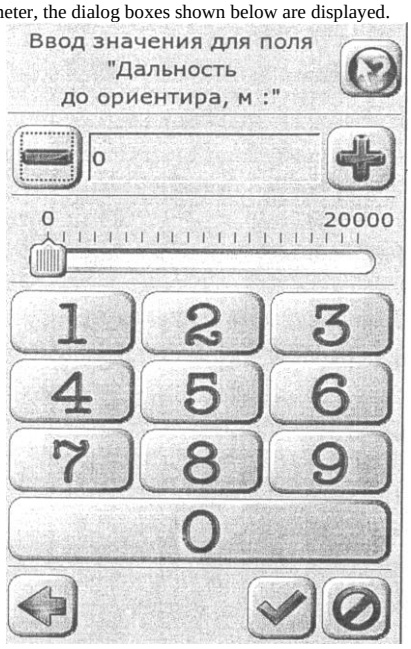
For functions that require a series of sequential operations, you must initiate the function by pressing the "Start" key and follow further instructions in accordance with the messages indicated in the dialog box. After all actions are completed or interrupted by the operator, the dialog box displays the initial state of the function. During the execution of successive operations, the selection of another function is blocked.

For functions that have several ways of performing them, depending on the selected method (mode), the composition of the controls that ensure the execution of this function changes.

Manual input of parameters is ensured by touching the PMF screen in the area of the corresponding value field, which has a white background.

To enable manual input of a numeric or angular parameter, the dialog boxes shown below are displayed.





At the top of the window for entering numerical values there are keys for controlling step-by-step changes in values and a scale informing about the range of permissible values and the current value of the entered value.

In the middle part of the window for entering digital values there are keys for dialing numbers. The functions of the remaining controls are given below:

–  – deleting the rightmost digit;

–  – input confirmation;

–  – cancel editing.

The value of angular quantities is changed by pressing the indicator keys of the digit of the familiarity of the quantity. An indicator of the current angle value is displayed on the left side of the window. The functions of the remaining controls are given below:

–  – return the original value;

–  – button – switch, to change the direction (increase) of changing the value of a digit;

–  – button – switch, to change the direction (decrease) of changing the value of a digit.

After switching on the CO, data is automatically read from the CO storage device and the technical condition of its components is monitored. Subsequently, the current state of the orientation system is determined by operational messages, a list of which is presented in Table 9 .

Table 9

Name from message	Reason for the message	Operator actions
Gyrocompassing in progress	Message about the system operating in gyrocompass mode	Wait for the end of the gyrocompass mode or cancel it when snapping an angle to a reference point. Do not allow attempts to start the Δω correction measurement mode
There is preliminary readiness	CO readiness allowing movement	
Gyrocompassing completed	Ending the gyrocompass mode	
Gyrocompassing is not completed	An attempt to start movement was detected before gyrocompassing was completed	Stop the tank
The gyroscope is not ready	Starting the tasks of setting the directional angle, calibration until the message “Preliminary readiness” appears	Do not enter tasks until the message “Preliminarily ready” appears
Movement!	Attempt to change coordinates, angle, launch service tasks while moving	Stop unauthorized actions
Movement Stop	Start of movement Stop (message 10 s after actual stop)	
Movement Prohibition	An attempt was detected to start moving before the system entered the preliminary readiness stage.	Stop the tank
No final readiness	An attempt to start movement was detected at the preliminary readiness stage	
The initial coordinates from the ASN have been established	Completing the installation of initial coordinates from ASN	
No coordinates from ASN	An attempt to set the initial coordinates from the ASN in the absence of data from it	Determine the reason for missing data
Tilt > 5º!	Launching gyrocompassing modes or measuring the Δω correction at unacceptable angles of inclination	Move tank
Pitch > 5°	Exceeding the permissible angle of inclination	Move tank
Lateral slope > 5º	Exceeding the permissible angle of inclination	Move tank
The amendment to the rate of departure of the SSGKKU is being determined	An attempt to start the gyrocompass mode when the system is operating in the mode of measuring the correction Δω	Do not start gyrocompass mode
Δω more than 3.5°/hour	Negative result when measuring correction	Replace SSGKKU
No frame rotation SSGKKU	Failure when the system operates in gyrocompassing and Δω correction measurement modes	Replace SSGKKU

After a time of 3 to 8 minutes, a message about the start of gyrocompassing (about the preliminary readiness of the system) is displayed on the PMF screen. The SO is ready to perform orientation tasks after a message appears (from 14 to 27 minutes after turning on the power, depending on the ambient temperature) about the end of gyrocompassing.

In the integrated mode, while the tank is moving, the coordinates are determined using the odometric channel and corrected using data from the ASN; in the absence of data from the ASN, in offline mode using the odometric channel; in the event of a malfunction of the odometric channel, the coordinates are determined using data from the ASN.

System operating modes, calculated values of the tank location coordinates, directional angle, as well as other navigation information are displayed on the PMF screen. In addition, the current directional angle, deviation from the direction to the destination, deviation from the given direction are displayed on the driver’s APU. Information exchange between CO and UARMk is carried out via the RS-232 interface.

Based on the known current coordinates of the tank and destination in The CO automatically calculates the distance to the destination, the directional angle to the destination and its deviation from the directional angle of the tank. The CO provides solutions to a number of service tasks, the list of which is presented in Table 10.

Table 10

Task name	Contents of the task
1 Setting the initial directional angle:	Determining the initial value of the directional angle
1.1 About the gyrocompass	A variant of the problem that provides determination of the directional angle by gyrocompassing
1.2 By reference	A variant of the problem with the calculation of the directional angle from the known directional angle of the reference direction α_{or} and the sighting angle α_{viz} measured when sighting in this direction
2 Setting the initial coordinates:	Determining the original coordinates
2.1 About t ASN	Variant of the task of setting the initial coordinates determined by ASN
2.2 By reference	A variant of the problem with calculating the initial coordinates from the coordinates of a remote point, the measured value of the distance to this point and the angle of sight to it
3 Overcoming a water obstacle:	Calculation of the coordinates of the reference point X_{or}, Y_{or} from the current coordinates, the distance D 1 to this point and the sighting angle to it α_{viz} 1 before overcoming the obstacle and calculating the coordinates of the tank on the opposite bank of the obstacle using the coordinates X_{or}, Y_{or} and range recorded in RAM D2 to the reference point and the angle of sight on it α_{viz} 2
4 Coordinate correction	Clarification of the coordinates of the tank according to the coordinates of the control point lying on the route of movement, taking into account the increments of coordinates during the time between the moment of passing the control point and the moment of issuing the command for correction
5 Calibration	Determination of the passport values of corrections for the displacement of the dynamic axis of the tank Δα, as well as the path correction coefficient Km . Amendments are determined by conducting races on the measuring section.
6 Determination of correction to escape rate	Determination of the passport value of the correction Δω for the SSGKKU's own care. The problem is solved automatically by measuring the escape velocity at 24 angular positions of the gyroblock in the azimuthal plane and calculating the average value from the measurement results. In the course of solving the problem, the state of the SSGKKU is analyzed

All tasks, with the exception of the "Coordinate Correction" task, can only be launched while parked. An attempt to start them in motion is blocked with the display of the operational message "Movement!" Starting the tank in cases where the "By gyrocompass" option, the "Set directional angle" task and the "Determination of correction to escape speed" task are running, interrupts the execution with the task being canceled and the operational message "Gyroscope not ready" being displayed. The execution of the "By gyrocompass" option of the task "Setting the directional angle" and the task "Determining the correction to the escape velocity" is carried out automatically. An attempt to launch them in parallel is blocked with the display of the operational message "Gyrocompassing in progress" or "Earnings system control in progress," depending on which of the tasks was launched earlier.

Any task can be terminated by canceling it.

In addition, the CO implements tasks for calculating target coordinates and range to the target and viewing angle to the target:

– determination of the target coordinates X_c, Y_c is performed using the current values of the tank coordinates and the values of the range to the target D_c and the angle of sight on it α_{viz} entered into the CO ;

– determination of the range to the target D_c and the angle of sight on it α_{visas} is carried out using the current values of the tank coordinates and the values of the target coordinates X_c, Y_c entered into the system .

2.13.5.1 heading guidance system

SSGKKU is designed to determine the initial and current directional angles, longitudinal and transverse inclination angles of the tank, and transmit information about their values to the computer.

SSGKKU consists of a gyro unit that generates analog information about angles, and blocks of electrical elements that control the operation of the gyro unit and SSGKKU as a whole.

2.13.5.2 Calculator

The computer is designed to interface electrical and logical components of the system , solve service problems, process navigation information and exchange with UARMk.

The computer contains a computer, an input-output device, a power supply and switching unit.

2.13.5.3 Satellite navigation equipment 14TS821SZH

ASN consists of an electronic unit PI, to which an external antenna module is connected using a set of high-frequency cables. Satellite navigation equipment is designed to receive radio navigation signals from navigation and spacecraft of the GLONASS and GPS systems, high-precision determination of coordinates and altitude of the tank location and output of this information to the CO computer. In addition, satellite navigation equipment provides information about the current time and date.

The design of the antenna module is sealed and protected from mechanical influences and Napalm-type fire mixtures. The electronic PI unit is made in a metal case with shock absorbers. The electronic unit includes a programmable timer, powered by a separate 3 V battery. To access the battery, the case has a cover that covers the battery compartment.

ASN determines the absolute values of the coordinates and altitude of the tank's location, both initial and current. The operation of the ASN is based on the antenna module receiving signals from the navigation space satellite systems GLONASS, GPS, and processing the received information by an electronic unit. The accuracy of determining coordinates depends on the number of satellites received and the geometry of their location in space. ASN, in addition to determining coordinates and altitude, provides information about the current time and current date. ASN does not have its own controls and indications. The ASN operating modes are controlled by the computer via the RS-232C serial channel.

2.13.5.4 Mechanical universal speed sensor

DSMU is a shaft rotation angle converter connected to the guide wheel of the tank's caterpillar propulsion system, carrying information about the speed of the tank, the increment of the distance traveled, the direction of movement and is designed to ensure the operation of the SO, OMS and DKMV.

DSMU converts the angle of rotation of the shaft connected to the guide wheel into a sequence of electrical pulses, the repetition rate of which is proportional to the speed of movement, and the number is proportional to the distance traveled by the tank. From DSMU to The computer transmits two identical sequences of pulses through two channels, shifted relative to each other in phase by 90°. The phase shift is used to determine the direction of the tank's speed vector (forward or backward).

2.14 Surveillance equipment

2.14.1 Outdoor video surveillance system

The external video surveillance system (hereinafter referred to as the SNV) provides the commander with all-round visibility during the day and at dusk, as well as the joint work of the OMS and the SNV.

The commander's APU screen displays images from one of four television cameras with a 95° viewing sector or from four television cameras simultaneously (panoramic view).

The START includes:

– television camera (hereinafter referred to as the television camera) in the amount of 4 pcs.;

– video switch (hereinafter referred to as VIS);

– KVI-VSU cable;

– single spare parts.

N o t e – The presence of a single spare parts for the strategic offensive weapon depends on the type of camera supplied as part of the system.

Components of the strategic offensive weapons are located outside and inside the tank turret:

– three television cameras 14 (Figure 12.1), 16, 17 are mounted under the roof 13 on the stand of the ZhS antenna module, pos. 20;

– TV camera 7 on the right side of the tower - on brackets 6, 10;

– KVI pos. 5 inside the turret in the commander's hatch.

Each START television camera has electrically heated protective glass, which turns on and off automatically depending on the ambient temperature.

The KVI ensures the reception of video signals from television cameras and from the control system, the formation of a video image and its delivery to the commander's APU.

The following controls are located on the front panel of the KVI:

– START-SUO switch with light indication of START activation;

– viewing direction selection buttons (1↑, 2→, 3↓, 4←, PAN ⊞).

The video signal from the KVI is supplied via the KVI-VSU cable pos. 2 on the tank commander's APU, where the video image is formed. The view of the APU screen with the order of images from each camera during a panoramic view is shown in Figure 12.2 .

A single START spare parts kit contains spare parts for television cameras, which can be replaced, if necessary, during operation: glass in the frame, a spare drying cartridge, an o-ring (drying cartridge), as well as a key with which they are replaced.

2.14.2 TV rear view camera

The rear view television camera (hereinafter referred to as the television camera) is intended for use as a means of viewing the area by the driver in the rear sector. The image from the television camera is displayed on the driver's APU screen.

The television camera 16 (Figure 12.4) is installed in the protection housing 30 through a rubber gasket 15 and is pressed with a set screw 20, screwed into a removable rod 19.

For the correct location of the camera on its body, on the lens side, two pins are provided, which, when installing the camera, enter holes in the protection housing 30.

The body 30 of the camera protection is attached with bolts 31 to the bracket 32, which is welded to the rear plate of the tank.

The protection housing 30 and the protective cover 29 protect the television camera 16 from dirt and damage. Additionally, to protect the camera lens from dust, a rubberized flap 13 is installed on the protective cover 29, the fit of which to the protection housing 30 is ensured by adjusting shims 12.

The connection of the television camera to the on-board network and the transmission of a video signal from it is ensured by the television camera harness 2 and other harnesses that are laid in the tank body together with the routes of the electrical equipment harnesses according to the electrical connection diagram (Figure).

The electrical connector of the harness 2 (Figure 12.4) of the television camera is closed by a casing 3.

To automatically open and close the protective cover 29, a pneumatic actuator is used, consisting of the following components: cylinder body 4, piston 6, rod 8, stop 7, fixed on rod 8 with an elastic steel ring. The ends of the spring 9 rest against the flange 17 and the end of the stop 7. The protective cover 29 and the rod 8 are connected to each other by a connecting rod 26.

2.14.2.1 Turning on the camera

To turn on the television camera, you must press the VIDEO button on the driver's panel, while simultaneously:

– voltage is supplied to the electro-pneumatic valve installed in the MTO, and the protective cover 29 opens;

– voltage is supplied to the television camera;

– On the driver's APU, an image of the terrain visible through the television camera appears, and an image of the tank's conventional track in the form of four red lines.

When the electric pneumatic valve is turned on, air through the pipelines of the air system under pressure enters the pneumatic drive of the protective cover of the television chamber, the piston 6 moves the rod 8, which compresses the spring 9 and through the connecting rod 26 opens the protective cover 29 until it stops in the rubber tube 28.

Additionally, to reduce shock loads when opening the protective cover 29, a fitting with a throttling hole is installed at the outlet of the air system tubes from the MTO.

When installing fuel drums, visibility through the rear view camera is significantly limited.

2.14.2.2 Turning off the camera

The camera is turned off when the VIDEO button on the driver's panel is pressed again, while the voltage from the camera and the electro-pneumatic valve is turned off, the pressure in the pneumatic cylinder is released, and spring 9, unclamping, returns the protective cover 29 to its original closed position.

2.14.3 Prism observation devices

2.14.3.1 Commander's prism observation devices

At the base of the tank commander's hatch, seven TNP4E-06 prismatic observation devices are installed, providing all-round visibility (except for the rear sector). Each device has a built-in glass temperature regulator, which automatically maintains the temperature on the surfaces of the upper (input) and lower (exit) windows.

Electrical heating of instrument windows is turned on when the AZR OBOGR .T NP is turned on on the right distribution panel and the switch on the monitoring device is set to one of the two positions OUT. or BOTH, based on operating conditions.

The TNP4E-06 observation device consists of two heated prisms (upper and lower), placed in a metal case 2 (Figure 12.8); amplifier 4 glass temperature controller with toggle switch 3 for two positions: OUT. (switching is done in the direction away from you) and BOTH (switching is done towards you). A rubber gasket 1 is installed on the device body to prevent dust and moisture from entering the tank.

Surveillance devices are installed in the shafts and secured with brackets 5 and screws 6.

If necessary, a light filter 7 is installed on the lower window of the observation device, supplied complete with the observation device, secured to the device with springs 8.

2.14.3.2 Prismatic gunner observation devices

In front of the gunner's hatch, two TNP4E-06 and one TNP-165A observation devices are installed in the shafts in the turret roof, providing visibility in the front and side left viewing sectors.

The electric heating of the windows of the TNP4E-06 devices is turned on when the AZR OBOGR .T NP is turned on on the left distribution panel and the switch on the monitoring device is set to one of the two positions OUT. or BOTH, based on operating conditions.

The TNP-165A device does not have electric window heating and hydropneumatic cleaning.

The mounting of the TNP4E-06 devices installed at the commander and the gunner is shown in Figure 12.8, the mounting of the TNP-165A device is shown in Figure 12.6

2.14.3.3 Prismatic driver observation device

In front of the driver's hatch, in the shaft, a prismatic observation device TNPO-168V with electrical heating of the upper (input) and lower (exit) windows is installed.

Automatic maintenance of the set temperature on the surface of the glass is ensured by the glass temperature regulator RTS-27-4MS, which is installed on the right bow fuel tank and connected to the monitoring device by a cable with an electrical connector.

The TNPO-168V observation device with a rubber gasket 8 (Figure 12.9) and a shock-absorbing-sealing spacer 9 is installed in the tank shaft and secured with an eccentric clamp 4. By adjusting the forks 7 in height, the device is installed tightly.

The eccentric clamp is installed so that the observation device is pressed by hand on the clamp handles without the use of a tool, while the forks 7 can be adjusted in height.

If necessary, a light filter is installed on the lower window of the observation device, which comes complete with the observation device, or a shutter 10 of the lower window is installed under the springs 3 of the observation device.

2.14.3.4 Driver's night vision device

2.14.3.4.1 Purpose and design of the device

5 night vision device (hereinafter -referred to as the TVN -5 device) is designed to ensure the driving of a tank at night in natural light conditions (in passive mode) or when illuminated by a headlight with an infrared (IR) filter (in active mode).

The TVN -5 device is a periscope with a biocular output, built on the basis of an electron -optical converter with microchannel amplification.

The TVN -5 device consists of housing 1 (Figure 12.10) of the upper prism, housing 10 with bushings, an electron-optical path, a secondary power source and controls.

For ease of observation, the device is equipped with a headband 4, and a rubber eyecup 5 is placed on the eyepiece.

At the bottom of the device there are two shock absorbers 8, which are necessary for fastening the device in the tank, and a plug 7 for the electrical connector for connecting the device to the on-board network. The shock absorbers are attached to the device with screws 9.

The device has a built-in diaphragm and shutter that protect the device from light exposure. The curtain is closed when the CURTAIN handle pos. 11 is turned to the right all the way, and the observer can see the inscription CLOSED at the top. The diaphragm is closed when the DIAPHRAGM handle pos. 2 is turned to the left all the way, and the observer can see the inscription CLOSED on top. DIAPHRAGM handle pos. 2 is also intended to turn on the device.

The required temperature on the glass surfaces of the head prism and the eyepiece of the device is automatically maintained by a built-in temperature controller. The eyepiece heating is turned on constantly, and the prism heating is turned on with the PRISM HEATING toggle switch pos. 6.

Gasket 12 is intended for hermetically sealed installation of the device in the tank shaft.

To check the functionality of the device during daylight hours, the device includes a diaphragm 13.

A detailed description of the TVN -5 device is given in the operating manual IAZHYU.200120.013 RE .

2.14.3.4.2 Placing the device in the tank

The TVN -5 device, depending on the situation, is installed in the tank in the “combat” or “travel” position.

“Combat-style” the TVN -5 device is installed in the shaft instead of the TNPO168V daytime observation device using an adapter clip 1 (Figure 12.11) together with a spacer 2. To fasten the device, use the mounting parts of the TNPO -168V device: forks 3, rollers 4 and an eccentric clamp 5.

The TVN 5 device is mounted in a “traveling” manner -on bracket 2 (Figure 12.12), which is secured in front of the driver’s hatch on axis 4 with stopper 3. The device is secured in the bracket with screw 1.

In the non-operating position, the TVN -5 device with a napkin (from the device kit) and a clip are placed in the TVN box located between the front tank and the right bow fuel tank. Diaphragm 13 (Figure 12.10) from the device kit and the bracket are placed in the spare parts of the tank.

The cable for connecting the TVN -5 device to the tank’s on-board network in the non-working position is placed in clips on the front sheet of the hull inside the tank.

To work in low light conditions at night, a headlight with an IR filter is used, which is installed on the upper nose plate of the hull on the right in the direction of travel of the tank.

2.14.3.5 Driver's protective cap

The protective cap is designed to protect the driver from dust, dirt and precipitation when the tank is moving in field conditions.

The protective cap consists of a shield 1 (Figure 12.13) for the driver and the rear part 2 of the cap, which consists of a metal base and a waterproof cover.

The driver's shield 1 and the rear part 2 of the cap are connected by wing nuts 6.

On the driver's dashboard 1 there are installed :

– mechanical glass cleaner 7;

– GPO nozzle pos. 5, for cleaning glass with water emulsion or air, with a hose for connecting to the tank's gas purification system;

– electrical connector for connecting electrically heated glass to the electrical equipment of the tank.

For installation on the driver's hatch, quick-release locks 3 are installed on the base of the rear part 2 of the cap.

On the cover of the back of the 2 caps there are zippers, which, when used in the summer, provide ventilation.

The driver's shield 1 can be installed separately, without the rear part 2 of the cap, while it is bolted through grooves on the squares in its lower part to special bonks on the tank body.

When not in use, the folded rear part 2 of the cap, placed in a special case, and the driver's shield 1 are placed in the tank according to the ZI-O sheet.

2.14.4 Hydropneumatic cleaning system for observation and aiming devices

2.14.4.1 GPO system of surveillance devices in the housing

The hydropneumatic cleaning system (GPO) in the housing is designed to clean the protective glass of the TNPO-168V surveillance device from dirt with water and air, and from dust and snow - with air.

The GPO system is connected to the tank's air system and consists of the following main parts:

– tank 7 (Figure 12.14);

– dispenser 5;

– valve 2 with tap;

– pipelines.

Tank 7 for water is located in the bow of the hull. Tank filling capacity - 8 l. To refill it, a filling pipeline is provided, closed with plug 3. The neck of the filling pipeline with plug 3 is located on the right, near the opening of the driver's hatch. To drain tank 7, a hose is provided, closed with plug 6. The hose is laid along the bottom of the body, and the end of the hose is secured in clips to the left of the driver's seat.

A water dispenser 5 is mounted on tank 7. The dispenser is used to dispense a portion of water when cleaning the TNPO-168V surveillance device from dirt.

Valve 2 with a tap is located on the upper front plate of the housing in front of the right control lever. It serves to turn on the GPO system with lever 4 and switch the cleaning mode "WATER" or "AIR" with handle 8. When the handle 8 is in a horizontal position, cleaning will be done with water, and when it is in a vertical position, it will be cleaned with air.

Sprayer 1 is used to blow air or wash TNPO-168V protective glass with water. Spray gun 1 is connected by a hose to outlet fitting 9.

When lever 4 is pressed, air from the system through valve 2 with a tap enters dispenser 5, where it is mixed with liquid coming from the tank, and then the mixture is supplied through a pipeline to the sprayer. When the handle 8 of valve 2 with the tap is in a vertical position, air enters the sprayer 1, bypassing the dispenser 5.

Each time you press lever 4 to turn on valve 2 with a tap, air is taken to clean the air intake device (AUD) of the PKUZ-1A instrument complex.

2.14.4.2 GPO system of surveillance devices in the tower

The GPO system is designed to clean the protective glass of observation and aiming devices from dirt with water and air, and from dust and snow with air.

The GPO system consists of the following main parts:

– air rotating device 25 (Figure 12.15);

– air reducer 22;

– balloon 19;

– electric air valves 20, 21, 23, 26;

– tank 9;

– dispensers 5, 8;

– check valves 13, 24, 27;

– taps 16, 28.

The air rotating device 25 is designed to supply air from the air system of the tank to the air purification system in the tower. It is located in the central hole of VKU-1, and consists of a fixed rod with rubber sealing rings and a movable glass placed on it.

The check valve 24 is designed to prevent the discharge of the cylinder 19 when the air pressure in the air system of the housing drops. The check valve 24 is mounted on a tube connected to the air rotating device 25.

The air reducer 22 is designed to reduce the air pressure to 70 $кгс/см^2$ in front of the electric air valves 20, 21, 23, 26.

The cylinder 19 serves to store a supply of air and provide it with the gas purification system. It is located in the niche of the rotating conveyor deck.

Electric air valves 20, 21, 23, 26 are designed to supply air when cleaning the protective glasses of observation and aiming devices is turned on. They are located in the lower front part of the turret, in front of the gunner.

Electric air valve 20 supplies air to clean the protective glass of the commander's observation and aiming devices from dust and snow when the toggle switch of the GPO switch is pressed, pos. 10 up, to the AIR position. GPO switch pos. 10 is located on the bracket in front of the PK-90 commander's console.

Electric air valve 21 supplies air to clean the protective glass of the commander's observation and aiming devices from dirt when the toggle switch of the GPO switch is pressed, pos. 10 down to the WATER position.

Electric air valve 23 supplies air to clean the protective glass of the gunner's observation and aiming devices from dirt when the toggle switch of the GPO switch pos. 4 down to the WATER position. GPO switch pos. 4 is located on the bracket, near the PDT control panel.

Electric air valve 26 supplies air to clean the protective glass of the gunner's observation and aiming devices from dust and snow when the toggle switch of the GPO switch pos. 4 up, to the AIR position.

Water tank 9 is located in front of the turret, in front of the gunner. Tank capacity - 7 l. To fill the tank, there is a filler neck with plug 7, located on the roof of the turret, behind the protection of the backup sight. A filter 6 is screwed into the filler neck to prevent mechanical particles from entering the tank during refueling. To drain water from the tank, a drain hose 12 with a plug 11 is provided. The end of the hose is attached to clips on the right wall of the tank and is located behind the control panel of the control system and AZ.

Dispensers 5 and 8 are designed to dispense a portion of water when cleaning the gunner's and commander's observation and aiming devices in WATER mode. They are installed on the bottom of tank 9.

The check valve 13 prevents air leakage from the drain holes of the electric air valve 20 when the electric air valve 21 is turned on. The check valve is installed at the outlet of the electric air valve 20.

The check valve 27 prevents air leakage from the drain holes of the electric air valve 26 when the electric air valve 23 is turned on. The check valve is installed at the outlet of the electric air valve 26.

Tap 16 is intended for the commander to select devices that will be cleaned when he turns on the GPO switch pos. 10. The crane is located on a bracket, under the PK-90 commander's console. The choice of devices that will be cleaned is carried out by turning the tap handle to fixed positions. If the tap handle is set to the lower position, then when switch 10 is turned on, the control panel will be cleaned. If the tap handle is set to the upper position, then when switch 10 is turned on, the front observation device No. 1 and the observation devices No. 2 and No. 7 located to the left and right of it will be cleaned, etc.

Tap 2 8 is intended for the gunner to select devices that will be cleaned when he turns on the GPO switch pos. 4. The crane is located in front, on the bracket, under the PNM sight. The choice of devices that will be cleaned is carried out by turning the tap handle. If the tap handle is installed in a vertical position, then when the GPO switch is turned on, pos. 4 the PNM sight will be cleaned. If the tap handle is set to the left position, then when the GPO switch is turned on, pos. 4 the left and right observation devices will be cleaned.

Sprayers 1, 2, 3, 14, 15, 17, 18 are designed for blowing air or washing with water the surfaces of protective glass of observation devices and sights to be cleaned. They are located at the corresponding instruments and sights.

When you press the toggle switch of the GPO switch pos. 4 with the gunner up (AIR position), the electric air valve 26 is turned on and air enters the valve 28. Depending on the position of the valve handle 28, the air enters the sprayer 2 of the PNM or the sprayers 1 and 3 of the left and right observation devices and is cleared of dust or snow. When you press the toggle switch of the GPO switch pos. 4 with the gunner down (WATER position), the electric air valve 23 is turned on, and air enters the dispenser 5. From the dispenser, the mixture of air and water enters the tap 28. Depending on the position of the handle of the tap 28, the mixture of air and water enters the sprayer 2 PNM or the sprayers 1 and 3 left and right observation devices and cleaning of dirt is carried out.

When you press the toggle switch of the GPO switch pos. 10 with the commander up (AIR position), the electric air valve 20 is turned on and air enters the valve 16. Depending on the position of the valve handle 16, the air enters the spray nozzles 14, 15, 17, 18 and dust or snow is removed. When you press the toggle switch of the GPO switch pos. 10 with the commander down (WATER position), the electric air valve 21 is turned on and air enters the dispenser 8. From the dispenser, the mixture of air and water enters the tap 16. Depending on the position of the handle of the tap 16, the mixture of air and water enters the spray nozzles 14, 15, 17, 18 and dirt is removed.

2.15 Habitability facilities

2.15.1 Habitat heater

The heater is designed to create comfortable conditions for crew members located in the crew compartment during the cold season. The heater is installed on the heater and is constantly connected to it in the engine cooling sys-

tem. The heater consists of the upper and lower parts of the housing 1 (Figure 13.5), a tubular-plate radiator 2, an electric motor 3 with fans 4. The housing serves to direct the air flow through the radiator and to protect the radiator, electric motor and fan impellers from damage.

The heater is turned on by the B. COMPARTMENT HEATING switch located on the driver's panel. In addition, the heater can be controlled automatically when the heater is started or stopped. Control of the specified heater operating mode is available in the DCM menu.

2.15.2 Thermoelectric air conditioner

Thermoelectric air conditioner (TEL) is designed for local supply of cooled air.

The layout of the CHP elements on the tank is shown in Figure 13.1

KHP consists of two cooling units (CO) pos. 3, installed in the tank's control compartment at the commander's and gunner's workplaces; expansion tank 6; tubes 10; 2 sleeves and 5 fittings for coolant; container 11 and tubes 4 for draining condensate.

The cooling units are connected to the pump, heat release radiator and expansion tank via 10 tubes, 2 hoses, secured with fasteners 1.

2.15.2.1 Cooling unit

The cooling unit (hereinafter referred to as BO) is designed to cool air and supply it to the breathing zone of crew members, "Air Conditioning" mode. BO is also used in the "Ventilation" mode. The commander's BO is located on the right on the front plate of the turret. The gunner's BO is located on the left in the turret above the MPB.

The BO consists of a housing 6 (Figure 13.2), in which an electric fan 13 and a thermoelectric cooling unit, consisting of a heat exchanger, are installed. The heat exchanger is equipped with thermoelectric modules with radiator plates and an auto-return thermostat, designed to turn off the heat exchanger in the event of a malfunction.

The following are installed on the front panel of the BO housing:

– three deflectors 2, designed to change the direction of supply of cooled air;

– switch 1, designed to turn on the "ventilation" mode;

– switch 8, designed to turn on the "air conditioning" mode;

– regulator 7, designed to adjust the air supply speed;

– signal LED 9 is green, which lights up when the CHP is turned on;

– red signal LED 11 informs about the underwater driving mode. When this LED is on, the operation of the CHP in the "Air Conditioning" mode is automatically blocked;

– signal LED 10 is red, lights up when the coolant level drops below the minimum;

– signal LED 12 is red, lights up in case of malfunctions that occur in the CHP (lack of coolant in the system, overheating of thermoelectric modules due to a malfunction of the electric liquid pump, fans for blowing the heat release radiator).

Inside, on the rear panel of the BO housing, an electric fan 13 is installed, designed to supply cooled air to the breathing zone of the crew members.

On the right side wall of the BO are installed :

– ground connection terminal;

– electric fan fuse 3;

– electrical connector 5 for connecting BO.

On the side walls of the BO there is a condensate drain tube 14, pipes 4 for connecting the coolant distribution hoses, and a coolant drain fitting 15.

2.15.2.2 Container

The container is located outside the tower on the right side.

The container consists of a housing 14 (Figure 13.3a) and covers 1 and 2. The housing contains: a heat sink 9 with two fans attached to it to blow it; pump 12 for pumping coolant; control unit 10; sensor 8 OPVT; sleeves 4, 13 and electrical installation kit 11. Covers 1 and 2, in preparation for underwater driving, are installed in the position according to Figure 13.3b, and serve to seal the inlet and outlet shutters of the container. In this case, the sensor 8 OPVT opens and blocks the operation of the CHP in the "Air Conditioner" mode.

2.15.2.3 Control block

The control unit is housed in a container. On the housing 1 (Figure 13.4) of the control unit there are fuses 3 and 4, designed to protect the components of the CHP, and electrical connectors 2. The integrity of fuses 3 and 4 is indicated by illuminated LEDs 5.

2.15.2.4 Expansion tank

The expansion tank is intended for refilling the coolant heater and to compensate for the thermal expansion of the coolant during operation of the coolant heater.

Expansion tank 6 (Figure 13.1) is located on the turret behind the commander's hatch under the protective casing 7.

The expansion tank is an aluminum container that has a neck for filling the coolant and two pipes for connecting to the coolant distribution hoses. After filling the coolant, the neck is closed with a lid 8. On the side wall of the tank there is a sight glass, on the lid of which there are marks MAX and MIN , and a minimum coolant level sensor is installed. If there is no coolant or if its level drops below the permissible level, the minimum coolant level sensor generates an electrical signal to activate the signal LED located on the front panel of the coolant.

2.15.2.5 Operating principle of CHP

The source of cold in the CHP are thermoelectric modules (hereinafter referred to as TEM) located in the BO. When DC electrical voltage is applied to the TEM, the cold sides of the TEM emit cold, which, concentrating on the radiator plates, cools the air that is supplied by the electric fan to the breathing zone of the crew members. At the same time, the hot sides of the TEM release heat, which is transferred to the coolant through tubes 10 (Figure 13.1) and sleeves 2 to a heat release radiator located in container 11. Fans, blowing on the radiator, discharge heated air into the environment.

The voltage supply to power the KHP is carried out through the AZR KOND., located on the left side in the tank turret under the AZR shield.

2.16 Air system

The air system is designed to supply compressed air to the tank's consumer systems and provides:

– starting the engine with compressed air;
– operation of the intake air heating system;
– operation of the GPO system of the driver's observation device and the GPO system of observation and aiming devices in the turret;
– cleaning the sensor of the sensor of the protection system against weapons of mass destruction;
– charging air cylinders from the air system of another tank;
– charging air cylinders of another tank;
– charging TDP cylinders;
– operation of the pneumatic drive of the valves of the FVU supercharger;
– operation of the device for braking with the stopping brake;
– activation of the engine power limiting mechanism;
– operation of the pneumatic drive of the rear camera cover;
– operation of attachments.

The air system consists of :

– compressor 3 (Figure 14.1);
– moisture-oil separator 1;
– valve 19 for automatically draining sludge from the moisture-oil separator;
– pressure automatic 4 ADU2S;
– settling tank 10;
– two cylinders 15;
– pressure gauge 13;
– air bleed valve 12;
– three electric pneumatic valves 9;
– devices 6 for engine preservation;
– air reducers 8 and 18;
– four electric air valves EK-48 pos. 17;
– connecting pipelines.

2.16.1 Compressor AK150SV-Yu

The AK150SV-YU piston-type two-cylinder, three-stage air-cooled compressor is designed for filling cylinders with compressed air.

The compressor is installed on the input gearbox, the compressor is driven from the input gearbox drive unit through a spring coupling and gearbox.

Operating pressure created by the compressor, 120^{+40}kgf/ см^2.

The compressor takes air from the air cleaner head, and lubrication comes from the transmission lubrication system.

The main components of the compressor are crankcase 11 (Figure 14.2) with eccentric shaft 10 with connecting rods, cylinder 12 of the first and second compression stages with piston 13 of the first and second stages, cylinder 6 of the third compression stage with piston 9 of the third stage.

On cylinder 12 of the first and second stages there is fitting 2 for supplying air to the compressor, and on cylinder 6 of the third stage there is fitting 7 for removing air from the compressor. Both cylinders have inlet and discharge valves connected to each other by tube 4 of the second stage and tube 15 of the first stage. For better cooling, the cylinder jacket is equipped with ribs.

When the engine is running, due to the rotation of the eccentric shaft, the compressor pistons perform a reciprocating movement.

When the piston 13 of the first and second stages moves downward, a vacuum is created in the cylinder 12 of the first and second stages, the inlet valve 1 opens, and the air entering through the pipeline from the air cleaner fills the space above the piston.

When the piston 13 of the first and second stages moves upward, the intake valve 1 closes and air compression begins in the cylinder 12 of the first and second stages. Compressed air opens the discharge valve 16 and through the tube 15 of the first stage through the inlet valve 14 enters the cavity of the second compression stage, located between the upper and lower compression rings of the same cylinder.

When the piston 13 of the first and second stages moves downward, the air in the cavity of the second stage is compressed and, opening the discharge valve 3, flows through the tube 4 of the second stage through the inlet valve 5 into the working cavity of the cylinder 6 of the third stage. Thus, in the cylinder 12 of the first and second stages, two stages of air compression are carried out.

The third stage of compression occurs when the piston 9 of the third stage moves upward in the cylinder 6 of the third stage. Compressed air, opening the injection valve 8 of the third stage, is pumped through the air outlet fitting 7 and the connecting pipeline into the moisture-oil separator, where it is cleaned of oil and moisture, passes through an additional filter and through the ADU2S pressure automatic device and enters the cylinders.

2.16.2 Moisture-oil separator

Moisture-oil separator 1 (Figure 14.1) is used to clean compressed air from moisture, oil and mechanical impurities. It is installed on the right gearbox housing.

The moisture-oil separator consists of a housing 8 (Figure 14.3) with brackets 6 welded to it for mounting on the tank with shock absorbers 7. The housing has a fitting 3 for air supply and a fitting 4 for draining sludge. In the upper part of the housing there is a cover 1 with a hole for connecting a tube that removes air from the moisture-oil separator. Filter elements (mesh and felt pads) are installed in the internal cavity of the housing. The compressed air coming from the compressor with oil and water particles in the moisture-oil separator sharply changes the direction and speed of flow, the oil and water particles flow down the walls to the bottom of the housing, and the dried air passes through the filter elements of the moisture-oil separator, filter 2, and enters the pressure switch.

2.16.3 Automatic drain valve

Valve 19 (Figure 14.1) for automatic sludge drainage is designed to drain sludge from the moisture-oil separator; it is installed between the moisture-oil separator 1 and the sludge drain fitting 20, located outside in the upper part of the feed sheet on the right. The sludge drain valve is mounted on the right gearbox housing.

When the engine is running, piston 4 (Figure 14.4) by seal 3 is pressed against the seat of fitting 1 by the fuel pressure created by the engine fuel priming pump and blocks the sludge drainage route. When the engine stops, the fuel pressure decreases, and piston 4 is pressed from the seat by spring 2 and air pressure in the line from the compressor to the pressure switch. Air displaces sludge from the moisture-oil separator through the pipeline and the sludge drain fitting into the atmosphere. Signs of normal operation of the sludge drain valve are a short hiss of air after stopping the engine and fresh traces of sludge products leaking from the sludge drain fitting.

2.16.4 Pressure automatic valve ADU2S

The ADU2S pressure automatic device is designed to automatically maintain the compressed air pressure in the system within specified limits. This is ensured by turning on the compressor to operating mode at the lower pressure limit or by switching the compressor to idle mode when the upper pressure limit is reached. The pressure switch is installed in a sealed casing 3 (Figure 14.5) and is mounted on a bracket through shock absorbers to the engine oil tank. On the casing there is a rubber valve 15, designed to release air during idling operation of the compressor, and a plug 4 for purging the pressure switch if its normal operation is disrupted.

The pressure switch consists of a housing 14, an air inlet fitting 11, an air outlet fitting 9, a pressure reducing valve 12, an on valve 6, an off valve 13, a membrane 8 and a shut-off valve 10.

When the engine is running, compressed air from the compressor opens shut-off valve 10 and enters the line to fill the cylinders.

At this time, the shutdown valve 13 is in the closed position, and the on valve 6 is in the open position, while cavity A communicates with the atmosphere through the hole in the on valve 6. As the pressure in the cylinders increases, the membrane 8, bending upward, presses through the pin on the switching valve 6 and, when the switching pressure of the pressure switch is reached, closes it, and the communication of cavity A with the atmosphere stops.

When the pressure in the cylinders reaches the shutdown pressure, shutdown valve 13 opens and air from the compressor will be released into the atmosphere through pressure reducing valve 12 and rubber valve 15.

The compressor will begin to operate in idle mode at a backpressure of compressed air from 13 to 17 kgf/ см^2, which is set by adjusting the pressure reducing valve 12. In this case, the shutdown valve 13 is held in the open position by air pressure from 13 to 17 kgf/ см^2, since the working surface of the valve is much larger than the surface of the needle located in the central part of the valve. Shut-off valve 10 prevents air from escaping from the cylinders.

If the air pressure in the cylinders becomes less than the switching pressure, then the springs will open the switching valve 6 and cavity A will communicate with the atmosphere. As a result, the air pressure under valves 12 and

13 will drop and they will close. After closing the shut-off valve 13, the air from the compressor, overcoming the resistance of the shut-off valve 10, will enter the cylinders.

On the tank, the pressure automatic ensures the cut-off pressure from 135 to 160 кгс/см^2, the cut-in pressure is not lower than 120 kgf/ см^2, difference between switch-off and switch-on pressure is not less than 10 kgf/ см^2.

2.16.5 Sump

Sump 10 (Figure 14.1) is installed in the control compartment on the bottom in front of the gear selector at the lowest point of the air system pipeline route. It is designed for additional purification of compressed air from moisture before it enters the cylinders and consists of a housing with an inlet fitting and a flange welded to it for attaching a sump. An outlet fitting is installed in the upper part of the housing, connecting the sump with the pipeline to the cylinders and the air bleed valve.

At the bottom of the housing there is a hole for draining condensate, closed with a plug.

2.16.6 Air bleed valve

Air bleed valve 12 is necessary when connecting a high-pressure hose to air bleed fitting 11 for charging tank cylinders from an external source, providing air intake from an external source, charging cylinders of another tank, charging TDP cylinders, connecting the pneumatic system of the trawl.

The air bleed valve is installed on the sump housing. The inlet fitting of the valve is connected to the air route running from the sump to the cylinders, and the output fitting of the valve is connected through pipelines to fitting 11 of the air bleed.

2.16.7 Air cylinders

Air cylinders are designed to store a supply of compressed air.

Two cylinders 15 with valves screwed into them are fixed on the upper inclined sheet of the housing in the forward part of the control compartment to the right and left of the driver’s seat. The capacity of each cylinder is 5 liters.

When the valves on the cylinders are open, when starting the engine, compressed air from the cylinders enters the engine air distributor through the electric pneumatic air release valve.

2.16.8 Electropneumatic valves

The air release electro-pneumatic valve is designed to supply compressed air to the air distributor when starting the engine and is installed in the control compartment on the inclined nose plate to the right of the driver's seat.

The PTO activation electro-pneumatic valve is designed to activate the engine power limiting mechanism and is installed on a bracket welded to the moisture-oil separator housing.

The electro-pneumatic valve for the pneumatic drive of the rear view camera cover is designed to supply air to the pneumatic drive for opening the protective cover of the rear view camera and is installed on a bracket welded to the moisture-oil separator body.

When the electro-pneumatic valve is closed, the air, passing the inlet fitting 3 (Figure 14.6) and the holes in the seat 2 and body 1, enters cavity B.

The spool 5 is pressed against the seat of the sleeve 6 by the force of the spring 4 and the compressed air in cavity B. The valve 10 is pressed against the seat 2 by the force of the spring 12 and the air pressure in cavity B through the piston 11. The line connected to the inlet fitting of the electro-pneumatic valve is closed.

When the electromagnet is turned on, the pusher 9 acts on the spool 5, which, moving, communicates cavity B through its grooves and holes in the body of the electromagnet 8 with the atmosphere, and is pressed against the seat of housing 1, blocking the communication of cavity B with cavity D of the inlet fitting. The pressure of compressed air in cavity B drops sharply, as a result of which valve 10, under the influence of the force of compressed air in cavity G, moves and communicates cavity G with the line connected to the output of the electro-pneumatic valve.

When the electromagnet is turned off, the spool 5, under the action of the spring 4, moves and is pressed against the seat of the sleeve 6, blocking the communication of cavity B with the atmosphere and at the same time opening the entrance to compressed air from cavity G to cavity B.

Under the influence of the force of compressed air and spring 12, piston 11 moves and presses valve 10 to seat 2. In this case, the line connected to the inlet fitting is closed, and the air from the line connected to the output of the electro-pneumatic valve by drain valve 13 is bleed from the cavity into the atmosphere.

2.16.9 Pressure gauge

Pressure gauge 13 (Figure 14.1) is designed to monitor air pressure in the system and is installed on a bracket in the control compartment on the upper inclined sheet of the housing to the right of the driver’s seat.

2.16.10 Preservation device

The preservation device with a check valve is designed to preserve the engine and prevent oil from entering the air line during engine preservation.

The device is located on the left intake manifold of the engine. The engine is preserved through a fitting closed with a plug.

2.16.11 Gearbox RT-160-25 (RT-160-70)

The RT-160-25 (RT-160-70) reducer consists of a housing 3 (Figure 14.7), a high-pressure valve 2, a pusher 7, a buffer piston 5, a spring 6 and a safety valve 8. The pressure of the air leaving the reducer is regulated automatically by overlapping the nozzle in housing 3 with high pressure valve 2. Air from the cylinder through filter 1 enters the cavity under the high-pressure valve 2 and, passing through the housing nozzle and the grooves of the pusher 7, presses on the piston 5 of the buffer. The buffer piston moves under pressure, compressing spring 6. High-pressure valve 2, together with pusher 7, moves and reduces the flow area of the nozzle in housing 3, which ensures that the pressure of the outlet air is maintained within specified limits.

When the pressure of the outlet air decreases, the piston 5 of the buffer under the action of the spring 6 moves in the opposite direction, forcing the pusher 7 and the high-pressure valve 2 to move with it, increasing the flow area of the nozzle in the housing 3, and the pressure of the outlet air is restored.

Safety valve 8 serves to release air into the atmosphere when the gearbox is faulty. Felt filter 1, installed in front of the gearbox, protects the gearbox valves from clogging.

Reducer RT-160-70 pos. 8 (Figure 14.1) with a filter serves to reduce the air pressure supplied to consumers to 70 kgf/ $см^2$. The gearbox is located in the fighting compartment on the partition of the engine-transmission compartment.

Reducer RT-160-25 pos. 18 with a filter serves to reduce the air pressure entering the air intake and power take-off system to 25 kgf/cm ^{2} . The gearbox is located in the engine-transmission compartment on the air cleaner bracket.

2.16.12 Electric air valves EK -48

Two series-connected electric air valves installed on the engine bulkhead in the fighting compartment on the starboard side serve to control the booster device for braking the tank with a stopping brake.

An electric air valve installed in the fighting compartment on the turret plate near the engine bulkhead serves to control the booster valves of the FVU supercharger.

The electric air valve, installed in the engine compartment on the air cleaner bracket, serves to supply air to the intake air heating system.

Electric air valve EK-48 consists of a body 4 (Figure 14.8) with outlet fitting, inlet fitting 1, inlet valve 3, exhaust valve 5, piston 6, servo valve 13 and traction relay 10.

When the traction relay 10 is turned on or when the manual activation lever 9 is pressed, the servo valve 13 moves, opening the inlet valve hole and closing the hole in the holder with its ball end 7, connecting the cavity under the valve with the atmosphere. Air from the cavity of the inlet fitting 1 passes through the internal holes and enters the cavity under the piston 6.

Air under pressure moves the piston 6, simultaneously forcing the inlet valve 3 to move until it is completely open and the outlet valve 5 until it is completely closed. Air from the cavity of the inlet fitting 1 through the open inlet valve 3 enters the cavity of the outlet fitting and then into the air line.

After turning off the traction relay 10 or stopping the action on the lever 9, the servo valve 13 under the action of the spring 12 returns to its original position. The hole of the inlet valve 3 is closed with a gasket 14, the hole in the holder 7 opens, and the air from the cavity under the piston 6 escapes into the atmosphere.

2.17 Fire-fighting equipment

2.17.1 Purpose, composition, placement and device

Fire-fighting equipment together with the 3ETs13-1 system (hereinafter referred to as PPO) is designed to detect and extinguish fires in the crew compartment, logistics department. Fire extinguishing inside the tank is provided by fire protection equipment in automatic, semi-automatic and emergency operating modes. In the absence of power supply to the tank, fire extinguishing in the crew compartment is ensured by manual activation of the fire protection system from the launch unit. In addition, to extinguish fires inside and outside the tank, including napalm-type fire mixtures, there are two hand-held fire extinguishers.

The PPO consists of ten optical sensors 1 (Figure 15.1); five temperature sensors 4; two high-speed cylinders 2, two generators 3 of fire extinguishing aerosol GOA-19, intended for extinguishing fires in logistics facilities. The launch unit is located under the lid of box 5 on the left fender next to the first spare parts box.

The PPO is controlled by the equipment of the 3ETs13-1 system. The PPO controls are located on the control and alarm panel P13.

2.17.1.1 Optical sensor OD1-1S

The optical sensor OD1-1S is an electronic device that provides a signal to trigger the fire alarm when detecting flame radiation with a temperature of at least plus 800 °C , dimensions not less than 0.45x0.45 m, from a distance of no more than 1.5 m.

Optical sensors are installed to monitor the most fire-hazardous areas of the habitable compartment and are located in the following places:

– sensor No. 1 - on the front inclined sheet, in the area of the air cylinder;
– sensors No. 2, 3, 4 and 10 - on the left side above the VT ;
– sensor No. 6 - on the rear roof sheet;
– sensor No. 5 – on the driver's seat bracket;
– sensor No. 7 - on the rack in the supercharger area;
– sensor No. 8 - on the starboard side next to cylinder No. 1 PPO;
– sensor No. 9 - on the nose sheet in the area of the electro-pneumatic valve.

2.17.1.2 Thermal sensor TD-1

Thermal sensor TD-1 is a device that, when exposed to heat with a temperature of at least plus 150 °C provides a signal to trigger the fire alarm.

Thermal sensors are located in the most fire hazardous places in the MTO:

– sensor No. 1 - under the MAF filter mounting tapes;
– sensor No. 2 - on the bevel gear support;
– sensor No. 3 - on the left on the transmission oil tank;
– sensor No. 4 - on the left on the edge of the MTO partition;
– sensor No. 5 - in the camber of the engine cylinder block.

2.17.1.3 Fast acting cylinder

The quick-release cylinder has a shutter head, which consists of a body 3 (Figure 15.2), a plug 9 screwed into the body, a punch 5 with a locking ring and a washer 4 with a membrane that closes hole A for the exit of the fire extinguishing agent. A squib 10 is installed in the cavity of the plug. The signal to activate the squib from the equipment of the 3ETs13-1 system is supplied through an electrical connector secured by a union nut 11. When the squib is triggered, the membrane is pierced with a punch, and the fire extinguishing agent is thrown into the habitable compartment.

To protect the internal cavity of the plug from dust and moisture, a rubber seal 8 is installed on the plug. A fitting 7 with a gasket is screwed into the head body, covering the hole for charging the cylinder with fire extinguishing agent. The fitting is protected by a plug 6 screwed onto the head body.

To control the charge of the cylinder, a pressure indicator 2 is screwed into the head housing, which is connected to the equipment of the 3ETs13-1 system by electrical connector 1. The cylinder is filled with 13B1 refrigerant in the amount of $1{,}9^{+0{,}1}$kg. Freon 13B1 is a colorless gas with a specific odor. To accelerate the flow of refrigerant, nitrogen was added to the cylinder at a pressure of 70 $кгс/см^2$.

The design of the fast-acting cylinder ensures the release of 90% of the fire extinguishing agent in a time of no more than 80 ms.

High-speed cylinders are located in the habitable compartment:

– tank No. 1 on the starboard side behind the starboard fuel tank;
– cylinder No. 2 on the left side in the area where the AB rack is located.

2.17.1.4 Fire extinguishing aerosol generator GOA-19

The fire extinguishing aerosol generator GOA-19 is a steel cylindrical cylinder, and consists of a body 2 (Figure 15.3), with a charge installed inside for an aerosol-forming composition, an electric igniter 3. Thermal cord 1 is removed from the bottom of the cylinder .

The signal to trigger the GOA-19 is supplied through a cable assembly passing through union nut 4. When triggered, the electric igniter ignites a charge from an aerosol-forming composition, and a large amount of aerosol is released in the form of gray-blue smoke, which extinguishes the fire.

In the event of a lack of power supply during a fire, the GOA-19 is triggered by the thermal start unit, at a temperature at the installation site of more than plus 350 °With or when the thermal start unit is exposed to an open flame.

Fire extinguishing aerosol generators, intended for extinguishing fires in the MTO, are located on the left on the stern sheet.

2.17.1.5 Launch node

The launch unit (Figure 15.4) is designed to forcibly launch the high-speed cylinder No. 2 of the crew compartment PPO system in the absence of power supply to the tank. The launch unit is placed in a sealed box under the cover 5 and secured in the clamp 4. When the cover 1 is opened and the ring 2 is pulled out, a thermal battery installed inside the housing 3 is mechanically launched, which generates an electric current and, through a cable assembly, transmits a signal to trigger the high-speed cylinder.

2.17.1.6 Manual freon fire extinguisher

A manual freon fire extinguisher is a two-liter cylinder filled with 114B2 freon in an amount $2^{+0{,}1}$of kg. Freon 114B2 is a heavy, colorless liquid with a specific odor. To accelerate the flow of refrigerant, nitrogen is added to the

cylinder at a pressure of 45 кгс/см^2. A shut-off valve is screwed into the neck of the cylinder, on the fitting of which a spray disc is installed.

One fire extinguisher is located behind the driver's seat and is attached with a clamp to the VT guard , the second is located in the third outer spare parts box.

2.17.2 Operating modes of the software system

The PPO system operates in automatic, semi-automatic, emergency and additional modes.

The PPO system is ready for operation when the battery switch is turned on and the OPVT-PPO switch is installed on the P13 control and alarm panel, pos. 3 (Figure 15.5) in the "PPO" position.

When the battery switch is turned on, the words "1B", "2B", "3B", "4B" light up on the P13 control panel, which indicates the serviceability of the squib circuits of high-speed cylinders, the electric igniters of the GOA-19 fire extinguishing aerosol generators and the presence of pressure in the cylinders.

When switching the OPVT-PPO switch pos. 3 on the P13 remote control in the "OPVT" position (on the P13 remote control the word "OPVT" flashes) the circuits for closing the blinds, activating the squibs (electric ignitors of fire extinguishing aerosol generators), starting the supercharger and turning on the MOD electromagnet are blocked. In this case, when the "FIRE" command is passed, only a light alarm is provided on the P13 remote control and an audible alarm to the driver about the presence of a fire in the corresponding compartment.

2.17.2.1 Automatic operating mode of the software system

This mode provides detection and double extinguishing of fire in the control and weapons departments and in the logistics department separately or simultaneously.

When a fire is detected, optical sensors or temperature sensors provide an electrical signal to the equipment of the 3ETs13-1 system.

In case of fire in the control and weapons departments:

– on the P13 remote control the word "PO" lights up;

– the commander's signal light and the "FIRE" indicator on the remote TV display light up;

– a command is issued to turn on a speech sound signal in the driver's headset;

– a command is issued to stop the blower at the beginning of the fire extinguishing cycle and to start the blower after the fire extinguishing cycle;

– a command is issued to activate the "1B" cylinder with the fire extinguishing agent (in this case, the inscription "1B" on the P13 remote control goes out);

– after (20±5) from the moment the inscription "1B" goes out, the inscription "PO" on the P13 control panel goes out, the fire alarm light turns off and the blower starts.

In case of fire in the logistics department:

– on the P13 remote control the inscription "ZO" lights up;

– the commander's signal light and the "FIRE" indicator on the remote TV display light up;

– a command is issued to the MOD and a delay is provided for the activation of the fire extinguishing aerosol generator until the engine stops completely, while the cooling system fan stop squib is triggered by a signal from the DCMV;

– a command is issued for the electric ignition of the fire extinguishing aerosol generator "3B" (at the same time the inscription "3B" on the P13 control panel goes out);

– after (40±10) from the moment the inscription "3B" goes out, the inscription "ZO" goes out on the P13 control panel and the fire alarm light turns off.

If a fire reoccurs in the control and armament or logistics departments, the fire extinguishing cycle is repeated, the squib of the cylinder "2B" or the electric igniter of the fire extinguishing aerosol generator "4B" is activated and the inscription "2B" or "4B" goes out on the P13 control panel.

2.17.2.2 Semi-automatic operating mode of the software system

In the event of visual detection of a fire in the control and weapons departments and the fire protection system does not respond, fire extinguishing is carried out from the "PO" button on the P13 remote control or from the "PPO" button on the right or left distribution panels. In MTO - from the "ZO" button on the P13 remote control. In both cases, the fire control system operates in the same way as in automatic fire extinguishing mode.

2.17.2.3 Emergency mode of operation of the fire protection system

When operating in emergency mode (for example, fuse " F 1" (10 A) or " F 2" (2 A) on the P13 remote control has blown, the light indication on the remote control does not work), the PPO system provides:

– when you press the "PO" button on the P13 remote control, the "2B" cylinder is put into operation;

– When you press the "ZO" button on the P13 remote control, the "4B" fire extinguishing aerosol generator is activated.

In the absence of power supply and exposure to high temperature, the fire extinguishing aerosol generators located in the MTO are activated.

2.17.2.4 Additional mode of operation of the software system

In case of visual detection of a fire in the control and weapons departments when the fire control system is turned off or in the absence of power supply, the fire is extinguished manually, using the launch unit. The launch unit is located in a box on the left fender in the area of the first spare parts box. To start the PPO system, you need to open the lid on the box and pull out the ring of the launch unit - the "2B" cylinder will be put into operation.

2.18 Defense system against weapons of mass destruction

The system of protection against weapons of mass destruction is designed to protect the crew, as well as components and assemblies located inside the tank, from a shock wave, penetrating radiation from a nuclear explosion and from gamma radiation from radioactively contaminated areas. It also protects the crew from radioactive and toxic substances, as well as from bacterial agents.

Protection against shock waves is provided by the armor and sealing of the tank. Protection from penetrating radiation from a nuclear explosion and from gamma radiation from a radioactively contaminated area is provided by armor. Protection of the crew from radioactive and toxic substances, as well as bacterial agents, is ensured by sealing the fighting compartment and control compartment and creating excess pressure of purified air in them.

At the same time, the system provides light and sound signaling, monitoring the level of radiation and excess pressure inside the tank, as well as monitoring the presence of toxic substances outside the tank.

The protection system consists of the following main parts:

– instrument complex PKUZ-1A;
– equipment of the 3ETs13-1 system in terms of control of actuators of protection;
– filter-ventilation unit;
– actuators;
– sub-porometer;
– special materials.

2.18.1 Operation of the defense system against weapons of mass destruction

When gamma radiation from a nuclear explosion is detected, the PKUZ -1A instrument complex issues 1 signal "A" to the 3ETs13 equipment -, which simultaneously causes:

– the engine stopping mechanism is triggered - the fuel supply to the engine is stopped and it stops;
– stopping the supercharger, if it was turned on, and closing its valves;
– activation of the actuator for sealing the exit blinds;
– switching the FVU valve to the FVU operating position through an absorber filter;
– glow on the measuring panel of the PKUZ -1A instrument complex of indicator A ;
– the glow of the inscription F on the P13 control panel of the 3ETs13 -1 system equipment;
– issuing an intermittent sound signal to the entire crew via AVSKU.

After (40±10) s after the nuclear explosion, the supercharger is automatically turned on and its valves open.

The radiation level inside the tank is determined by digital indicator 11 (Figure 16.1) on the measuring console of the PKUZ -1A instrument complex, with the switch OFF . p oz. 7 on the measuring panel should be in position "1".

When a tank moves through an area contaminated with radioactive substances with a low level of gamma radiation, the PKUZ -1A instrument complex issues a command "P" to the equipment of the 3ETs131 system.

This happens simultaneously:

– moving the FVU valve to a position in which air from the supercharger passes through the absorber filter;
– turning on the supercharger with opening its valves. Excessive pressure is created in the fighting compartment and control compartment;
– lighting of the "P" indicator on the measuring console of the PKUZ -1A instrument complex and issuing an intermittent sound signal to the entire crew via AVSKU;
– the glow of the inscription "F" on the P13 remote control.

The radiation level inside the tank in a radioactively contaminated area is determined similarly to the level by command "A".

substances are detected in the air, the PKUZ 1A instrument complex -issues an "O" command to the 3ETs13 -1 unit. In this case, the same actuators are activated as upon the "P" command, only instead of the "P" indicator on the measuring panel of the PKUZ1A instrument complex, the "O" indicator begins to light.

2.18.2 Operation of 3ETs13-1 system equipment in the protection system

The system is ready for operation with the battery switch turned on and the OPVT - PPO switch set to the PPO position.

When a signal "O" (toxic substances) or "R" (radioactive contaminated area) is received from the PKUZ-1A instrument complex (automatic mode), commands are issued to activate the electromagnet of the FVU valve (the "F" lamp lights up on the P13 control panel) and to start supercharger. Air is supplied to the fighting compartment and control compartment through an absorber filter. An intermittent sound signal is issued through AVSK to the entire crew.

When you press the ORB button on the P13 remote control, commands are issued in accordance with the automatic mode described above.

When a signal "A" (gamma radiation from a nuclear explosion) is received from the PKUZ-1A instrument complex, commands are automatically issued to block the guidance of the DPU, the MOD electromagnets, the blinds, the FVU valve (the lamp F lights up on the P13 control panel) and to stop the supercharger. An intermittent sound signal is issued through AVSKU. Through$0{,}5^{+2{,}5}$ the command is removed from the MOD electromagnets, blinds and FVU valve (on the P13 control panel the "F" lamp continues to light). After (40±10) s, the DPU guidance lock is turned off and the supercharger is started, maintaining the "ORB" mode.

2.18.3 Filter ventilation unit

The filter ventilation unit provides:

– supplying purified air to the fighting compartment and control compartment of the tank, and creating excess pressure (pressure) in them;

– ventilation of the fighting compartment and control compartment and reduction of gas pollution in them when firing from a cannon and machine gun.

The filter-ventilation unit is located near the power compartment partition on the right side of the tank hull and consists of a supercharger, valves 5 (Figure 16.2) and 9, a pneumatic booster 11, a backup manual drive for controlling the supercharger valves, and a connecting pipe 27, pipe 25 with valve FVU pos. 19 and its control mechanism, filter-absorber 14.

The supercharger is a centrifugal fan with inertial air purification from dust. It consists of an electric motor 1, on the shaft of which the rotor is fixed 3 and guide vane 4, housing 2 and covers 10. The cover has air intake and dust exhaust pipes. The openings of these pipes, which go out onto the roof of the tank hull, are closed by valves 5 for air intake and 9 for dust emission. Armor protection 7 of the supercharger is installed above the valves.

When the supercharger is turned on, the valves are automatically opened by booster 11; when turned off, they are closed by the force of springs 6 and 8.

Booster 11 serves to automatically open the supercharger valves when it is turned on. It consists of a body, a rod, rigidly connected by a rod to the armature of an electromagnet.

Booster 11 is hinged on the bracket and connected to the lever 5 (Figure) supercharger valves using lever mechanism 4. Manual drive cable 3 is connected to one of the arms of lever mechanism 4.

The operation of the supercharger in non-automatic mode is controlled using the SUPERCHARGER-EL switch. DESCENT, located on the left switchboard of the tower, as well as by turning the handle of the manual backup drive to the supercharger valves, in automatic mode - according to the signals "A", "O", "P" and "Fire" of the 3ETs13-1 system.

When installing the SUPERCHARGER-EL. switch. DESCENT to ON position. voltage is supplied to the electric air valve EK-48 and compressed air enters the booster. Under the influence of air, the booster rod moves and at the end of the stroke turns on the booster electromagnet to hold. This opens the supercharger valves and turns on the supercharger.

When setting the SUPERCHARGER-EL .S START switch to the SUPERCHARGER position. OFF The voltage is removed from the electromagnet and the electric motor. The blower stops and its valves close.

The manual backup drive is intended only for emergency activation of the supercharger with simultaneous opening of its valves.

The drive consists of a cable 3, a handle 1 with a ring and a switch 2.

In branch pipe 25 (Figure 16.2) with the FVU valve there is an FVU valve pos. 19, designed to disable the absorber filter when operating the tank under normal conditions. A handle 17 of the lever mechanism is installed on the branch pipe for manually switching the FVU valve pos. 19 and an actuator for automatic switching based on signals from the 3ETs13-1 system of the FVU valve pos. 19 to the operating position of the FVU through the absorber filter 14a. A contact is made on the bracket of pipe 25 with the FVU valve. When the valve is switched to the FVU operating position through the absorber filter, contact 16 closes, and the signal lamp F on the P13 panel lights up, indicating that the filter is in operation.

To manually switch the FVU valve pos. 19 to the operating position of the FVU through the absorber filter, it is necessary to pull the rod 24 of the electromagnet until the rod 22 of the actuator is released, and under the action of the spring 21 the valve will close. To return the valve to its original position, it is necessary to pull the handle 17 of the lever mechanism by the ring 18 until the actuator rod 22 is fixed in the cocked position.

The absorber filter is designed to clean the air supplied by the blower from toxic substances and to finally clean the air from dust, which can be radioactive. It is placed under the supercharger on rack 13 and is attached with tapes to the rack and the side of the housing through shock absorbers 12, the filter-absorber is connected to pipe 25 with the FVU valve through flange 15.

The FVU has two operating modes:

– ventilation mode, in which air is supplied by a supercharger to the control and combat compartments, bypassing the absorber filter;

– filter ventilation mode, in which air is supplied by a supercharger to the control and combat compartments through an absorber filter.

The operating mode of the FVU is determined by the position of the FVU valve pos. 19.

When the supercharger is turned on and its valves are open, air is drawn through the intake pipe into the cavity of the rotating rotor blades. As the rotor passes, dust particles in the air are thrown by centrifugal force to the walls of the housing and are thrown out along with part of the air through the dust ejection pipe. Air purified from dust through pipes 27 and 25 and filter-absorber 14, or bypassing it (depending on the position of the FVU valve), is supplied to the fighting compartment and control compartment of the tank, creating excess pressure (pressure) in them.

2.18.4 Instrument complex PKUZ-1A

2.18.4.1 Purpose and composition of the instrument complex for radiation and chemical reconnaissance PKUZ -1A

The PKUZ 1A instrument complex -provides the following tasks:

– issuing a command “A” to the actuators of protective equipment, light and sound alarms when a powerful flow of gamma radiation from a nuclear explosion is detected;

– issuing a “P” command to actuators, light and sound alarms when gamma radiation is detected from a radioactively contaminated area;

– measuring the radiation level inside the tank;

– issuing an “O” command to actuators, light and sound alarms when toxic vapors are detected in the air outside the tank.

The PKUZ 1A instrument complex -consists of the following components:

– measuring console (block B-1);

– sensor (block B-2);

– air intake device with a cyclone;

– two tubes;

– cable.

The measuring panel and the sensor are connected to each other by a cable, the sensor and the cyclone are connected by tubes. The cyclone is connected to the atmosphere through the armored protective cover of the air intake device.

The PKUZ 1A instrument complex -is located in the control compartment to the right of the driver’s seat, with:

– the measuring panel and sensor are located in the niche of the right bow fuel tank;

– the air intake device with a cyclone is located on the roof of the hull to the right of the driver's hatch.

The instrument complex is supplied with a spare parts kit -01A, which is part of a single spare parts kit for the tank.

2.18.4.2 1A instrument complex-

The PKUZ 1A instrument complex -has a radiation part and a gas detector. The radiation part of the complex provides detection of the gamma radiation flow, measurement of its power, signaling and generation of commands to the actuators of the protection system.

The gas detector of the complex ensures the detection of toxic substances (CA) during continuous pumping of ambient air through it and the issuance of commands to actuators and alarms.

2.18.4.3 Measuring console

The measuring panel is the radiation and signal part of the PKUZ -1A instrument complex.

The following controls and alarms are located on its front panel:

– five LED indicators 1 (Figure 16.1) with the inscriptions “O”, “P”, “A”, “HEATING”, “OFF”. K”, signaling the passage of commands “O”, “P”, “A”, turning on the heating of the cyclone and inlet tube, and turning off the passage of commands;

– button “HEATING CONTROL”, “ORA”, closed with plug 3, to check the functionality of the PKUZ -1A instrument complex using the commands “O”, “R”, “A” and heating;

– OPERATING MODE switch pos. 4, having three positions:

- OFF (turned off);
- RA (activation of actuators by commands “P” and “A”);
- OPA (activation of actuators by commands “O”, “P” and “A”);

– toggle switch “NETWORK-OFF” pos. 6 for turning on and off the PKUZ -1A instrument complex;

– switch “LOB .” pos. 7, having positions “1”, “4”, “10”, intended for entering into the readings of the digital indicator the corresponding multipliers that compensate for the effect of attenuation of gamma radiation by the body and built-in equipment of the tank at the location of the measuring console;

– knob "SET" ZERO" pos. 8 for setting up the complex using the “O” command;

– toggle switch “THRESHOLD O” pos. 9 to switch the sensitivity threshold of the “O” circuit;

– linear LED indicator 10, intended for indication during setup and operation of the complex upon command “O”;

– digital indicator 11 showing the value of the absorbed dose rate of gamma radiation;

– plate 2 with instructions for setting up and checking the complex;

– 5 fuse holders.

2.18.4.4 Sensor

The sensor is a gas detector and consists of the following components:

– compartment 10 (Figure 16.4) filter;

– electrometric compartment 7;

– compartment 6 microsupercharger.

All compartments are hermetically sealed with lids.

On the front side of the sensor there is a window in the filter compartment cover for monitoring the readings of the smoke filter frame counter (PDF). The counter indicates the number of unused PDF frames (the filter tape has 40 frames).

On the cover of the electrometric compartment there is a lug, inside of which there is a filter with filter elements made of polyurethane foam and special fabric for cleaning dust from the air taken from the habitable compartment of the tank. The cavity with the filter elements is closed with a separate cover, fixed with a spring latch.

The filter is connected to the microsupercharger by tube 5.

Air flow regulator 2 is mounted on top of the filter housing. Under the regulator knob on the filter cover there is an arrow marked with the letters M (less) and B (more). When the regulator knob is rotated towards B, the flow rate of pumped air increases, and when rotated towards M it decreases.

On the side wall of the sensor from the filter compartment side there are:

– input rotameter 13 for determining the air flow pumped through the ionization chamber. When air flow increases, the rotameter float rises, and when it decreases, it goes down;

– valve handle 11, which has two positions:

- vertical - OPERATION, in which air enters the sensor through the inlet fitting;
- horizontal - SET. ZERO, at which air enters the sensor through a cartridge with silica gel;

– handle 14 for transferring PDF frames, turning it down all the way ensures changing PDF frames and moving the scale 12 of the frame counter. To turn the handle, you must release it from the latch;

– cartridge 9 with silica gel, designed to filter air when setting up the sensor, i.e. when setting a conditional chemical zero, which corresponds to the glow of two green segments of the linear LED indicator 10 (Figure 16.1) on the measuring panel.

The inlet hole of the cartridge is closed with plug 8 (Figure).

On top of the sensor body there are input 1 and output 4 air channel fittings and a cover under which the alpha source is located. An inlet heated tube is connected to the inlet fitting, and an air exhaust tube is connected to the outlet.

2.18.4.5 Air intake device

The air intake device (AUD) provides:

– air intake from the surrounding atmosphere;

– protection of the sensor of the PKUZ 1A instrument complex -from water entering its air channels at a water level above the VZU of up to 350 mm when the complex is operating;

– cleaning the air from dust and throwing it outside;

– heating the air to the required temperature before supplying it to the sensor;

– release of air after analysis (after passing through the sensor) into the surrounding atmosphere.

The air intake device consists of a cyclone 1 (Figure 16.5) installed in a special glass 2, an armored cover 3 and a shield 6.

The cyclone is a cylinder with holes for air intake and exhaust and fittings for connecting the input and output tubes from the sensor of the PKUZ -1A instrument complex. Inside the cyclone there is a system of channels that provides centrifugal air purification and dust emission, as well as a heating element for heating the air.

The glass is welded into the roof of the tank hull and has a sump to collect water that gets into the intake cavity when the tank moves along a polluted road, fords or during underwater driving.

Plug 4 closes the hole for draining water from the sump.

An armored cover 3 with inlet and outlet air ducts connected inside by channel A is installed on the glass. When a wave overwhelms the cover, air from the outlet duct through channel A begins to flow into the inlet duct, preventing water from getting inside. When the PKUZ 1A instrument complex is not working, -the fittings of the input and output air ducts are closed with rubber caps 5 and a shield 6. The area of the input and output fittings is cleaned of dirt with compressed air from the GPO system at the same time as cleaning the driver's observation device.

The air for the sensor is taken from outside the tank under the influence of vacuum created by a microsupercharger operating in it. The air passes through the air intake unit, where it is cleaned of dust in a cyclone, heated, and supplied to the sensor through a heated inlet tube. In the sensor, air passes through the valve in the OPERATION position, the input rotameter 13 (Figure 16.4), the smoke filter and enters the ionization chamber of the sensor. From the ionization chamber, air enters the microsupercharger. At the same time, air enters the microsupercharger from inside the tank, passing through the sensor filter, air flow regulator 2 and tube 5. Air is discharged from the microsupercharger through the outlet tube from the outlet fitting 4 into the cyclone.

The ejector jet created by the microsupercharger ensures that dust is ejected from the cyclone to the outside.

2.18.5 Actuators of the protection system

The actuators of the protection system automatically stop the engine and close openings in the tank that may be open during operation.

These include:
– FVU valve switching mechanism;
– booster for supercharger valve control drive;
– engine stopping mechanism;
– mechanism for closing the output shutters of the engine cooling system;
– DPU stopper.

The actuators, with the exception of the booster, DPU stopper and MOD, are similar in principle of operation and differ only in design. Each of them consists of a body 8 (Figure 16.6), a rod 6 with a recess, a spring-loaded latch 7, a working spring 5 and an electromagnet 1.

Rod 2 is removed from the electromagnet to manually unlock the mechanism. In the cocked position, the mechanism is held by a clamp 7, which fits into the groove of the rod.

When power is supplied to the electromagnet, its armature, connected to the latch, removes the latch from the recess on the rod 6, the rod is released and, under the action of the working spring 5, the corresponding hole is closed.

2.18.6 System 3ETs13-1

The 3ETs13-1 system (in terms of joint operation with the PKUZ-1A instrument complex) provides control of actuators when signals “A”, “P”, “O” are received from the PKUZ-1A instrument complex or buttons for manual activation of these commands.

The 3ETs13-1 system includes the following assembly units:
– automation unit B13-1S;
– control and alarm panel P13;
– ventilation control box KUV11-6-1S;
– temperature sensors TD-1 - 5 pcs.;
– optical sensors OD1-1S - 10 pcs.;
– spare parts kit No. 1 in a single tank spare parts kit.

The 3ETs13-1 system is discussed in more detail in section 2.17of this manual.

2.18.7 Ventilation control box KUV11-6-1S

The ventilation control box KUV11-6-1S is designed to control the blower.

The box is placed on the inclined front plate of the tank hull above the measuring console of the PKUZ-1A instrument complex.

2.18.8 Sub-porometer

The sub-pressure meter is used to monitor the presence of excess pressure in the habitable compartments of the tank (control and combat compartments).

The sub-pressure meter is installed at the base of the commander's hatch on the left, at the rear, and is a transparent tube with a ball. The tube is placed in a housing mounted on a sleeve. During normal use, the tube is closed with a cap. In the working position, the cap is removed and the pressure gauge is connected to the atmosphere. If the excess pressure in the habitable compartments is at least 490 Pa (50 mm water . with t.), the pressure meter ball rises in the tube to the upper position.

2.19 Curtain setting system

2.19.1 Purpose and composition of the SDR

The curtain deployment system (SPS) is designed to protect the tank from anti-tank systems with laser target designators and from artillery systems with laser rangefinders, as well as to deploy a masking smoke screen in the selected direction.

The SDR includes:
– laser radiation indicator, consisting of two fine and two coarse heads;
– TSHU-1-2B unit (hereinafter referred to as the control unit);
– twelve launchers of the 902 system.

2.19.2 Design and placement of SDR elements

2.19.2.1 Laser light indicator

The laser radiation indicator (hereinafter referred to as OR) is intended for registration of laser radiation, its primary processing and the provision of information about irradiation to the control system.

Structurally, the OR consists of two fine and two coarse heads. Inside each head there is an optical system with a photodetector (there are two photodetectors in the rough head), an electronics unit and a power supply. On the back wall of the head there are two electrical connectors for connecting to the tank systems. The fine head has a horizontal viewing sector of 45 °, and the coarse one has 135 °, and the fine head provides the ability to determine the direction of radiation along the horizon with a discreteness of 3 ° 45'. The combined installation of two fine and two coarse heads provides all-round visibility in the horizontal plane. In the vertical plane, the viewing sector of the fine and coarse heads ranges from 5 °down to 25 °up. The left and right precision heads are housed in armored housings, which are attached to the front of the turret to the left and right of the gun, respectively. The left and right rough heads are also located in armored housings, which are welded to the side wall of the turret, the right one behind the commander's hatch, and the left one behind the gunner's hatch.

Installation of fine and coarse heads is shown in Figure 17.1 and Figure 17.2, respectively.

An accurate head 8 (Figure 17.1) with a gasket 14 is installed in the body 13 and secured with bolts 9. The head is closed at the front by a mask 4 with a gasket 15. The mask is attached to the body with bolts 10. A protective glass 2 with a gasket 18 is installed in the window of the mask. The glass is secured to the mask with a plate 17 and screws 3. When not in use, the entrance window is closed with a protective rubber cover 1 with a cable 16. To dry the front cavity, under the cover 6 with gasket 5 there is a desiccant 7, which is screwed into a glass connected to the cavity to be dried. In the upper part of the housing, for access to the electrical connectors, there is a cover 12, which is attached to the housing with bolts 11.

A rough head 14 (Figure 17.2) with a gasket 12 is installed in the body 16 and secured with bolts 18. The head is closed at the front by a mask 7 with a gasket 11. The mask is attached to the body with bolts 17. Protective glasses 3 with gaskets 2 are installed in the windows of the mask. to the mask with plates 5 and screws 1. When not in use, the entrance windows are closed with protective rubber covers 6 with cables 4. To dry the front cavity, under the cover 9 with gasket 8 there is a desiccant 10, which is screwed into a glass connected to the cavity to be dried. In the upper part of the housing for access to the electrical connectors there is a cover 15, which is attached to the housing with bolts 13.

2.19.2.2 Control block

The control unit is designed to process information coming from the OR heads, determine the direction and type of radiation, and also control the operation of the SPS.

The control unit is an electronic device containing a microprocessor with circuits to ensure its operation. The control unit is made of an aluminum alloy housing, on the walls of which shock absorbers and electrical connectors are located. The control unit is installed in a niche at the rear of the tower.

2.19.2.3 System 902 launchers

System 902 launchers are designed to launch smoke grenades.

The launcher consists of a barrel 2 (Figure 17.3), mounted on a thread in the breech 6 and locked with a stopper 4. An electrical contact unit with a cable 19 is located in the breech. The electrical contact unit has a central movable electrical striker 11, a fixed contact 10 with an insulator, threaded into breech, spring 13, electric striker, insulating sleeve 14 and body 12. A locking ring 8 is installed in the groove of the breech, ensuring locking of the grenade in the barrel. The launcher barrel is closed with plug 1, which provides sealing and additional compression of the grenade to the breech contacts. The launcher is connected to the tank's on-board network via a contact device consisting of a pin bushing 15 soldered to the cable wire 19, a washer 17, an insulator 16 and a cover 18.

The launchers are placed on the turret as follows: a group of six launchers on a single bracket welded to the right side of the turret, a group of six launchers on a single bracket welded to the left side of the turret.

The launcher is secured to the bracket with three bolts. Each launcher has a conventional number, which is printed on its mounting bracket. The launchers in the horizontal plane are oriented like a fan with the same pitch in such a way that the protection sector they provide is combined with the viewing sector of the precision OR heads.

The correspondence of the conventional numbers of launchers printed on the brackets with the conventional numbers of launchers displayed on the PMF is given in Table 11 .

Table 11

Launcher number displayed on the PMF (left side)	1	2	3	4	5	6
Launcher number stamped on the bracket	1L	2L	3L	4L	5L	6L
Launcher number displayed on the PMF (right side)	1	2	3	4	5	6
Launcher number stamped on the bracket	1P	2P	3P	4P	5P	6P

2.19.2.4 Smoke grenade 3D17

The 3D17 smoke grenade is designed to create a smoke screen with masking properties and is the main one for the SPZ.

The 3D17 smoke grenade consists of a body 3 (Figure 17.3), an adapter 7, an electrocapsule sleeve 9, a propellant charge 20, a moderator 21, an igniter 22, smoke elements 23 and a loop 24 for removing the grenade from the launcher.

It is allowed to use a 3D6 grenade to set up a smoke screen in the SPZ functions “GROUP START” and “START BY LVP”. The ammunition, consisting of 12 smoke grenades 3D17 or 3D6, is placed and permanently stored directly in the barrels of the 902 system launchers.

To power the SPZ with an alternating current voltage of 36 V with a frequency of 400 Hz, a PT-800 converter from the control system is used.

To protect the electrical circuits of the SPZ by direct current, an AZR “SPZ” is provided, which is installed on the left distribution panel in the tower.

To protect electrical circuits by alternating current, the protection unit located on the VT deck at the gunner's place is equipped with fuse links P 9 and P10 in the SPZ panel with fuse links F1 and F2.

The electrical connection diagram of the SPZ is shown in the figure .

2.19.3 Operation of the curtain setting system

An anti-tank complex with a laser homing head (HELLFIRE, MAVERICK, COPPERHEAD type) works as follows: the operator aims the target designator reticle and the laser beam 6 combined with it (Figure 17.5) at tank 1 and holds it during the entire flight time of the missile. The laser homing head of the missile 4 catches the laser radiation 2 reflected from the tank and is guided along it to the tank. The SPZ detects the laser radiation of the target designator, determines the direction towards it and fires a smoke grenade in this direction, which, when exploding, forms a smoke screen 3. The curtain covers the tank from the operator, in addition, it reflects and weakens the laser radiation. As a result, the operator's adjustment of the laser target designator is disrupted, and the missile, not receiving laser radiation reflected from the tank, becomes uncontrollable and flies along trajectory 7. At this time, the tank, continuing to move, changes its location. All this leads to disruption of the missile guidance process.

When attacking artillery systems with laser rangefinders, the SPZ works in a similar way, while the smoke screen formed when a grenade explodes covers the tank, making an aimed shot impossible.

2.19.3.1 Enabling SDR

The SPS is turned on automatically when the OMS is turned on, and the ARMk (from the PTK) must be turned on.

The control signal to turn on the SDS comes from the control system to the control unit, which turns on, supplies power to the OR heads and carries out self-monitoring, control of the OR heads and communication lines with them, as well as control of the charge of the launchers. If there is a connection between the control unit and the automated control system, the “automatic” mode is automatically set and the control results are transferred to the automated control system. If the control results are negative, they are displayed on the PMF. After which the SDR goes into a waiting state. Switching the SPZ into “semi-automatic” or “control” modes is done from the PMF ARMk using the menu. The control and monitoring of the operation of the SPS is carried out from the PMF and the commander’s console.

2.19.3.2 SDR operating modes

The SDR can operate in the following modes:
– "AUTO";
– "SEMI-AUTOMATIC";
– "CONTROL".

The following functions are available in the “AUTOMATIC” and “SEMI-AUTOMATIC” modes:
– “TARGETING TO THE SOURCE OF LASER RADIATION” (TSU-LI);
– “SHOOTING A GRENADE ALONG THE PANORAMA LINE OF SIGHT” (Launch along the LVP);
– “START GOODLY”;
– "GROUP START".

2.19.3.2.1 Operation of SDR in “AUTOMATIC” mode

The mode is the main one for the SPZ and is characterized by the fact that determination of the direction to the laser emitter, indication of laser irradiation, selection of a launcher and firing of a smoke grenade are carried out automatically, without the participation of the tank crew. In this mode, the SPS works together with the OMS and ARMk.

Laser irradiation is recorded by OR heads, with coarse heads recording only the fact of irradiation, and fine heads recording its direction. The control unit processes the signals received from the OR heads and determines the true direction to the laser emitter since the signal can simultaneously arrive from several heads. In addition, the control unit

determines the type of laser emitter - “laser rangefinder”, if a single pulse of laser radiation is received, which indicates an attack by an artillery system with a laser rangefinder, or “target designator”, if a sequence of pulses is received, which indicates an attack by an anti-tank missile system with a laser target designator.

Information about the direction of attack (up to the head) and the type of attacking weapon, as well as recommendations to the crew, depending on the specific situation, are displayed on the PMF. At the same time, to increase the efficiency of alerting the crew, a sound signal in the form of four to five short-term sound signals is received in the AVSKU, and if the crew members are on external communication, then during the passage of these sound signals they will automatically switch to internal communication.

When registering radiation with precise heads, the control unit selects a launcher whose orientation corresponds to the direction of irradiation and monitors its charge. If the control results are positive, a signal is issued to fire the grenade. From the control unit, this signal is sent to the electrocapsule sleeve 9 (Figure 17.3) of the grenade, which is triggered and ignites the powder of the propellant charge 20. The gas pressure ejects the grenade from the launcher, while the moderator 21 is simultaneously ignited. After 1 s, the moderator burns and ignites the igniter 22, which ignites the smoke elements 23. The gas pressure ruptures the housing 3, the smoke elements are scattered and, burning, for no more than 3 s create a smoke screen.

Depending on the situation (strong side wind, etc.), the operator can additionally fire grenades in the direction of irradiation from adjacent launchers by pressing the DZ START button on the commander’s console. When you press the DZ START button, one additional grenade is fired from an adjacent charged launcher, while you can shoot no more than two additional grenades.

If the selected launcher is discharged (during automatic firing), the firing command is issued to the adjacent loaded launcher closest (in terms of rotation angle in the horizontal plane) to the gun. If this launcher is also discharged, the command to fire is issued to the launcher adjacent to the initially selected one, but farthest from the gun. If this launcher is also discharged, there will be no automatic shooting, but when the operator presses the START button, the turret will turn up until the axis of the nearest loaded launcher coincides with the direction of shooting and it will be fired (the “START WITH ROTATION” function).

In the event of a partial malfunction of the precision head, the control unit determines the most likely direction of attack and fires several grenades in this direction.

For the duration of operation of the SPZ with received laser radiation (in a given direction), while information about the direction of radiation is displayed on the PMF, (about 8 s for the rangefinder and for the duration of radiation reception plus 8 s for the target designator) the SDS does not respond to other radiation.

2.19.3.2.2 Operation of the SDR in the “SEMI-AUTOMATIC” mode

The mode is auxiliary and is characterized by the fact that the SPZ determines the direction of laser irradiation, provides light and sound indications about it, and the smoke grenade is fired when the DZ START button is pressed on the commander’s remote control. Otherwise, this mode corresponds to “automatic”. The “semi-automatic” operating mode can be used during crew training and in cases where automatic grenade firing is not required.

2.19.3.2.3 Operation of the SDR in the “CONTROL” mode

The mode provides a quick check of the operability of the SPZ systems and the charging of the 902 system launchers, while the following is performed:

– self-monitoring of the control unit;

– control of the charge of system 902 launchers;

– control of OR heads and communication lines with them;

– control of the audio path.

The control results are displayed on the PMF and AVSKU.

2.19.3.2.4 Function “TARGETING TO LASER RADIATION SOURCE”

This function ensures that the control panel rotates towards the laser radiation source, while the SPS works as follows:

– when registering laser irradiation with precision heads, the control unit calculates and outputs to the control system the value of the angle by which the control panel must be rotated so that the laser radiation source is in the control panel’s field of view. To turn the control panel, the commander, after receiving the corresponding message on the PMF, must press and hold the TsU-LI button on the commander’s remote control until the turn is completed;

– when registering laser irradiation of the “target designator” type with coarse heads, the commander, after receiving the corresponding message on the PMF, must press and hold the TsU-LI button on the PC, while the control unit will issue a command to the control system to rotate the turret until the radiation is captured by the fine head, after which the operation of the control unit similar to the above;

– the “TsU-LI” function is not provided when registering laser irradiation of the “range finder” type with rough heads.

2.19.3.2.5 Function “START BY HDL”

This function ensures that a grenade is fired along the line of sight of the panorama. In the absence of laser irradiation of the tank, the commander points the central aiming mark of the PKP (line of sight) in the required direction of placing the curtain and holds it in this position, then presses and holds the DZ START button on the commander’s remote control. In this case, the control unit provides the control system with the value of the angle through which it is necessary to rotate the turret so that the direction of one of the charged launchers coincides with the selected direction. The turret rotates through this angle, after which the control unit issues a signal to fire a grenade from the selected launcher. After shooting, the cycle ends; to shoot again, you must repeat the above steps, adjusting the position of the control panel if necessary.

2.19.3.2.6 "GROUP START" function

This function ensures sequential shooting of grenades from all loaded launchers, for which the commander simultaneously presses and holds the DZ START and TSU-LI buttons on the commander’s remote control. This function is intended for setting up a smoke screen in emergency situations, for example, when evacuating the crew from a tank damaged on the battlefield.

2.19.3.3 SDR locks

To ensure the safety of the crew, as well as to eliminate the mutual influence of the emergency protection system and other tank systems, the following interlocks are provided:

– the control unit blocks firing from all launchers of the 902 system when the driver's hatch is open, but the laser irradiation alarm is maintained;

– the control unit does not receive signals from the heads OR:

- when fired from one's own cannon;
- when measuring range with PKP or PNM rangefinders;

– the control unit blocks the launchers closest to the guns, two on each side:

- when measuring range with a PNM range finder;
- during the flight of a guided projectile;

– the control unit blocks firing from launchers whose axes are located in the sector from minus 18°45' to plus 18°45' relative to the PKP line of sight when measuring range with the PKP rangefinder.

–

2.19.4 Smoke exhaust system

The smoke exhaust system is designed for setting up smoke screens. The tank is equipped with a multiple-action thermal smoke equipment operating on the principle of evaporation of diesel fuel in the engine exhaust gases.

The smoke exhaust system consists of a fuel supply electromagnetic valve MKT-17B, nozzles and pipelines.

The solenoid valve with a bracket is mounted on the head cover of the right block and the right intake manifold of the engine.

When the BCN-TDA switch is set to the TDA position, the valve opens and fuel under pressure created by the engine fuel priming pump is supplied to the injector installed on the spacer of the exhaust gas system.

The fuel from the injector in an atomized state enters the exhaust gas stream, where under the influence of high temperature it evaporates and, mixing with gases, forms a vapor-gas mixture. Since the temperature of the vapor-gas mixture is much higher than the temperature of the outside air, when it is released into the atmosphere and comes into contact with air, fuel vapor condenses and fog forms.

2.20 Equipment for underwater tank driving

Underwater driving equipment is designed to allow a tank to overcome water obstacles.

The equipment provides:

– tank sealing;

– feeding the crew and engine with atmospheric air;

– protecting the engine from water penetration if the engine stops under water;

– pumping out water if it gets into the tank;

– maintaining a given direction of movement of the tank under water;

– conducting combat operations after leaving the water without stopping the tank and carrying out any work that requires the crew to go outside.

Underwater driving equipment consists of removable and non-removable (permanently installed) assembly units.

Removable assembly units include:

– air supply pipe;

– pipe-hole;

– exhaust valves;

– gun muzzle seal;
– sealing the embrasure of a coaxial machine gun;
– container for OPVT.

To non-removable assembly units relate:
– tank hull and turret seals;
– tower ball seals;
– sealing the gun's armor protection;
– bilge pump;
– water flow hatch on the power compartment partition;
– OPVT valve on the power compartment bulkhead;
– sealing the roof over the power compartment.

In addition, the OPVT includes life jackets and insulating gas masks (for each crew member). Removable assembly units in the non-working position are placed permanently on the tank in special places for their stowage. The air supply pipe, life jackets and insulating gas masks are located in the OPVT container. The manhole pipe is included in the group spare parts kit.

2.20.1 Removable assembly units OPVT

2.20.1.1 Air supply pipe

The air supply pipe is designed to provide atmospheric air to the crew and the tank engine when moving underwater. The pipe is installed in a special hatch on the gunner's hatch cover.

The air supply pipe consists of the top 14 (Figure 18.1), middle 11 and bottom 10 pipes, connected to each other by bolts 4 with nuts 3. Rubber gaskets 5 and 13 are installed between the flanges of the pipes. A support flange 6 with a glued rubber gasket 7 is welded to the bottom pipe 10 and two brackets 16 for transporting the pipe. A nut 9 with two folding handles 8 is screwed onto the support flange. With the support flange 6 the pipe rests on the gunner's hatch cover. The pipe is secured from the inside of the hatch with a nut 9. The upper flange 12 of the middle pipe 11 is made floating to ensure that the middle pipe is inserted into the lower pipe 10.

A removable step is installed on the middle pipe 11 along the black annular strip. IN The top tube 14 on bracket 2 is installed at night with a signal light 1. The light is connected to a plug socket located on the bottom sheet of the turret to the left of the gunner’s seat. A push-button switch is built into the electrical wire of the lantern, with the help of which signal communication with the shore is carried out.

For ease of transportation and storage, the upper 14 and middle 11 pipes are inserted into the lower pipe 10, and the flanges of the folded pipes are connected with bolts and nuts. In this case, a protective casing 19 is installed on the supporting flange of the lower pipe 10, and a shield 15 is installed at the other end of the pipe under the bolts.

The stop 17 with axis 18 is used to install the pipe in a horizontal position.

2.20.1.2 Pipe-hole

The manhole pipe is installed on the commander's hatch, serves for initial training of crews in overcoming water obstacles and allows the crew to exit the tank when it stops under water without flooding the tank.

The manhole pipe consists of an upper 2 (Figure 18.2) and a lower 7 pipes connected to each other by ties 3. The joints are sealed with rubber cords 11 and 12. Inside and outside the manhole pipe there are brackets installed for the crew to exit, at the top there is a retractable handrail 1 and a folding step.

2.20.1.3 Exhaust valves

Exhaust valves are designed to protect the engine from water ingress if it stops while the tank is moving under water .

The exhaust valves are a panel 19 (Figure 18.3) with two valves consisting of a plate 17 with a paronite gasket and a seat 18. The plates are pressed to their seats by springs 15. The plates are mounted on a shaft 9, at one end of which there is a lever 11 with a roller for opening valves A bracket is welded to the panel, in which a spring-loaded stopper 10 is installed to fix the valves in the open position. To protect the paronite valve gaskets from destruction by exhaust gases during long-term movement of the tank with installed exhaust valves, a safety shield 22 is installed on the valve discs fixed in the open position. The shield is secured to the discs with a spring-loaded strip 21.

The exhaust valves are installed on the flange 6 of the exhaust pipe, secured with two couplers 7 with nuts 8 and an L-shaped bolt 13 with a nut 16. The head of the L-shaped bolt is inserted into the groove of the strip 14 welded on the flange of the exhaust pipe. A copper-paronite gasket 20 is installed between the flange 6 of the outlet pipe and the valve panel 19.

When the engine is running under the influence of exhaust gas pressure, the valves remain open. If the engine stops, the valves close under the action of springs and water pressure, preventing water from entering the engine.

When leaving the water and the drive to the OPVT covers is activated, rod 2 turns lever 1 of the drive to the valves. Lever 1, acting on lever 3, moves rod 5, which, using pusher 12, turns lever 11 with the roller. In the extreme position of lever 11, a spring-loaded stopper 10 holds the valves in the open position. Spring 4 serves to return rod 5 to the non-working position.

2.20.1.4 Gun muzzle seal

The muzzle of the gun is sealed with a rubber boot, which is installed on the muzzle of the gun barrel.

2.20.1.5 Coaxial machine gun embrasure seal

The embrasure of the coaxial machine gun is sealed with a cover made of rubberized fabric, which is secured with screws to the shell welded to the turret.

2.20.1.6 Roof seal over the power compartment

The roof seal above the power compartment consists of sealing covers 1 (Figure 18.4), 6, 8, protective cover 2 and a drive to the sealing covers.

The entrance and exit blinds above the power compartment and the blinds above the air cleaner are sealed with two sealing covers 6, two covers 8 and a cover 1.

Covers 6, mounted on hinges 3, in the closed position seal the entrance louvers of the roof above the transmission. The covers are opened by torsion bars 5 installed on the covers and torsion bars 4 installed on the roof above the transmission. Torsion bars 4 have a working and non-working position. In the working position, the torsion bar hook enters the vertical socket 28 of the bracket welded on the roof, while the working shank is installed vertically, resting on the roof hinge. When closing the lid, its square 15 turns the shank, tightening the torsion bar. In the non-working position, the torsion bar hook must be installed in the horizontal socket 23 of the bracket, and the shank must be placed under bracket 24 on the roof.

Removable covers 1 and 8 are installed in one of two positions: working (closed) and non-working (open). In the closed position, the covers 8 seal the exit blinds. In the open position, they rest on supporting brackets 7. During normal operation, brackets 7 are installed in the non-working position (horizontally) on the brackets of the fuel barrels.

In the closed position of the covers 6 and 8, the seal is carried out by pressing the rubber gaskets 25 to the edges of the frames 26, using locks. The lock is a spring-loaded stopper 30 in a housing 29 welded to the flanges of the lids. When closing the covers, the stopper 30 enters the hole of the hook 31 installed on the roof and ensures reliable fixation of the covers. On the stoppers 30, flags 27 are installed to open the locks when they are exposed to the stops 9 of the drive rod 10 to the covers. The left cover 6 is additionally pressed against the frame with a lever 14.

Cover seal 1 is designed in a similar way.

The drive to covers 6 and 8 is carried out from the tower. It consists of a copier 22 and a staple 20 mounted on the tower; front lever 21; longitudinal composite rod with return spring 19; rear lever 11 and transverse link 10 with stops 9.

The longitudinal rod consists of hinged rods 12 and 18. Rod 12 is removable.

Cover 1 does not have a drive and is opened manually.

To cock the drive to the covers, it is necessary to turn the turret using a manual drive and place the head of the lever 21 under the bracket 20 on the turret.

To open the covers using the drive, you need to turn the tower to the left by about 6° (set 27-33 according to the azimuth indicator). In this case, the lever 21, sliding its head along the copier 22, rotates clockwise and through the longitudinal rod and lever 11 transmits the movement to the transverse rod 10. The transverse rod, acting with stops 9 on the stopper flags 27, opens the lid locks, and the longitudinal rod 12 with the stop 13 rotates the lever 14, releasing the left cover 6. Under the action of the torsion bars, the covers 6 are opened slightly and held in the open position by stoppers 32 secured to the body and covers 6 by means of cotter pins 33. By air pressure from the fan of the cooling system, the covers 8 are opened and thrown onto the supporting brackets 7 or stern lattice screens.

In the non-working position, covers 6 are folded onto the roof above the engine. To ensure the safety of cover 6 in the folded position with covers 8 laid on them and removable rod 12, they are closed on top with a protective cover 2. Cover 1 and stopper 32 with secured cotter pins 33 are placed in the outer third box of spare parts on the left fender.

2.20.1.7 Container for OPVT

The container for OPVT is designed for storing removable elements of OPVT; it is installed on the left shelf in anticipation of overcoming water obstacles up to 5 m deep.

The container consists of an aluminum body 1 (Figure 18.8) and a lid 2.

To install the container you need:

– fasten brackets 9 to the left shelf using bolts 12, spring washers 13 and washers 14;
– install brackets 3 on brackets 9 and fix them with rods 11 with springs 10;
– Install tapes 6 on brackets 3 and fix them with axes 7 with pin 8;
– Place the container for OPVT on brackets 3 and secure it with tapes 6, hinges 5 and nuts 4.

2.20.2 Fixed assembly units OPVT

2.20.2.1 Gun armor protection seal

The armor protection of the gun is sealed with a cover 3 (Figure 18.5) made of rubberized fabric. A metal cable 5 is sewn along the perimeter of the cover, at the ends of which ties 6 are attached. The seal is carried out by tightening the cable in the grooves of the shells 2 and 4, welded to the tower. A rubber gasket 8 is installed between the flange of the cover and the end of the armor protection. To prevent damage to the cover when moving the gun barrel and tur-

ret, the cover is tightened with a spring 1. To drain water from the cavity of the armor protection, a plug 7 is installed in the lower shell.

2.20.2.2 Sump pump

The water pump is designed to pump water out of the tank body when overcoming a water barrier. Installed in the area of the power compartment partition on the left side. It consists of a pump with an electric motor, a strainer and a pipe with a check valve connected to the water discharge hole in the turret plate. The hole is closed from the outside with a stopper. Pump capacity 100 l/min at back pressure 4 kPa (4 m w.c.) . with t.). The internal cavity of the electric motor is connected to the atmosphere through a fitting on which a rubber tube is placed. The two-wire motor power circuit ensures that the pump is turned on regardless of the position of the battery switch.

2.20.2.3 Water flow hatch

The water flow hatch serves to transfer water from the power compartment to the combat compartment . The hatch is located in the lower left part of the power compartment partition and is closed with a spring-loaded lid 5 (Figure 18.6). The hatch is opened by a cable 2, attached to a double-armed lever 1, installed on the turret plate and connected to the longitudinal rod 3 of the OPVT covers.

When the drive is cocked to the sealing covers, the longitudinal rod, moving through the double-armed lever 1 and cable 2, opens the hatch cover 5.

When the sealing covers are opened, the drive to the overflow hatch returns to its original position, and the cover of the water overflow hatch closes under the action of springs 4 and 6.

2.20.2.4 OPVT valve

The OPVT valve provides air supply to the engine during underwater driving of the tank. The valve is made in the upper left part of the power compartment partition and consists of a valve 3 (Figure 18.7) mounted on a rod 6, which moves in a guide sleeve 4. The valve is pressed against the shell of the power compartment partition by a spring 5. Cable 2 is fixed to the rod using nuts 7 and nuts 8. The cable passes through guide rollers 1, its other end is fixed to a double-arm lever. To protect the rod from contamination, it is covered with a casing 9.

When the drive is cocked to the sealing covers, the longitudinal rod, moving, rotates the double-armed lever and, tensioning the cable, opens the valve. When the sealing covers are opened, the double-arm lever returns to its original position, the cable is released, and the valve closes under the action of a spring.

2.21 Equipment for self-digging

Self-digging equipment is designed for excerpts from individual trenches. It is located externally on the lower nose plate of the body and consists of the following parts: a blade, four spacers with guides, a latch and two clamps.

The blade is designed to cut the soil and move it, spacers - to hold the blade in working position when cutting soil, guide bars - to hold the spacers and ensure their movement when turning the blade, clamps - to hold the blade in the stowed position, a latch - to facilitate moving the blade from traveling to working position and back.

Equipment for self-digging can be installed in two positions: traveling and working. In the stowed position, the blade is attached with two clamps to the bottom sheet of the tank's nose. In the working position, the blade is lowered and when the tank moves forward, it cuts the soil, relying on spacers. When the tank moves backwards, the blade slides with its back side along the ground surface.

2.22 Equipment for making passages in minefields

To overcome mine-explosive obstacles, a KMT-8 track mine trawl with or without an EMT electromagnetic attachment can be installed on the tank, and an EMT electromagnetic attachment can also be installed separately.

The description and rules for operating trawls are set out in the technical description and operating instructions for the KMT-8 trawl (232 TO), the electromagnetic attachment EMT (283 TO).

List of accepted abbreviations

A3	-	automatic loader;
AB	-	accumulator battery;
AVSKU	-	switching internal communication equipment;
AZR	-	circuit breaker (breaking) circuit;
ADF	-	data transmission equipment;
AMS	-	automatic gear shifting;
ARMk	-	unified automated commander workstation;
AC	-	adaptive communication;
ASVP	-	interface and correction equipment;
ASN	-	satellite navigation equipment;
ASUV TK	-	automated control system for combined arms and supporting military formations at the tactical level;
ASC	-	automatic target tracking;
ACB	-	asphalt shoes;
BV	-	computer block;
BVD	-	sighting and rangefinder unit;
BZ	-	mirror block;
BZA	-	battery protection unit;
BKVS	-	video signal switching unit;
BKS	-	starter switching unit;
BKU	-	control button block;
BO	-	cooling unit
BOE	-	optical-electronic unit;
BP	-	power unit;
BPR	-	backup power supply;
BPS	-	armor-piercing sub-caliber projectile;
BR	-	final drive;
BS	-	on-board network;

emergency hospital	-	multi-channel sight stabilization unit;
BSU	-	coordination and control unit;
BOO	-	Control block;
BU PKP	-	commander's panoramic sight control unit;
BU PNM	-	multi-channel sight control unit;
BU STV	-	tank weapon stabilizer control unit;
BUVI	-	time interval installer control unit;
BUD	-	the engine control unit;
BCN	-	electric fuel priming pump;
BTsOI	-	digital image processing unit;
BSPA	-	antenna R -168BShPA;
VVU	-	rotating air device;
VDZ	-	built-in dynamic protection;
VZU	-	air intake device;
VKU	-	input switching device;
VKU-1	-	rotating contact device;
VLD	-	upper frontal part;
VN	-	vertical guidance;
VNA	-	inlet guide vane;
VR	-	input gearbox;
Armed Forces of Ukraine	-	video viewing device;
VT	-	rotating conveyor;
HF	-	high frequency;
GN	-	horizontal guidance;
GPO	-	hydropneumatic cleaning;
fuels and lubricants	-	fuels and lubricants;
DGU	-	diesel generator set;
DZ	-	dynamic protection;
DI	-	barrel bend sensor;
DCMV	-	driver display system;
VCT	-	roll and pitch sensor;
DLU	-	linear acceleration sensor;
DM	-	meteorological sensor;
DMV	-	decimeter waves;
DP	-	reception on duty;
DPB	-	tower position sensor;
DPP	-	gun position sensor;
DPU	-	remote machine gun installation;
DSMU	-	mechanical universal speed sensor;
DTV	-	air temperature sensor;
DUS	-	absolute angular velocity sensor;
Spare parts	-	spare parts, tools and accessories;
HRA	-	pre-prepared frequency;
ZRV	-	shot clearance zone;
ZH	-	reverse;
IR	-	infrared;
OR	-	laser radiation indicator;
KVI	-	video switch;
KDA	-	additional subscriber block;
KP	-	Transmission;
KSS	-	complex of communication means ;
KAZ	-	active protection complex;

KHPP - thermoelectric air conditioner;
HDL - panorama line of sight;
LD - laser rangefinder;
LKU - laser control channel;
M OM - power limiting mechanism;
MAF - oil filter;
MV - meter waves;
MZN - oil pump;
MAUD - engine stopping mechanism;
MPB - turret rotation mechanism;
IPC - cassette lifting mechanism;
MRA - radio station R -168MRA;
MTO - engine and transmission compartment;
MUP - pallet removal mechanism;
MC - centrifugal oil purifier;
NRZ - unbreakable protection;
OB - poisonous substances;
coolant - coolant;
RAM - random access memory;
WMD - weapons of mass destruction;
OPVT - equipment for underwater tank driving;
HMO - field of view;
PA - semi-automatic;
PVV - heating of intake air;
PVKU - driving rotating contact device;
PDT - television double sight;
PDF - smoke filter;
PZ - loading panel;
PZM - oil injection device;
PC - commander's console;
PKP - commander's panoramic sight;
PMF - multifunctional panel;
Mon - pointing console;
Mon PDT - television backup sight panel;
Mon PKP - commander's panoramic sight control panel;
Mon Mon - multi-channel gunner's sight control panel;
Mon
PNM - multi-channel gunner's sight;
BY - software;
PP - transceiver;
PPO - fire-fighting equipment;
PPRF - software adjustment of operating frequency;
PTK - software and hardware complex;
ATGM - anti-tank missile system;
PU - Remote Control;
PCP - anti-chemical protection;
PS - noise suppressor;
RD - radio data;
RJ - mode;
RMPB - manual turret rotation mechanism;
RMS - rubber-metal hinge;
RNM - manual fuel priming pump
RPG - hand-held anti-tank grenade launcher;
RPZU - reprogrammable read-only memory;
RSG - starter-generator relay;

RFS	-	barrel cleaning solution;
SA	-	own address;
SVK	-	built-in control system;
Micro-wave	-	ultra high frequencies;
SG	-	starter - generator;
CIPF	-	cryptographic protection means;
SMU	-	blackout device;
START	-	external video surveillance system;
CO	-	universal orientation system;
JV	-	scanning reception;
SDR	-	curtain installation system;
SSGKKU	-	self-orienting gyroscopic course guidance system;
SSU	-	stabilization and control system;
STV	-	tank weapon stabilizer;
SU DPU	-	remote machine gun control system;
OMS	-	fire control system;
TV	-	television;
TDA	-	thermal smoke equipment;
TK	-	thermal imaging camera;
TM		technical camouflage;
injection pump		high pressure fuel pump;
THAT		Maintenance;
TP		thermal imaging;
TCPT		television cold shooting tube;
TEM		thermoelectric module;
UARMk		unified commander's workplace;
UVI		time interval setter;
MIND		amplifier;
UM DPU		remote machine gun power amplifier;
UP		power supply installation;
UPZ		narrow field of view;
FVU		filter and ventilation unit;
FCDS		fixed frequency - dual-frequency simplex;
FES		fixed frequency - simplex;
FChS-TM		fixed frequency - simplex with technical masking;
CPM		central aiming mark;
CC		target designation;
PPP		number of jump frequencies;
ShPZ		wide field of view;
ShchR		distribution board;
ShchRL		left distribution board;
ShchRP		right distribution board;
computer		electronic computer;
ED		electric motor;
ECM		electronic map of the area;
EM		electromagnet;
EMPB		electromechanical turret rotation mechanism;
EMC		locking electromagnet.

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1.2	1.2	1	Танк Т-90М. Вид сзади
1.3	1.3	1	Рабочее место механика – водителя
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2			СИЛОВАЯ УСТАНОВКА
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2.38 .38	2	Схема работы системы питания двигателя воздухом	**Formatted:** Indent: Left: 0 cm, First line: 0 cm, Space After: 8 pt, Line spacing: Multiple 1,08 li

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3.4	3.4	3	Привод компрессора
3.5	3.5	3	Привод вентилятора
3.6	3.6	3	11 Гидромуфта привода вентилятора
3.7	3.7	3	Золотниковая коробка управления гидромуфтой привода вентилятора
3.8	3.8	3	Опора вентилятора
3.9	3.9	3	Привод стартера-генератора
3.10	3.10	3	Коробка передач
3.11	3.11	3	Редуктор бортовой
3.12	3.12	3	Гидросистема трансмиссионной установки. Схема гидравлическая принципиальная
3.13	3.13	3	Механизм распределения
3.14	3.14	3	Устройство клапанное
3.15	3.15	3	Кран - распределитель
3.16	3.16	3	Элемент фильтрующий

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9.34	.35	8	Мишень выверочная на 100 м
9.35	.36	8	Прибор выверки УПВ
9.36	.37	8	Гидропривод СТВ (питающая установка и цилиндр исполнительный)
10			СИСТЕМА УПРАВЛЕНИЯ ДИСТАНЦИОННОЙ ПУЛЕМЕТНОЙ УСТАНОВКОЙ
10.1	.1	9	Установка спаренного 7,62 мм пулемета
10.2	.2	9	Дистанционная пулеметная установка
10.3	.3	9	Станок ДПУ
10.4	.4	9	Стыковочное устройство
10.5	.5	9	Пульт управления СУО и АЗ
10.6	.6	9	Пульт загрузки
10.7	.7	9	Циклограмма работы АЗ
10.8	.8	9	Расположение узлов АЗ
10.9	.9	9	Кассета
10.10	.10	9	Механизм подъема кассет
10.11	.11	9	Захват
10.12	.12	9	Схема размещения боекомплекта
10.13	.13	9	Установка пушки
11			**ЭЛЕКТРООБОРУДОВАНИЕ**
11.1	0.1	1	Электрооборудование корпуса. Схема электрическая соединений
11.2	0.2	1	Электрооборудование башни. Схема электрическая соединений
11.3	0.3	1	Система охлаждения стартера-генератора
11.4	0.4	1	Дорожная сигнализация. Схема электрическая принципиальная
11.5	0.5	1	Блок коммутации стартера

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13.9	2.9	1	Установка прибора наблюдения ТНПО-168В
13.10	2.10	1	Прибор ночного видения ТВН-5 с диафрагмой
13.11	2.11	1	Установка прибора ночного видения ТВН-5 в положение «по-боевому»
13.12	2.12	1	Установка прибора ночного видения ТВН-5 в положение «по-походному»
13.13	2.13	1	Колпак защитный
13.14	2.14	1	Система гидропневмоочистки в корпусе
13.15	2.15	1	Система ГПО в башне
13.16	2.16	1	Установка прибора наблюдения ТНП-165А
14			**СРЕДСТВА ОБЕСПЕЧЕНИЯ ОБИТАЕМОСТИ**
14.1	3.1	1	Устройство кондиционера и схема расположения элементов
14.2	3.2	1	Блок охлаждения
14.3	3.3	1	Контейнер
14.4	3.4	1	Блок управления КТЭ
14.5	3.5	1	Отопитель
15			**ВОЗДУШНАЯ СИСТЕМА**
15.1	4.1	1	Воздушная система. Схема
15.2	4.2	1	Схема работы компрессора
15.3	4.3	1	Влагомаслоотделитель
15.4	4.4	1	Клапан автоматического слива отстоя
15.5	4.5	1	Автомат давления АДУ2С
15.6	4.6	1	Электропневмоклапан
15.7	4.7	1	Редуктор РТ - 160 - 25, РТ - 160 - 70
15.8	4.8	1	Электровоздушный клапан ЭК - 48

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16			**ОБОРУДОВАНИЕ ПРОТИВОПОЖАРНОЕ**
16.1	5.1	1	Оборудование противопожарное
16.2	5.2	1	Баллон быстродействующий
16.3	5.3	1	Генератор огнетушащего аэрозоля ГОА-19
16.4	5.4	1	Узел запуска
16.5	5.5	1	Пульт управления и сигнализации П13
16.6	5.6	1	Прибор КПК13. Схема электрическая подключения
16.7	5.7	1	Замена баллонов ППО
16.8	5.8	1	Замена генератора огнетушащего аэрозоля ГОА-19 в отделении управления и отделении вооружения
16.9	5.9	1	Замена генераторов огнетушащего аэрозоля ГОА-19 в МТО
17			**СИСТЕМА ЗАЩИТЫ ОТ ОМП**
17.1	6.1	1	Пульт измерительный (блок Б-1)
17.2	6.2	1	Установка фильтровентиляционная
17.3	6.3	1	Приводы к клапанам нагнетателя
17.4	6.4	1	Датчик (блок Б-2)
17.5	6.5	1	Устройство воздухозаборное
17.6	6.6	1	Механизм исполнительный
17.7	6.7	1	Механизм лентопротяжный ПДФ
18			**СИСТЕМА СПЗ**
18.1	7.1	1	Установка точной головки
18.2	7.2	1	Установка грубой головки
18.3	7.3	1	Установка пусковая с дымовой гранатой 3Д17
18.4	7.4	1	Система СПЗ. Схема электрическая соединений
18.5		1	Принцип действия СПЗ

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	7.5		
18.6		1	Схема проверки СПЗ от дальномера
	7.6		
19			**ОПВТ**
19.1		1	Труба воздухопитающая
	8.1		
19.2		1	Установка трубы-лаза на люк командира
	8.2		
19.3		1	Клапаны выхлопные с приводом
	8.3		
19.4		1	Уплотнение крыши над силовым отделением
	8.4		
19.5		1	Уплотнение броневой защиты пушки
	8.5		
19.6		1	Лючок перетока воды с приводом
	8.6		
19.7		1	Клапан ОПВТ с приводом
	8.7		
19.8		1	Контейнер для ОПВТ
	8.8		
20			**СХЕМА ПЕРЕХОДОВ ЧЛЕНОВ ЭКИПАЖА**
20.1		1	Схема переходов членов экипажа
	9.1		
21			**ТРАЛ**
21.1		2	Схема подключения при пуске от внешнего источника тока
	0.1		
21.2		2	Трал КМТ-8. Монтаж пневмосистемы
	0.2		
21.3		2	Трал монтаж пневмосистемы и электрооборудования
	0.3		
21.4		2	Монтаж кронштейнов тралов
	0.4		
21.5		2	Укладка передних щитков с КМТ
	0.5		
22			**КАРТА СМАЗКИ**
22.1		2	Карта смазки
	1.1		
23			**ПРИБОР ДУ**
23.1		2	Прибор ДУ
	2.1		

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