OJSC “BELAZ” – Management Company of Holding
“BELAZ-HOLDING”

MINING DUMP TRUCK
BELAZ-75180

OPERATION MANUAL
75180-3902015 OM

Republic of Belarus

The present Operation Manual contains the detailed description of the design and principle of operation of assemblies, units and systems of BelAZ-75180 mining dump truck and its modifications. The Manual presents the recommendations for adjusting the certain mechanisms and systems, provides the basic operation and maintenance rules.

The Manual is intended for the drivers, technicians and all the persons involved in the operation of BelAZ mining dump trucks.

The manufacturing plant works continually for improving the design of the dump trucks and reserves the right of making modifications to improve the quality and to prolong their lifetime.

The most comprehensive information on all the modifications can be found at the website www.belaz.by

Please, send any comments regarding the design and operation of the dump truck to the address: 222160, Republic of Belarus, OJSC “BELAZ” – Management Company of Holding “BELAZ-HOLDING”, 40 Let Oktyabrya Str., 4 Zhodino, Minsk Region 222160.

OJSC “BELAZ” – Management Company of Holding “BELAZ-HOLDING”

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1 GENERAL INFORMATION

BELAZ-75180 mining dump truck (hereinafter referred to as the truck) with payload capacity of 180 ton is intended for carrying the overburdens and minerals of various densities at quarries as well as soil and other bulked materials at the construction sites.

The truck is designed for operation on specially equipped roads with hard pavement having ultimate longitudinal slopes of 6 – 8%. In case of driving the dump truck on roads with continuous longitudinal slopes exceeding 6%, the sections with the reduced longitudinal slopes (2% and less) or horizontal sections with the length of at least 50 m after every 600 m of the road with continuous slope shall be provided for. The roads shall be designed for passing the vehicles with the axle weight at least 275000 kg.

The roads as well as the grounds for loading and unloading the truck shall comply with the requirements of the Code of Practice (СНиП) 2.05.07, “Unified Safety Regulations for Open-Cast Mining of Minerals” and “Unified Safety Regulations for Open-Cast Mining of Coal”.

The pavement surface of the quarry roads shall be flat. The surface evenness of the roads (clearance under a rod with the length of (3 ± 0.05 m) shall comply with the requirements of the Code of Practice (СНиП 3.06.03) with the assessment criteria of “good” (the clearance shall not exceed 2.5 cm).

Should the road section with the length equal to the truck base contain up to five irregularities with the depth of 3 to 5 cm or one irregularity with the depth of up to 10 cm, the dimensions of which in plane exceed the tyre bearing pattern, the speed of the truck on such sections shall not exceed 25 km/h. At the increase of the irregularities number, the speed shall be maintained within the range from 15 to 20 km/h.

Operation of dump truck on road sections with the irregularities having the depth of 10 cm or more and also on passage sections in open-pit benches and at spoil heaps with the depth irregularities more than 20 cm and at dimensions, specified above, shall be prohibited.

Dump trucks are manufactured in the following climatic versions U1, UXL1, XL1, T1 according to the State Standard (GOST) 15150. The climatic version is to be specified in the delivery contract.

The dump truck is designed for operation in regions situated at the altitude of up to 2000 m above the sea level with the respective modification of the traction and dynamic characteristics.

To increase the efficiency of the dump truck, it is recommended to use it in combination with excavators, having capacity of the bucket from 30 to 45 m^3. The height of load drop to the body floor shall not exceed 3 m, and the weight of pieces of overburdens and minerals shall not exceed 4.5 t.

Overall dimensions of the dump truck are given in the figure 1.1 and in the table 1.1.

Modification BELAZ-75180-02 is equipped with diagonal ladder from the left side to provide access to the dump truck deck from the ground. Appearance of the truck with diagonal ladder is shown in the figure 1.2.

In addition to this Manual is also recommended to follow directions stated in the Engine Operation Manual, in the Traction Electric Drive documentation and also in the Operation Manuals for additional units and systems, installed on the dump truck. The abovementioned documentation is forwarded with the dump truck at the dispatch.

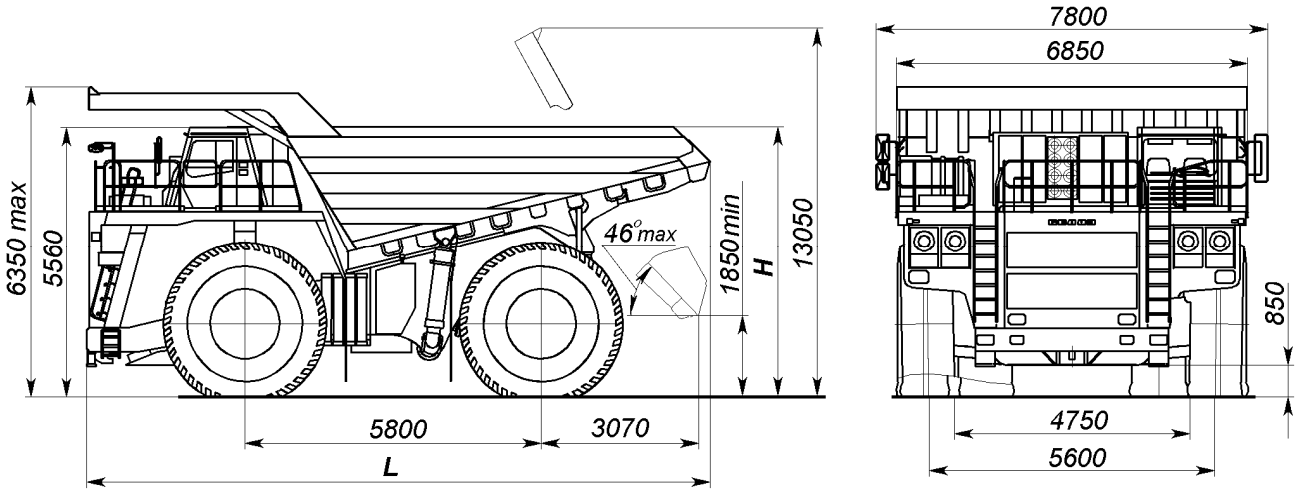


Figure 1.1 – Overall dimensions of the dump truck

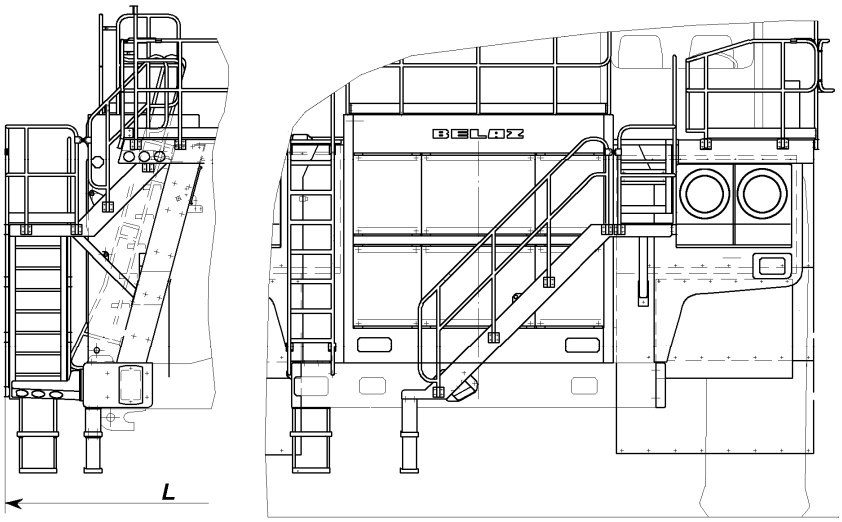


Figure 1.2 – Appearance (front view) of the truck BELAZ–75180-02 with diagonal ladder

Table 1.1 – Distinctive overall dimensions

	L, мм	H, мм
BELAZ-75180	12600	5580
BELAZ -75180-02	13400	5720

Strict observance of the Operation Manuals, and also recommendations on correct applications of lubricants, frequency of maintenance and proper operating will ensure reliable and trouble-free operation of the dump truck.

Location of the main marking, identification nameplate, and nameplates of «FOPS», «ROPS» systems.

On the right side of the bumper the identification number of the dump truck is marked by a punch method.

The identification number of the product consists of 17 symbols located horizontally in the line without blanks between symbols that are limited by proof-correction marks and contain only the information required for correct and well-defined identification of the product.

The Universal cod of the Manufacturer is marked by the first three symbols (1, 2, 3) – mean the geographic zone, country code and product code, the next five symbols (4, 5, 6, 7 and 8) – the dump truck identification product index. The 9-th symbol is the reference letter; the 10-th symbol is the year of production in accordance with table 1.1, dump truck serial number is marked by symbols from 11 to 17.

The identification nameplate and nameplates of “FOPS” and “ROPS” systems are located on the outer left side of the cab.

Table 1.1 – Designation of production year

Year	Designation	Year	Designation
2015	F	2017	H
2016	G	2018	J

2 SAFETY REQUIREMENTS AND WARNINGS

2.1 Safety requirements

Prior to assembling, operation, maintenance and repair of the dump truck, the drivers and service personnel shall be given the obligatory instruction in safety engineering and safe methods and ways of performing the works as well as observance of the general safety requirements for the motor vehicles. It is also necessary to follow the Unified Safety Regulations for Open-Cast Mining of Minerals, Operating Rules for Consumers' Electrical Installations, Safety Rules for Operating the Consumers' Electrical Installations, Rules for Design and Safe Operation of Pressure Vessels.

The drivers and servicing personnel shall be provided with protective clothes, safe footwear, protective helmets, goggles and other personal protection equipment.

The enterprises operating the dump trucks shall ensure the safe labour conditions and develop the instructions for performing the maintenance and repair works which would provide for the written permit to work with increased safety requirements as well as the works related to the maintenance of the fire extinguishing system.

Besides, it is necessary to observe the below stated requirements conditioned by the dump truck design:

2.1.1 Prior to servicing and/or repair of the dump truck, apply the parking brake and put the chocks under the wheels. The maintenance and repair works shall be only performed with the engine stopped except for the works for adjusting the electric drive as provided in the respective documentation.

2.1.2 In case of stop of the truck on a slope, take measures to exclude its spontaneous movement: apply the parking brake, stop the engine and put the wheel chocks under the wheels.

2.1.3 Prior to leaving the cab, make sure that the parking brake is applied and the switch of the reverser is set to the neutral position – "N" (neutral), the traction electric drive is OFF using the switch on the console.

2.1.4 When servicing and/or repairing the dump truck, the raised body shall be locked by means of a special locking rope, both ends of which shall be drawn into the eyelets on the axle housing and fastened by means of towing pins. When doing this, there shall be no load in the body. Stuck load in the quantity not exceeding 3% of the payload capacity is allowed. No works under the body lifted and locked by means of the rope when it is loaded or under the tail wind with the velocity exceeding 6.5 m/s are allowed.

THE LOCKING ROPE IS ONLY DESIGNED FOR LOCKING THE EMPTY BODY.
NEVER LOWER THE BODY FORCEDLY IF IT IS LOCKED.

When the body is being lifted nobody shall stand close to the dump truck, because the soil remaining on the body could cause an injury. Do not leave the cab when the body is being lowered or lifted.

2.1.5 The dump truck is equipped with ladders, footsteps, handrails and special areas to ensure the safety of the works for assembling, adjustment and maintenance.

When performing the works without enclosures and/or handrails, the safety belt as well as portable ladders and stands should be used. When doing this, the safety requirements shall be observed.

2.1.6 When moving on the ladders and top areas (fenders), it is necessary to hold the handrails fitted on the ladders, fenders, bonnets and cab so that there would be three supporting points at any time (either two hands and one foot or two feet and one hand). The ladders and special areas shall be cleaned from dirt, snow and ice.

Never use the controls as handrails when entering or leaving the cab.

It is recommended to walk up and down the truck ladders while facing the truck.

2.1.7 Never stand or walk on the ladders, footboards, top areas (fenders or bonnets) and areas intended for servicing the truck.

2.1.8 Never jump down from the truck.

2.1.9 Never walk up or down the truck on the ladders or footsteps while holding tools or other things in the hands. To lift or lower the tools and other things, use the lifting equipment ensuring the safety of the said operations. When performing any works while standing on the ladders and/or special areas, nobody shall stand under them.

2.1.10 When traction electric drive is ON so there is dangerous voltage available in the drive equipment (control cabinet, ventilated brake resistors unit, power cables). Access or touch components in mentioned areas can lead to current shock or to death).

Prior to performing operations over the electric drive equipment deactivate traction electric drive, eject ignition key. Place warning poster “Don’t switch ON – people are working”.

After the electric drive is deactivated dangerous voltage can be available on the units power components. Before access or touch components make sure there is no dangerous voltage.

The electric safety rules to be observed when setting and adjusting the traction electric drive are stated in the instruction for adjustment of the traction electric drive.

THE TRACTION ELECTRIC DRIVE OPERATES UNDER DANGEROUS VOLTAGE. FAILURE TO OBSERVE THE SAFETY REQUIREMENTS COULD CAUSE AN ELECTRIC SHOCK OR DEATH.

During operation the vented brake system has very high temperature. When performing any maintenance operations provide sufficient time for cooling.

2.1.11 Prior to removing the suspension cylinders and hydropneumatic accumulators from the dump truck, vent the gas from their chambers. To vent the gas from the suspension cylinder completely, it is necessary to open the charging valve at least three times with the interval of 3 to 5 minutes.

2.1.12 Prior to disassembling the suspension cylinder and hydropneumatic accumulator, make sure that there is no excess pressure in its chambers; to do this, open the charging valves. When checking the working fluid level in the oil retainer of the suspension cylinder, the check hole plug should be screwed out slowly to release the excessive gas pressure in the chamber. When performing this operation, do not stand in front of the plug.

2.1.13 Prior to charging the suspension cylinders and hydropneumatic accumulators with gas, make sure that the charging device is faultless and the cylinder with compressed gas is marked properly. The cylinder shall be marked with the word “NITROGEN” and brown circular stripe.

IT IS STRICTLY PROHIBITED TO CHARGE THE SUSPENSION CYLINDER AND HYDROPNEUMATIC ACCUMULATORS WITH OXYGEN, BECAUSE IT WOULD LEAD IMMINENTLY TO EXPLOSION.

2.1.14 Prior to detaching the wheel from the truck, deflate completely the tyre. If it is necessary to separate the twinned rear wheels, deflate the tyres of both the wheels.

NEVER DETACH OR FIT THE WHEELS WITH EXCESSIVE PRESSURE IN TYRES.

Prior to fitting the wheel, inflate the tyre to the pressure of 0.1 MPa and make sure that the lock ring is fitted properly. It is only allowed to inflate the tyre to the rated pressure after fastening the wheel on the hub. Nobody shall be present near the tyre being inflated.

2.1.15 Never dismantle and/or disassemble the components of the brake systems and steering control being under the working fluid pressure.

To depressurize the front and rear circuits of the service brake system, turn out the obturating needles on the brake valve.

The working fluid pressure in the hydraulic system of the steering control and parking brake is released by pressing the button of steering collector or automatically within 80 seconds after scheduled stopping of the engine. The hydraulic pneumatic accumulators shall be only installed and dismantled with the gas chamber depressurized.

2.1.16 Never eliminate the faults, disassemble the fittings and/or perform the welding works in the pressurized pneumatic starting system and pneumatic system of the dump truck. The pressure shall be released through the condensate drain cocks; when doing this the shutoff valves of the air cylinders shall be open.

2.1.17 Never operate and/or adjust the pneumatic starting system with faulty pressure gauges.

2.1.18 The operation (including the technical examination and repair) of the pneumatic cylinders, pressure gauges, safety valves and fittings shall comply with the requirements and regulations stated in the Rules for Design and Safe Operation of Pressure Vessels.

2.1.19 Clean the batteries and vent holes in them from dirt; check the density and level of the electrolyte in the batteries and bring them to the norm in proper time at the specified intervals. Never to use faulty storage batteries (with the short-circuited plates). When servicing and repairing the storage batteries, keep in mind that contact of the electrolyte with the skin can cause severe burns.

2.1.20 When screwing out the cap of the expansion tank, be careful and wait for cooling down of the engine cooling fluid, because the steam in the tank can be pressurized. It should be kept in mind that the low-freezing cooling fluid is toxic and capable of causing poisoning unless sanitary norms are observed.

2.1.21 Making any modifications to the electric equipment systems without consultation with the manufacturer is strictly prohibited.

2.1.22 The truck shall ensure the safety and protection of the operator against dangerous and harmful industrial factors appearing during the operation.

Levels of vibration (total and local) created by the truck:

The weighted root mean square value of acceleration the operator's arms and hands are exposed to is less than 2.5 m/s^2, the weighted root mean square value of acceleration the operator's body is exposed to does not exceed 0.5 m/s^2. The equivalent sound pressure level in the operator's cab created by the truck does not exceed 80 dB(A) with the doors and windows tightly closed.

The measurements were performed on the serial dump truck with the use of the testing procedure determined by the respective standards and directives of the European Parliament and Council 98/37 EC.

2.1.23 The overall dimensions and weight of the dump truck do not allow it to be transported to the place of operation in the assembled state. Therefore, it shall be assembled in the workshops of the exploiting organizations. To ensure the safety of the assembling and adjusting works, the personnel involved in the assembling shall be obligatorily instructed in the accident prevention as well as fire and electric safety.

2.1.24 In case of use of the cab windows as an emergency exit, it is necessary to break the glass by the hammer included in the tools kit which is in the box for the driver's personal things located under the additional side seat.

2.1.25 Never operate the dump truck without the operator's seat belt installed. Both the driver and the instructor (if the cab is equipped with the instructor's seat) shall buckle the seat belt prior to driving the truck.

2.2 Fire Safety

To avoid the fire on the truck, it is necessary to observe the general Regulations of Fire Safety when handling the flammable substances and follow the requirements stated below:

2.2.1 Check regularly the leak-tightness of fuel and oil pipelines of the systems of the engine, steering control, braking systems and dumping mechanism.

2.2.2 The dump truck shall be cleaned regularly from flammable materials: stains of fuels and lubricants, coal dust, etc.

2.2.3 Do not leave the dump truck when the engine starting pre-heater is running.

2.2.4 The truck is equipped with the fire extinguishing system. To extinguish the fire, use the combined fire extinguishing system having stopped previously the engine.

NEVER USE THE SOLUTION FIRE-EXTINGUISHING LINE FOR EXTINGUISHING THE ENERGIZED ELECTRIC EQUIP-MENT AND SPILLAGE OF FUEL AND OIL. NEVER USE THE POWDER FIRE-EXTINGUISHING LINE, IF THERE IS ANYBODY WITHIN THE ZONE PROTECTED BY THE ABOVE SYSTEM.

2.2.5 OPERATION OF THE TRUCK WITH FAULTY FIRE EXTINGUISHING SYSTEM IS PROHIBITED. THE MAINTENANCE OF THE FIRE EXTINGUISHING SYSTEM SHALL BE PERFORMED IN STRICT COMPLIANCE WITH THE REQUIREMENTS STATED IN THE SECTION "FIRE-EXTINGUISHING SYSTEM".

2.2.6 Never use bare flame when checking the cooling fluid level in the expansion tank of the engine cooling system to avoid the ignition of gases.

2.2.7 Never use bare flame when inspecting the storage batteries.

2.3 Warnings

2.3.1 Driving the dump trucks shall be only allowed to persons who have driving licenses issued by the appropriate qualification board and appropriate qualification category according to the Safety Rules for Operating the Consumers' Electrical Installations, having studied the construction, rules of operation and peculiarities of the driving, and who has experience of working with quarry automobile transport.

2.3.2 Maintenance of the truck shall be performed by the technicians and electricians who have studied the construction of the dump truck, rules of its operation as well as safety and fire prevention requirements.

2.3.3 Any faults detected in the truck operation process shall be eliminated without waiting for scheduled maintenance that would prevent serious breakdowns.

2.3.4 Maintenance of the trucks shall be performed at the intervals specified in this Manual and under conditions excluding the contamination of the parts and assemblies.

2.3.5 Fuels, lubricants and working fluids shall be only used in compliance with the recommendations of this Manual. Never use oils and fuels of other brands. The reliable operation of the hydraulic systems is ensured providing the cleanness of oil and internal cavities of the hydraulic equipment are maintained clean.

2.3.6 When the traction electric drive reverser switch on the instrumentation panel is set to the “Вперед” (forward position) and the body position sensor gives a signal that the body is lowered, when setting the body control switch to the “Опускание” (lowering) the body floating position gets actuated. In this position, the piston chambers of hydraulic cylinders are connected with the drain line that excludes the body lifting.

The floating position of the body can be disabled by means of a switch on the instrumentation panel, which breaks the supply circuit of the hydraulic distributor electromagnet, to allow the truck manoeuvring during the unloading.

When being lifted or lowered, the body can be stopped in any intermediate position by setting the handle of the body lifting switch on the instrumentation panel to the neutral position.

MOVEMENT WITH THE BODY LIFTED IS PROHIBITED.

2.3.7 The body should be lifted at the engine rotational speed of 1200 – 1300 rpm. When the last section of the dumping mechanism appears at the end of the lifting, the rotational speed shall be reduced to the minimum one.

2.3.8 In autumn and winter, when the ambient temperature is below 5°C, it is not allowed to start the cold engine without warming up the cooling fluid by means of the starting pre-heater to the temperature recommended in the operating manual for the engine. After warming up the cooling fluid by means of the starting pre-heater, close the isolation cock on the output pipe.

2.3.9 For the summer period, the fuel heater shall be disconnected from the engine cooling system by means of the isolation cock. To disconnect the cab heating radiator from the engine cooling system for the warm period of the year, close the cock on the discharge pipeline.

2.3.10 It is not allowed to stop the engine under load. Prior to stop the engine after operation with the full load, it is necessary to let it run at low idling rotational speed for 3 – 5 minutes.

In order to release pressure in pneumatic hydraulic storage batteries there is a time relay installed in starting and disconnection system of the engine for 80 sec of delay for disconnection of storage batteries and electronic control unit of the engine after engine stop.

2.3.11 If the engine is stopped for the period exceeding 0.5 hours, disconnect the storage batteries to protect them from discharge.

2.3.12 The hydraulic drive of the dump truck is provided with the function of automatic engagement of the brake gears of the rear wheels in case of oil pressure drop in the brake circuits. In this case the pilot lamps on the instrumentation panel light up and the audible alarm will be on. To continue the operation of the truck. it is necessary to reveal the reason of the fault and eliminate it.

2.3.13 Never operate the dump truck with the faulty auxiliary (electric) brake.

2.3.14 The limited allowed speed of the loaded dump truck driven downhill with brake performance is given in the Table 2.1.

Table 2.1 – The limited allowed speed of the loaded dump truck driven downhill with brake performance

Slope, %	Speed, km/h	Slope, %	Speed, km/h
2	55	8	34
4	55	10	27
6	47	12	22

2.3.15 Never stop the engine during the truck movement, because the steering control does not operate when the engine is not running.

2.3.16 To protect the metering pump against damage after parking of the truck with the engine non running, especially in winter at the temperatures of below 0°C, the steerable wheels shall be only turned after warming up the steering mechanism by working fluid for at least 10 minutes.

2.3.17 The dump truck body shall be loaded from the side or back. Carrying the excavator bucket over the cab is prohibited.

2.3.18 The dump truck should be loaded in accordance with its rated payload capacity stipulated in the dump truck specification as well as with the loading certificates for each specific quarry.

The redistribution of the total weight to the front axle shall not exceed 5%.

In case of fitting additional mechanisms and systems, partial or full body lining or making other modifications increasing the operating weight of the truck, it is necessary to determine the new operating weight and payload capacity. In any case, the gross weight of the dump truck shall not exceed that specified in the chapter “Technical Specifications”.

In exceptional cases, it is allowed to exceed the rated payload capacity within 10%. The number of such cases shall not exceed 10% of the number of all rips for the period under considerations (day) and the average value of loading for all the trips within the period under consideration shall not exceed the rated one.

In exceptional cases, the one-time excesses of the rated payload capacity within 10-20% are allowed. They shall be accounted when determining the average loading for the period of time under consideration.

IT IS STRICTLY PROHIBITED TO EXCEED THE RATED PAYLOAD CAPACITY BY 20% AND MORE, EVEN IN EXCEPTIONAL CASES.

The information on the actual loading of the dump truck shall be continually registered and submitted on the first request. Overloading the dump truck makes the driving of it more difficult and reduces considerably the service life of the parts and assemblies as well as of the dump truck as a whole.

2.3.19 The faulty dump truck shall be towed by a special towing vehicle. When towing the dump truck with the rope fasten to the bumper, the mechanism of the parking brake system shall be released.

No towing the dump truck without lubricating oil in the reduction gears of the power-wheels is allowed; otherwise the gear transmission will be damaged.

2.3.20 Under icy condition of the road as well as when driving on snow-covered or moist roads, the road adherence decreases considerably. When driving the truck under such unfavourable conditions, the speed should be decreased down to the value ensuring the safe operation.

2.3.21 Walk up or down the truck ladder and/or standing on the ground near the truck is not allowed during thunderstorm.

Should the thunderstorm begin when you are in the operator's cab, do not leave the cab until the thunderstorm ceases completely.

2.3.22 Operation and maintenance of heating-cooling unit shall be performed in accordance with references given in section "Cab" of the present Manual and AC Manual.

Regardless any weather conditions and time of the year (excluding preservation for storage) AC system shall be actuated at least once a month for 15 minutes minimum. At the low temperatures it should be done in heated workshops. Such measure provides lubrication of the AC components.

In order to keep AC compressor in working condition it is prohibited to operate the dump truck with dismounted belts of AC compressor drive.

After repair works of air conditioning system related to disconnection of quick coupling on high and low pressure hoses it is necessary to make sure before AC actuation that the couplings are safely connected. Otherwise AC actuation with disconnected or poorly connected quick couplings will lead to AC compressor breakage.

The works related to disconnection of the AC components for its replacement or refilling shall be performed by specially trained personnel having a certificate to carry out such type of operations by means of special equipment for maintenance of vehicle air conditioner in well ventilated area.

Due operation of air conditioner and regular service maintenance proved documentary are the main conditions for warranty claim acceptance.

2.3.23 When operating the dump truck, the operating parameters of the systems shall be continuously monitored. It will make it possible to detect the fault in proper time and prevent serious damages. The operating modes of the assemblies and systems should be maintained within the optimum ranges specified in Table 2.2.

Table 2.2 – Monitored operating parameters of the dump truck systems

Monitored Parameters	Parameter value
Engine cooling fluid temperature, °C:	
minimum recommended	70
maximum allowable	95
Engine oil temperature, maximum allowable, °C	120
Oil pressure in the lubrication system, MPa:	
at the minimum idling rotational speed	0,138
at the rated rotational speed	0,310 – 0,483
Working fluid pressure in the hydraulic pneumatic accumulators, MPa	$13{,}5^{+0,5}$ – $17^{+0,5}$
Compressed air pressure in the pneumatic system, MPa	0,65 – 0,8

2.4 Safety Rules and Welding Precautions

2.4.1 Prior to beginning the welding works directly on the assembled truck, it is necessary to disconnect both the “plus” and “minus” terminals of power supply of the trucks from the respective terminals of the storage batteries.

2.4.2 To avoid fire when welding, make sure that there are no flammable engineering maintenance materials (fuel, oils) in the immediate vicinity of the welding place (on the chassis members or ground) and protect the fire-hazardous parts (hoses, wires, etc.) against the molten metal spatter.

2.4.3 The “ground” wire of the welding unit shall be connected to the part or unit to be welded at the distance of not more than 0,6 metres from the welding place so that no current would pass through the wires and cables of the traction electric drive control, payload and fuel consumption control system, video survey system, cylinders of the hydraulic system and suspension, ШСЛ bearings of the central levers and rods, bearings of the wheel hubs, bearings and toothings of the wheel gearings of the power-wheel reduction gear.

Special attention shall be paid to prevention of passing the current through the bearings in the traction alter-nator or power-wheel motors, because it would cause their damage and premature failure.

2.4.4 Never fasten the “ground” wire of the welding:

– unit to the hydraulic system components (pumps, hydraulic cylinders, distributors, pipelines, oil tank, etc.);

– on the main units of payload and fuel consumption control system, video survey system.

The connection place shall be cleaned from paint and rust. To provide reliable contact of the “Ground” cable with the surface to be welded.

2.4.5 When performing welding operations close to electronic units of payload and fuel consumption control system, video survey system certain units are to be dismantled.

2.4.6 When welding on the dump truck, the circuit breakers of the control and auxiliary circuits in the control cabinet shall be open.

When welding near the electric wires and cables, the measures shall be taken to prevent them from being damaged.

Do not remove any control boards or disconnect the plug-and-socket units of the traction electric drive control system; otherwise the contact could be broken that would cause the failure of the system.

The welding works related to the power cabinet shall be performed under supervision of the expert in the field of electric drives and in such way that penetration of the molten metal spatter into the cabinet would be excluded.

2.4.7 When welding on the truck with the engine equipped with an electronic control system, observe the following rules to protect the electronic components against damages:

– prior to beginning the welding works, disconnect all the plug-and-socket units connecting the circuits of the control, power supply, alarm and data transmission of the engine with the respective circuits of the truck;

– never fasten the “ground” wire to the bracket of the electronic module of the engine (ECM) or ECM module itself;

– should it be necessary to perform the welding works on the attached units of the engine or assemblies mounted immediately in the engine, these units shall be removed from the engine.

If such removal is impossible, all the ECM plug-and-socket units shall be disconnected prior to beginning the welding works. Should the engine be equipped with several ECM’s, the plug-and-socket units shall from all the modules.

2.4.8 When reconnecting the engine circuits to the truck circuitry (both after performing the welding works and when assembling the truck), the following rules shall be observed:

– all the plug-and-socket units connecting the circuits of the control, power supply, alarm and data transmission of the engine with the respective circuits of the truck shall be connected prior to connecting the storage batteries;

– when connecting the storage batteries the “minus” cable shall be connected first and then the «plus» one;

– Never set the key in the ignition switch to the working position before connecting the cables to both terminals of the storage batteries;

– it is only allowed to disconnect the plug-and-socket units connecting the circuits of the engine with those of the truck (for example, for tracing the faults) provided the key is removed from the ignition switch and the storage batteries of the truck are disconnected.

2.4.9 Never perform the welding works near the fuel and oil tanks, charged hydraulic pneumatic accumulators and pipelines connected with them, gas cylinders of the fire extinguishing system and/or near the suspension cylinders charged with gas and filled with oil.

2.4.10 Never perform the welding works in the pressurized pneumatic starting system and pneumatic system of the truck. The pressure shall be released through the condensate drain cocks; when doing this the shutoff valves of the air cylinders shall be open.

2.4.11 Prior to performing the welding works, make sure that the hydraulic system pipelines are not pressurized. To depressurize the front and rear circuits of the service brake system, turn out the obturating needles on the brake valve. The working fluid pressure in the hydraulic system of the steering control and parking brake is released automatically within 80 seconds after scheduled stopping of the engine.

2.4.12 When welding, protect the chromium-plated surfaces of the dump truck assemblies (cylinders of the suspension, hydraulic system, etc.) against the molten metal spatter.

2.4.13 Never perform the repair works involving the welding on the wheel rim assembled fitted the tyre.

2.4.14 When welding for repairing the cab equipment, it is necessary to take measures for preventing the inflammation of the parts of upholstery and noise insulation of the cab interior.

2.4.15 Prior to welding near the boxes of storage batteries, special attention should be paid to observance of the fire safety rules and necessary safety precautions.

2.5 Warning Plates

The plate attached to the truck informs about one or more potential dangers when servicing or repairing of the assembly or when performing the works in the zone of location of the plate and describes the safety measures and/or actions to be undertaken to prevent the danger.

Should the plate become dirty, it shall be cleaned using a piece of cloth moistened in soapy water. Never use solvents, petrol and other caustic substances.

The places for attachment of the warning plates on the dump truck chassis are shown in Figure 2.1 and for the plates see Figures 2.2 – 2.15.

Depending on the consumer's country, the tables can contain the text in Russian, English or Spanish.

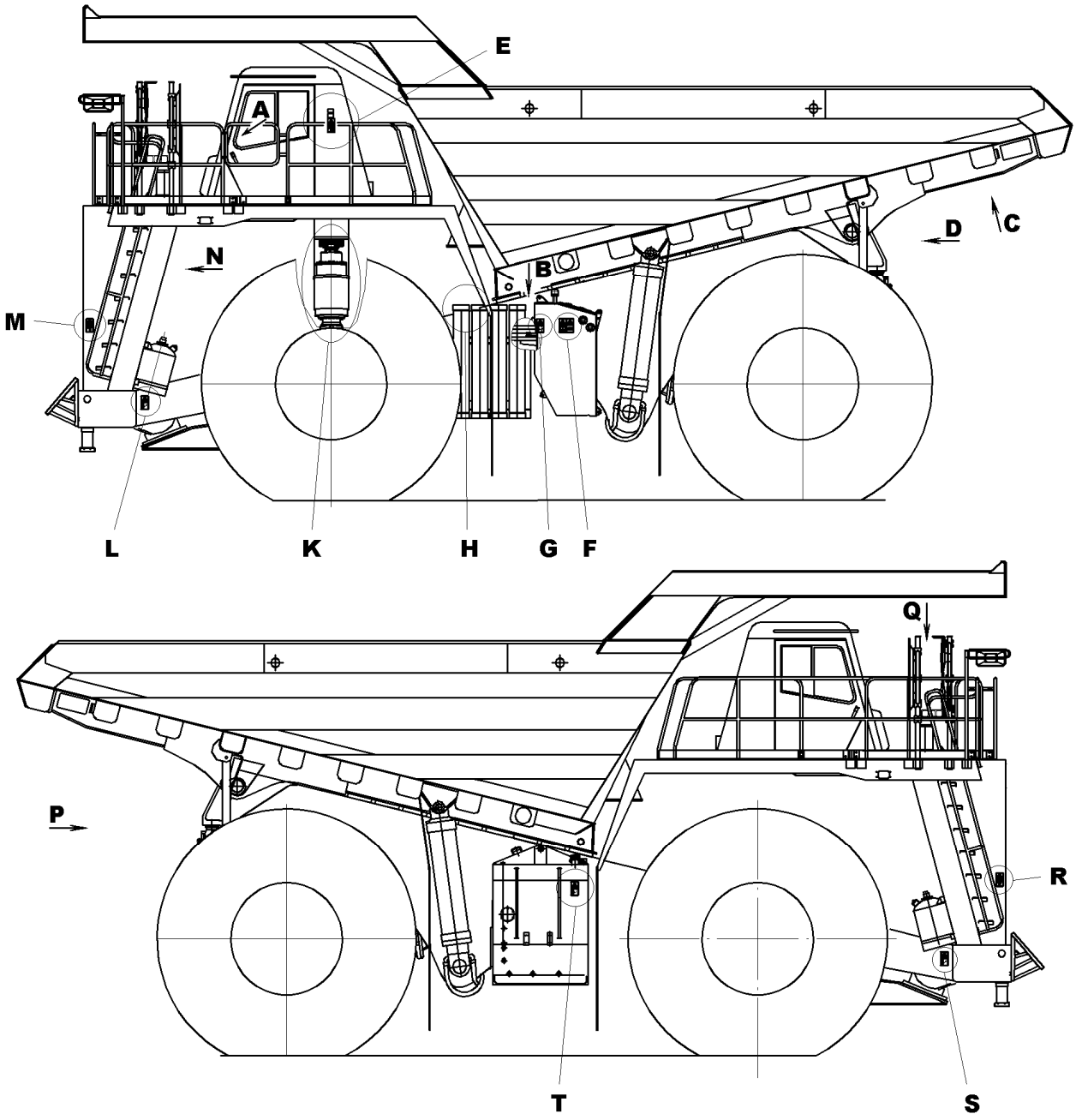


Figure 2.1 – Places for attachment of the warming plates:

1 – cab; 2 – cardan shaft; 3 – cardan shaft shroud; 4 – body; 5 – rear suspension cylinder; 6 – oil tank; 7 – frame; 8 – hydraulic pneumatic accumulator; 9 – front suspension cylinder; 10 – left-hand frame side member; 11 – front bonnet; 12 – rear shell; 13 – rear axle; 14 – expansion chamber; 15 – right-hand frame side member; 16 – fuel tank

I - XIV – Warning plates

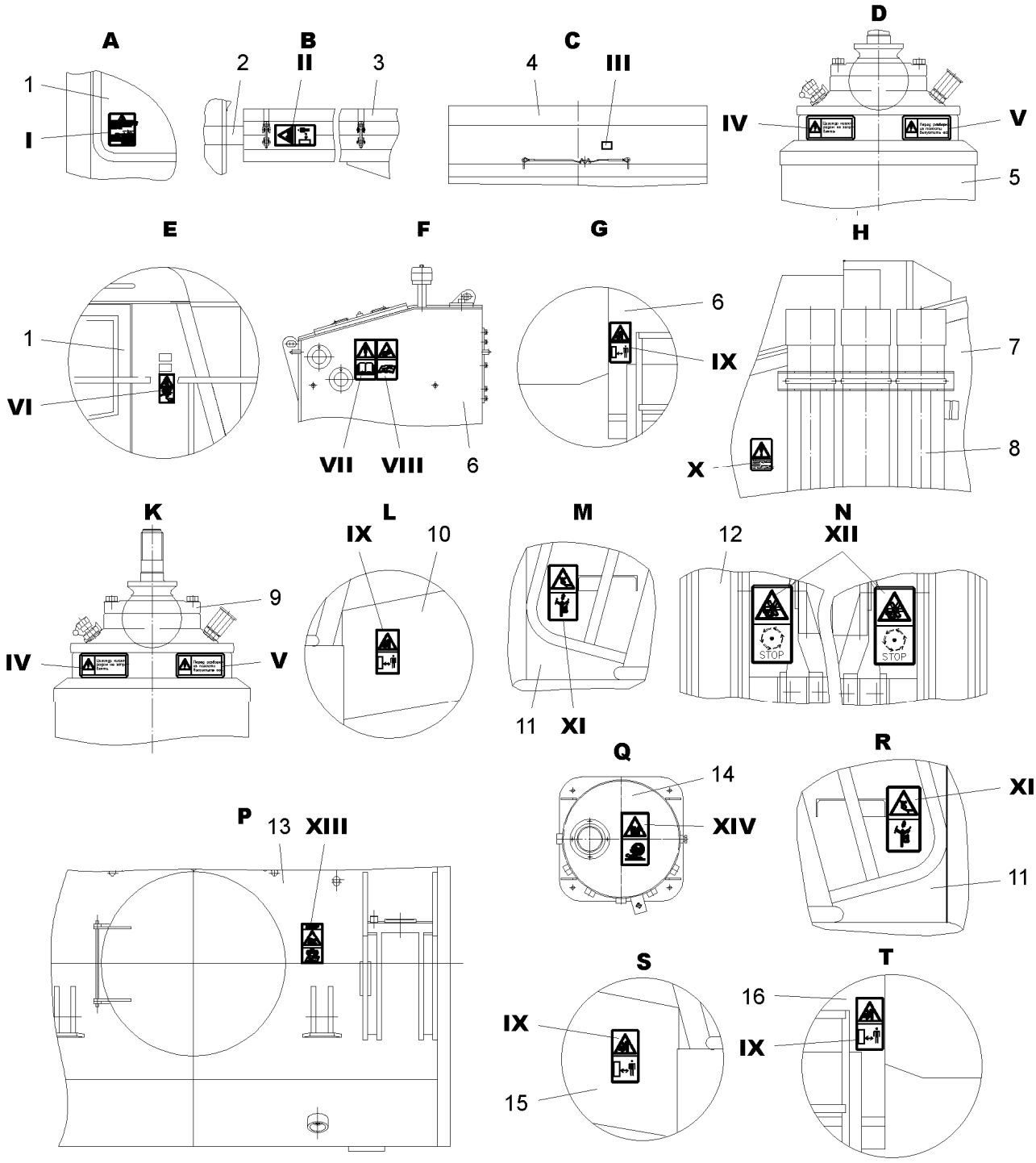


Figure 2.1 – Places for attachment of the warming plates (cont'd)

Plate I (Figure 2.2) is attached in the cab, at the bottom left corner of the windscreen.

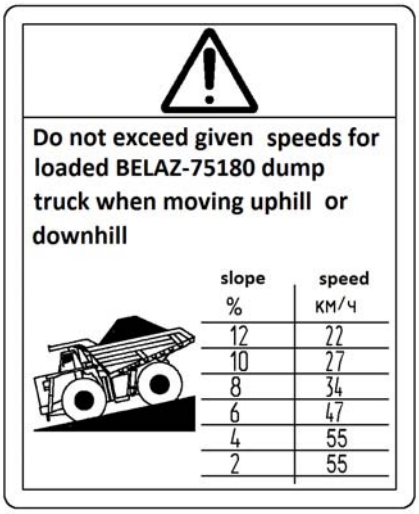


Figure 2.2 – Warning plate

Warning.

Do not exceed the speeds specified for the loaded dump trucks when driving downhill

Plate II (Figure 2.3) is attached to the shroud of the oil pump cardan shaft.

Figure 2.3 – Warning plate

Danger of dragging the body into the mechanism.

Stand at a safe distance from the danger source

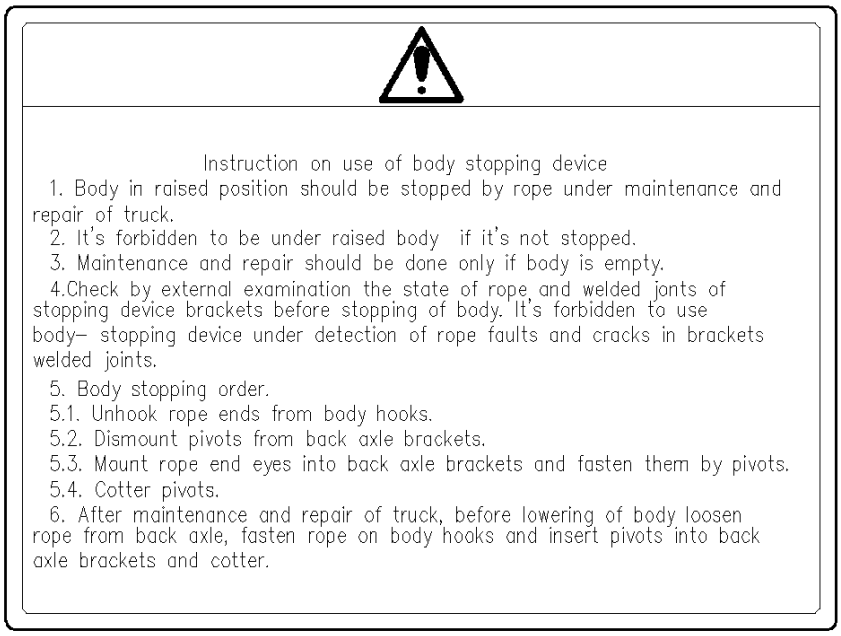


Plate III (Figure 2.4) is attached to the rear portion of the body as seen in the direction of the truck movement between the last two counterforces; the content of the plate is shown in Section 13.2 “Body”.

Figure 2.4 – Warning plate
Instruction for Using the Body Locking Device

Plates IV (Figure 2.5) and **plates V** (Figure 2.6) are attached to the top portion of the main pipe of the cylinders of the front and rear suspension.

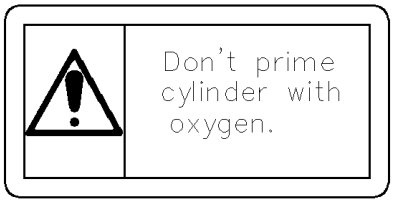


Figure 2.5 – Warning plate

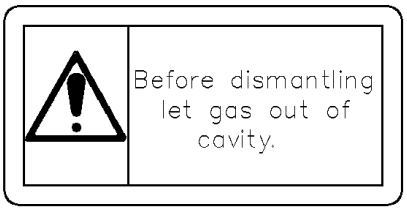


Figure 2.6 – Warning plate

Plate VI (Figure 2.7) is attached from the outside of the cab behind the left-hand door.

Figure 2.7 – Warning plate

Danger of crushing of the entire body

Prior to entering the dangerous zone, fasten the locking device. Read the operator's manual

Plate VII (Figure 2.8) and **plate VIII** (Figure 2.9) are attached at the top portion of the oil tank body.

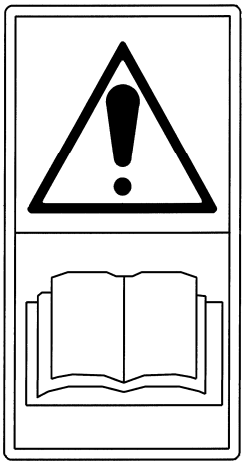


Figure 2.8 – Warning plate.

Warning.

Read the operator's manual

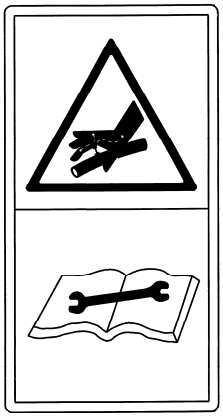


Figure 2.9 – Warning plate.

Pressurized fluid.

Avoid leakage of pressurized fluid! Read the technical manual to be familiar with the appropriate maintenance procedure

Plates IX (Figure 2.10) are attached in the front portion of the truck frame side members on the bodies of the oil and fuel tanks.

Figure 2.10 – Warning plate

Danger of crushing or squeezing of the entire body

Stand at a safe distance from the danger source

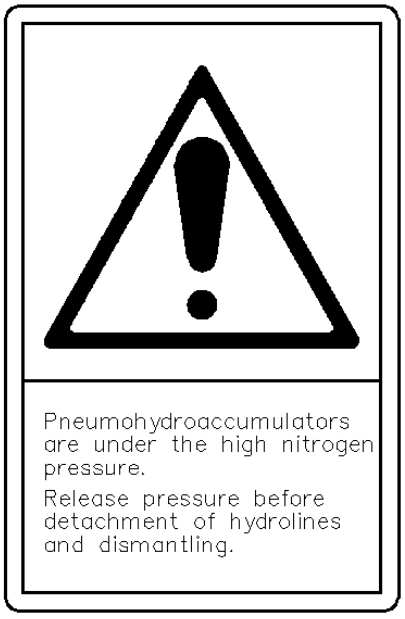


Plate X (Figure 2.11) is attached to the frame on the left of the hydraulic pneumatic accumulators.

Figure 2.11 – Warning plate

Warning.

The hydraulic pneumatic accumulators are under high pressure. Prior to disconnecting the hydraulic lines or dismantling, release the pressure

Plates XI (Figure 2.12**)** are attached to the inside of the front bonnet near the handrails of ladders.

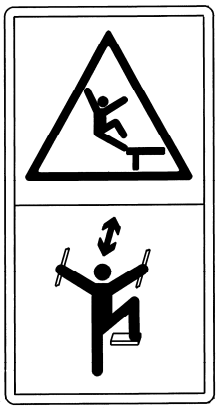


Figure 2.12 – Warning plate

Danger of dropping from height

When going up and down ladder, it is necessary to use the three-point support

Plates XII (Figure 2.13) are attached to the rear shell of the radiator unit on both sides from the fan.

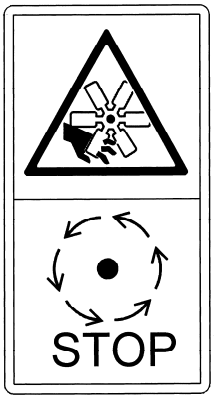


Figure 2.13 – Warning plate

Danger of injury of the hand fingers: engine fan.

Do not touch the moving parts of the machine until they are stopped completely

Plate XIII (Figure 2.14) is attached to the rear-axle housing to the right from the hatch.

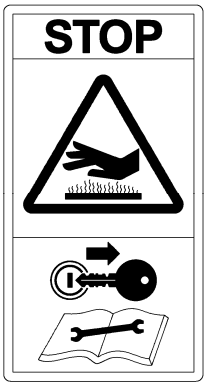


Figure 2.14 – Warning plate

General danger warning.

Prior to maintenance or repair, stop the engine and remove the ignition key

Plate XIV (Figure 2.15) is attached to the expansion chamber of the radiator.

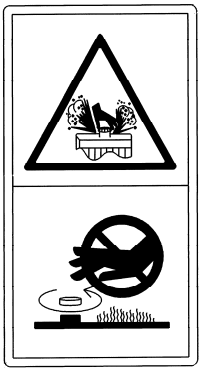


Figure 2.15 – Warning plate

Hot pressurized fluid.

Do not screw out the plugs until they have cooled down.

3 TECHNICAL SPECIFICATION

Dum truck is equipped with CUMMINS QSK 50-C diesel engine and AC drive system КТЭ-160 of JSC «Electrosila» production.

Technical specification of the dump truck is given in Table 3.1.

Table 3.1 – Technical specification

Parameters	Parameters value
Payload capacity, kg, not exceeding:	180000
Operating weight, in basic specification, kg	145200
Gross weight, kg, not exceeding	325200
Gross weight distribution, %:	
Front axle	33
Rear axle	67
Minimum turning radius, m, not exceeding	14
Overall turning diameter, m	30
Nominal body capacity – struck, m^3	78,5*
Nominal body capacity (“heaped” 2:1), m^3	108,5*
Body raising time, laden, sec	20
Body lowering time, sec	22
Controlled fuel consumption l/100 km., not exceeding	600
ENGINE	
Diesel, four-stroke, V-shaped, with electronic control system, direct fuel injection, gas turbine super charging and intermediate charged air cooling, equipped with pneumatic or electric engine start-up system (according to the contract)	
Model	CUMMINS QSK 50-C
Rated power, kW	1491
Rotation speed according to rated power, rpm	1900
Maximum torque at 1500 rpm, N.m	7865
Number of cylinders	16
Working displacement volume, l	50,3
Cylinder bore, mm / Piston stroke, mm	159 / 159
ELECTRIC TRACTION DRIVE	
Consists of traction alternator, electric traction drive, control cabinet, ventilated brake resistors, ventilation equipment and set of additional equipment	AC drive system КТЭ-160
Traction alternator	ГСТ 1600-8
Power, kW	1600
Electric traction motor	ТАД-5
Power, kW	610
Maximum travel speed of loaded dump truck on horizontal road section, km/h (over the truck traction performance)	60
Motor-wheel reduction gear	Two-row differential reduction gear
Gear ratio	38,67

Continuation of Table 3.1

Parameters	Parameters value
RUNNING GEAR	
Frame	Welded, made of high-strength steel, side girders of box section and variable height are connected by cross-beams with casting elements
Suspension for front and rear wheels	Pneumatic hydraulic dependent suspension, trailing arms with central joints and cross-rods
Wheels	Diskless, with split rims and tapered bead seats
Tires	Tubeless, pneumatic
Tire size – air pressure in tires, MPa	BRIDGESTONE 37.00R57 – (0,7 + 0,025) МПа BRIDGESTONE 42/90R57 – (0,7 + 0,025) МПа MICHELIN 37.00R57 – (0,6 + 0,025) МПа
HYDRAULIC SYSTEM	
Integrated hydraulic system for steering, dumping mechanism and drive for braking gears. It consists of oil tank, adjustable axial-piston pump wirh cardan drive from traction alternator shaft, liquid distribution unit on the basis of three-position hydraulic distributor of spool type with safety valves and high pressure hoses. Electric hydraulic control.	
STEERING	
Hydraulic drive	Hydrovolumetric steering consists of dosing pump, flow amplifier, two hydraulic cylinders of double action and linkage of unsplit type
Emergency drive	By pneumatic hydraulic accumulators
BRAKE SYSTEM	
Service brake system	Brake mechanisms are of disk type with automatic clearance adjustment between the linings and the disk. The drive is hydraulic, separate for front and rear wheels, with the system of actuation of rear brakes when pressure drops in brake circuits. Power source is the pump, power storage devices are pneumatic hydraulic accumulators.
Parking brake system	The brake mechanisms are of disk type, constantly closed. Hydraulically controlled spring drive.
Auxiliary brake system	Electric braking by traction electric motors in generator mode with forced air cooling of brake resistors
Reserve brake system	The parking brake system and operable circuit of the service brake system are used
DUMPING MECHANISM	
Type of mechanism	Hydraulic
Cylinders	Telescopic, two-staged, with second stage of double action
ELECTRICAL EQUIPMENT	
Connecting circuit	Single-wire circuit, negative terminals of energy sources and current consumers are connected to "ground". Hood light and socket of hand lamp are connected by two-wire circuit
Current	Constant, voltage 24В
Accumulator batteries:	6CT-190A, 2 pcs. with pneumatic start-up system and 4 pcs. With electric start-up system

Continuation of Table 3.1

Parameters	Parameters value
CAB AND BODY	
Cab	All-metal, two-seated, hermetic, thermo-and-noise insulated. It meets ROPS requirements. It is equipped with two sun visors, double-blade electrical windshield wiper, heater-conditioning unit, windshield washer, hooks and seats. Rear view mirrors are located at both truck sides
Body	Welded structure of bucket type, provided with protection visor over cab. Body floor is heated by exhaust gases. It is equipped with a device for fixing the body in the raised position and provided with rock ejectors.
FILLING CAPACITIES, L**	
Engine lubrication system	218
Engine cooling system	465
Fuel tank	2300
Hydraulic system	670
Motor-wheel reduction gears, (two)	105 x 2 = 210
Suspension cylinder, kg:	
front (two)	27,6 x 2 = 55,2
rear (two)	47 x 2 = 94

Notes

1. The "*" mark indicates that the body of another capacity (83,3 м^3 / 112,4 м^3) can be installed on the customer's order. The body capacity depends on the load density and the terms and conditions of the contract

2. The "**" mark indicates that the refilling capacities were obtained from the testing results and given for reference only; the refilling shall be performed according to the recommendations of the respective chapters of this manual.

4 CONTROLS, INSTRUMENTATION AND CAB EQUIPMENT

4.1 Controls and Cab Equipment

The arrangement of the controls and equipment in the driver's cab is shown in Figure 4.1.

The auxiliary (electric) brake pedal 1 ensures the long-term maintaining of the required speed of motion downhill.

The switch 2 of the turn indicator, headlight beams and horn is located on the left side of the steering column. Shifting the switch arm forward the right turn indicators light on and shifting the same backwards the left turn indicator lights on. When turn is over shift the switch arm in the neutral position. When the turn indicator is on, the pilot lamp located in the dashboard blinks.

Shifting the switch arm upward (non-fixable position) the upper beam of the headlights is actuated to signal to the oncoming traffic, shifting the same downward (fixed position) the upper beam of the headlights is actuated; when pressing the arm end (non-fixable position) the horn is actuated. Turning the switch handle from the zero position to the first one the marker lights are actuated and to the second one – the lower beam of the headlights is actuated.

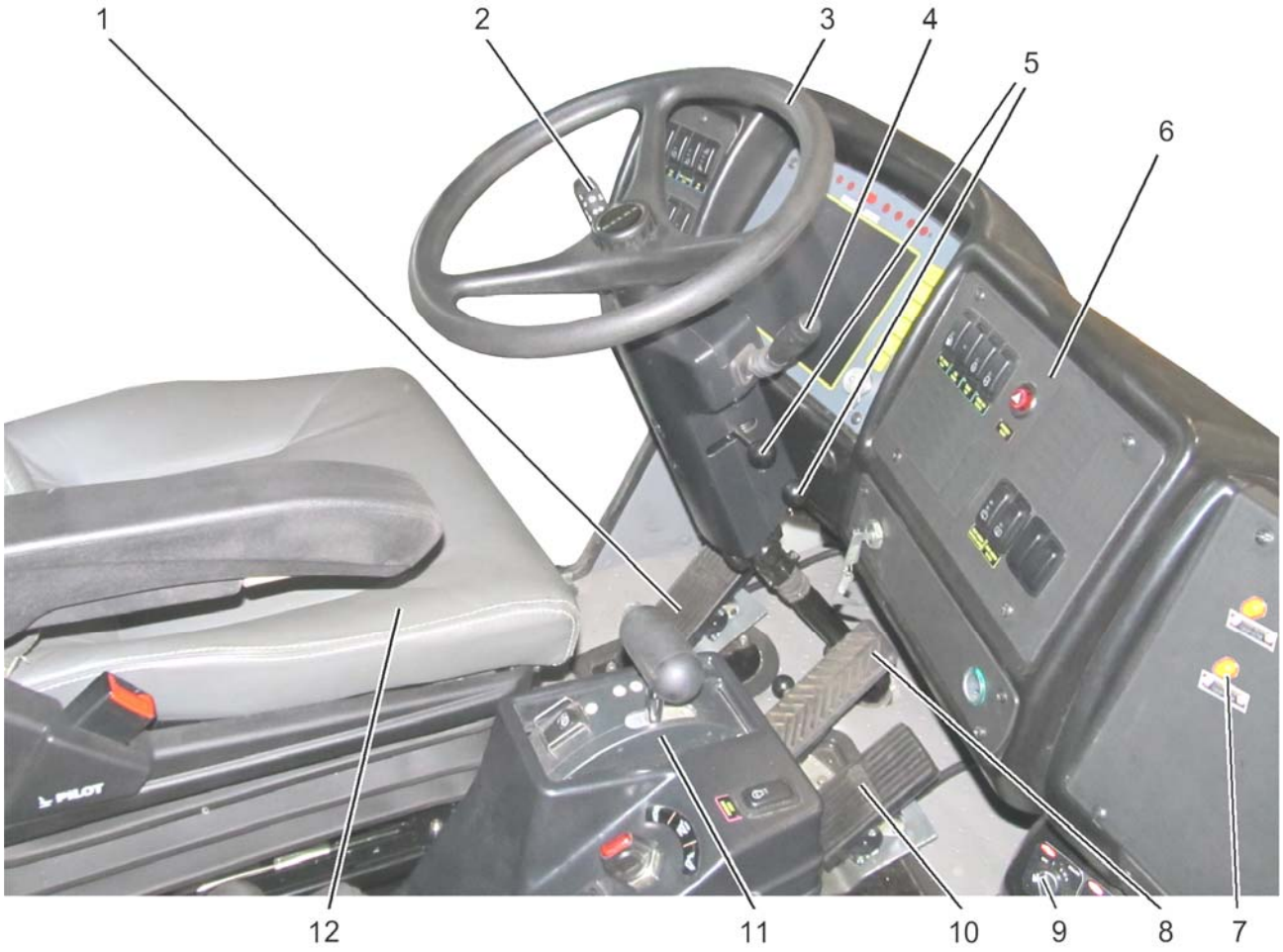


Figure 4.1 – Controls and cab equipment:

1 – auxiliary (electric) brake pedal; 2 – switch of the turn indicators, headlight beams and horn; 3 – steering wheel; 4 – switch of the windscreen wiper and windscreen washer; 5 – handles for adjusting the steering column height and tilt angle; 6 – dashboard; 7 – traction electric equipment panel; 8 – service brake control pedal; 9 – control panel of the heating and air-conditioning unit; 10 – fuel feeding control pedal; 11 – console with the controls; 12 – driver's seat

The steering column with the steering wheel 3 has adjustable height and tilt angle. To adjust the height or tilt angle of steering wheel, unlock it by turning **the handles 5** located on the column and then set it to the required position.

The switch 4 of the windscreen wiper and windscreen washer is located on the right side of the steering column. It has four fixable positions and one non-fixed one. Pulling the switch arm towards the driver to the first position the windscreen wiper is actuated and causes the brush to move with a pause; pulling the same to the second and third positions causes the brush to move with various speeds. Depressing the switch arm end (non-fixable position) from any fixable position switches on the windscreen washer.

The traction electric drive panel 7 is located to the right of the main **dashboard 6.**

The service brake pedal 8 is provided with a latch for fixing it in the braked position.

The front panel of **the heating and air-conditioning unit 9** accommodates the control elements of the heater and air conditioner as well as the rotating vents for changing the direction of the air flow (detailed description is given in section “Cab”).

Fuel feeding control pedal 10 can be latched in the intermediate position using manual control handle (is not shown in the figure) which limits pedal back movement.

The console 11 with the dump truck controls is located between the driver's and the passenger's seats.

The driver's seat 12 is pneumatically cushioned, with the mechanisms for adjusting the seat height, longitudinal movement, turn and backrest fixation (detailed description is given in section “Cab”).

4.2 Dashboard

Location of controls and gages on dashboard is given in Figure 4.2, on console with dump truck controls which is located between the seats are shown in Figure 4.3, on traction electric drive panel – see Figure 4.4, on additional dashboard located above windscreen – see Figure 4.5.

4.2.1 Dashboard

When pressing **the switch 1** (see Figure 4.2), the ladder illumination spotlight switches on.

When pressing **the switch 2**, the deck illumination spotlight switches on.

When pressing **the switch 3**, the lights for illuminating the working zone of the chassis are actuated. The lights are switched on automatically when the body is being lifted and lowered.

The switch 4 is intended for switching on the lights for illuminating the lateral space.

More detailed description of the purposes, rules of use and maintenance of the electronic panel 5 is given in the Operation Manual for the panel provided when shipping the panel from the manufacturer's factory.

The non-fixable **switch 6** is intended for priming the engine after maintenance or long-term parking of the dump truck.

7, 11, 13 и 22 – plugs.

The pushbutton 8 for switching on forcedly the engine fan and opening the radiator blinders is to be used in case of the automatic system failure and for testing the system operation. When the switch is set to the OFF position, the system is operated in the automatic mode.

The switch 9 is intended for increasing the engine idling speed to prevent the injectors from being gummed-up after long-term idling.

The switch 10 is intended for switching on the hazard light. When pressing the lockable button, all the turn indicators and warning lamp built in the switch button start blinking. To switch off the hazard light, press the button again.

When you press the **cigarette lighter 12** the spiral is heating, then the lighter automatically returns to its original position.

The switch 14 is intended for switching on the rear window heating.

The switch 15 is designed to actuate rear windshield wiper and washer.

The ignition key switch 16 for starting the engine has three positions: first - when the key is inserted into the switch up to the stop – “ground” is actuated and dump truck network is powered; second - when the key is turned in the switch clockwise to the angle of 45^0 – power of electronic unit of the engine is actuated; third – when the key is turned in the switch clockwise to the angle of 90^0 up to the stop - the engine starting system is actuated.

The emergency audible alarm relay 17 is connected to the circuit in parallel to the pilot lamps indicating the emergency state of engine systems and hydraulic systems of steering control and brakes.

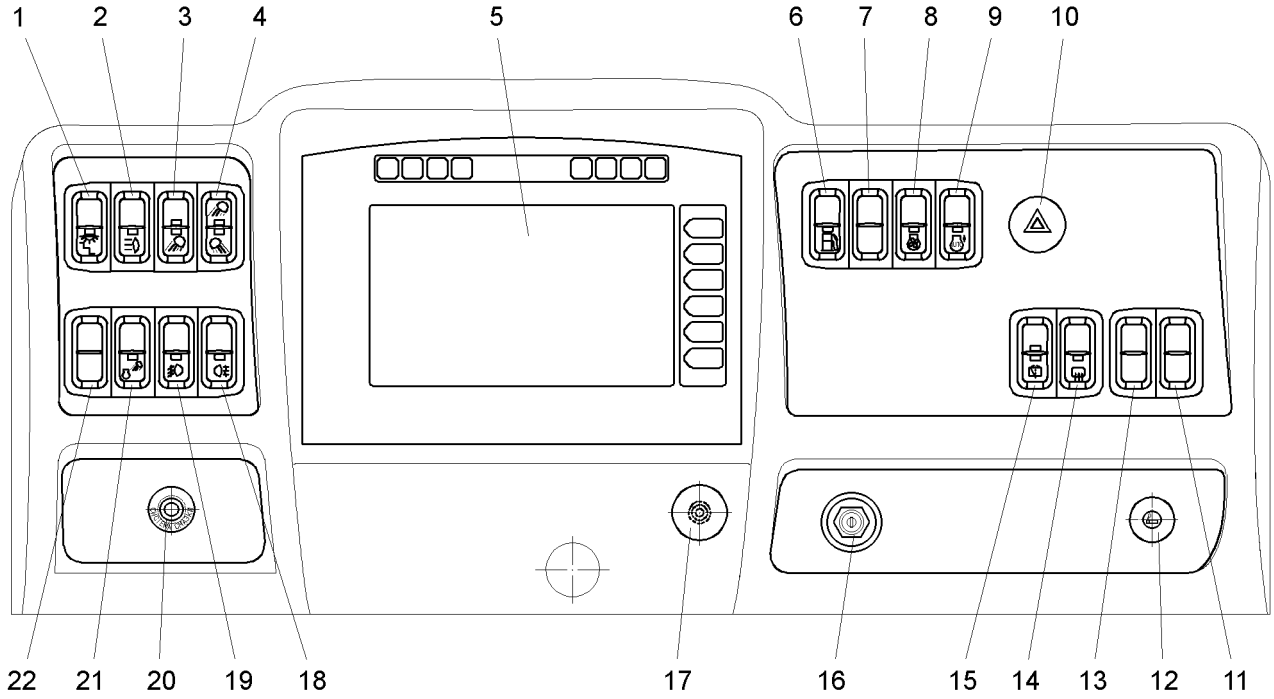


Figure 4.2 – Dashboard:

1 – ladder illumination switch; 2 – switch of the deck illumination spotlight; 3 – switch of the working zone illumination light; 4 – switch of the lights for illuminating the lateral space; 5 – electronic dashboard; 6 – fuel priming pump switch; 7, 11, 13 u 22 – plugs; 8 – switch for running forcedly the engine fan; 9 – engine speed governor switch; 10 – hazard waning light switch; 12 – cigarette lighter; 14 – rear window heating switch; 15 – switch of the rear windscreen wiper and washer; 16 – ignition key switch; 17 – alarm relay; 18 – switch of the rear fog light; 19 – switch of the front fog lights; 20 – pushbutton switch of the centralized lubrication system; 21 – switch of the swivelling lamps for illuminating the engine compartment;

To switch on the front and rear fog lights, press **the switches 18 and 19**.

Description and rules of use of the automatic centralized lubrication system including the pushbutton **switch 20** is given in the Operation Manual for the system.

When pressing **the switch 21** the swivelling lights for illuminating the engine compartment are actuated.

4.2.2 Console with the dump truck controls

The handle 1 (see Figure 4.3.) of the parking brake actuation valve is fixed in two extreme positions. When the handle is in the upright position, the truck is braked. To unbrake the truck, pull the cock handle upward and move it forward to the horizontal position. When the handle is in an intermediate position, the braking efficiency will be proportional to the angle of its turn (following action).

When parking brake is applied (when setting the parking brake to the “включено” (ON) position), actuation of the transmission is locked up (forward motion and reverse motion) function of protection against motion gets enabled.

The electric drive switch 2 (transmission) has two positions:

– in the upper position (T), the traction electric drive is ON;

– in the lower position the traction electric drive is OFF.

The arm 3 of the electric drive reverser has four fixed positions:

N – neutral;

D – forward motion;

R – reverse motion;

– load brake – braking of the dump truck during the loading/unloading operations.

Aiming braking dump truck during loading-unloading or in emergency situation when parking brake valve is faulty when switchover reverser is shifted to the position "Ⓘ" automatic application of rear service brakes occur.

When pressing the button of the non-fixed **switch 4**, the fuel feed is shut off and the system for releasing the pressure in the hydropneumatic accumulators of the steering control. **Switches for emergency engine stop** (two) are installed in the lower part on side panels at the both sides of front engine compartment.

The switch 5 of the body dumping mechanism has three positions:

– the middle position of the handle corresponds to the neutral position;

– the handle is turned counter-clockwise up to the stop: lifting the body;

– the handle is turned clockwise up to the stop: lowering the body.

The switch handle can be only moved to any position after being pressed up to the stop.

The handle is provided with a built-in warning lamp, which lights up when the handle is outside the neutral position.

The body can be stopped in any intermediate position in the process of its lifting or lowering by setting the switch handle to the middle position.

The blocking is switched off with **the switch 6**, which prevents the lowering of the body during the dump truck movement with switched on traction electric drive. It is required to hold the body in raised or middle position in case of manoeuvring during dumping. Hold the pressed switch for all the time of manoeuvring. Signal lamp blinks continuously if the engine is working or during dump truck movement.

7 – plug.

The mode of electric braking is switched on with **the switch 8** when the dump truck moves at constant speed. The speed is set by the driver depending on the setting angle of electric braking pedal; the same speed is maintained as it was in the moment of switching on the switch.

If the switch is switched off, for actuation electric braking is applied the additional brake – if you press harder the pedal you get more braking.

Figure 4.3 – Console with the dump truck controls:

1 – parking brake control valve; 2 – electric drive switch (transmission); 3 – electric drive reverser switch arm with pawl; 4 – engine-stopping pushbutton; 5 – switch for lifting and lowering the body; 6 – body interlock switch; 7 – plug; 8 – switch of the electric braking modes

4.2.3 Panel of the electric traction equipment

The arrangement of gages and controls of electric traction drive in driver's cab is shown in Figure 4.4.

The indicator 1 "SPEED LIMITATION" (orange) informs in blinking mode that dump truck has reached maximal allowed speed.

The indicator 2 "PROTECTION" (red) indicates about the automatic switch in control cabinet is switched off or there is a malfunction in the drive system.

The indicator 3 "BODY" (red) informs about isolation reduction in the power part of the drive.

The indicator 4 "OVERHEAT" (orange) informs that there is a malfunction in the temperature control system or the temperature of the traction electric drive components exceeds the allowable value.

The indicator 5 «Drive readiness» – shows that self-testing of the system was successful and dump truck is ready for movement.

The indicator 6 «CAN» – shows that there is communication between the both converters.

Description of **cab controller 7** of control system of electric traction drive system is given in the Manual, supplied with the set of documents for drive system.

More detailed description of gages and controls is given in the Operation Manual for electric traction drive system «Electrosila».

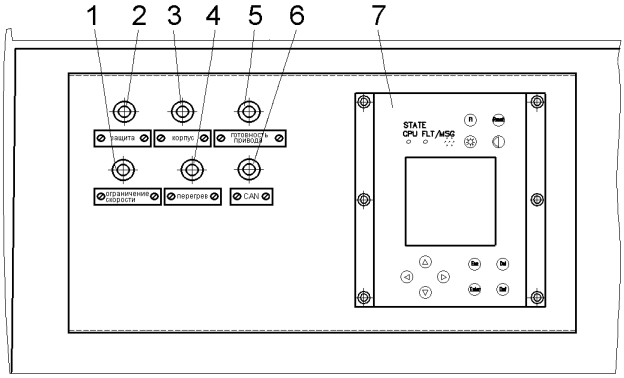


Figure 4.4 – Panel of electric traction drive equipment:

1 – indicator of the ON state of the speed limiter; 2 – indicator of operation of the protective facilities of the traction electric drive; 3 – indicator of power circuit closing; 4 – indicator of overheating of the traction electric motors; 5 – indicator of electric traction drive readiness for operation; 6 – indicator of converter condition; 7 – cab controller

4.2.4 Additional Dashboard

The additional dashboard is located above the windscreen (see Figure 4.5).

Description of application rules of the **panel 1 is given** in the Operation Manual for the combined fire extinguishing system (CFES).

The audio system comprises two speakers 2 and truck cassette radio 4.

The rules of application of the **console 3** are given in the Operation Manual for high voltage line proximity device (HVLPD).

The dome lamp 5 with the switch serves for lighting the driver's workplace

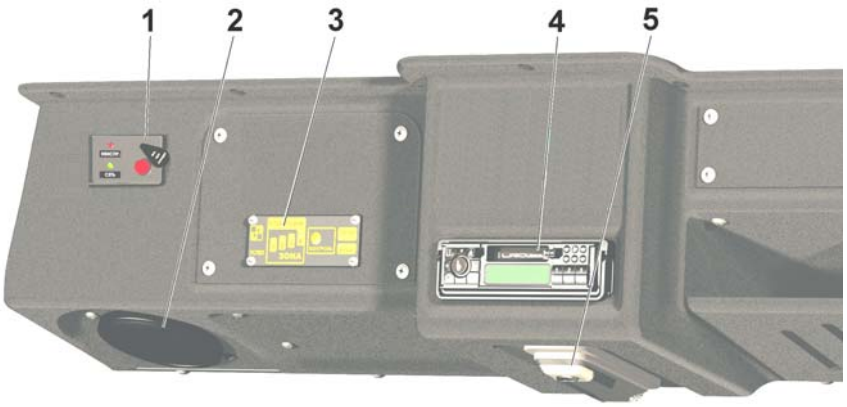


Figure 4.5 – Additional dashboard:

1 – control panel of CFES; 2 – speaker of audio system; 3 – console of HVLPD; 4 – cassette radio; 5 – cab lighting

4.3 Control Panel of the Engine Starting Preheater

The control panel (Figure 4.6) of the engine starting preheater is installed in the front bumper near the preheater and closed with a cover.

The control spiral 1 is connected in parallel with the glow plug and the readiness of the glow plug is controlled by the spiral incandescence degree.

Turning the lever of **the switch 2** clockwise the glow plug and control spiral are powered. The lever returns to the initial position automatically.

The switch 3 of the solenoid valve has two positions: when it is in the upper position (OPERATION), the solenoid valve is connected into the circuit; when it is in the lower position (PURGING), the solenoid valve is de-energized and the fuel feeding to the injector is shut off.

The switch 4 of the electric motor has three positions: the upper position (OPERATION) corresponds to the high speed of the motor; the middle position corresponds to the OFF state and the lower position (START) corresponds to the connection of the motor through a resistor; the rotational speed is lower.

The **bimetallic fuse 5** protects the circuit of the starting preheater motor against overloading. To reset the fuse after its operation, press the button.

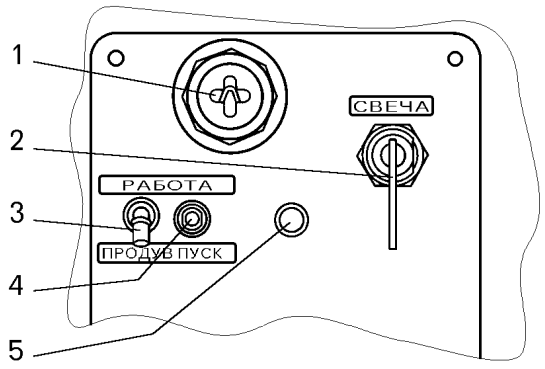


Figure 4.6 – Control panel of the starting preheater:

1 – control spiral; 2 – glow plug switch; 3 – electromagnetic valve switch; 4 – electric motor switch; 5 – bimetallic fuse pushbutton

5 ENGINE SYSTEMS

5.1 Diesel-Alternator Set

The engine 1 (Figure 5.1) and the traction alternator 4 of the dump truck are bolted to the underframe 2 and form a single unit called the diesel-alternator set.

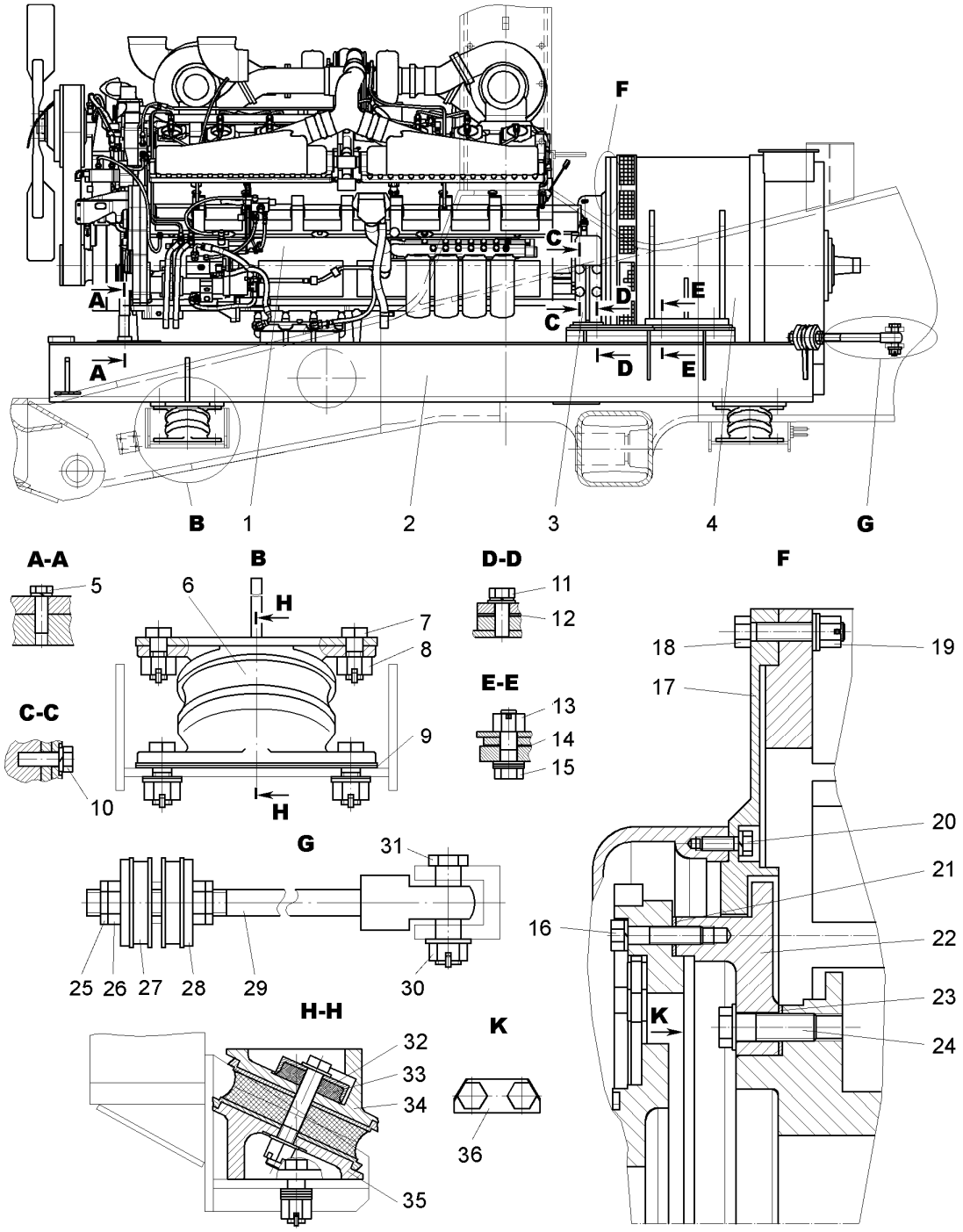


Figure 5.1 – Installation of the diesel-alternator set:

1 – engine; 2 – underframe; 3 – bracket; 4 – alternator; 5, 7, 10, 11, 15, 16, 18, 20, 24 – bolts; 6 – shock-absorber; 8, 13, 19, 26, 30 – nuts; 9, 12, 14, 21, 23 – adjusting shims; 17 – starter adaptor; 22 – rotor adapter; 25 – locknut; 27 – shock absorber of the rod; 28 – thrust washer; 29 – rod; 31 – pin; 32 – body; 33 – cushion; 34 – upper flange of the shock absorber; 35 – lower flange of the shock absorber; 36 – lock plate

The diesel-alternator set mounted on the dump truck frame through the four shock absorbers 6. The shock absorber consists of a rubber element with steel reinforcement cured-on it from two sides.

The shock absorber is bolted between the lower flange 35 and the upper one 34, which are bolted, in turn, to the truck frame and module underframe. When being mounted, the upper portion of the rubber shock absorber shall be located near the truck frame side member. The planarity tolerance of the top surfaces of the four shock absorbers shall not exceed 1.5 mm that shall be checked prior to installation of the module and adjusted using the shims 9. It is allowed to place not more than two shims under one shock-absorber. The adjustment can be also performed by by selecting the shock absorbers according to their height.

The diesel-alternator set is kept from longitudinal displacement by means of the rod 29. The torque of tightening the nuts 26 shall be from 50 to 70 N.m. The nuts shall be tightened 0.5 turn one-by-one.

When dismantling the diesel alternator set, the factory setting of the shock absorbers 6 and adjusting shims 9 placed under them should not be disturbed. Should the initial setting be disturbed for any reason, the planarity of their top surfaces shall be checked and adjusted by placing the shims or selecting the shock absorbers according to their height.

When dismantling or replacing the engine, alternator or underframe, the alternator armature shaft shall be centred with the engine shaft to reduce the dynamical loads.

Further in sections of the chapter are specified the engine external systems mounted on the chassis of the dump truck. The specification, technical maintenance of the engine itself is given in the corresponding chapters of the Operating manual for the engine.

5.2 Engine Fuel Feed System

The fuel feed system of the engine consists of the fuel tank 5 (figure 5.2) with the fuel transfer pump 6, fuel preliminary filter 3, fuel pipelines and fuel feed control actuator. Filter manufactured by «Fleetguard» (4328041) is bolted to the right frame side member. It is used as a primary one for the preliminary cleaning of fuel and installed between the tank and the fuel filters of the engine.

THE TRANSPARENT FILTER BOWL IS NOT FILLED WITH FUEL FULLY WHEN THE ENGINE IS RUNNING. IT WILL BE FILLED GRADUALLY AS THE FILTER BECOMES CLOGGED. THE FILTERING ELEMENT SHALL BE REPLACED WHEN THE FUEL LEVEL WILL REACH ITS TOP EDGE.

The design, maintenance and replacement of the filter elements are described in the documentation provided with the filter. The more detailed information can be obtained from the manufacturer.

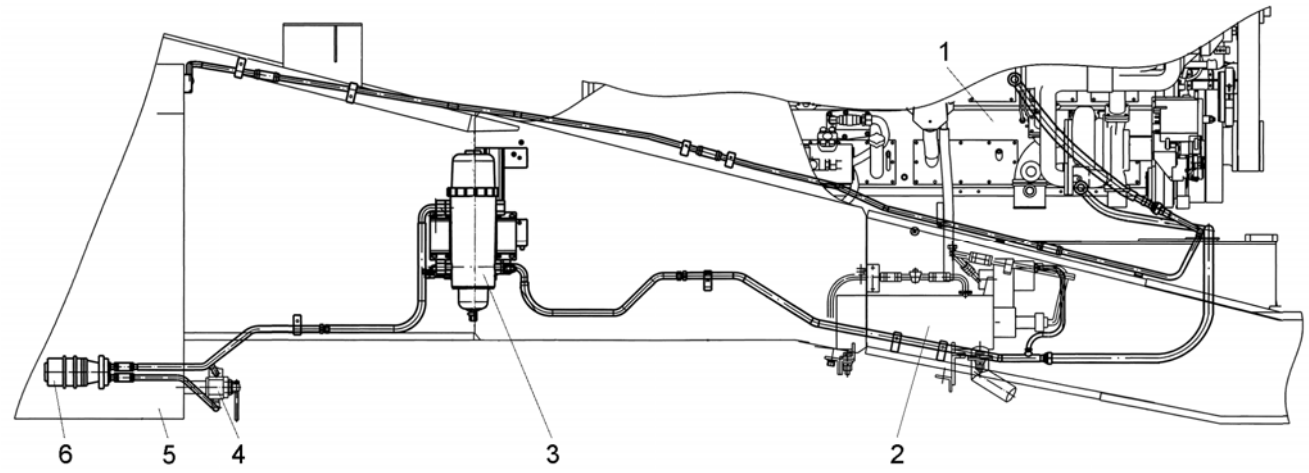


Figure 5.2 – Schematic of the fuel feed system of the engine:

1 – engine; 2 – starting preheater; 3 – fuel preliminary filter; 4 – shutoff cock of the fuel tank;5 – fuel tank; 6 – fuel transfer pump.

Fuel tank.

Fuel tank is a welded construction of rectangular shape that is fixed on the right side member of the frame. The water drainage sump as well as feed and intake compartments are made of partitions and walls in internal cavity of the tank. Rated capacity of the tank is 2300 liters.

The tank is equipped with a filler neck 3 (figure 5.3), fuel intake with the suction pipe 9 with mesh filter and shutoff cock 4, control light and electric sensors of the maximum and minimum fuel levels, drain plugs 7, breather 1 and cover 8 of the hatches for cleaning the tank.

From the suction pipe 9 the fuel enters through the pipelines to the fuel preliminary filter, and then goes to the engine fuel filters. The fuel drained from the engine flows to the top point of the fuel tan.

The sensor of the minimum fuel level gives a signal to the warning lamp located on the control panel when the fuel level in the tank reaches the minimum value, the sensor of the maximum fuel level gives the signal to the lamp mounted on the front wall of the tank when the fuel level in the tank reaches the maximum value to avoid overfilling.

The quantity of fuel in the fuel tank is shown on the display of the loading and fuel monitoring system (LFMS) located on the electronic instrumentation panel (for more details, see the Operating Manual for the loading and fuel monitoring system).

To provide dual redundancy of the electronic fuel gauging system, the upper wall of the tank is provided with a probe 5, the metal tape of which has marks with digits indicating the fuel quantity in the tank in liters.

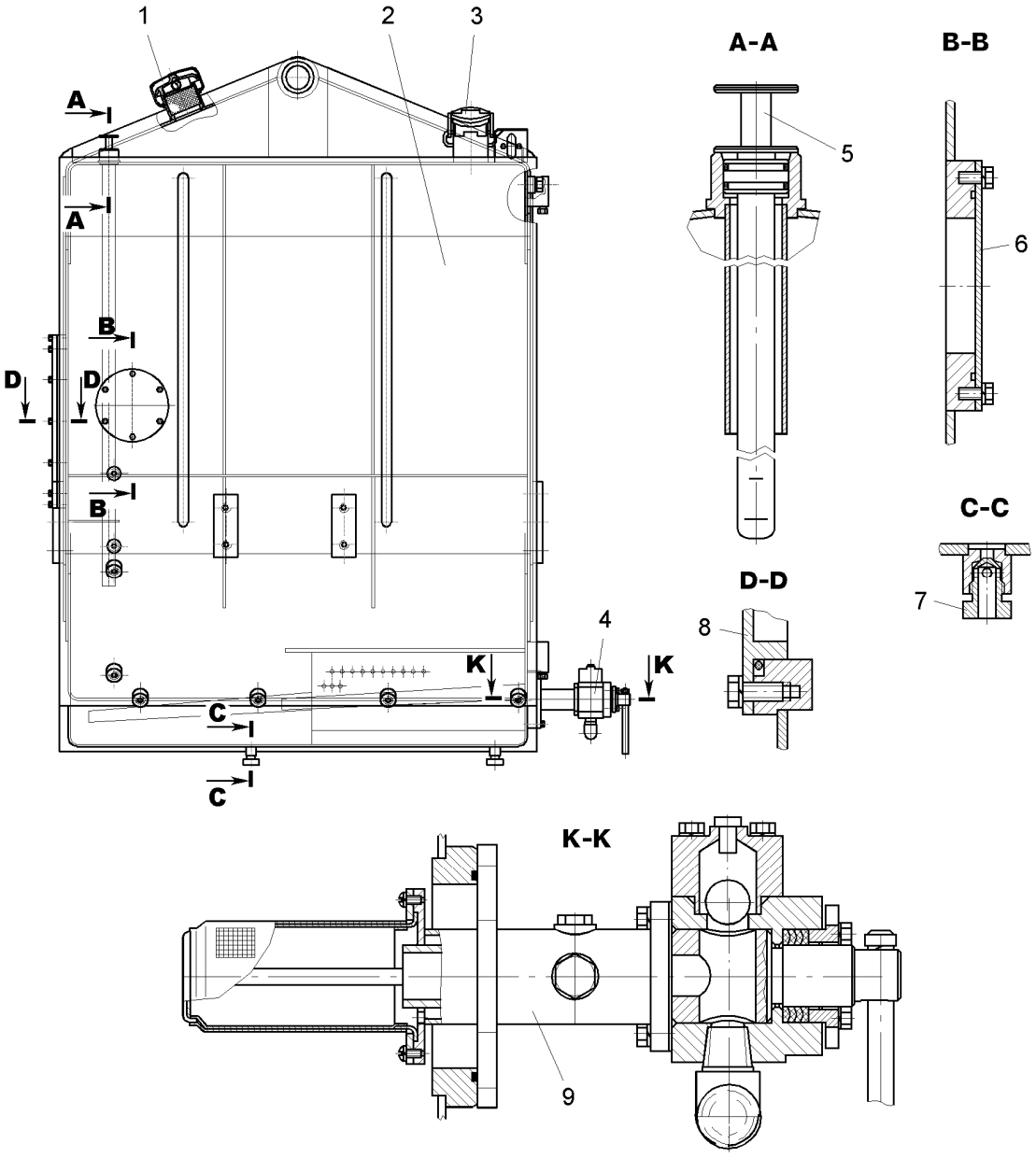


Figure 5.3 – Fuel tank:

1 – breather; 2 – fuel tank body; 3 – filler neck; 4 – shutoff cock; 5 – probe; 6, 8 – covers; 7 – drain cock plug; 9 – suction pipe with filter

The tank can be equipped optionally with the accelerated refuelling system manufactured by Wiggins Company.

The system consists of the valve 11 (Figure 5.4) and tap 6. As fuel flows into the tank from the filling nozzle through the valve into the tank, it forces the air out of the tank through the tap.

As the fuel level approaches the tank top, the hollow balls 9 come to the surface and press the ball 8 against the ring 7 while shutting off tightly the air venting through the tap 6. As fuel continues flowing from the refuelling nozzle, the pressure in the tank grows. As the pressure reaches certain value, the nozzle is switched off automatically.

It's necessary to pull lock 5 leg out of fixed position and insert it into the hole located below in order to take out probe 4.

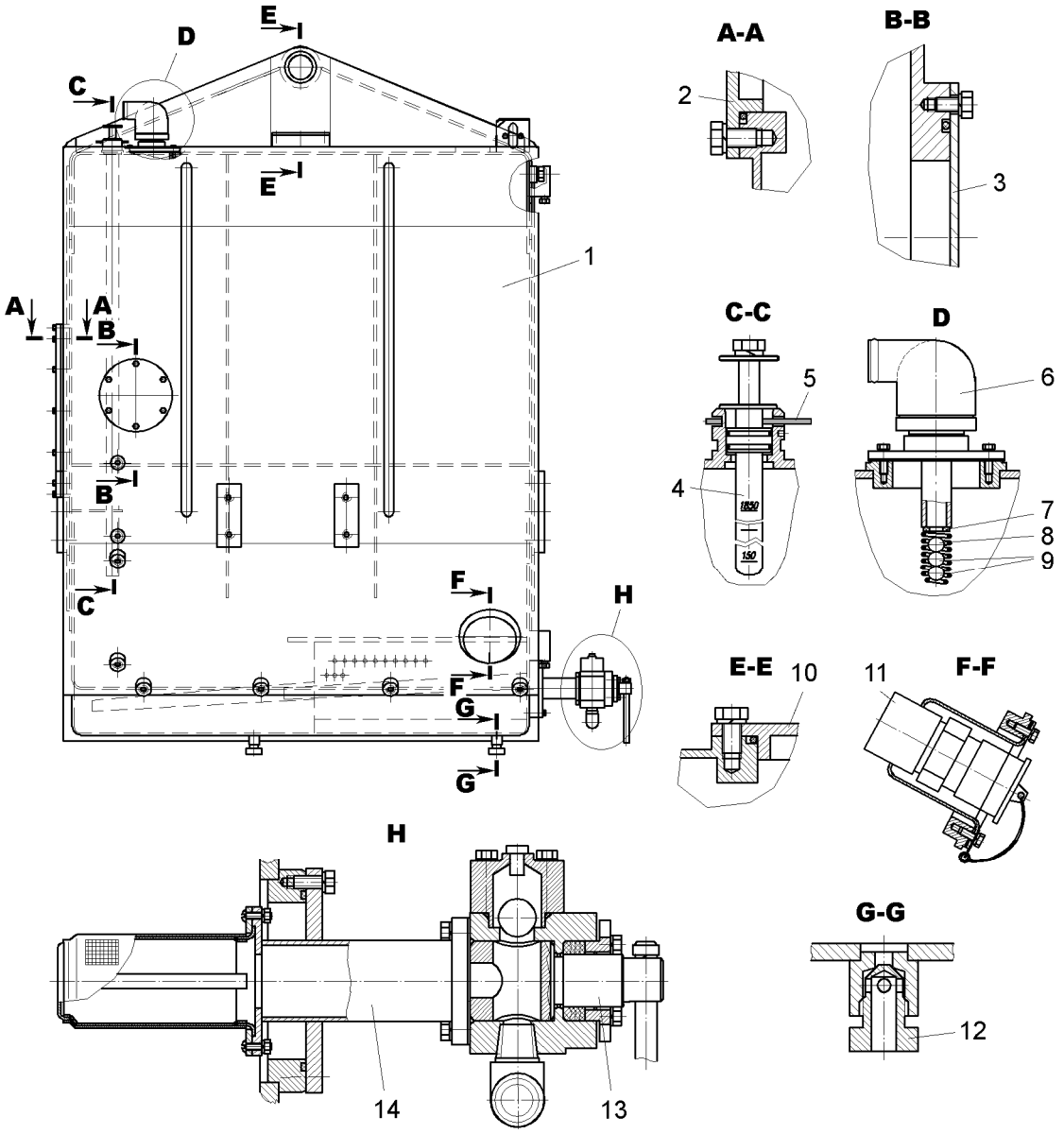


Figure 5.4 – Fuel tank with the accelerated refuelling system manufactured by Wiggins Company:

1 – fuel tank body; 2, 3, 10 – covers; 4 – probe; 5 – lock; 6 – fuel tap; 7 – sealing gate; 8 – ball; 9 – hollow balls; 11 – accelerated refuelling valve; 12 – drain plug; 13 – shut-off cock; 14 – suction pipe with filter

Fuel transfer pump.

The fuel transfer pump (figure 5.5) is mounted on the fuel tank and intended for pumping the feeding system with fuel prior to starting the engine.

When installing the fuel transfer pump at the factory, the spring and ball are removed from the reduction valve for reducing the pressure down to 0,2 MPa. Prior to replacing the pump under the operation conditions, it is necessary to screw out the plug 2 from the pump installed on the truck and remove the spring and ball from the reduction valve.

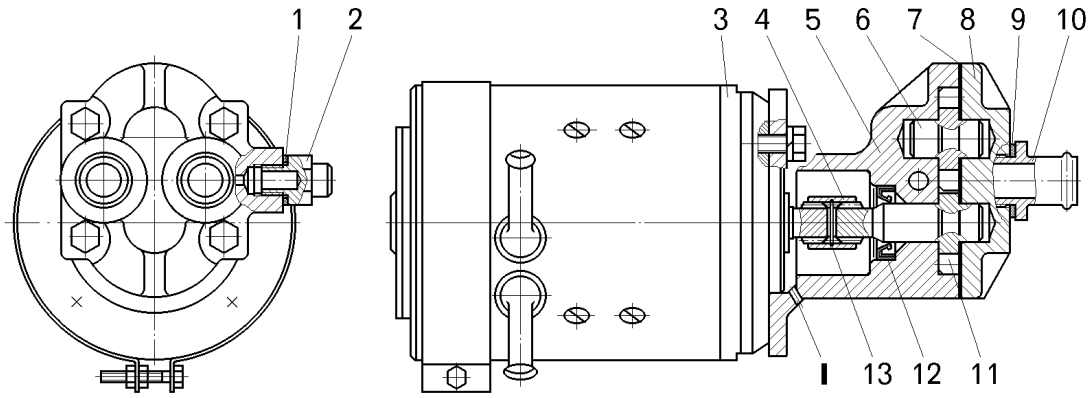


Figure 5.5 – Fuel transfer pump:

1, 7, 9 – gaskets; 2 – plug; 3 – electric motor; 4 – clutch; 5 – pump body; 6, 11 – pump gears; 8 – cover; 10 – connecting branch; 12 – cup; 13 – lock ring;

I – drain channel

Fuel feed pedal see figure 5.6. The adjustable resistor, mounted under the pedal 1, alters the current intensity on the electronic regulating device depending on the pedal position.

The electronic regulator mounted on the fuel pump provides the control of the engine rotational speed and its power by altering the quantity of fuel fed into the injectors.

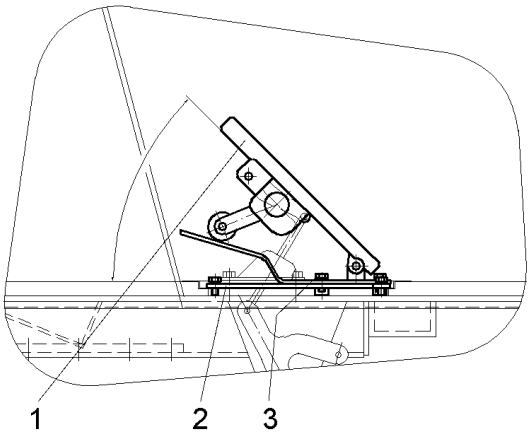


Figure 5.6 – Installation of fuel feed pedal:

1 – pedal; 2 – bracket; 3 – bolt

5.3 Engine Air Feed System

The air feed system of the engine serves for providing the air intake, its cleaning and supply of cleaned air from filters 1 (figure 5.7) to the engine through pipelines, branch tubes, tubes and hoses. The system has four air filters, air pipelines with attachment and sensors 10 of filter clogging.

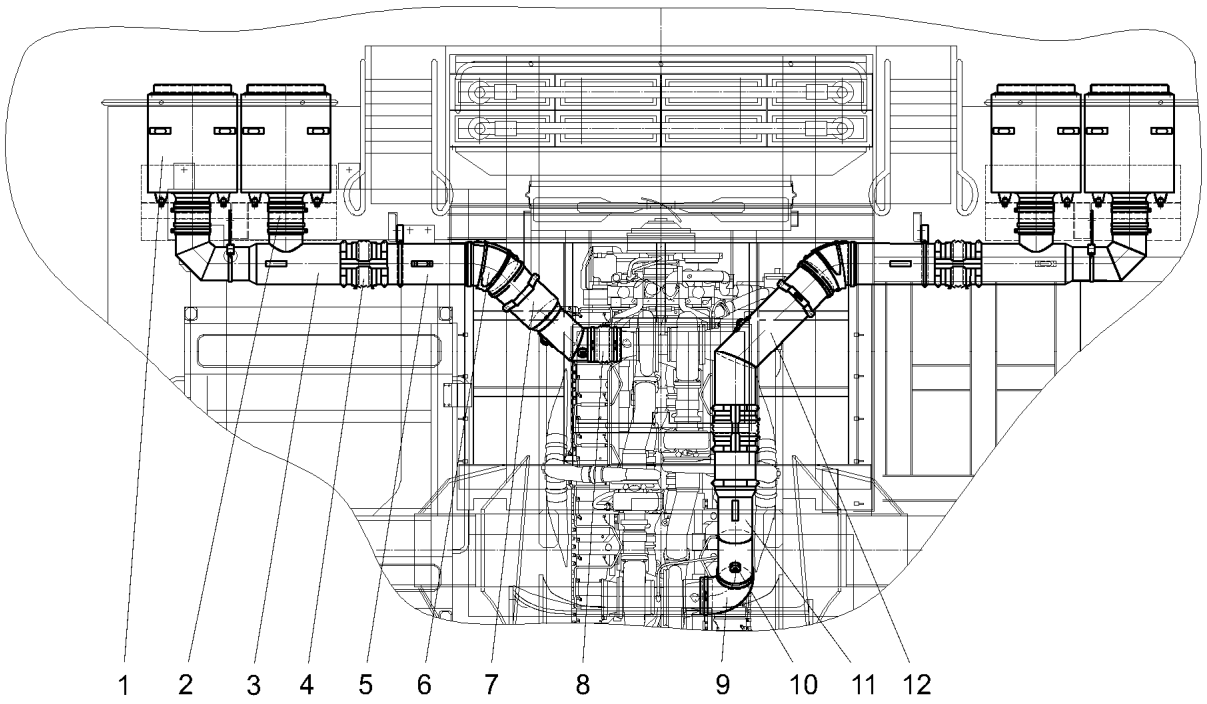


Figure 5.7 – Installation of engine air filters:

1 – air filter; 2 – tube; 3, 5, 7, 11, 12 – pipelines; 4, 6, 8 – branch tubes; 9 – angled hose; 10 – sensor of clogging;

Air filter (figure 5.8) is of combined three-stage type with cardboard filter elements. The first stage consists of centrifugal inertial apparatus (cyclone) 9 for preliminary cleaning of air; the second stage consists of the paper filtering element 2 for final cleaning of air and safety element 3.

The inertial apparatus consists of ten cyclones 9 closed by the cover 8. Under the action of the underpressure in the suction chamber of the turbocharger, the outside air is sucked into the cyclones through swirlers. In the swirlers, the air is brought into the rotary motion due to that the coarse dust particles are separated from the air flow and removed through the holes E in the cyclones.

The air cleaned in the inertial apparatus is passed through the final-cleaning filtering element 2 and protective element 3. Filter elements are made of special lightweight paper of low resistance to air flow and high filtering capacity. The filter elements are made in the form of the cylinders and consist of corrugated paper filter, internal and external protective covers made of corrugated metallic sheets, upper and lower covers. Each filter comprises one main and one protective filtering element fastened to the holder 4 by means of the nuts.

The protective element protects the engine in case of damage of the main element.

The air cleaned in the filters is fed to the turbocharger via suction pipeline. The sensors of clogging of the filters are mounted on the pipes downstream the air filter for monitoring the condition of the main filtering element.

As the filtering element gets clogged, the underpressure in the suction pipeline increases; on reaching the maximum allowable state the sensor operates and the warning lamp on the control board lights up to signal about the necessity of replacement of the main filtering element.

The air filter operates in the winter-summer mode. In the «winter» mode as the outer air so the air of the engine compartment are sucked, in the “summer” mode the cover is mounted so that only the outer air is sucked.

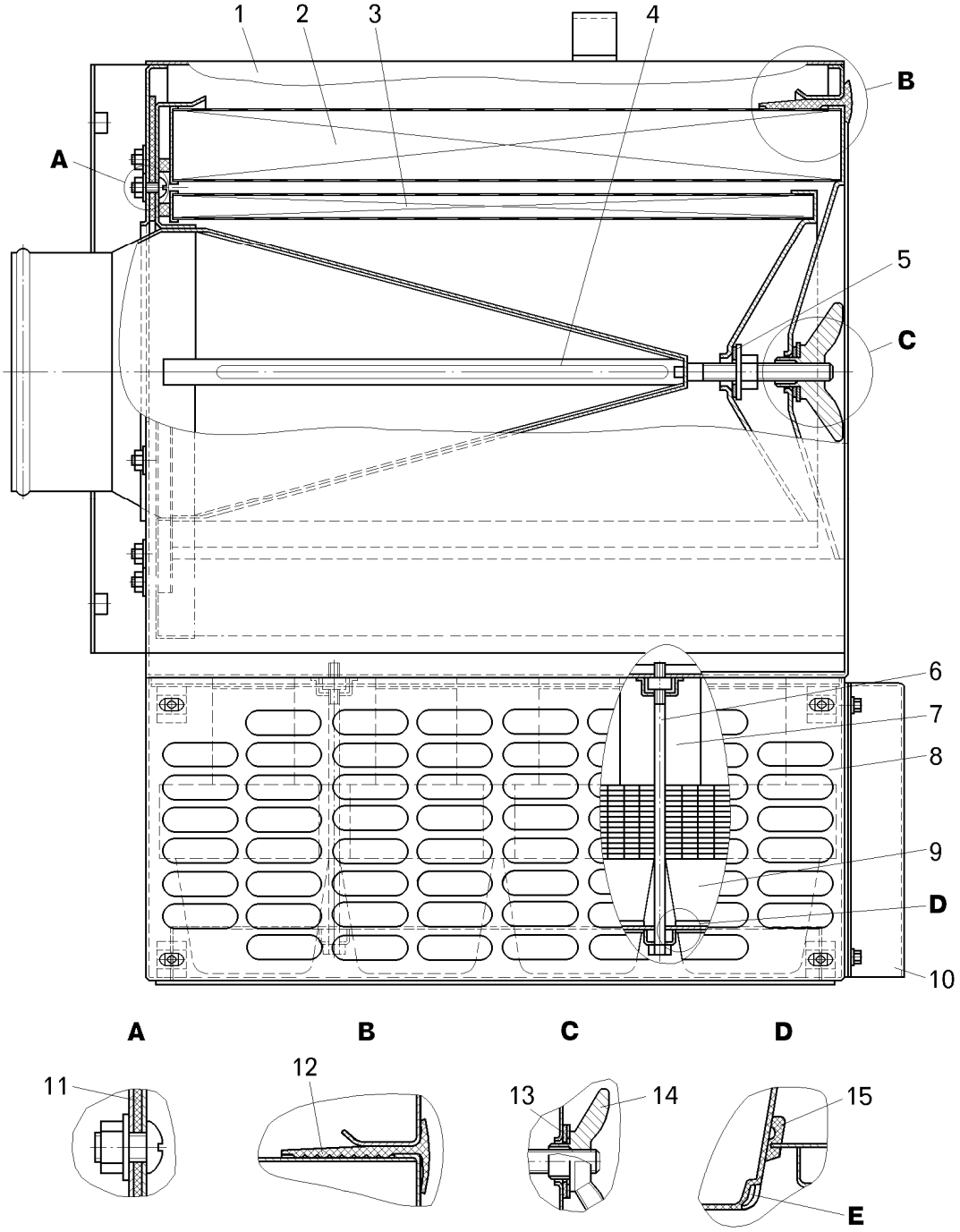


Figure 5.8 – Air filter:

1 – air filter body; 2 – main filtering element; 3 – protective filtering element; 4 – filtering element holder; 5, 11, 13 – sealing gaskets; 6 – cyclone holder; 7 – cyclone pipe; 8 – cover; 9 – cyclone; 10 – dust guard; 12 – seal; 14 – nut; 15 – cyclone seal;
E – dust-throwing hole in the cyclone hood

5.4 Engine Cooling System

Engine cooling system is of closed liquid type, with the forced circulation of the cooling fluid. It consists of two independent circuits: circuit for engine cooling and circuit for cooling the charge air. The engine starting preheater and the cab heater radiator are connected to the engine cooling system. The cooling system of the truck in the tropical version is not equipped with the radiator louvers, engine starting preheater.

The optimum temperature regime of the engine is maintained automatically by opening temperature regulators, powering on the fan and opening of shutters of the radiators depending on the cooling fluid temperature. The engine cooling prior to its stoppage is performed forcedly by powering on the fan and opening of shutters of the radiators by the switch located on the control board.

The fan impeller is mounted on the engine and the radiator shutters have automatic control actuator from the pneumatic cylinder.

It is recommended to use special low-freezing cooling fluids for the engine cooling system according to the operating manual for the engine in all seasons.

IT SHOULD BE REMEMBERED THAT LOW-FREEZING COOLING FLUID IS TOXIC AND IN CASE OF BREACH OF SANITARY STANDARDS CAN CAUSE THE INTOXICATION.

Radiators are five-row with solid-drawn flat-oval pipes, single-pass, split ones, are mounted in front of the engine in two units. Each radiator unit is mounted on three supports and from both sides is fixed by means of rods to the brackets of the fenders from both sides.

The radiator consists of two casings, the upper and lower ones, with five-row seamless plane-oval tubes and cooling plates. Between the casings there is a spacer sealed by means of gaskets on both sides. The end plates of the casings and the spacer are bolted together. The upper and lower radiator tanks are bolted to the end plates of the casings and sealed by means of gaskets. From the sides, the casings are closed by pillars which are fixed to the tanks and spacer. From the sides, the casings are closed by pillars which are fastened to the tanks and spacer.

The radiators are connected through the pillars in pairs into two units. The shutters of the radiators are fixed to the front unit, and to the rear unit - the fan guard. The brackets mounting of the units to the truck frame are bolted to the lower tanks of the radiator units.

The expansion tank is provided with a filler neck through which the system is filled with cooling fluid. The cooling fluid level shall be to the bottom end of the filler neck pipe.

The filler cap are leak-proof and fitted with the vapour and air valves.

The cooling liquid level sensor is installed in the expansion tank. In case of emergency cooling fluid level in the engine cooling system, the warning lamp on the control panel lights up and the audible alarm is switched on at the same time.

Draining the cooling fluid.

To drain the cooling fluid from the system quickly and completely, it is necessary to remove the cap from the expansion tank and open the cocks. When screwing out the cap of the expansion tank, be careful and wait for cooling down of the engine cooling fluid, because the steam in the tank can be pressurized.

After draining the fluid, refit the cap and leave the cocks open. To drain the cooling fluid from the cab heater radiator, open the cock on the pressure pipeline.

To drain the cooling fluid, open the drain cocks on the engine (see the operating manual for the engine), cock on the starting preheater, cock on outlet pipe from the preheater and cocks on outlet pipes from the radiator and pipes of cooling system (from below).

It is possible to install the plugs instead of cocks in the cooling system.

It has been practically ascertained that on the engine after draining the cooling fluid through all the above valves due to the engine design features the complete draining of the cooling fluid from the upper portion of the bodies of the thermostats and, respectively, water pipes connecting the thermostats with the radiator is not ensured because the thermostat valve in closed position closes tightly bypass hole in the casing and do not let drain the cooling liquid. To remove the cooling fluid from the thermostat boxes completely, it is necessary to disconnect the water pipes from them and drain or remove water through the opened holes with disassembling the thermostat boxes along the split line.

5.5 Engine Preheating System

Dump trucks of tropical modification are not equipped with start-up preheater.

For facilitating the engine starting at the low temperature, the dump truck is equipped with ПЖД-600 (figure 5.9) starting preheater which is operated on diesel fuel. The preheater is connected to the engine feed and cooling systems.

At fuel combustion in the preheater boiler the heat is developed. The circulation pump passes the fluid through the preheater cooling jacket, where it is heated, fed to the engine cooling jacket and returned again to the preheater boiler.

The preheater boiler consists of four cylinders made of stainless steel which form the outer and inner cooling jackets, respectively.

The fluid is fed under pressure by means of the circulation pump 4 to the boiler via the pipe 11, passed through the outer and inner jackets of the boiler, heated and drawn into the engine through the fitting 6 for heating the engine.

The preheater burner consists of the outer cylinder 17, to which the cover and the flange for fastening the combustion chamber are welded, and the inner cylinder 14. The primary air swirler 16 is located between the cover and the inner cylinder. For maintaining the stable burning, the inner cylinder of the burner has three rows of holes, through which the secondary air is fed into the combustion chamber.

The pumping unit of the preheater is driven by the electric motor 2 connected to the dump truck storage batteries. The air charger 3 of the pumping unit as well as the circulation pump 4 are fastened to the electric motor body from the side of the long output end of the shaft and the gear fuel pump 1 – from the side of the collector.

The fuel pump is provided with a reduction valve for controlling the quantity of the fuel to be fed. To increase the quantity of fuel delivered to the preheater through the injector, it is necessary to turn in the reduction valve screw until flame traces appear from the preheater exhaust pipe.

The preheater injector is of centrifugal type with stacked plate filter. To clean the injector from dirt, it is necessary to remove it, disassemble, wash the plate filter, clean out the hole in the chamber and central hole.

After assembling the injector, it should be checked for atomization of fuel. To do this, switch on the pumping unit without connecting the solenoid valve to the preheater boiler and open the solenoid valve for feeding the fuel into the injector. The injector shall atomize the fuel in the form of fog-like cone with the angle of at least 60^0. The solenoid valve 18 serves cuts off the fuel feeding to the injector when switching off the preheater.

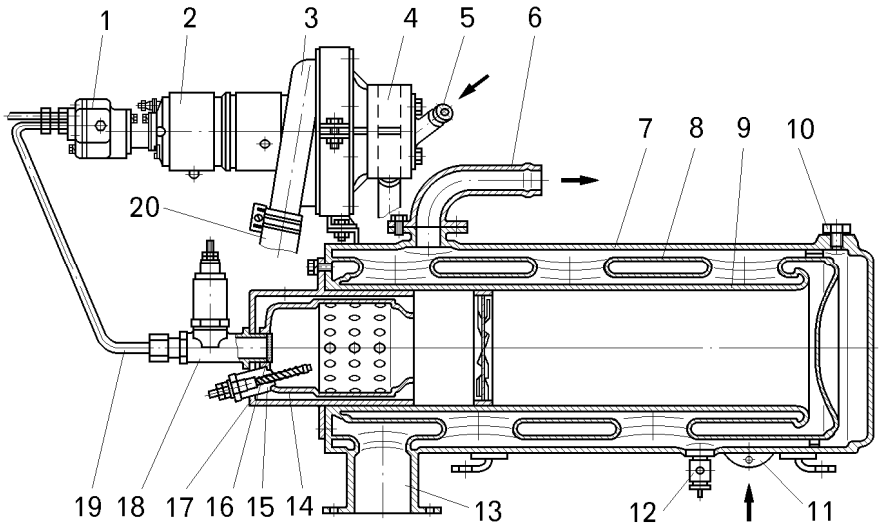


Figure 5.9 – Starting preheater:

1 – fuel pump; 2 – electric motor; 3 – supercharger; 4 – circulation pump; 5 – coolant suction branch pipe; 6 – branch pipe for the preheated fluid removal; 7 – outer liquid jacket; 8 – reverse gas flue; 9 – inner liquid jacket; 10 – plug; 11 – pipe for feeding coolant from the circulation pump into the boiler; 12 – drain cock; 13 – exhaust branch pipe; 14 – inner cylinder of the combustion chamber; 15 – glow plug;16 – swirler; 17 – outer cylinder of the combustion chamber; 18 – solenoid valve with injector; 19 – fuel pipe; 20 – air duct

The glow plug 15 is intended for ignition of fuel when firing the preheater.

When firing the preheater, the fuel is fed by means of the pump through the open solenoid valve into the injector and further, under pressure into the combustion chamber. In the combustion chamber, the fuel is mixed with air delivered by the fan and ignited from the glow plug at the starting moment. After igniting the fuel, the glow plug is de-energized and the burning is maintained automatically.

Prior to start-up the preheater open the isolating cocks on the inlet and outlet branch pipes of the cooling system, check the fuel presence in the fuel tank, open the cock on the fuel tank.

Prior to firing the preheater, it is necessary to open isolating cocks of the cooling system located at the fittings at the preheater inlet and outlet, check the presence of fuel in the fuel tanks, open the cocks on the fuel tank and fuel heater. Set the electric motor switch 4 (see Figure 4.6) to the “Работа” (Operation) position for 10 – 15 s. The solenoid valve switch 3 shall be in the “Продув” (Blowing down) position.

Switch on the glow plug for 30 – 40 s by turning the switch 2. Then the control spiral 1 located at the control board by the heater and connected serially with the plug shall become heated to bright red colour. After 30 – 40 s from the moment of energizing the glow plug, set the solenoid valve switch 3 to the “Работа” (Operation) position and the motor switch 4 – to the “Пуск” (Start) position. At the ambient temperature of above minus 15^0C, the switch 4 on the control panel may be set immediately to the “Работа” (Operation) position without setting it to the “Пуск” (Start) one. After ignition of fuel in the preheater burner that can be detected by buzzing of the flame, release the lever of the glow plug switch and set the switch 4 to the “работа” (Operation) position.

If no specific rumble of the flame is heard from the preheater boiler, set the electric motor switch 4 to the neutral position and the solenoid valve switch 3 – to the “Продув” (Blowing down) one and then repeat the starting process.

If the preheater failed to start working within 3 min, check the presence of fuel in the fuel pump; to do this, disconnect the tube for feeding the fuel to the fuel pump and vent the air plugs.

Once the fuel flow appears again, reconnect the tube and repeat the starting process. If the preheater fails to run after that, check the fuel feeding into the combustion chamber and the glow plug incandescence.

The preheater running is considered normal, if at uniform buzzing of the flame in the boiler, after 3 – 5 min the pipeline feeding the fluid to the engine cooling jacket will be hot and the outer cover of the boiler – cold. If the boiler cover gets hot and there are pulses of boiling fluid, switch off the preheater, determine the cause of absence of the circulation and eliminate the fault.

To switch off the preheater, cut off the fuel feeding into the combustion chamber by setting the solenoid valve switch 3 to the “Продув” (Blowing down) position to remove the residues of combustion and exclusion of possible gas explosion at further starting. After 1 – 2 min of operation without burning, switch off the electric motor by setting the switch 4 to the neutral position.

When using the starting preheater, observe the following rules:

– never leave the dump truck during the operation of the preheater. Be ready to eliminate immediately any fault having arisen. In case of fire, shut immediately the cock on the fuel tank, switch off the preheater and then proceed to extinguishing the fire;

– never warm up the engine in a closed room without ventilation; otherwise the personnel could be poisoned with carbon monoxide;

– engine start-up preheater is connected to the engine cooling system through shutoff cocks, excluding the circulation of coolant through the preheater when the engine running;

– start-up the preheater without cooling fluid in the boiler and adding the cooling fluid into the overheated boiler is prohibited; otherwise the boiler can be damaged;

– prior to the start-up the preheating, after the cooling system filling, open the shutoff cocks on the branch pipes, back off two-three turns the plugs, located at inlet and outlet pipes, preheater boiler and release the air out of the system;

–simultaneous operation of the preheater and the engine is prohibited. After the engine preheating to shutdown the preheater, close the shutoff cocks and after that start-up the engine;

– it is necessary to keep cleaned as preheater as the engine because oiled engine and fuel leakage can cause fire;

– the restart of the preheater immediately after its stoppage without preliminary blowing down within 3 – 5 minutes is prohibited.

5.6 Engine Pneumatic Starting System

Installation of the engine pneumatic starting system along chassis is showed in Figure 5.10, schematic diagram of the system is shown in Figure 5.11.

The engine pneumatic starting system is powered from pneumatic system of the truck though reverse flow valve. The working pressure of compressed air in the engine starting system is 0,65 – 0,8 MPa.

For the first start-up of the engine must be filled with compressed air system from an external source via the 7 square (see figure 5.10), located on the right frame side member. The working pressure of compressed air in the engine starting system from external source of compressed air is limited by safety valve and is (1,5 $\pm$ 0,15) MPa.

When voltage is applied from the ignition key switch the electromagnet valve 3 gets opened and from receivers 5 when shut-off cock 4 is open the compressed air is supplied to the pneumatic starter 9. The pneumatic starter gear gets engaged engine flywheel ring gear. Thereafter, a channel in the pneumatic starter gets opened and through it the compressed air is supplied to the starting valve 2. The valve gets opened and compressed air is supplied from the receivers to the pneumatic starter motor. Pneumatic starter gets actuated and rotates the crankshaft.

For the lubrication of the pneumatic engine impelers during the start-up is used the doser 8, the oil is supplied along the pipeline from the reservoir 1.

To drain the condensate on each of the receivers is installed the cock.

The technical examination and repair of the cylinders, pressure gauges, safety valves and fittings shall be performed according to the requirements and regulations stated in the “Rules for Design and Safe Operation of Pressure Vessels”.

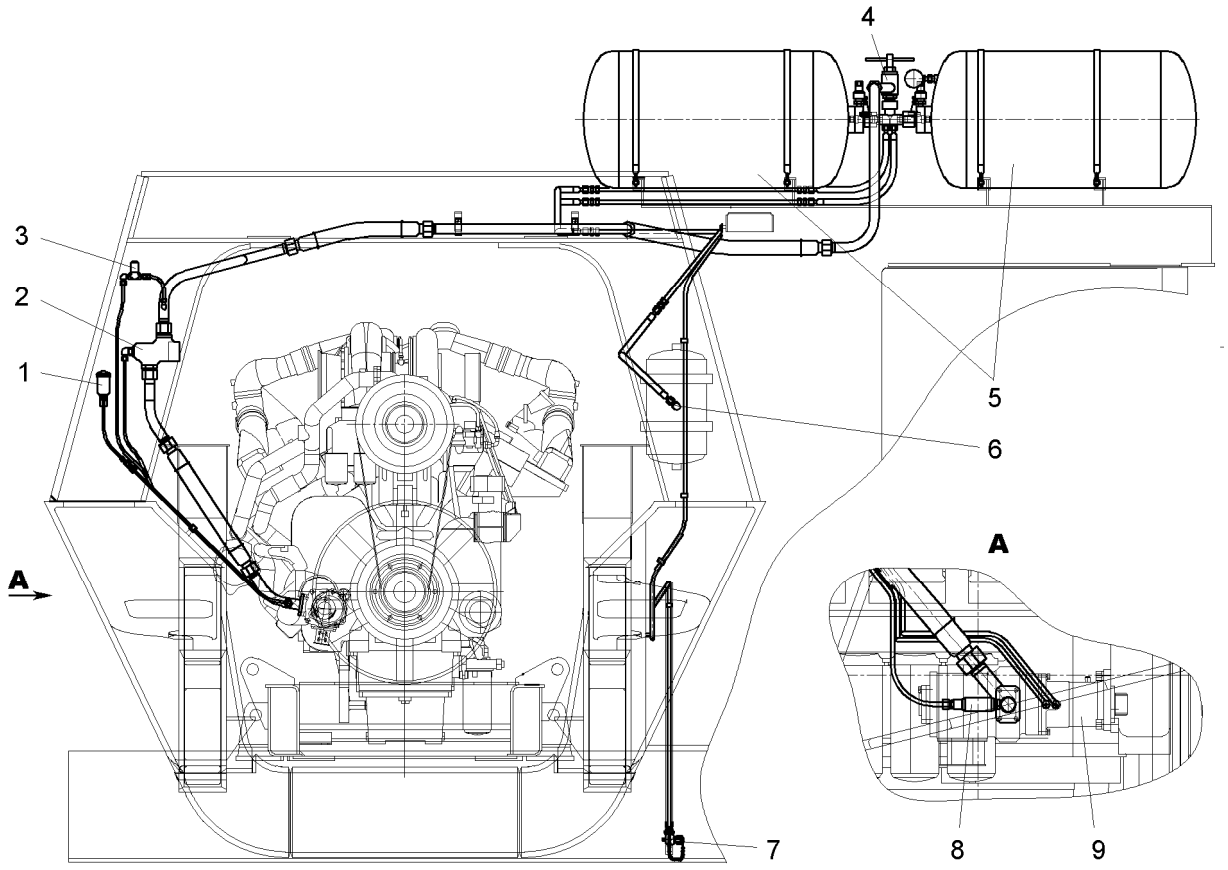


Figure 5.10 – Installation of the engine pneumatic starting system:

1 – tank; 2 – starting valve; 3 – electromagnet valve; 4 – shut-off cock; 5 – air cylinders; 6 – pneumatic system receiver; 7 – knee-piece; 8 – lubricating dozing unit; 9 – pneumatic starter

IT IS ONLY ALLOWED TO DISASSEMBLE OF THE SYSTEM AND ITS ELEMENTS, DISMANTLE OF THE FITTINGS AND PIPELINES AND/OR PERFORM THE PREVENTIVE AND WELDING WORKS AFTER RELEASING THE AIR PRESSURE IN THE SYSTEM TO THE ATMOSPHERIC LEVEL. AIR SHALL BE VENTED FROM THE SYSTEM THROUGH THE CONDENSATE DRAIN COCKS; WHEN DOING THIS THE SHUTOFF VALVES OF THE AIR RECEIVERS SHALL BE OPEN.

IT IS PROHIBITED TO ADJUST AND/OR OPERATE THE PNEUMATIC STARTING SYSTEM WITH FAULTY PRESSURE GAUGES AND WITHOUT SEALS ON THE SAFETY VALVES.

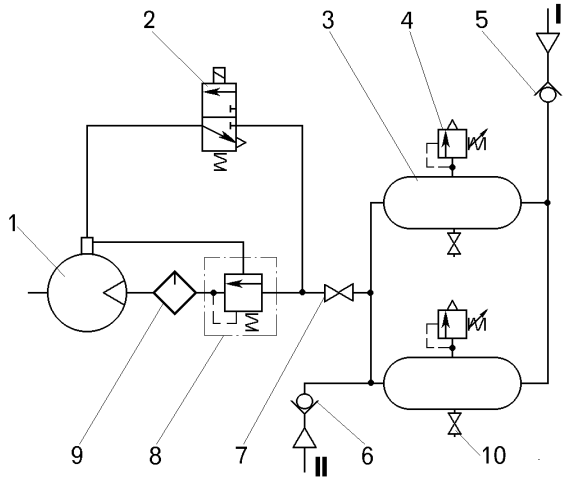


Figure 5.11 – Schematic diagram of the pneumatic starting system of the engine:

1 – pneumatic starter; 2 – electromagnet valve; 3 – receiver; 4 – safety valve; 5, 6 – reverse-flow valve; 7 – shut-off cock; 8 – starting valve; 9 – lubrication dozing unit; 10 – condensate drain cock

I –from the engine pneumatic system; II – from external source of compressed air

The pneumatic starter **is intended for starting the engine and consists of the rotary-vane pneumatic motor 1** (figure 5.12), reduction gear 4 and drive mechanism 6 with forced pneumatic engagement of the gear 8 with the flywheel ring gear.

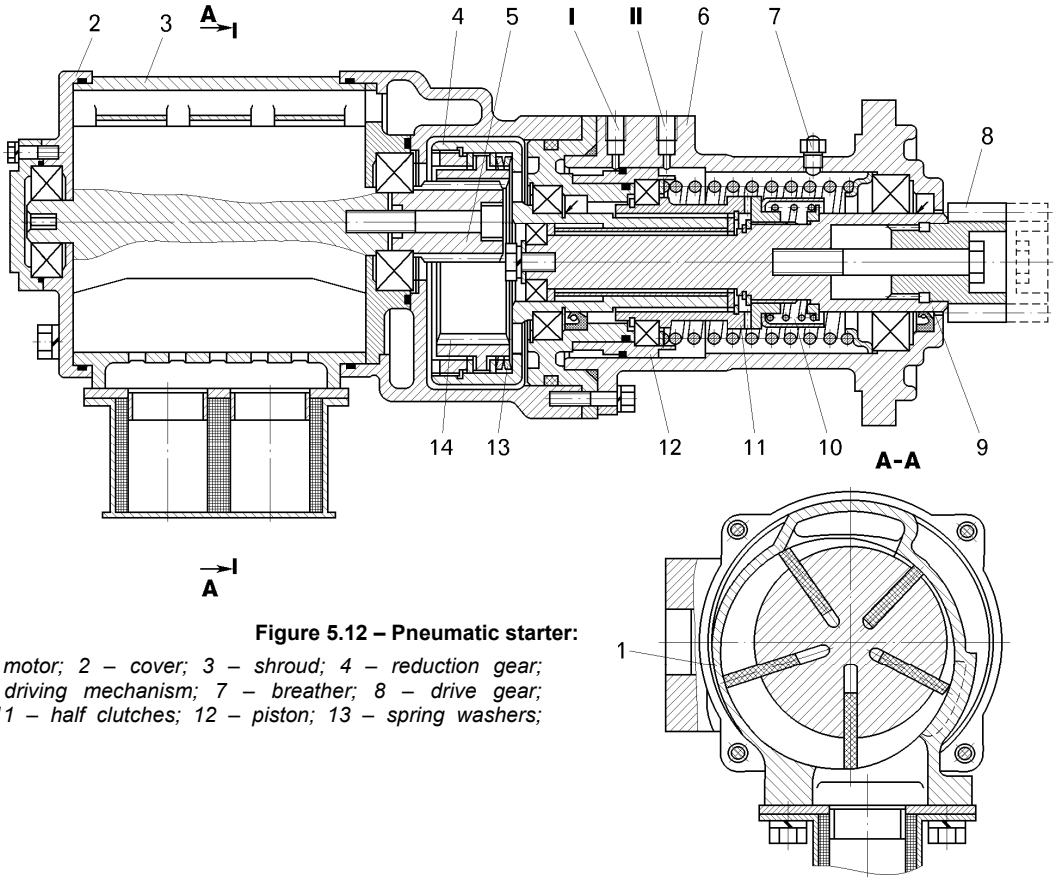


Figure 5.12 – Pneumatic starter:

1 – pneumatic motor; 2 – cover; 3 – shroud; 4 – reduction gear; 5 – drive gear; 6 – driving mechanism; 7 – breather; 8 – drive gear; 9 – driving shaft; 10, 11 – half clutches; 12 – piston; 13 – spring washers; 14 – driven gear;

I, II – outlets

The reduction gear has two cylindrical internally toothed gears 5 and 14. The friction clutch with spring washers 13 limiting the torque is installed in the driven gear. The drive gear driving mechanism has a ratchet clutch preventing the transmission of the counter-rotation to the pneumatic motor after starting the engine. The pneumatic starter bearings are of closed type.

To start the driving mechanism, compressed air is fed to the outlet I. The piston 12 together with the driving 11 and driven 10 half-clutches and shaft 9 move to the right and engage the gear 8 with the flywheel ring gear. The piston connects the outputs I and II and the pneumatic motor starts running.

When being run, the pneumatic starter is lubricated with oil from the tank through the lubrication dozing unit, prior to filling the tank with oil for the first time, it is necessary to vent air from the pipelines.

The starting valve ensures the compressed air feed from the receivers to the pneumatic starter at the moment of starting the engine.

When feeding the compressed air from the electric valve to the cavity III (figure 5.13) the spool-type valve 4 moves to the left (as seen in the figure) and connects the cavity II with the cavity IV. The compressed air is fed from the receivers to the pneumatic starter.

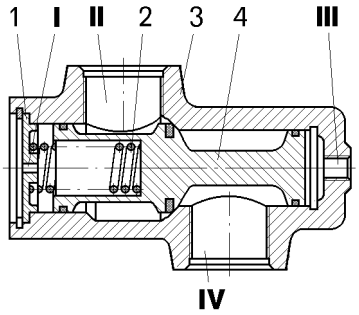


Figure 5.13 – Starting valve:

1 – thrust; 2 – spring; 3 – body; 4 – spool;
I – to the atmosphere; II – to the pneumatic starter; III – from the solenoid valve;
IV – from the receiver

The lubrication dozing unit is intended for lubricating the impellers of the pneumatic motor during the start.

The cavity I (figure 5.14) is connected with the inlet pipeline of the pneumatic starter and oil from the tank is fed to the cavity II. When starting the engine, compressed air moves the piston 2 to the right (as seen in the Figure) and the ball 7 shuts off the channel connected with the tank and the valve 6 drops open and oil being under the piston is displaced into the intake duct. In the intake duct, oil is caught by the compressed air flow and fed to the pneumatic motor cavity to lubricate its parts.

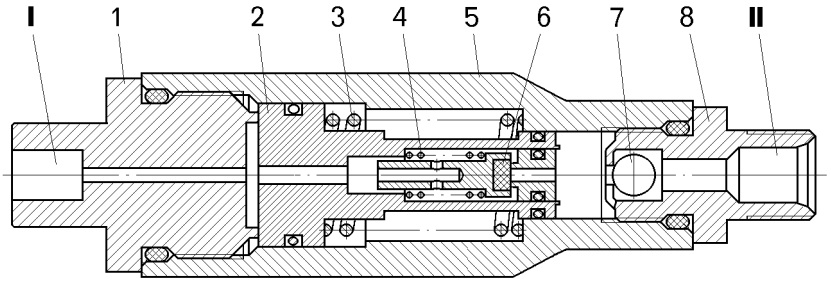


Figure 5.14 – Lubrication dozing unit:

1 – throttle; 2 – piston; 3, 4 – springs; 5 – body; 6 – valve; 7 – ball; 8 – valve body;
I – cavity connected with the intake duct of the pneumatic starter; II – cavity connected with the tank

The safety valve is screwed into the body of the air cylinder. The valve shall be drop open under the pressure of (1,5 $\pm$ 0,15) MPa and drop shut under the pressure of ($1,2_{-0.1}$) MPa.

To adjust it, screw the bushing 5 (figure 5.15) into the body 3. During the operation, the safety valves shall be adjusted at least once a year.

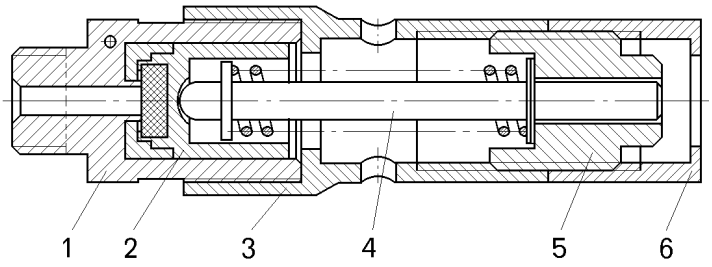


Figure 5.15 – Safety valve:

1 – seat; 2 – valve; 3 – body; 4 – rod; 5 – pressure bushing; 6 – nut

Reverse-flow valve (figure 5.16) is designed for protection of circuit against compressed air loss in case of drive tightness failure. The valve provides air passage only in one direction – to receivers of pneumatic starting system. Air can't pass in reverse direction.

Compressed air goes through outlet II to inlet valve 5, opens it, releasing spring 4, and goes through holes in valve guide 2 to air cylinder. After pressure reduction in outlet II the valve is closed under spring force and separates outlets I and II, preventing passage of compressed air in reverse direction.

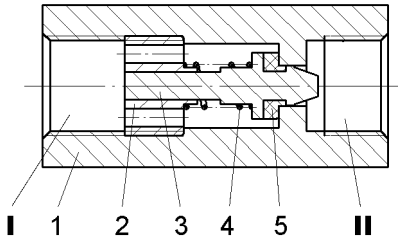


Figure 5.16 – Reverse-flow valve:

1 – body; 2 – valve guide; 3 – rod; 4 – spring; 5 – inlet valve;

I – outlet connected to receiver of pneumatic starting system; II –outlet connected to receiver of pneumatic system or outside source of compressed air

5.7 Exhaust System

On the dump trucks the exhaust gases from the supercharger through the inlet pipes 1 and 9 (figure 5.17), metal hoses 14, exhaust pipes 2 and 3 pass to the branch pipes 6 and further to the body for its heating.

To provide fire safety requirements intake and exhaust tubes are with thermo insulation and on the metal hoses are installed thermo isolating shrouds 11.

The body serves as a muffler.

When mounting the metal hoses in confined state fix it with the clevis 10 on the inlet tube in accordance with the pointer directing exhaust gases. Spread the hose till the complete extension of the band 13, pointing the average mounting length having put it on the exhaust tube. To fix it with the clamp 15. Tightening torque of the clamps 25 – 35 N.m. It is allowable not to remove the band after the installation completion.

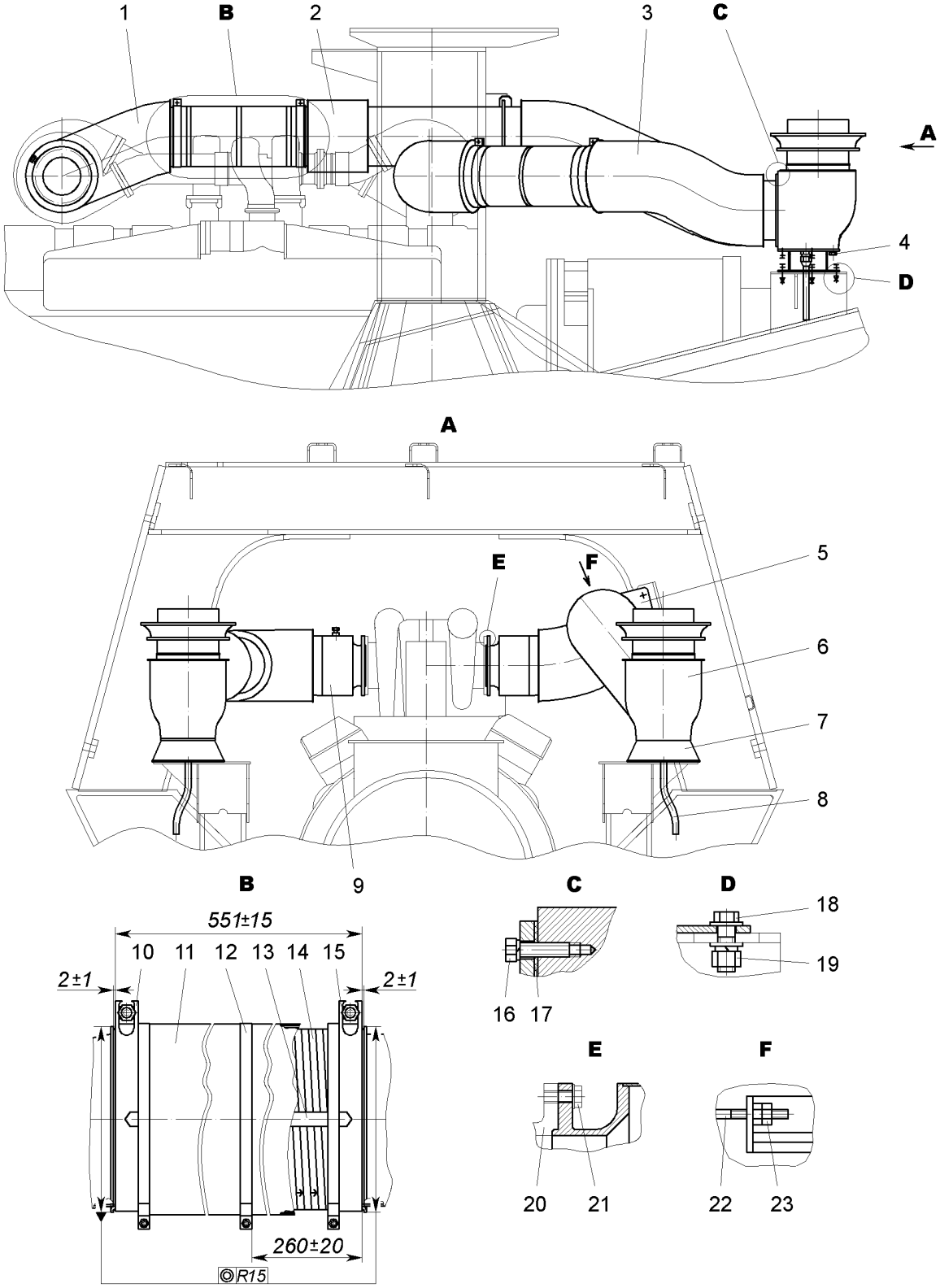


Figure 5.17 – Installation of the exhaust system:

1, 9 – inlet tubes with thermo insulation; 2, 3 – exhaust tubes with thermo insulation; 4, 16, 18, 21 – bolts; 5, 7 – brackets; 6 – branch pipe; 8 – tube; 10, 12, 15 – clamps; 11 – thermo insulation shroud; 13 – band; 14 – metal hose; 17 – gasket; 19, 23 – nuts; 20 – flange of turbocharger; 22 – portable ladder

5.8 Maintenance of the Engine Systems

The maintenance of the engine systems consists in regular inspection of their condition, their fastening, refilling them with operational materials and checking their serviceability.

For the schedule of the engine maintenance and order of the maintenance works, see the operating and maintenance manual for the engine.

Daily maintenance (DM).

When performing the daily maintenance:

– check and if necessary refill oil in the engine pan and tank of the pneumatic starting system, coolant liquid in the cooling system and fuel in the fuel tank.

The oil level in the pan shall be between the marks (maximum and minimum) on the oil measuring ruler; the check shall be performed not earlier than after 5 min from the moment of stopping the engine on the truck placed in strictly horizontal position (see the operating manual for the engine).

For trucks with **pneumatic starting system** fill the tank of pneumatic starting system with motor oil SAE15W/40, if necessary, vent air from the pipelines. The oil level shall be lower of the top edge of the tank body by 15 – 20 mm when filling for the first time, it is necessary to vent the air from the pipelines.

The expansion tank of the cooling system shall be filled with the cooling fluid to the bottom end of the filler neck pipe (see the operating manual for the engine).

The fuel tank shall be filled with fuel to the maximum level. To exclude the overflow, the lantern mounted on the front wall of the tank lights up when the fuel level reaches the maximum.

The brands of oils, fuel and cooling fluid to be used are given in the chapter “Operational Materials”;

– to check exteriorly the condition and fixing of pipelines and hoses of engine systems. The pipelines and hoses shall be fixed reliably, the leakage of fuel, cooling liquid and motor oil is not permitted;

– to drain the residual from the fuel tank. To drain the residual in 30 – 40 minutes after fueling the dump truck till the appearance of the clean fuel;

– start-up the engine. The engine shall run reliably over the whole rotational speed range;

– Check the condition and operation of the fuel feed control actuator.

The fuel feed control pedal shall move freely, without jerks. The pedal movement shall provide the variation of the engine rotational speed in the idling mode from the minimum stable to the maximum one;

– Check the clogging of the engine air filters by means of the pilot lamp on the control board. Should the pilot lamp light up, replace the main filtering element. The protective element shall be replaced after each third replacement of the main filtering element;

– Every day, after the shift end, drain the condensate from the receivers of the pneumatic starting system of the engine (for trucks with **pneumatic starting system)**. After complete draining of the condensate from receivers, pump the system again until the pressure regulator operates and only then stop the engine.

Maintenance of the air filter proceeds as follows:

– Turn out the wing nut 15 (see figure 5.8) fastening the main filtering element 2;

– Remove the gasket 13;

– Remove carefully the filtering element from the bowl;

– After fitting the new filtering element or mounting of the new one, check the condition of the element while illuminating it from inside by means of a lamp. No ruptures of paper or damages of sealing elements are allowed;

– Clean the internal cavity of the air filter bowl from dust and dirt using rags moistened in detergent solution. Clean the air filter cyclones from dust using the holes in the cyclones for removing coarse dust particles;

– Insert the filtering element into the air filter bowl and tighten the wing nut with applying the torque from 15 to 20 N.m (hand force) having inserted preliminarily the seal gasket 13.

The approximate service life of the main filtering element is 500 hours.

When replacing the protective filtering element, it is necessary to:

– Turn out the nut fastening the protective element, remove the gasket 5 and remove the filtering element 3;

– Fit the new element and tighten the wing nut with applying the torque 15 – 20 N.m having inserted preliminarily the seal gasket 5.

Maintenance 2 (M-2).

When performing the M-2:

– Perform the operations for servicing the air filters. Clean the cyclones and bowls of the air filters from dust. If necessary, replace the filtering elements (for the sequence of operations, see the daily maintenance).

Maintenance 3 (M-3).

When performing the M-3:

– Check the fastening of all the units to the engine and of the diesel-alternator set to the frame. All the units shall be fastened reliably, if necessary, re-tighten the fasteners;

– Check the fastening of the cooling system radiators to the frame and if necessary, retighten them and clean the outer surfaces of the radiators.

– Check the condition of the rubber shock-absorbers of the diesel-alternator set. The shock absorbers with rubber exfoliated or detached from metal shall be replaced with new ones.

Seasonal maintenance (SM).

When performing the seasonal maintenance:

– Wash the fuel tank, fuel pipes and filtering element of the fuel tank breather. There shall be no sediment on the bottom and walls of the tank, the filtering element shall be clean;

– Once a year, before the beginning of the autumn and winter operation period, perform the maintenance of the engine starting preheating system. Clean the glow plug, injector and burner from scale, wash the solenoid valve filter, cleanse the drain hole of the fuel pump of the engine starting preheating system.

Repeat the maintenance after each 50 hours of the preheater operation.

6 TRACTION ELECTRIC DRIVE

Mine dump truck is equipped with AC traction electric drive (electic transmission) КТЭ-160 manufactured by OJSC “Electrosila” which comprises traction alternator, two electric motor- wheels (reduction gear assembly with traction electric motors), two ventilated brake units, control cabinet, ventilation equipment and complete set of auxiliary equipment.

The documentation for traction electric drive is elaborated by the manufacturing plant, enclosed for shipment and included in the complete set of operating documentation of the dump truck.

6.1 Electric Drive Units

6.1.1 Ventilated brake unit УВТР2х600

VBU is designated to convert electrical energy generated by traction electric motors of motor-wheels in the mode of electric brake of the dump truck to the thermal one and aiming to disperse it over the environment.

When receiving a command to slow down the drive system uses motor-wheels as generators. The generated power is sent by commutation devices to the VBU representing a resistive load. Resistance of the unit serves as "load" for the motor-wheels and prevents their rotation.

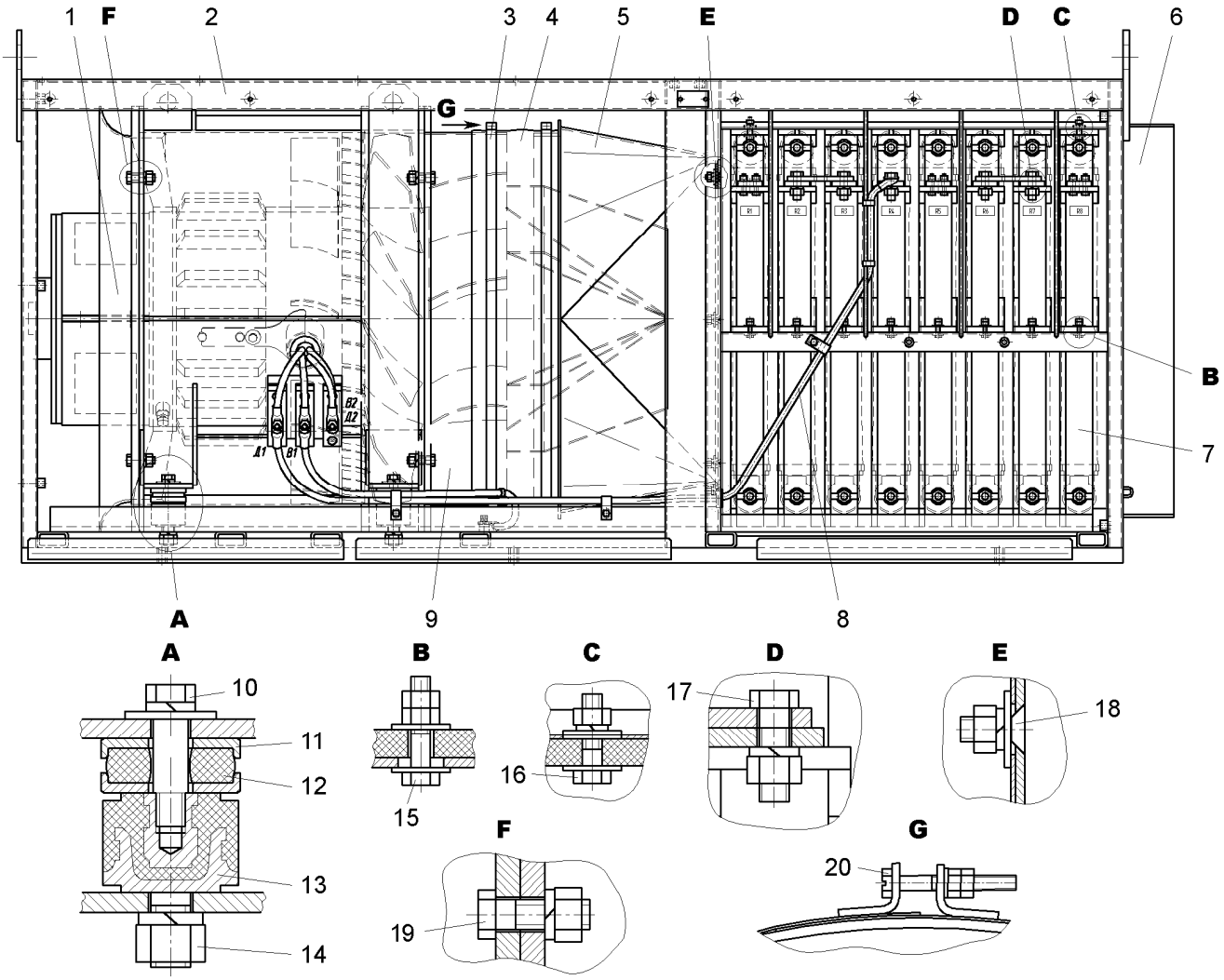


Figure 6.1 – Ventilated brake unit:

1 – fan; 2 – framework; 3 – tape; 4, 5 – branch-pipes; 6 – panel; 7 – resistors section; 8 – power cable; 9 – air duct; 10, 15, 16, 17, 19 – bolts; 11 – washer; 12 – suspension pad; 13 – insulator; 14 – nut; 18, 20 – screws

VBU consists of an axial fan blower 1 (figure 6.1) and two groups of four resistors sections 7 in each. Fan and resistors are interconnected by means of air duct 9, branch pipes 4,5 and two tapes 3. All parts and assemblies of the unit are mounted in the framework 2. The electric drive fan is powered from the resistor R4 of the first group of resistors.

The energy for the rotation of the cooling fan electromotor is generated by traction electric motors of motor-wheels running in the electric braking mode as generators. The intensity of the electric braking is set owing to change of the brake pedal angle via the associated with pedal angle sensor voltage from which is supplied to traction electric drive control system.

When the power generated by motor-wheels during braking rises, the speed of cooling fan electric motor gets increased too, thereby this leads to increasing speed of the air stream cooling brake resistors.

The **fan** comprises DC electric motor 3 (figure 6.2) ДПТВ-16,25-02 or ЭТВ-20М3Л) and fan impeller 5, mounted on the key 6 of the electric motor armature shaft.

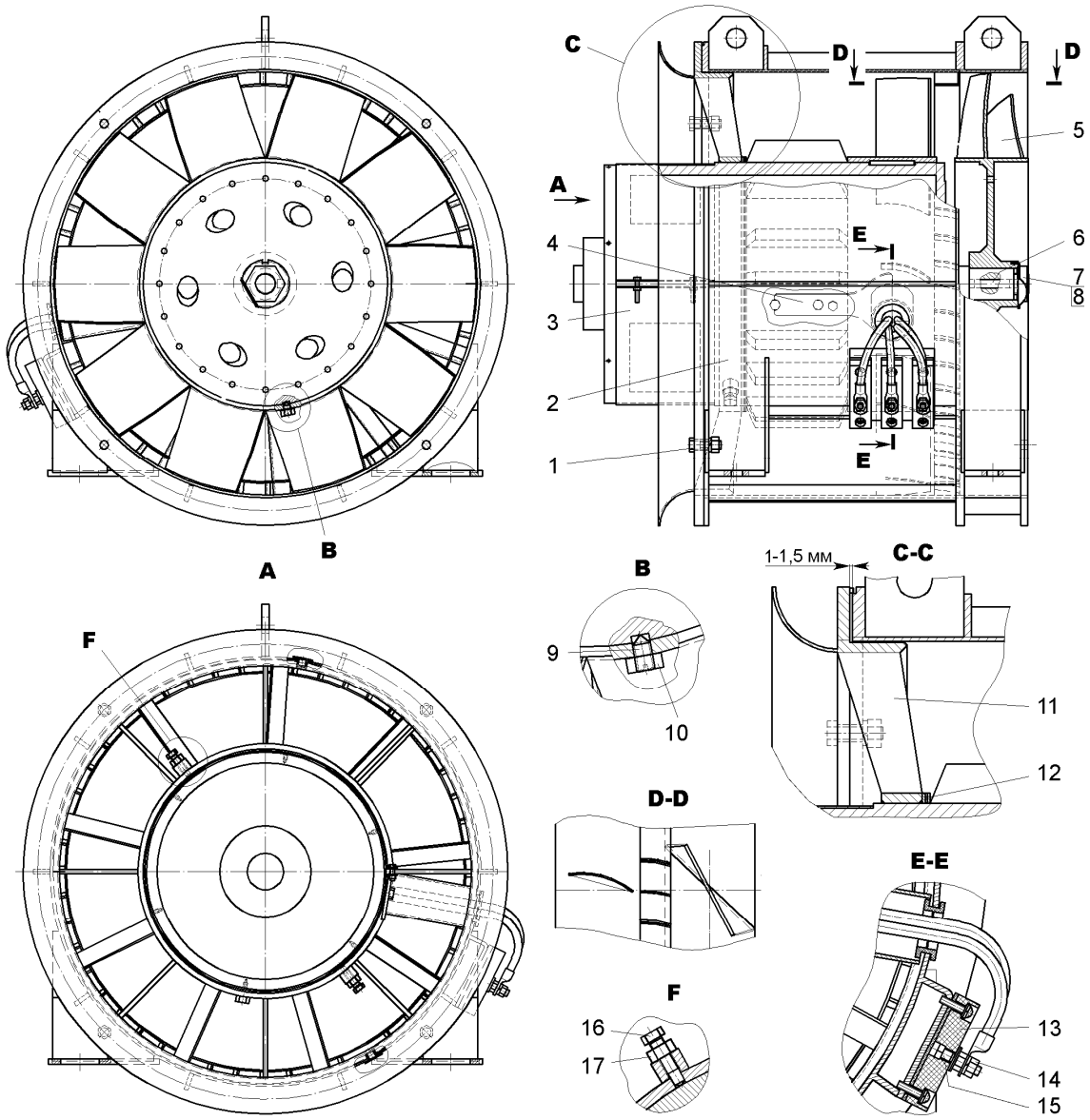


Figure 6.2 – Fan (electric motor ДПТВ-16,25-02):

1, 15, 16 – bolts; 2 – housing; 3 – electric motor; 4 – bracket; 5 – fan impeller; 6 – key; 7, 10 14, 17 – nuts; 8 – washer; 9 – locking screw; 11 – support; 12 – rings; 13 – carrier socket

The impeller is fastened on the shaft with the nut 7 which is secured from loosening by the washer 8.

Electric motor is mounted in the inner space of the shroud 2, in the front part it is centered by the shroud itself, in the rear part by means of the support 11. The gap between the end surfaces of the shroud 2 and support 11 shall be 1-1, 5mm and is set before bolt tightening 19 with the rings 12 (only for electric motor ДПТВ-16,25-02). Electric motor fixing in the shroud is performed by means of bolts 16, screw 9 and bracket 4 (screw and bracket are only for the electric drive ДПТВ-16,25-02). Bolt and screw are fixed with the nuts 17 and 10 correspondingly. For the motor ЭТВ-20М3Л the pin 20 (figure 6.2a) is installed additionally.

In order to increase the capacity of the fan impeller is applied the unit of guiding blades mounted in the fan shroud. Fan unit is mounted on rubber shock absorbers 12 (figure 6.1) to reduce the vibration loads on VBU parts and assemblies.

To pour lubricant to the bearings of the fan ЭТВ-20М3Л when servicing it is necessary to unscrew plugs 16 (Figure 6.2a) in the pipes 1 and 5 to the drainage holes of the outer bearings covers.

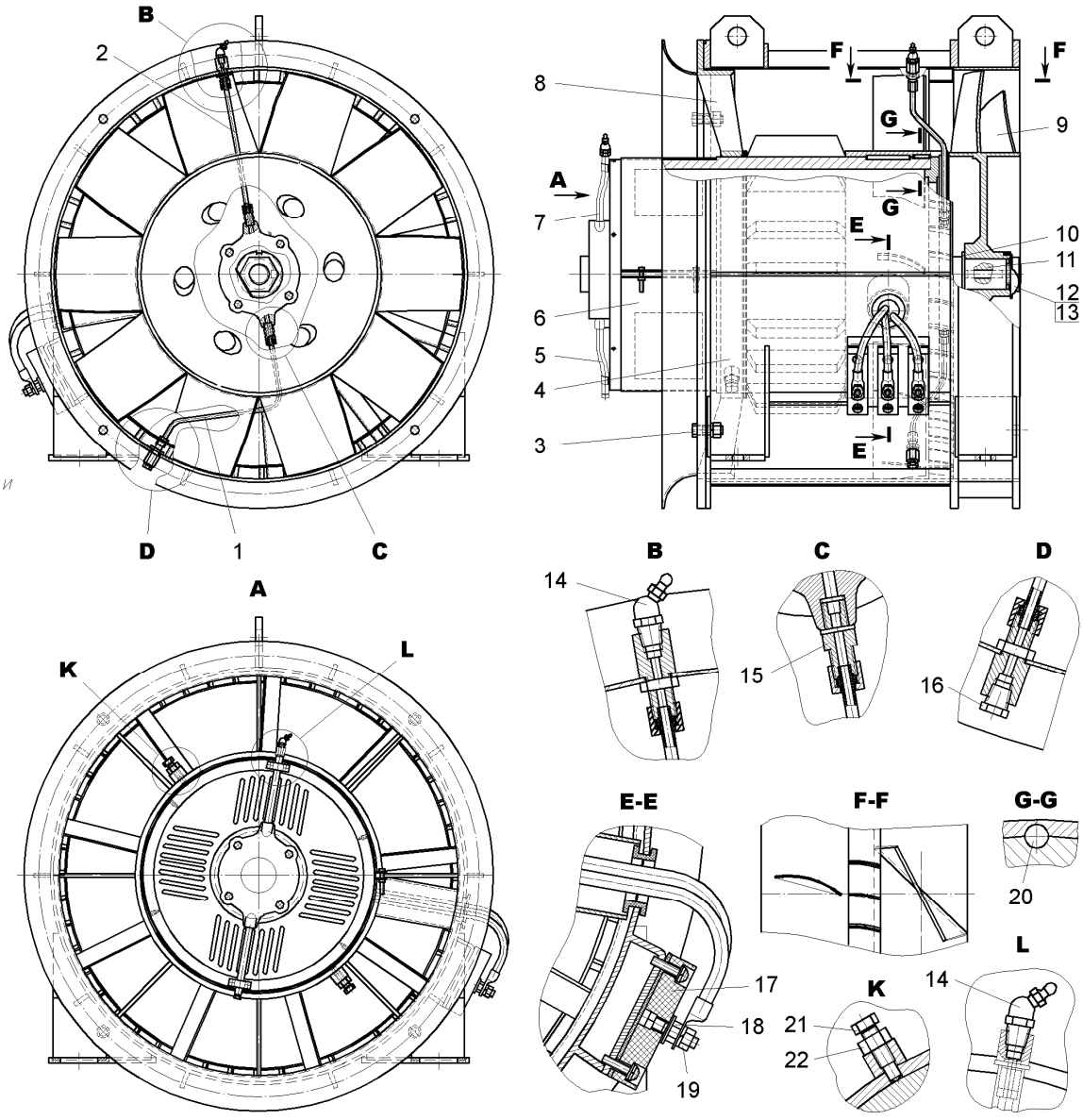


Figure 6.2a – Fan (electric motor ЭТВ-20М3Л):

1, 2, 5, 7 – pipes; 3, 18, 21 – bolts; 4 – shroud; 6 – electric motor; 8 – support; 9 – fan impeller; 10, 13 – washers; 11 – key; 12, 19, 22 – nuts; 14 – greaser; 15 –tip; 16 – plug; 17 – carrier socket; 20 – pin

Press in grease till old one is displaced and new grease appears through greasers 14 mounted in pipes 2 and 7 connected to the pressure holes of the outer bearings covers. Let the electromotor run for two – three shifts of the truck operation with open drain holes to let the excessive grease outlet, then close holes using plugs 16.

The resistors section comprises eight resistors sections interconnected by buses. The resistor 4 (Figure 6.3) is made of multiply curved flat fecral tape. Two outputs are soldered (riveted) to the tape ends. To provide rigidity to the structure there are side frames 5 mounted at both sides made of non-combustible material; they are strapped together by rods 8, insulated pipes 7. The curved parts of the tape are fastened to the rod by means of steel holders 1 and 2.

Resistor, held by steel holders is attached to the rods through ceramic insulators 9 and gaskets 10, which in their turn are pressed by springs 12 for compensating thermal expansion of insulators.

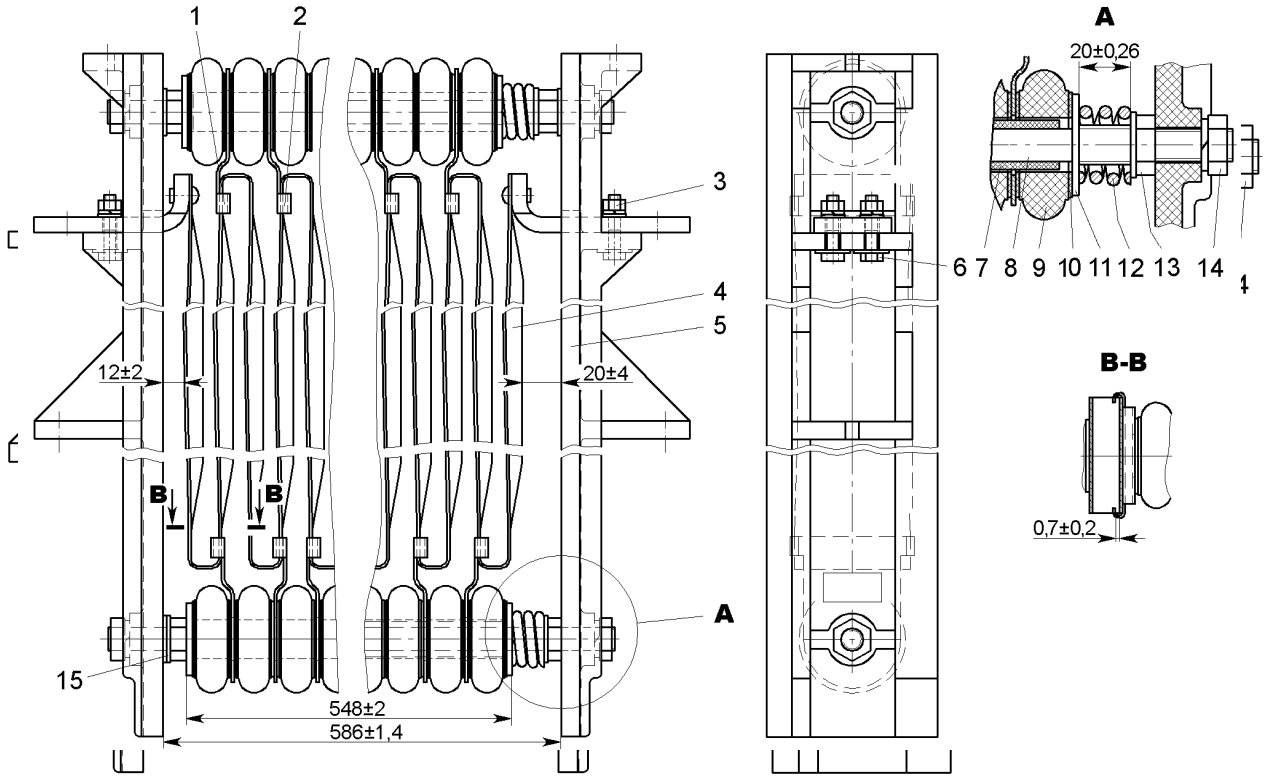


Figure 6.3 – Resistors section:

1, 2 – holders; 3, 13, 14 – nuts; 4 – resistor; 5 – side frame; 6 – bolt; 7 – tube; 8 – pin; 9 – insulator; 10 – gasket; 11 – washer; 12 – spring

6.1.2 Installation of running control unit and brake pedal of auxiliary brake

Installation of the running control unit is shown in figure 6.4.

Installation force of the spring 2, required for the pedal return 8 in initial position is provided by installation of spring hook in the corresponding hole of the thrust 9. If possible installation force of the spring shall be minimum. After the rod installation 6 the space between the cap 5 and the rod is filled in with Litol-24.

Running control unit is meant for switching the traction mode circuits. It is installed at the bottom of the cabin floor. Control unit consists of the casing 4 (figure 6.5) where are fixed the cam components 1 and the shaft 21 with cam rings 17. On the shaft is installed the lever 13 which is connected by means of the rod with the fuel feed system. Cam rings have profiled openings for cam components control.

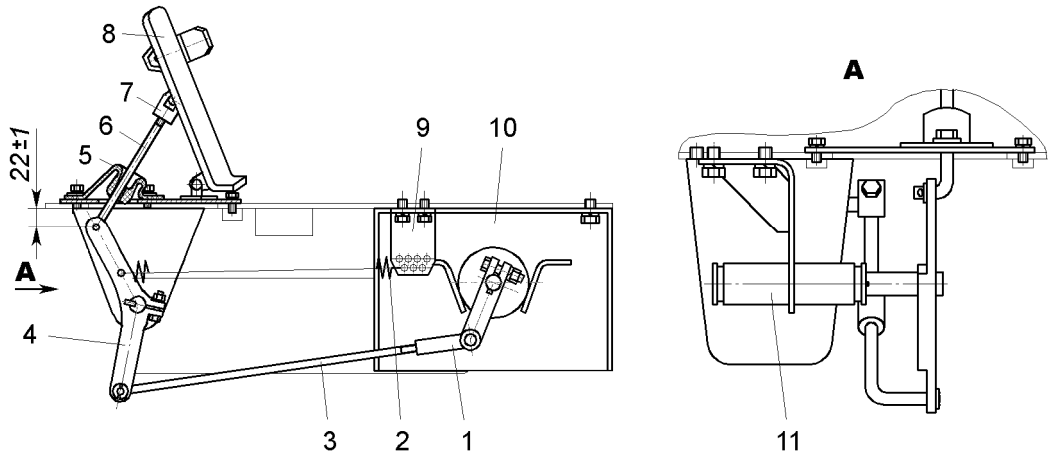


Figure 6.4 – Installation of running control unit:

1 – fork; 2 – spring; 3, 6 – rods; 4 – lever; 5 – protective cap; 7 – fork; 8 – traction pedal; 9 – spring support; 10 – running control unit; 11 – accelerator shaft

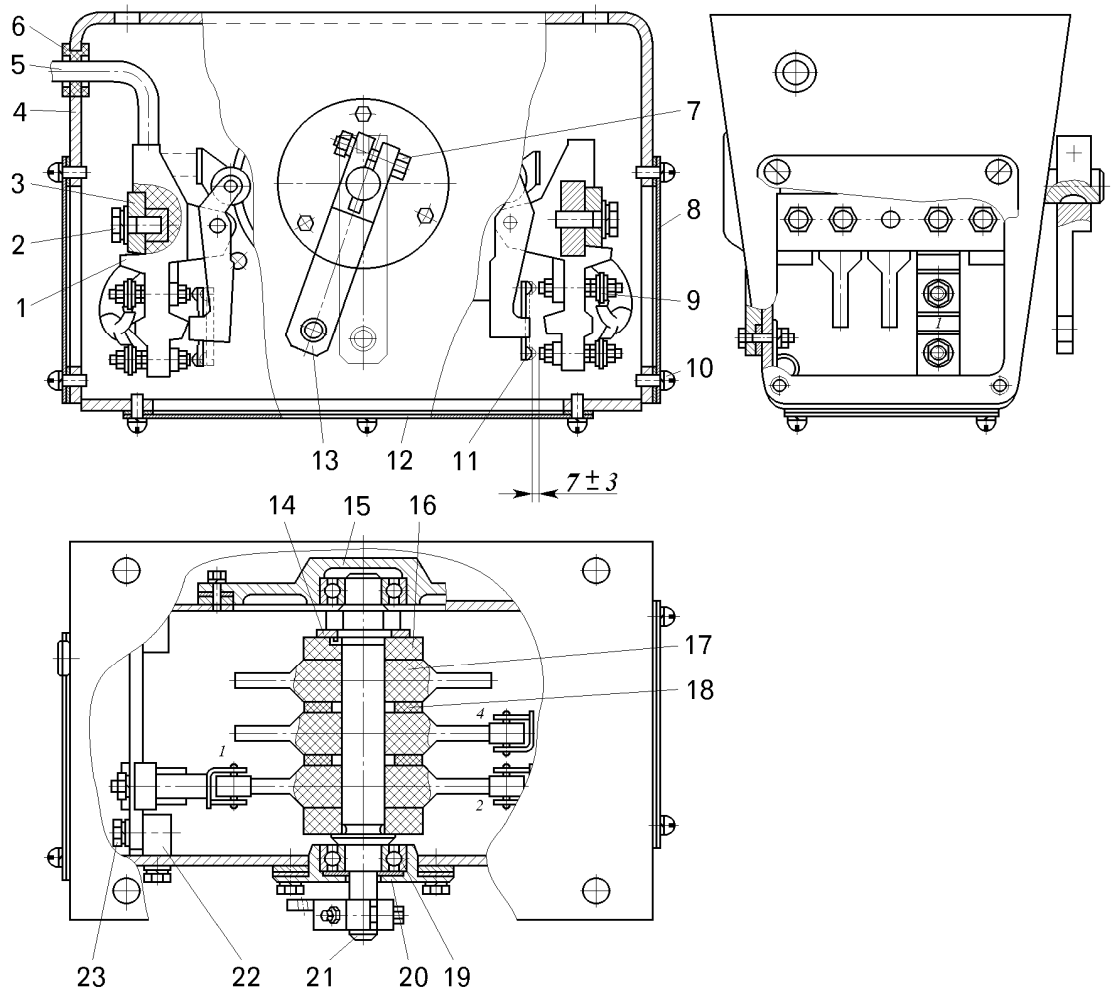


Figure 6.5 – Running control unit:

1 – cam component; 2, 7, 23 – bolts; 3 – rail; 4 – housing; 5 – wire harness; 6 – sealing ring; 8, 12 – hatch covers; 9 – contact bolt; 10 – screw; 11 – bridge contact; 13 – lever; 14 – locking washer; 15, 20 – bearing covers; 16 – ring; 17 – cam rings; 18 – insulation washer; 19 – bearing; 21 – cam drum shaft; 22 – bracket

When pressing the pedal of fuel feed system the lever 13 is rotated and it rotates the shaft 21 with cam rings 17. If during rotation of the shaft the cam components roller gets into the washer hole, the contact points 11 are closed and vice versa, opening of contact points occurs when the roller gets onto the cam ring lobe. The gap in the contact points 11 of cam components in opening condition shall be (7 ± 3) mm.

The coincidence of the cam components rollers with cam rings shall be made by moving the rail 3 in the axial direction of the shaft. For adjustment is required to change the rod length of the running control unit having switched the chains of traction electric drive at engine shaft rotation frequency (900+100) min^{-1}.

Installation of brake pedal of auxiliary brake is shown in figure 6.6.

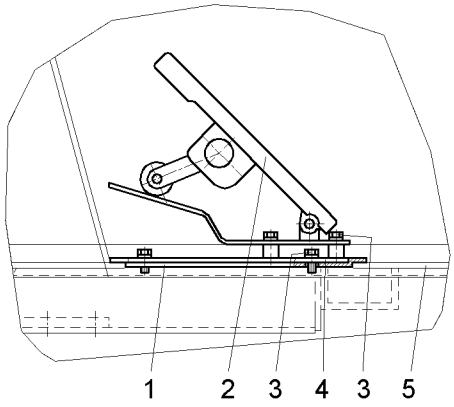


Figure 6.6 – Installation of brake pedal of auxiliary brake:

1, 4 – brackets; 2 – electronic brake pedal; 3 – bolt; 5 – cabin floor panel

6.2 Ventilation and cooling system of traction electric drive

Ventilation and cooling system is meant for maintaining optimum temperature for operation of traction electric drive components.

Cooling air supply system provides the air intake through air channels of control cabinet 1 (figure 6.7) and air line 2, cleaned air from impurities though the air line 2, pipeline 3, hose 5 and branch pipe 7 enters in the inlet pipe of traction alternator 8 on the part of contact wheels.

The part of the air is drawn through by the fan mounted in the front part of the alternator and is meant for the alternator cooling. Having passed through clearance space the air is drawn back from the alternator through ports protected with grids in the stator housing, on the part opposite to contact wheels.

The rest part of the air enters in the fan for traction motors cooling, further via forced-air lines is delivered to the rear-axle housing and via channels to the reducing gears of electric motor wheels for cooling traction electric motors.

The air is drawn back through fan ports of traction electric motors and holes in the hatch cover of rear-axle housing.

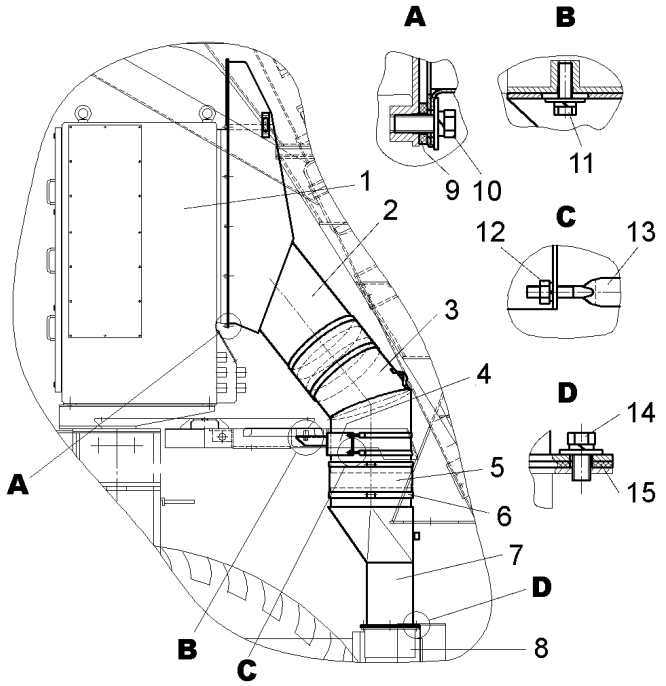


Figure 6.7 – Installation of intake air lines for traction electric motors cooling traction machines:

1 – control cabinet; 2 – air line; 3 – pipeline; 4 – bracket; 5 – рукав; 6 – collar; 7 – branch pipe; 8 – traction alternator; 9, 15 – gaskets; 10, 11, 14 – bolts

Fan of traction electric motors cooling.

Fan impeller assembly consists of front disc 23 (figure 6.8) and rear one 18. The aluminum vanes 19 (24 pieces) are mounted between discs and fastened by means of the bolts 20. The vanes are fastened by means of the nuts 21. The plates 22 are meant for locking the nuts and bolts.

The fan impeller with the hub 7 is mounted by the key 3 on the tapered shaft end of the rotor shaft of the traction alternator 4. The hub is press fitted on the rotor shaft and tightened by means of the round split nut 6 with the torque of 882 – 980 N.m. The nut is locked against unscrewing by means of the bolts 10 which are fixed between themselves by means of the split pin 11.

The fan shroud 5 is fastened on the bearing shield of the traction alternator by bolts 2. The gasket 1 between the traction alternator and the fan shroud and gasket 16 between the cover 9 and the fan shroud 5 are glued with the 88 CA adhesive 38.105.1760.

The fan impeller assembly with the hub is dynamically symmetrical. The relative position of the components is fixed with pins 8 (2 pieces).

IT IS PROHIBITED TO DISASSEMBLE THE FAN IMPELLER INTO THE COMPONENT PARTS; OTHERWISE THE MUTUAL ARRANGEMENT OF THE PARTS OF THE BALANCED SET WOULD BE DISTURBED THAT WOULD INCREASE IMBALANCE BEYOND THE SPECIFIED NORM WHEN RE-ASSEMBLING THE UNIT THAT WOULD IN TURN CAUSE THE INCREASED VIBRATION AND REDUCE THE SERVICE LIFE OF COLLAR BEARINGS OF TRACTION ALTERNATOR.

6.3 Traction electric drive maintenance, ventilation and cooling system

When performing daily maintenance:

– Check the condition of the air lines. The soft hoses of the air lines shall have no ruptures. When the engine is running at the minimum speed, air shall flow from the vent holes of the electric motor-wheels;

– Check the condition of the locks and seals of the commutator inspection holes and seals of the control cabinet doors. The covers of the commutator inspection hole and cabinet doors shall be closed and adjoin tightly over the whole perimeter.

When performing the M-2:

– Clean the filters of the cabinet and intake air lines, inner surfaces of the cabinet from dust;

– Check the reliability of fastening the components of air cooling of the traction electric drive. The hoses and fittings shall be fastened reliably and free of mechanical damages and cracks;

– Check the condition, fastening, connection and installation of the output conductors and cables of the traction electric drive. The wire and cables shall be fastened reliably. No mechanical damages of the cables and insulation of their conductors;

– Perform maintenance of the ventilated brake unit.

DURING OPERATION VENTILATED BRAKE UNIT HAS A VERY HIGH TEMPERATURE PRIOR TO PERFORMING ANY MAINTENANCE OPERATIONS PROVIDE SUFFICIENT TIME FOR ITS COOLING.

1. Carry out inspection and cleaning of the unit.

Make sure that the fabric branch-pipe 4 (see figure 6.1) has no breaks and mechanical damages. Operation of the system with damaged branch-pipe is prohibited. There should not be any foreign objects in the air line channel. Pay special attention to the fastening of branch-pipe by clamps.

Clean from dirt the outer surface of the electromotor 3 (see figure 6.2), then open commutator inspection holes, clean and blow up the collector chambers. The air pressure in the pipeline should be at least 200 – 250 kPa. If oil and other contaminations are found inside, then don't blow up prior to removing them.

If there are dirt and oil found in the collector, then it should be wiped by pileless fabric soaked in a solution of alcohol and acetone (mixture of: 5 parts of alcohol, 1 part of acetone). At the same time wipe contact surface of the brushes and contaminated surfaces of brush holders. Working collector surface should be smooth, polished, of purple or reddish colour.

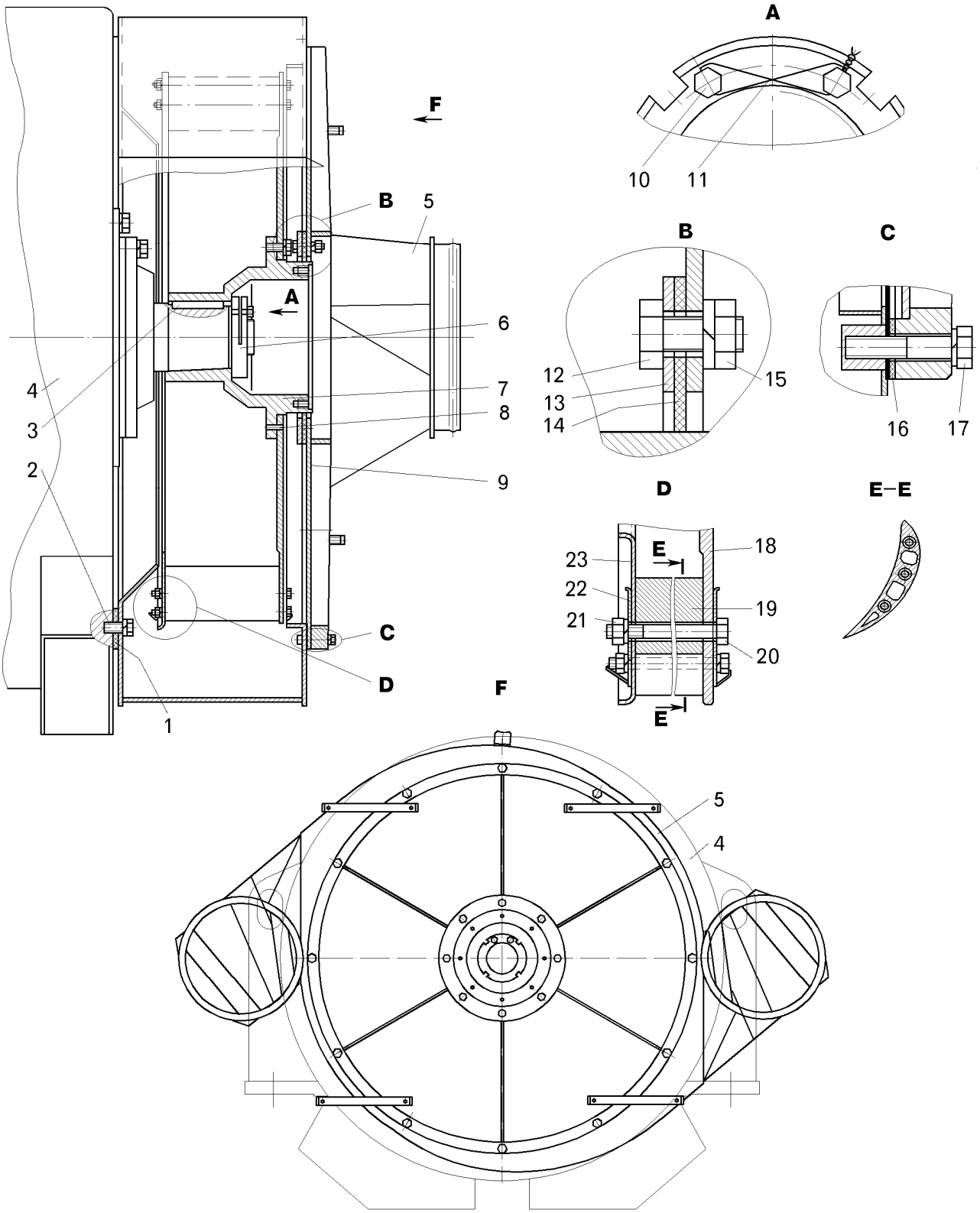


Figure 6.8 – Fan of traction electric motors cooling:

1, 14, 16 – gaskets; 2, 10, 12, 17, 20 – bolts; 3 – key; 4 – traction alternator; 5 – shroud with air line; 6, 15, 21 – nuts; 7 – fan impeller hub; 8 – pin; 9 – cover; 11 – split pin; 18 – rear disc; 19 – vane; 22 – plate; 23 – front disc

When scuffs, burns, flowing are found so sand the collector working surface.

Cleaning the brush holder yokes is to be performed using rigid hair brush.

Pay attention to the presence of nicks in the contact points of bracket 4 ("fork") side surfaces with the pipe using for fan wires input of fan shroud (presence of nicks indicates low sufficiently of electromotor latching preventing its turn).

Check for short circuited coils of the resistors sections, overheated or warped resistors 4 (see Figure 6.3), broken or cracked insulators 9, overheated terminals, lost fasteners.

Purification of porcelain insulators should be performed using soft pileless fabric. In the case of a significant contamination of insulators perform their cleaning using with wire brush.

Insulators sections should not be turned by hand. In the case turning squeeze springs up to the size of 20 mm (see figure 6.3). If insulators are still turned tighten the nuts, compressing the springs with torque of 10 – 12 Nm, and then tighten nuts fastening side frames with torque of 10 – 15 Nm.

2 Check by external inspection the fastening of the unit components: fan set, resistors section, resistors elements.

All components must be secured reliably and if necessary tighten the threaded joints.

3. Check for electric motor brushs hang.

Make sure that the brushes move freely in the brush holder by shaking them (without excessive tossing) allowed gap between the brush and holder is of 0,05 – 0,3 mm. To ensure this gap grind brushes sides using sandpaper with grit of 8 – 10.

When performing the M-3:

– perform maintenance of the ventilated brake unit.

1. Measure the brushes wear.

The height of the worn out brush should be at least 13 mm (ЭТВ-20М3Л) and 20 mm (ДПТВ-16,25-02).

If the height of the brush is less than the allowable value, if broken flexible joints (shunts) are detected as well as chipping of the brushes working surface over the area exceeding 10% is found, replace the brushes by new ones. Perform brushes replacement by sets in each brush holder. New brushes prior to installing are to be rubbed to the collector on the pad covered with fine sandpaper having the collector shape. Then insert the brush into the brush holder, and grind them to the collector. For this purpose between the collector and the brushes place sandpaper with grit of 8 – 10 (grain to the brush), and pull several times in the same direction. When polishing brushes should be pressed only under the force of brush holder springs without hand help.

The pressing on the brushes should be within thresholds of 3,2 – 3,8 N (ЭТВ-20М3Л), 4,7 – 6,25 Н (ДПТВ-16,25-02). If necessary, carry out adjustment of the pressing force.

2. Check the insulation resistance of the electromotor windings.

During operation under normal conditions (ambient temperature +20°C) insulation resistance of the electromotor windings relatively to the housing must be at least 10 MOm (ЭТВ-20М3Л), 20 MOm (ДПТВ-16,25-02) and not less than 3 MOm (ЭТВ-20М3Л), 2,5 MOm (ДПТВ-16,25-02) in a heated state at the upper limit of the operating temperature.

Insulation resistance is measured using megohmeter for voltage of 500 V. If the resistance is below these standards, the electromotor needs to be dried by blowing with hot air at the temperatures ranging from 100 to 120°C. At the beginning of the drying resistance will decline slightly, and then it starts to grow rapidly. Finish drying when the insulation resistance growth slows down.

3. Check the insulation resistance relatively to the housing.

After the resistors repair or replacement it is necessary to check the insulation resistance relatively to the housing. Insulation resistance is measured using megohmeter for voltage of 2500 V, and should be at least 0,5 MOm.

Prior to replacing the resistor section check its active resistance, which should be of 0.35 Om.

4. Add grease to the bearing units of the electromotor ЭТВ-20М3Л (see above).

7 REAR AXLE

The rear axle consists of housing 9 (Figure 7.1) to which two electric motor-wheels are fastened by bolts 7. Rear axle housing through the rear suspension (central hinge, cross rod and suspension cylinders) is hingedly connected to the frame.

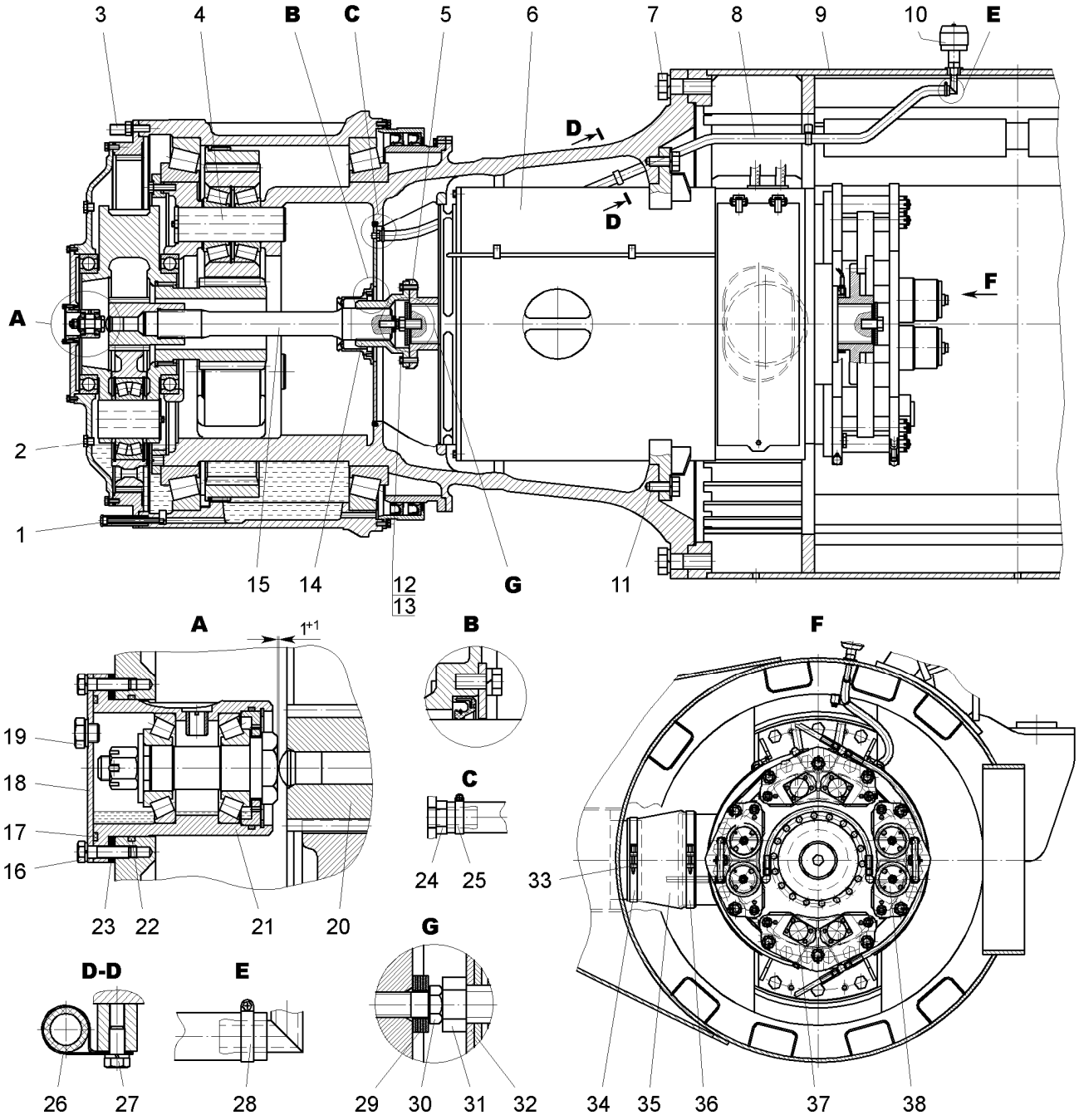


Figure 7.1 – Rear axle:

1 – probe; 2 – inspection plug; 3 – stud; 4 – electric motor-wheel reduction gear; 5 – electric motor flange; 6 – traction electric motor; 7, 11, 12, 16, 27, 30, 31 – bolts; 8 – connecting hose; 9 – rear axle housing; 10 – breather; 13 – cotter pin; 14 – flange; 15 – torsion shaft; 17, 22 – sealing ring; 18 – cover; 19 – plug; 20 – I row sun gear; 21 – stop; 23 – adjusting ring; 24 – connecting branch; 25, 28, 33 – clamps; 26 – clip; 29 – washer; 32 – plate; 34, 36 – bands; 35 – hose; 37 – braking mechanism of service brake system; 38 – braking mechanism of parking brake system

In rear part of the housing there is a hatch for the access into the inner cavity. The inner sizes of housing cavity provide a free access for maintenance of braking mechanisms and traction electric motors. Inside the housing there is a socket for portable light connection.

7.1 Electric motor-wheels

The electric motor-wheel comprises of electric motor-wheel reduction gear 4 (see Figure 7.1), traction electric motor 6 with the mounted on them braking mechanisms of service 37 and parking 38 braking systems. Traction electric motor is fastened to the body of motor-wheel reduction gear by bolts 11 (torque 800 – 1000 N.m), flange 5 is mounted on spline of traction electric motor shaft 6 and fastened by bolt 31 (torque 260 – 320 N.m). Bolts 30 and 31, studs 3 and connecting branch 24 are installed in hermetic Unigerm-9 (Унигерм-9).

The torque to the first– row sun gear 20, mounted on spline of torsion shaft 15 is transmitted from the flange of traction electric motor 5 through the flange 14, mounted on spline of torsion shaft 15 and connected with flange of traction electric motor by bolts 12 (torque 270-315 N.m.), and torsion shaft 15. Torsion shaft and sun gear are kept from axial displacement by stop 21. The stop structure is given on Figure 7.2.

The description of brake gears is given in section “Brake systems”.

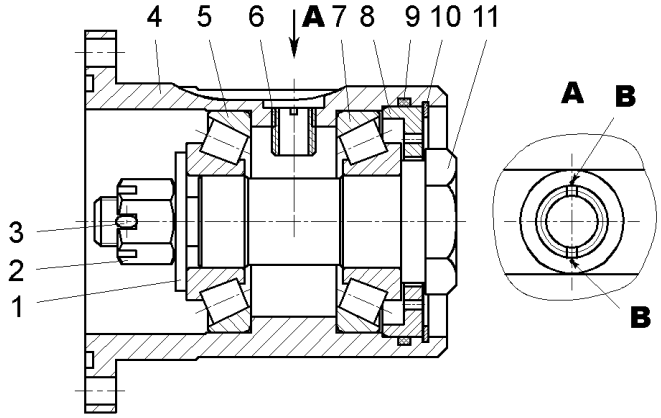


Figure 7.2 – Stop:

1 – washer; 2 – nut; 3 – cotter pin; 4 – stop carrier; 5, 7 – bearing; 6 – pipe; 8 – cover; 9 – sealing ring; 10 – locking ring; 11 – stop shaft

B – places of center marking

7.2 Electric motor-wheels reduction gear

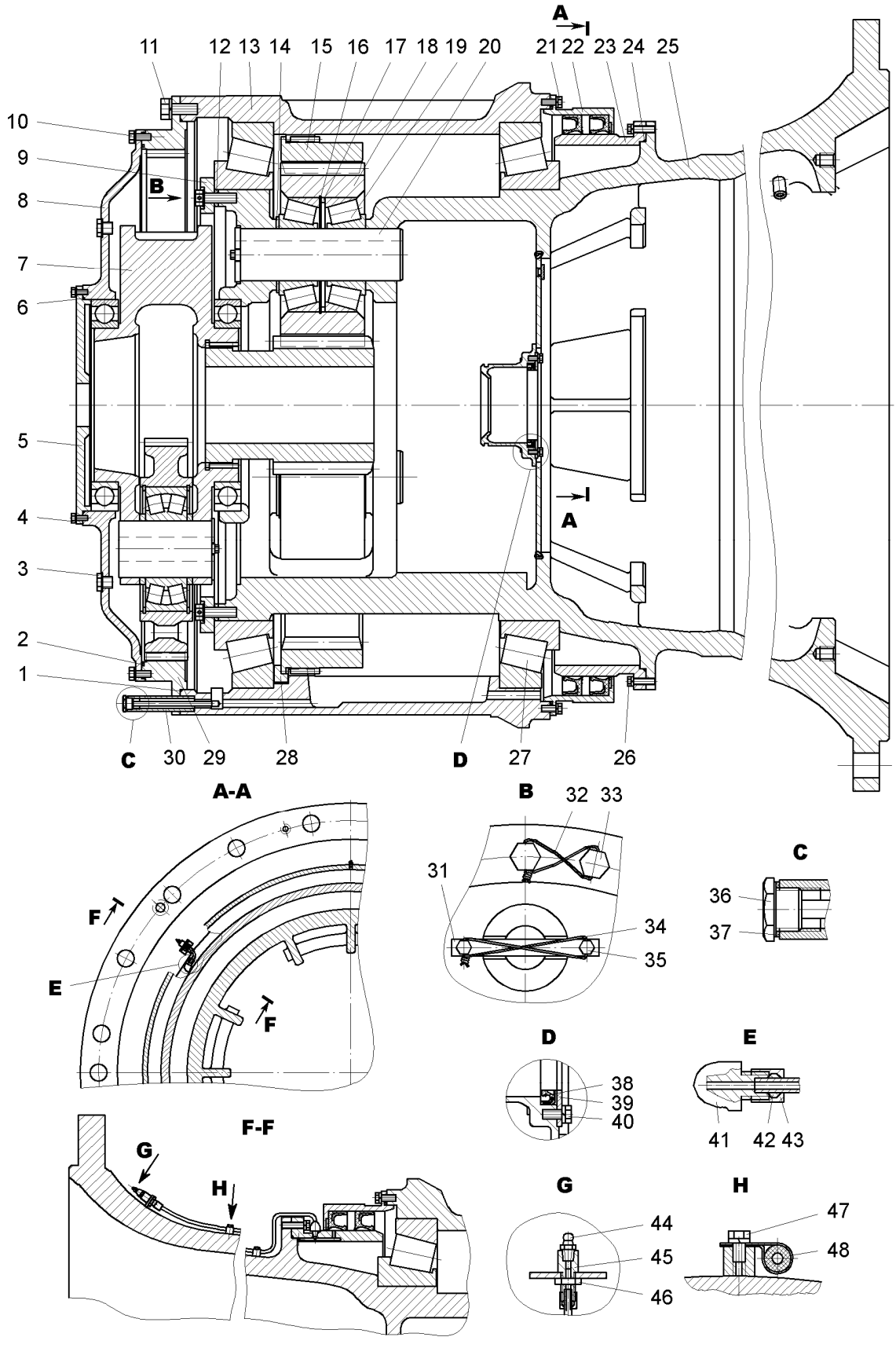
The electric motor-wheel reduction gear is two-row, differential, with spur gears.

The reduction gear consists of casing 25 (Figure 7.3), where on axles 20 on tapper roller bearings 19 second row satellites 18 are mounted. Rear wheel hub 13 is installed in the casing on two tapper roller bearings 27, where the second row crown gear 15 is mounted on spline. The first row crown gear 29 is fastened to hub 13 by bolts 11, where carrier 7 with the first row satellites is installed in. The outside cover 8 of reduction gear is fastened to the crown gear by bolts 10, to which the outside cover 5 is fastened by bolts 4. Bearings 27 on motor-wheel casing 25 are fastened with the help of thrust ring 9 and bolts 33. The bolts are stopped among themselves by cotter-pin 32 in pairs.

The first row sun gear 20 (see Figure 7.1) is engaged with three satellites 1 (Figure 7.4), which are mounted on axles 3 in the first-row carrier 6 on spherical roller bearings 9. Satellites axles are fixed by locking plates 13, which are fastened to the first-row carrier by bolts 14, locked among themselves by cotter-pin 15.

Figure 7.3 – Motor- wheel reduction gear:

1, 2, 6, 24 – sealing rings; 3 – plug; 4, 10, 11, 21, 26, 33, 35, 40, 47 – bolts; 5 – outside cover; 7 – carrier with satellites; 8 – outside cover of reduction gear; 9 – hub bearing retaining ring; 12 – distance ring; 13 – rear wheel hub; 14 – ring; 15 – second-row crown gear; 16 – locking ring; 17 – distance ring; 18 – satellite; 19, 27 – bearings; 20 – second-row satellite axle; 22 – inside cap with collars; 23 – collar ring; 25 – casing of motor-wheel reduction gear; 28 – gear stop; 29 – first-row crown gear; 30 –drain tube; 31 – locking plate; 32, 34 – cotter-pin; 36 – probe; 37 – gasket; 38 – collar; 39 – ring; 41 – angle; 42 – conical clutch; 43 – coupling nut; 44 – oiler; 45 – end tip; 46 – nut; 48 – clip


A
I
11
12 13 14 15 16 17 18 19 20
21 22 23 24 25
10
9
8
7
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D
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A-A
F
E
F
B
32 33
31
34
35
C
36
37
D
38
39
40
E
41
42 43
F-F
G
H
G
44
45
46
H
47
48

The satellites are engaged with the crown gear 29 (see Figure 7.3.) which transmits the torque to the rear wheel hub 13.

The first row carrier 6 (see Figure 7.4) is mounted on two ball bearings 5.

The second-row sun gear 8 is installed in the carrier spline opening. From axial displacement it is kept by locking ring 4 and locking plates 7, which are fastened to the carrier by bolts 12. Bolts are stopped among themselves by cotter-pin 11 in pairs.

The second– row sun gear 8 is engaged with the three second– row satellites 18 (see Figure 7.3.), and the satellites – with crown gear 15 which transmits the torque to hub 13 of motor-wheel through the spline connection.

The second – row satellites rotate on two tapper roller bearings 19 installed in axles 20 in the reduction gear casing 25. The satellite axles are fixed by locking plates 31 which are fastened to the casing by bolts 35, locked among themselves by cotter-pin 34.

The rubber sealing rings ensures the hermiticity of fixed joints of reduction gear. The torsion shaft flange is sealed by collar 38. Hub 13 is sealed by two large-size collars 3 (Figure 7.5), installed in collar 4.

The cavity between collars is filled by grease. In order to refill the grease during the operation the hub cap has two oilers 2, and connecting hoses with oilers 44 (see Figure 7.3.) are mounted on the reduction gear casing, connected with the cavity of outside collar by valves.

The gears and bearings of the first and second row of the reduction gear are performed by dipping them into oil and splashing of oil during the rotation of the reduction gear components.

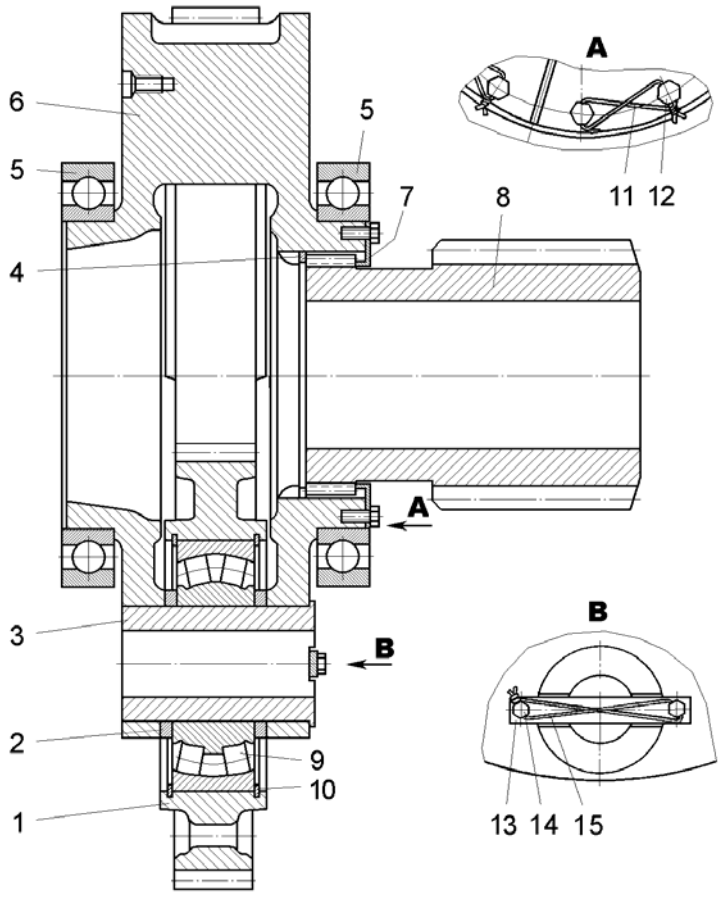


Figure 7.4 – Carrier with satellites:

1 – first-row satellite; 2 – distance washer; 3 – first-row satellite axle; 4, 10 – locking rings; 5, 9 – bearings; 6 – first-row carrier with flanges; 7 – locking plate; 8 – second-row sun gear; 11, 15 – cotter-pins; 12, 14 – bolts; 13 – locking plate of satellite axle

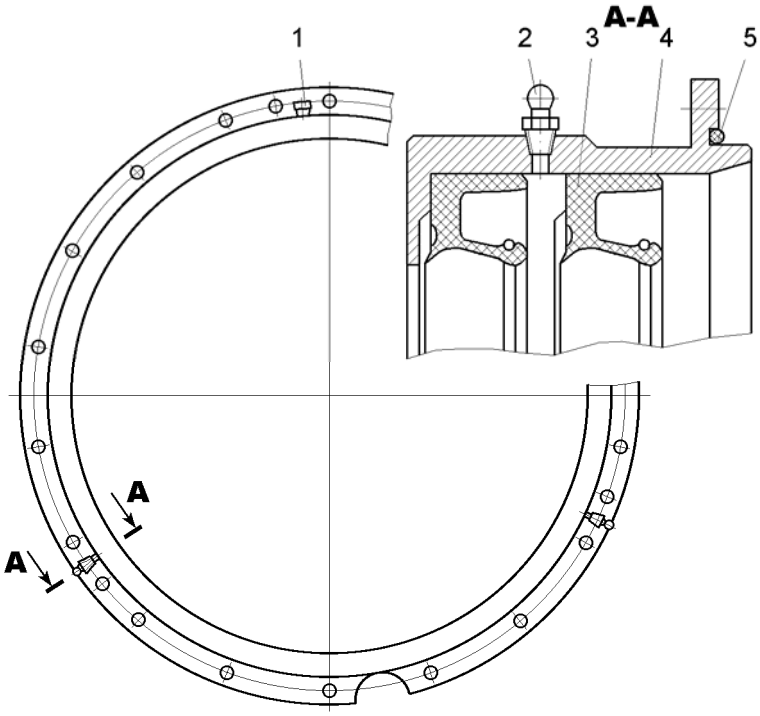


Figure 7.5 – Inside cap with collars:

1 – plug; 2 – oiler; 3 – collar; 4 – inner cap; 5 – sealing ring

Adjustment of taper bearings of motor-wheels hubs.

Adjustment of taper bearings of the motor-wheel hub shall be performed on reduction gear removed from the dump truck. The removed reduction gear must be placed on the flat ground, the electric motor mounting flange shall be directed down and lock from the rotation.

The adjustment of taper bearings of motor-wheel hub shall be performed in the following order:

1. Hub 13 (see Figure 7.3) in assy with bearing cups 27 and crown gear 15 is to be mounted on casing of reduction gear 25 in assy with collar ring 23, inner cap with collars 22, inner race of inner bearing 27 and satellites 18 of second-row.

At mounting the inner cap with collars 22 on collar ring 23, pay attention to the correctness of fitting the edges of dust boots of the large-size collars. To lubricate the leading edges of collars at the installation, the cavities between the leading edge and dust boot must be filled by lubricant Litol-24 (Литол-24) along the perimeter. After adjustment the taper bearings inner caps 22 shall be fastened to hub 13;

2. For ensuring adjoining of the rollers to the working side of the bearing, turn the hub by one– two revolutions in one and another direction on the bearing. Fit the inner race of outer bearing and thrust ring 9.

3. Screw on (without tightening) six bolts P (Figure 7.6) equally spaced by two regularly. Check the hub rotation torque through the second row. It shall be not more than 580 N.m. (not more than 150 N.m on the second-row technological gear). Fix the value of this torque;

4. By rotating the hub through the second row tighten six bolts P subsequently in pairs of the diametrally located ones applying the torque of 20 N.m. Repeat the tightening of the bolts P in the same sequence until the torque of 40 N.m is set on. Check the clearance B between the end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with the clearance exceeding 0.5 mm), proceed to item 5.

If not so, repeat tightening of the bolts P in the same sequence until the torque of 60 N.m is set on the six bolts. Check the clearance between end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with clearance exceeding 0.5 mm), proceed to item 5.

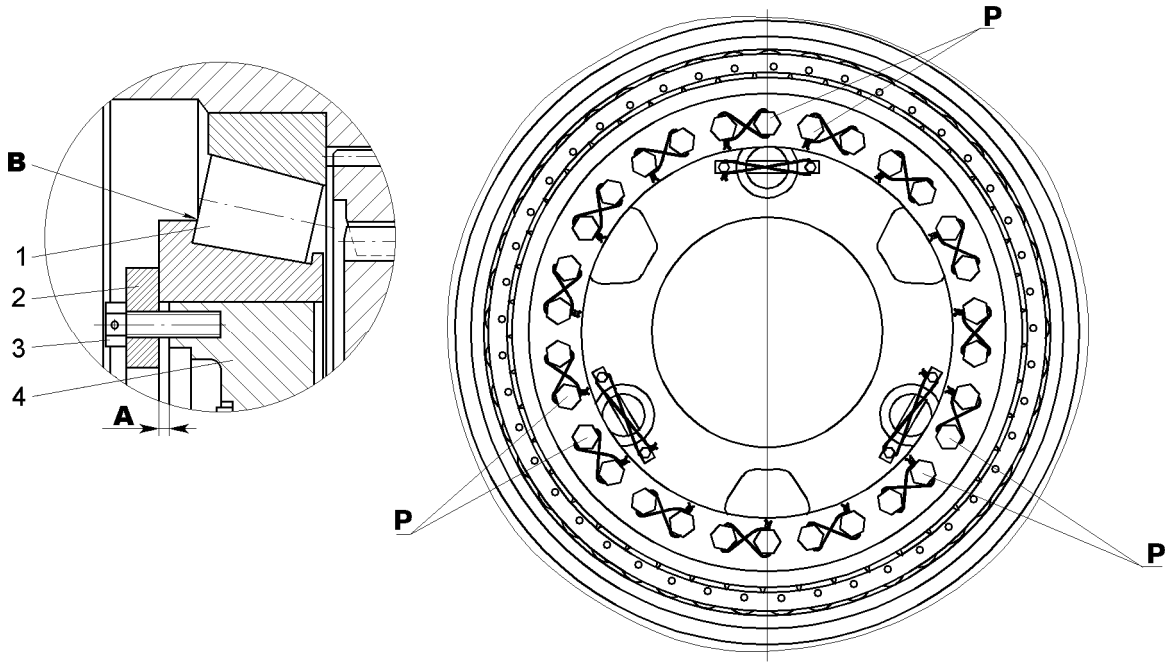


Figure 7.6 – Check of clearance:

1 – bearing; 2 – thrust ring ; 3 – bolt; 4 –reduction gear casing;
A – clearance; B – place of probe installation

If not so, repeat tightening of the bolts P in the same sequence until the torque of 80 N.m is set on. Check the clearance between the end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with clearance exceeding 0.5 mm), proceed to item 5.

If not so, repeat tightening of the bolts P in the same sequence until the torque of 100 N.m is set on six bolts. Check the clearance between the end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with the clearance exceeding 0.5 mm), proceed to item 5.

If not so, repeat tightening of bolts P in the same sequence until the torque of 120 N.m is set on the six bolts. Check the clearance between the end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with the clearance exceeding 0.5 mm), proceed to item 5.

If not so, repeat tightening of the bolts P in the same sequence until the torque of 140 N.m is set on six bolts. Check the clearance between the end faces of the rollers and working shoulder of the bearing using a probe. If the clearance on 70% of the rollers does not exceed 0.4 mm (so that there should not be more than three neighboring rollers with clearance exceeding 0.5 mm), proceed to item 5.

In case of impossibility of meeting the above requirements, disassemble the unit and identify the defects of the parts.

5. Check the hub rotation torque through the second row. It can be increased in comparison with the earlier measured torque under Item 3 not more than by 308,5 N.m (on the second-row technological gear not more than 80 N.m);

6. Measure the clearance A1, A2, A3 at the three equally spaced places opposite to the bolts P with the accuracy of 0,02 mm;

7. Grind 30 distance rings to the dimension A = ((A1+A2+A3)/3 + 0,3) $\pm$ 0,015 mm;

8. Unscrew six adjusting bolts P;

9. Screw in 30 adjusting bolts, putting one distance ring from the ground set, according to Item 8, on each so that the distance rings would be arranged in the clearance A;

10. Tighten 30 adjusting bolts with the torque 400 – 450 N.m;

Adjustment of taper bearings of second-row satellites.

Adjustment of taper bearings of the second– row satellites shall be performed individually for the place of installation of the satellite into the casing. Therefore, in case of satellites removal and subsequent installation without any part replacement, the satellites shall be installed into the casing as a complete set obligatorily to the same place, from where they were removed.

After replacing of any part (satellite, bearing or distance ring), it is necessary to adjust the satellites taper bearings. To do this:

– mount satellite 3 assembled with bearings (Figure 7.7) into the window of the reduction gear casing;

– apply the force **P** 500 – 550 N to the inner race of the external bearing and turn the satellite several times to ensure adjoining of the rollers to the working shoulders;

– measure clearance A between bearing end face of inner race and casing boss;

– grind the distance ring to the dimension ($A_{-0,2}$ mm) and install the distance ring into the respective gap.

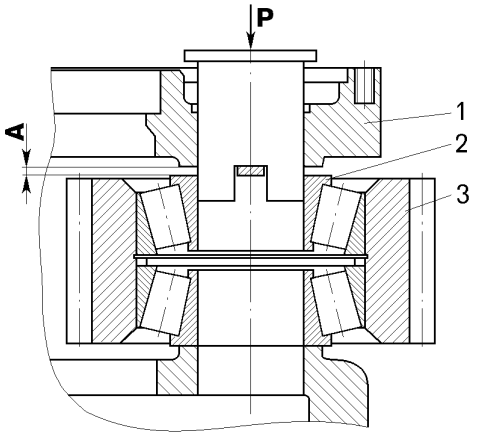


Figure 7.7 – Adjustment of bearings of the second-row satellites:

1 – reduction gear casing; 2 – second row satellite bearing; 3 – second row satellite

Adjustment of axial clearance of sun gear and torsion shaft.

In case of noticeable wear of the sun gear retainer check and adjust if necessary the clearance 1 – 2 mm between sun gear 20 (see Figure 7.1) and retainer 21, in case of replacing the reduction gear parts during the repair it is necessary to perform the adjustment.

To ensure the clearance, proceed as follows:

– remove the outside cover 5 (see Figure 7.3.)

– measure the distance **A** (Figure 7.8) between the electric motor shaft and bearing end **K** of reduction gear with the accuracy $\pm$1 mm ;

– reach the length of torsion shaft with sun gear L=(A – 85) $\pm$ 1,5мм by matching washers 3.

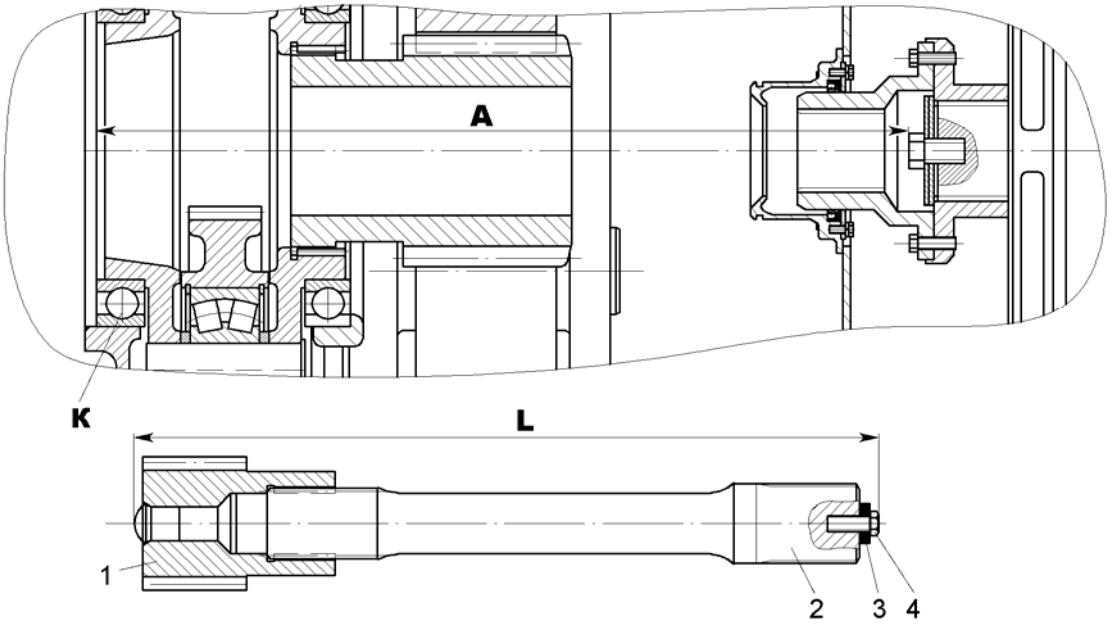


Figure 7.8 – Adjustment of torsion shaft length:

1 – sun gear; 2 – torsion shaft; 3 – adjusting washers; 4 – bolt

– torsion shaft assembled with sun gear shall be installed into the electric motor shaft up to the stop;
– install outside cover 5 (see Figure 7.3) into the place;
– install retainer 21 (see Figure 7.1) up to the stop into sun gear 20;
– measure the clearance between the end face of outside cover and retainer;
– select a set of adjusting rings 23 at 1 – 2 mm (by width) more of the measured clearance and to install them between the outside cover and retainer;
After fixing the retainer by bolts 16 in its cavity fill in 0,2 l of reduction gear oil through plug 19.

7.3 Technical maintenance of electric motor-wheels

Technical maintenance of electric motor-wheels consists in periodical inspection of the condition, fastening and adding operational materials as well as checking its serviceability.
The list of lubricating materials to be used and intervals of checking and changing oil, see in the Section "Technical Maintenance'.

At performing Daily Maintenance (DM):

– check the condition of electric motor-wheels by visual inspection. Leakage of oil is not allowed. If any leakage occurs, determine the cause of the fault and repair the unit.

At performing Technical Maintenance 1 (TM-1):

– check the oil level in reduction gears of electric motor-wheels.
For this purpose, place the dump truck on the horizontal ground so that the inspection plug 2 (see Figure 7.1.) will be vertically below. Unscrew the plug, the oil level shall be up to the lower edge of the threaded hole. Add oil if necessary;
This check is to be performed in 15 min after the dump truck stop that the oil can drop off in the lower part of the hub;
– add 100 gr. of lubricant Litol-24 in two oilers 44 (see Figure 7.3) of the large-size collar groove
– take a sample of oil for analysis (for the procedure of oil analysis in the reduction gears of electric motorized wheel see Appendix B);
– clean magnets on probes 1 (see Figure 7.1) installed in drain tubes from metallic dust appearing due to the wear. At the detection of large metallic particles (chips), check the gears, splined connections and bearings.

At performing TM-2:

– remove outside cover 5 (see Figure 7.3), extract the torsion shaft in assy from the sun gear and check their condition visually;
– in case of noticeable wear of retainer, check and if necessary adjust clearance between the sun gear and the retainer;
– clean drain holes in the lower part of rear axle casing tube;

At performing TM-3:

– check and if necessary retighten the bolts of the electric motor-wheel fastening to the rear axle casing. Tightening torque see in Appendix A;
– Perform the visual inspection for the presence of cracks at the place of: joints of the rear axle casing with the reduction gear of the electric motor wheel; area of welding of the rear axle casing lever flange and welding of the lower bracket of the torque rod.
In case of cracks detection on casing the electric motor-wheel reduction gear, on casing of rear axle – it is necessary to open breaks and weld them.
– replace filter elements of breather 10 (see Figure 7.1) of motor-wheels reduction gear.

At performing Seasonal Maintenance (SM):

– check and if necessary to retighten bolts of traction electric motor fastening to reduction gears of electric motor-wheels. Tightening torque see in Appendix A;
– adjust taper bearings of motor-wheel hub.

Lubrication of large-size collars (cavity between collars) shall be performed at the tires replacement or during the repair of reduction gear.

For this purpose it is necessary to turn the hub so that plug 1 on cover 4 (see Figure 7.5) will be below. At filling the fresh grease it is necessary to unscrew the plug for the output of debris-contained lubrication out of the cavity between collars.

After this operation each oiler 2 shall be added with the lubricant – 150 gr.

Changing the oil in motor-wheels reduction gears shall be performed on the basis of spectral analysis, but not later than after each 2500 motor-hours of the engine operating time (transmission oil SAE 80W-140 API:GL-5 or SAE 85W-140 API:GL-5 depending on the operation season. The oil-flash temperature in the open pot shall not exceed 2100C (GOST 4333 or ASTM D 92).

Oil drain from the electric motor-wheel reduction gear shall be performed through drain tube 30 (Figure 7.3).

To drain the oil from the reduction gear it is necessary to install the hub so that one of the drain tube will be in down position. Unscrew probe 36 and drain the oil into a reservoir. For easy oil drain unscrew the plug of check hole or the central outside cover with the retainer.

8 RUNNING GEAR

8.1 Frame

The frame is of welded construction, consists of two variable-height side members 3 and 7 (figure 8.1) interconnected by means of load-bearing cross-beams welded between them. Each side member consists of three parts. Front and rear parts – welded, box-type, with variable cross section; made of low-alloy high tensile plate steel welded to the middle part moulded from low-carbon steel.

The first crossbeam 1 consists of two load-carrying plates covered both side members from above and below. Central cylinder brackets of front suspension are situated in the central part of the crossbeam.

The second crossbeam 2 is a load-bearing closed loop consisting of the upper and lower cross-bars connecting the frame side members. Upper cross-bar is welded and connected with the front suspension brackets. Lower cross-bar is casted and connected with the front suspension traversal rod.

The third crossbeam 5 which is welded to the side members reinforces the middle part of the frame constitutes the tube which is welded to the casted flanges along the side members height. The bracket of the central pivot of rear axle is welded to the middle part of the crossbar.

In rear part the side members are connected by rear cross-bar 6 which covers the cross-members above, behind and below. A bent diagram which connects upper and lower sheets of the cross-bar with side members is installed in front part of rear cross-bar. In rear part of the cross bar the body support brackets are welded, below – the mounting bracket of crossbar of rear axle.

Between third and rear cross-bars the side members are connected by the fourth cross-bar 4 which enhances the frame rigidity and is used as the brackets support of the dumping mechanism cylinders.

The frame is defined by high durability while operating in the most difficult operating conditions. In order to ensure long and failure-free operation of main load-carrying units of the structure it is necessary to comply with operating rules and avoid the dump truck overload as well as to periodically control the technical condition of the frame. Detected defects of the frame and body after the checkup (cracks, breaches, fractures) shall be eliminated in time.

While the operation of dump trucks the welded joints shall be checked for cracks in the most loaded spot of the frame: in the place where the second cross-bar is welded to the front suspension, where the rear cross-bar is welded to the side members, where the second cross-bar supports and elements are welded to the side members, where the brackets of central pivot and cross-bar. See the check-up of the frame technical condition, defects determination and repair in the repair manual.

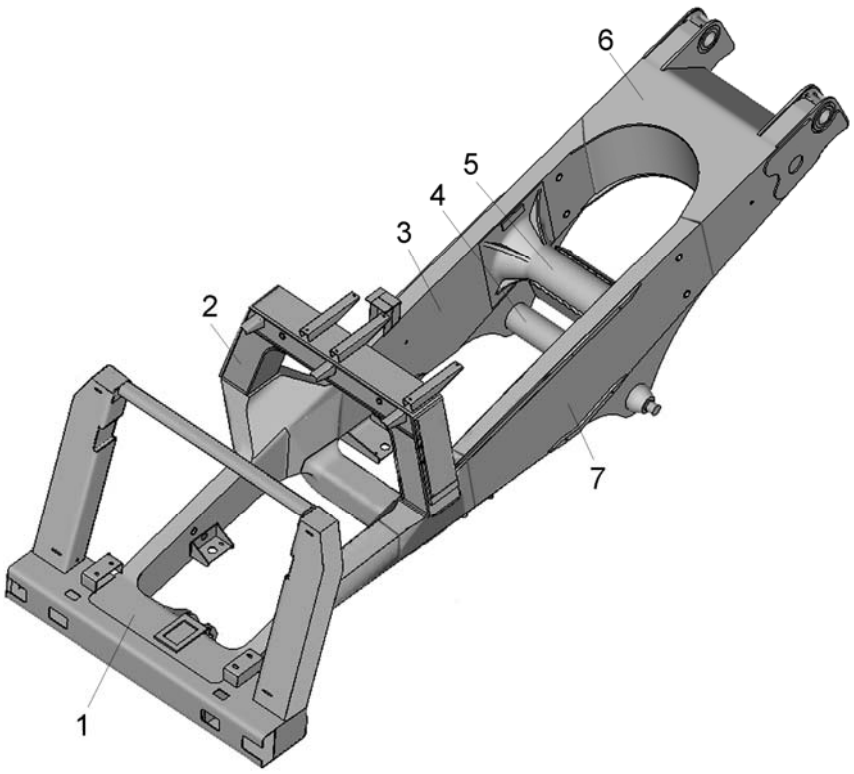


Figure 8.1 – Frame:

1 – first cross-bar; 2 – second cross-bar; 3, 7 – side members; 4 – fourth cross-bar; 5 – third cross-bar; 6 – rear cross-bar

8.2 Suspension

The front suspension of the dump truck is of axle type, consists of two pneumohydraulic cylinders 2 (figure 8.2), lug 22 with a joint, front axle lever and transversal rod 4.

The loads acting upon the front axle wheels are transmitted to the frame through the suspension cylinders, transversal rod and lug with joint. The suspension cylinders sustain only vertical loads, the rod – vertical, transversal and longitudinal ones.

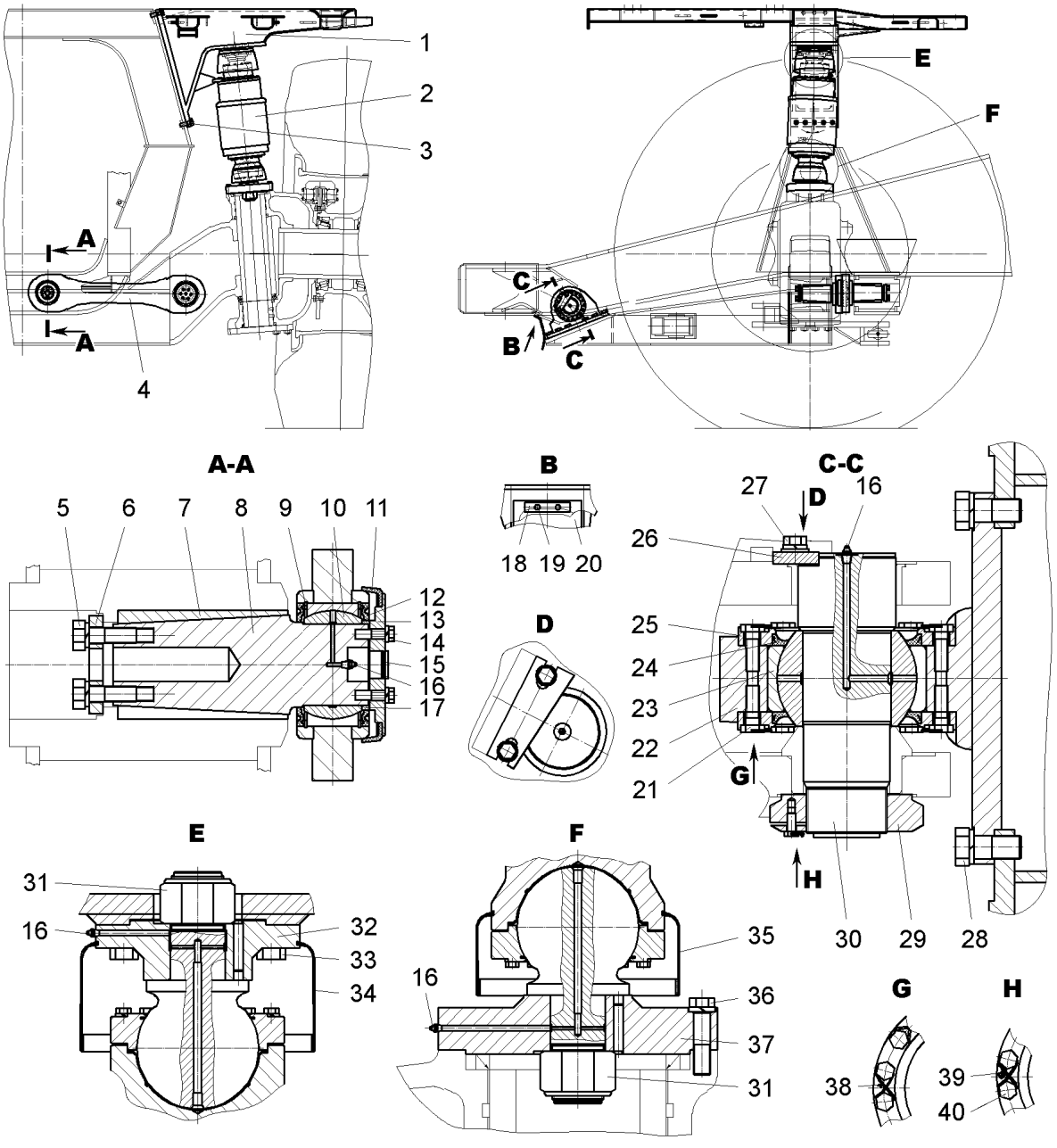


Figure 8.2 – Front suspension:

1 – bracket of the side panel mounting; 2 – suspension cylinder; 3, 5, 14, 19, 21, 27, 28, 33, 36, 40 –bolts; 4 – suspension rod; 6 – thrust; 7 – bushing ; 8, 30 – pins; 9 – locking ring; 10, 23 – joint-type bearings;11 – sealing ring;12 – gland; 13 – cover; 15 – plug; 16 – oil-collar ; 17 – distance bushing; 18 – clamping strap; 20 – mudguards; 22 – lug with base; 24 – gland; 25 – cover; 26 – lock bar; 29 – special nut; 31 – self-locking nut; 32 – upper bracket of the suspension cylinder; 34, 35 – casings; 37 – lower bracket of the suspension cylinder; 38, 39 – splint-wire

Suspension cylinders are fastened to upper 32 and lower 37 brackets with the help of self-locking nuts. Upper bracket 32 is fastened with the help of bolts 33 to the bracket 1 of the side panel fastening which is fastened to the frame of the dump truck with the help of bolts 3 (the bracket is welded after the dump truck assembly at the operation site).

Lower bracket 37 is fastened by bolts 36 to the upper end face of the front axle steering knuckle. Transversal rod 4 is hingedly connected with the help of tapered pins 8 with the frame cross-bar and front axle beam. Lug 22 is fastened to the front axle lever with the help of bolts 28, to the frame bracket – hingedly by pin 30. The pin is withheld from the turning by lock bar 26.

Thread torque are shown in table 8.1.

During the technical maintenance lubricate the cylinders joints of the suspension by grease Litol-24 through oil-collar s 16 until the grease comes out of the safety valves, central hinge and rod hinges – until the gland grease appears.

The rear suspension of the dump truck – axle, consists of two pneumohydraulic cylinders 2 and 4 (figure 8.3), suspension transversal rod 3, rear axle lever and lug 6 with a hinge.

The loads acting upon the rear axle wheels are transmitted t the frame through the suspension cylinders, transversal rod and central hinge. The suspension cylinders sustain only vertical loads, rod – transversal, central hinge – vertical, transversal and longitudinal ones. Suspension pneumohydraulic cylinders are fastened to brackets on the frame and rear axle casing with the help of self-locking nuts 34.

Transversal rod 3 is fastened to the brackets on the frame and rear axle casing with the help of joint bearing 27 installed on pins 31 and fastened through distance bushing 28, clamping plate 30 by bolts 25 and 29.

Lug 6 of central hinge is fastened to the central lever with the help of bolts 15 and nuts 14, to the frame bracket – hingedly through spherical bearing 7, pin 12 by bolt 18 with thrust washer 16.

During the technical maintenance lubricate the cylinders joints of the suspension by grease Litol-24 through oil-collar s 11 until the grease comes out of the safety valves, central hinge and rod hinges – until the gland grease appears.

Thread torque of front and rear suspension are shown in table 8.1.

Table 8.1 – Thread torque

Position № in the figure	Thread torque, Nwm
Figure 8.2	
5 – mounting bolts of front suspension rod pins	620 – 780
14 – mounting bolts of covers to the pins of front suspension transversal rod	161 – 199
21 – mounting bolts of covers of front suspension central hinge bearing	245 – 300
27 – mounting bolts of locking plate of front suspension central hinge pin	450 – 560
28 and **3** – mounting bolts of a lug of front suspension central hinge to the lever and mounting bolts of the side plate bracket to the frame	1633 – 2018
29 – retaining nut of central hinge pin of front suspension	1800 – 2000 (after tightening turn though 60° (one edge)
31 –retaining nuts of spherical joints of front suspension cylinders	2700 – 3150
36 – mounting bolts of lower bracket of front suspension cylinder	830 – 1020
33 – mounting bolts of upper bracket of front suspension cylinders	1192 – 1472
40 – clamp bolts of retaining nut of central hinge pin of front suspension	44 – 62
Figure 8.3	
5 and **25** – mounting bolts of clamping plates to transversal rod pins of rear suspension and bearing cover of rear suspension central hinge	450 – 560
14 – retaining nut of central hinge lug of rear suspension to a lever	1300 – 1500
18 –pin mounting bolt of rear suspension central hinge	1600 – 2000
34 – retaining nuts of cylinders spherical joints of rear suspension	2700 – 3150

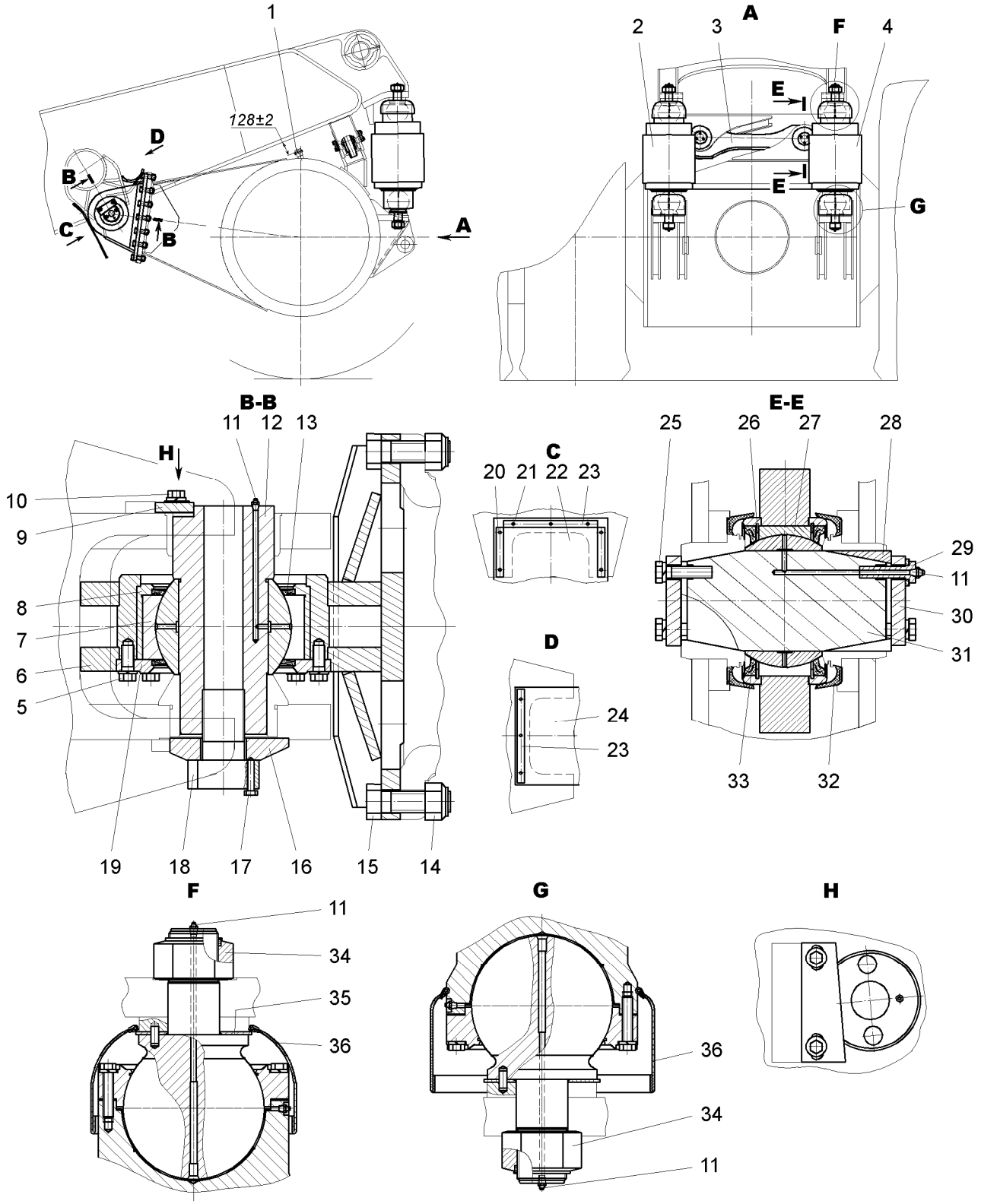


Figure 8.3 – Rear suspension:

1 – thrust; 2, 4 – suspension cylinders; 3 – suspension rod; 5, 10, 15, 17, 18, 21, 25, 29 – bolts; 6 – lug; 7, 27 – hinged bearings; 8 – lug bushing; 9 – lock bar; 11 – oil-collar ; 12, 31 –pins;13,33–glands; 14, 34 – self-locking nuts; 16 – thrust ring; 19 – cover; 20, 23 – clamping plates;22,24–mudguards; 26 – locking ring; 28 – bushing; 30 – plate; 32 – sealing ring; 35 – disc; 36 – casing

The suspension cylinder is piston-type pneumatic spring in combination with hydraulic shock absorber. Industrial gaseous nitrogen serves as a working element in the cylinder. The LUKOIL-AZh, МГП-12 or ГРЖ-12 are used as a working fluid in the suspension cylinder.

Front and rear suspension cylinders are similar in the construction; the difference consists in the parts size, slots configuration at the shock strut piston, quantity of filled oil and gas pressure. The sliding rod-pipe joint of the main cylinder for the front suspension cylinder is sealed by two gasket sets and one rear suspension cylinder set.

Spherical joints Ø180mm with the shank end Ø80mm are used in the cylinders of front suspension with the rod Ø280mm; spherical joints Ø220mm with the shank end Ø80mm are used in the cylinders of rear suspension. The structure of the front suspension cylinder is shown in figure 8.4, rear suspension cylinder – figure 8.5.

The suspension cylinder consists of main cylinder pipe 19 and rod 19 with welded piston and shock absorber baffle. Lower cover 4 is fastened with the help of bolts 5 to the lower part of the rod, which presses casing 12 to the rod end face; upper cover 23 is fastened to the upper part of the main cylinder pipe with the help of bolts 5 and 37. Spherical joints 25 are installed into the upper and lower covers and fastened by covers 26 with the help of bolts 2. Filling valve 22 and sensor valve 39 of load and fuel control system are threaded into upper cover 23.

Inserts 35 from metallic polymeric tape are installed between the covers spherical surfaces and spherical joint. Adjusting gaskets 27 are installed for the adjustment of openings in the hinges. Spherical joints are lubricated through the compression collar s.

Two compression valves and a rebound valve are situated on the shock-absorber baffler. Absorber rod 14 with longitudinal grooves with variable sections moves in the rebound valve case 30, which functions as variable resistance throttle of a rebound valve.

Casing 12 makes up groove P3 which is filled up with working fluid up to the level plug 8. Working fluid is designed for the casing seal lubrication.

The hermeticity of pipe hinge of main cylinder 19 and casing 12 is ensured by locking ring 43 and band 44. Protective cover 10 protects the outside surface of the cylinder from dust and mud; protective cover is fixed between ring 15 and seal 16.

The fixed joints hermeticity is ensured by rubber seal ring of round cross-section.

In order to prevent working fluid leakage out of the suspension cylinder the movable joint rod – pipe of main cylinder is sealed by fluoroplastic collar 52. Two collars (two seal kits) are installed in front suspension cylinders, in rear suspension cylinders – one collar (one seal kit).

The collar is installed with tightness which is adjusted by adjusting shim kit 49 and hold up spring 48. The collar preload while the assembly shall be 2,0 – 2,3 mm (inner diameter along the edge of the collar 277,7 – 278,0 mm for the front suspension cylinder and 337,7 – 338,0 mm for the rear suspension cylinder).

Axle bearings made of polymeric materials are situated on rod piston 18 and rod guide 11.

Safety valve 13 protects casing 12 from overloads at pressure increase in its groove due to the volume reduction at cylinder compression and due to possible leakage of working fluid through the collar and other joints. In order to bring the cylinder into the operating condition, it shall be filled in with nitrogen through filling valve 22.

At compression stroke (when a wheel runs into an obstacle) the piston rises up in the cylinder and compresses gas. Due to the gas pressure increase the compression stroke is elastically restricted.

While the rebound travel (after the obstacle passing) the rod moves down.

In order to damp oscillation that happens while the dump truck movement the suspension cylinder has hydraulic shock-absorber which consists of two compression valves, rebound valve casing 30 and absorber rod 14 with longitudinal grooves of variable sections.

While the compression, the working fluid goes from the groove P1 to ring groove P2 through the compression valves restricted openings and channels in the shock absorber baffler. Moreover the oil goes through the channels made by rebound valve casing 30 and longitudinal grooves at absorber rod 14. Cylinder absorber rods of front and rear suspensions differ in tapered slot configuration. In order not to mix up the rods while the cylinders repair, the marking is applied to their upper and lower end face.

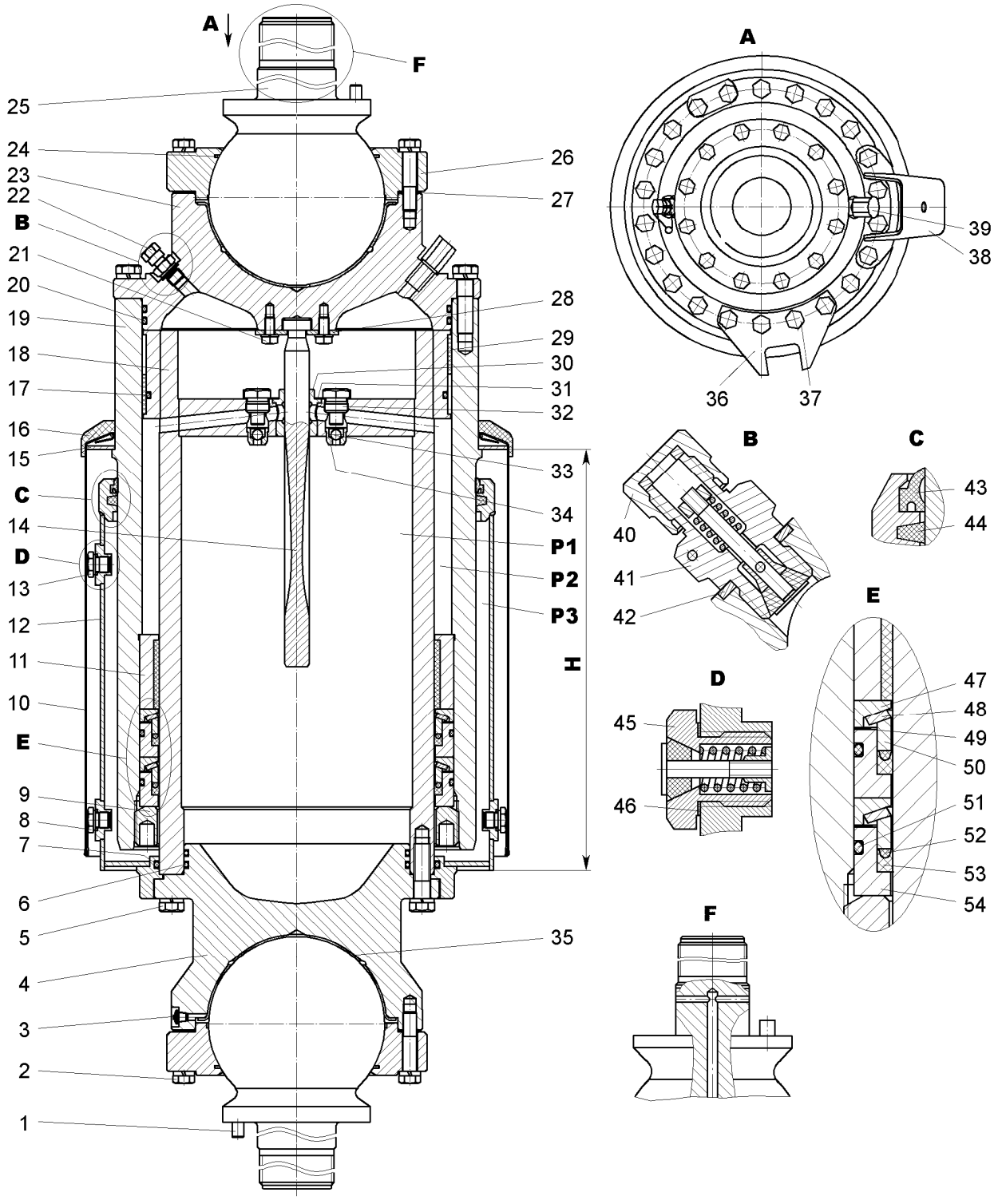


Figure 8.4 – Pneumohydraulic cylinder of front suspension (75170–2907020-10):

1 – pin; 2, 5, 21, 37 – bolts; 3, 13 – safety valves; 4 – lower cover; 6, 7, 17, 20, 24, 51 – rings; 8 – plug; 9 – threaded bushing; 10 – protective cover; 11 – rod guide with axle-bearing; 12 – casing; 14 – rod; 15 – ring; 16 – seal; 18 – rod; 19 – main cylinder pipe; 22 – filling valve; 23 – upper cover; 25 – ball bearing; 26, 40 – covers; 27, 49 – adjusting gaskets; 28 – flange; 29 – piston guiding sleeve; 30 – rebound case casing; 31 – lock washer ; 32 – compressing valve plug; 33 – ball; 34 – compression valve seat; 35 – thrust bearing; 36 – steering lock; 38 – sensor casing; 39 – sensor valve; 41 – charging valve casing; 42, 46 – sealing gaskets; 43 – retaining ring; 44 – band; 45 – valve casing; 47 – locking ring; 48 – spring; 50 – thrust ring; 52 – distance ring; 53 – rod collar ; 54 – collar ring;
H – dimension; P1, P2, P3 – grooves

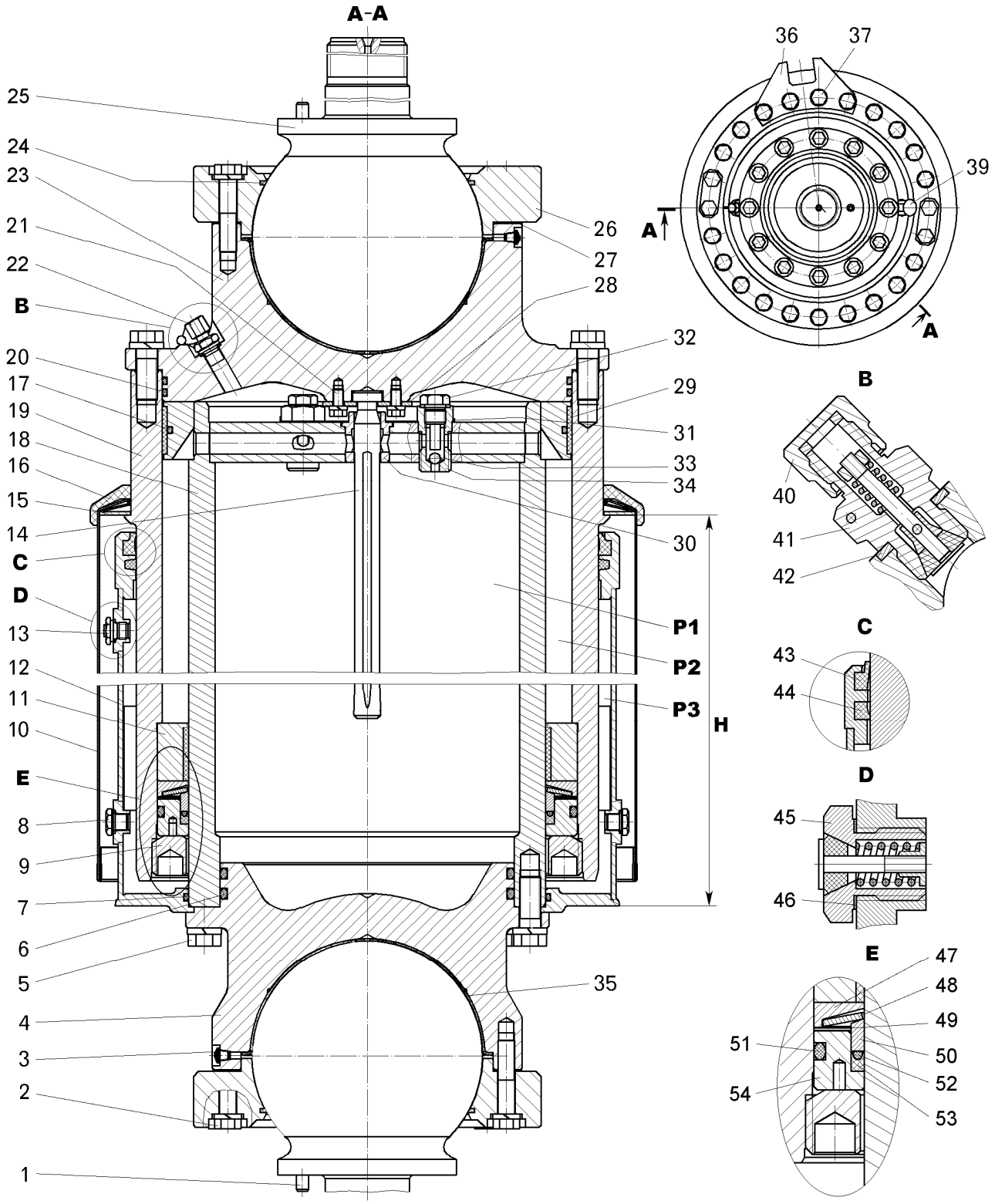


Figure 8.5 – Pneumohydraulic cylinder of rear suspension (7521–2917020/021-32):

1 – pin; 2, 5, 21, 37 – bolts; 3, 13 – safety valves; 4 – lower cover; 6, 7, 17, 20, 24, 51 – rings; 8 – plug; 9 – threaded bushing; 10 – protective cover; 11 – rod guide with axle-bearing; 12 – casing; 14 – rod; 15 – ring; 16 – seal; 18 – rod; 19 – main cylinder pipe; 22 – filling valve; 23 – upper cover; 25 – spherical joint; 26, 40 – covers; 27, 49 – adjusting gasket; 28 – flange; 29 – piston guiding sleeve; 30 – rebound case casing; 31 – lock washer; 32 – compressing valve plug; 33 – ball; 34 – compression valve seat; 35 – thrust bearing; 36 – steering lock; 38 – sensor casing; 39 – sensor valve; 41 – charging valve casing; 42, 46 – sealing gaskets; 43 – retaining ring; 44 – band; 45 – valve casing; 47 – locking ring; 48 – spring; 50 – thrust ring; 52 – distance ring; 53 – rod collar ; 54 – collar ring;
H – dimension; P1, P2, P3 – grooves

While the rebound travel the compression valves close and the fluid from groove P2 goes only through the channels made by rebound valve casing and longitudinal grooves of variable section at the absorber rod which passage section changes according to the cylinder unclamping which makes required resistance to the working fluid flow-over from groove P2 to groove P1 and prevents full cylinder unclamping.

While installation of the suspension cylinder to the dump truck as well as while the cylinder repair it is necessary to pay attention to the making on two sides of the tube of main cylinder near upper cover against charging valves 22. The marking includes the cylinder notional index (17-0 for the front suspension cylinders and 21-1 for the rear suspension cylinders), after the dash or gap in two-three signs – cylinder serial number and after the dash – two last figures of the manufacturing year.

8.3 Suspension technical maintenance

The suspension technical maintenance includes periodic examination of the condition, mounting, refilling with operational materials and functional check. The list of applied lubricating materials, inspection and relubrication frequency see in section “Technical maintenance”.

While the running-in on a shift basis before the torque stabilization it is necessary to check and if necessary to tight up the most crucial thread connections of the suspension indicated in table 8.1 (It is necessary to check nuts of spherical joints of cylinders mounting of front suspension and if needed to tighten while the mining dump truck assembly before the cylinders installation).

After the running-in it is required to adjust the clearance between inserts and the suspension cylinders spherical joints.

While the technical maintenance it is necessary to oil with Litol-24 through the oil-collar s cylinder-pivots of front and rear suspension, central hinges and rod hinges. While the installation of the centralized automatic lubrication system, the assembly units are lubricated automatically during the system operation.

Early maintenance:

– exterior check of the condition of rods, suspension cylinders and levers hinges of front and rear axle.

External indicator of the suspension cylinders defect is their height change towards normal operating condition. If the suspension cylinders work incorrectly (the dump truck roll, strong oil leakage) it is necessary to check their condition by H dimension determination (see figures 8.4 and 8.5). This dimension is determined by a special characteristical ruler (figure 8.6) which has two scales: charging and working. Scale marks indicate the gas pressure quantity in the cylinder (MPa) of given dimension at the cylinders correct charging. The charging scale is designed for the control of re-charging cylinder or there is no gas in the cylinder. Working scale is designed for the check-up of the suspension cylinders charge while operation.

In order to control dimension H, it is necessary to set an empty dump truck on an even horizontal surface. The suspension cylinder is considered to be normally charged if the housing of end face 12 (see figure 8.4 and 8.5) is situated opposite the zone of permissible spread of working scale dimension. While measuring the ruler is installed under the protective cover 10 up to the stop into the ring 15 so that not to displace it up from the mounting support.

Figure 8.6 – Characteristical ruler:

1 – dimension of fully compressed cylinder; 2 – nominal dimension of the cylinder in a loaded dump truck; 3 – pressures charging scale in the cylinder в цилиндре; 4 – nominal dimension of the cylinder in a loaded dump truck; 5 – zone of permissible divergence of the cylinder in a loaded dump truck; 6 – pressures working scale in a cylinder; 7 – dimension of fully unclamped cylinder; 8 – dimension of rear compressed cylinder filled in with oil

Taking into account that dimensions of all suspension cylinders are interrelated and change of one dimension of a defective cylinder will cause the change of the rest cylinders dimensions. As a rule the defective cylinder is the one with the minimum size.

It is necessary to measure the gas dimension of the defective cylinder with the help of the device (figure 8.7) and if it's lower than normal one (according the working scale of the characteristical ruler) is by more than 0,3 MPa for front and 0,2 MPa for rear cylinders it is necessary to recharge.

Drastic fall of the cylinder height shows that the working fluid flows through joints and the cylinder recharge with gas in a dump truck without the failure correction. The defective cylinder shall be dismantled from the dump truck, disassembled with regards to the safety instructions and to remove a trouble.

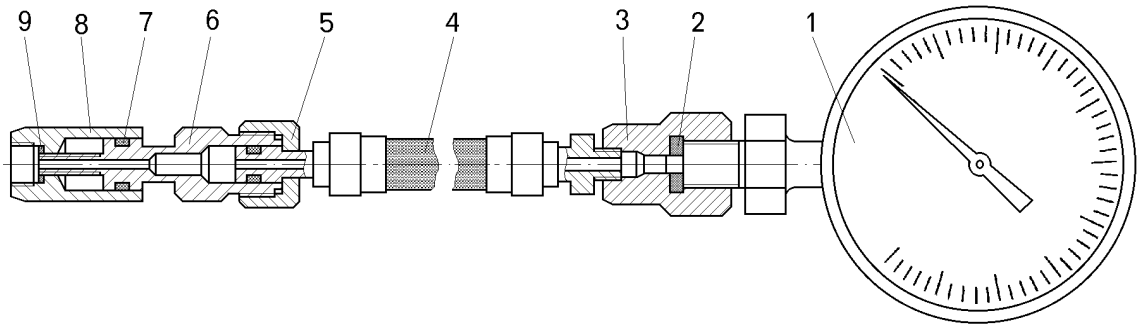


Figure 8.7 – The device for the pressure sensing in cylinders:

1 – manometer; 2, 9 – seal gasket; 3, 8 – adapters; 4 – hose; 5 – nut; 6 – needle; 7 – O-ring

Technical Maintenance–2:

– to perform the exterior check of welded joints of brackets and suspension levers. All parts shall be securely fixed, cracked on parts and welded joints are not allowed. Detected cracks shall be welded up.

– to check and if needed to tighten up tension bolts of front suspension rod pins on a frame and front axle. Torque is indicated in table 8.1,

When performing the M-3:

– Check and retighten as necessary:

1) the nut fastening the pin of the central joint of the front suspension.
2) the bolts fastening the upper and lower brackets of the front suspension cylinders;
3) the bolt fastening the pin of the central joint of the rear suspension;

The tightening torques are given in in table 8.1.

Other kinds of the maintenance.

After every five thousand hours of running of the engine, check and re-tighten as necessary:

1. Mounting bolts of front suspension central hinge to the lever;
2. Lug retaining nuts of rear suspension central hinge to the lever;
3. Mounting bolts of clamping plates to pins of rear suspension transversal rod and covers to pins of front suspension transversal rod;
4. Spherical joints retaining nuts of front and rear suspension cylinders;
5. Bearing covers mounting bolts of front and rear suspension central hinges.

Thread torques are shown in table 8.1.

On reaching the truck's run of 175 – 200 thousand kilometres:

PERFORM SCHEDULED ADJUSTMENT OF THE GAP BETWEEN THE INSERTS AND THE SPHERICAL SUPPORTS OF SUSPENSION CYLINDERS TO EXCLUDE THE POSSIBILITY OF INSERT USE WITH HIGH GAP.

Clearance adjustment between inserts and suspension cylinders spherical joints.

Clearance adjustment shall be performed upon completion of the dump truck testing (while testing the inserts are being calibrated) and upon the dump truck run of 175 – 200 thousand km.

In order to calibrate inserts it is necessary to hang out by turn upper and lower spherical joints of suspension cylinders (in compliance with the safety regulations).

The adjustment shall be performed by the removal of adjusting shims.

After the adjustment the gap in hinge joint shall not be observed and hinge joint (in oiled condition) shall rotate in all directions from manual effort by torque 150 – 200 N.m.

Retaining nuts of the spherical bearing of front and rear suspension cylinders shall be tightened up with a torque indicated in table 8.1.

While the operation it is necessary to check the hinges lubrication which is indicated by the oil outcome through safety valves on upper and lower covers. In case the oil doesn't come out through the valves it is necessary to find and eliminate the defect cause.

Spherical joint inserts can operate within 350 – 400 thousand km in case of constant lubrication and scheduled adjustments of spherical joints inserts clearance. After indicated operation run the inserts shall be changed.

The inserts lifespan indicated above can vary upward or downward depending on the dump truck operation conditions, hinges lubrication quality and lubricants quality.

– to check oil level in suspension cylinders housings.

Turn off plug 8 (see figure 8.4 or 8.5) or drain oil if its level is higher than the plug, if lower – to add up to the control plug level. If oil level is higher than the plug level – it is necessary to check the level during next technical maintenance, because it can be the reason of the wear (damage) of the collar or O-rings.

The oil brand see in section "Operational manual";

– check the suspension cylinders charge with gas and if needed to charge.

The procedure of the front suspension cylinder recharging with the oil shall be performed as follows:

– the gas from the cylinders shall be disinflated through filling valves with the help of the device. The cylinders shall be compressed to the maximum. If after the cylinder compressing the foaming oil comes through the open valve, it is necessary to close the valve and let the oil settle down until full nitrogen discharge;

– after the gas fully comes out, it is necessary to unscrew the filling valve and fill the oil into the cylinder through the opening up to the threaded hole level;

– screw in the filling valve and charge the cylinder with the nitrogen according to the charging scale of characteristical ruler; check the cylinder pressure with the help of a manometer. The pressure shall coincide with the pressure at the characteristical ruler.

Rear suspension cylinders installed in a dump truck shall be refilled with oil as follows:

– Special supports (as a set of a dump truck) shall be installed to the thrust base 1 (see figure 8.3) and the gas shall be disinflated from the suspension cylinders through the filing valve (see above), at that the cylinders shall be compressed up to the side member thrust of the frame into the installed supports.

After the cylinders are compressed, it is necessary to check the accuracy of the thrust bases installation. The check shall be performed by the characteristical ruler. The cylinder housing shall be at the level of line 8 (see figure 8.6) of the characteristical ruler within the accuracy of 5 mm at the compressed cylinders up to the frame side members thrust into the supports. At that the ruler shall be set up the same as at the measurement of the dimension H. The refilling of rear cylinders with the working fluid is performed the same as the refilling of front cylinders.

The cylinder filled in with working fluid shall be charged with the gas (nitrogen) as follows:

– before the suspension cylinders are charged, it is necessary to make sure that the charger is in working condition and the marking conformity of the compressed gas cylinder. The gas cylinder shall have the title "Nitrogen" and annular marking band of brown color.

IT IS STRICTLY PROHIBITED TO CHARGE THE SUSPENSION CYLINDERS AND HYDROPNEUMATIC ACCUMULATORS WITH THE OXYGEN WHICH WILL LEAD TOAN EXPLOSION.

– connect the reduction gearbox of the device with the nitrogen cylinder through adapter 2 (figure 8.8);

– wind adapter 17 of the device on the cylinder filling valve of the suspension;

– open the valve of the nitrogen cylinder. The gas pressure in the cylinder shall be controlled by manometer 3;

– while tightening adjusting screw 12, create gas pressure in the cylinder before its unclamping;

– close the valve on the cylinder and with the help of connecting pipe 8 let the gas out the channels and the device hose;

– screw needle 15 before the filling valve starts opening. Start of the filling valve opening can be defined by the pointer deviation moment of manometer 10. In order not to damage the valve spring, the needle shall be screwed carefully;

– open the valve on the cylinder and with the help of screw 12 of the reduction gear attain the cylinder compression up to the rate when the pressure according manometer 10 is the same as the pressure level which is indicated on the characteristical ruler (see figure 8.6) or in accordance with table 8.2;

– screw needle 15 (see figure 8.8), close the valve on the cylinder, disconnect the device from the filling valve;

It is not recommended to perform the cylinders preventive refilling with oil and recharge with nitrogen earlier than 50 – 70 thousand km run.

IN ORDER TO AVOID GAS LEAKAGE THROUGH A FLEXIBLE ROD SEAL, SUSPENSION CHARGD CYLINDERS SHALL BE STORED AND TRANSPORTED IN UPRIGHT POSITION; VERTICAL DEFLECTION SHALL NOT EXCEED 30°.

Table 8.2 – Gas pressure in suspension cylinders of a loaded dump truck (in accordance with working scale of the characteristical ruler)

Suspension cylinder	Cylinder designation	Gas pressure, MPa
front	75170-2907020-10	3,9
rear	7521–2917020/021-32	1

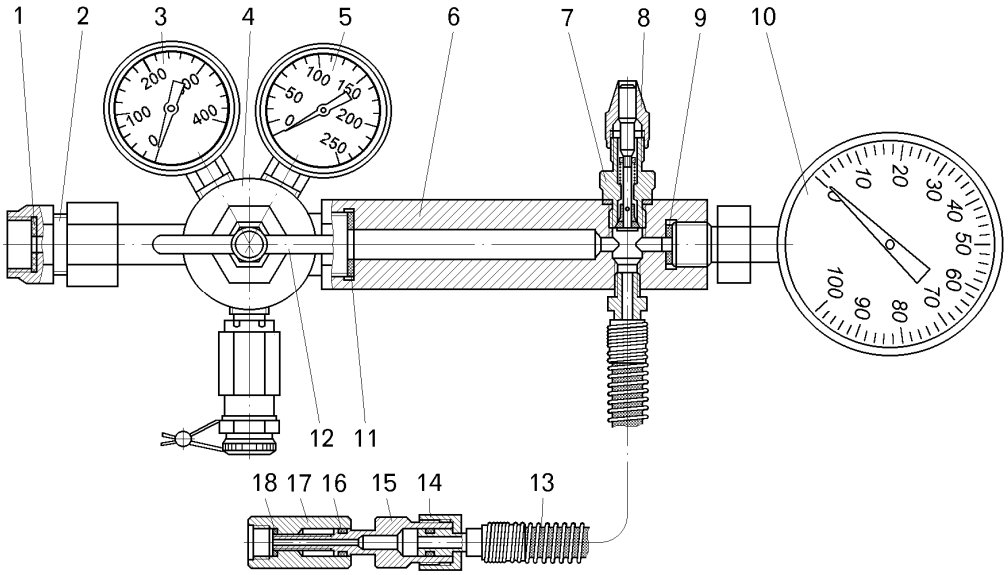


Figure 8.8 – The device for the suspension cylinders charge:

1, 9, 11, 18 – sealing gaskets; 2, 6, 17 – adapters; 3, 5 – manometers; 4 – reduction gear; 7 – valve; 8 – fitting for the gas outlet; 10 – manometer for the gas pressure control in the suspension cylinder; 12 – reduction gear adjusting screw; 13 – hose; 14 – nut; 15 – needle; 16 – sealing ring.

8.4 Front axle

Front axle is of steerable, non-driving type. It consists of beam 2 (figure 8.9), right 1 and left 4 steering knuckles, connected with the beam by cylindrical pivots 8 that are fixed in the beam tips with the help of clump bolts 7. Steering knuckle turns on a pivot in four bushings 10, installed in upper and lower lug of the steering knuckle. Bushings are lubricated through compression collars 6 and are sealed by collars 11 and 13.

Beam 2 of front axle is welded, of boxlike section with welded molded end tips on the sides. Front part of the beam is welded to central lever 3 of front suspension with turning cylinders brackets, which is pivotally connected with the frame member.

Thrust bearing 9 is installed between lower lug of a turning knuckle and a beam end face. The clearance between upper lug of a steering knuckle and a beam end face shall not exceed 0.5mm.Regulation shall be performed with the help of compensators 12.

The lower lug of the steering knuckle is fixed to pivot arm 15 of the steering linkage with the help of pins 18 (figure 8.10), expanding conical sleeves 17 and nuts 16.

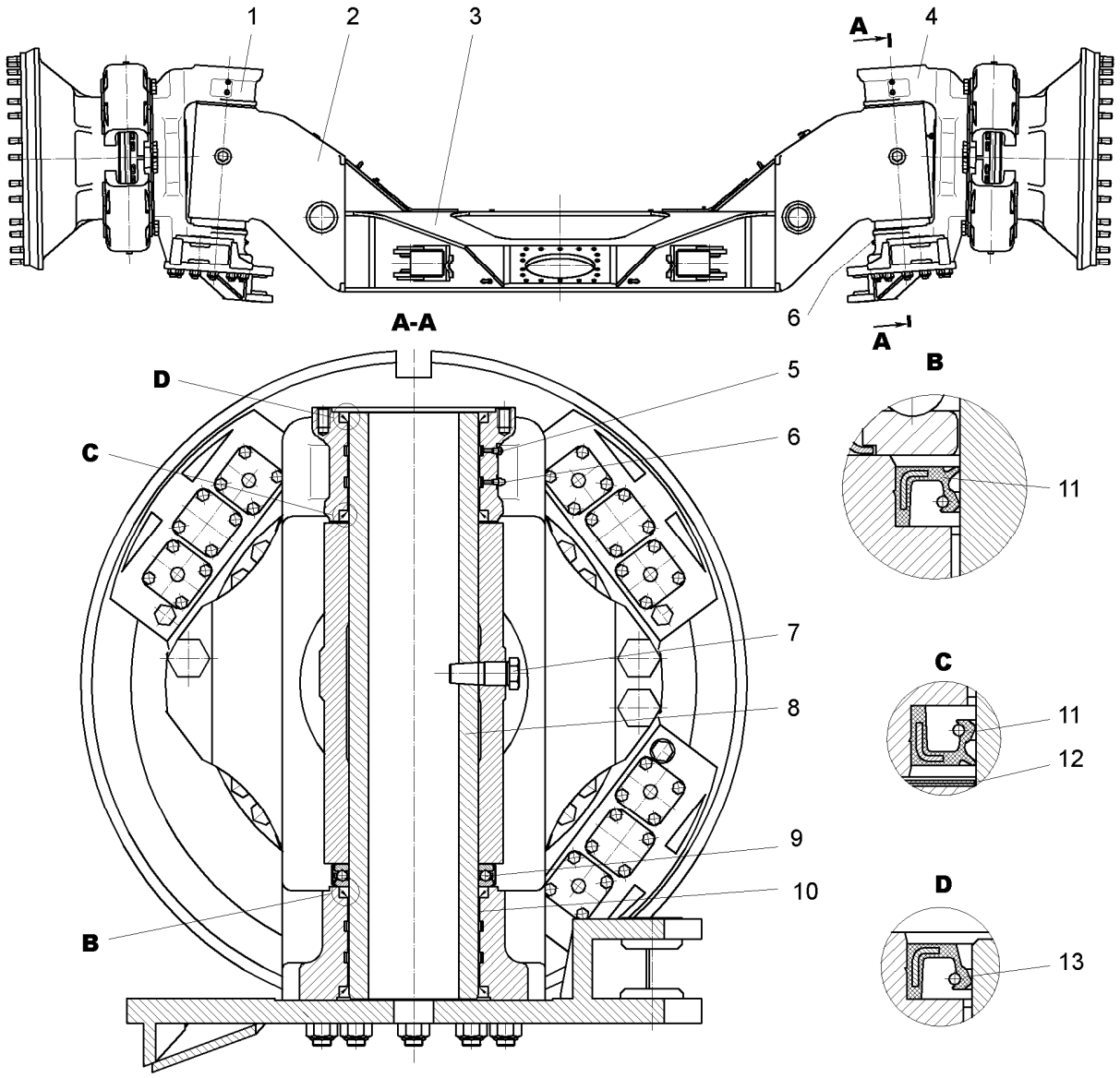


Figure 8.9 – Front axle:

1, 4 – steering knuckles; 2 – front axle beam: 3 – beam lever; 5 – safety valve; 6 – oil-collar ; 7 – pivot stopper; 8 – pivot; 9 – thrust bearing; 10 – pivot bushing; 11, 13 – collar s; 12 – compensators

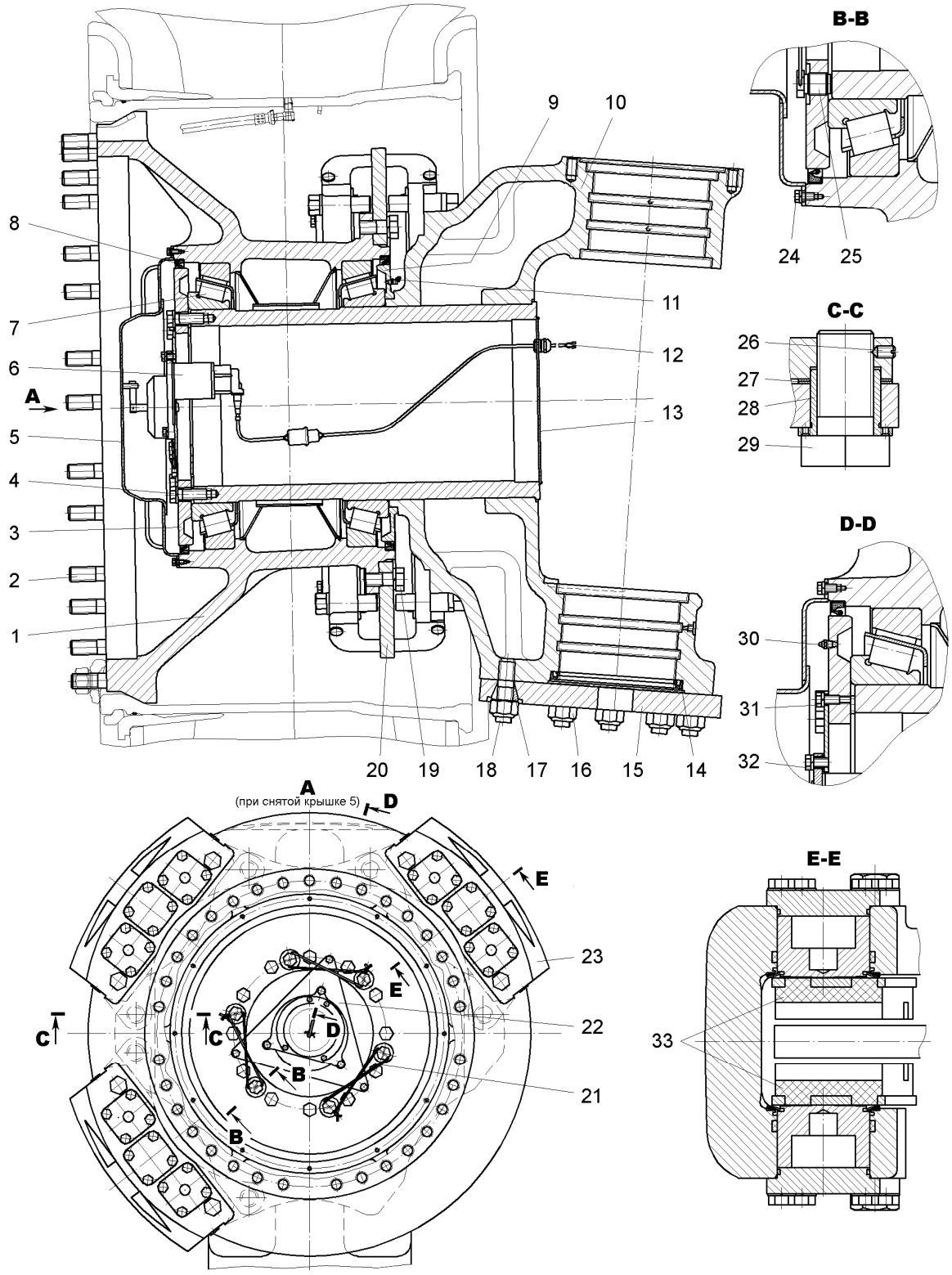


Figure 8.10 – Steering knuckle with a hub and brakes:

1 – front wheel hub; 2, 18 – pins; 3 – pressure ring; 4, 19, 24, 25, 29, 31, 32 – bolts; 5 – cover ; 6 – speedometer drive; 7 – bearing; 8 – sealing collar ; 9 – inner cover of front hub; 10 – steering knuckle; 11, 30 – oil-collar s; 12 – speedometer wiring harness; 13 – plug; 14 – collar ; 15 – pivot rod; 16 – nut; 17 – expanding sleeve; 20 – brake disk; 21 – cotter-pin; 22 – flange; 23 – brake housing; 26 – screw; 27 – washers; 28 – bushings; 33 – brake pads

Front wheel 1 hub with the attached bolts 19 (micrometers 1190 – 1470 N.m) by brake disk 20 rotates on a pivot of steering knuckle 10 on two conical roller bearings 7. Bearings are sealed by sealing collar s 8.

Brake housing 23 is attached to steering knuckle 10 with the help of two bolts 29. The bolts are installed on bushings 28 and are stopped from turning by nuts 26.

Speedometer sensor 6 drive is installed in front axle left wheel.

Provide the clearance of 1,5 mm min by adjusting washers between the axles end faces of brake housing 23 and brake disk 20. Bolts torque 29 2500 – 3000 N.m.

While the assembly pins 2 and 18 are installed with the help of sealant Unigerm-9

While the assembly and maintenance it is necessary to put lubricant Litol-24 into inner cavity between the dust guard and collar s cutting edge (see figure 8.9), inner cavity of collar s 11 and 13 - 2/3 of volume, the space between the bearing roller assembly 7 (see figure 8.10) shall be filled in with lubricant MC-1000, put the lubricant into the hub cavity between bearings, into ring 3 cavity and cover 9.

Oil-collar s 11 and 30 (three items for a steering knuckle) are designed for the lubrication of wheel hubs bearings, oil-collar s 6 (two items for a steering knuckle) – for pivot bushings lubrication.

8.5 Front axle technical maintenance

The front axle technical maintenance consists in periodic inspection of the condition, mounting, refilling with operational materials and adjustment of the wheel hub bearings. The list of applicable lubricants, frequency of the oil check-up and change see in chapter “Technical maintenance”.

Technical maintenance-1:

– with the help of the exterior check examine the condition of the tips welded joints of the front axle beam. The detailed examination of the most loaded spots (special examination zones) in accordance with figure 8.11.

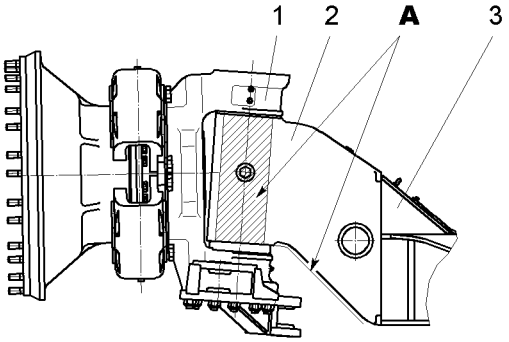


Figure 8.11 – Examination zones:

1 – steering knuckle; 2 – tip; 3 – beam
A – special examination zones

Seasonal maintenance:

– adjust the wheel hubs conical bearings

The adjustment of wheel hubs conical bearings.

The adjustment of wheel hubs conical bearings shall be performed as follows:

– apply the parking brake and put the anti-rolling thrusts under rear wheels;

– hang out the front part of the dump truck till the full wheels separation from the ground floor and install special supports under the frame side-member;

– remove outer cover 5 (see figure 8.10) of the front wheel hub;

– remove a cotter and turn back for two-three turns six bolt 25;

– отвернуть на два-три оборота двенадцать болтов 4;

– while rotating the hub fasten bolts 4 with torque 110 – 160 N.m;

– unscrew these bolts by 15 – 20°;

– tighten bolts 25 with torque 110 – 160 N.m;

– tighten bolts with torque 110 – 160 N.m;

– bolts 25 shall be fasten by cotter in pairs;

– install the outer cover of the front wheel hub and tighten with bolts.

– remove the dump truck from the supports; remove thrusts from the rear wheels

8.6 Wheels and tires

Six diskless wheels are installed in the dump truck, front axle wheels – single, driving axle – dual. The wheels are attached to the hub by clamps, pins and nuts.

Torque of retaining nuts of front and rear wheels clamping 1265 – 1565 N.m.

The wheel consists of rim 9 (figure 8.12), two board 5, landing 1 and locking 2 rings.

The rim has conical inner surface for the wheel centering and fastening on the hub. Locking ring is sectional. The rim and extractor landing ring have tapered bead seats where tire 6 bead are forced on.

Distance ring 1 (figure 8.13) is installed between rear dual wheels.

The tires are tubeless. The rim with the removal landing ring is sealed by rubber seal ring 7 (see figure 8.12) front and rear wheels extensions are taken outside in order to inflate tires and check pressure.

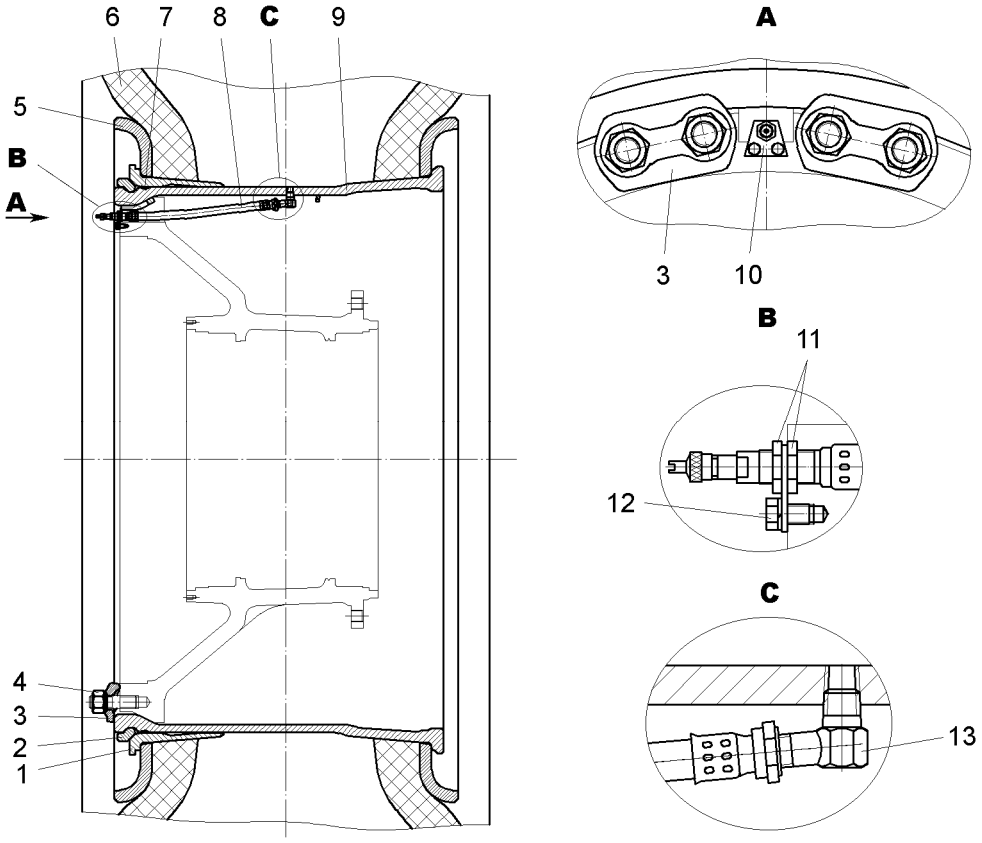


Figure 8.12 – Front wheels mounting:

1 – landing ring; 2 – locking ring; 3 – clamp; 4 – nut; 5 – bead ring; 6 – tire; 7 – sealing ring; 8 – flexible lead connector; 9 – wheel rim; 10 – valve mounting plate; 11 – nuts; 12 – bolts; 13 – valve

Tires operational modes.

Main factors which define economic efficiency of tires usage:

– loading of tire (Q);
– max permissible dump truck speed;
– dump truck cruising speed (V, cruising speed);
– tire inflation pressure (P);
– dump truck and tires maintenance;
– condition of the roads, quarries and dumps.

Failure to follow the recommendations in respect of any factors will lead inevitably to faster wear of the tires and their premature failure that will in turn increase considerably the cost of the haulage.

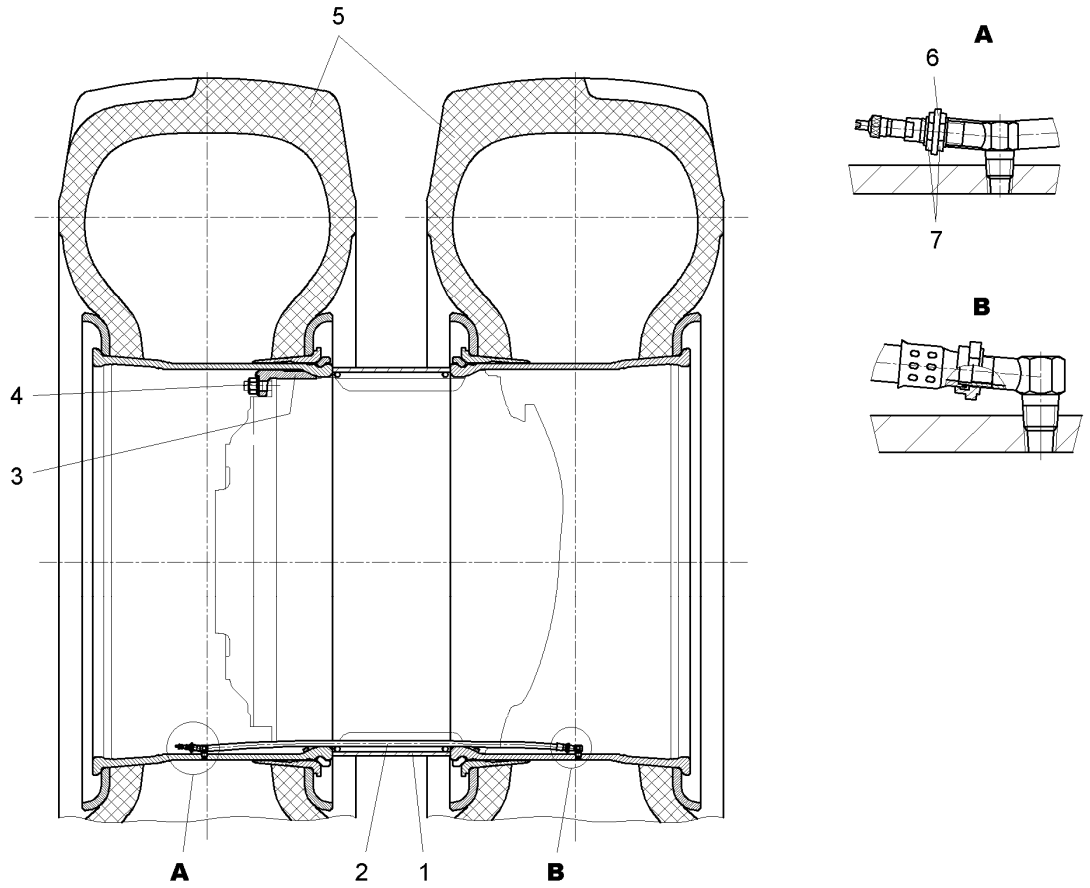


Figure 8.13 – Rear wheels mounting:

1 – distance ring; 2 – flexible extension; 3 – clamp; 4, 7 – nuts; 5 – wheels and tires; 6 – extension mounting plate

The main technical characteristic of mining tires operational capability is the working capacity index – TKMH (ton-km per hour)

The index TKMH allows to determine the amount of the load and the tire haul distance per hour without danger of premature heat destruction.

TKPH = Qc x Vc.э.;
Qc = 0,5 x (Qп + Qг); Vc.э. = 2L x n/t
Where:
Qc –average tire load;
Qп –tire load of the unloaded dump truck;
Qг –tire load of the loaded dump truck;
Vc.э. –average service speed of the dump truck per shift;
L – transportation distance;
n – number of rides per shift;
t – total time of the dump truck operation.

Nominal working capacity TKMH for tires of the off-road equipment is set for the ambient temperature tc = 38 ^{0}C. The operating range of TKPH accepted value for each tire is limited by max load haulage distance.

The average service speed of a dump truck per shift and the distance of the haulage distance in mining conditions shall not exceed the value stated in valid regulatory document for a tire. At the haulage distance increase, the operational mode shall be specified in accordance with the tires manufacturer. The excess of maximum safe load by 20% per tire will lead to the tire service life reduction by 30%.

8.7 Wheels and tires technical maintenance

The technical maintenance of wheels and tires consist in the checkup and tightening of fixing joints, checking and regulating of tires pressure as well as technical maintenance of tires and rims by visual inspection.

Additionally to the requirements of the present manual it is necessary to meet requirements tires manufacturer operational documentation.

Daily maintenance:

– Daily before operation visually check tires and wheels mounting condition, if needed tighten nuts. Wheels shall be securely fastened.

Daily upon return it is necessary to inspect tires and wheel rims. Foreign objects that got stuck in the tire tread, tire sidewall and between dual tires shall be removed.

Damaged tire casing (up to the cord thread), rims, as well as coverings with the wear limit of tread pattern shall be removed from the dump truck and repaired.

In case of intense and uneven wear of the tread pattern it is necessary to eliminate the causes of the wear and take measure to eliminate the problem regardless the technical maintenance period.

While changing the wheels after the first travel nuts shall be tighten by torque indicated in Appendix A (Micrometer 1265 – 1565 N.m). Further the nuts shall be tightened after two-three travels until the torque stabilization of all nuts;

– check the tire pressure, if needed regulate until normal.

In order to carry out an inspection it is necessary to use the electronic control panel in the driver's cab which displays information about dump truck tires pressure which comes from sensors mounted on wheels.

In case the tire pressure doesn't correspond to the permissible operating range, the pressure indications will be marked in red and the audible alarm will be on. In case there is no information about the pressure in any tire it is necessary to use a manometer.

The inflation pressure of tire at its temperature equal the ambient temperature shall correspond to values indicated in table 8.3

Table 8.3 – Tire inflation pressure

BRIDGESTONE 37.00R57	(0,7 ± 0,025) MPa
BRIDGESTONE 42/90R57	
MICHELIN 37/00R57	(0,6 ± 0,025) MPa

Tire inflation pressure can be defined by the tires manufacturer.

The air pressure in a heated tire shall be checked every day upon the shift end on an empty truck by manometers that were metrologically tested. During the maintenance the pressure in radial tires can be higher by ~15% due to the tire heating which is allowed by the tire design.

If the pressure in a heated tire is higher than permissible, it is necessary to find out and eliminate the cause of the high pressure (bad technical condition of a tire, overload, over-speed, continuous service).

If the reasons of the tires pressure increase are not defined, the tire shall be cooled up to the ambient temperature or garage premises and it is necessary to check the pressure for compliance with the normal one. The dump truck operational mode when the pressure in heated tires is higher than permissible value is not allowed.

IT IS STRICTLY PROHIBITED TO ADJUST THE PRESSURE IN A HEATEN TIRE.

While the setting of the pressure in a cold tire it is necessary to take into account the allowance per table 8.4 to the rated pressure depending on the difference of ambient temperature and inside temperature. If the ambient temperature is higher than indoor temperature, the allowance shall be subtracted from the nominal pressure value, if lower – added.

Table 8.4 – Corrections to the tire rated pressure depending on the difference of ambient temperature and within the garage

Temperature difference, ^{o}C	10	20	30	40	50	60
Correction to the rated pressure in the tire, MPa	0,02	0,03	0,05	0,07	0,08	0,1

As the result of the operation at enhanced deformation while driving with reduced pressure, in case of overload and overspeed, the tire can become explosive because of the carcass failure.

Taking into account the dump trucks operating experience, it is recommended to use industrial nitrogen gas in order to avoid the risk of tires inner combustion, to enhance reliability of tires pressure control system.

It is forbidden to operate mining dump trucks if tires have:

– tread pattern wear, wherein the rest height according to wear indicator is 0 mm;
– tread detachment and coating rubber regardless of the dimensions;
– ply break and separation ;
– protector cracks reaching the cord;
– cuts and ruptures with damaging of the basic (bearing) breaker threads or tire carcass ply;
– faulty valves and slides as well as valves without caps or with plugs;
– air pressure not complying with the established norms. When mounting the tires, make sure that the difference in outer diameters of dual tires doesn't exceed 19 mm.

It is recommended to perform the scheduled re-arrangement of the front tires to the rear axle after 1/3 of its service life. The front axle shall be fitted with new tires. The tire re-arrangement shall be also performed in case of their damage, intense uneven wear of the tire tread pattern or in case of necessity of correct selection of the dual tires.

ATTENTION! THE DIFFERENCE IN DUAL BIAS TIRES MORE THAN 3% AND RADIAL MORE THAN 1% IS NOT PERMISSIBLE!

ATTENTION – WHEN OPERATING DUAL TIRES INSTALLED IN REAR AXLE IN REAR AXLE THE EMERGENCY MODE OF PRESSURE LOSS IN ONE OF TIRES OF LOADED DUMP TRUCK IS POSSIBLE. AS THE RESULT THE TIRE IS AFFECTED BY THE LOAD WHICH IS TWOFOLD BIGGER THA PERMISSIBLE LOAD AND IT CAN CAUSE TO HE PLY BREAK AND SEPARATION. IN ORDER TO DEFINE THE TIRE OPERATIONAL CAPABILITY IT IS NECESSARY TO DISASSEMBLE THE TIRE AND INSPESCT ITS INNER SURFACE.

IT IS STRICTLY PROHIBITED:

– for the safety reasons it is prohibited to mount tires with repaired local damages and tires fixed by overlapping of a new protector on front axle;
– to mount tires of different brands on front axle;
– to mount dual radial and bias tires.

In order to prevent premature failure and mechanical damage of tires it is necessary to maintain the condition of mining roads, access to excavators and dumps.

There shall be no oil-products destroying rubber. Parking of dump trucks fully loaded within more than 2 days is prohibited. In case of preservation the dump truck shall be placed on supports which will secure complete tires unloading.

The tire design is shown in figure 8.13.

Technical maintenance-1:

– check and if needed fasten retaining nuts of front and rear wheels.

Torques is indicated in Appendix A.

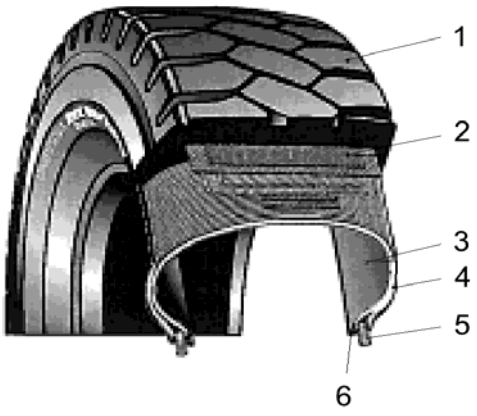


Figure 8.13 – Radial tire design:
1 – tread; 2 – breaker; 3 – inner ply; 4 – carcass; 5 – bead wire; 6 – chafer

8.8 Mounting and dismantling of wheels and tires

To dismantle wheels it is necessary to lift the appropriate part of the dump truck and place it onto the support. In order to prevent personnel injuries it is necessary to discharge air from the tire before unscrewing front wheel retaining nuts.

Before unfastening rear dual wheels it is necessary to discharge the air from both tires. This regulation shall be complied with while performing any works connected with unfastening or dismantling of wheels. Some cracks in the locking parts can appear in the locking rim. If there is air inside a tire, a sudden rim burst can occur which may lead to accidents.

IT IS FORBIDDEN TO UNFASTEN THE WHEEL WITHOUT MAKING SURE THAT IT DOESN'T CONTAIN AIR!

To dismantle front wheel, unscrew nuts and remove clamps. While unfastening the nuts, the wheel shall be supported by a fixing device. To remove the rear wheels, turn out partially the nuts and shift the clamps. Make sure that the clamps can move freely, turn out the nuts completely and remove the clamps while supporting the wheel by means of fixing device.

When mounting and dismantling the wheels, protect the adapters of the valves and extenders against damage.

DISMANTLING AND ASSEMBLY OF TIRES TO A HUB AS WELL AS INSTALLATION TO THE DUMP TRUCK IS FORBIDDEN IF THE TIRES SURFACE TEMPERATURE IS LOWER 40^{0}C.

The tires shall be only mounted and dismantled on the tire-mounting bench ensuring the smooth and even application of the load to the wheel parts in accordance with the following directions on the stand.

IT IS STRICTLY PROHIBITED TO KNOCK RIMS FROM TIRES BY HAMMERING IN ORDER TO AVOID DEFORMATION OF WHEELS PARTS, DINTS AND CRACKS.

Prior to mounting, check the completeness of the tire and wheel parts and assemble the wheel with the tire of the specified size only.

The tires shall be only mounted on the wheels with not damaged painting from both the outer and inner side. Using the corrosive wheels could cause their breakdown during the motion that in turn could cause accidents. Besides, using the non-painted wheel parts would complicate not only mounting, but also subsequent dismantling of the tire, because the tire beads stick to non-painted surfaces stronger than to painted ones.

Prior to mounting, check the tire condition by external inspection. The internal cavity of the tire shall be clean and dry. The tire beads shall have no flash residues. The presence of moisture, dirt and rubber flash could become the cause of impeded or impossible deflation of the tire due to clogging the valve bore.

Check carefully the condition of the rim elements while paying special attention to the absence of cracks over the grooves for the lock and sealing rings, over the fillets of the shoulders of the base ring and bead seat and over the welded connection between the locking part of the rim and bead seat to the rim shell. To detect cracks, it is recommended to use the visual, dye-penetrant, magnetic-particle or ultrasound inspection. When performing the visual inspection, a magnifier may be used.

Never allow the operation of the rims and other parts of the wheels if they have such defects as cracks, rust and paint sags at the places contacting with the tire and other wheel parts as well as those with distorted geometry (excessive ovality of the bead ring and rim, twisting of the lock ring, dents, burrs, etc.).

Never use the rims with damaged lock groove and/or lock rings with the above defects; otherwise the tire could get stripped spontaneously when being inflated.

The dirty areas of the wheel, especially mounting shelves and areas at the valve hole shall be cleaned from dirt and rust by means of a metallic brush, degreased and touched up. In case of destruction of more than 25% of the total painting of the wheel parts, perform the completely painting using primers and enamels intended for metal.

The tire shall be inflated on the tire-mounting bench with the fixed pressure device on the hydraulic cylinder rod ensuring the safety of the works. To inflate the tire, proceed as follows:

– Inflate the tire preliminarily to the pressure of 0.08 – 0.10 MPa and check the correctness of assembling of the tire with the rim;

– inflate the tire up to the recommended operating pressure in order to ensure firm adherence of the tire bead to the rim seat and hold for 10 – 14 minutes. In order to check hermeticity pour soap solution into the groove of the safety shoulder. Hermeticity of joints valve – rim and valve chamber – spool valve is also checked by soap solution;

– reduce the air pressure in the tire up to 0,08 – 0,1 MPa, unfasten and remove the wheel from the bench.

The hermeticity of second bead shall be checked in a similar manner, but the wheel lock ring shall be downwards. Final hermeticity estimation of the wheel assembly with a tire shall be checked by a reducing pressure manometer during 24 hours. Pressure reduction is not allowed.

THE AIR PRESSURE IN THE TIRE SHALL BE BROUGHT TO NORMAL VALUE ONLY AFTER FASTENING THE WHEEL ON THE HUB. PEOPLE ARE NOT ALLOWED NEARBY THE INFLATING TIRE.

When mounting the tire onto the rim, be especially careful to protect the tire beads, sealing rings and rim elements ensuring the air-tightness of the joints. Never reuse the sealing ring. Never use the hole for the valve for slinging the rim.

To protect the slides from dirtying and damage, the adapters of the valves and extenders shall be fitted with caps.

When transporting the tire, its beads shall be protected against damages. For slinging the tire, use soft belt sling. The tires shall not be lifted by hooking them directly by beads or cord binding the protective facilities of the beads, or using the rope or chain slings.

The tires shall be transported and stored in the upright position. The mounted tires shall be stored with the air pressure in them of 0,08 – 0,10 MPa.

While transportation of the tire avoid the tire bead damage. The fixing is made by a flexible band sling with width not less 140 mm. It is forbidden to fix the tires bead by a hook, wire rope sling or chain sling as well as bead protective covering rope.

To mount the wheel onto the front hub, proceed as follows:

– Turn the hub with the slot faced downwards and mount the wheel onto the hub having aligned the rim stopper with the hub slot;

– Fit the upper and lower clamps and then the left and right ones and tighten the nuts;

– Fit the other clamps and tighten the nuts. Tighten the nuts in diametrally opposite pairs to ensure the wheel wobble over the side wall of the tyre casing to be not more than 10 mm;

– Tighten nuts. After tightening the nuts, inflate the tyre to the required pressure.

To mount the rear wheels proceed as follows:

– Before mounting of the inner wheel check the hermeticity of the valve and the extension with the help of soap emulsion. Press the extension valve shaft and make sure that air comes out. If air doesn't come out, find out the reason, fix a problem or replace the extension;

– Mount the inner wheel with the valve extender onto the hub with the slot oriented downwards, distance ring and outer wheel. Fit the clamps and tighten the nuts fastening the wheels gradually in three-four operations while following the crosswise pattern (by turn diametrally oppositely);

– Inflate the tyres to the required pressure. The wheel wobble over the side wall of the tyre casing shall not exceed 10 mm.

Repeated fastening of retaining nuts of front and rear axle shall be performed after first run and then after two-three runs until tightening torque of all the wheels gets stabilized.

For more detail about dismantling, disassembling, reassembling and mounting of the wheels, see the Repair Manual.

8.9 Tires pressure monitoring system

Mining dump trucks can be equipped with the tires pressure monitoring systems of different brands:

– telemetering monitoring system (TMS);

– telesupervision system.

The systems are replaceable.

The systems automatically control the tires pressure, transmit alarm and visual signals to the driver in case of emergency, register date and time of the emergency occurrence and elimination.

The system technical characteristics, description, tires pressure control sensors, maintenance and repair see in the system operation guide which is included into the operational manual and will be attached while the dispatch.

Mounting of TMS and transmitting modules of front and rear wheels, tires pressure monitoring system are set in the installation specification.

9 STEERING

Steering of the dump truck is of hydrostatic power type, with inner hydraulic feedback. It consists of dosing pump A1 (Figure 9.1), connected with steering column shaft by cardan shaft, flow amplifier A2, collector A3, double axial-piston pump H of variable capacity, four hydro-pneumatic accumulators АК1 – АК4, two hydraulic turning cylinders Ц1 and Ц2, filters Ф1, Ф2, oil tank and oil pipelines.

9.1 Principle of operation of hydraulic drive

After starting the engine the flow of working fluid from the front section of double adjustable axial-piston pump H through filter Ф1 and return valve КО7 is supplied to collector A3 and then to the charging of hydro-pneumatic accumulators of steering and brake system. Hydro-pneumatic accumulators are designed for accumulation of working fluid under the pressure and its supplying into hydraulic system, as well as in emergency situation, when at any reason the supply of working fluid from the pump would be stopped.

The presence of hydro-pneumatic accumulators in the hydraulic system allows at the abrupt engine stop or pump fault to make two full turns of the steerable wheels from the one extreme position to another when driving the truck for mowing to a safe place and stopping.

From collector the working fluid goes into hydraulic drive of braking systems, to flow amplifier A2 and to the pump pressure control unit. Pump pressure control unit maintains the pressure of working fluid the hydraulic system of steering and brake system within 13,5 – 17 MPa, through the control of line “LS” of pump section regulator valve of variable capacity.

Working fluid to distribution valve P1 of steering is supplied through flow amplifier A2, which is controlled by the same distribution valve.

When steering wheels are in neutral position (no turning) and the engine is running the working fluid from hydro-pneumatic accumulators through collector A3 is supplied in hydraulic line HP to priority valve P5 of flow amplifier A2 and further from hydraulic lines is supplied to distribution valve P3 of flow amplifier and to the closed distribution valve P1 of hydraulic steering A1.

When turning the steering wheel to the left, hydraulic distribution valve spool P1 of steering rotates and allows the oil go through distribution valve P1 of steering and turns the rotor. On the other side of the rotor the oil passes through holes in distribution valve of steering control unit and goes into hydraulic line L and further to the distribution valve of direction selection P2 of flow amplifier. While the pressure is increased in hydraulic line L the oil goes also to the cavity of spool spring of distribution valve P2. Under the oil pressure, the spool of distribution valve P2 is shifted right (according to scheme). This shift allows the oil get through passages in spool of distribution valve P2 to distribution valve P3 and through orifice hole in the end face of its spool.

Under the oil pressure the spool of distribution valve P3 shifts left (according to scheme) and opens the hole available in sleeve so that to pass the oil coming from steering control unit through distribution valve P2.

Simultaneously due to the shift of spool of distribution valve P3 the holes in the area of distribution valve springs installation are opened, and the oil from priority valve P5 goes to the cavity of spool of distribution valve P3. Under the oil pressure, coming from the spool cavity of distribution valve P3, the spool of distribution valve P4 is shifted towards its springs that allows through the additional line of holes in the spool of distribution valve P3 sends additional quantity of the oil into the cavity of distribution valve spool P4. The cumulative quantity of oil through distribution valve P3 of flow amplifier on pumping lines is supplied into the head end of the left turning hydraulic cylinder Ц1 and into the rod end of the right turning hydraulic cylinder Ц2. Steerable wheels turn left. The oil from the opposite chambers of hydraulic cylinders is forced back into the flow amplifier and through distribution valve P2 on hydraulic line HT is drained into hydraulic tank.

When turning the steering wheel to the right the oil goes through distribution valve P1 of steering and than is supplied into hydraulic line R and further to distribution valve P2 of flow amplifier. Under the oil pressure the spool of distribution valve P2 is shifted left (according to scheme).

The oil passes through the flow amplifies in the same manner as at turning to the left.

The cumulative quantity of oil through distribution valve P3 of flow amplifier on pumping lines is supplied into the head end of the right hydraulic turning cylinder Ц2 and into the rod end of the left hydraulic turning cylinder Ц1. Steerable wheels turn right.

From the opposite chambers of hydraulic cylinders the oil is forced back into flow amplifier and through distribution valve P2 on hydraulic line HT is drained in hydraulic tank.

Anti-shock relief valves КП1 and КП2 are installed in the flow amplifier which are designed for relieving overpressure in hydraulic cylinders in case of extreme situation. When there is no turn the spool of distribution valve of direction selection P2 is set in neutral (mid) position and blocks the oil output from hydraulic cylinders.

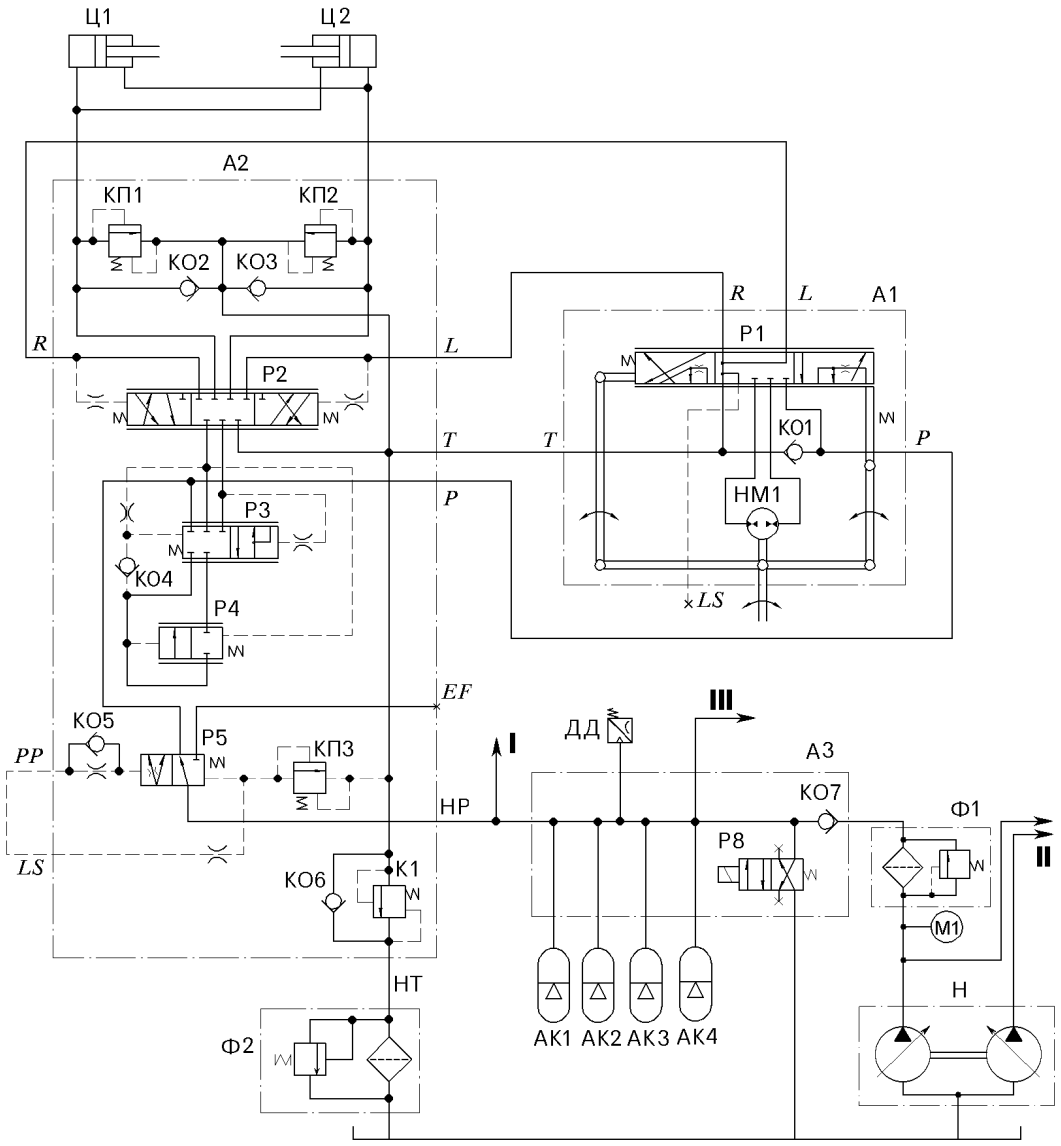


Figure 9.1 – Steering hydraulic circuit diagram:

Н – double axial-piston pump of variable capacity; А1 – dosing pump; А2 – flow amplifier; А3 – collector; НМ1 – hydraulic motor of steering; Р1 – steering distribution valve; Р2 – distribution valve of turn direction selection; Р3, Р4 – flow amplifier distribution valve; Р5 – priority valve; Р8 – distribution valve for hydro-pneumatic accumulators discharge; АК1-АК4 – hydro-pneumatic accumulators; Ф1, Ф2 – filters; К1 – back pressure valve; КО1 – КО7 – return valves; КП1, КП2, КП3 – safety valves; Ц1, Ц2 –hydraulic turning cylinders; ДД – pressure sensor; М1 – manometer (installed at hydraulic system diagnostics);

I –in hydraulic oil brake system; II – in hydraulic system of dumping mechanism; III – to pump pressure control unit

This creates hydraulic “lock” in hydraulic turning cylinders preventing their shifting.

When head-on-crash, causing critical loading, striving for turning the wheel to the left, the pressure in opposite chambers of hydraulic cylinders is increased. Safety valves are set to the pressure of 24 MPa and when reaching this pressure the valve is opened and connects the specified chambers of hydraulic cylinders with the drain hydraulic line. At the same time the pressure in opposite chambers of hydraulic cylinders will drop below the atmospheric. For equalizing the oil pressure in chambers of hydraulic cylinders, return valves КО2 and КО3 are installed in the flow amplifier, which transmit the oil into hydraulic cylinders from the drain hydraulic line.

In case of pump fault (reduced pressure in liquid cavity of hydro-pneumatic accumulators of steering) the analog pressure sensor ДД with measuring range from 0 – 25 MPa is installed in steering collector A5 for visual and audible signaling.

The actual pressure value, measured by sensor, is displaced on the dashboard. At the pressure of 13 – 18,5 MPa indication zone is of green color, at the pressure less than 13 MPa and more than 18,5 MPa – red color. When pressure is below then 13 MPa the emergency-type indicator of red color (emergency pressure in steering) and audio signal is switched on. When pressure is lower than 8 MPa electromagnetic distribution valve is actuated in the rear brakes circuit– automatic actuation of rear wheels brake mechanisms.

When turning the steerable wheels on the immobile dump truck, and when the maximum pressure in steering hydraulic system is required, and at minimum pump capacity at low engine rpm the maximum speed of steerable wheel turn can be limited (“heavy steering”). This phenomenon has positive nature as for tires safety.

9.2 Steering control units

Steering column. For the comfort operation of the driver**,** steering column 5 (Figure 9.2) is adjusted on tilt angle and the height. The tilt angle can be adjusted after turning handle 14 down. The adjustment of height can be performed after turning handle 15 towards the driver.

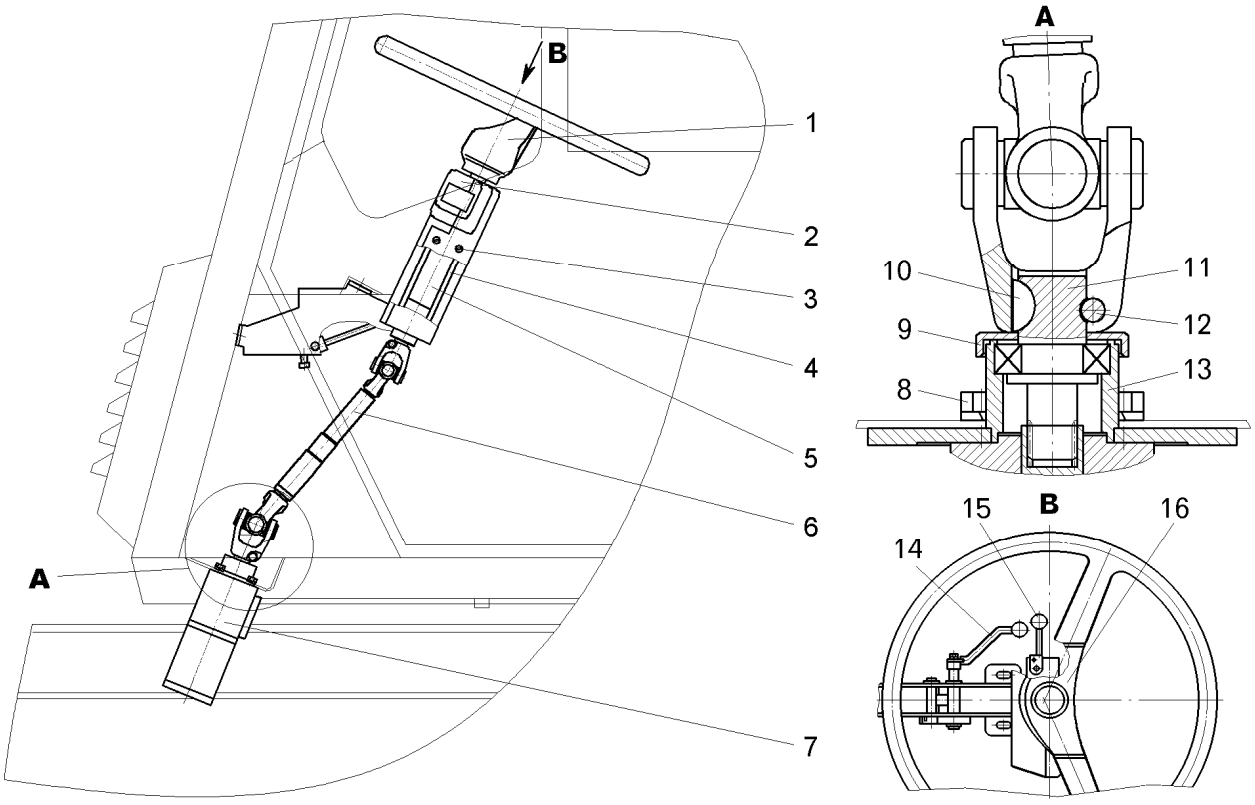


Figure 9.2 – Mechanical drive of dosing unit:

1 – steering wheel; 2 – cover of upper housing; 3 – upper housing; 4 – housing; 5 – steering column with bracket; 6 – cardan shaft of steering; 7 – dosing pump; 8, 12 – bolts; 9 – bearing cap; 10 – cotter; 11 – shaft; 13 – flange with bearing; 14 – handle for adjusting the steering column tilt angle; 15 – handle for adjusting the steering column height; 16 – cover with logotype

Cardan shaft of steering (Figure 9.3) interconnects the steering column shaft with the shaft of dosing pump, to which it is fastened with the help of cotters 9 and tie bolts.

Cardan shaft consists of two cardans 1, pipes 3 and splined shaft 6. Splined joint is closed by protective coupling 5 that is fastened on the shaft and the pipe by cotter-pins 4. Cardan consists of two yokes 7, cross 11 with safety valve 9 and four needle bearings 14 that are pressed in yokes holes and fixed by locking rings 13.

End sealing 12 holds the grease in bearing and protects it from dirt. Yokes, connected with the pipe and splined shaft, at the assembling shall be arranged in the plane.

The grease put into the splined joint and needle bearings insures the cardan shaft operation within the lifespan of the dump truck till the overhauls.

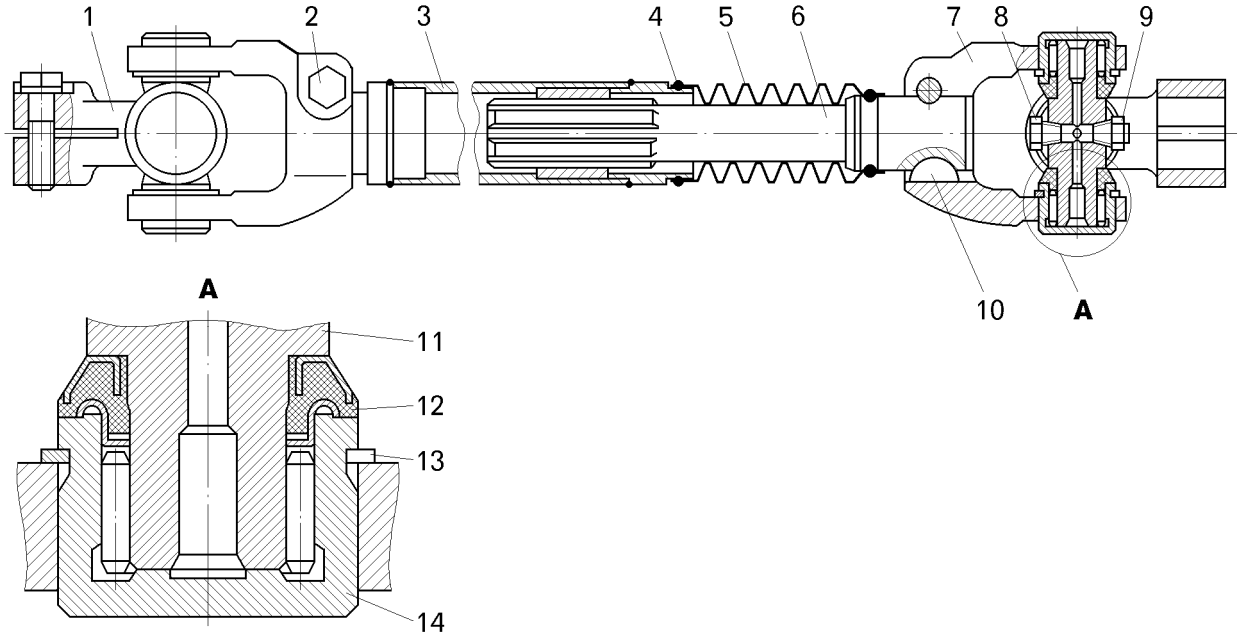


Figure 9.3 – Steering cardan shaft:

1 – U-joint; 2 – tie bolt; 3 – pipe; 4 – cotter-pin; 5 – protective coupling; 6 – splined shaft; 7 – yoke; 8 – plug; 9 – safety valve; 10 – cotter; 11 – cross; 12 – end sealing; 13 – locking ring; 14 – needle bearing

Dosing pump (Figure 9.4) consists of two elements: distribution block 2 and feedback hydraulic motor 1.

Distribution block 2 consists of body 17, spool 12, sleeve 9, composite seal 14 as a part of rubber and safety rings, thrust bearing 15 and dust boot 13, pressed into the ring groove in upper part of the body.

Spool occupies the fixed position in the sleeve with the help of pin 10 and reed springs 11, installed through the slots of spool and sleeves and can be rotated towards the sleeve to the angle of 15^0 to both sides when applying the torque.

Delivery and drain channels of distribution block are separated between each other by return valve 16.

Feedback hydraulic motor 1 consists of crown 5, stars 6, covers 4 and distributing disk 7. The rotary moment is transmitted from the star to the spool-sleeve pair or vice versa by cardan 8. All components of hydraulic motor are screwed with the body by seven bolts 3.

The leakproofness of connectors of hydraulic motor and distribution block is secured by rubber sealing rings 18 и 19.

Dosing pump is connected to the hydraulic system of steering through four threaded holes on body 17 of distribution block 2: P, T, L and R.

In neutral position of spool 12 with sleeve 9 the working fluid, delivered by feeding pump in line P of hydraulic steering comes along the body channels and holes of sleeve and spool into line T, and from there to the drain into hydraulic tank. When turning steerable wheel the fluid from the delivery line through sleeve and spool is supplied to feedback hydraulic motor.

In this case star 6 of hydraulic motor by fluid flow, coming into hydraulic motor and further into the cylinder line, is rotating and then by means of cardan 8 and pin 10 turns sleeve 9 to the direction of spool rotation 12. The spool is shifted and connects delivery lines from pumps with the corresponding chambers of turning hydraulic cylinders. Steerable wheels turn.

When stopping the rotation of spool 12 and its holding sleeve 9 turns to the direction of initial position to the moment of pressure drop in line P down to the value, less than external load, and the truck stops turning. When spool 12 is released under the force of plate springs the spool turns in its initial position towards the sleeve and the pump is fully unloaded to the drain.

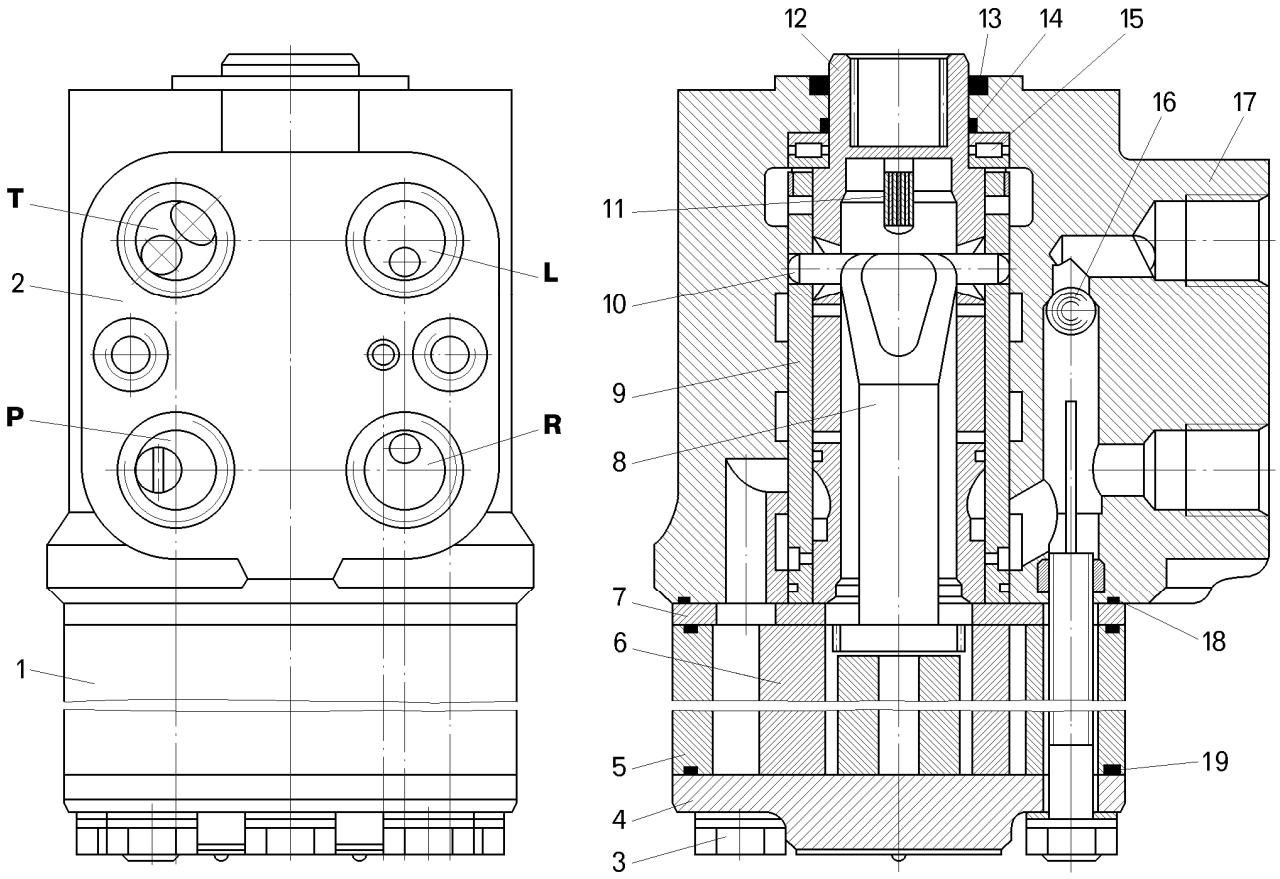


Figure 9.4 – Dosing pump:

1 – feedback hydraulic motor; 2 – distribution block; 3 – bolt; 4 – cover; 5 – crown; 6 – star; 7 – distributing disk; 8 – cardan; 9 – sleeve; 10 – pin; 11 – reed springs; 12 – spool; 13 – dust boot; 14 – composite seal; 15 – thrust bearing; 16 – return valve; 17 – body; 18, 19 –sealing rings;

P – pressure line; T – drain line; L and R – cylinder lines for turning to the left and to the right accordingly

Flow amplifier is designed for passing a large quantity of oil required for providing the operation of the steering control through the hydraulic cylinders. The flow amplifier is controlled by dosing pump. The flow amplifier (Figure 9.5) comprises priority valve 10, flow amplifier spool 8, spool of selecting the turn direction 6, safety valve 11 for adjusting the maximum pressure in the hydraulic system, shockproof safety valves 1 and 5 as well as return valves.

When the steering wheel is in the neutral position, the working fluid from the pumps goes into chamber HP of priority valve 10 and then via channel P goes to the dosing pump, the spool of which is in closed position. Besides, the working fluid is fed to the closed zone of flow amplifier slope 8 and through the throttling hole passes to chamber PP at the end of the priority valve slope.

When turning the steering wheel, the working fluid under control pressure goes from the dosing pump to spool 6 in chambers L or R (depending on the turn direction). While the pressure in these chambers increases, the working fluid also passes through orifice hole C into the chamber of the distribution valve spring. Under the working fluid pressure, the spool of distribution valve 6 is shifted and the working fluid is fed from chamber B of spool 6 to chamber D of the flow amplifier spool.

The working fluid passes from chamber D through the holes of sleeve 8 and channel between the sleeve and spool 9 to hole G, where it is initially blocked. Besides, the working fluid is passed through the outer groove of sleeve 8 into chamber H and through orifice hole J to the end face of sleeve 8. Under the working fluid pressure sleeve 8 is shifted and opens hole G, through which the working fluid passes from the dosing pump into control chamber Q of valve 6.

Due to sleeve 8 shifting, holes E are opened that allows the working fluid to pass from the priority valve 10 into the inner chamber of sleeve 8. The pressure of the working fluid, coming into the inner chamber of sleeve 8, is shifted spool 9 relatively to its spring and opens a series of holes K which are located in the same plane as hole G is. The quantity of the working fluid passed from the inner chamber of the sleeve 8 is dosed by holes K being opened in proportion to hole G.

The number of holes K in sleeve 8 is 4. Through these holes, the working fluid goes into control chamber Q of valve 6 in addition to the working fluid going from the dosing pump. The total quantity of the working fluid fed into chamber Q through channels CL or CR is supplied into the hydraulic cylinders to turn the steerable wheels to the left or to the right.

As the wheels turn, the working fluid passes from opposite chambers of the hydraulic cylinders into flow amplifier chamber M and then through return-and-cutout valve 3 and drains through outlet channel HT to the hydraulic tank.

Safety valves 1 and 5 are intended for releasing the top pressure in the hydraulic cylinders in case of emergency. During the dump truck running and without turning, the spool of valve 6 is in the neutral (middle) position and blocks the oil discharge from hydraulic turning cylinders. It creates the hydraulic “lock” in the hydraulic cylinders preventing them from shifting.

When head-on-crash, causing critical loading, striving for turning the wheel to the left, the pressure in opposite chambers of hydraulic cylinders is increased. Safety valves are set to the pressure of 24 MPa and when reaching this pressure the valve is opened and connects the chambers of hydraulic cylinders, connected with hydraulic lines of the right turn, with the drain hydraulic line.

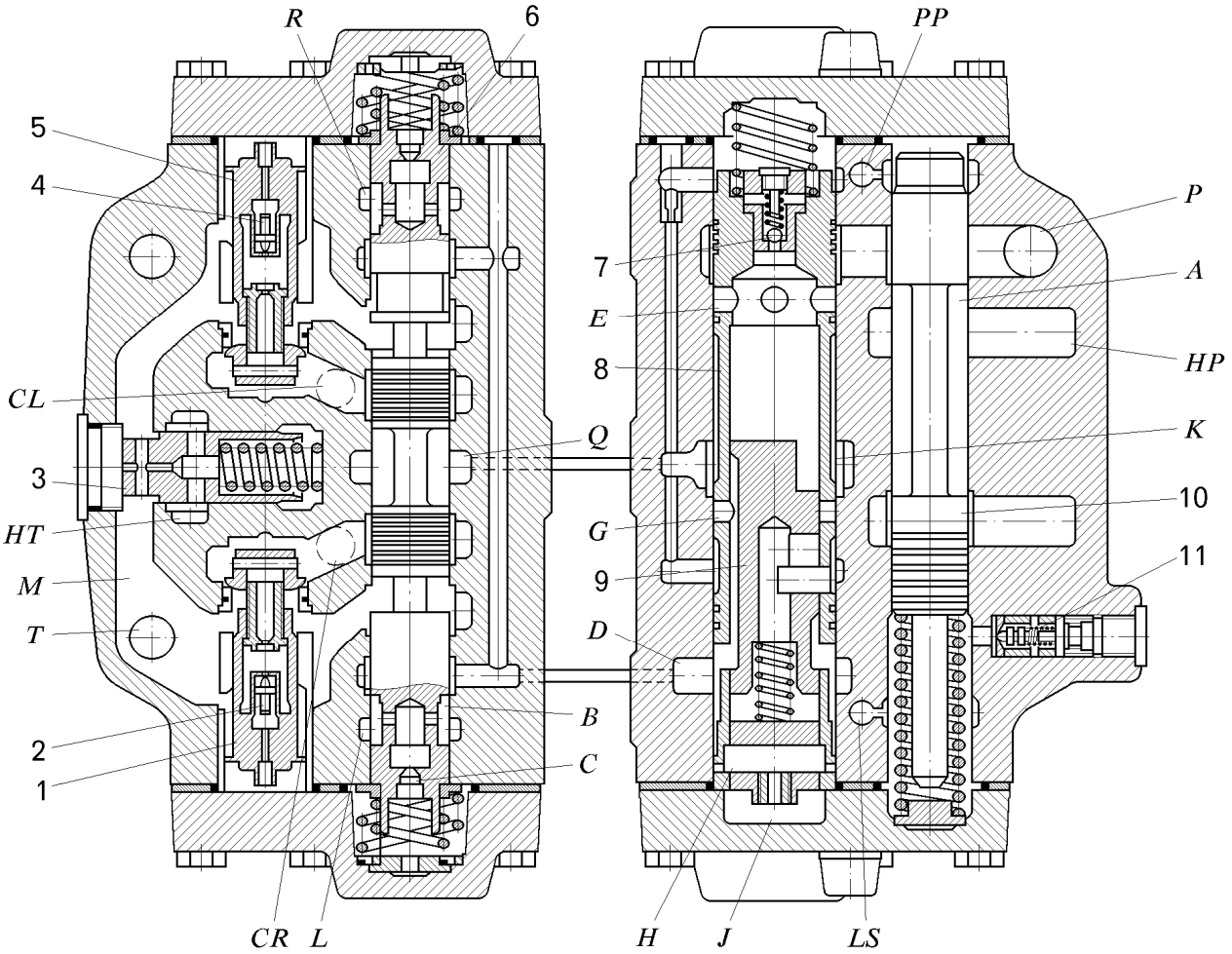


Figure 9.5 – Flow amplifier (structural drawing):

1, 5 – safety valves of suction and critical load; 2, 4, 7 – return valves; 3 – return-and-cutout valve; 6 – selection direction valve spool; 8 – flow amplifier valve sleeve; 9 – flow amplifier valve spool; 10 – priority valve; 11 – safety valve;

CL, CR, HP, HT, LS, P, T – channels; A, B, D, H, L, M, PP, Q, R – chambers; C, E, G, J, K – orifice holes

At the same time the pressure in opposite chambers of hydraulic cylinders, connected with hydraulic lines of the left turn, will drop below the atmospheric. For equalizing the oil pressure in the chambers of hydraulic cylinders, the flow amplifier is equipped with return valves 2 and 4, which transmit the oil into hydraulic cylinders from the drain hydraulic line.

Collector is designed for distribution of working fluid flow into steering hydro-pneumatic accumulators and service brake system. Distribution valve 8 is mounted on the collector (Figure 9.6), designed for discharging of oil chamber of steering hydro-pneumatic accumulators.

Distribution valve is controlled by electromagnet that is switched-on from the on-board electric mains of the dump truck at pressing on the engine shutdown switch, as well as by button-switch 7, placed on the electromagnet. Return valves installed in the hydraulic service brake system prevent discharging of hydro-pneumatic accumulators of the service brake system. Return valve 3 prevents the working fluid escape out of hydro-pneumatic accumulators through the pump in emergency operating conditions of steering.

Pressure sensor is screwed into the collector that sends a signal to the working fluid pressure indicator on the electronic dashboard and when pressure drops below 13 MPa sends to switching on the pilot lamp (red color) and audio signal.

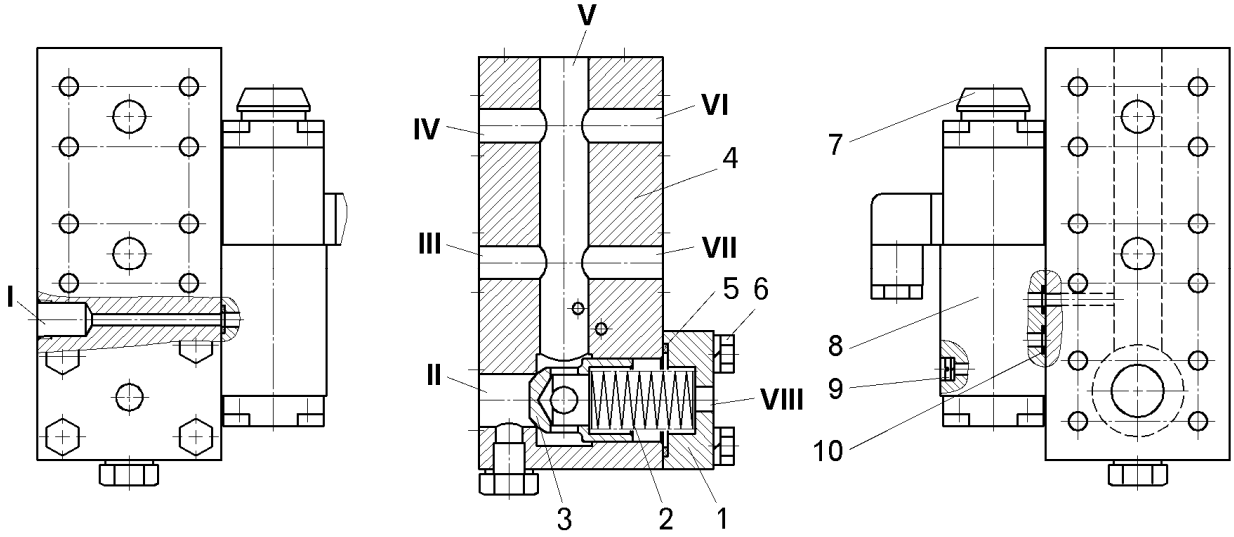


Figure 9.6 – Collector:

1 – cover; 2 – spring; 3 – valve; 4 – body; 5, 10 – sealing rings; 6 – bolt; 7 – button of forced depressurization in hydro-pneumatic accumulators; 8 – electromagnet distribution valve; 9 – screw

I – channel connected with the drain; II – channel connected with the forced hydraulic line from the pump; III, IV, VI, VII – channels connected with hydro-pneumatic accumulators; V – channel connected with the flow amplifier; VIII – channel connected with the pump pressure control unit

Hydro-pneumatic accumulator.

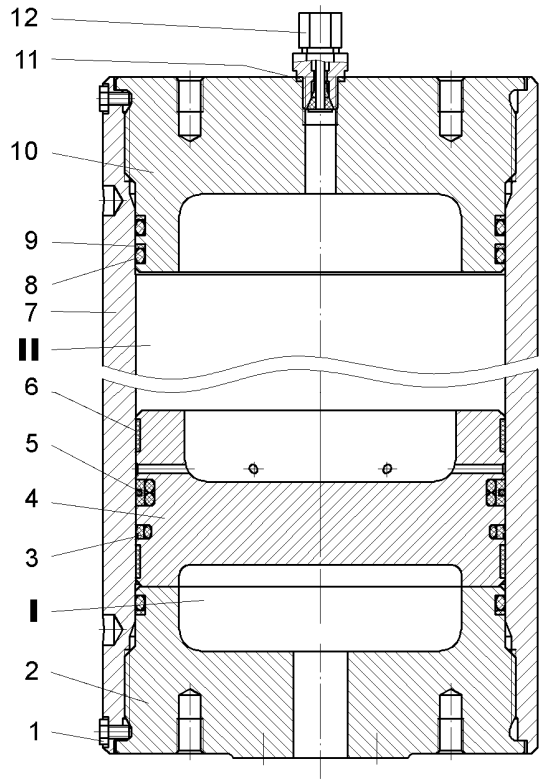
The hydraulic system of the steering control is equipped with four hydro-pneumatic accumulators which accumulate the emergency reserve of the working fluid under pressure and deliver it into the hydraulic system for additional charging as well as to control the dump truck in case of sudden engine shutdown or other causes having resulted in cessation of feeding the working fluid into the hydraulic system from the pump.

THE GAS AND WORKING FLUID IN HYDRO-PNEUMATIC ACCUMULATORS ARE UNDER HIGH PRESSURE. THEREFORE THEY SHALL BE OPERATED IN ACCORDANCE WITH THE APPLICABLE RULES OF ARRANGEMENT AND SAFE OPERATION OF PRESSURE VESSELS.

Hydro-pneumatic accumulator consists of casing 7 (Figure 9.7), upper 10, lower 2 covers and piston 4. Covers are screwed into the body (torque 500 – 700 N.m.) and fixed by bolts 1.

The piston is sealed by piston packings 3 and 5, rings 6 are piston guides. The piston divides casing on two chambers – fluid I and gas II.

At assembling to fill in the gas chamber of hydro-pneumatic accumulator by working fluid at a volume of (500 $\pm$ 100) см^3



The gas chamber is charged by nitrogen through filling valve 12, using the device for suspension cylinders charging.

The gas chamber of hydro-pneumatic accumulator is charged by dry technic nitrogen gas under the pressure of 7,5 to 8 MPa.

Figure 9.7 – Hydro-pneumatic accumulator:

1 – bolt; 2 – lower cover; 3, 5 – piston packing; 4 – piston; 6 – guide ring; 7 – casing; 8 – ring; 9 – protective washer; 10 – upper cover; 11 – sealing gasket; 12 – filling valve;
I – fluid chamber; II – gas chamber

Turning cylinder – of double action, consists of cylinder body 3 (Figure 9.8) and rod 4 with piston 2. The piston is fastened on the rod by self-locking nut 1. Cover 5 is fastened to the cylinder body by bolts 6. Tip 9 is threaded on the rod end that is locked by terminal connection.

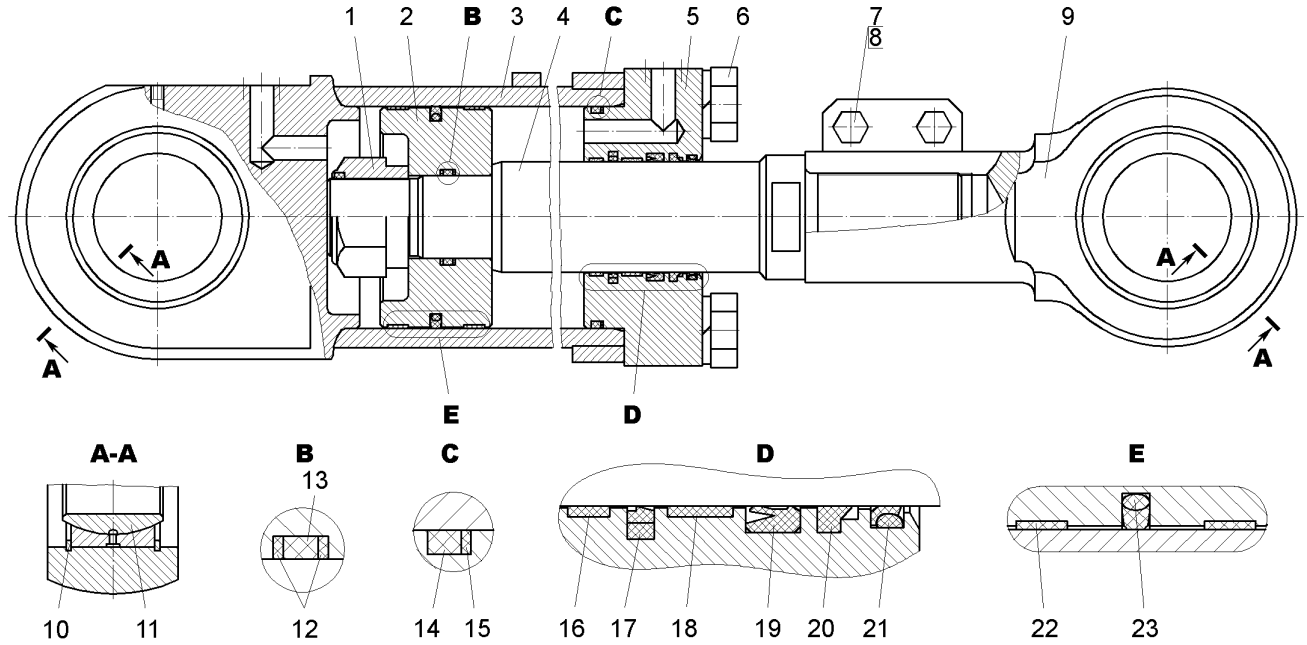


Figure 9.8 – Turning cylinder:

1 – self-locking nut; 2 – piston; 3 – cylinder body; 4 – rod; 5 – front cover; 6, 7 – bolts; 8 – nut; 9 – tip; 10 – locking ring; 11 – joint-type bearing; 12, 15 – protecting rings; 13, 14 – rings; 16, 18, 22 – guide rings; 17 –rod sealing; 19 – collar; 20, 21 – scrapers; 23 – Piston packing

Turning cylinders are fastened to the front axle brackets with its bodies, and with its rods to the cross-steering levers with the help of pins 8 (Figure 9.9.) and joint-type spherical bearings 11 (see Figure 9.8)

Movable joint of piston 2 with the cylinder body 3 is sealed with the help of piston packing 23, the piston is moved along the surface of the cylinder body on guide rings 22.

Movable joint of rod 4 with cover 5 is sealed by collar 19 and rod seal 17. The rod is moved along the cover surface with the help of guide rings 16 and 18. In order to prevent the entry of dirt inside the cylinder, the cover is equipped with scrapers 20 and 21.

Fixed joints of rod 4 with piston 2 are sealed with protective rings 12 and ring 13, and covers 5 with body 3 by protective ring 15 and ring 14.

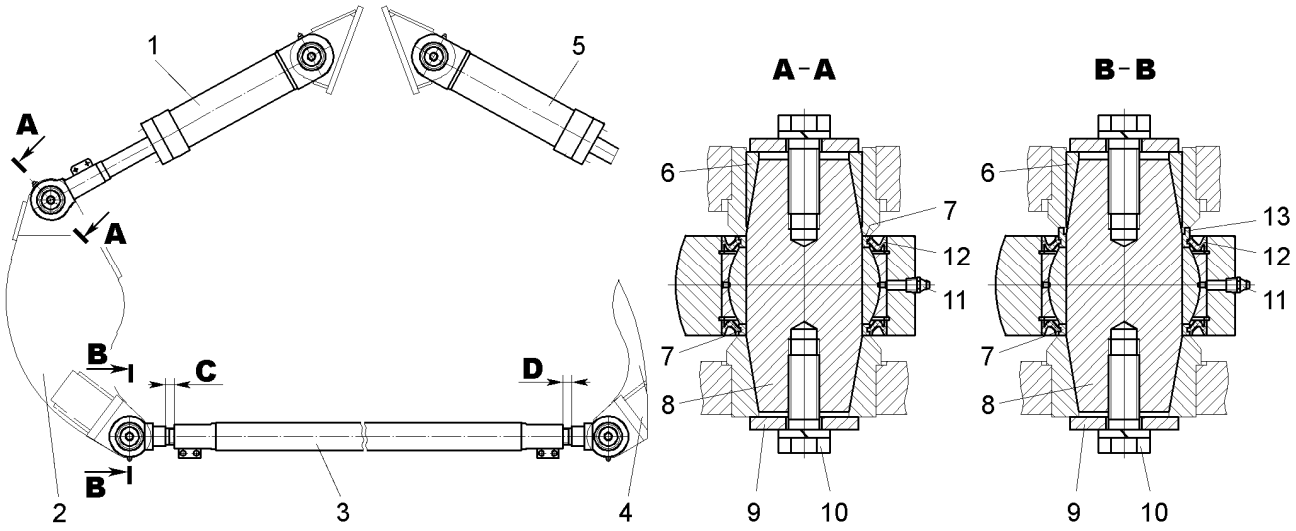


Figure 9.9 – Steering linkage:

1, 5 – turning cylinders; 2, 4 – pivoted levers; 3 – steering linkage; 6 – distance bushing; 7, 13 – rings; 8 – pin; 9 – clamping plate; 10 – bolt; 11 – oiler; 12 – seal;

B, C – dimensions

Steering linkage rod consists of linkage rod tube with ends 4 (Figure 9.10), two ends 3 and 6 of which are screwed into linkage rod 4 and locked by terminal connections. Linkage rod with pivoted levers is connected pivotally through spherical bearings 6 (see Figure 9.9) and pins 12.

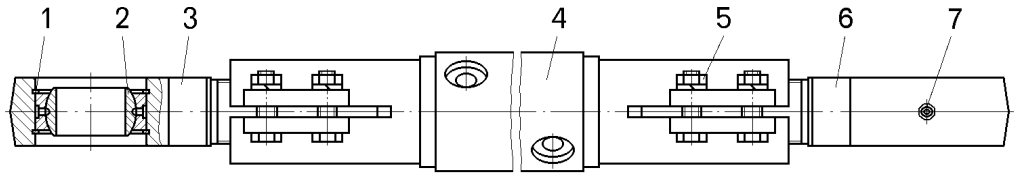


Figure 9.10 – Steering linkage rod:

1 – locking ring; 2 – joint-type spherical bearing; 3 – linkage rod end, left; 4 – linkage rod tube with ends; 5 – nut of terminal connection; 6 – linkage rod end, right; 7 – oiler

9.3 Technical maintenance of steering

Maintenance of steering control units during the operation consists in monitoring the oil level in the tank of integrated hydraulic system, checking the leak-proofness of the system, periodical lubrication of sliding surfaces, checking the tightening of the threaded connection and monitoring the charging of the hydro-pneumatic accumulators by nitrogen.

The list of the applied lubricants, inspection interval and change of the lubricants are given in Chapter «Technical Maintenance».

The list of scheduled operations of technical maintenance of units of steering hydraulic system is common for the integrated hydraulic system and given in Chapter «Dumping mechanism».

At Daily Maintenance (DM):

– Check the condition and fastening of the hydraulic system pipelines and hoses by external inspection and re-tighten them if necessary (at the places of leakage);

– Check the condition and fastening of turning cylinders, levers and steering control linkage by external inspection. No bends, cracks and/or other damages are allowed;

– Check the operability of the emergency drive of the steering control.

When the engine is running and the hydro-pneumatic accumulators are completely charged, the warning lamp of the emergency pressure in the hydraulic system of the steering control shall not burn and no beep shall be heard. With the dumping mechanism control switch set to lifting, turn the steering wheel to one full revolution to the left and right, steerable wheels at that shall turn.

– Check the serviceability of the steering control on the run.

At Technical maintenance 2 (TM–2):

– Check the integrity of the hydraulic system pipelines and hoses as well as their fastening. Replace the sleeves and hoses having leaks, swelling, cracks and having lost the elasticity. The loosened fasteners of the hoses shall be re-tightened;

– Check the following fasteners and re-tighten them if necessary:

1) bolts of fastening the pins of the steering cylinder and steering linkage;
2) nuts of the terminal connections of the ends of the turning cylinders and of the steering linkage;
3) nuts of mounting studs of steering linkage levers;

The tightening torque is given in Appendix A.

– Check the condition of welded seams of the brackets of turning cylinders and steering linkage levers;

– Check the nitrogen pressure in the hydro-pneumatic accumulators of the steering control and charge if necessary.

CHECKING THE NITROGEN PRESSURE IN THE HYDRO-PNEUMATIC ACCUMULATORS AND THEIR CHARGING SHALL BE PERFORMED ONLY WHEN THE PISTON IS IN THE BOTTOM POSITION, I.E. IN THE ABSENCE OF THE WORKING FLUID IN THE LIQUID CHAMBER.

In the presence of oil pressure the hydro-pneumatic accumulators shall be discharged. The release of working fluid pressure in the hydro-pneumatic accumulators of steering is performed automatically after scheduled shutdown of the engine within 80 sec. or at pressing on button-switch on steering collector. To release the pressure in hydro-pneumatic accumulators of the service brake system screw out needle valves on the brake valve.

In order to check the nitrogen pressure, unscrew the cover of filling valve and connect, depending on the performed works, the device for pressure measuring (see Figure 8.8) or the device for charging the nitrogen (see Figure 8.9). The gas chamber of hydro-pneumatic accumulator shall be charged by dry technical nitrogen gas up to the pressure of 8 MPa.

The order of nitrogen charging:

– connect the charging device to the nitrogen bottle through adapter 2 (see Figure 8.9);

– screw the device adapter 17 on the filling valve of hydro-pneumatic accumulator;

– unscrew vent of the nitrogen bottle (gas pressure in the bottle is controlled by manometer 3);

– by turning adjusting screw 12 of reducer, create small gas pressure in hydro-pneumatic accumulator;

– close vent of the bottle and with the help of connecting fitting 8 to release the gas from the channels and the device hose. Gauge hand 10 shall be set in “zero”;

– screw needle 15 before starting opening the filling valve, be careful to protect the valve spring from the damage. The beginning of opening the filling valve shall be determined at the moment of deflection of gauge hand 10;

– open vent on the bottle and with the help of adjusting screw 12 of reducer, set the pressure in the hydro-pneumatic accumulator (according to the readings of manometer 10) just over than the required;

– unscrew needle 15, close vent on the bottle and disconnect the adapter from the filling valve;

– by screwing connecting fitting 8 of the device, adjust the pressure in hydro-pneumatic accumulator to the required. After adjustment remove the device from the filling valve and close valve by the cover;

– check air tightness of the filling valve using soapy emulsion.

When performing the seasonal maintenance:

– Check the rotational speed of the steering wheel at the extreme positions of the steerable wheels ("slipping"). This phenomenon is caused by the internal leaks in the hydraulic system of the steering control.

The check shall be performed on the unloaded dump truck at the operation working fluid pressure in the hydraulic system.

The operation shall be performed in the following order:

– Start the engine and set the rotational speed of 1500 rpm;

– Turn the steerable wheels to the extreme position. Determine the rotational speed of the steering wheel while continuing rotating the latter in the same direction. It shall not exceed 6.0 rpm. The wristwatch with a second hand may be used instead of the stopwatch.

Other kinds of the maintenance.

When the truck reaches 40-50 thousand kilometres run.

– Check gaps in the steering cylinders joints, steering linkage rods. Replace joint-type bearings if necessary.

Gaps in the steering linkage joints are checked by sharp turning of the steering wheel to right and left while engine operates. There shall be no backlash in the steering linkage joints.

When backlash in the joints of the steering cylinders and steering linkage rod increases up to 0.5 mm, it is necessary to replace spherical bearings.

– Adjust the toe-in of the steerable wheels.

The adjustment shall be performed in case of replacement of the steering link and/or steering knuckles and in case of increased wear of the tyre tread.

Adjustment of the front wheels toe-in.

IN CASE OF REPLACEMENT OF STEERING LINKAGE LEVER, STEERING KNUCKLES ON THE DUMP TRUCK AND AT THE INCREASED WEAR OF TIRE TREADS, CHECK AND IF NECESSARY ADJUST THE TIE-IN OF STEERABLE WHEELS.

When installing turning cylinders 1, 5 (Figure 9.9) and steering linkage 3 bolt 10 sidewise the distance bushing 6 shall be tighten only after tightening the bolt on the other side of the pin.

The adjustment of front wheels toe-in is to be performed as follows:

– Set the wheels to the position corresponding to the straightforward run of the dump truck;

– measure the distance between the points of the machined planes of hubs at the level of wheel axis in front of the dump truck;

– measure the distance between the corresponding points from the rear. The dimension measured from the rear shall exceed that measured from the front by 10 – 20 mm;

– Install linkage 3 having adjusted its length in accordance with the position of the steerable wheels; here the difference between the dimensions C and D shall not exceed 5 mm;

– After adjusting the toe-in of the wheels, tighten the nuts of the clamping joints of the linkage ends with torque of 125 – 150 N.m.

10 BRAKE SYSTEMS

10.1 General information

The dump truck is equipped with the service, parking, auxiliary and reserve brake systems.

The service brake system with hydraulic actuator divided into the circuit of front and rear wheels. It acts upon all the wheels. It is not intended to slowdown the speed motion and braking in ordinary mode. The system should only be used when the auxiliary brake system is not efficient enough and in case of emergency situation for the emergency stop; for complete stop of a truck moving at low speed and short time parking

The parking brake system has hydraulic drive and acts on the rear axle wheels. It is designed for braking of dump truck during parking.

The auxiliary brake is of electric type, used during traction motor braking mode.

As a reserve (emergency) brake, the parking brake and the serviceable circuit of the service brake system are used.

For parking when loading and unloading the position " P " – parking switch of the electric drive reverser or mechanical lock on the pedal of the service brake valve is used.

The hydraulic drive of the dump truck is equipped with the function of automatic engagement of rear wheel brake gears in case of oil pressure drop in the brake circuits.

Operation of Hydraulic Drive of the Brake Systems.

When the engine is running, the working liquid from the tank is supplied into the manifold A3 by axial-piston pump of variable-capacity H (Figure 9.1) through the filter Ф1 and charges the pneumatic hydraulic accumulators АК3 – АК5 of steering.

Further, the working liquid goes into pneumatic hydraulic accumulators АК1, АК2 of rear and front circuits of service brake system through double protective valve К08 (Figure 10.1) and charges them.

From the pneumatic hydraulic accumulators АК1, АК2, the working liquid is fed to service brake valve A4 under pressure. When the pedal is released, the service brake valve spools shut off the channels from the pneumatic hydraulic accumulators and connect the chambers of the service brake cylinders A5 – A6 with the drainage. The dump truck is unbraked.

When pressing the pedal, the valve spools A4, while moving, first close the drain channels and then, while moving further, connect the channels from the pneumatic hydraulic accumulators with the channels to brake cylinders; the working liquid goes under pressure from the liquid chambers of pneumatic hydraulic accumulators АК5, АК6 under the pistons of the brake cylinders. The service brake system is braking the dump truck.

The hydraulic drive is divided into two independent circuits by double protective valve К08, separate sections of service brake valve A4 and separate pneumatic hydraulic accumulator АК5 and АК6 for each circuit. The pressure relays РД1, and РД2 for the working liquid in the pneumatic hydraulic accumulator and stop-light switches РД5 and РД6 are connected in each circuit.

In case of pressure drop, pressure relays РД1 and РД2 (the actuation pressure is 12 MPa) installed in the pneumatic hydraulic accumulators of the rear and front circuits give a signal for switching of buzzer and emergency transparent of red color on the dashboard.

The pressure relays РД5, РД6 (the actuation pressure is 0,5 MPa) installed in the control lines of the brake gears of rear and front wheels give a signal for actuation of braking signals and stop-lights.

In case of pressure drop (braking with parking brake), the pressure relay РД4 (the actuation pressure is 10 MPa) installed in the parking brake control line gives a signal for switching on (flashing) of parking brake emergency transparent of red color on the dashboard.

The parking brake gears are released by feeding the working liquid under pressure under the pistons of parking brake cylinders A8 by turning the lever of parking brake valve A7 which is fed from pneumatic hydraulic accumulators АК1 – АК4 of steering.

When pressure value is less than 8 MPa pressure sensor installed in the steering collector provides actuation of electromagnet hydraulic distributor A9 in the rear brakes circuit.

In this case, the hydraulic distributor A9 receives electric current, the spool of hydraulic distributor shifts and working liquid from the pneumatic hydraulic accumulator АК5 goes into the cylinders of rear wheel brake gears through two-line valve A10. Rear service brakes actuate automatically at low emergency pressure of working liquid in the hydraulic drive.

Automatic actuation of rear service brakes happens also when the lever of reverse switch on console in the cab shifts in position " P " (loading brake).

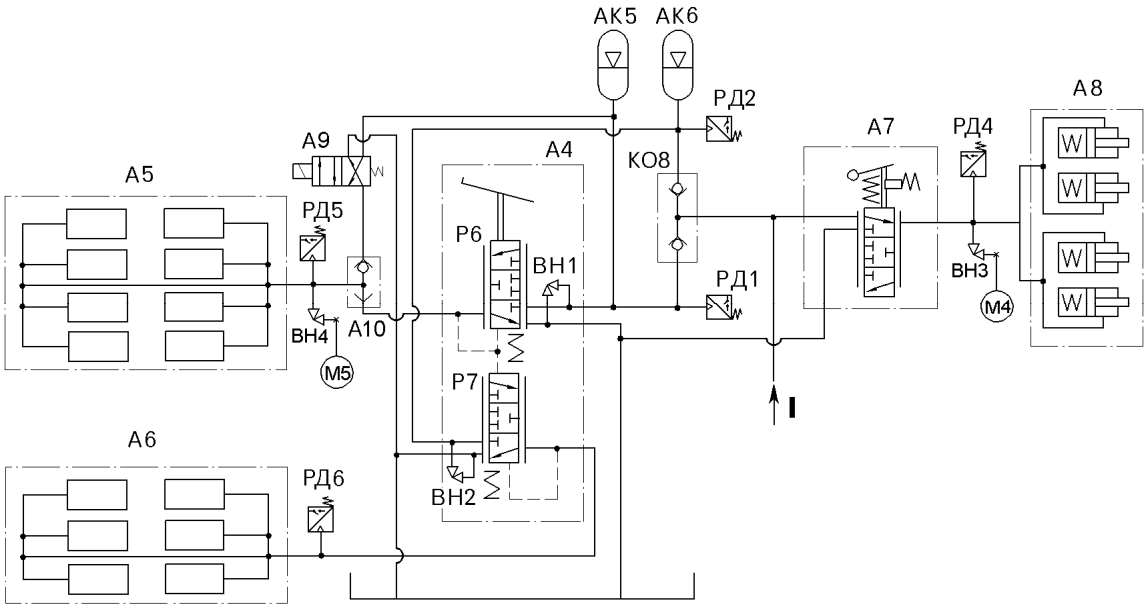


Figure 10.1 – The main hydraulic circuit of brake systems:

A4 – service brake valve; A5 – service brake gears of rear circuit; A6 – service brake gears of front circuit; A7 – parking brake valve; A8 – parking brake gear; A9 – hydraulic distributor;A10 – two-line valve; АК5, АК6 – pneumatic hydraulic accumulators; К08 – double safety valve; РД1, РД2 – pressure relay; РД4 - РД6 – pressure relay (brake signal switch); М4, М5 – pressure gauges (to be installed at the time of hydraulic system diagnostics);

I – from steering collector

10.2 Service Brake System

The service brake system consists of four disk-type brake gears, hydraulic drive, controls and controlling devices for monitoring the system operation.

The service brake system is controlled by pedal of brake valve.

The brake gears of front wheels are of single-disk dry-friction type with hydraulic drive.

The brake case 2 (Figure 10.2) is fastened to the front axle steering knuckle 1 by two bolts 15. The bolts are fitted into bushings 14 and locked against turning out by screws 12.

The brake disk 5 is fastened to front wheel hub by bolts. The brake case contains six cylinders (three cylinders on each side), with pistons 6 inserted. The brake case supports 10 bear two brake linings 3 which press the pistons to disk when braking. The piston is sealed by rubber cup 17 with protective ring 16 over the outer diameter and coupling 4 protects the working surface of the piston from dirt. From the outside, the cylinders are closed with covers 8. The cylinders are interconnected by channels for working liquid supply under piston.

Each cylinder has a device for automatic adjustment of gap between brake disk and linings (View E). it is based on special spring friction bushing 22 with preset shifting force along the rod 18.

During braking, the working liquid is supplied into chamber **G**, while piston 6 with pusher 25 shifts, pressing the brake lining to the disk. When releasing the brake, pressure in chamber **G** drops and piston under the action of spring 24 shifts in the opposite direction for the gap size **H** = 1 – 1,5 mm.

Size **H** is adjusted by washers 21 during assembly of brake case at the manufacturing plant or during replacement of parts (friction bushing 22, spring 24, piston 6) in the process of operation.

If brake linings are worn out when the piston stroke exceeds size H, the pusher 25 rests against the spring cup 23 which overcoming the force of friction bushing tension along the rod is shifting by the value of brake lining wear. When returning back (brake release) the piston shifts back only for the **H** value and friction bushing remains at the same place, which provides automatic adjustment of the gap between brake lining and disk.

When replacing brake linings piston 6 must be returned to the initial position up to stop to cover 7

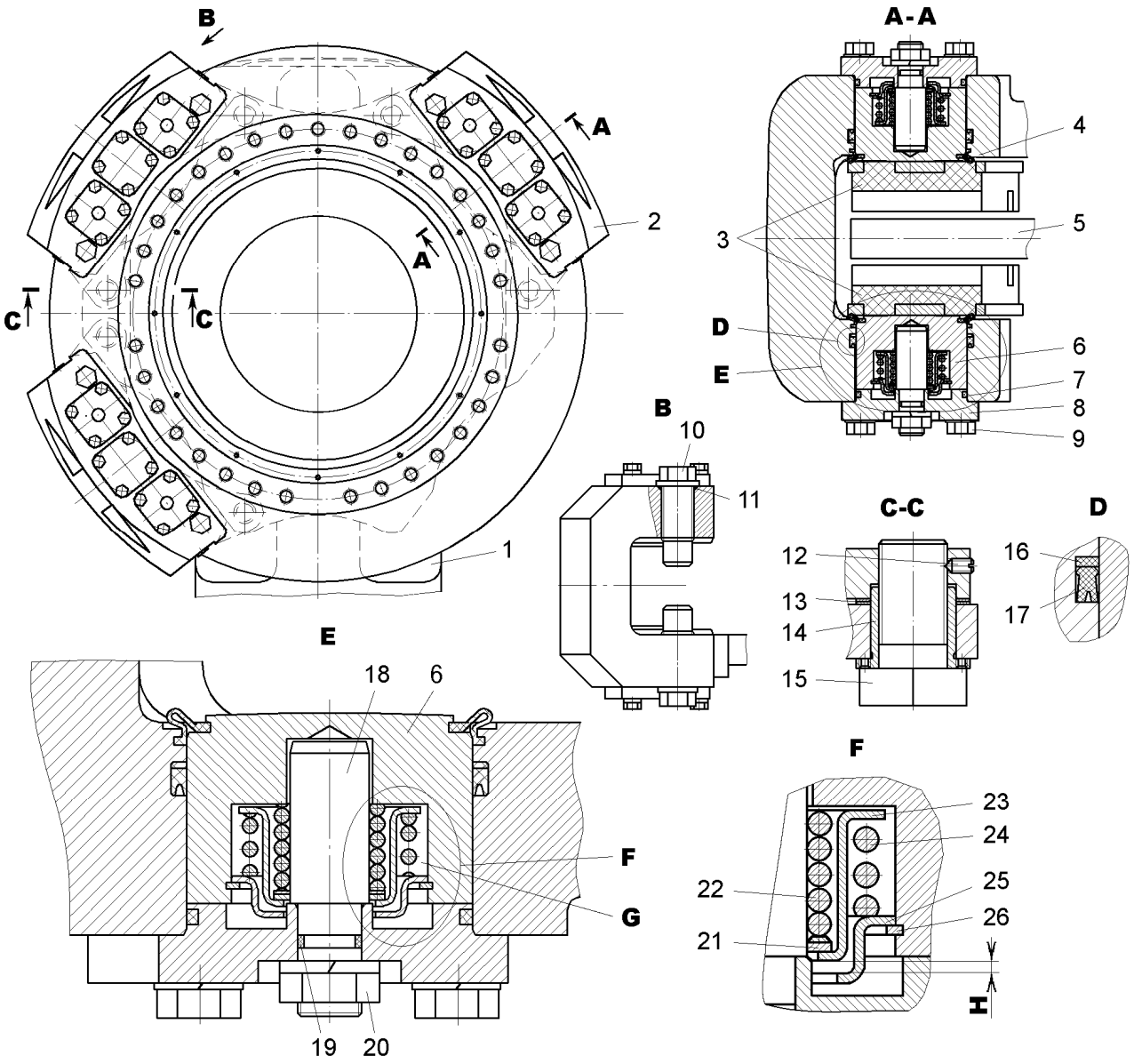


Figure 10.2 – Brake gear of front wheel:

1 – steering knuckle; 2 – brake case; 3 – brake lining; 4 – protective coupling; 5 – brake disk; 6 – piston; 7, 11, 19 – rings; 8 – cover; 9, 15 – bolts; 10 – support; 12 – screw; 13, 21 – adjusting washers; 14 – bushing; 16 – protective ring; 17 – cup; 18 – rod; 20 – nut; 22 – friction bushing; 23 – spring cup; 24 – spring;25 – pusher; 26 – locking ring;

G – chamber of working liquid supply; H – size, determining the gap between brake lining and disk

The brake gears of rear wheels are of single-disk dry-friction type with hydraulic actuation.

The end shield of each traction motor 13 (Figure 10.3) bears two service brakes through the brackets 22 and 23. The service brake consists of two webs 3 and 18 tied together with studs 6 through inserts 19 and supports 20. There are eight cylinders 10 (two on each side of web) fastened to webs, with pistons 29 inside. The piston is sealed with rubber ring 63 with protective washer 62 over the outer diameter and coupling 26 protects the working surface of piston from dirt. The cylinders are interconnected by internal channels in webs 3 and 18 for feeding of working fluid under the piston.

Each cylinder is equipped with the device for automatic gap adjustment between brake disk 28 and brake linings 27. It is based on the special spring friction bushing 60 with preset shifting force along the rod 30. One end of the bushing rests against the piston 29 and another – to the end face of cup 61. The cup bears the release spring 64 fixed in the piston by means of thrust ring 57 and locking ring 56.

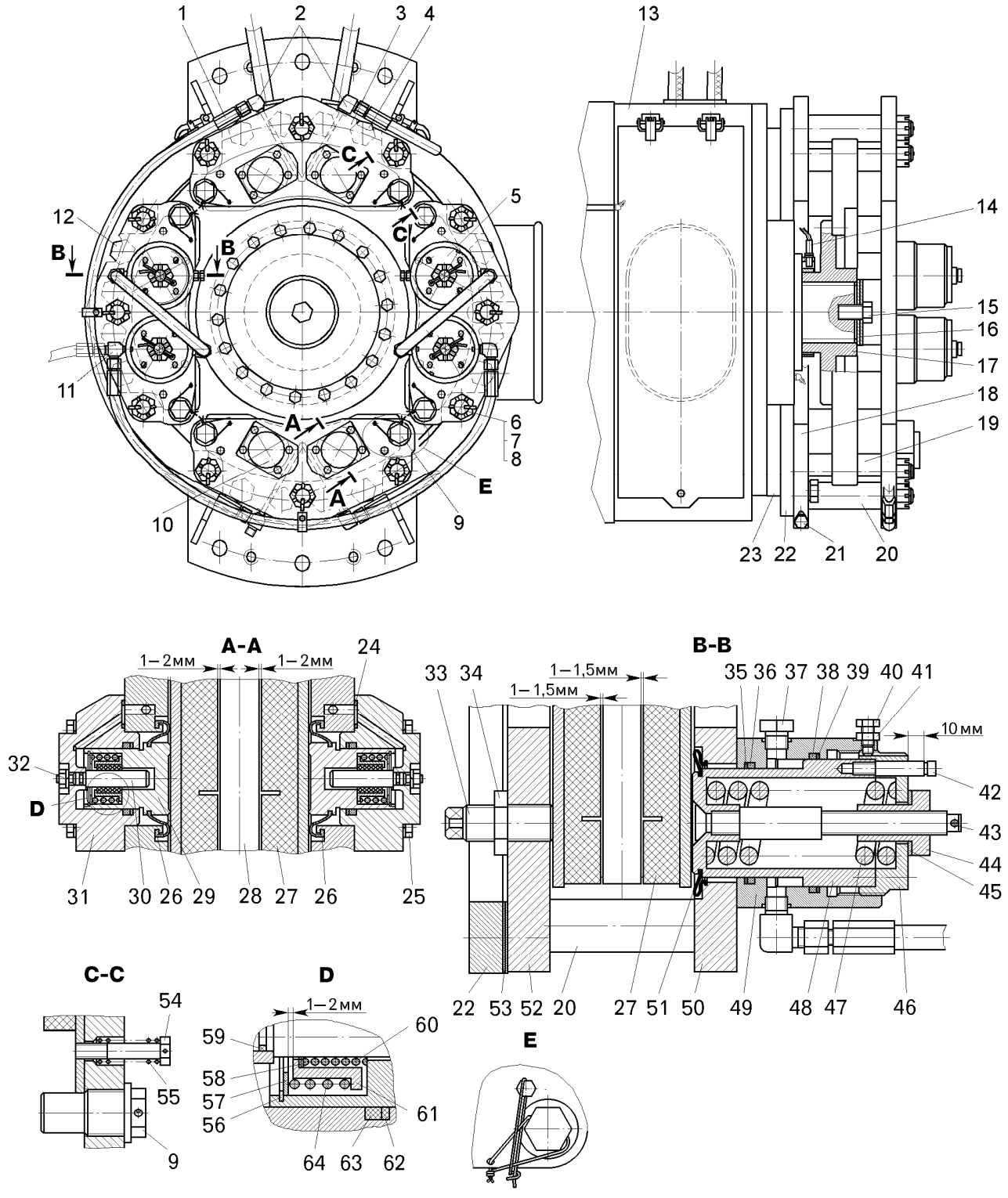


Figure 10.3 – Brake gears of rear wheels and parking brake:

1 – high pressure hose; 2 – elbows; 3, 18, 50, 52 – webs; 4, 12, 15, 25, 54 – bolts; 5 – parking brake cylinder; 6 – stud; 7, 32, 34, 41 – nut; 8 – cotter-pin; 9, 20 – supports; 10 – service brake cylinder; 11 – T-connector; 13 – electric traction motor; 14 – speed limit gauge; 16 – plate; 17 – disk with flange; 19 – insert;21, 37 – plugs; 22, 23 – brackets; 24, 36, 38, 59, 63 – sealing rings; 26, 51 – protective couplings; 27 – brake lining; 28 – brake disk; 29, 48 – pistons; 30 – rod; 31, 49 – bodies; 33 – thrust; 35, 39, 62 – safety washers; 40 – locking bolt; 42 – indicator; 43 – cotter-pin; 44 – release nut; 45 – washer; 46 – cover; 47, 55, 64 – springs; 53 – adjusting gaskets; 56 – locking ring; 57 – thrust ring; 58 – adjusting shim; 60 – friction bushing; 61 – cup

As the brake lining 27 becomes worn out, the piston 29 moves the friction bushing 60 relatively to the rod 30 to the value of wear of the brake lining when braking the dump truck. When releasing the brake, friction bushing does not move in the reverse direction relatively to the rod that ensures the clearance between the disk and the brake lining equal to 1 – 2 mm and corresponding to the distance between the end face of spring cup and thrust washer. This clearance is set by means of adjusting shims 58 when assembling of the cylinder.

The brake disk 28 is bolted to the flange 17 mounted on the splines of rotor shaft of electric traction motor 13. When applying the brakes, pistons 29 press the brake linings 27 to the disk and brake the truck. The reaction from the braking forces is perceived by supports 9 serving simultaneously as guides for brake linings.

Double protective valve divides hydraulic drive of service brake system into two independent circuits.

The housing 3 (Figure 10.5) comprises the piston 5 held in the middle position on both sides by means of bushings 10. The housing is closed with the plugs 1 on the both sides. The ball valves 4 dividing the system into two circuits are pressed against the piston seats on two sides by the springs 11 through the pushers 2.

The working liquid is fed to the central channel I. Under the action of hydrostatic force, the check valves 4 open and liquid is passed through the outlets II and IV to pneumatic hydraulic accumulators and sections of the brake valves. Liquid is supplied directly to the parking brake valve from the pressure line via channel III.

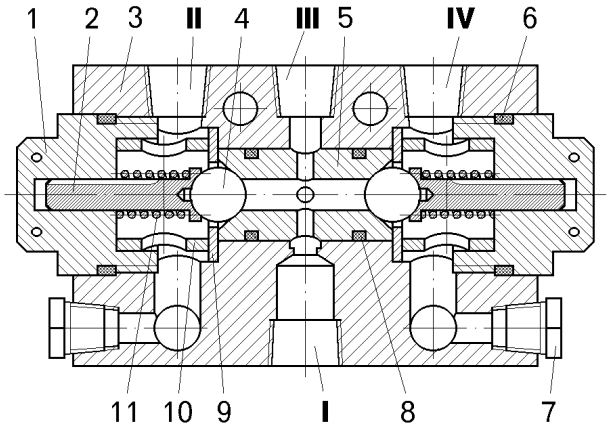


Figure 10.4 – Double protective valve:

1, 7 – plugs; 2 – pusher; 3 – housing; 4 – ball; 5 – piston; 6, 8 – sealing rings; 9 – washer; 10 – spacer; 11 – spring;
I – channel, connected with forced hydraulic line; II and IV – channels, connected with pneumatic hydraulic accumulators; III – channels, connected with parking brake control valve

Pressure relay (Figure 10.5 a) is intended for switching on brake signal in taillights when service brake system is applied (actuation pressure is 0,5 MPa).

Pressure relay (Figure 10.5 b) is intended for switching on warning lamps mounted on the dashboard and audible alarm in case of oil pressure drop in the pneumatic hydraulic accumulators below the specified limit of 13 MPa.

Pressure relay installed in the parking brake control circuit when pressure drops (braking by parking brake system) sends a signal to emergency alarm transparent (flashing) on the dashboard (actuation pressure is 10 MPa

Pneumatic hydraulic accumulator. In the hydraulic system, in the circuit of service brake system there are two pneumatic hydraulic accumulators which accumulate the energy of working liquid under pressure and releasing it to the hydraulic system when braking the dump truck.

The design of pneumatic hydraulic accumulators of service brake system is similar to pneumatic hydraulic accumulators of steering described in the chapter “Steering Control”.

THE PNEUMATIC HYDRAULIC ACCUMULATORS CONTAIN GAS AND WORKING LIQUID UNDER HIGH PRESSURE (UP TO 17 MPa), THEREFORE THEY SHALL BE OPERATED IN ACCORDANCE WITH THE RULES FOR DESIGN AND SAFE OPERATION OF PRESSURE VESSELS.

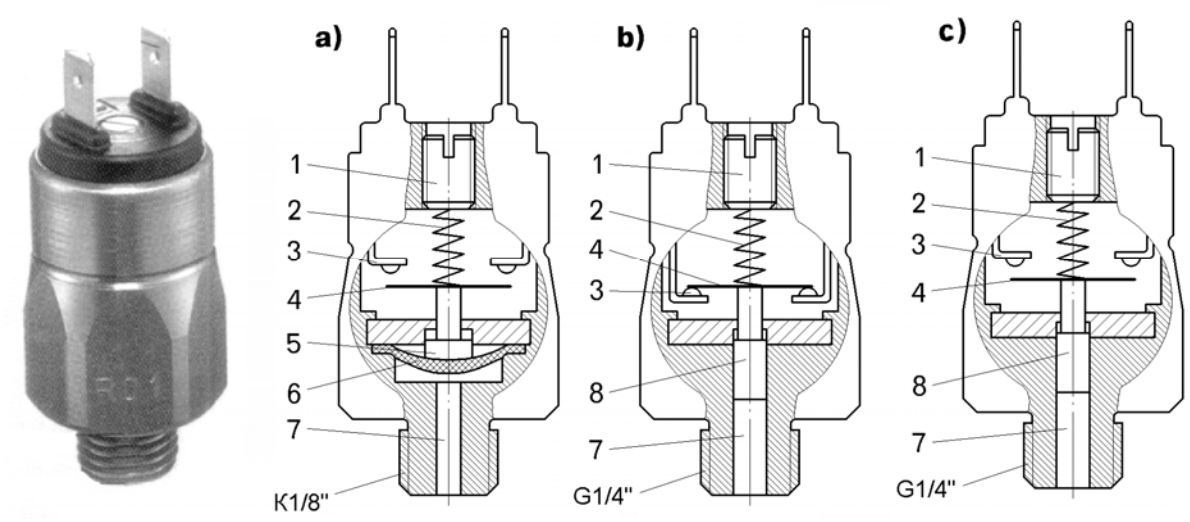


Figure 10.5 – Pressure relay:

a) diaphragm-actuated pressure relay (working position with open contacts); b) piston-actuated pressure relay (working position with closed contacts); c) piston-actuated pressure relay (working position with open contacts);

1 – adjusting screw; 2 – spring; 3 – contact; 4 – contact disk; 5 – plunger; 6 – diaphragm; 7 – channel for working liquid supply; 8 – piston

The brake valve is of two-section following-action pedal-actuated type; it is intended for controlling the service brake system. The upper section (Figure 10.6) controls rear brake gears and the lower section controls front brake gears. The brake valve consists of two housings 24 and 27 each comprising barrels 5 with spools 4. The housings are closed with the plug 1 and cover 12.

The pedal is locked in the braked state by means of fixing element 16.

During maintenance and repair of brake systems, the hydraulic system is depressurized by screwing out locking needles 25.

The under-pedal threaded fixing element 22 ensures the pedal position in which the roller 18 adjoins tightly to pusher 13 and prevents from its displacement.

The chambers I and III are connected with the pneumatic hydraulic accumulators, the outlets V and VI – with the drainage into the hydraulic tank and the chambers II and IV – with the chambers of brake gear cylinders.

When the pedal is released, the chambers II and IV, and, therefore, the chambers of the wheel brake cylinders are connected through the outlets V and VI with drainage into hydraulic tank. The chambers I and III from the pneumatic hydraulic accumulators are closed by the centering face of spools 4 and working liquid does not go into the cylinders of wheel brake gears. The brake of dump truck is released.

When pressing the brake pedal 17, spools 4 shift downwards (as seen in the figure) and with their centering faces first close the outlets V and VI of drain into the hydraulic tank, and then connect the chambers I and III from pneumatic hydraulic accumulators with the chambers to wheel cylinders. Liquid is passed under pressure from the pneumatic hydraulic accumulators through chambers I, II and III, IV into the cylinders of the wheel brake gears and actuates them.

The pressure of the working liquid in the wheel cylinders is determined by the force applied to the pedal. At the same time, the liquid is supplied through radial and axial channels in spools 4 to the end chambers of spools that ensures the follow-up action of brake valve according to the force applied to the pedal.

Under the force created by the working liquid pressure in the end chambers, spools move upwards (as seen in the figure) and close the channels from the pneumatic hydraulic accumulators. Both the working liquid supply and pressure increase in the wheel cylinders cease.

To amplify the braking effect, it is necessary to apply more force to pedal. The force created by liquid pressure applied to the ends of spools matches with that applied to the pedal that provides the following action of the valve in respect of the force applied to the pedal. The follow-up action of valve according to the force applied to the pedal is provided by the elastic balancing element 10. The working liquid in the chambers of pusher 26 and piston 3 acts as a damper excluding the self-excited oscillation of spools.

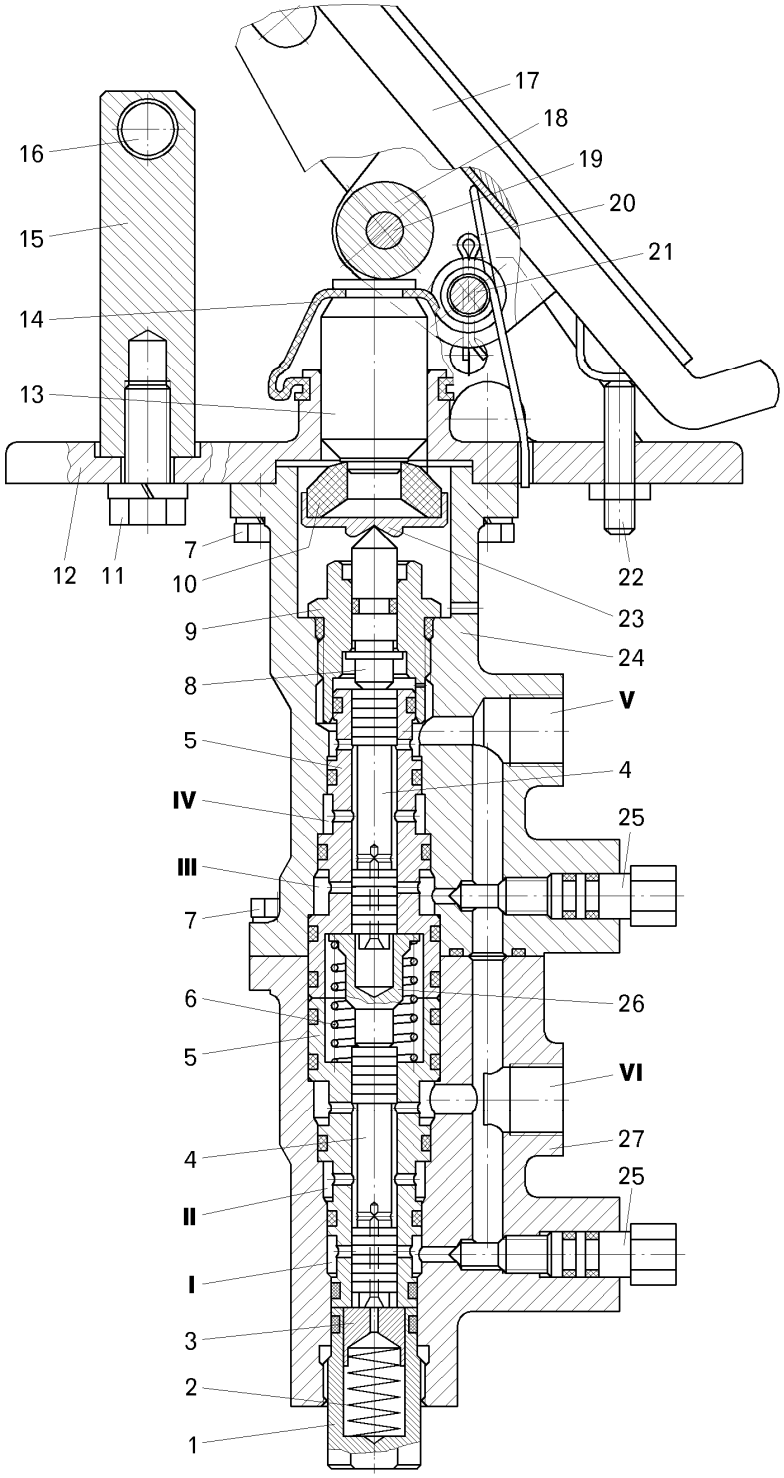


Figure 10.6 – Brake valve:

1, 9 – plugs; 2, 6 – springs; 3 – piston; 4 – spool; 5 – barrel; 7, 11 – bolts; 8 – rod; 10 – balance element; 12 – valve body cover; 13, 26 – pushers; 14 – covering; 15 – bushing of fixing element; 16, 22 – fixing elemens; 17 – pedal; 18 – roller; 19, 21 – axles; 23 – spring plate; 24 – top housing; 25 – locking needle; 27 – bottom housing;

I, III – chambers connected with the outlets to pneumatic hydraulic accumulators; II, IV – chambers connected with the outlets to the brake cylinders of wheels; V, VI – outlets connecting with the drainage into the hydraulic tank

10.3 Parking Brake System

The parking system is intended for braking the truck in the parking zones as well as in the emergency cases of failure of service brake system.

Brake gear of parking brake system is of dry-friction type with hydraulic actuation and two spring energy accumulators. The brake disk 28 (see Figure 10.3) is common for the parking and service brakes. The parking brake gear is fastened to bracket 22. The webs 50 and 52 are interconnected by studs 6 through the inserts 19 and supports 20. The outer web bears two parking brake cylinders 5 with pistons 48 and springs 47. The pistons are sealed with rubber rings 38 with protective washers 39 over the outer diameter and protective coupling 51 protects the working surface of piston from dirt

In the braked state, piston 48 presses the brake linings to brake disk under the action of spring 47. For unbraking, the control pressure of liquid is supplied into the space under the piston, which, while moving, compresses the spring and ensures the clearance between brake linings and brake disk.

If the brake linings are worn out in case of using the parking brake as a reserve one, it is necessary to adjust the clearance of 1 – 1,5 mm between brake linings and brake disk when the gear is in the unbraked state. The clearance between brake linings and brake disk is determined by the movement of indicator 42. The distance from the groove on the indicator 42 to the end of cover 46 shall be 10 mm in the unbraked state.

If the indicator displacement exceeds 3 mm when braking the dump truck, it is necessary to adjust the clearance between brake linings and disk. The brake linings shall be replaced when the friction layer of the brake lining is worn to the residual thickness less than 10 mm.

The clearance between the inner brake lining and brake disk is set by turning the stop 33 and that between the outer brake lining and brake disk – by turning cover 46 using a special wrench with the parking brake released and the parking brake cylinder depressurized.

To release the parking brake, it is necessary with the charged pneumatic hydraulic accumulators of steering to supply liquid under pressure to the space under piston 48 for compressing the spring 47 (parking brake release) and rotate the unbraking nut 44 clockwise up to the stop.

In the emergency, when there is no pressure in the pneumatic hydraulic accumulators, it is necessary to rotate the unbraking nut 44 clockwise up to the stop to release the parking brake. In order to return the cylinder to the working state, turn out the unbraking nut 44 counter-clockwise flush with the unbraking screw and lock it with cotter pin 43.

Prior to adjusting the clearance, loosen the locknut 41 and locking bolt 40 and after the adjustment tighten the bolt and lock it with locking nut.

In case of failure of brake retraction unit, the parking brake of dump truck can be actuated by turning out fastening nuts 7 for fixing of parking brake web 50.

IT IS STRICTLY PROHIBITED TO TURN OUT THE UNBRAKING NUT 44 FOR DISASSEMBLING THE PISTON COVER AND REMOVING THE SPRING 47 WITHOUT SPECIAL DEVICE ENSURING THE RELIABLE FIXATION OF PISTON 48 AND COVER 46 AND SMOOTH LOOSENING OF SPRING 47.

Parking brake control valve is of following-action lever-actuated type. It is intended for controlling the parking brake.

The valve lever 1 (Figure 10.7) is locked in the applied (braked) state by means of latch 2. In order to shift the lever to the released (unbraked) position, it is necessary to release the control lever 1 from the slot by lifting slightly the lever latch upwards and moving the lever forward.

The outlet S is connected with pneumatic hydraulic accumulator, the outlet T – with drainage into the hydraulic tank and the outlets B and DS – with the cylinders of parking brake gear.

When the lever 1 is set to the “released” (I) position, the passage from the chamber S from the pneumatic hydraulic accumulator into the chamber B to the brake cylinders is open.

When setting the lever 1 to the “applied” (II) position, where it is fixed in the slot, pressure is released from chamber B into chamber T in direct proportion to the lever travel and speed. Therefore, the chamber of parking brake cylinder is connected through chamber T with the drainage into the hydraulic tank. At this moment, chamber II from pneumatic hydraulic accumulator is blocked and no working liquid is supplied into the parking brake cylinder. The parking brake gear is applied by the force of power springs.

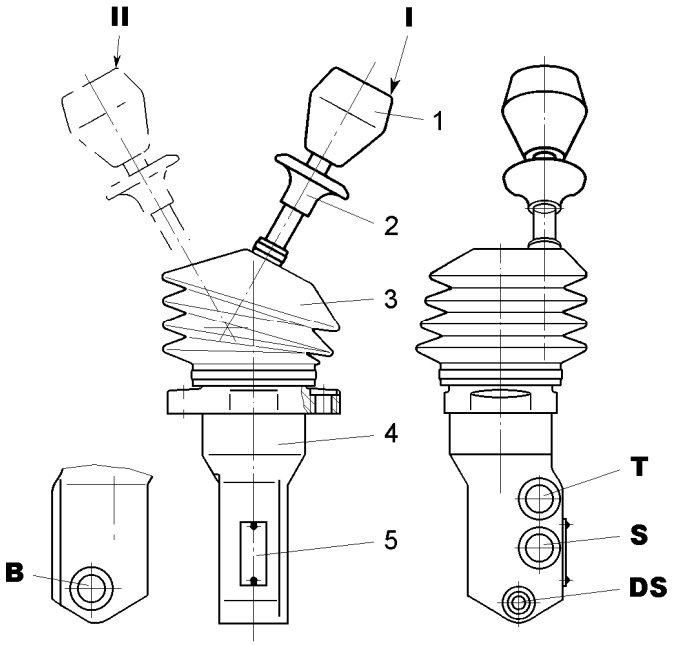


Figure 10.7 – Parking brake control valve:

1 – lever; 2 – latch; 3 – protective cover; 4 – body;5 – information plate;

S – outlet connected with pneumatic hydraulic accumulator; B, DS – outlets connected with brake cylinders; T – outlet connected with draining into the hydraulic tank.

I – unbraked (released) position of the lever; II – braked (applied) position of the lever

10.4 Auxiliary Brake System

The auxiliary brake system is intended for maintaining the necessary speed when moving downhill for a long time. The electrical braking mode of electric traction drive is used as an auxiliary brake system of dump truck.

It is prohibited to operate a dump truck with the faulty auxiliary brake system, because braking with service brake system when driving downhill would cause overheating of disks and increased wear of brake linings and subsequent worsening of brake efficiency.

For braking the dump truck or maintaining its speed within the certain limits when driving downhill, release the drive pedal and press the pedal of auxiliary brake system (electric brake). The speed is set by the driver depending on the angle of electric braking pedal.

To drive the truck downhill at the constant speed in the electrical braking mode, it is necessary to enable the speed stabilization mode by means of switch on dashboard. The speed will be maintained at the value as it was at the moment of actuation of the switch.

The auxiliary braking system is not efficient at the truck speed below 10 km/h. To stop the truck completely, the service brake system shall be applied.

10.5 Rules of Brake Systems Application

THE SERVICE BRAKE SYSTEM IS NOT INTENDED FOR SLOWING DOWN THE MOTION OR BRAKING IN THE USUAL MODE. IT IS ONLY INTENDED FOR STOPPING THE TRUCK AT LOW SPEED, HOLDING IT STILL FOR SHORT TIME AND FOR EMERGENCY STOPPING IN THE CRITICAL SITUATION.

IF THE CONTROL OF AUXILIARY BRAKE IS LOST, SERVICE BRAKE SYSTEM SHALL BE USED FOR STOPPING THE TRUCK. THE TRUCK SHALL BE STOPPED AS QUICKLY AS THE BRAKE SYSTEM ALLOWS.

WHEN THE SERVICE BRAKE SYSTEM IS USED FOR STOPPING THE TRUCK IN THE CRITICAL SITUATION, DO NOT TRY TO DRIVE THE TRUCK FURTHER UNTIL THE CAUSE OF THE CRITICAL SITUATION IS ELIMINATED.

AFTER ELIMINATION OF THE FAULT, THE ENTIRE BRAKE SYSTEM SHALL BE INSPECTED TO ENSURE THE FURTHER SAFE OPERATION OF THE TRUCK.

DO NOT APPLY THE PARKING BRAKE DURING THE MOTION; OTHERWISE THE BRAKING SYSTEM COMPONENTS CAN BE DAMAGED.

THE BRAKE SYSTEMS SHOULD BE USED CAREFULLY, TAKING INTO ACCOUNT THE ROAD CONDITIONS.

10.6 Maintenance of the Brake Systems

The maintenance consists in regular inspection of the condition, checking the leak-proofness and timely re-tightening of threaded connections, refilling the system with consumables and checking the serviceability of brake systems.

When performing the inspection, it is necessary to check fastening of brake disks, housings of brake gears, cylinders of brake gears of rear wheels and parking brake, covers of brake gears of front wheels and parking brake, fastening of pneumatic hydraulic accumulators and condition of brake shoes and disks.

A list of lubricants to be applied, checking intervals and change of lubricants is given in chapter “Maintenance”. A list of routine maintenance works for hydraulic system of brakes, which are common for the integrated hydraulic system is given in the chapter “Dumping Mechanism”.

When performing the daily maintenance:

– Check the condition and fastening of hydraulic system pipelines and hoses by visual inspection and re-tighten them, as necessary (at the places of leakage);

– Check the conditions of mechanisms of service and parking brake systems by visual inspection. The brake gears shall have no mechanical damages, cracks and/or leaks of the working liquid;

– Check the serviceability of brake systems.

When performing the TM-2:

– Check the integrity of pipelines and hoses of hydraulic system as well as their fastening. Replace sleeves and hoses with leaks, swelling, cracks and/or those having lost elasticity. The loosened fasteners of hoses shall be re-tightened;

– Check the condition and fastening of mechanisms of service and parking brake systems. The parts shall be fastened reliably, bolts and nuts shall be tightened as far as they will go and the crown nuts shall be fixed with cotter pins;

– Check the condition of brake disks and wear of brake linings of brake gears of front and rear wheels and of parking brake, and replace brake linings if required.

Brake linings shall be replaced when friction material of liner is worn to the residual thickness of less than 10 mm.

When replacing the brake linings, do not fit new brake linings and used ones in the same gear. After replacing service brake linings, it is necessary to run them in by braking the truck from the speed of 10 km/h with the interval of 5 minutes five times.

Damaged brake linings must be replaced.

It is allowed to use disk, when wear of working surfaces does not exceed 3 mm from each side.

Should the brake lining be worn out, brake linings of brake gears of left and right wheels shall be replaces at the same time. The brake linings shall be from the same manufacturer.

– Check the clearance between brake disk and brake linings of parking brake system; if necessary, adjust the clearance or replace brake linings; Running of parking brake linings is performed by braking the truck at the speed of 5 – 10 km/h five times by shifting slowly the handle of parking brake actuation;

– Check the tightness of adjoining of pedal roller to the pusher of valve controlling service brake system. When the pedal is lifted until it rests against the pedal adjusting screw, the roller shall adjoin the pusher without causing its displacement;

– Check the nitrogen pressure in the pneumatic hydraulic accumulators and recharge them as necessary. The procedure of checking the pressure and charging the pneumatic hydraulic accumulators with nitrogen is described in the chapter “Steering Control”.

CHECKING THE NITROGEN PRESSURE IN PNEUMATIC HYDRAULIC ACCUMULATORS AND THEIR CHARGING SHALL BE ONLY PERFORMED WHEN THE PISTON IS IN THE BOTTOM POSITION, I.E. WHEN THERE IS NO WORKING LIQUID IN THE LIQUID CHAMBER.

When there is oil pressure, the accumulators shall be discharged. To depressurize the pneumatic hydraulic accumulators of service brake system, turn out the locking needles on brake valve.

The release of working liquid pressure in the pneumatic accumulators of steering control is performed automatically after scheduled stop of the engine within 80s or by pressing the push button on steering control manifold.

After performing operations connected with loss of sealing in pressure lines of brake systems hydraulic drive in order to remove air from working liquid it is necessary to pump of corresponding circuits – for service brakes circuit press on brake pedal several times, as for parking brake circuit apply parking brake control valve several times.

Replacement of brake linings of front wheels without brake gears disassembly.

Should the brake linings be worn out, brake linings of brake gears of left and right wheels shall be replaces at the same time. The brake linings shall be from the same manufacturer.

To replace the brake linings of brake shoes, proceed as follows:

– Remove the front wheel from hub (section “Mounting and dismantling of tires”);

– Depressurize the hydraulic system of brakes (to do this, turn out locking needles of brake valve);

– Disconnect the pipelines of brake system from brake cases 2 (see Figure 10.2);

– Unscrew locking screws 12 by 2-3 turns;

– Loosen lower bolt 15 of brake case fastening to steering knuckle 1;

– Screw out the upper bolt while holding the brake case;

– Turn smoothly the brake case held on lower bolt to the horizontal position and remove brake linings;

– Return the pistons of brake case to the initial position, having pushed the pistons until their ends rest against covers 8;

– Fit the new brake linings;

– Tighten the bolts 15 (tightening torque is given in the appendix B). Ensure the clearance of at least 1,5 mm between the end faces of axles of brake linings of brake case 2 and brake disk 4 by means of adjusting washers 13;

The surface of each adjusting washer, joint of brake case and steering knuckle are to be coated with mixture: sealant volume of 80 – 85% of TU U 6.10-00204234-004-95 standard and 15 – 20% of grinding material 14A, 10H, 14A 8H GOST 28818-90. The mixture is to be stirred preliminarily up to grinding material is evenly blended with sealant. Substitutes of grinding material: 25A 10H GOST 28818-90; 63C 10H GOST26327-84;

– Stop the bolts 15 against unscrewing by locking screws;

– Reconnect the brake system pipelines to brake cases.

Replacing of brake linings of rear wheel brake gears and parking brake gears.

The brake linings are replaced immediately in the driving axle housing, without dismantling the motor-wheel reduction gear. The brake linings shall be from the same manufacturer.

To replace the brake linings of rear wheel brake gears and parking brake gears, proceed as follows:

– Depressurize the hydraulic system of brakes (to do this, turn out locking needles of brake valve);

– Unlock the unbraking nut 44 (see Figure 10.3) and turn it in up to the stop, taking all measures excluding self-motion of dump truck (put the stops under wheels);

– Unlock and screw out the supports 9 and bolts 54 on all webs of service brake and, if necessary, on webs of parking brake;

– replacement of brake linings is impossible without removing of one parking brake gear. For this purpose loose cotter-pin and unscrew castle nut on external web, remove web, unscrew bolts of inner web fastening and remove web;

– Remove the released brake linings of service and parking brake gears rotating them to the direction of the removed parking brake gear;

– Slide the pistons 29 of service brake cylinders 10 into the body 31 up to the stop;

– Fit new brake linings 27, screw supports 9 and bolts 54 and lock them in the required order; Cotter-pin of bolt 54 shall not block the axis shifting of bolt to the distance of at least 25 mm;

– install back the removed parking brake gear, tightening torques for threaded connections are given in Appendix A;

– Adjust the clearances between parking brake linings and brake disk;

– Turn out unbraking nuts 44 until nut holes are aligned with screw hole and fix them with cotter pin 43.

Adjusting the clearances between brake linings and disk of parking brake.

To adjust the clearances between brake linings and disk, proceed as follows:

– Set the clearance of 1 – 1,5 mm between brake lining 27 and brake disk 28 by rotating the stops 33. After setting the necessary clearance, lock the stops 33 with nuts 34;

– Set the clearance of 1 – 1,5 mm between brake lining 27 and brake disk 28 by rotating covers 46 assembled with piston 48 using a special wrench to be inserted into the holes in the cover. Turn out loose nuts 44 until the nut holes are aligned with screw hole and fix it with cotter pin 43.

– Screw in two lock bolts 40 and lock them with nuts 41.

When performing the TM-3:

– Check the fastening bolts of brake gears housings of front wheels, nuts and fastening bolts of brake gears of rear wheels and re-tighten them if required. The tightening torques are given in Appendix A.

11 PNEUMATIC SYSTEM

11.1 Components and Operation of Pneumatic Units

The pneumatic system is intended for supplying the engine starting system, drive of the radiator louvers, pneumatic mechanisms of the control cabinet with air, for filling the cylinder of the pneumatic cushioning mechanism of the driver's seat and for connecting the tyre inflation system.

The pneumatic system comprises the compressor 2 (Figure 11.1), air cooler 3, drain tank 4 with the condensate draining cock 5, pressure regulator with adsorber 6 and regeneration receiver 7, receiver 10 with the condensate draining cock 5 and pressure sensor 9.

The pressure regulator 6 controls the operation of the compressor 2.

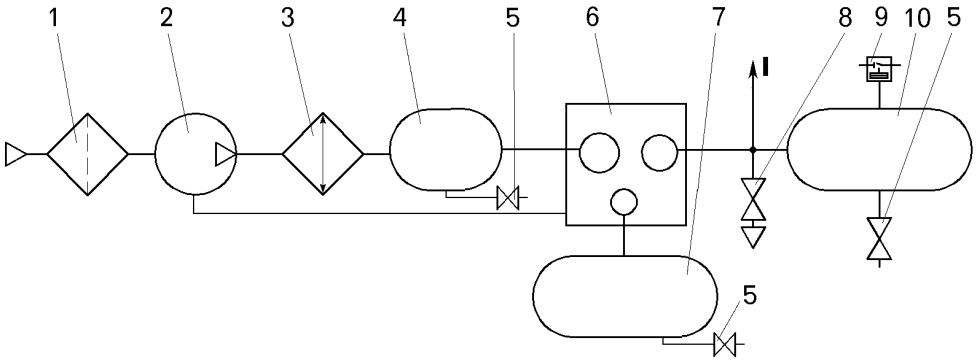


Figure 11.1 – Schematic diagram of the pneumatic system:

1 – air filter of the engine; 2 – compressor; 3 – air cooler; 4 – drain tank; 5 – condensate draining cock; 6 – pressure regulator with adsorber; 7 – regeneration receiver; 8 – control outlet valve; 9 – pressure sensor; 10 – receive;
I – to the compressed air consumers

The installation of the pneumatic system on the dump truck is shown in Figure 11.2.

The compressor 3 installed on the engine serves as a compressed air source. The compressor sucks air from the intake air duct 4 of the engine and feeds it through the air cooler 2 and drain tank 1 into the pressure regulator with adsorber 7.

In the cooler 2, air is cooled and cleaned from condensate which is accumulated in the drain tank 1. The regulator 7 ensures the air drying, maintains the air pressure in the pneumatic system within the range 0.65 to 0.8 MPa and controls the compressor operation.

From the pressure regulator, the air is fed into the receiver 5 and further to the consumers. The pressure sensor in installed in the consumer receiver for monitoring the compressed air pressure. The pilot lamp is installed on the instrumentation panel in the dump truck cab.

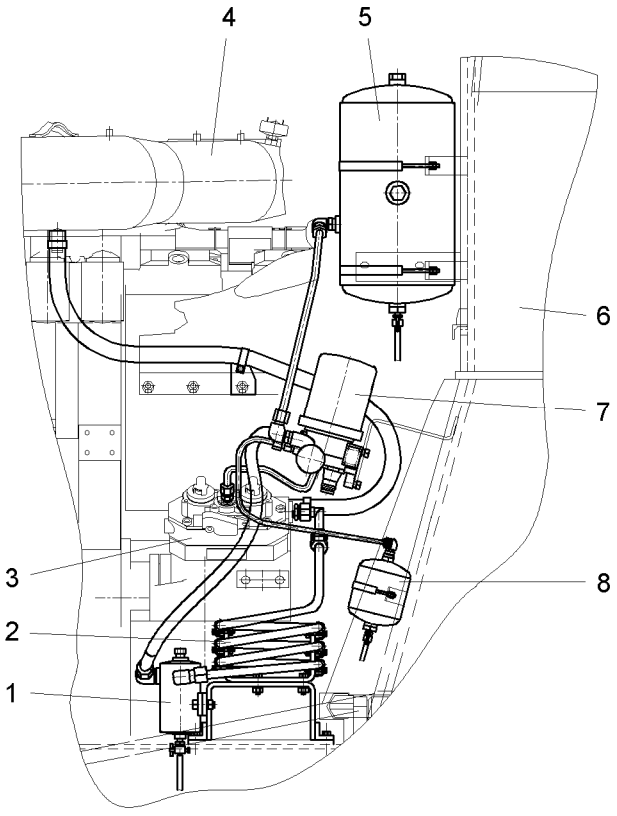


Figure 11.2 – Installation of the pneumatic system:

1 – drain tank; 2 – cooler; 3 – compressor; 4 – air duct; 5 – receiver; 6 – second crossbeam of the frame; 7 – pressure regulator with adsorber; 8 – regeneration receiver

11.2 Units of Pneumatic System

Pressure regulator with adsorber

The design of the regulator is shown in Figure 11.3, the simplified diagram of the regulator illustrating the principle of its operation is shown in Figure 11.4 and the technical characteristics of the regulator are given in Table 11.1.

The compressed air from the pressure pipeline of the compressor is fed to the outlet I (see Figure 11.4) and further to the chamber A, passed sequentially through the filters 7 and 10, zeolite adsorber 8 and gets into the chamber B. At the same time, the compressed air is fed from the chamber A to the safety valve 2.

In the chamber B, the cleaned and dried compressed air releases the check valve 12 and is passed into the chamber C and into the truck's pneumatic system through the outlet II. At the same time, the compressed air is passed from the chamber B through the channel F into the chamber D and further through the outlet III into the regeneration receiver.

From the chamber C, the compressed air pressure is passed through the channel G to the following piston 14 and ball control valve 16. The deformation-force characteristic of the spring 13 of the following piston 14 is selected in such a way that when the pressure in the truck's pneumatic system is below the value 0.8 MPa, the ball control valve 16 is pressed tightly against the seat and no compressed air pressure is transmitted to the piston 17 and safety valve 2 connected with the latter, which is pressed against its seat by the force of the spring 1.

When the air pressure in the pneumatic system exceeds the value 0.8 MPa, the following piston 14 moves to the right while compressing the spring 13, and the valve 16 together with the following piston 14 comes off its seat as the pre-compression of its spring decreases so that the compressed air pressure is transmitted to the piston 17 of the safety valve 2.

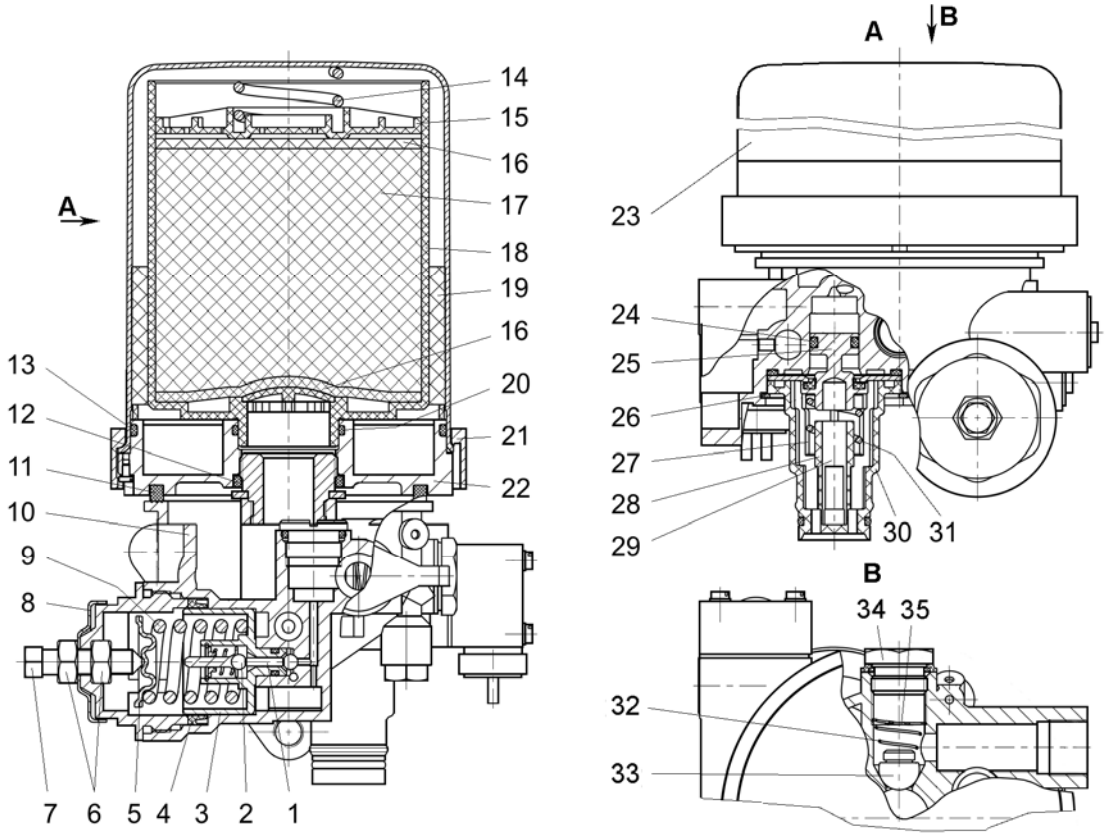


Figure 11.3 – Pressure regulator with adsorber:

1 – valve body; 2 – ball valve; 3 – following piston; 4 – cup; 5 – spring plate; 6 – nut; 7 – adjusting bolt; 8 – cap; 9, 14, 31, 32 – springs; 10 – pressure regulator body; 11 – gasket; 12, 13, 20, 24 – seal rings; 15 – sleeve cap; 16 – filter gasket; 17 – drying bag (zeolite adsorber); 18 – sleeve; 19 – polyurethane-foam filter; 21 – ring; 22 – base; 23 – cap; 25 – piston; 26 – lock ring; 27 – valve body; 28 – valve seat; 29 – valve control rod ;30 – safety valve cover; 33 – check valve; 34 – plug; 35 – washer

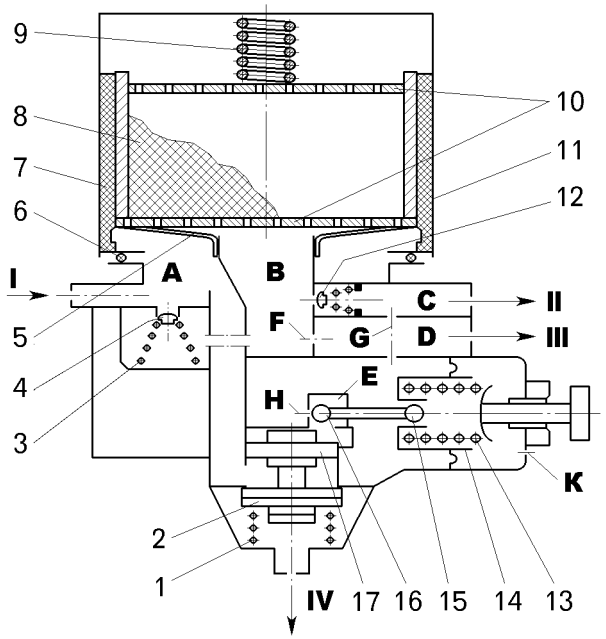


Figure 11.4 – Schematic of the pressure regulator with adsorber:

1, 3, 9, 13 – springs; 2 – safety valve; 4 – bypass valve; 5 – sleeve; 6 – seal; 7 – polyurethane-foam filter; 8 – zeolite adsorber; 10 – filter gasket; 11 – body; 12 – check valve; 14 – following piston; 15, 16 – ball valves; 17 – piston;

I – outlet from the compressor; II – outlet into the pneumatic system; III – outlet into the regeneration receiver; IV – outlet into the atmosphere;

A, B, C, D – chambers; E – chamber connected with the compressor;

F, G, H – channels; K – channel to the atmosphere

At the same time additional force is transmitted to valve 2, breaking the balance between the compressed air pressure of chamber A and spring 1, as a result safety valve 2 opens, connecting chamber A with atmosphere.

The check valve 12 is pressed against its seat to prevent the compressed air from being vented into the atmosphere. Simultaneously, the cleaned air from the regeneration receiver (outlet III) is passed through the chambers D and B into the adsorber from the bottom (while regenerating the adsorbent), to the chamber A and further through the the safety valve 2 into the atmosphere with the excessive moisture and contaminants.

At the same time, the compressed air is fed from the chamber E via air duct into the compressor bypass valve while switching the compressor to the idling mode.

When the compressed air pressure in the truck's pneumatic system drops down to 0.65 MPa, the following piston 14 moves to the left under the action of the spring 13 and the ball control valve 16 is pressed against its seat while shutting off the access of compressed air to the piston 17 of the safety valve 2. As a result, the spring 1 presses the safety valve 2 to the seat while isolating the chamber A from the atmosphere.

In so doing, the air pressure in the chamber E decreases, the bypass valve in the compressor drops shut and the compressor is switched to the mode of filling the system.

For the case of clogging of the adsorber, the bypass valve 4 is provided. It connects the chambers A and B, if the pressure difference between them reaches 0.20-0.25 MPa. In this case, air from the compressor is fed directly to the pneumatic system of the truck.

During the operation, the regulator needs no special maintenance.

Table 11.1 – Technical characteristics of the pressure regulator with adsorber

Parameter or dimension	Parameter value
Maximum working pressure, MPa	1,35
Actuation pressure, MPa	$0{,}65^{+0{,}05}$
Deactuation pressure pressure, MPa	$0{,}80_{-0{,}05}$
Safety valve actuation pressure, MPa	от 1 до 1,35

The **control outlet valve** (Figure 11.5) is intended for connecting the measuring instrumentation to it when checking the air pressure.

To check the pressure, screw out the cap 2 and turn the instrument nut onto the valve. When turning the nut on, the instrument fitting acts upon the pusher 3 and presses the valve from the seat. The air is fed into the instrument through the hole in the pusher. After disconnecting the instrument, the valve is pressed against the seat in the body 1 by the spring 5 so that the air stops escaping from the circuit. After disconnecting the instrument, screw on the cap 2.

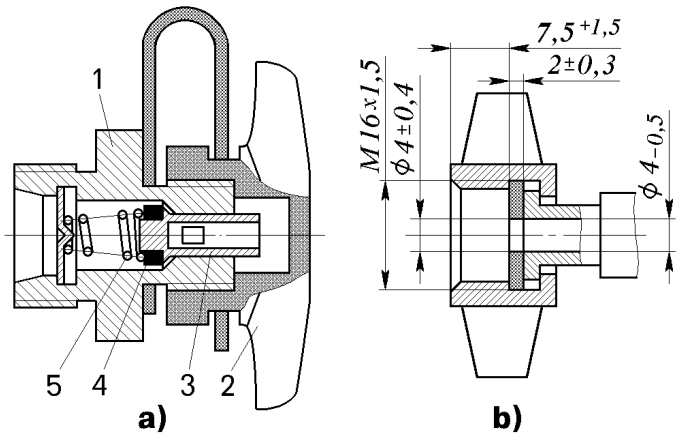


Figure 11.5 – Control outlet valve:

a – control outlet valve; b – tip for connecting the monitoring devices to the control outlet valve
1 – body; 2 – cap; 3 – valve pusher; 4 – sealing ring; 5 – spring

11.3 Maintenance of Pneumatic System

The reliable operation of the pneumatic system is only guaranteed provided that the system is a whole and its individual components (apparatus) are air-tight. Therefore, the works influencing the air-tightness of the connections of the apparatus and air ducts shall be performing especially thoroughly when maintaining the pneumatic system.

The maintenance of the pneumatic system consists in the regular inspections of the system condition, checking tightness, fastening of the apparatus, and its operability.

When performing the daily maintenance:

– Check the tightness of the pneumatic system.

The pneumatic system shall be tested for air-tightness at the air pressure in it of at least 0.65 MPa, with the consumers of the compressed air switched off and compressor not running.

The drop of the compressed air pressure in the pneumatic system shall not exceed 0.05 MPa for 30 minutes. The places of major air leaks could be detected aurally and those of minor leaks – using soapy emulsion. Any air leak from the pipeline connections shall be eliminated by tightening or replacing individual components of the connections.

In case of any fault, the disassembling of the apparatus and elimination of the defects shall be performed by qualified specialists under the workshop conditions only.

– Drain the condensate from the receiver and drain tank of the pneumatic system, regeneration receiver of the pressure regulator and receivers of the pneumatic engine starting system every day after the shift.

After complete draining of the condensate from receivers, fill the system again with air until the pressure regulator operates and only then stop the engine.

It is prohibited to use bare flame in case of freezing of the condensate.

The intensity of accumulation of the condensate depends on the technical condition of the compressor and humidity of the environment air. The presence of condensed moisture in the pneumatic system receivers is a criterion of unsatisfactory drying and indicates the necessity of replacement of the absorbent in the pressure regulator.

12 LOW-VOLTAGE ELECTRICAL EQUIPMENT

The DC electrical equipment of the dump truck rated at the voltage of 24 V is based on a one-wire circuit. The negative poles of both the current sources and the current consumers are connected with the ground.

The under-bonnet lamps and socket for hand lamp are connected via two-wire circuit.

The low-voltage electrical equipment of the truck includes the following major systems: those of power supply, engine starting and stopping, monitoring instruments, external and internal light, light and audible signalling, heating and air-conditioning, protection.

The schematic diagrams of the low-voltage electrical equipment of the dump truck, list of components of the electrical equipment diagrams and diagrams of electrical equipment assembly on the chassis and the cab are delivered together with the dump trucks within the complete set of operation documents. Every dump truck is only provided with the appropriate electrical diagrams.

The sensor contacts, contactors, relays and switches are shown in the diagram in the OFF position.

12.1 Power Supply System

The power supply system of the truck includes two series-connected storage batteries for trucks with pneumatic starting, four series-parallel connected storage batteries for trucks with electric starting, generator with the installed voltage regulator, switched with the storage batteries in parallel, digital device of controlling the system voltage on the electronic control panel.

Storage batteries. The truck is provided with storage batteries of the 6CT-190A type.

Technical characteristic of the storage battery

Rated voltage, V 12
Capacity for 10-hour discharge at the electrolyte temperature of 30°C, A-h 174
Discharging current for 10-hour discharge, A 17.4
First-charging current for the dry-charged batteries, A 19

The electrolyte volume required for filling one battery is 12 l. Depending on the climatic region, the storage batteries shall be filled with electrolyte of certain density in accordance with Table 12.1.

Table 12.1 – Dependence of the electrolyte density on the climatic region

Climatic region (average monthly air temperature in January, °C)	Season of the year	Electrolyte density as measured at the temperature of plus 25°C, g/cm^3	
		When being poured	At the end of charging
Very cold with the temperature from minus 50 to minus 30	winter	1.28	1.30
	summer	1.24	1.26
Cold, from minus 30 to minus 15	throughout the year	1.26	1.28
Moderate, from minus 15 to minus 8	throughout the year	1.24	1.26
Hot dry, from minus 15 to plus 4	throughout the year	1.22	1.24
Warm humid, from 0 to plus 4	throughout the year	1.20	1.22
Note: The deviation of the electrolyte density within the range of ±0.01 g/cm^3 is allowed.			

The electrolyte shall be prepared of sulphuric accumulator acid and distilled water in a vessel resistant to sulphuric acid (made of ceramic, plastic, ebonite or lead). Water shall be poured into the vessel first and then sulphuric acid shall be added with continuous stirring. To obtain the electrolyte of appropriate density refer to Table 12.2.

When filling the battery, the electrolyte temperature shall be at least plus 15°C and not more than plus 25°C in the regions with cold and moderate climate and not more than plus 30°C in the regions with tropical climate.

Table 12.2 – Relationship between the electrolyte density and quantity of water and sulphuric acid in 1 l of electrolyte

Required electrolyte density at 25°C, g/cm^3	1.20	1.22	1.24	1.26	1.28	1.40
Quantity of sulphuric acid with the density of 1,83 g/cm^3, l	0.200	0.221	0.242	0.263	0.285	0.426
Quantity of distilled water, l	0.859	0.839	0.819	0.800	0.781	0.650

Prior to filling the battery with electrolyte, screw out the plugs from the battery and remove the film covering the air hole and cut off the projection at the plug end face. If a sealing disk under the plug is used instead of the film and projection, remove it. After filling the battery with electrolyte, the air holes shall remain open.

The electrolyte shall be poured to the level above the protective shield by 10-15 mm.

In the batteries, the covers of which are provided with ventilation nipples for adjusting automatically the electrolyte level, it is necessary to remove the sealing parts from the holes in the nipples, screw out the battery plugs and draw them tightly onto the ventilation nipples. Then pour the electrolyte in a thin jet into the batteries to the top edge of the filler neck. Remove the plugs from the nipples and the electrolyte level in the batteries will decrease automatically to the required value.

Check the electrolyte density after neither earlier than 20 minutes nor later than two hours from the moment of pouring the electrolyte. Should the electrolyte density drop by not more than 0.03 g/cm³ against that already poured, so the batteries can be put into operation.

Should the electrolyte density drop by more than 0.03 g/cm^3, so the batteries shall be charged.

The electrolyte temperature in the battery before charging shall not exceed 30°C in the cold and moderate zones and not more than 35°C in hot dry and warm humid zones. Should the electrolyte temperature exceed the specified one, it shall be cooled down. Should the electrolyte temperature exceed the specified one, it shall be cooled down.

To charge the battery, its positive side shall be connected to the positive pole of the power supply and its negative side – to the negative pole of the power supply. The charging current shall be 19 A.

The batteries shall be charged until plentiful gas release begins in all the cells of the battery and electrolyte density and voltage remain constant for two hours. Should the electrolyte temperature exceed 45°C, the charging current shall be reduced by half or the charging shall be interrupted for the time necessary for cooling down to the temperature of 30-35°C. The voltage of the storage batteries shall be monitored by means of the voltmeter with the scale of 30 V and resolution of 0.2 V.

Should the electrolyte density measured with the account of the temperature correction (table 12.3) at the end of charging differ from the standard, it will be necessary to correct the electrolyte density. Distilled water shall be added, if the electrolyte density exceeds the normal value and sulphuric acid with the density of 1.4 g/cm3 shall be added if the electrolyte density is below the normal value.

After correcting the electrolyte density, continue charging the batteries for extra 30 minutes until the electrolyte gets completely mixed and than disconnect the batteries. After 30 minutes from the moment of disconnection of the batteries, measure the electrolyte level in all the battery cells.

Should the electrolyte level be below the normal value, the electrolyte of the density specified in Table 12.1 shall be added into the battery. Should the electrolyte level exceed the normal value, withdraw the excess electrolyte using a rubber bulb;

The negative side of the storage batteries is connected with the ground of the dump truck through the switch.

Table 12.3 – Temperature corrections to the electrolyte density

Electrolyte temperature when measuring the density, °C	Correction to the areometer indication, g/cm^3
from minus 55 to minus 41	minus 0.05
from minus 40 to minus 26	minus 0.04
from minus 25 to minus 11	minus 0.03
from minus 10 to minus 4	minus 0.02
from minus 3 to plus 19	minus 0.01
from plus 20 to plus 30	0
from plus 31 to plus 45	0.01
from plus 46 to plus 60	0.02
Note: At the electrolyte temperature exceeding plus 30°C, the correction shall be added to the actual reading of the areometer and at the temperature of below plus 20°C – subtracted from the areometer reading.	

The generator is a three-phase type with the built-in voltage regulator, mounted on the engine. For the design and maintenance, please, refer to the operation and maintenance manual for the engines by CUMMINS make.

12.2 Engine Starting and Stopping System

The system provides the preheating of the cooling fluid of the engine and its starting.

The engine starting system comprises the starter, oil priming pump and fuel transfer pump driven from electric motors, starting preheater of the cooling fluid and switchgear. The engine starting system could be of pneumatic or electric type (according to the contract). The starting preheater of the cooling fluid is an autonomous unit. It is used depending on the season of operation of the dump truck.

To start the engine, proceed as follows:

– Insert the key into the ignition switch up to the stop. In this position, the contactor connecting the minus leads of the storage batteries to the truck ground will operate to energize the monitoring instruments and pilot lamps;

– Switch on the fuel priming pump by means of the switch and bleed the feeding system (after continuous parking or maintenance);

– Turn the key in the key switch at the angle of 45° - to switch on the power supply of the engine electronic module;

– Turn the key in the key switch at the angle of 90° to switch on the electric motor of the oil-priming pump; on reaching the pressure in the lubrication system of approximately 0.2 kg/cm^2, the pump is switched off and the engine is started;

– After starting the engine, release the key of the ignition switch so that it would return into the initial position.

Electric starter continuous run time must be not more than 15 sec. If the engine doesn't begin stable operation within this period, it's necessary to turn off the starter and restart the engine in one minute.

Press the **engine shutdown pushbutton** to stop the engine. Time relay (for 80 sec) for electric power and engine electronic control unit turn-off delay after engine shutdown is installed in engine starting and shutdown system in order to release pressure in steering hydropneumatic accumulators. The same functions are to be actuated by **emergency engine shutdown pushbuttons** (two) installed in the lower part on the side panels from both sides of the front bonnet; they are intended to shutdown the engine from the "ground".

Electric starter is delivered with engine. See its design, maintenance and repair in maintenance documentation of the electric starter producer.

12.3 Audible and Light Alarm System

The light alarm system inform the driver on the conditions of the dump truck systems, such as variation of the parameters within the allowable range and reaching the emergency values of the parameters as well as provides the information on the manoeuvres, i.e. braking and turning.

The sensors of electrical signals are installed in the channels of the systems and on the function elements of the aggregates, but the receivers of the signals (instruments and lamps) – on the dash panel in the cab. The lamps with red light filter are alarms and those with green and blue light filters are information signals.

When switching on the alarm signalling, all the right and left turning indicators and pilot lamp, mounted into the switch button, blink. The warning lantern is mounted on the fuel tank to exclude overfilling the tank when refuelling.

The stop light is switched on when braking the dump truck by means of the service, parking, emergency and auxiliary braking systems. When applying the parking brake system, the pilot lamp in the pilot lamp block lights up. The pilot lamp blinks.

The audible signalling system comprises of the electrical horns, electrical horn of reversing and audible emergency alarm (in the cab).

The electrical horns are switched on by pressing the switch arm end of the turn indicators and headlights located at the left hand side from the steering column.

The electrical horn of reversing is switched on simultaneously with switching the reverse. Its circuit is provided with a relay interrupter so that the reverse signal is intermittent.

The sound signalling device is connected in the circuit in parallel to the warning lamps of the emergency conditions of the engine, steering control and brake systems and warns the driver about the emergency condition of the above mentioned systems by means of an additional audible signal.

12.4 External and Internal Lighting System

The system is intended for illuminating the road section when driving the truck at night time and under the restricted visibility conditions, illuminating the ladder, deck and operation area, side space and the engine compartment, information about the overall dimensions of the dump truck and the cab illumination. The lighting system includes also hand lamp socket.

Fog lights, illuminating lamps of ladder, deck, operation area, side space and the engine compartment are actuated by the switch located on the control panel. Floodlamp lighting is actuated by the switch located on the additional control panel (above the windshield).

Turn indicators, side lights, upper and lower beam headlights, horn are actuated by the switch located at the left hand side from the steering column.

For the arrangement of the controls of the external and internal lighting systems and description of the rules of their use, see chapter 4, «Controls, control-measuring devices and equipments of the cab».

The double-dipping headlights are mounted while assembling the dump truck (see assembly instruction) and hereinafter, at the technical maintenance, the head light beams adjustment is not requested.

12.5 Protection of the Electrical Equipment Circuits

The electrical equipment of the truck is protected by automatic thermal switches installed in the cabinet with low-voltage electrical equipment in the cab. Circuit-breakers and circuits protected by them are shown in the low-voltage electrical diagrams of the dump truck attached to the operating documentation.

When appearing the malfunction in the electrical circuit, first check the condition of its circuit breakers. The actuation of the circuit breaker (open circuit) indicates a short circuit or an overload in the circuit. In this case, determine the fault and then only switch on the circuit breaker.

12.6 Alarm of the Approach to the Overhead Power Transmission Line

The Alarm of the Approach to the Overhead Power Transmission Line Device (AAOPTLD) is intended for warning the driver about the staying of the dump truck at the dangerous distance to the wires of the overhead power transmission line by audible and light alarm, and interlocking the body lifting at a dangerous distance from the wires of the overhead power line.

The order of the indicator installation, operation, maintenance, possible malfunctions and troubleshooting are described in the operating manual of the device attached to the operating documentation.

Arrangement of AAOPTLD antennas is given in the instructions for dump truck assembly.

12.7 Maintenance of the Electrical Equipment

When performing the maintenance of the electrical equipment components, observe the following guidelines:

– It is prohibited to connect the leads improperly, inverse the polarity when connecting the storage batteries or external power supply source;

– When washing the dump truck, take measures to exclude the direct exposure of the water to generator;

– To remove dust and dirt from the generator by using a brush moistened in gasoline or a piece of cloth, or blow it with compressed air;

– To remove the electrolyte from the storage batteries by using a piece of cloth moistened in ammonia or calcinated soda (10%) solution.

The maintenance of the electrical equipment consists in cleaning regularly its components from dirt and dust and checking the serviceability of the generator, storage batteries, measuring devices with the established intervals as well as its fastening.

Besides, the maintenance shall obligatorily include the checking of the condition of the electrical wiring and plug connectors, as well as fastening of the electrical wiring to the apparatus terminals and connecting panels. Tightening torque of power conductor terminals to the “ground” contactor as well as for M3H contactor (relay PR60 on the storage batteries box) is of 12 – 13 N.m.

When performing the daily maintenance:

– Clean the glass of lamps, lights, turning indicators;

– Check the voltage of the storage batteries prior to starting the engine using a voltmeter on the control panel; Start the engine. Make sure that the monitoring instrumentation, lighting elements, light and audible alarm devices are in good running order.

When performing the M-2:

– Check visually the condition, installation and connection of the electrical wires and cables of the low-voltage electrical equipment. Neither damage of insulation of the wires and cables nor loosening of their fastening is allowed;

– Re-tighten the fastening the lugs to the terminals and fastening of the storage batteries. Lubricate the terminals of the batteries;

– Check the electrolyte level in the storage batteries and top up the electrolyte as necessary. Cleanse the vent holes in the plugs of the batteries. Prior to checking, clean the storage batteries using rags moistened in 10% ammonia solution. The electrolyte level shall be above the protective shield by 10-15 mm.

To check the electrolyte level, make two marks on a glass tube with the diameter of 3-5 mm at the distance of 10 and 15 mm from the end (Figure 12.1).

Screw out the plug in the battery and insert the tube into the hole until it rests against the protective shield to check the electrolyte level. Close the free end of the tube with your finger and lift it – the tube shall be filled with electrolyte to the level between the marks. It is just the electrolyte level in the battery.

Check the electrolyte density in the storage batteries. If necessary, restore the electrolyte density and recharge the batteries;

Check the lighting elements and light alarm fastening.

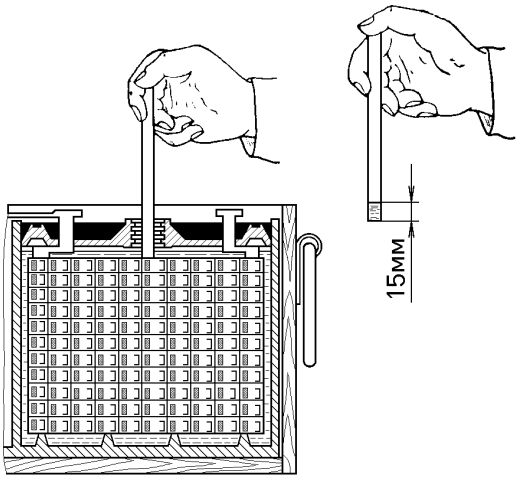


Figure 12.1 – Checking the electrolyte level in the storage battery

Electrolyte density checking.

The electrolyte density shall be determined by means of an areometer (Figure 12.2) in each cell of the battery.

Determine the battery discharge degree having compared the actual density of the electrolyte with its density specified for the appropriate climatic region as stipulated in Table 12.4.

The Table presents the electrolyte density at 25°C. The battery discharged by more than 25% in winter and by more than 50% in summer shall be put for charging.

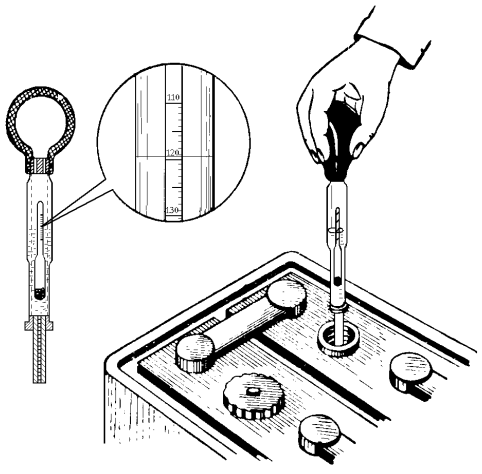


Figure 12.3 – Checking the electrolyte density

Table 12.4 – The level of the storage battery charge depending on the electrolyte level

The battery is charged fully	The battery is discharged	
	by 25 %	by 50 %
1.30	1.26	1.22
1.28	1.24	1.20
1.26	1.22	1.18
1.24	1.20	1.16
1.22	1.18	1.14
Note: The electrolyte density at 25°C is specified in the Table.		

– Check the fastening of the lighting and light alarm devices.

Upper and lower beam **headlights of LED type** are installed during the dump truck assembling (look the directions on the dump truck assembly) and further when the dump truck maintaining the additional adjustment is not required.

When performing the seasonal maintenance:

– Adjust the electrolyte density in accordance with the season and re-charge the storage batteries.

13 CAB AND BODY

13.1 Cab

The cab is two-seated, all-metal, two-door, with an inbuilt ROPS safety system, heat and noise insulation and soft internal lining. It is installed on the left on the brackets and fastened to them at four points by means of the bolts 3 (Figure 13.1) through the rubber shock absorbers (4) damping the cab oscillations during the motion.

The cab comprises the pneumatically sprung driver seat and a passenger seat with the folding back, transforming in the table for eating. The seats are equipped with safety belts. Under the passenger seat there is a box for driver's personal things. There is a console with controls placed between the seats.

The cab is equipped with the moulded control panel with the built-in display diagnostics block. The upper control panel is made of the moulded plastic with the possibility of placing the additional equipment.

The cab is equipped with windscreen and rear window washers and wipers, heated rear window and a heat-conditioning block installed under the panel in the front right space.

The cab is also equipped with the sunblind shutters, lighting lamp and coat rack. The place for the first-aid kit is also provided. The ceiling, side and rear walls are coated with the soft multilayer lining.

The cab glazing provides good visibility from the driver seat. The windscreen is fitted with flat three-layer glass (two polished glasses with transparent plastic film between them), the rear and side windows are fitted with hardened safe glasses.

The doors are fitted with locks and moulded lining with the built-in pocket for documentation. The sliding glasses are installed in the cab doors. The doors are also equipped with external and internal handles. The air-tightness of the door and windows is provided by the rubber seals.

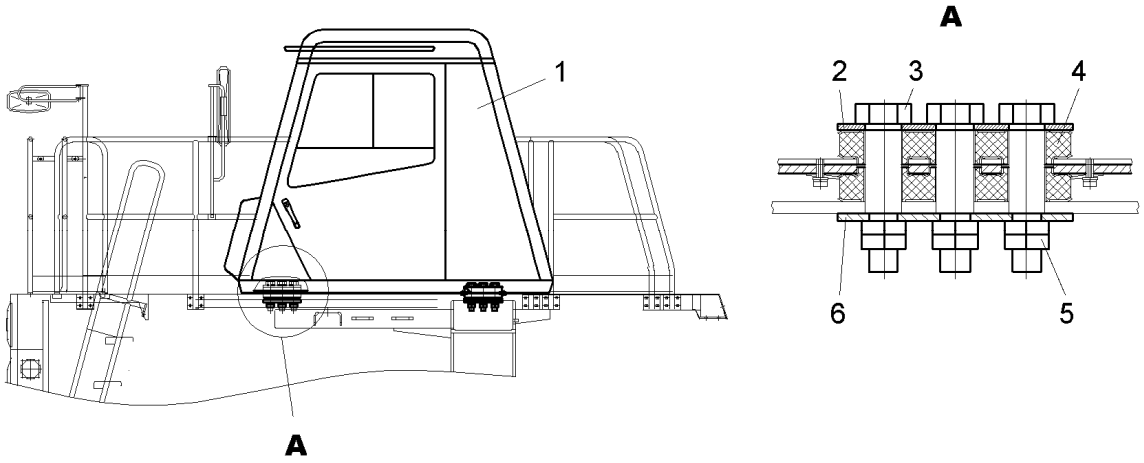


Figure 13.1 – Installation of the cab on the dump truck chassis:
1 – cab; 2, 6 – plates; 3 – bolt; 4 – cab support cushion; 5 – nut

The driver seat is a pneumatically sprung seat with mechanisms of height adjustment, longitudinal movement, backrest tilt and fixation.

Longitudinal seat movement is performed by shifting lever 1 (Figure 13.2) left, placing the seat in the required position and releasing the lever.

Adjustment of tilt and fixation of the seat back 8 is performed with lever 6. At shifting the lever in the upper position the back is placed in the upper position.

Adjustment and fixation of height and tilt of the seat cushion is performed with levers 2 and 4. At shifting the levers upwards the seat is placed in its uppermost position. By shifting the levers by turns tilt position of the seat cushion is achieved.

The seat frame has two threaded holes 9, size 7/16", for fastening the seat belt. The fastening bolts are included in the scope of delivery of the seat belt.

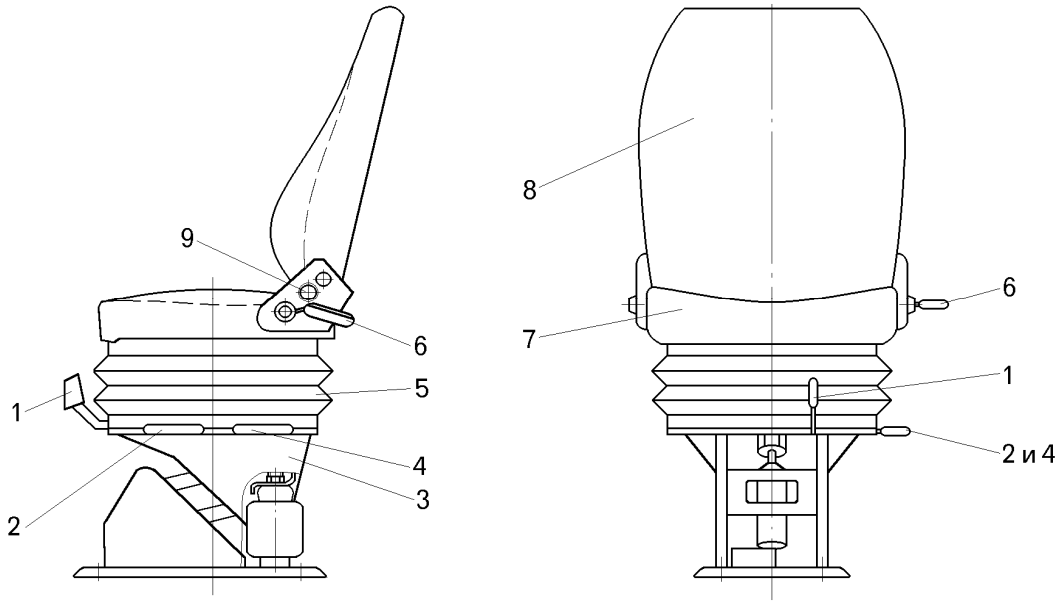


Figure 13.2 – Driver seat:

1 – lever for longitudinal seat movement; 2, 4 – levers of mechanism for seat adjustment by height; 3 – seat support with pneumatic equipment; 5 – adjustment mechanisms casing; 6 – lever of mechanism for seat back tilt and fixation; 7 – seat cushion; 8 – seat back; 9 – seat belt holder screw hole

The pneumatic cushioning mechanism is supplied from the pneumatic system receiver and mounted in the support 3. It consists of the pneumatic cylinder 6 (Figure 13.3), pneumatic control valve 3, shock absorber 4, upper 1 and lower 2 levers and buffer 5.

On the customer's request, the cab can be equipped with pneumatically sprung seat, provided with air compressor built into the seat and connected to the truck power circuit.

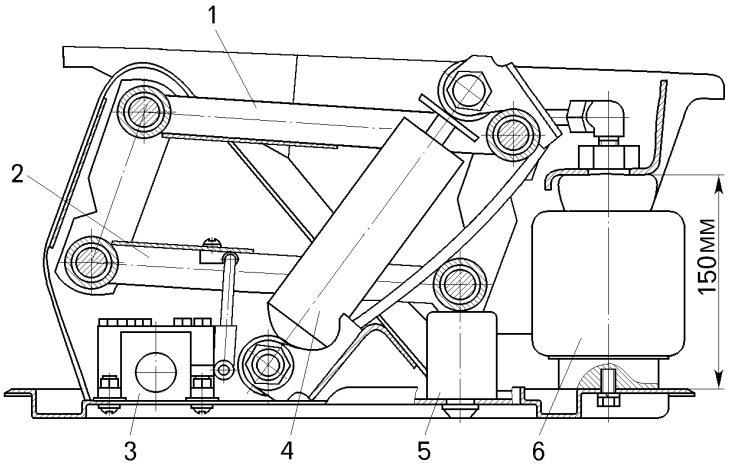


Figure 13.3 – Seat support with pneumatic equipment:

1 – upper lever; 2 – lower lever; 3 – pneumatic distributor; 4 – shock absorber; 5 – buffer; 6 – pneumocylinder

The driver's seat manufactured by PILOT Company of P1102 SUPREME model (Figure 13.4) is a pneumatic suspension with a compressor, automatic adjustment by weight up to 150 kg, equipped with armrests and safety belt.

The seat is equipped with pneumatic compressor connected to the dump truck on-board electrical power circuit of 24V through a fuse.

Adjustment by weight is performed in automatic mode when connecting the "ground" of the dump truck. Adjustment of the cushion position and seat backrest is performed by using the switches 5, 6, 7. Additional seat adjustments are performed with the compressor being OFF.

The pre-adjusted positions of the seat after adjusting by weight and height are also saved when the "ground" of the truck is off.

ATTENTION: WHEN ADJUSTING DO NOT OPERATE THE COMPRESSOR MORE THAN ONE MINUTE IN OPERATING MODE.

The other operator needs the seat to be adjusted again.

Adjustments to the seat should be performed on a stationary dump truck.

The driver's seat should be serviced and repaired only by specialists, in accordance with national standards and installation instructions. National installation standards can be obtained from PILOT Company or its representative offices.

To prevent injury of the driver's back, first adjust the seat based on the weight of the driver, and after each other driver.

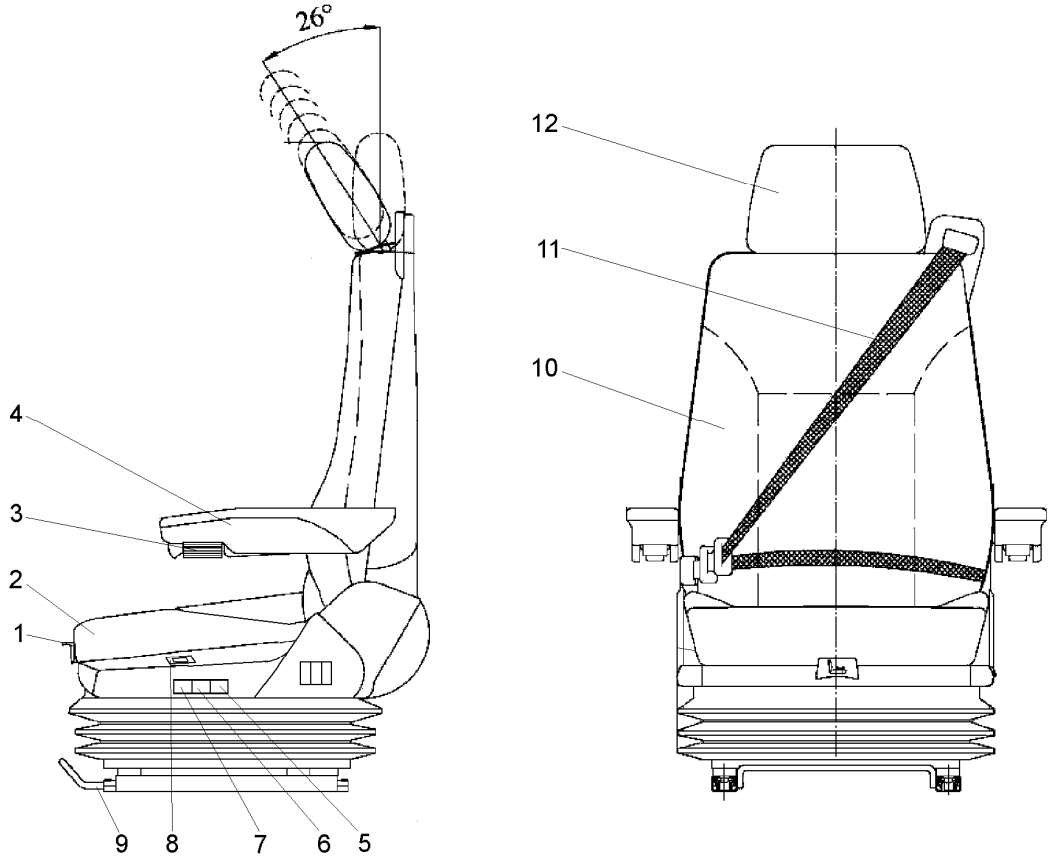


Figure 13.4 – Driver's seat "PILOT":

1 – lever for longitudinal adjustment of the seat cushion shift; 2 – seat cushion; 3 – adjustment of the armrests tilt; 4 – armrest, 5 – integrated pneumatic support; 6 – smooth pneumatic adjustment of the seat by height with memory (up to 80 mm); 7 – shock absorber adjustment; 8 – button of air release from pneumatic suspension; 9 – lever for longitudinal adjustment of the seat shift; 10 – backrest of the seat; 11 – waist safety belt; 12 – headrest

Heating and air-conditioning unit.

The heating and air-conditioning unit is installed in the cab under the instrumentation panel cover opposite to the passenger seat. The front panel of the unit accommodates the controls of the heater and air conditioner as well as rotating vents 1 (Figure 13.5) for varying the direction of the air flow.

ATTENTION! THE AIR CONDITIONER ONLY OPERATES WHEN THE TRUCK ENGINE IS RUNNING.

To switch on the heater, use the rotary switch 2. The rotary switch varies the rotational speed of the air blowing fan. The fan has three speeds and OFF position.

The switch 5 varies the position of the shutter of the outdoor and indoor air intake into the heater (outdoor air only, indoor air only (recirculation), outdoor and indoor (mixed)) and controls the quantity of the air delivered into the cab.

To clean the air to be delivered into the cab through the heater, two **filtering elements** are installed in the front wall of the cab in the air filter body.

The filtering element shall comply with the following requirements:

– Rated throughput capacity at least 500 m^3/h;

– The filter efficiency shall comply with the requirements of the State Standard GOST ISO 10263-2-2000;

– The filters with mechanical damages shall not be installed in the air filter body;

– The filter replacement shall be performed in accordance with the operating conditions and information on the service life from the data sheet;

– The filter surface shall be free of sharp edges, corrosion, dents, holes, warps as well as cracks and tears;

– The overall dimensions of the filter are 208x350 mm and the thickness is not more than 50 mm;

– The used filters are not restorable and shall be replaced with new ones.

The fluid from the engine cooling system is used for the heater operation. To connect the heater to (disconnect the same from) the engine cooling system, the feeding hose of the heater is fitted with a cock.

TO ENABLE THE HEATER OPERATION, THE COCK FOR FEEDING THE ENGINE COOLING FLUID SHALL BE SET TO THE "OPEN" POSITION.

To switch on the air conditioner and to control the temperature of the delivered air, it is necessary to use the rotary switches 2 and 4.

Use the switch 4 for varying the temperature of the cooled and dried delivered air. This switch has the scale coloured blue.

To switch on the air conditioner, turn the switch 4 clockwise. Then turn the switch 2 to one of the three marked positions. After 3 – 5 minutes, set the desirable temperature in the cab by means of the switch 4 and set the necessary direction of the air by means of rotary vents 1. To switch off the air conditioner, turn both switches counter-clockwise to the zero position.

To adjust the air flow (from maximum to full shutting off) for blowing the driver's feet, use the handle 3. During the operation in the air-conditioner mode, it is recommended to shut off the air flow for blowing the driver's feet.

Charging the air conditioner, its commissioning and repair shall be performed in accordance with the Operating Manual for the air conditioner by the specialists of the air conditioner supplier company or their regional representatives.

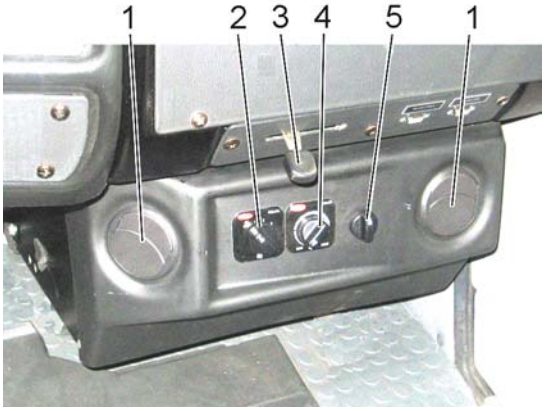


Figure 13.5 – Heating and air-conditioning unit:

1 – rotating vents; 2 – switch for varying the speed of the air blowing fan; 3 – handle for controlling the air flow for blowing the driver's feet; 4 – switch for controlling the air temperature; 5 – switch for varying the position of the outdoor and indoor air intake shutter

TO ENSURE THE EFFICIENT OPERATION OF THE AIR-CONDITION SYSTEM IN SUMMER, IT IS NECESSARY THAT THE COCK FOR CONNECTING THE HEATING UNIT TO THE ENGINE COOLING SYSTEM WOULD BE SET TO THE "ЗАКРЫТО" (SHUT) POSITION AND THE SWITCH OF THE POSITION OF THE OUTDOOR AIR INTAKE SHUTTER 5 – TO THE "ЗАКРЫТО" (SHUT) POSITION (INTAKE OF THE INDOOR AIR (RECIRCULATION) ONLY).

THE GUIDELINES FOR MAINTENANCE OF THE AIR-CONDITIONING SYSTEM AND SAFETY PRECAUTIONS ARE STATED IN THE ATTACHED OPERATION MANUAL FOR THE БС-306 STANDARD AIR CONDITIONER.

ATTENTION! PRIOR TO STOPPING THE TRUCK'S ENGINE, SWITCH OFF THE AIR-CONDITIONING USING THE SWITCH 4!

The windscreen washers. The cab is equipped with washers for front and rear windscreens The windscreen washer consists of a polyethylene tank for the fluid and a pump with an electric motor installed in this tank. The pump is connected with two nozzles by means of hoses.

When switching on the pump, the fluid from the tank is fed via hoses to the nozzles which spray it onto the glass. In the tank cap, there is a hole for equalizing the pressure in the tank when the pump is running. The fluid jet direction shall be adjusted by turning the ball in the plastic nozzle in such a way that the jet would be directed to the upper zone of the sector wiped by the windscreen wiper brush.

To exclude the clogging of the nozzles and filter, the tank shall be filled with filtered fluid only and the nozzles shall be regularly cleaned. As working fluid for the windscreen washer, use special low-freezing fluids mixed with water in proportion according to the instructions for application of the fluid.

The tank (with the pump) for the front windscreen washer is installed in the front lower corner of the cab, the same for rear windscreen is installed near the cab rear panel, behind the passenger's seat inside the low-voltage control cabinet.

The windscreen wiper for the front windscreen is of two-brush type, it consists of the electric motor with driving mechanism and levers with brushes fastened to the front panel of the cab. The windscreen wiper for the rear windscreen is of single-brush type, it consists of the electric motor with driving mechanism, and lever with brush fastened to the rear panel of the cab.

During operation, the wiper blade of the brush must be clean and undamaged, brush in the adapter must swung freely and without jamming. It is not allowed to actuate the wiper when the brush is frozen to the glass to avoid the drive damage. Recommended replacement of brushes is to be performed each 12 months, check of threaded joints tightening – each 6 months.

Video surveillance system. The truck is equipped with the video surveillance system consisting of two cameras installed on the post of the front handrail of the right-hand fender and last crossbeam of the frame, monitor located in the cab and complete set of additional equipment. The installation of the video surveillance system on the chassis and in the cab of the dump truck is described in the Assembling Manual.

13.2 Body

The body is a metal, welded, bucket-type construction with an overhead guard above the cab. The body design is well suitable for loading the dump truck by both an excavator and a front loader. The body is equipped with stone shields protecting the tyres and empennage against damaging by pieces of rocks falling when loading the dump truck. The body heating by the engine exhaust gases is provided.

The base and sides of the body are made of high-strength wear-resistant steel sheets and reinforced by the box-section counterforces. The top edges of the sides are provided with massive stiffeners of round-section rolled steel protecting the sides against destruction during loading.

For heavier operation conditions (carrying the rocks with specially high hardness and abrasiveness), the body bottom can be provided with additional flooring on the customer's request.

The body is pivotally fastened to the brackets on the frame by means of the pins 16 (Figure 13.6). The axial clearances in the pin joints of the rear supports of the body are adjusted by the adjusting washers 17 and shall not exceed 2 mm. The clearance shall be determined in the zone of the least distance between the planes. The locking plate is aligned with the latch slit.

The shock absorbers 12 are fastened by means of the bolts 13 to the side members of the body base. The uniform adjoining of the shock absorbers to the bearing surface of the frame side members is ensured by placing the adjusting shims 11. The gap between the shock-absorber and the frame side member shall not exceed 1 mm. In some places, a wedge-shaped clearance of up to 3 mm is allowed. Compression of individual shock-absorbers as seen in detail view D is allowed.

The guides limiting the transversal movement of the body are welded to the body base. The clearance of 0 – 1,2 mm between the body guides and contact plates 7 is set by means of the adjusting plates 6. The end plate of the first crossbeam of the bottom has the hole for removing the soot from the engine exhaust gases which is closed with the cover 5.

The direction of discharge of the engine exhaust gases is adjusted by means of rearrangement of plugs 21.

The stone pushers 18 are provided for removing the pieces of rocks squeezed between the doubled tyres of the driving axle.

To ensure the normal operation of the stone pushers, it is necessary to remove the hoist cramps from the spacing ring of the rear wheels and clean the place of welding (to exclude the damage of the stone pushers).

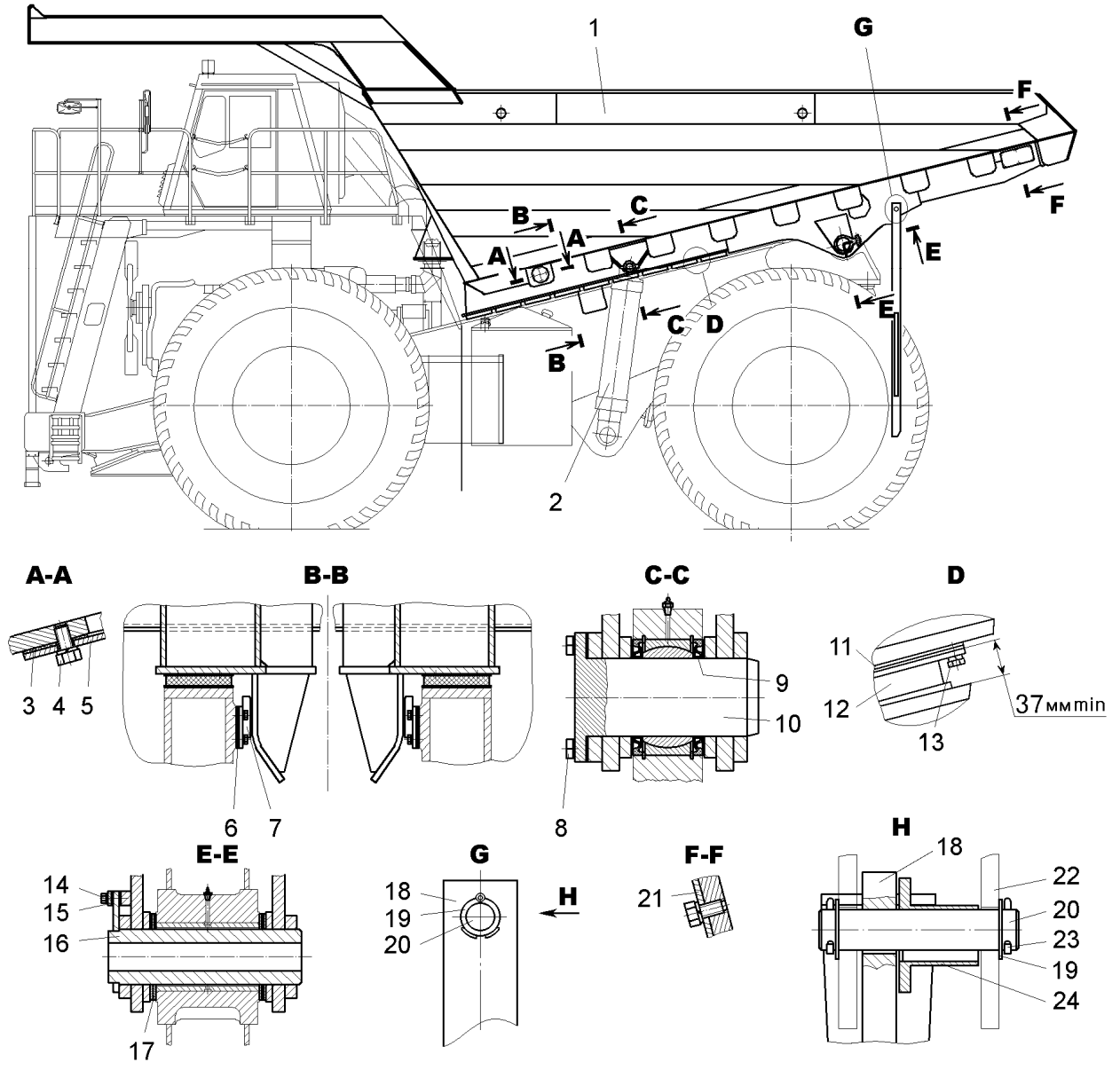


Figure 13.6 – Body installation:

1 – body; 2 – dumping mechanism cylinder; 3 – gasket; 4, 8, 13, 14 – bolts; 5 – cover; 6 – adjusting plate; 7 – contact plate; 9 – spacer bushing; 10, 20 – pins; 11 – adjusting gasket; 12 – shock absorber; 15 – cover; 16 – pivot; 17 – adjusting washer; 18 – stone pusher; 19 – washer; 21 – plug; 22 – bracket jaw; 23 – splint; 24 – thrust bushing of the stone pusher

To lock the body 2 (Figure 13.7) in the lifted position when inspecting and repairing the dump truck assemblies, the bracket for fastening the locking rope is welded to the body bottom. The rope 1 is fastened by the thimbles on its ends to the ears of the rear axle housing brackets by means of two towing pins 4.

To prevent the pins from dropping out of the ears, they shall be fixed with cotter pins. Each time prior to locking, check the condition of the rope and welds of the locking device bracket.

THE LOCKING ROPE IS DESIGNED FOR LOCKING THE EMPTY BODY ONLY.

The information plate 7, “Instruction for using the body locking device” is attached to the rear portion of the body.

Instruction content:

1. When performing the maintenance and repair of the dump truck, the body shall be locked in the lifted position by means of the rope.
2. It is prohibited to be under the lifted body unless it is locked.
3. The maintenance and repair shall be only performed with the empty body of the dump truck.
4. Prior to locking the body, check the condition of the rope and welds of the locking device brackets. It is prohibited to use the body locking device, should any damages of the rope and/or cracks in the bracket welds be detected.
5. Body locking procedure:

– remove the rope ends from the body hooks;
– Remove the pivots from the rear axle brackets;
– Insert the thimbles at the rope ends into the rear axle brackets and fix them with pivots;
– Fix the pivots with cotter pins.

6. Prior to lowering the body after maintenance and repair of the dump truck, disconnect the rope from the rear axle, fasten it on the body hooks, insert the pivots into the rear axle brackets and fix them with cotter pins.

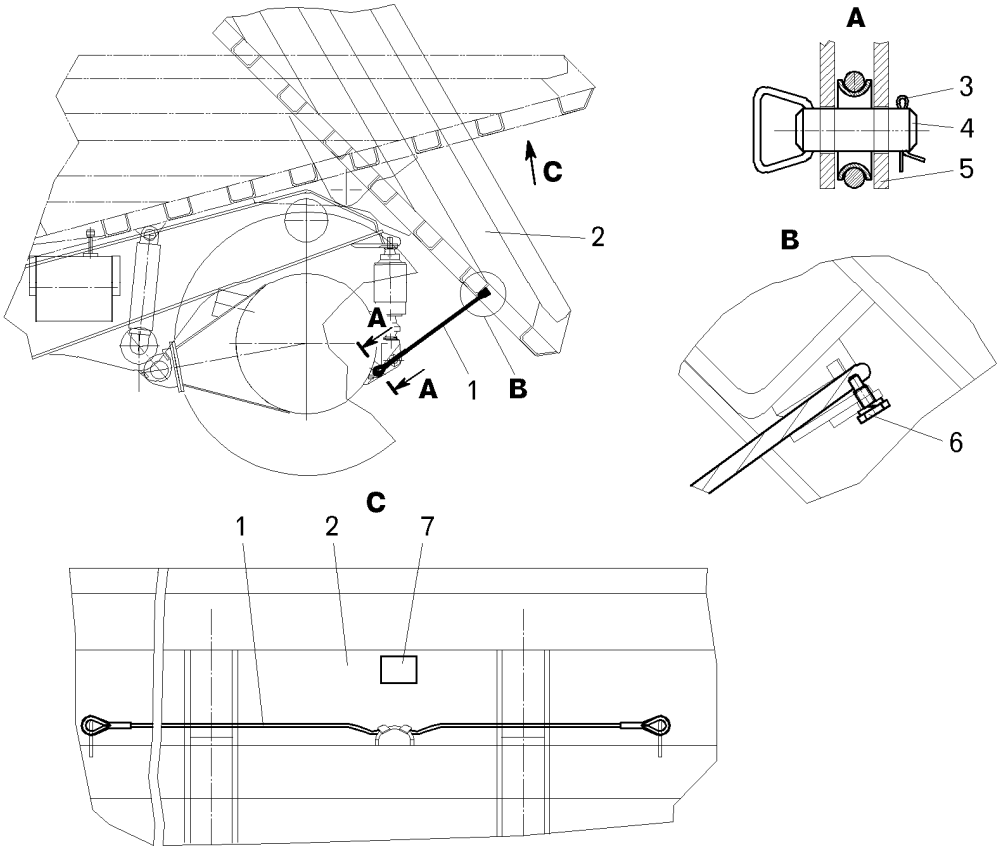


Figure 13.7 – Locking the body:

1 – rope for locking the body; 2 – body; 3 – cotter pin; 4 – pivot; 5 – bracket of the rear axle housing for fastening the rope; 6 – locking bolt; 7 – warning plate

13.3 Maintenance of the Cab and Body

The air conditioner should be maintained in accordance with the air conditioner operation manual, which is part of the operational documentation set.

Daily maintenance:

– Check the fluid level in the windscreen washer tank and top up it as necessary;

– Check the operation of the windscreen wipers and washers. The fluid jet shall hit the windscreen at the upper zone of the sector wiped by the windscreen brush;

– Clean the cab windows and rear view mirrors;

– Check the condition of the conditioning system (refer to the air conditioner operation manual).

Technical Maintenance 2 (TM-2):

– Check the condition of the welds of the frame and body. Weld up any cracks detected.

– Check the security of mounting of the air conditioner compressor. The assemblies of the system should be attached securely; there should be no mechanical damages.

The air conditioning system should be maintained (refer to the air conditioner operation manual).

Technical Maintenance 3 (TM-3):

– Check by visual inspection the fastening of the fendering elements as well as elements of the running control unit. All the assemblies should be fastened reliably; if necessary retighten threaded joints.

– Perform the maintenance (replacement) of the filtering elements of the cab air intake system. The filters should be clean and free of mechanical damages.

THE USED FILTERS ARE NOT RESTORABLE AND SHALL BE REPLACED WITH NEW ONES!

Seasonal maintenance (SM)

– Remove soot from the body soot collectors through the side hatches. With the covers of hatches removed, start the engine and let it run for 5–10 minutes at the rotational speed of 1000 – 1200 rpm until soot is removed.

14 DUMPING MECHANISM

The dumping mechanism ensures the lifting and lowering the body and its stopping in any intermediate position during the lifting or lowering process. The mechanism is equipped with the hydraulic translational motion drive with electrohydraulic control. It consists of two two-section telescopic hydraulic cylinders Ц1 and Ц2 (Figure 14.1), hydraulic distributor A1, control unit A2, axial-piston pump H, automatic pump-unloading device A3, two-line valves K3 and K4, oil tank of the integrated hydraulic system with the filter Ф2, magnetic filters in the sucker of the pump and in the drain manifold, and oil pipelines interconnecting the above units.

The dumpling mechanism is controlled from the cab by means of electric switch located on the instrumentation panel.

14.1 Operating Principle of the Hydraulic Drive

When the control switch of the dumping mechanism is set to the neutral position, the working fluid delivered by the front section of the variable-capacity axial-piston pump H is passed to the distributor P2 of the hydraulic distributor A1, reducing valve КР of the control unit A2 and through the filter to the manifold of the hydraulic system of the steering control charging the pneumatic hydraulic accumulators of the steering control and braking system; and delivered by the rear section of the pump is passed to the distributor P1 of the hydraulic distributor A1.

The automatic pump-unloading device A3 maintains the working fluid pressure in the pneumatic hydroaccumulators of the steering control and braking systems within the specified range (13 –17 MPa) and switches off the front section of the pump while bringing it to the zero capacity when the pneumatic hydraulic accumulators are charged and the control switch of the dumping mechanism is in the neutral position. The pump is adjusted for maintaining the minimum pressure of 3 MPa.

The reducing valve КР of the control unit A2 reduces the working fluid pressure from 17 MPa to 4 MPa and maintains it constant in the hydraulic control system of the dumping mechanism when the system is working.

From the reducing valve КР the working fluid is fed to the hydraulic distributor P9.

The hydraulic distributor P9 with electromagnets ensures the control of lifting or lowering the body and stopping the latter in any intermediate position.

The hydraulic distributor P10 with solenoids provides for the floating position of the hydraulic cylinders Ц1 and Ц2 by connecting their piston chambers with the draining hydraulic line and controlling the overflow valves К1 and К2 of the hydraulic distributor A1.

The hydraulic distributor A1 changes the direction of the working fluid flow from the pump to the piston and rod chambers of the hydraulic cylinders Ц1 and Ц2 depending on the position of the spool-valves of the hydraulic distributors P1 and P2.

The safety valves КП1, КП2 adjusted to the working fluid pressure of 21 MPa protect the pressure hydraulic line of the pump against overloading in case of fault of the pressure regulator of the pump, which limits the capacity on reaching the pressure of 18 MPa.

The safety valve КП3 adjusted to the working fluid pressure of 8 MPa protects the hydraulic system against overloading when lowering the body.

When the switch mounted in the instrumentation panel is set to the neutral position, the solenoids of the hydraulic distributor P9 of the control unit are de-energized and its spool-valve is set to the middle position. The end chambers of the spool-valves of the distributors P1 and P2 are connected with the drainage.

When the switch on the instrumentation panel is set to the “Lifting” position, the electromagnet moves the spool-valve of the hydraulic distributor P9 of the control to the leftmost (as seen in the Figure) position. Here, the working fluid is fed via the control hydraulic line into the lower (as seen in the Figure) end chambers of the spool-valves of the hydraulic distributors P1 and P2 and moves them to the uppermost position (as seen in the Figure).

The working fluid is fed from the distributors through the throttle hole of the overflow valve K1 and two-line valve K4 to the governor unit of the pump front section and brings it to its maximum capacity. Simultaneously, the working fluid is fed from the pressure hydraulic line of the piston chamber of the hydraulic distributor A1 and two-line valve K3 to the governor unit of the pump rear section and brings it to its maximum capacity.

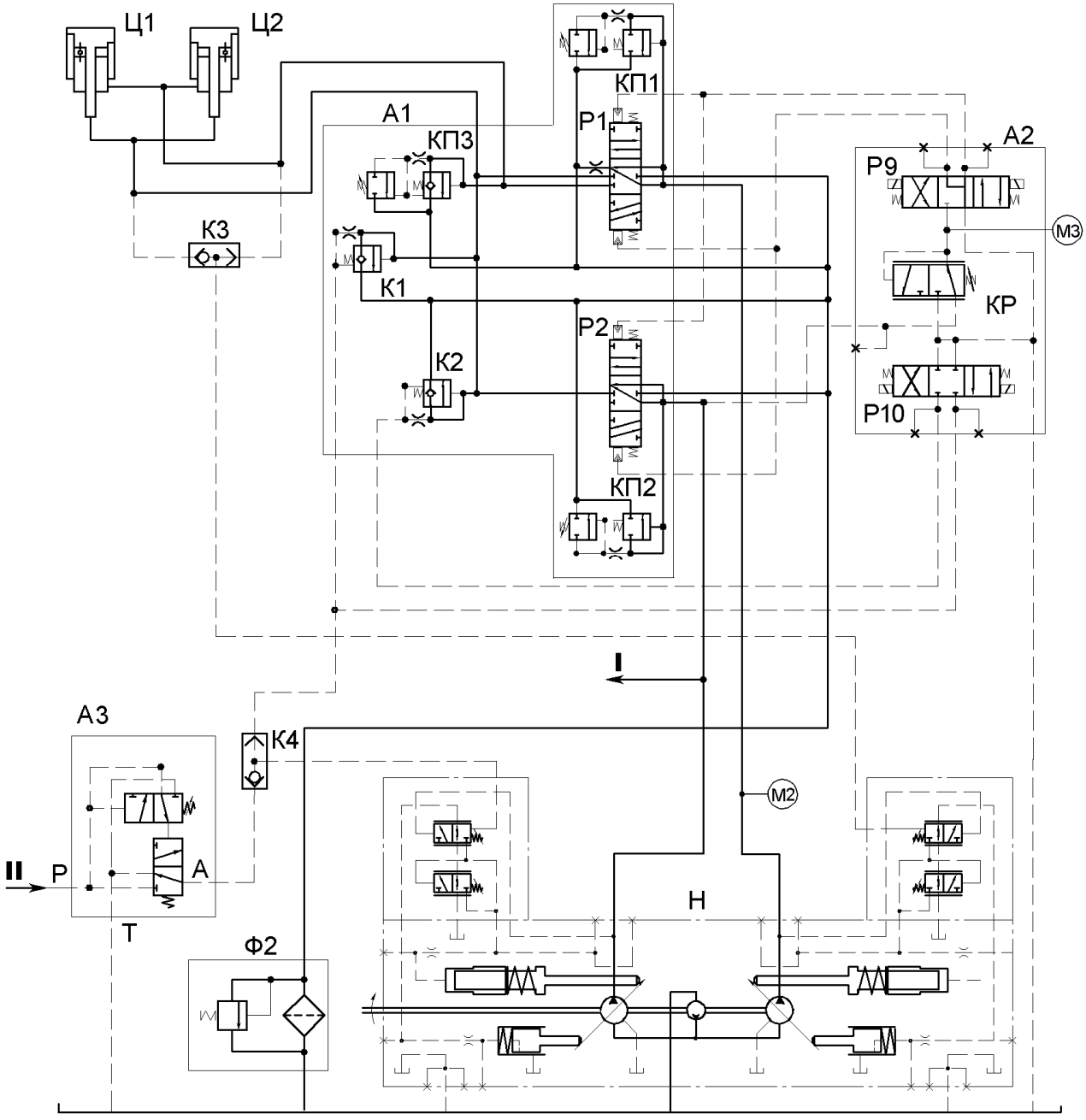


Figure 14.1 – Schematic hydraulic diagram of the dumping mechanism:

Н – variable-capacity axial-piston pump; А1 – hydraulic distributor; А2 – control unit; А3 – automatic pump-unloading device; Ц1, Ц2 – dumping mechanism cylinders; Р1, Р2, Р9, Р10 – distributors; КП1-КП3 – safety valves; КР – reducing valve; К1, К2 – overflow valves; К3, К4 – two-line valves; Ф2 – filter (in the oil tank); М2, М3 – pressure gauges (to be mounted when performing the diagnostics of the hydraulic system);

I – to the hydraulic system of the steering control and brake systems; II – from the manifold of the steering control

The working fluid flow from the pump is fed via the pressure hydraulic lines through distributor A1 into the piston chambers of the hydraulic cylinders Ц1 and Ц2, the links of which get separated and lift the body. Here, the rod chambers of the hydraulic cylinders are connected by means of the hydraulic distributor P1 with the drainage into the tank through the filter Ф2.

The indirect-action safety valves КП1 and КП2 consist of the main valve and auxiliary one. Should the hydraulic system be overloaded at the moment of the body lifting, the auxiliary valves drop open and connect the chamber behind the throttle of the main valves with the drain hydraulic line. The pressure difference arising due to consumption of liquid through the throttles disturbs the equilibrium of the main valves. They drop open and connect the pressure hydraulic lines with the drain. The pump reaches the zero capacity.

When the switch on the instrumentation panel is set to the “Lowering” position, the spool-valve of the hydraulic distributor P9 moves to the rightmost position (as seen in the Figure). The working fluid is fed via the control hydraulic line into the end chambers of the spool-valves of the hydraulic distributors P1 and P2 and moves them to the lowermost position (as seen in the Figure). The working fluid flow from the pump is fed via the pressure hydraulic line through the hydraulic distributer A1 into the rod chambers of the hydraulic cylinders Ц1 and Ц2, the links of which collapse and the body is lowered. Here, the piston chambers of the hydraulic cylinders are connected by means of the hydraulic distributors P1 and P2 with the drainage into the hydraulic tank through the filter Ф2.

To stop the body in any intermediate position during the lifting or lowering, set the switch to the “Нейтраль” (Neutral) position. When it is done, the spool-valves P1, P2 and P9 are set to the centre position. The working fluid in the piston and rod chambers of the hydraulic cylinders gets blocked and the body is held in the intermediate position.

When the traction electric drive reverser switch is set to the “Вперед” (Forward) position and the body position sensor gives a signal that the body is lowered, setting the body control switch to the “Опускание” (Lowering) position would set the body to the floating position. In this position, the solenoid of the hydraulic distributor P10 is energized. The hydraulic distributor spool-valve moves and connects the cavities behind the throttles of the overflow valves K1 with the drain hydraulic line. The pressure behind the overflow valve throttle drops, the valve gets opened and connects the piston chambers of the hydraulic cylinders with the drain hydraulic line which excludes the body lifting.

TO EXCLUDE THE IMPACT OF THE BODY AGAINST THE FRAME WHEN LOWERING THE EMPTY BODY, IT IS RECOMMENDED TO SET THE SWITCH OF THE REVERSER OF THE TRACTION ELECTRIC DRIVE TO THE “ВПЕРЕД” (FORWARD) POSITION AFTER FIRST STAGE FOLDING AND THEN SET THE CONTROL SWITCH OF THE BODY POSITION TO THE “НЕЙТРАЛЬ” (NEUTRAL) POSITION.

To exclude the spontaneous lowering of the body during the truck manoeuvring when unloading the same, the solenoid of the hydraulic distributor P10 is de-energized by the body lowering interlock switch mounted in the instrumentation panel.

14.2 Assemblies of the Dumping Mechanism

Pump. The combined hydraulic system is equipped with A20VLO 190DRS/10R-NZD double variable-capacity axial-piston pump manufactured by Bosch Rexroth. The adjustment of the working fluid flow is stepless.

The pump is driven by the cardan shaft 5 (Figure 14.2) from the fan wheel hub 3. The double pump 10 is fixed on the brackets 9 and installed coaxially with the traction generator.

The allowable displacement of the axles is as follows:

– in the vertical plane 0 – 10 mm, to be adjusted by means of the plates 13;
– in the horizontal plane up to 3 mm, to be adjusted by moving the bracket 9;
– misalignment of axes up to 0,5 mm at the length of 100 mm.

The pump consists of two sections. The design of the front section is shown in Figure 14.3.

The pump section consists of the pumping assembly and governor unit. The pumping assembly converts the torque on the shaft into the reciprocating motion of the pistons which suck the working fluid when performing the first half of the revolution and discharge it when performing the second one.

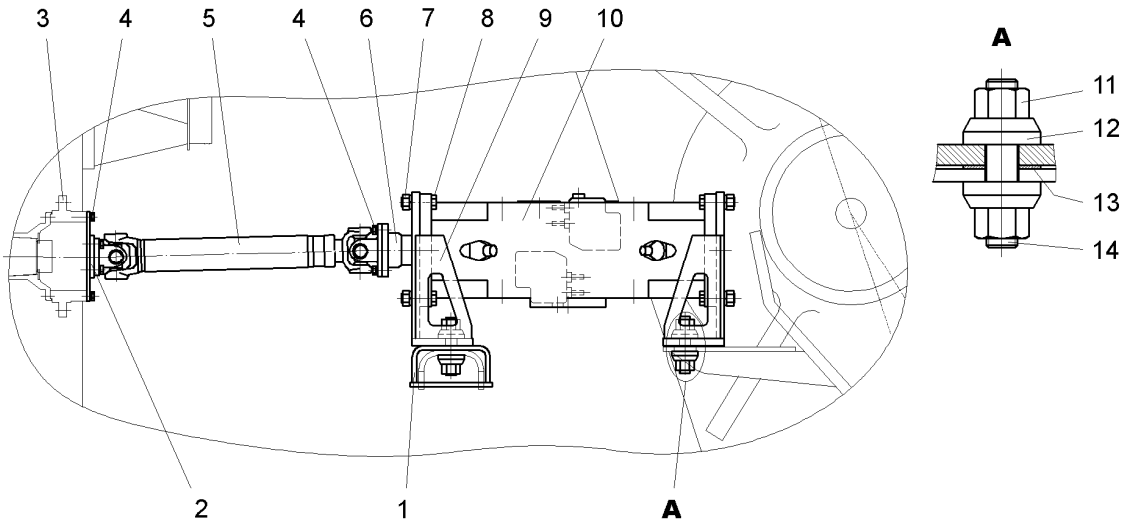


Figure 14.2 – Installation of the pump of the integrated hydraulic system:

1 – beam; 2, 6 – flanges; 3 – fan wheel hub; 4, 8 – bolts; 5 – cardan shaft; 7, 11 – nuts; 9 – pump bracket; 10 – pump; 12 – bushing; 13 – adjusting plates; 14 – tie rod

The pumping assembly comprises the shaft 3 mounted in the casing 5 on the bearings 4 and 12. From the side of the drive end of the shaft, the pump is closed by the cover 1 with the cup 2. The cylinder block 10 is spline-mounted on the drive shaft. The pistons 18 move in the cylinders of the unit to suck and discharge the working fluid through the slots of the distributor 15 into the channels of the governor unit 8 and pressure line of the pump.

The governor unit is intended for stepless variation of the pump capacity. The piston travel value is determined by the angle of inclination of the base plate 6, which is in turn determined by the position of the spool-valve of the cut-off valve of the working fluid flow rate by the pressure and limitation of the maximum capacity 21.

The valve is adjusted to the maximum pressure of 18 MPa. The spool-valve of the valve 20 is adjusted to the pressure of 1,8 MPa at the manufacturing plant and serves for limiting the flow of the working fluid.

The minimum and maximum capacity of the pump is limited by the adjusting screws 7.

IT IS STRICTLY PROHIBITED TO ADJUST THE PUMP BY MEANS OF THE SCREWS 7 AND TO ADJUST THE VALVES 20 AND 21! THE ADJUSTMENT SHALL BE PERFORMED BY SPECIAL SERVICE TEAMS OR TRAINED PERSONNEL.

The pump is the main and most expensive part of the hydraulic system, therefore its reliable operation is a guarantee of the successful operation of the hydraulic system as a whole.

The mail causes of reducing of the service life of the pump and its faults are as follows:

– Contamination of the working fluid or using the working fluid after expiration of its service life;

– Use of working fluids of unauthorized brands or non-suitable for the respective operation season;

– Overheating of the working fluid;

– Getting of air into the suction line due to lack of air-tightness of the suction line;

– Underpressure in the suction line exceeding 0,2 atm due to clogging of the air filter of the breather, low level of the working fluid or incomplete opening of the oil tank shutter;

– Starting the pump after repairing the hydraulic system without preliminary filling the drain chamber and suction line with the working fluid or starting the pump when the body is lifted and working fluid level in the oil tank is decreased, respectively.

To exclude the operation of the pump without lubrication when starting the truck engine after repair or maintenance of the hydraulic system, it is necessary to provide for forced bleeding of air from the suction lines plugged with air. To do this:

– Open the oil tank shutter on the suction line;

– Bleed the air from the suction line by screwing out the plug on the suction pipe;

– Bleed the air from the pump casing by screwing out the plugs 19. After bleeding the air, tighten the plugs.

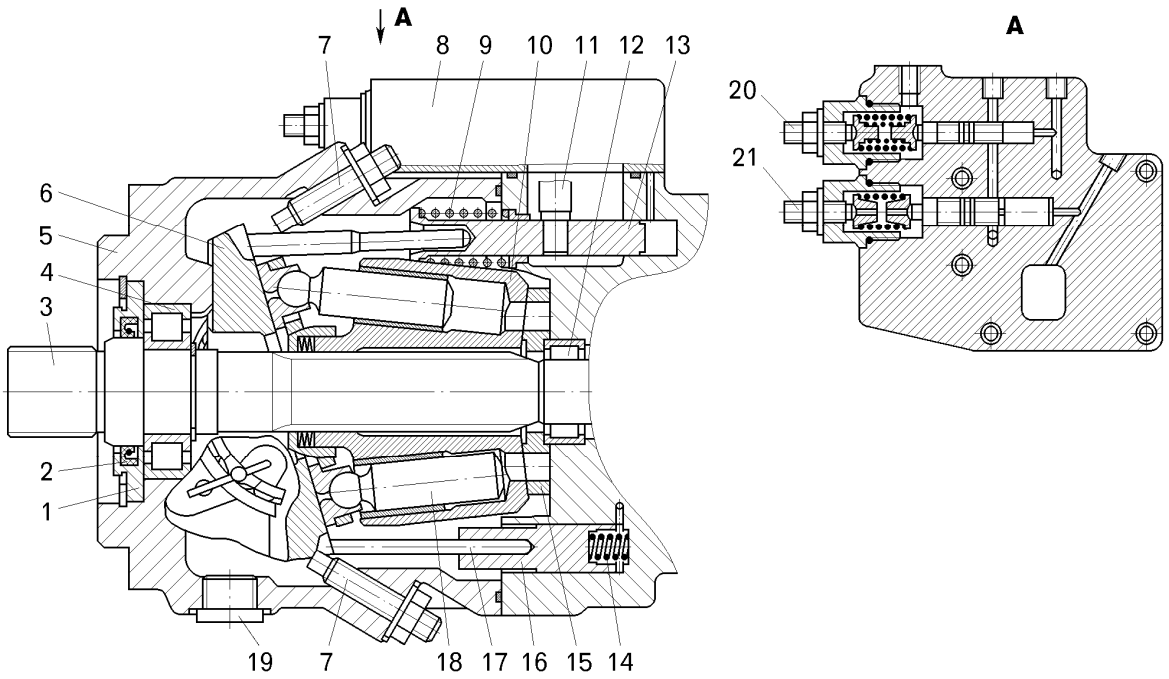


Figure 14.3 – Axial-piston pump:

1 – cover; 2 – cup; 3 – drive shaft; 4, 12 – bearings; 5 – pump casing; 6 – wobble plate; 7 – adjusting screw; 8 – governor unit; 9, 14 – springs; 10 – cylinder block; 11 – lever; 13, 16 – plunger; 15 – distributor; 17 – rod; 18 – piston; 19 – plug; 20, 21 – valves

Filter. The pressure line of the axial-piston pump is equipped with the filter Ф1 (see Figure 14.1).

The filter element 7 is installed in the filter body 6 (Figure 14.4). To ensure the leak-proofness, the choke 4 is fitted from the one side of the filter element and the bushing 10 is fitted from the other side; seal rings are mounted in their grooves. The plug, filter element and bushing are pressed against the filter cover 13 screwed on the body by the spring 3.

The filter cover is fitted with a bypass valve operating in case of clogging of the filter element. The filter separates the mechanical impurities with the size exceeding 0.01 mm from the working fluid.

The filter cover is fitted with the clogging indicator 16 which sends the signal to the pilot lamp on the instrumentation panel in case of clogging of the filter element. Should the pilot lamp light up, the filtering element shall be replaced.

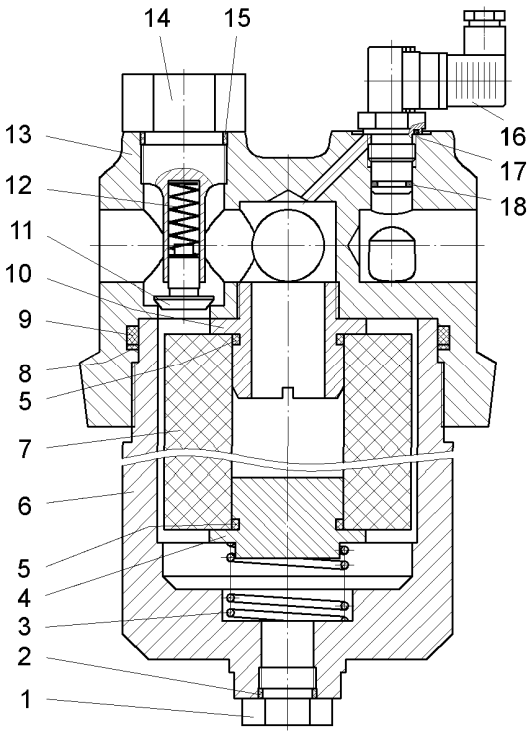


Figure 14.4 – Filter:

1 – plug; 2, 5, 9, 15, 17, 18 – seal rings; 3, 12 – springs; 4 – choke; 6 – filter body; 7 – filter element; 8 – protective washer; 10 – bushing; 11 – valve; 13 – filter cover; 14 – valve guide; 16 – filter element clogging indicator

The drain manifold is installed in the drain line of the hydraulic system and is intended for cleaning the working fluid from metal-origin contaminants (chips, scale, etc.).

The working fluid is fed via oil drain pipelines through the holes in the body 3 (Figure 14.5) into the internal chamber. The magnets 4 clean the working fluid from metallic particles and the working fluid is passed to drainage into the oil tank.

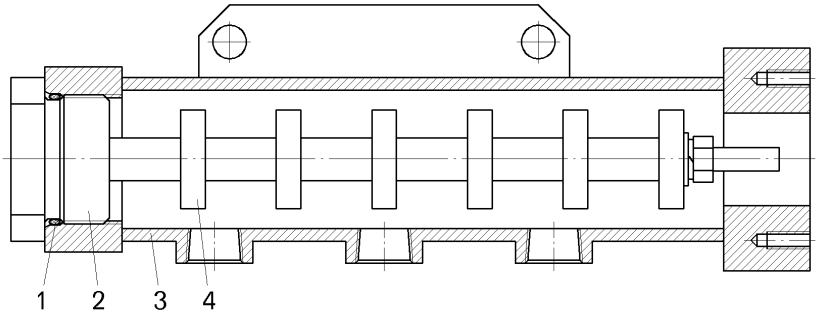


Figure 14.5 – Drain manifold:

1 – ring; 2 – magnetic separator; 3 – casing; 4 – magnet

Suction pipe.

The suction pipe 2 (Figure 14.6) of the pump is fitted with the magnetic separator 4. It is intended for cleaning the working fluid from the metal-origin contaminants (chips, scale, etc.)

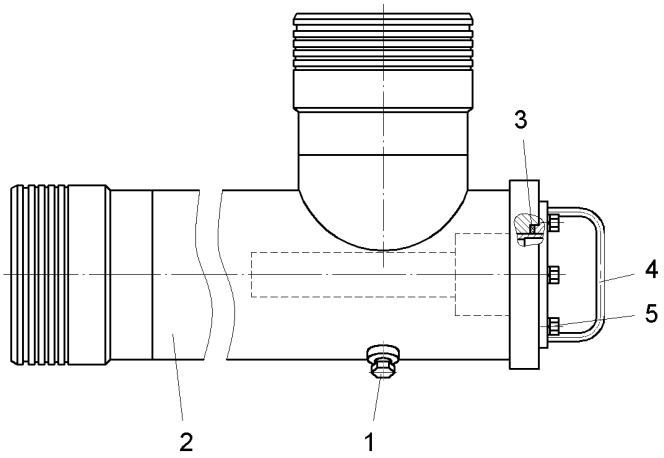


Figure 14.6 – Suction pipe with magnet:

1 – plug; 2 – suction pipe; 3 – ring; 4 – magnetic separator; 5 – bolt

The hydraulic distributor is intended for changing the direction of the working fluid flow from the pump to the rod and piston chambers of the hydraulic cylinders or to drainage into the oil tank. It consists of two discharging casings, 1 and 3 (Figure 14.7), drain casing 2, two spool-valve-type distributors 5, two overflow valves 8, three indirect-action safety valves. Each safety valve consists of the valve 6 and auxiliary valve 7.

The spool-valves 13 of the hydraulic distributors are three-position ones, with spring return to the neutral position. The spool-valves are moved by the pressure of the working fluid fed from the control unit, which is applied to the end covers 9 of the hydraulic distributors.

The safety valve operates as follows. As the pressure in the hydraulic system exceeds the pressure setting of the valve 27, the valve opens and connects the chamber behind the throttle of the valve 19 with the drainage. When it is done, the valve 19 moves while compressing the spring 20, and connects the pressure line with the drainage. The stem 24 supports the adjusting valve 27 and prevents self-excited oscillations of the valve.

When setting the floating position of the body, the hydraulic distributor of the control unit connects the chambers behind the throttle of the overflow valves 8 with the drain hydraulic line. The pressure behind the overflow valve throttle decreases, the valve opens and connects the piston chambers of the hydraulic cylinders with the drain hydraulic line that excludes the body lifting during the dump truck motion.

From the pump the working fluid flow is fed to the channels VII and VIII. When the spool-valve is in the neutral position, the channels VII and VIII are connected with the channel III. As the control pressure from the control unit is applied to the channels I or V, the spool-valve 13 displaces and directs the working fluid flow from the pump through the channels II or IV to certain chambers of the hydraulic cylinders. In this case, the inverse chambers are connected with the drain hydraulic line.

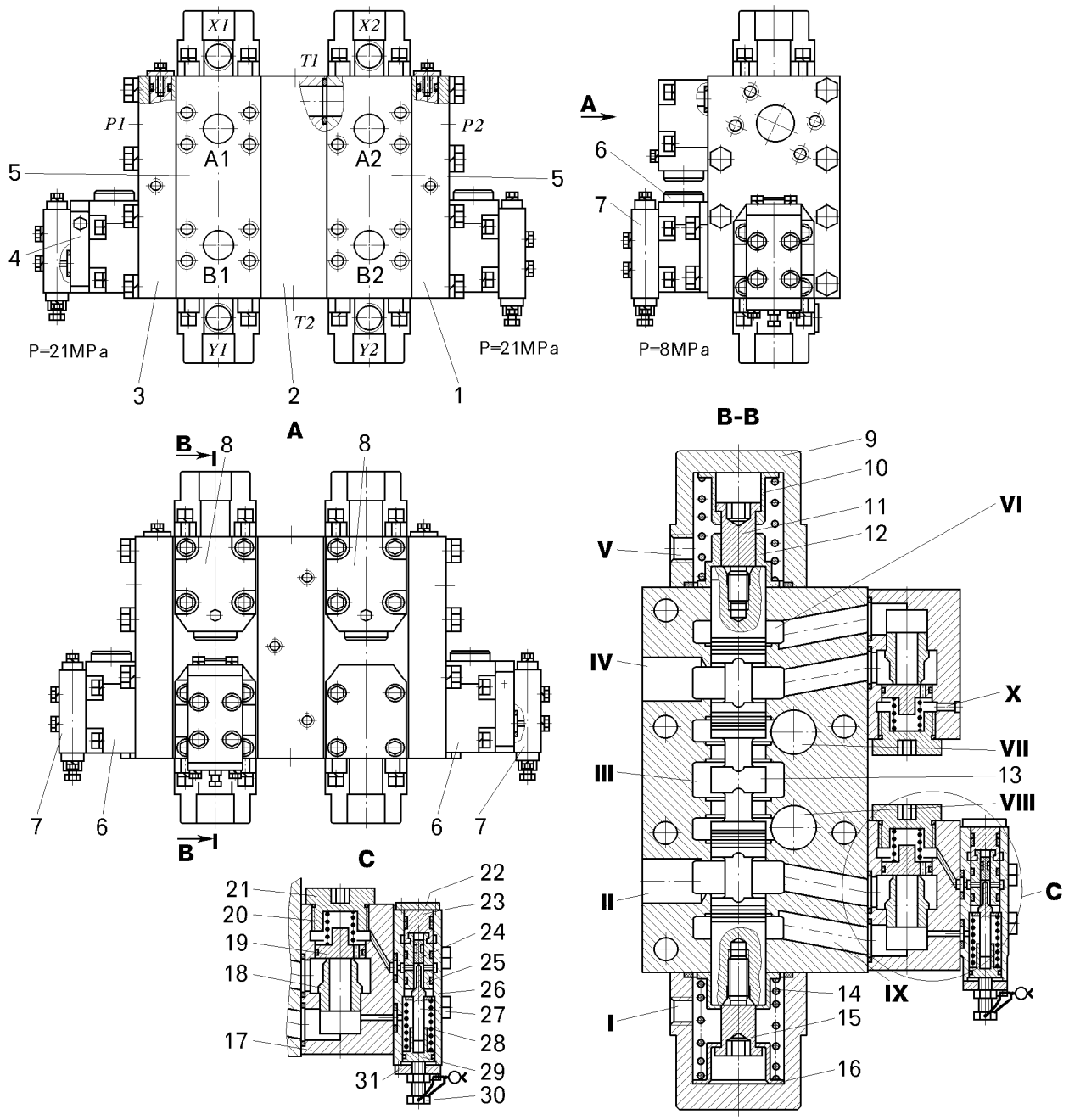


Figure 14.7 – Hydraulic distributor:

1, 3 – discharging casings; 2 – draining casing; 4 – adapter plate; 5 – distributor; 6 – valve; 7 – auxiliary valve; 8 – overflow valve; 9, 21, 22 – covers; 10, 12, 16 – supports of the springs; 11, 15 – tail pieces; 14, 20, 28 – springs; 13 – spool-valve; 17 – casing; 18 – seat; 19 – valve; 23 – choke; 24 – stem; 25 – seat; 26 – casing; 27 – adjusting valve; 29 – piston; 30 – adjusting bolt; 31 – cover springs;

I, V – channels for feeding the control pressure from the control unit; II, IV – channels connected with the piston and rod chambers of the hydraulic cylinders; VI, IX – chambers connected with the drain hydraulic line; III, VII, VIII – chambers connected with the pressure hydraulic lines from the pump; X – channel for controlling the overflow valve

The control unit is intended for controlling the lifting and lowering the body and stopping it in intermediate positions. It consists of the casing 19 (Figure 14.8), to which the solenoid-controlled hydraulic distributors 15 are fastened. The casing channel comprises the sleeve 9 and spool-valve 11 of the reducing valve which is adjusted to a certain pressure by means of an adjusting bolt 1. The channels in the casing are marked with the letters by impact method.

The reducing valve reduces the pressure of the working fluid fed from the pump to (4±0.2) MPa and maintains it constant in the hydraulic system for controlling the dumping mechanism.

To adjust the reducing valve, feed the working fluid to the channel P at the pressure 4 – 20 MPa, draw the drainage into the tank from the channel T1, connect the pressure gauge with the measuring range of 10 MPa to the nipple 21 and open the obturating needle 24. With the solenoids de-energized, set the reducing valve by means of the adjusting bolt 1 to the pressure of (4±0.2) MPa.

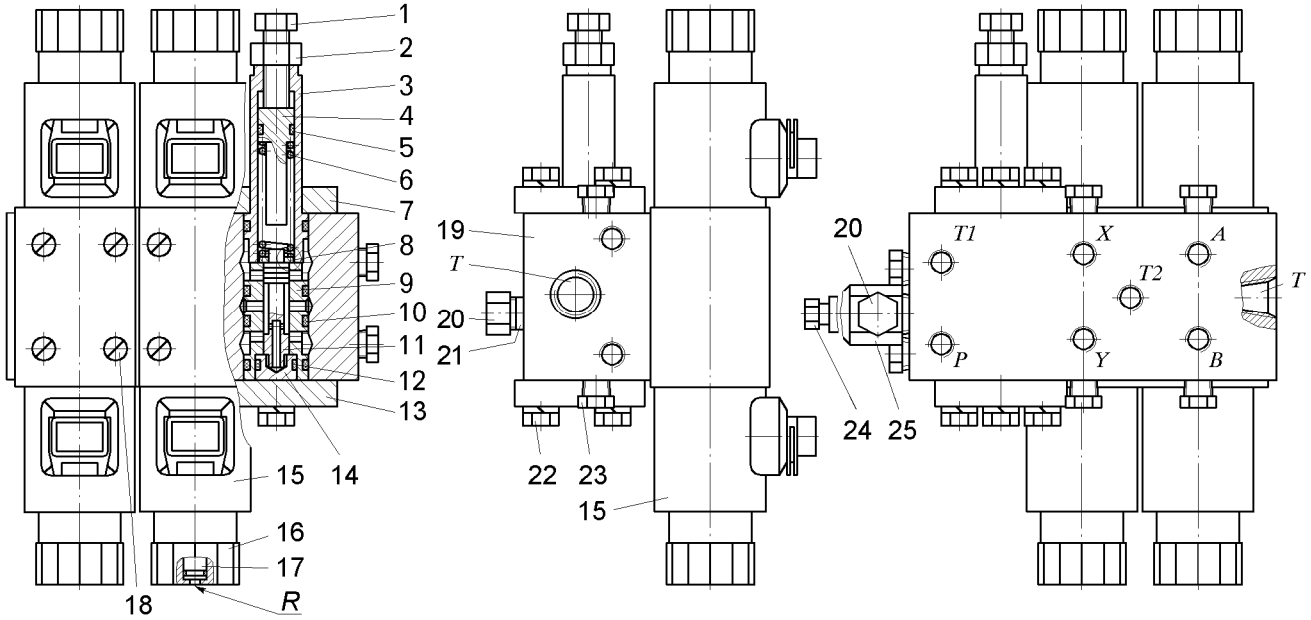


Figure 14.8 – Control unit:

1 – adjusting bolt; 2 – nut; 3 – spring cover; 4 – spring choke; 5, 10, 12 – sealing rings; 6 – valve spring; 7, 13 – covers; 8 – spring stop; 9 – sleeve; 11 – spool-valve; 14 – sleeve plug; 15 – hydraulic distributor; 16 – lock nut; 17 – manual emergency control pusher; 18 – screw; 19 – control unit body; 20 – protective cover; 21 – union for connecting the pressure gauge; 22 – bolt; 23 – plug; 24 – obturating needle; 25 – valve body;

X, Y – channels for pressure delivery to the chambers of the control panel (lifting-lowering); A, B – channels for controlling the overflow valves in the floating position mode; T, T1, T2 – channels for draining the working fluid into the tank; P – channel for feeding the working fluid from the pump; R – manual emergency control device

The automatic pump-unloading device maintains the working fluid pressure in the hydraulic system of the steering control and brake system within the range of 13,5 – 17 MPa by means of control of the line “LS” of the governor of the variable-capacity pump. From the front section of the pump the working fluid is passed through the steering control manifold for charging the pneumatic hydroaccumulators and fed via channel II (see Figure 14.1) into the outlet P (Figure 14.9) of the automatic pump unloading device.

The working fluid is fed via channels in the casings 2 and 14 and plunger 12 into the space under the end face of the spool-valve 6 and moves it downwards (as seen in the Figure) so that the passage of the working fluid from the outlet P to the outlet A is opened. Further the working fluid is fed through the two-line valve into the governor unit of the pump and brings the pump to the maximum capacity.

On reaching the pressure of 17 – 17,5 MPa in the pneumatic hydroaccumulators, the plunger 12 and balls 11 and 15 move to the right (as seen in the Figure) while overcoming the force of the spring 18; the ball 11 cuts off the infeed of the working fluid to the end chamber of the spool-valve 6; at that time the ball 15 opens the passage of the working fluid from the end chamber of the spool-valve 6 to the drainage.

At that the spool-valve 6 moves upwards (as seen in the Figure) under the action of the spring 3 to cut off the infeed of the working fluid from the outlet P to the outlet A; here the passage of the working fluid from the outlet A to the outlet T is opened. The control line of the governor unit of the pump is connected through the outlets A and T of the automatic unloading device with the drainage and the pump is brought to the minimum capacity.

At that the pressure in the discharge line of the pump will drop from 17 – 17,5 MPa to 2,8 – 3 MPa. The upper pressure of the working fluid in the pneumatic hydroaccumulators is adjusted by altering the force of compressing the spring using an adjusting bolt 22.

As the working fluid pressure in the pneumatic hydroaccumulators decreases down to 14 – 13,5 MPa, the force of the spring 18 returns the plunger 12 and the balls 11 and 15 into the initial position. The working fluid is fed under pressure via channels into the upper end chamber of the spool-valve 6 and the plunger moves downwards to connect the outlets P and A.

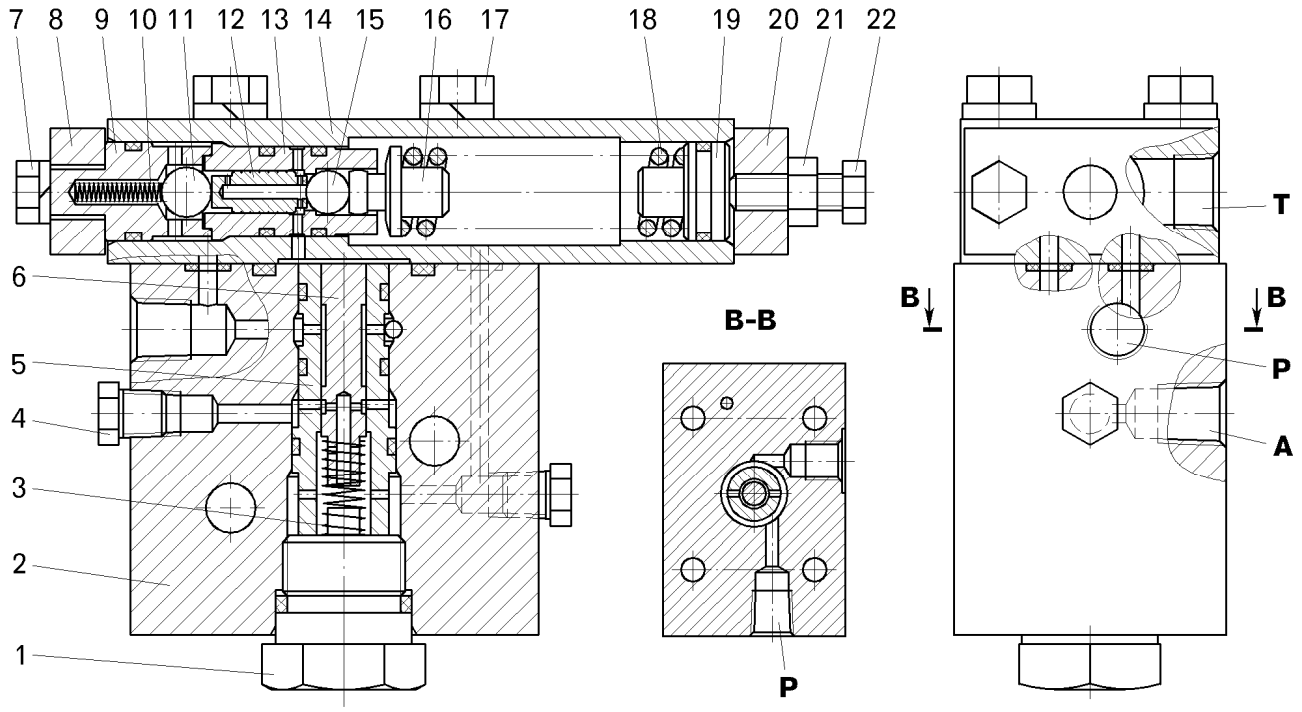


Figure 14.9 – Automatic pump-unloading device:

1 – choke; 2, 14 – casings; 3, 10, 18 – springs; 4 – plug; 5, 13 – sleeves; 6 – spool-valve; 7, 17, 22 – bolts; 8, 20 – covers; 9, 19 – chokes; 11, 15 – balls; 12 – plunger; 16 – block; 21 – nut

P – outlet connected with the manifold; T – outlet connected with the drainage; A – outlet connected with the line "LS" of the governor of the variable-capacity pump

The two-line valve serves as an OR logic element in the hydraulic system and ensures the connection of the outlet II with one of the hydraulic lines I or III, depending on the pressure in them.

The valve consists of the body 4 (Figure 14.10) comprising the stop 1, sleeve 2 and cover 7 which is screwed into the threaded hole in the body. The spool-valve 3 moves inside the sleeve 2. The leak-proofness of the joints is ensured by the sealing rings.

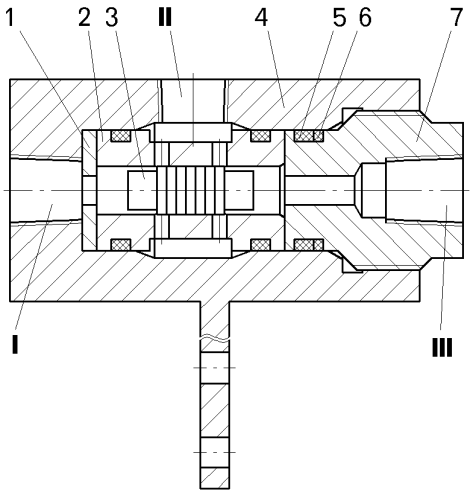


Figure 14.10 – Two-line valve:

1 – stop; 2 – sleeve; 3 – spool-valve; 4 – body; 5 – sealing ring; 6 – protective ring; 7 – cover;

I, III – outlets to the piston or rod chamber of the hydraulic cylinders; II – outlet to the governor unit of the pump section

The dumping mechanism cylinders are telescopic two-stage ones, with one dual-actions stage (Figure 14.11).

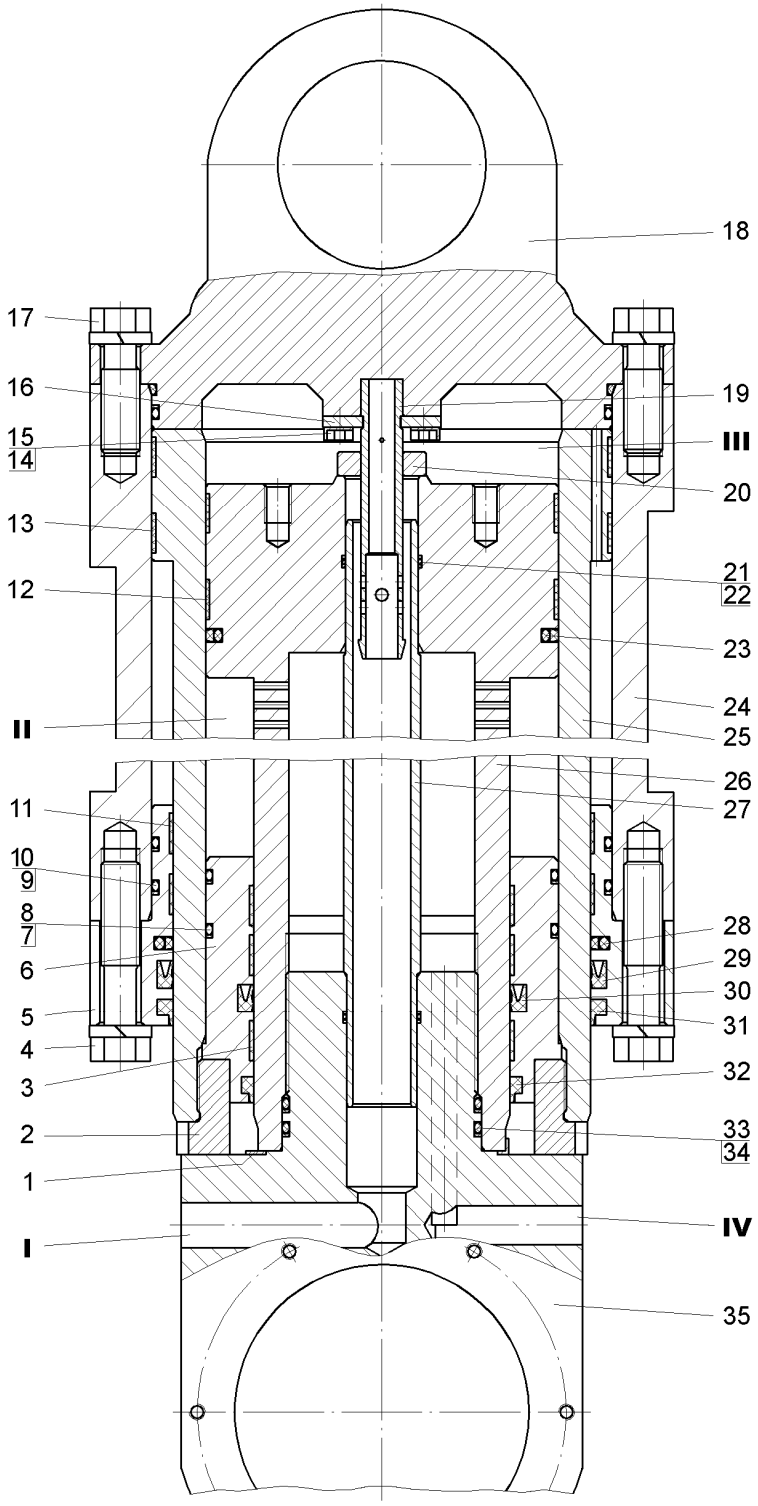


Figure 14.11 – The cylinder of the dumping mechanism:

1 – head locking ring; 2 – bushing; 3, 11, 12, 13 – guide rings*; 4, 14, 17 – bolts; 5 – guide; 6 – bushing; 7, 21 – protective ring; 8, 10, 22, 33 – ring; 9, 34 – protective washer; 15, 16 – plates; 18 – cylinder cover; 19 – stem; 20 – valve; 23 – piston seal; 24 – outer pipe; 25 – pipe; 26 – rod with piston; 27 – inner cylinder pipe; 28 – rod seal; 29, 30 – collars; 31, 32 –wipers; 35 – cylinder head; I, IV – channels; II – rod chamber, III – piston chamber*

During the process of lifting the working fluid flows through the channel I along the inner pipe 27 into the piston chamber III. Under the pressure of the working fluid the cover 18 and rigidly connected to it by bolts 17 the outer pipe 24 moves. At the end of the extension the outer pipe by its shoulder thrusts to the shoulder of the pipe 25 and its extension with the bushing 6 starts. By moving upwards, the bushing covers the throttle openings in the rod 26, as a result of which the cylinder stroke is retarded.

Lowering the body is of forced type. The working fluid is supplied through the channel IV through the throttle openings into the rod chamber II, and pipe 25 together with bushing moves downwards against stop. Retraction of the first stage is performed under the weight of the empty body. Displaced from the piston chambers, the working fluid along the inner pipe 27 is drained into the tank.

For braking the body at the end of lowering process and smooth landing of it onto the frame shock absorbers valve 20 is designed. At the end of lowering process the valve rests on the piston end and shuts the main stream of draining of the working fluid. Subsequently, the working fluid is drained through the throttle openings in the stem 19, so boosting of the working fluid in the piston chamber III is created, thus smooth body landing is ensured.

Impermeability of fixed cylinder joints is provided by sealing rubber rings, as of flexible joints – by collars 29 and 30, piston 23 and rod 28 seals.

The hydraulic cylinders are fastened to the frame and body by means of the spherical bearings 3 (Figure 14.12). The upper and lower supports are lubricated through the lubricator 7.

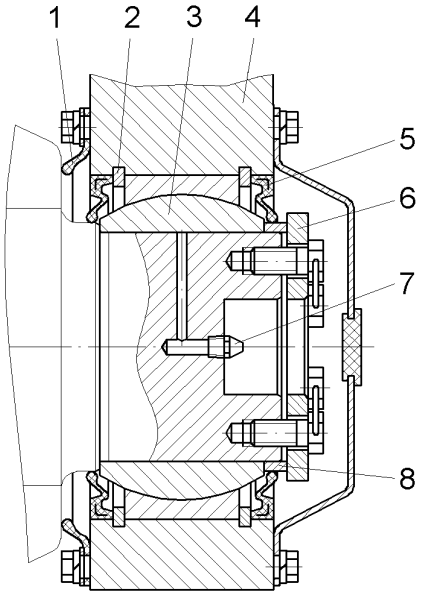


Figure 14.12 – Installation of the dumping mechanism cylinder (lower support):

1 – wiper; 2 – locking ring; 3 – spherical bearing; 4 – cylinder; 5 – gland; 6 – disc; 7 – lubricator; 8 – distance bushing

Body lifting limiting mechanism.

To ensure the automatic stopping of the body lifting, the limiting mechanism is intended.

When the body is lifted to 43 – 45° (end of the lifting), the sensor 6 actuates (see Figure 14.13). It breaks the electrical circuit supplying the lifting solenoid and the body stops automatically due to that the dynamical loads on the hydraulic cylinders decrease.

After the sensor 6 is installed, its actuation should be adjusted by moving brackets 4, at the size of the hydraulic cylinder should be reached C=(1180±10) mm.

Installation of the body position sensor.

The sensor is installed after installation of the body on the dump truck, its position should be adjusted by size as per Figure 14.14.

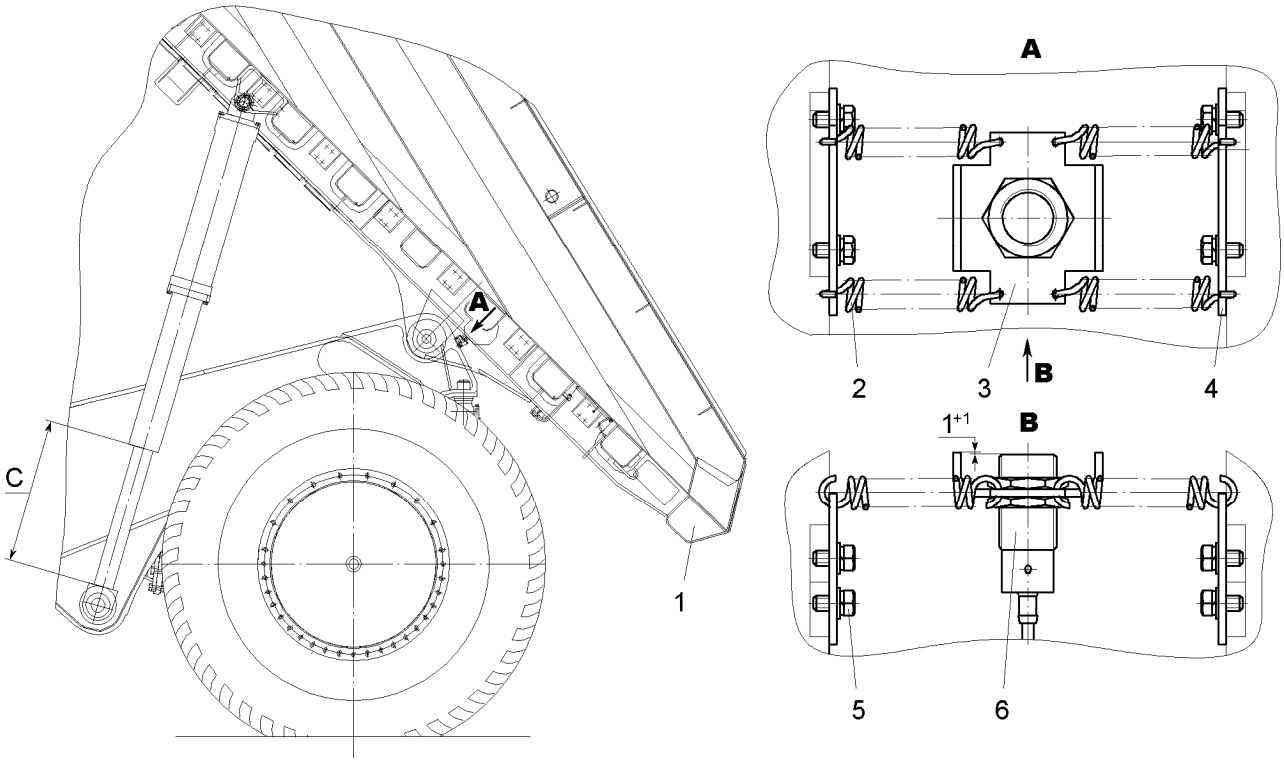


Figure 14.13 – Body lifting limiting mechanism:
1 – body; 2 – spring; 3 – plate; 4 – bracket; 5 – bolt; 6 – sensor

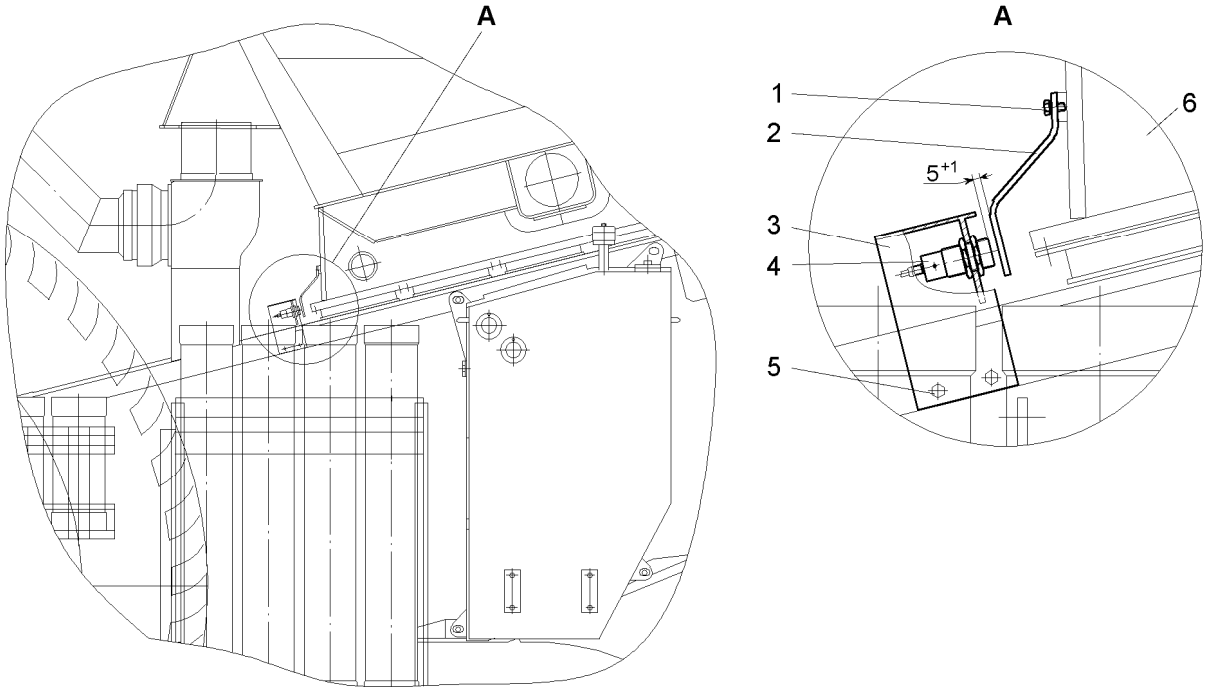


Figure 14.14 – Installation of the body position sensor
1, 5 – bolts; 2 – plate; 3 – bracket; 4 – sensor

The oil tank of the integrated hydraulic system of the dumping mechanism, steering control and brake systems is of welded bearing construction and installed on the left side member of the frame.

When the shutter on the suction pipe is open, the working fluid from the tank is passed to the pump through the suction connection 6 (Figure 14.15) located in the tank bottom.

Before the start of the engine after repair of the hydraulic system the shutter should be opened because with the shutter closed the working fluid will not flow to the pump and the pump will fail.

The working fluid is drained into the tank from the drain lines of the hydraulic units through the opening I in the bottom of the tank, from the hydraulic distributor through the pipe 3.

The working fluid level in the tank is to be monitored visually according to the upper and lower indicators through the level inspection holes 11. The working fluid level shall be not above the middle of the upper inspection hole when the pneumatic hydroaccumulators are discharged and not below the middle of the lower inspection hole when the pneumatic hydroaccumulators are charged.

The oil tank is equipped with electrical sensor which in case of drop of the working fluid level to the emergency value as well as during the dumping mechanism operation gives the signal for switching on the pilot lamp located on the instrumentation panel, the sensor of clogging of the filtering element 15 of the filter and sensor of control of the working fluid temperature.

The surplus of the working fluid is drained through the drain valves 12. To ensure the complete draining of the working fluid, the magnetic draining plugs 7 are screwed out additionally from the tank.

The oil filter with a safety valve 13 which is actuated in case of clogging of the filtering element 15 is mounted in the body of the tank in the drain pipeline of the hydraulic system.

The tank is filled with working fluid from the oil-filling pump with the help of a special filling device through the filler valve 5.

14.3 Maintenance of the Dumping Mechanism

The maintenance of the dumping mechanism consists in monitoring the working fluid level in the oil tank of the integrated hydraulic system and replacing the fluid, checking the leak-tightness and timely re-tightening of the threaded connections, lubricating the rubbing surfaces periodically and replacing the filtering elements of the oil filters and breather.

Special attention shall be paid to the quality of cleaning the working fluid, timely replacement of the filtering elements of the filters of the hydraulic system and air filter of the breather, because the cleanness of the working fluid is one of the main factors affecting the reliability and durability of the hydraulic system operation.

The filter of the oil tank and the filter installed in the pressure line of the pump are provided with the clogging indicators which give the signal to the pilot lamp on the instrumentation panel when the filtering element gets clogged. When the pilot lamp lights up, replace the filtering element.

Prior to beginning the running-in of a new dump truck, it is necessary to clean the working fluid by means of the on-board filtering elements of the hydraulic system. The cleaning procedure is described in the Assembling Manual.

Daily maintenance (DM):

– Check the condition and fastening of the hydraulic system pipelines and hoses by external inspection and re-tighten them as necessary (in the places of leakage);

– Check the level of the working fluid in the oil tank of the integrated hydraulic system and add the fluid as necessary.

The working fluid level in the tank should not be above the middle of the upper inspection hole when the pneumatic hydroaccumulators are discharged and not below the middle of the lower inspection hole when the pneumatic hydroaccumulators are charged (after the start of the engine).

Working fluids complying with the operation season and outside air temperature shall be used in the hydraulic system. The working fluids recommended depending on the climatic conditions of operation are listed in Table 14.1; using the oils made by well-known manufacturers of the world is preferable. Never mix oils of different grades.

The performance characteristics of the working fluids shall meet the values given in Table 14.2.

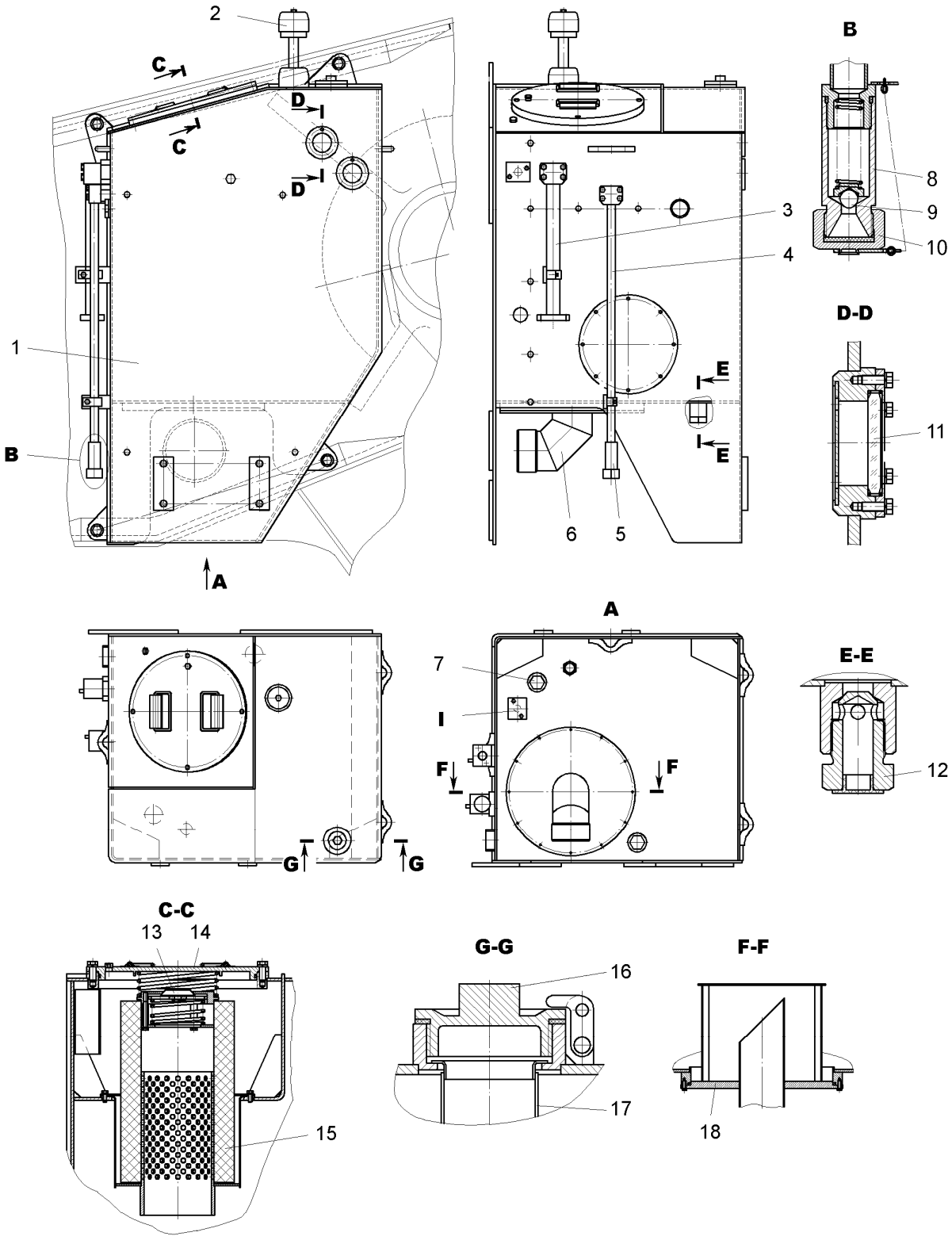


Figure 14.15 – Oil tank:

1 – oil tank; 2 – breather; 3, 4 – pipes; 5 – filler valve; 6 – suction connection; 7 – magnetic drain plug; 8 – filler valve body; 9 – ball; 10, 18 – covers; 11 – inspection hole; 12 – drain valve; 13 – safety valve; 14 – filter cover; 15 – filtering element; 16 – plug; 17 – filter body with mesh

I – drain from the drain lines of the hydraulic units

Table 14.1 – Recommended oil grades depending on the operation conditions

Climate zone	Oil body class ISO	Oil grade	Temperature scale
			-50 -40 -30 -20 -10 0 +10 +20 +30 +40 +50 +60 +70 +80 +90
Tropical	VG68	Shell Tellus S2 V 68	* **
		Mobil DTE 10 Excel 68	
		ТНК Гидравлик HVLP 68	
		LUKOIL GEYSER LT 68	
		Gazpromneft Hydravlik HVLP 68	
Temperate summer	VG46	Shell Tellus S2 V 46	* **
		Mobil DTE 10 Excel 46	
		ТНК Гидравлик HVLP 46	
		LUKOIL GEYSER LT 46	
		Gazpromneft Hydravlik HVLP 46	
Temperate winter	VG22	Shell Tellus S2 V 22	* **
		Mobil DTE Excel 22	
		ТНК Гидравлик Зима 22	
Cold	VG15	Shell Tellus S4 VX 32	* **
		Univis HVI 26	
		ТНК Гидравлик Арктик 32	
		ВМГЗ	* **
		Univis HVI 13	
		МГЕ-10А	

Admissible temperature limits of atmosphere air

Admissible temperature limits of working fluids (viscosity from 1500 to 10 mm^2/sec (cSt))

Optimal temperature limits of working fluids (viscosity from 20 to 35 mm^2/sec (cSt))

* *Temperature limits, when heating of working fluids is required*

** *Temperature limits for applying of working fluids for short term operation*

Table 14.2 – Allowable performance characteristics of the working fluids

Description of the parameters	Value
Purity class according to the State Standard (GOST) 17216	12
Kinematic viscosity, mm^2/s (cSt): – optimum – maximum starting – minimum short-term	 20 – 35 1500 10
Filtering fineness (rated), micron	10

It is necessary to keep in mind that contaminated working fluid is the main cause of the premature wear and faults in the units of the dumping mechanism, steering control, brake system and, especially, in the pump.

The first replacement of the working fluid shall be performed after completion of the running-in, the following replacements shall be performed after every 4000 – 5000 hours, but not later than the seasonal maintenance.

In case of overheating of the working fluid (tp>95ºC), it is necessary to change the working fluid ahead of time after eliminating the cause of the overheating because the working fluid used in the hydraulic system at increased temperatures for long time gets oxidized and loses its performance characteristics.

Prior to departure to the route at the temperatures of the outdoor air below 0ºC, the working fluid in the oil tank shall be warmed up. To warm up the working fluid, start the engine and let it run without loading the pump until the oil temperature in the tank reaches 15ºC.

Maintenance 2 (M-2):

– Re-tighten the fastening of the cardan shaft of the pump drive. The bolts tightening torque should be of 105 – 130 N.m.

– Check the intactness of the hydraulic system sleeves and hoses as well as their fastening. Replace the sleeves and hoses having any leaks, swelling, cracks and/or those having lost elasticity. Re-tighten the loosened fasteners of the hoses and bolts fastening the flanges to the pump;

– Replace the filtering element in the oil tank of the integrated hydraulic system;

– Replace the filtering element of the breather of the tank of the integrated hydraulic system;

– Replace the filtering element of the filter installed in the pressure line of the front section of the pump to the manifold of the steering control.

The filtering elements of the oil tank filter as well as steering filter are to be replaced when persistent alarming of the correspondent warning banner (red color) on the electronic instrumentation panel.

Seasonal maintenance (SM):

– Check the plays in the joints of the pump drive cardan shaft. When swinging the cardan shaft by hand no play shall be felt;

– Disassemble the drain manifold and suction pipe and clean the magnets from metallic particles;

– Wash the oil tank of the hydraulic system. The internal surface of the tank shall be clean and free of gum residues. Screw out the drain magnetic plugs from the tank and clean them from metallic particles;

– Change the oil in the tank to that of the grade corresponding to the season.

– Perform checking of the oil pressure in the integrated hydraulic system (see section “Hydraulic system diagnostics”). Compare indications of the oil pressure with indications on the electronic instrumentation panel.

Other kinds of maintenance.

PERFORM THE SCHEDULED REPLACEMENT OF THE HIGH-PRESSURE HOSES OF THE INTEGRATED HYDRAULIC SYSTEM AFTER EVERY 20 THOUSAND HOURS OF RUNNING OF THE ENGINE OR AFTER EVERY THREE YEARS OF OPERATION OF THE DUMP TRUCK (WHICHEVER COMES FIRST). USE THE HIGH-PRESSURE HOSES SPECIFIED IN THE CATALOGUE OF PARTS.

It is recommended to fit the following filtering elements in the hydraulic system:

– in the oil tank of the integrated hydraulic system: Regotmas (Реготмас) 690AM-1-CM manufactured by Filter-R Small Enterprise LLC or EE-5006AC (ЭФМ-ЕЭ-06АС), Technical Specifications (ТУ) 4591-55620847-02 manufactured by Euroelement LLC or M5409MK manufactured by DIFA OJSC;

– in the filter of the pressure line of the axial-piston pump: Regotmas (Реготмас) 631ВМ-1-СМ manufactured by Filter-R Small Enterprise LLC or ЭФМ-ЕЭ-23С ТУ 4591-55620847-02 manufactured by Euroelement LLC, М5402МК manufactured by DIFA OJSC or 05.8500.12.200.10.В.Р.8 manufactured by Internormen or HC8500FKS8H manufactured by PALL;

– In the oil tank breather: ЭФВ-3-1А УХЛ2 ТУ 3689-004-26361511 СМ manufactured by Filter-R Small Enterprise LLC or DIFA 4347MK manufactured by DIFA OJSC.

WHEN LOWERING THE BODY TO UNLOAD THE DUMP TRUCK WITH FAULTY DUMPING MECHANISM USING THE TOWING VEHICLE, IT IS NECESSARY TO DRAIN THE WORKING FLUID FROM THE CYLINDERS INTO THE HYDRAULIC SYSTEM OF THE TOWING VEHICLE TO EXCLUDE THE OVERFLOW OF THE WORKING FLUID THROUGH THE BREATHER DUE TO OVERFILLING THE OIL TANK OF THE FAULTY DUMP TRUCK.

14.4 Diagnostics of the Hydraulic System

THE DIAGNOSTICS AND ADJUSTMENT OF THE HYDRAULIC SYSTEM SHALL BE PERFORMED BY SPECIAL SERVICE TEAMS OR TRAINED PERSONNEL.

To perform the diagnostics of the hydraulic system, proceed as follows:

1 Check the check parameters of the hydraulic system. It is allowed to perform the check simultaneously with the tests of the hydraulic system.

2 Check the pressure in the gas chambers of the pneumatic hydroaccumulators (HPA). The check shall be performed in the absence of the working fluid in the HPA. The pressure shall be equal to (8+0.2) MPa.

To check the leak-proofness of the gas chambers of the HPA, check the pressure again after (24+1) hours. No pressure drop is allowed. To check the pressure, use the pressure gauge МП3-У-10МПа х 1,5 ТУ 25-02.180335.

3 Connect the pressure gauges to the pressure measuring points indicated in the plans of the hydraulic pipeline:

– pressure gauge МП160М-25МПа-1,5 ТУ РБ 37388602.002 (pressure gauge – М1, see Figure 10.1) – to the pressure line of the front section of the adjustable pump A20VLO190DRS (valve 75306-8609360 on the filter 75137-3442010);

– pressure gauge МП160М-25МПа-1,5 (pressure gauge – М2, see Figure 14.1) – to the pressure line of the rear section of the adjustable pump A20VLO190DRS (valve 75306-8609360 on the plate 78221-4617382-50);

– pressure gauge МП160М-10МПа-1,5 (pressure gauge – М3, see Figure 14.1) – to the reduced-pressure line of the control unit 75132-8606410 (valve 75306-8609360);

– pressure gauge МП160М-25МПа-1,5 (pressure gauge – М4, see Figure 10.1) – to the line for supplying the parking brake cylinders (connecting valve 75212-3408430 in the rear axle housing);

– pressure gauge МП160М-25МПа-1,5 (pressure gauge – М5, see Figure 10.1) – to the line for supplying the service brake cylinders (connecting valve 75212-3408430 in the rear axle housing).

4 While checking the check parameters use the measuring methods specified in the State Standard GOST 17108. Precision of measurement of the parameters is as per the third group of precision.

The parameters shall be monitored at the temperature of the working fluid in the hydraulic system of the dump truck from 10 to 30ºС.

5 Check the settings of the pressure regulator of the front section of the adjustable pump A20VLO190DRS (the pressure of charging the HPA) and functioning of the automatic pump unloading device:

5.1 Stop the engine. Screw in the needle of the valve 75306-8609360 located on the manifold 75170-3408800.

5.2 Disconnect the high-pressure hose (HPH) from the two-line valve 78221-4619074 to the governor of the pump front section A20VLO190DRS, from the connection 342661 on the pump governor as per Figure 14.16, and close the hose with a plug.

5.3 Start the engine and measure the pressure at the minimum stable rotational speed of idling. The pointer of the pressure gauge M1 shall deflect and indicate the value of the pressure of P1=(3.1±0.2) MPa. If the pressure value deviates from the specified one, adjust the pressure P1 by means of the screw of the LS regulator (see Figure 14.15) located on the governor of the front section of the pump A20VLO190DRS. Tighten the locking nut applying torque=(10±2) N·m.

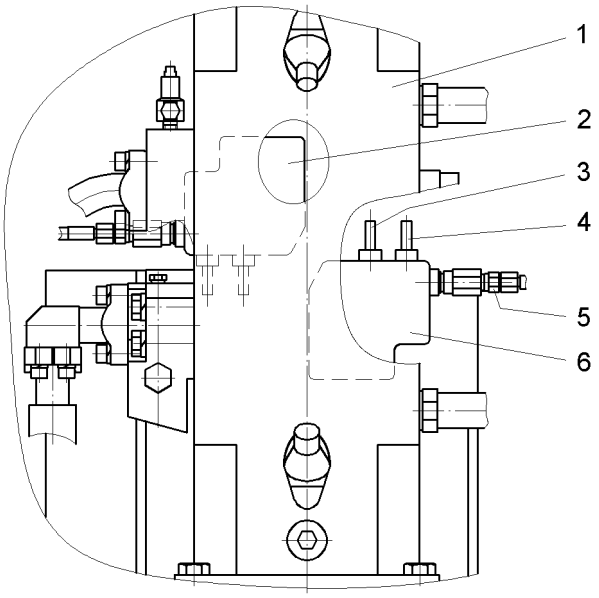


Figure 14.16 – Two-section pump:

1 – pump; 2 – governor of the rear section of the pump; 3 – screw of the DR-regulator; 4 – screw of the LS-regulator; 5 – connection 342661; 6 – governor of the front section of the pump

5.4 Stop the engine.

5.5 Reconnect the hose to the connection on the pump governor. Disconnect the HPH, which runs from the automatic pump unloading device 75131-3428010 to the two-line valve 78221-4619074 and the HPH, which runs from the valve 75306-8609360 on the manifold 75170-3408800 to the automatic pump unloading device, from the nipples 344025 on the automatic pump unloading device and connect the free ends of the HPH with one another by means of the nipple 342662. Connect the nipples, which became free, by means of the HPH 7513-8609670 (L=250мм).

5.6 Screw out the needle of the valve 75306-8609360 (two-three revolutions) located on the manifold 75170-3408800.

5.7 Start the engine at the minimum stable rotational speed of idling. The pointer of the pressure gauge M1 shall jump to point to the pressure value P2=(8.0±0.2) MPa and then move smoothly during the time T1=(15±3) sec to point to the pressure value P3=(18+0,5) MPa. In case of deviation of the pressure value from the specified one, by unscrewing the locking nut adjust pressure P3 by means of the screw of the DR-regulator (in accordance with Figure 14.16) located on the pressure regulator on the front section of the pump. Tighten the locking nut applying torque=(10±2) N·m.

5.8 Stop the engine. Screw in the needle of the valve 75306-8609360 on the manifold 75170-3408800. Reconnect the HPH back to the automatic pump unloading device.

5.9 Screw out the needle of the valve 75306-8609360 on the manifold 75170-3408800. Start the engine and check the operability of the automatic pump unloading device, which shall operate as follows if the setting is correct :

– The pointer of the pressure gauge M1 shall jump to point to the pressure value P2=(8.0±0.2) MPa (the pressure of charging the pneumatic hydroaccumulators (HPA) of the steering control with nitrogen);

– Then the pointer of the pressure gauge M1 shall move smoothly for the time T2 from10 to 15 sec to point to the pressure value P4=(16.5+0.5) MPa;

– On reaching the pressure of P4, the pointer of the pressure gauge shall jump to point to the pressure value P1=(3.1±0.2)MPa (the pump is unloaded);

– When turning the steering wheel from one extreme position to the other, the pointer of the pressure gauge M1 shall jump to point to the pressure value P5=(13±0.5) MPa, then the pressure shall increase smoothly (the pump is loaded) to the value P4. The charging cycle of the steering HPA is closed;

– When the controls are in the neutral position, the following charging of the HPA shall be performed after the expiration of the time T3 of at least 180 sec. Otherwise, check the main units of the hydraulic system for increased inner leakages.

6 Checking the operation of the system of hydraulic actuator of the service and parking brake.

6.1 At full depression of the brake pedal and subsequent release of it fix the pressure P6 by means of the pressure gauge M5 (see Figure 10.1). Both increase and decrease of the pressure shall be smooth (without jumps or derangements). The pressure increase in steps of up to 0.4 MPa is allowed. At full depression of the service brake pedal the pressure as read from the pressure gauge M5 shall be less (by not more than 1 MPa) or equal to the pressure value in HPA (12.5-17 MPa).

6.2 On applying and releasing the parking brake, fix the pressure P7 by means of the pressure gauge M4 as per the Figure 10.1. When the parking brake is released (parking brake is disengaged) the value P7 shall be at least 12.5 MPa, when the parking brake is applied (parking brake is retarded) the pressure value as per the pressure gauge M4 shall be not more than 0,8 MPa.

7 Checking the efficiency of operation of the redundant actuator of the steering control.

7.1 Start the engine.

7.2 Make sure that the HPAs of the steering control are charged completely (the pressure gauge M1 (Figure 9.1)) points to the pressure P1=(3.1±0.2) MPa).

7.3 Disconnect the power supply plug from the hydraulic distributor P8 of the manifold A3 (hydraulic distributor for discharging the HPA) and stop the engine.

7.4 With the engine stopped, check the operation of the emergency drive of the steering control (the turn of the steerable wheels from the middle position to one of the extreme positions and back to the middle position shall be ensured). On completing the check, connect the power supply plug of the distributor P8.

8 Perform the diagnostics of the dumping mechanism.

8.1 At the rotational speed of the engine crankshaft of (n=(1500±50) rpm), fix the pressures P8, P9, P10 by means of the pressure gauges M1, M2, M3 respectively (the rotational speed of the engine crankshaft shall be monitored by means of the tachometer in the dump truck cab).

When the HPA of the steering control are charged, the pressures shall be as follows:

– P8=(3.1±0.2) MPa – the pressure in the pumping line of the front section of the adjustable pump;
– P9=(1.8±0.5) MPa – the pressure in the pumping line of the rear section of the adjustable pump;
– P10=(3.1±0.2) MPa – the pressure in the control line.

8.2 Set the dumping mechanism control switch to the “Lifting” position and lift the body; when doing this, fix the pressures P11, P12, P13 by means of pressure gauges M1, M2, M3 and the body lifting time T4, which shall be as follows:

– P11 – from 2 to 6 MPa;
– P12 – from 2 to 6 MPa;
– P13 – from 2 to 4 MPa;
– T4=(26±3) sec.

8.3 the dumping mechanism control switch to the “Lowering” position and lower the body (after the first stage folding it is recommended to reduce the engine rotational speed to the idling value), while fixing the pressures P14, P15, P16 by means of the pressure gauges M1, M2, M3 and the lowering time T5:

– P14=(3.1±0.2) MPa;
– P15=(1.8±0.5) MPa;
– P16=(3.1±0.2) MPa;
– T5=(18±3)sec.

15 FIRE-EXTINGUISHING SYSTEM

WHEN OPERATING AND SERVICING FIRE-EXTINGUISHING SYSTEM IT IS NECESSARY TO FOLLOW THE OPERATING MANUAL DELIVERED ALONG WITH THE SYSTEM.

The combined fire-extinguishing system is intended for extinguishing of ignitions of classes A, B and C as well as electric equipment under the voltage of up to 1,000 V.

On the customer's request dump truck can be equipped with:

– fire-extinguishing system with remote actuation of the powder line and rear axle protection;

– fire-extinguishing system with automatic actuation of the engine compartment powder lines and rear axle.

15.1 Specification

Fire-extinguishing agents:	
powder line…….....	fire-extinguishing powder
solution line…….	water solution of calcium chloride
Weight of fire-extinguishing agents, kg (± 5%):	
powder line of engine compartment……..…….....	50
powder line of rear axle…….....	6
solution line…….	33
Working gas……..	nitrogen or air
Gas cylinder volume, dm^3, not more than:	
powder line of engine compartment …….....	8
powder line of rear axle …….	40*
solution line ……..……	7
Pressure in gas cylinder of engine compartment powder line and solution line, MPa……	see Table 15.1
Working pressure in system tanks, MPa, not more than	1.2
Range of fire-extinguishing agent emission, m, at least:	
solution …….	10
powder ……	4
Time of fire-extinguishing agent emission, s, not more than:	
solution ……	60
powder of the engine compartment ..……	60
powder of the rear axle …..…….	15
Length of flexible hose of solution line, m, at least……	15
Supply voltage of remote actuation device, V	24^{+6}_{-4}
Useful current, A, not more than:	0,05
Actuation:	
powder line of engine compartment …….....	automatic or remote or manual
powder line of rear axle ……...	automatic or remote
solution line…….	manual

* – gas volume generated by cold gas source brought to normal conditions

15.2 Arrangement and operation mode of Fire-Extinguishing System with Remote Actuation of Powder Line and Rear Axle Protection

The fire-extinguishing system consists of three independent lines: powder line of engine compartment II (Figure 15.1), powder one of rear axle IV which are monitored and controlled by remote actuation device and solution line III. The lines can be actuated either separately or simultaneously.

The powder line of engine compartment is designated for extinguishing ignitions in engine compartment, fuel and oil tanks by emission of fire-extinguishing powder through holes in distributing pipelines.

The powder line of rear axle is designated for extinguishing ignitions in rear axle by emission of fire-extinguishing powder to target points through holes in distributing pipeline.

The solution line serves for extinguishing ignitions in places located outside the zone of powder line protection and at the places of reignition by fire-extinguishing solution emission into fire seat.

When opening the valve of the cylinder 13 (see Figure 15.1) gas passes into the tank 21 through the reducer 14 with calcium chloride solution. The pressure of 1.2 MPa is created over the solution and displaces the solution into intake 20 and hose 16. When pressing the lever of locking device 19 the solution is discharged in specified direction to the distance of up to 10 m.

The fire-extinguishing system is equipped with **remote actuation device** consisting of:

– control panel 22 equipped with light and sound indication, and switches for the electrical actuation of the powder lines in the engine compartment 23 and the rear axle 24;

– remote control for manual actuation of fire extinguishing systems for engine 25 and rear axle 26;

– the locking and starting head 9 with the electrical actuation device and the manual start button 10 installed on the gas cylinder 11 of the powder line in the engine compartment;

– thermal detector of the rear axle 28 thermostat and a source of cold gas with an electric igniter 27.

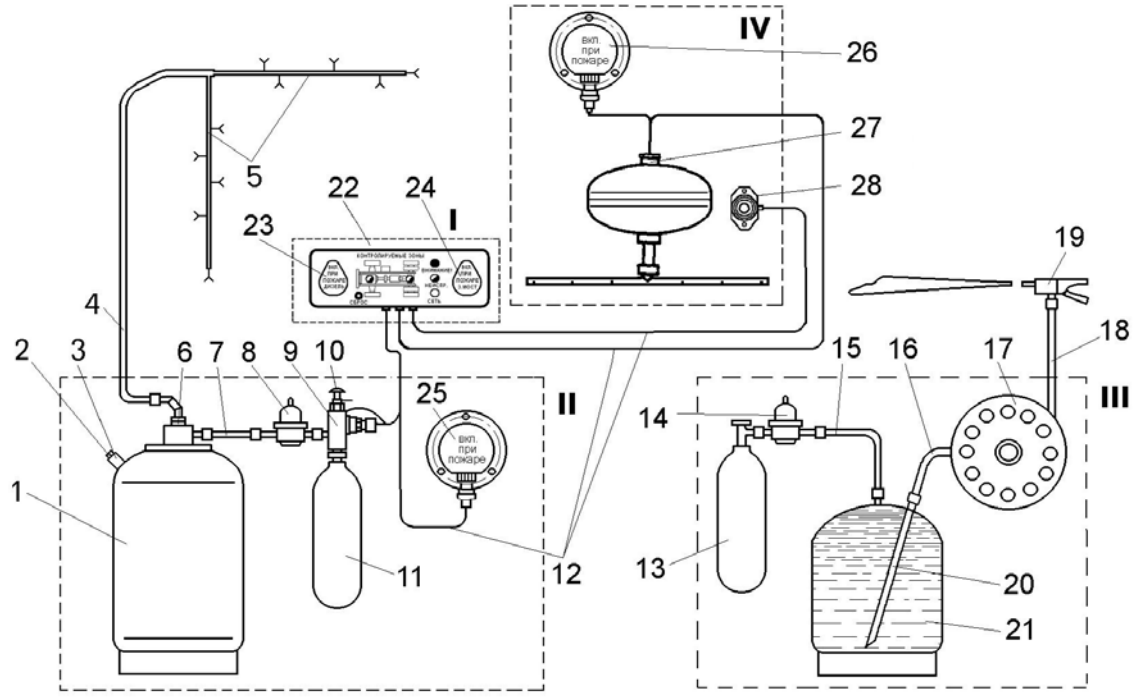


Figure 15.1 – Combined fire extinguishing system with remote actuation of the powder line and rear axle protection:

1 – powder tank; 2 – bolt; 3 – filler neck; 4 – powder duct; 5 – spraying circuit; 6 – membrane fuse; 7, 15 – gas ducts; 8, 14 – reducers; 9 – the lock-starting head, 10 – the button of manual start-up; 11, 13 – gas cylinders; 12 – wires; 16, 18 – hoses; 17 – reel; 19 – locking device; 20 – intake; 21 – solution tank; 22 – the control panel; 23 – switch for the electrical actuation of the powder lines in the engine compartment; 24 – switch for the electrical actuation of the powder lines in the rear axle; 25 – remote control for manual actuation of fire extinguishing systems for the engine; 26 – remote control for manual actuation of fire extinguishing systems for the rear axle; 27 – source of cold gas (SCG) with an electric igniter; 28 – thermal detector of the rear axle thermostat;

I – control panel; II – powder line of the engine compartment; III – solution line; IV – rear axle powder line

Remote switching device performs:

– light indication of the power circuit availability;

– light and sound fault indication of the thermal detector line; of the rear axle thermostat; circuits of remote control panels for manual actuation, electrical actuation circuits;

– protection of the device in case of short circuit and excessive voltage of external power supply source (on-board circuit of protected equipment);

– backup power supply of the device for up to 2 days when external power source is disconnected;

– control over the thermal detector of the thermostat actuation temperature rise in the rear axle;

– sound and light alarm when the thermal detector reaches a temperature of + 130 °C;

– remote actuation of the engine compartment and / or rear axle powder line by pressing the corresponding switch on the control panel or by pressing the button for electrical actuation on the manual remote control or the button for manual start-up of the powder line starting head in the engine compartment.

The control panel is designed for recording the signal from the thermal detector of the thermostat, forming and transmitting light signals to the front panel of the control panel, sound warning, remote electrical actuation of the powder lines.

When putting the truck into operation, turn on the power on the rear panel of the control unit using the switch "ON. – OFF". The "MALFUNCTION" indicator and the indicators of the monitored areas should be lit up red on the front panel of the control panel as the circuits are faulty. With prolonged storage of the truck, turn off the power.

There are following indicators located on the front panel of the control panel:

– the indicator "POWER" of green color: it lights up constantly – when power supply from the on-board circuit is available; flashing mode – when power supply from the on-board circuit is not available but there is power from the built-in battery.

– double-color indicator "MALFUNCTION": lights up green – if the electrical circuits are in good condition; lights up red – when any electrical circuit is broken.

– the indicator "WARNING!" of red color: blinking mode – when the thermostat thermal detector of the rear axle reaches the actuation temperature;

– the indicator of the engine compartment: lights up green – if the electrical circuits are in good condition in the monitored area; lights up red simultaneously with the indicator "MALFUNCTION" lighting up red – in case of a fault in the electrical circuits of the monitored area;

– rear axle indicator: lights up green – if the electrical circuits are in good condition and the thermostat thermal detector of the rear axle temperature is lower than the actuation temperature; lights up red simultaneously with the indicator "MALFUNCTION" lighting up red – in case of a fault in the electrical circuits of the monitored area; lights up red simultaneously with the indicator "WARNING!" blinking with red and the intermittent beep sounds – when the thermostat thermal detector in the monitored area reaches the actuation temperature;

– the indicator of the engine compartment or the rear axle briefly turns red and simultaneously the sound signal is on when pressing the button "ON WHEN FIRE / DIESEL"; or the button "ON WHEN FIRE / REAR AXLE", or the button of the electric actuation "ON WHEN FIRE " on the corresponding remote control panel.

– switches "ON WHEN FIRE / DIESEL" and "ON WHEN FIRE / REAR AXLE" are intended for actuation of the powder line actuator in the monitored area: position" O " means OFF," I " means ON;

– "RESET" button is intended to bring the remote start device into the initial operating state.

The design of locking-and-triggering head is shown in Figure 15.2. The gas emission from the cylinder in the locking-and-triggering head is sealed by membrane 15. Fuse 4 serves for holding the gas-generating trigger element 3 and current supply. Wire 5 “plus” is connected to the central contact and wire 6 “minus“ is connected to the body.

On pressing the electric triggering button, the voltage is supplied to the gas-generating triggering element 3, the gas-generating triggering element operates and powder gases move the piston 13 downwards, the membrane 15 bursts and gas from the cylinder 11 (see Figure 15.1) passes through the reducer 8 and then is fed through the gas pipeline 7 into the powder tank 1 where it fluffs the powder.

At the pressure of 1.2 MPa gas suspension bursts membranous protector 6 serving for preventing water vapour breakthrough from atmosphere is discarded through the powder line 4 into the engine compartment and to fuel and oil tanks.

The system can be also actuated manually. To do this, it is necessary to pull out the pin 9 (see Figure 15.2) and push the button for manual actuating 10. The rod 11 moves downwards and pushes the piston 13, the membrane 15 is punched and gas traps into the powder tank.

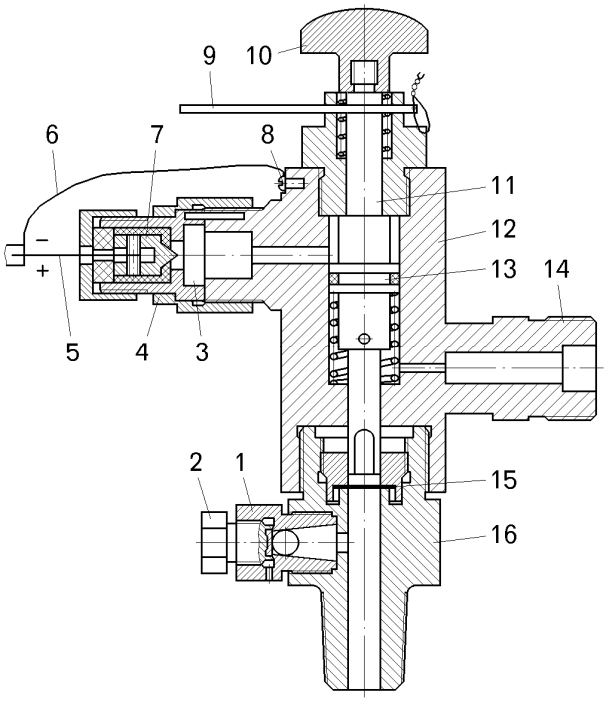


Figure 15.2 – Locking-and-triggering head:

1 – valve; 2 – bolt; 3 – gas-generating triggering element (gas-generating triggering element); 4 – fuse assembly; 5 – wire "+"; 6 – wire "–"; 7 – central contact; 8 – screw; 9 – pin; 10 – manual triggering button; 11 – rod; 12 – body assembly; 13 – piston with cutter; 14 – working union; 15 – membrane; 16 – body

15.3 Arrangement and operating mode of the fire-extinguishing system with engine compartment powder lines and rear axle automatic actuation

The fire-extinguishing system consists of three independent lines: the powder line of engine compartment II (Figure 15.3), the powder line of rear axle IV, both are monitored and controlled by remote actuation device, and the solution line III.

The automatic actuation device consists of:

– the line of heat alarm devices 25 in engine compartment and in rear axle;

– the control unit 22 equipped with control panel with light indication, audible alarm unit and electric actuation button 23;

– remote actuation panels 24 and 27 installed at an accessible place outside protected objects;

– the locking-and-triggering head 9 with electrical actuation device;

– the manual actuation button 10 mounted on the gas cylinder 1 of the engine compartment powder line;

– the cold gas source 26 with electric igniter installed in the tank of the powder line of rear axle.

The automatic actuation device performs:

– light signalling of the presence of power supply in the circuit;

– light and audible signalling of the heat alarm devices line defects, remote actuation panels circuits, circuit of the gas-generating trigger element and the circuit of cold gas source electric igniter;

– protection of the automatic actuation device in case of short circuit and overvoltage of an external power supply unit (vehicle's power supply system);

– backup power supply of the automatic actuation device with the duration of up to 5 days in case of disconnection from the external power supply unit;

– monitoring of temperature condition changes in the zone of heat alarm devices location;

– audible and light alarm if a specific heat alarm temperature reaches 100ºC and "ПОЖАР" (FIRE) lighting on reaching the critical temperature;

– automatic actuation of respective powder line the system when reaching the critical temperature;

– emergency actuation of the engine compartment powder line when pressing the button of electric actuation on the control panel or manual actuation button on the locking and triggering head, or any of the powder lines when pressing the button on the respective remote actuation panel.

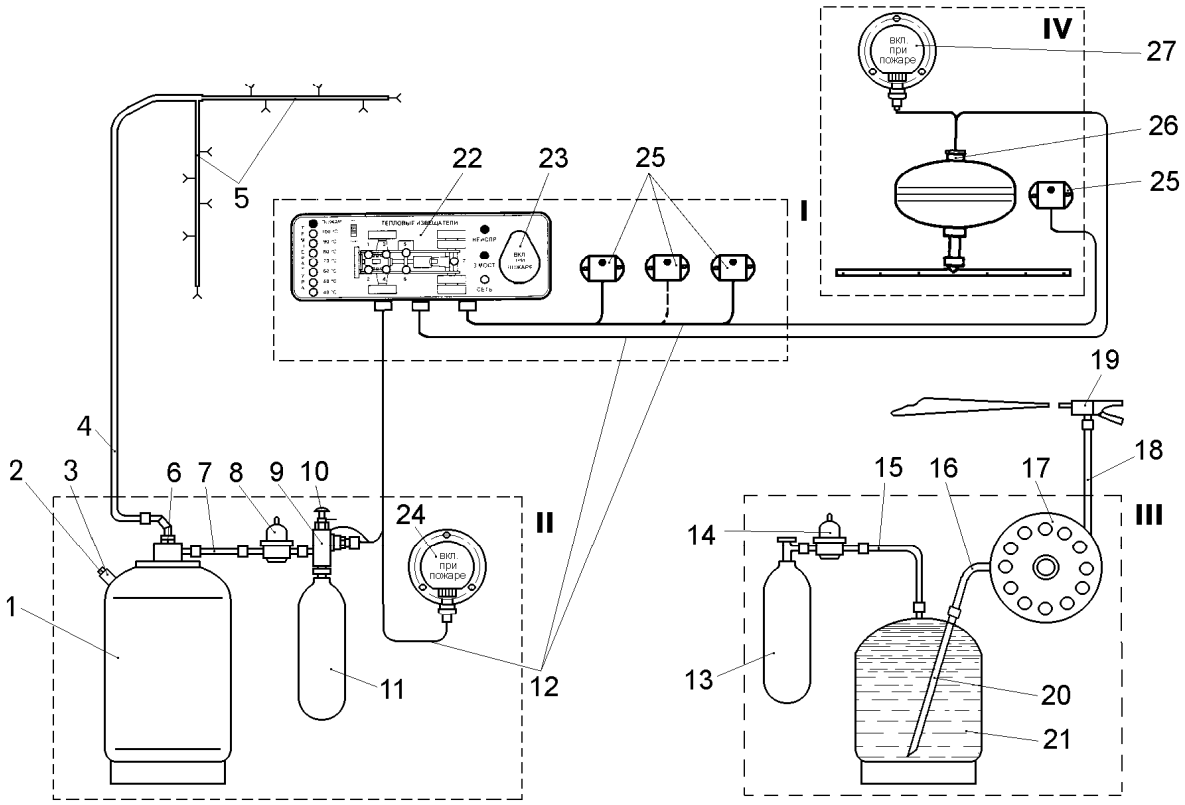


Figure 15.3 – Combined fire-extinguishing system:

1 – powder tank; 2 – bolt; 3 – filler neck; 4 – powder line; 5 – spraying circuit; 6 – membrane-type safety device; 7, 15 – gas pipelines; 8, 14 – reduction gears; 9 – locking-and-triggering head;10 – manual triggering button; 11, 13 – gas cylinders; 12 – wires; 16, 18 – hoses; 17 – drum; 19 – locking device; 20 – intake; 21 – solution tank; 22 – control unit; 23 – button for electric start of the control unit; 24 – button for electric start of the remote console for switching on the powder line of the engine compartment; 25 – heat alarm device; 26 – cold gas source with electric primer; 27 – button for electric start of the remote console for switching on the powder line of the rear axle;

I – automatic actuation device; II – powder line of engine compartment; III – solution line; IV – powder line of rear axle

The **heat alarm devices line** is designed as a four-wire line comprising heat alarm devices located in the engine compartment and one heat alarm device in the rear axle. On switching on the automatic actuation device pulses from the control unit are sent into the line of heat alarm devices and outputs of the heat alarm devices are connected alternately to the line. The poll of heat alarm devices is effected once a second.

In case of open circuit in the line of the heat alarm devices, no backward signal is received by the control unit and the indicator signalling about the fault on the control panel lights up as well as the audible signal rings.

The **control panel** is intended for registering the signal from the line of heat alarm devices, forming and transmitting the signals to the control panel, audible alarm device, gas-generating trigger element or electric igniter of the cold gas source.

When putting the truck into operation, turn on the power on the rear panel of the control unit using the switch "ON. – OFF". The "MALFUNCTION" indicator and the indicators of the monitored areas should be lit up red on the front panel of the control panel as the circuits are faulty. With prolonged storage of the truck, turn off the power.

The front panel of the control unit comprises:

– the “СЕТЬ” (POWER) indicator coloured green to indicate the presence of the power supply;

– indicator "REAR AXLE" when lighting up green informs about serviceability of the rear axle circuit, as detecting any malfunction it lights up red and in addition indicator "MALFUNCTION" lights up;

– the “НЕИСПРАВНОСТЬ” (MALFUNCTION) indicator coloured red which lights up in case of any fault in the circuit, the audible signal rings simultaneously with lighting up of the indicator;

– a number of vertically located indicators "TEMPERATURE":

“40ºС-90ºС” coloured green to signal about temperature condition changes at the places of location of the heat alarm devices,

“100°С” coloured amber warning on reaching dangerous temperature at a zone of one of the heat alarm devices;

“ПОЖАР” (FIRE) indicator coloured red signalling that the temperature of one of the heat alarms has reached 110°С; concurrently with lighting-up of the indicator the external audible systems are switched in (the signals are given) and the pulse for activating the gas-generating triggering element or electrical ignition unit of the cold gas source;

– the “ТЕПЛОВЫЕ ИЗВЕЩАТЕЛИ” (HEAT ALARM DEVICES) indicators coloured red on the plan of the protected object blink sequentially in the working mode that indicates the operability of heat alarm devices, and the indicator of amber color lighting steadily indicates the heat alarm device with the highest temperature;

– the button for automatic start-up of the executive mechanism of the powder line in the engine compartment;

– the switch of the automatic start-up of the executive mechanism of the powder line in the engine compartment and rear axle when visual confirming the absence of fire after the indicator "FIRE" is ON.

15.4 Safety Requirements

The drivers of dump trucks and persons preparing the fire extinguishing system for operation as well as persons performing maintenance and repair of the system shall follow attached operating manual for the fire extinguishing system, “Rules for Design and Safe Operation of Containers under Pressure”, “Technical Safety Rules for Performing Works at the Consumers’ Electrical Installations with the Voltage of up to 1000 V”, as well as following rules:

– It is prohibited to use the solution line for extinguishing energized electric equipment and spilled fuel and oil;

– It is prohibited to actuate the powder line if anybody presents in zone protected by this system;

– In case of contact of the solution with eyes wash them carefully with water;

– When filling the system with powder use protective equipment for upper respiratory passages;

– gas cylinders and fire-extinguishing agents tanks shall undergo hydraulic tests once five years.

When mounting and servicing the gas cylinders it is necessary to observe the following precautions:

– Prior to opening of the locking-and-triggering head of the cylinder dismantled from the dump truck fix the cylinder reliably in the fixture;

– The cylinder, locking-and-triggering head and valve shall be protected against impacts and the cylinder shall not drop;

– The cylinders with compressed gases shall not be exposed to direct heating from the heat sources;

– After charging the cylinder with a valve fit a cover onto the working fitting;

– The cylinders equipped with a locking-and-triggering head shall be fitted permanently with a pin protecting the cylinder from opening due to accidental pressing the head lever;

– The cylinder valve, pin of the cylinder with a locking-and-triggering head, reducers, control panel and remote actuation console shall be sealed;

– Cover removal from working fittings of the cylinders is allowed only after mounting the cylinders onto the dump truck and immediately prior to connecting hose to them;

– The conditions of storage and transportation of the cylinders shall comply with the requirements of the Rules for Design and Safe Operation of Containers under Pressure.

15.5 Maintenance

The powder tank of the fire-extinguishing system is charged with fire-extinguishing powder registered in the EC regulation No.1907/2006 (REACH regulation).

The tank shall be filled with the powder through corresponding hole on the tank body. To avoid the clogging of the powder line channels the powder shall hot have lumps exceeding 2 mm in size.

For recharging the powder tank on the dump truck to be operated in the European Union member state it is necessary to use the fire-extinguishing powder registered in the REACH regulations.

Prior to beginning the operation of the dump truck fluff the powder, check gas pressure in the cylinders, purge powder lines and pipelines and fit the gas-generating trigger element (included in the spare parts, tools and accessories kit) into the locking and discharging head of the cylinder, connect wires preserving polarity to the locking and discharging head, fill the solution line tank with the calcium chloride solution. The tank charge shall be filled with the solution through any of the holes on the tank body.

When performing the daily maintenance:

– Inspect the system externally. When performing the inspection check reliability of the threaded connections and presence of the seals on the cylinders, reducers, remote manual control panel, control unit and locking-and-triggering head.

When performing the seasonal maintenance:

– Wash the solution tank intake, purge the powder line and pipelines as well as fluff the powder with pure gas (air or nitrogen) under the pressure of 0,5 – 1,2 MPa;

– Check gas pressure in the cylinders and recharge them if necessary;

– Check density of calcium chloride water solution.

To wash the solution tank intake, screw out the hose 16 (see Figure 15.1) from the solution tank 21 and remove the intake 20. Wash the intake, refit the intake and connect the hose.

To purge the powder line 4 and pipelines, disconnect them from the tank 1 and connect them to the compressed gas source under the pressure of 0,5 – 1,2 MPa. Open the valve and make sure that the gas flows from the pipeline holes. Disconnect the powder line from the gas source and connect the powder line to the tank having made sure preliminarily that the membranous protector 6 is present.

Powder fluffing.

To perform this operation act as follows:

– Disconnect powder line 4 from tank 1 and remove membranous protector 6;

– Fit cover (included in the spare parts, tools and accessories kit) instead of membrane. Connect to tank powder line 4;

– Turn out bolt 2 from the filler neck 3;

– Disconnect gas duct 7 from reducer 8 and connect it to cylinder containing compressed nitrogen or air under the pressure of 2 – 15 MPa;

– Deliver the air into powder tank with short pulses until gas suspension emission from the hole of filler neck 3. If the air with powder does not flow from the hole of the neck find out the fault's cause and perform trobleshooting;

– Switch off gas supply and after finishing of gas emission from the filler neck disconnect the gas duct 7 from the cylinder;

– Connect the the gas duct 7 to the reducer 8, screw in the bolt 2 onto the filler neck, disconnect it from the tank powder line, remove the cover, fit the membrane and connect the powder line 4.

To check the pressure in the cylinder with valve screw out the reducer sleeve nut and adapter from the cylinder and connect pressure gauge (see figure 15.4) (included in the spare parts, tools and accessories kit) using captive nut 1; at this the screw 4 should be in closed position, i.e. be screwed in up to stop clockwise. Open the cylinder valve and supplying the pressure into the cavity of the case 2 determine gas pressure by means of the pressure gauge. Screw in the valve of the cylinder and deflate the measuring device from residual gas via the side hole having turned the screw by half-turnover anticlockwise and unscrew the captive nut from the valve.

If gas pressure is improper it is allowed to charge the small-displacement cylinders with valves from transport cylinders (this operation should be performed only by trained personnel or by specialized company involved into the servicing the equipment to operating under excessive pressure.

To check the pressure in the cylinder with the locking-and-triggering head it is necessary to disconnect the automatic actuation device, unscrew igniter 4 assy. from the casing (see figure 15.2), unscrew the electrical actuation device 3 and having unscrewed the screw 8 disconnect the wire "-" 6. Having unscrewed the captive nut of the reducer from the working fitting 14 screw onto it the transportation plug. Take out the cylinder from the basket and secure it horizontally with valve 1 downwards in the special appliance or in vise. Unscrew bolt 2 and screw in the pressure gauge (included in the spare parts, tools and accessories kit).

If gas pressure is improper it is allowed to charge the small-displacement cylinders with valves from transport cylinders (this operation should be performed only by trained personnel or by specialized company involved into the servicing the equipment to operating under excessive pressure).

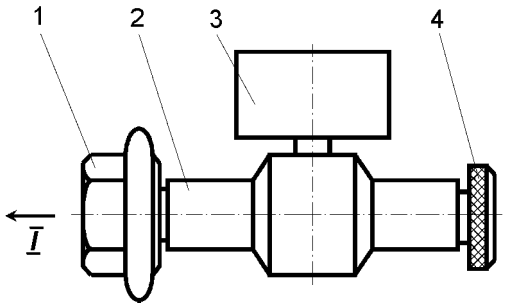


Figure 15.4 – Control appliance:

1 – captive nut; 2 – casing; 3 – pressure gauge; 4 – screw; I – to the cylinder valve

Table 15.1 – Working pressure in cylinders depending on environmental temperature

Environmental temperature, ^{0}C	Working pressure in cylinders, MPa	
	minimal	maximal
Минус 55	9,0	10,0
Минус 50	9,5	11,0
Минус 40	9,7	11,3
Минус 30	10,0	11,6
Минус 20	10,3	11,9
Минус 10	10,6	12,3
0	11,0	12,7
10	11,3	13,1
20	11,7	13,5
30	12,1	14,0
40	12,5	14,5
50	13,0	15,0

To charge gas cylinders with valve act as follows:

– Disconnect the reducer 14 (see Figure 15.1) from the cylinder 13;

– Connect the cylinder through gas pipeline 4 (Figure 15.5) to T-joint 3 and the T-joint – to the transport cylinder 1;

– Connect pressure gauge 5 to the T-joint 3;

– Unscrew the valves of transport cylinder 1 and the cylinder to be charged 2;

– On reaching the pressure (control by means of measuring device of pressure gauge 5) according to Table 15.1, for the respective environmental temperature, screw the valves of the transport cylinder and cylinder to be charged and deflate the measuring device from residual gas. Disconnect the gas pipeline 4 and T-joint 3 from the cylinders. Screw the cover onto the fitting of the low-capacity cylinder and seal it.

Perform charging the gas cylinders with locking-and-triggering head in the following sequence:

– connect the gas pipeline 4 (figure 15.5) to the tee 3, and the tee do to the transport cylinder 1;

– connect measuring device 5 to the tee 3;

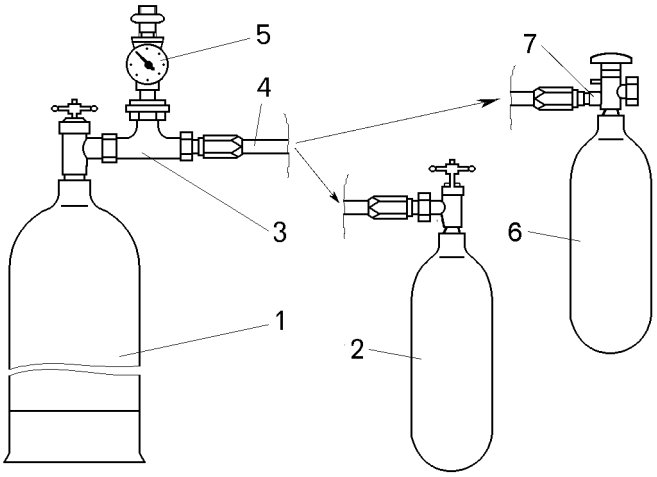
– connect the gas pipeline 4 to the valve of the locking-and-triggering head of the cylinder 6 (figure 15.4), through the adapter 7 (from the spare parts kit);

– open the valve of the transport cylinder 1;

– when pressure reaches value (control over the manometer of the measuring device 5) according to table 15.1, for corresponding ambient temperature close the valve of the transport cylinder and release the remained gas from the measuring device. Disconnect the gas pipeline 4, tee 3 and adapter 7 from cylinders. Screw the cap on the fitting of the small-displacement cylinder and seal up it.

Figure 15.5 – Layout of fire-extinguishing system and gas cylinder charging:

1 – transport cylinder; 2 – small-displacement cylinder; 3 – T-joint; 4 – gas pipeline; 5 – measuring device; 6 – small-displacement cylinder with locking-and-triggering head; 7 – adapter



Density of calcium chloride water solution check.

Density of calcium chloride water solution shall correspond to the data of Table 15.2. Density (mass concentration) of calcium chloride water solution shall be checked by means of the areometer with $\pm$ 0.005 g/cm^3 defect.

Table 15.2 – Freezing temperature of calcium chloride water solution

Weight $CaCl_2$, kg	Volume H_2O, l	Solution volume, l	Solution weight, kg	Density, gr/cm^3	Freezing temperature, ^oC
5,95	31,34	33	37,29	1,130	minus 10
8,83	30,44	33	39,27	1,190	minus 20
11,32	29,60	33	40,92	1,240	minus 30
12,83	41,91	33	41,91	1,270	minus 40
13,06	29,01	33	42,08	1,275	minus 45
13,28	28,93	33	42,21	1,279	minus 50

The table data are described according to the measurement results of calcium chloride solution with water with strength of 94,7 %. Taking into account the high hygroscopic capacity of calcium chloride and possible inaccuracy when preparing the solution it is necessary to comply with the measured values of the solution density.

Mix the solution thoroughly after 24 hours. Density measurement is mandatory: it shall correspond to the data stated in Table 15.2. Storage period of the solution is unlimited. The solution to be poured shall be free of mechanical impurities exceeding 2 mm in size. The tank charging with the solution shall be performed through any of the tank body holes.

Should it be found during the operation that no fire-extinguishing substance is released from the tanks, it might be eliminated by performing the following operations:

– Check gas pressure in the cylinders. If necessary charge or replace the cylinders;
– Purge the powder line and pipelines;
– Fluff the powder;
– Check if the solution in the solution line tank has been frozen. If necessary change the solution.

If the “Неисправность” (Fault) LED limp lights on the control unit it is necessary to check wires and connections of the remote actuation device.

MAKE NOTES ABOUT PUTTING INTO OPERATION AND RESULTS OF TECHNICAL MAINTENANCE IN THE FIRE-EXTINGUISHING OPERATION MANUAL.

16 PECULIARITIES OF OPERATION

BEFORE STARTING THE ENGINE AND OPERATION OF THE TRUCK IT IS NECESSARY TO STUDY AND FOLLOW ALL THE REQUIREMENTS STATED IN THIS OPERATION MANUAL, DOCUMENTATION FOR THE ENGINE, TRACTION ELECTRIC DRIVE, OPERATING MANUALS FOR ADDITIONAL UNITS AND SYSTEMS STATED IN THE RESPECTIVE OPERATING DOCUMENTATION.

16.1 Running-in of the Dump Truck

In the initial period of truck operation breaking-in of surfaces of the assemblies rubbing pairs and stabilization of systems operation of take place. Reliability and durability of units and systems thereinafter depend on the quality of surfaces working-in.

The duration of the dump truck running-in is 100 motor hours (at least 1000 km of run).

Before starting the running-in act as follows:

– Check technical condition paying attention to the tightening of the most critical external threaded joints;

– Check oil level in units, assemblies and systems, fuel in tank and cooling fluid in engine cooling system as well as check the presence of solid grease in friction units according to the layout of location of the lubrication points and list of lubricants to be used.

For the period of running-in of a new truck, following restrictions are introduced:

– maximum motion speed shall not exceed **35 km/h**;

– dump truck shall be driven on the roads with hard pavement;

– useful load of the dump truck shall be 75% of the rated value.

Within the period of running-in of new dump truck it is necessary to:

– adhere strictly to the specified thermal conditions excluding overheating of the engine, motor wheels reduction gears, traction alternator and electric motors;

– Every shift inspect and re-tighten if necessary external threaded joints of steering control units, brake systems, diesel-alternator, cardan shaft and electric machines;

– Every shift re-tighten external threaded joints of the guide vane and suspension cylinders until tightening torques are stabilized. For the tightening torques see Appendix A;

– re-tighten wheel nuts after the first run and then re-tighten them after every two-three runs until the tightening torque is stabilized at all the nuts.

Upon completion of running-in it is necessary to:

– change oil in motor wheels reduction gears;

– change working fluid in the oil tank of hydraulic system and filtering elements in the oil tank and filter, clean the magnetic drain plugs of the tank and magnets in the suction connection of the pump and drain manifold;

– perform M-1 and M-2 lubricating works according to the layout of lubrication points' location and list of applied lubricants;

– check and re-tighten if necessary external threaded joints of the suspension, steering control and brake systems. For the tightening torques see Appendix A;

– Adjust clearance between inserts and ball joint supports of suspension cylinders (see Section "Maintenance of Suspension").

Checking of nuts tightening torques of spherical joints for front suspension cylinders, tension bolts of fixing traction electric motor to the motor wheel reduction gear and tension bolts of fixing the motor wheel to the rear axle housing shall be performed when assembling the dump truck and further in accordance with the "Maintenance" section.

Should any parts and units included in Appendix A be replaced during the operation of dump truck, the operations for re-tightening threaded joints shall be performed as when running-in a new dump truck.

To ensure the performance of works for tightening threaded joints with applying normalized torques specified in Appendix A the operation and repair departments of transport companies shall be provided with the necessary tools.

16.2 Starting the Engine

Before starting the engine carry out all the operations stated in "Daily Maintenance" section.

If outdoor air temperature is below 5°C warm up the engine cooling fluid by means of the starting preheater to the temperature recommended by the Operating Manual for the engine.

Set all the switches on the instrumentation board to the OFF position.

Make sure that the truck is retarded with the parking brake, the lever of the reverser is set to the neutral position – ”N” (neutral), traction electric drive is switched off with the electric drive switch on the console.

Insert the key into the lock-switch up to the stop; with that negative terminals of storage batteries will be connected to the truck ground.

After long-term parking and maintenance of the dump truck pump the feeding system by removing the air from it. To do this, press the button of the fuel transfer pump.

If the key is turned through 45°, power supply of the engine electronic unit will be switch on.

Turn the key around 90°: oil pump electric motor will switch on and, when defined pressure in lubricating system is reached, pneumatic or electric starter will be switched on. The engine starts.

Electric starter continuous run time must not exceed 15 sec. If the engine doesn’t begin stable operation within this period, it’s necessary to turn off the starter and restart the engine in one minute.

After starting the engine release the key of the lock-switch to return it into the initial position.

At a minimum stable rotation speed of engine crankshaft, as well as during the dump truck motion alarm signalling lamps of systems emergency status (red color) and alarm situation banners on the EIP display are shall not light on. Lighting lamps or banners mean the fault of the corresponding system. Flickering lamp means switching on of parking brake system. If an alarm signal appears or deviations of the prescribed parameters are detected, identify the problem and remedy it.

To prevent coking of injection nozzles set up an increased crankshaft rotation speed by means of engine speed governor switch located on the instrumentation panel and warm up the engine at idle run within 3-5 minutes at rotation speed of around 1000 min^{-1}. Extended operation (more than 10 minutes) leads to coking of nozzles and piston rings.

16.3 Taking-off, acceleration and moving of dump truck

Set minimally stable rotation speed of engine crankshaft by means of turning off RPM governor.

Turn on traction electric drive fixing the switch of electric drive into “T” position. With that self-testing is in process within some seconds during which all 6 LED lamps on the traction electric equipment switch on for a short moment (4 lamps are in orange and 2 – in red).

After self-testing the Led lamps shall turn off for a while and then one LED lamp marked as “CAN” shall light in green color. The green color of “CAN” led lamp while switching off of the other lamps is its normal working condition and means that control commands from cabin are received by the drive of both wheels (presence of connection) and it’s possible to continue turning on of the electric drive.

After successful self-testing the cab controller screen (КК) takes the basis view where the 7th and 8th lines shall display the words “1 Инверт. СВЯЗЬ ЕСТЬ” (the 1st inverter: THE CONNECTION IS PRESENT), “2 Инверт. СВЯЗЬ ЕСТЬ” (the 2nd inverter: THE CONNECTION IS PRESENT) that confirms the presence of the connection with the drives and the 15th line shall display the words «СКТемпер СВЯЗЬ ЕСТЬ» (Temperature telemetric monitoring system: the CONNECTION IS PRESENT).

Set the reverser switch to the “Вперед” (Forward) or “Назад” (Reverse) position having chosen the desirable motion direction. Wait for lighting-up of the green LED lamp “Готовность” (Ready). This process takes 1-2 seconds. To speed up the process, the engine rotational speed can be increased for short time. Give the signal about the starting of motion, release the parking brake at idle engine (otherwise a jerk can occur) and take off by increasing the engine rotational speed.

Speed of movement shall be determined by a driver depending on the angle of travel pedal installation.

If it’s necessary to change the motion direction without switching off (demounting) the drive, after the retard the reverser switch “Вперед/Назад” (Forward/Reverse) shall be switched in one movement (without holding in the neutral position). Holding of the reverse switch in the neutral position for 2-3 seconds causes the demagnetization of the alternator and switching off (demounting) of the drive.

When taking off after a short-time parking, it is necessary to choose the motion direction by means of the reverser switch, wait for “Readiness” LED and take off as described above.

The downwards (downhill) movement of the truck shall be performed at the speed stabilization mode!

IT WILL BE IMPOSSIBLE TO RE-CONNECT THE DRIVE AFTER ITS TURNING OFF (IF THE ELECTRIC DRIVE SWITCH IS SET TO 'TURN OFF' POSITION), THEREFORE IT IS PROHIBITED TO TURN OFF TRACTION ELECTRIC DRIVE DURING THE MOTION!

In order to decrease the speed of movement decrease the crankshaft rotation speed having released the travel pedal. If the pedal is set to zero position, power circuit of traction mode will switch off and torque transfer to traction wheels will stop, dump truck will move at run-down mode.

16.4 Braking and stopping dump truck

To brake the dump truck or maintain its speed within certain limits when driving it downhill release the travel pedal and press the pedal of the auxiliary brake system (electric brake). The speed is determined by the driver depending on the angle of setting the electric brake pedal

See the rules of using the brake systems in sections 10.4 "Auxiliary Brake System" and 10.5 "Rules of Use of the Brake System".

After complete stopping of the dump truck retard the dump truck with parking brake and release the service brake pedal. Set the reverser switch to the "N" (neutral) position which will make case green lamp "Готовность" ("Ready") go out and de-energize the traction electric drive with electric drive switch located on the console.

16.5 Stopping the Engine

B to stop the engine after operation with the full load it is necessary to let it run at low idling rotational speed for 3 – 5 minutes. Then stop the engine.

To perform scheduled stop of the engine press the engine stop switch button on the console in the truck cabin. To perform emergency stop of the engine press the engine emergency stop button (two switches) installed on at the bottom of side panels at two sides of front fender hood.

DON'T STOP THE ENGINE UNDER LOAD OR IMMEDIATELY AFTER UNLOADING – THIS MAY CAUSE BREAKDOWN.

If dump truck is at parking put wheel chocks under the wheels.

BEFORE LEAVING THE CAB MAKE SURE THAT THE PARKING BRAKE IS APPLIED, THE SWITCH OF THE REVERSER IS SET TO "N" (NEUTRAL) POSITION, THE TRACTION ELECTRIC DRIVE IS TURNED OFF WITH THE ELECTRIC DRIVE SWITCH LOCATED ON THE CONSOLE.

For more detailed information about operator's operations at various operation conditions see the documentation of the electric drive manufacturer which is attached to the Operation Documentation for dump trucks.

16.6 Towing the Dump Truck

If any faults which cannot be eliminated at the operation site occur, it is necessary to tow the dump truck to the site of repair.

Depending on the fault nature, the faulty dump truck shall be towed by either front or rear part of the body as shown in Figure 16.1.

In this case it is necessary to observe following requirements:

– speed when towing by bumper shall not exceed 15 km/h;
– speed when towing by body shall not exceed 10 km/h;
– motion speed while turning shall not exceed 5 km/h;
– when towing provide measures excluding possibility of side contact of truck being towed with hauler.

In case of towing the dump truck when fixing by the front part of the frame, it is necessary to release the gear of the parking brake system.

The towing when fixing the dump truck by the last counterforce of the body is allowed in exceptional cases for short distances. In this case the steerable wheels of the dump truck to be towed shall be set to the position corresponding to the straightforward motion.

The body of the dump truck to be towed shall be completely unloaded.

No towing the dump truck without lubricating oil in the reduction gears of the power-wheels is allowed – it damages gear transmission.

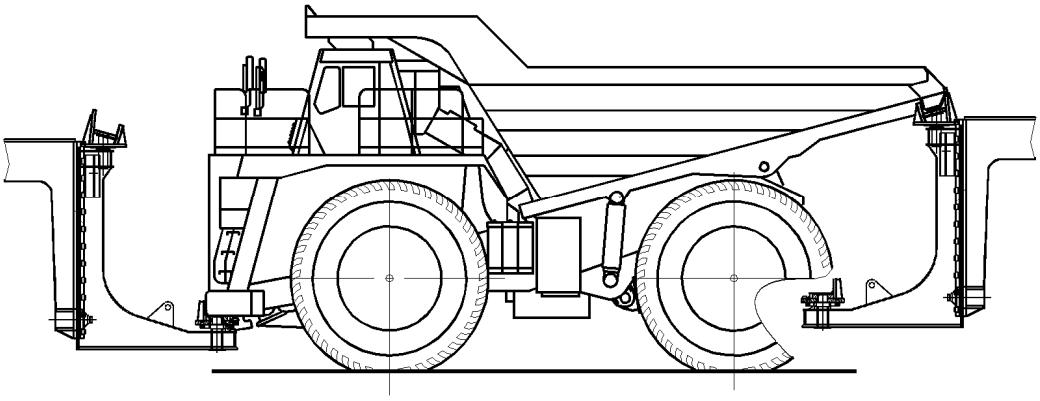


Figure 16.1 – Diagram of towing the dump truck by means of a towing vehicle

16.7 Unloading of faulty truck

For lowering the dump truck body when the engine is not running, make sure that the body is empty and set the dumping mechanism control switch to the «опускание платформы» (Body Lowering) position (the switch handle is turned clockwise up to the stop) and lower the body.

In case of damage of the electrical circuit of the control unit hydraulic distributor of the dump truck with the lifted body, it is allowed to lower the body manually while observing the safety precautions. To do this, it is necessary to press and hold down the manual control pusher (see Figure 14.8) of the hydraulic distributor of the control unit.

To ensure the lifting of the cargo body of the dump truck in case of impossibility of use of the standard hydraulic system (the dump truck is faulty), the possibility of unloading from the external energy source is provided. The pipeline connecting the hydraulic distributor of the dumping mechanism and the piston chambers of the hydraulic cylinders for lifting the body is equipped with the half-coupling 75125-8609930 (Figure 16.2).

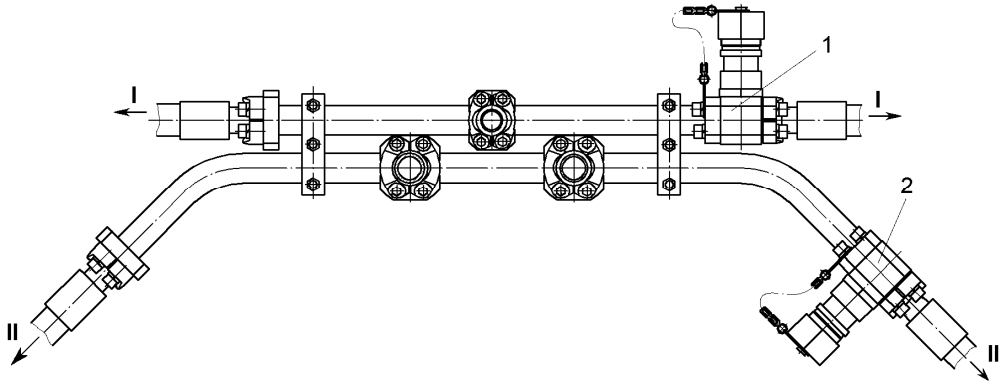


Figure 16.2 – half-coupling mounting on dump truck (pump side view):

1 – bearing plug half-coupling for connection with rod end of hydraulic cylinders; 2 – bearing plug half-coupling for connection with bottom end of hydraulic cylinders;

I – to rod ends of hydraulic cylinders; II – to bottom end of hydraulic cylinders

It is recommended to lift loading body by means of hydraulic system of BELAZ-74131 or BELAZ-74306 recovery tractors.

To unload the dump truck proceed as follows:

– Make sure that the body of the faulty dump truck and the gripping device of the recovery tractor are lowered and the controls of the emergency unloading system of the recovery tractor are in the neutral position;

– Connect the quick disconnect coupling 7423-8609930 with the mark “П” of the recovery tractor (Figure 16.3) with the half-coupling 2 (Figure 16.2) of the truck's emergency unloading system bottom ends using quick disconnect couplings 75131-8609930 and high-pressure hoses. Use high-pressure hoses and quick disconnect couplings from the complete set of the towing truck;

– Unscrew the adjusting screw of the safety valve installed in the line of rod sides on the hydraulic distributor of the faulty dump truck dumping mechanism (chapter “Dumping Mechanism”, Figure 14.7 – Hydraulic distributor) with two full turns (standard adjustment of the valve P=8 MPa);

– Start the engine;

– Set the emergency unloading switch on the towing truck в to the “Подъём” (“Lift”) position and lift the body of the faulty dump truck. To exclude the pumping of the working fluid from the hydraulic system of the towing truck into the hydraulic system of the faulty dump truck through the overflow valve of the dumping mechanism cylinder, it is necessary to stop the lifting of the body of the faulty dump truck when moving the last rod of the hydraulic cylinders for lifting the body by not more than 2/3 of its stroke;

– Set the emergency unloading switch on the towing truck to the “Опускание” (“Lower”) position, the body of the faulty dump truck shall be lowered. It is recommended to lower the body with interim stops while monitoring the oil level in the tank of the faulty dump truck. In case of exceeding of the allowable level, the lowering process shall be stopped and the excesses of the working fluid shall be drained to exclude the damage of the oil tank;

– After recovery of the serviceability of the faulty dump truck it is necessary to set the safety valve of the hydraulic distributor installed in the line of the rod chambers of the hydraulic cylinders for lifting the body to the pressure P=8 MPa.

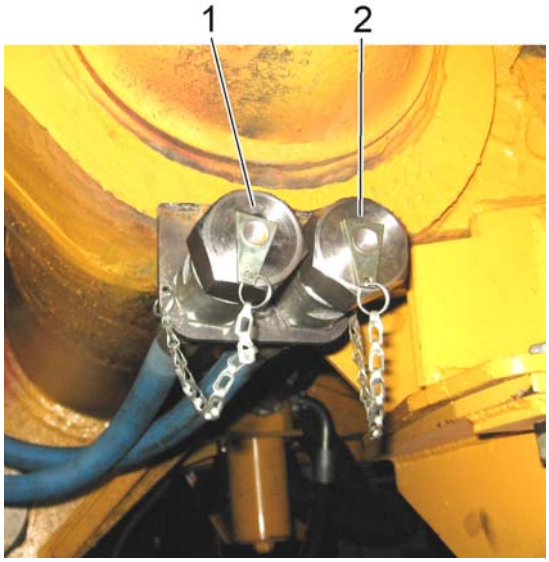


Figure 16.3 – Place of installation of the half-couplings on recovery tractors:
1 – coupling with the “Ш” marking; 2 – coupling with the “П” marking

16.8 Placing the Jacks

When performing maintenance and repair works and wheels replacing, it is recommended to use jacks.

The bottoms of the jacks shall rest upon the hard base.

After lifting the dump truck by the jacks and taking the wheels off the ground surface, it is necessary to put the dump truck onto supports (which shall be designed for the respective weight).

Prior to replacing the wheels, it is necessary to place the dump truck on a flat ground, apply the parking brake and put chocks under the wheels.

For lifting the front part of the dump truck, it is necessary to use two jacks each having the lifting capacity of at least 25 tons.

The jacks shall be placed symmetrically to the longitudinal axis of the dump truck under the front axle beam.

For lifting the rear part of the dump truck, it is necessary to use two jacks each having the lifting capacity of at least 40 tons.

The jacks shall be placed symmetrically to the longitudinal axis of the dump truck under the rear axle housing.

The schemes of placing of the jacks are shown in Figures 16.4 and 16.5.

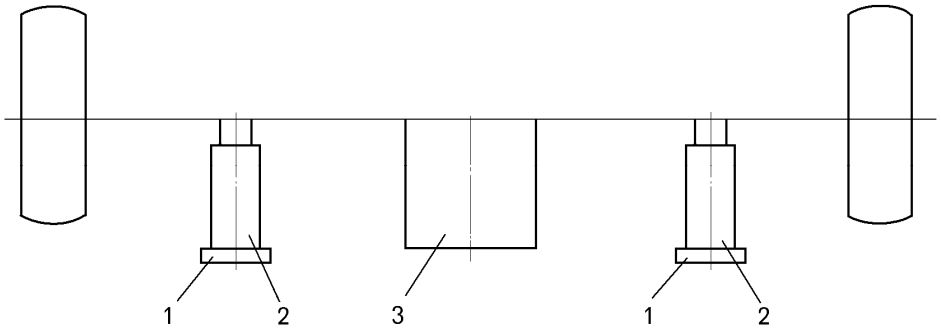


Figure 16.4 – Placing the jacks for lifting the front part of the dump truck:

1 – jack base; 2 – jack; 3 – support

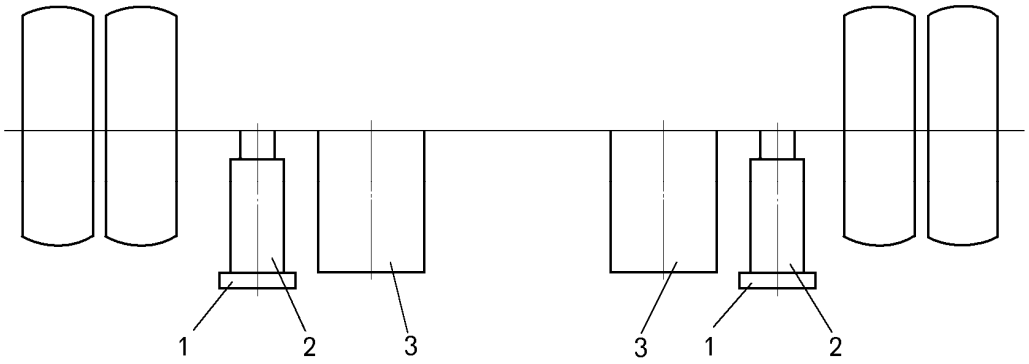


Figure 16.5 – Placing the jacks for lifting the rear part of the dump truck:

1 – jack base; 2 – jack; 3 – support

17 MAINTENANCE

17.1 Types and intervals of maintenance

Maintenance of units and systems must be regularly performed within specified terms to permanently maintain the dump truck available for operation and prevent intense wear of the parts during operation.

Maintenance of dump trucks must be performed in indoor heated areas, dimensions, technique and equipment of which shall ensure smooth carrying-out of all the maintenance works for actual fleet of mining equipment as prescribed by the present Manual.

The following types and intervals of maintenance are recommended:

– Daily maintenance (DM);

– Maintenance after 250 hours of engine service, but not more than 5,000 km of run of the dump truck (M-1);

– Maintenance after 500 hours of engine service, but not more than 10,000 km of run of the dump truck (M-2);

– Maintenance after 1,000 hours of engine service, but not more than 20,000 km of run of the dump truck (M-3);

– Seasonal maintenance (SM) to be performed when preparing the dump truck for the spring-summer or autumn-winter conditions of operation. The seasonal maintenance shall be performed concurrently with the regular maintenance.

Prior to the maintenance the dump truck shall be cleaned thoroughly from dirt and washed. Before washing close tightly the cabinets with power and motor-starting devices, protect the air intakes and ventilation windows of the electric machines as well as air intakes of the air filters against penetration of water with special protective boots and screens. The complete set of boots is included in the spare parts, tools and accessories kit.

To wash the truck it's necessary to use the neutral detergents; with that, the washing fluid temperature shall not exceed 40°C. The truck shall be washed at the ambient temperature of 10-40°C. In autumn and winter the truck shall be washed indoors in a heated area with the truck chassis pre-heated to the temperature of at least 10°C. Cleaning and washing works shall be performed according to the established safety and electric safety instructions.

The maintenance operations shall be performed under conditions excluding dust or dirt contamination of mating surfaces, units and assemblies.

ENGINE, TRACTION ELECTRIC DRIVE, SYSTEMS AND ADDITIONAL EQUIPMENT INSTALLED ON THE TRUCK MAINTENANCE OPERATIONS SHALL BE PERFORMED IN ACCORDANCE WITH THE REQUIREMENTS STATED IN THE MANUFACTURERS' OPERATING DOCUMENTATION. THE MENTIONED DOCUMENTATION IS INCLUDED IN THE SET OF OPERATING DOCUMENTATION SHIPPED WITH THE TRUCK.

For the list of maintenance operations including control, washing, fastening and adjustment works see Table 17.1.

Table 17.1 – List of maintenance operations

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
DAILY MAINTENANCE (DM)			
1	Check oil level and add oil to the engine pan if necessary	In accordance with the engine operating manual	Visually
2	Check the oil level in the tank of the pneumatic engine starting system and add it as necessary (for dump trucks with pneumatic starter)`	The oil level shall be lower than the top edge of the tank body by 15-20 mm (SAE15W/40 engine oil).	Visually
3	Check cooling fluid level and add the cooling fluid into the engine cooling system if necessary	The expansion tank of the system shall be filled with cooling fluid to the lower edge of the filler neck pipe	Visually

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
4	Check the fuel level in the fuel tank and add fuel, drain the sediment from the fuel tank if necessary	The sediment shall be drained until clean fuel appear[s]. The operation shall be performed after at least 30 minutes of motionless state of the dump truck	Visually
5	Check the cooling fluid level and add, if necessary, the cooling fluid into the oil tank of the hydraulic system	The level shall not be above the middle of the upper sight window when the hydropneumatic accumulators are discharged and below the middle of the lower sight window when the hydropneumatic accumulators are charged (after starting the engine). See the section “Maintenance of the dumping mechanism”	Visually
6	Check the fluid level in the windscreen washer tank and add the fluid if necessary	Fill the tank to the maximum level	Visually
7	Check the condition of pipelines and hoses of the integrated hydraulic system and external engine systems	No leaks of fuel, cooling fluid, engine oil and/or working fluid of the hydraulic system are allowed	By visual inspection
8	Check the absence of flammable materials on the outer surfaces of the parts and assemblies	If necessary, clean the dump truck from flammable materials: stains of fuels and lubricants, coal dust, etc.	By visual inspection. Rags, brushes
9	Check the condition of the locks and seals of the commutator inspection hole, seals of the doors of the cabinet with motor-starting devices	The covers of the commutator inspection holes and cabinet doors shall be closed and adjoin tightly over the whole perimeter	By visual inspection
10	Check the condition of the large-size cups of motor wheels	No oil leaks over the cups are allowed	By visual inspection
11	Check the condition of the air ducts of the ventilation and cooling system of the traction electric drive	The soft hoses of the air ducts shall have no ruptures. When the engine is running, air shall flow from the vent holes of the power-wheels	By visual inspection
12	Check the condition of the rods, suspension cylinders and joints of the levers	No bends, cracks and other damages are allowed. See the section “Maintenance of the Suspension”	By visual inspection
13	Check the condition of the tyres and fastening of the wheels	See the section “Maintenance of the Wheels and Tyres” and “Operating Manual for Tubeless Giant and Supergiant Tyres”	By visual inspection
14	Check the condition of the levers, steering cylinders and steering control arm	No bends, cracks and/or other damages are allowed	By visual inspection
15	Check the condition of the mechanisms of the service and parking brake systems	The brake gears shall be free of mechanical damages, cracks and\or leakage of the working fluid	By visual inspection
16	Clean the glasses of the cab, headlights, lanterns, turn indicators and rear view mirrors	The glasses of the cab, lighting armature and visual alarm devices shall be clean	Rags, brushes
17	Close the battery connect switch. Check the voltage of the storage batteries. Make sure that the monitoring instrumentation, lighting armature, light and audible alarm devices are in good order	The voltage shall be (25±1) V. The monitoring instrumentation, lighting and signalling devices shall be serviceable	Instruments on the instrumentation panel in the cab
18	Start the engine. Make sure that the engine systems are serviceable, check the operation of the control instrumentation. Check the air pressure in the tyres. Check condition and operation of the actuator of the fuel feeding control Check the serviceability of the steering control and brake systems on the run	The engine shall run steadily over the whole range of the rotational speeds; the monitoring speed shall display the performance characteristics of the truck systems. The fuel feed control pedal shall move freely, without jamming. The steering control components and braking systems shall be serviceable	Instruments on the instrumentation panel in the cab

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
19	Check the operation of the windscreen wiper and windscreen washer	The fluid jet shall hit the windscreen at the top zone of the sector wiping by the windscreen wiper brush	Visually
20	Check the operability of the emergency drive of the steering control	See the section “Maintenance of the Steering”	Visually
21	Check the leak-proofness of the pneumatic system	See the section “Maintenance of the Pneumatic System”	Aurally
22	Check the clogging level of the engine air filters by means of the pilot lamp on the instrumentation board	Should the pilot lamp light up, replace the main filtering element	Pilot lamp on the instrumentation panel in the cab
23	Drain the condensate from the receiver and drain tank of the pneumatic system, regeneration receiver of the pressure regulator and receivers of the pneumatic engine starting system every day after the shift	After complete draining of the condensate from receivers pump the system again until the pressure regulator operates and only then stop the engine	
24	Check the condition of the fire-extinguishing system	See the section “Maintenance of the fire-extinguishing system”	By visual inspection
25	Check the condition of the centralized automatic lubrication system	See the section “Maintenance of the Centralized Automatic Lubrication System”	By visual inspection
26	Check the condition of tyres pressure control system	See the section “Maintenance” in the Operation Manual of the tyres pressure telemetric control system	By visual inspection
27	Check the condition of air-conditioner system	See the section “Maintenance” of air-conditioner operation manual”	By visual inspection
FIRST MAINTENANCE (M-1)			
1	Perform all the operations of the daily maintenance		
2	Check the oil level in the reduction gears of the motor-wheels. Take the oil sample from the reduction gears of the motor-wheels for analysis. Clear the magnets installed in the drain tubes of the of the reduction gears of the motor-wheels out of metallic dust	See the section “ Technical Maintenance of the Electric Motor-wheels”. For the analysis procedure, see Appendix B	Wrench set, washing bath, hair brush
3	Check the condition of the welding seams of the front axle beam tips.	No cracks in welding seams are allowed. See the section “Maintenance of the Front Axle”	By visual inspection. Clean the inspection place. Rags, brushes
4	Check and tighten if necessary nuts fastening front and rear wheels	For the tightening torques, see Appendix A	Wrench set
5	Perform the lubricating works	See the “Lubrication of the Dump Trucks” section and “Operational Materials” chapter	Lubricating equipment
SECOND MAINTENANCE (M-2)			
1	Clean the dump truck out of dirt and wash it	The washing shall be only performed with the protective covers fitted. No water contamination of units and apparatus of the traction electric drive and electric equipment is allowed. Blow the apparatus cabinets with compressed air	Washing plant, complete set of boots
2	Perform all the operations of the maintenance M-1		
3	Clean from dust the cyclones and bodies of air filters. Check and If necessary replace filter elements	See section “Engine systems maintenance”	Kit of wrenches, lighting device while checking of filter elements integrity

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
4	Perform maintenance of the ventilated brake unit	Prior to checking blow the blocks of resistors with dry compressed air. See the “Maintenance of the traction electric drive” section	Wrench set, hair brush, blowing gun, compressor plant
5	Check the condition, fastening, connection and installation of the output leads and cables of the traction electric drive and low-voltage the electric equipment	The wire and cables shall be fastened reliably. No mechanical damages of the cables and insulation of their conductors is allowed	By visual inspection
6	Check the intactness of the hoses of the integrated hydraulic system and external systems of the engine as well as their fastening	Replace the sleeves and hoses having leaks, swelling, cracks and/or those having lost elasticity. Any loosened fastening of the hoses and bolts fastening the flanges to the pump shall be re-tightened	Wrench set
7	Check the condition of the welded joints of the frame and body and that of the welding seams of the suspension brackets and levers, brackets of the steering cylinders and steering linkage levers	No cracks are allowed Any detected cracks shall be welded up.	Backlight lamp, metallic brush, welding equipment
8	Clean the dust guards and monocyclones of the air ducts of the ventilation and cooling system of the traction electric drive. Check the reliability of fastening the air cooling components	The air ducts of the ventilation system shall be clean. The slits for throwing the dust shall not be clogged. The hoses and connections shall be fastened reliably and free of mechanical damages or cracks	Hair brush, blowing gun, compressor plant
9	Check the fastening of service and parking brake systems gears, condition of the brake disks and the wear of the linings of the brake gears of the front and rear wheels and, if necessary, replace the linings. Check the clearance between the brake disk and linings of the parking brake system and adjust it if necessary	The brake gears shall be fastened reliably. See the “Maintenance of the Brake Systems” section	Sliding callipers, wrench set
10	Check and tighten if necessary: 1) tension bolts of the steering cylinder and steering linkage arm pins ; 2) nuts of the terminal connections of the tips of the steering cylinders and of the steering arm; 3) nuts of the fastening nuts of the steering linkage levers; 4) tension bolts of pins of the front suspension rod on the frame and front axle.	For tightening torques, see Appendix B	Wrench set
11	Check the fastening of the lugs to the terminals and fastening of storage batteries. Check the electrolyte level and density in the storage batteries. If necessary, bring the level to the normal value, restore the density and recharge the batteries	See the section “Maintenance of the electric equipment”	Wrench set, aerometer
12	Remove the torque rod in assy with the sun gear and check their condition by visual inspection. Check and adjust the clearance between the torque rod and the stop if necessary. Clean the drain holes at the bottom of the pipe of the rear axle housing	See the section “Maintenance of the power-wheels”	Wrench set
13	Check the nitrogen pressure in the hydropneumatic accumulators of the steering control and brake system, if necessary bring it to the normal state	See the “Maintenance of the brake systems” section	Wrench set, measuring facility, nitrogen cylinder, charging device

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
14	Replace the filtering element of the tank breather, filtering element in the oil tank of the hydraulic system, filtering element of the filter installed in the pressure line of the pump	The filter element in the oil tank and that of the pump filter shall be replaced each time the clogging sensor operates (the warning lamp on the instrumentation panel lights up)	Wrench set
15	Check the tightness of adjoining of the pedal roller to the pusher of the valve controlling the service brake system	When the pedal is lifted to the rest against the adjusting screw, the shall adjoin the pusher without causing the latter's displacement	Wrench set, probe
16	Retighten the fastening of the cardan shaft of the hydraulic system pump drive	The tightening torque of the bolts shall be 105-130 N.m.	Wrench set
17	Check the fastening of the lighting armature and light alarm devices	See the section "Maintenance of the electric equipment"	Screwdriver, wrench set, screen
18	Check the condition of tyres pressure control system	See the section "Maintenance" in the Operation Manual of the tyres pressure telemetric control system	
19	Check reliability of fixing of air-conditioner compressor. Carry out maintenance of air-conditioning system	Units of the system shall be fixed securely, shall be free of mechanical damage. See the "Maintenance" section of the air-conditioner operating manual	
20	Perform the lubricating works	See the"Lubrication of the Dump Trucks" n section and"Operational Materials" chapter	Lubricating equipment
THIRD MAINTENANCE (M-3)			
1	Perform all the operations of the maintenance M-2		
2	Check the condition of fastening of all the units to the engine and of the diesel-generator to the frame. Check the fastening of the cooling system radiators to the frame and clean the outer surfaces of the radiators. Check the condition of the rubber shock absorbers of the diesel-alternator	All the units shall be fastened reliably. Tighten the threaded joints, if necessary. The shock absorbers displaying exfoliation of rubber or its peeling from metal shall be replaced	Wrench set
3	Perform the visual inspection for cracks in areas of: 1. connection of the rear axle housing with the reduction gear of the motor-wheels; 2. welding of the flange of the lever of the rear axle housing; 3. welding of lower bracket of reaction bar	If any cracks on the casing of the motor-wheel reduction gear are detected, prepare the cracks for welding and weld them up	Backlight lamp, metallic brush, welding equipment
4	Check by visual inspection fastening of fender group elements and traction controller. If necessary, retighten screw joints.	All the units shall be fastened reliably	Wrench set
5	Perform maintenance of the vented brake unit	See the "Maintenance of the traction electric drive" section	Wrench set, hair brush, blowing gun, compressor plant

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
6	Check and retighten if necessary: 1) the bolts fastening motor-gears reduction gears to rear axle housing 2) the nut fastening the pin of the central joint of front suspension; 3) the bolts fastening the upper and lower brackets of the front suspension cylinders; 4) the bolt fastening the pin of the central joint of rear suspension; 5) the bolts fastening housings of brake gears of front wheels; 6) Bolts and nuts fastening brake gears of rear wheels	The tightening torques are given in Appendix A	Wrench set
7	Replace filtering elements of the motor-wheels reduction gears breathers	See the section “Maintenance of the motor-wheels”	Wrench set
8	Perform the maintenance (replacement) of the cab air intake system filtering element.	The filters shall be clean and free of mechanical damages. Used filters are not restorable and shall be replaced with new ones. Look chapter “Cab and body”	Wrench set
9	Check the operability of the pumping elements of the centralized automatic lubrication system pump. If necessary, replace the pumping elements	See the “Maintenance of the Centralized Automatic Lubrication System” section	Wrench set
10	Perform lubricating works	See the “Lubrication of the Dump Trucks” section and “Operational Materials” chapter	Lubricating equipment
SEASONAL MAINTENANCE (SM)			
1	Check and if necessary tighten bolts fastening traction electric motors to the reduction gears of motor-wheels	See tightening torques in the Appendix A	Wrench set
2	Wash the fuel tank, fuel pipelines and the filter element of the fuel tank breather	There shall be no sediment on the bottom and walls of the tank. The filter element shall be clean	Wrench set, bath, hair brush, washing liquid
3	Perform the maintenance of the engine starting preheating system. The maintenance shall be performed once a year when transiting to the autumn and winter operation period and repeatedly after each 50 hours of operation of the heater.	Clean the glow plug, injector and burner from the scale, wash the electromagnetic valve filter and cleanse the drain hole of the fuel pump	Wrench set, metallic brush, bath, liquid for removing the scale, washing liquid
4	Adjust the taper bearings of the motor-wheels hubs	See the “Maintenance of the Motor-Wheels” section	Hydraulic jack, complete set of fixtures, micrometer
5	Adjust the taper bearings of the hubs of the front wheels	See the “Maintenance of the Front Axle” section	Wrench set
6	Check backlashes in the joints of the pumps drive cardan shaft	There should be no backlash when shaking the shaft by hand.	Wrenches kit
7	The rotational speed of the steering wheel at the extreme positions of the steerable wheels (“slip”)	See the section “Maintenance of the Steering Control”	Wrench set, pressure gauge, play gauge
8	Check the oil pressure in the integrated hydraulic system	See section "Hydraulic system diagnosis" in the chapter "Dumping mechanism".	Pressure gauge
9	Wash the oil tank of the hydraulic system, clean the magnetic drain plugs, perform the maintenance of the magnetic filters fitted in the suction connection of the pump and drain manifold	The internal surface of the tank shall be clean and free of gum residues. See the “Maintenance of the dumping mechanism” section	Wrench set, bath, hair brush, washing liquid

Continuation of Table 17.1

Item No.	Operation Description	Technical requirements	Control method, instruments, tools and accessories for performing the works
10	Perform the maintenance of the storage batteries	Adjust the electrolyte density in accordance with the season and re-charge the batteries. See the “Maintenance of electric equipment” section	Areometer, charging device
11	Remove soot from the body soot collectors through the side hatches	See the “Maintenance of the Cab and Body” section	Wrench set
12	Perform works for maintenance of the fire-extinguishing system	See the section “Maintenance of the Fire-Extinguishing System”	Wrench set
13	Perform lubricating works	See the section “Lubrication of the Dump Trucks” and the chapter “Operational Materials”	Lubricating equipment
OTHER KINDS OF THE MAINTENANCE			
1	After every five thousand hours of running of the engine, check and retighten if necessary: 1) the bolts fastening the ears of the central joint of the front suspension to the lever; 2) the nuts fastening the ears of the central joint of the rear suspension to the lever; 3) the bolts fastening the pressure plates to the transverse rod pins of the rear suspension and covers to the pins of the transverse rod of the front suspension; 4) the nuts fastening ball joints of the cylinders of front and rear suspension; 5) the bolts fastening the covers of the bearings the suspension central joints	See the tightening torques in Appendix A	Wrench set
2	Perform the scheduled replacement of high-pressure hoses of integrated hydraulic system after every 20 thousand motor hours or after every three years of operation of the dump truck (whatever comes first)	Use the high-pressure hoses specified in the catalogue of parts	Wrench set
3	When the truck reaches 40 – 50 thousand kilometres run: – check gaps in the steering cylinders joints, steering linkage rods; – Adjust the toe-in of the steerable wheels	See the section “Maintenance of the Steering Control”	Wrench set
4	When reaching the truck run of 175 – 200 thousand kilometres perform the following: – perform scheduled adjustment of the clearance between the inserts and the ball joint supports of the suspension cylinders – check the oil level in the covers of the suspension cylinders – check the charge of the suspension cylinders with gas and recharge them, if necessary	To exclude the possibility of operation of the insert with widened clearance. See the section “Maintenance of the Suspension”	Wrenches kit. Performance ruler, measuring devices, cylinder with nitrogen, charging device

17.2 Lubrication of Dump Trucks

The reliability of operation of the dump truck units depends considerably on the periodicity of lubrication of friction pairs as well as on the brand and quality of the lubricants being used. Use of lubricants not specified in the “List of Lubricants to Be Used” and failure to adhere to the periodicity of replacement of the lubricants affects adversely the serviceability of the assemblies and systems.

It is only allowed to use substitutes of the lubricants in case of unavailability of the main brands. When changing the brands of the lubricants, the old lubricants shall be removed completely. Mixing the lubricants of different brands is not allowed.

When checking the oil level in the units and systems as well as when filling them, the dump truck shall be placed on a horizontal ground.

When performing the lubrication using a lubricator, it is necessary to take care to prevent friction surfaces from dirt contamination while lubricating; to do this, clean the place for feeding the lubricant and wipe thoroughly the lubricators prior to lubrication.

Before filling the vessels with oil, clean thoroughly the caps from dirt and dust. The filling shall be effected with oil from oil dispensers. If the dispensers are not available, oil shall be poured through a funnel from clean oil-dispensing vessel. The dump truck assemblies shall be filled with preheated oil.

Waste oils shall be drained from warmed up assemblies. After draining oil, the magnets of drain plugs shall be cleaned.

Layout of the lubrication points of the dump truck is shown in Figure 17.1, the list of lubricants to be used is in Table 17.2, the operational materials to be used depending on the ambient air temperature are listed in Table 18.1 and the equivalent lubricants are listed in Table 18.2.

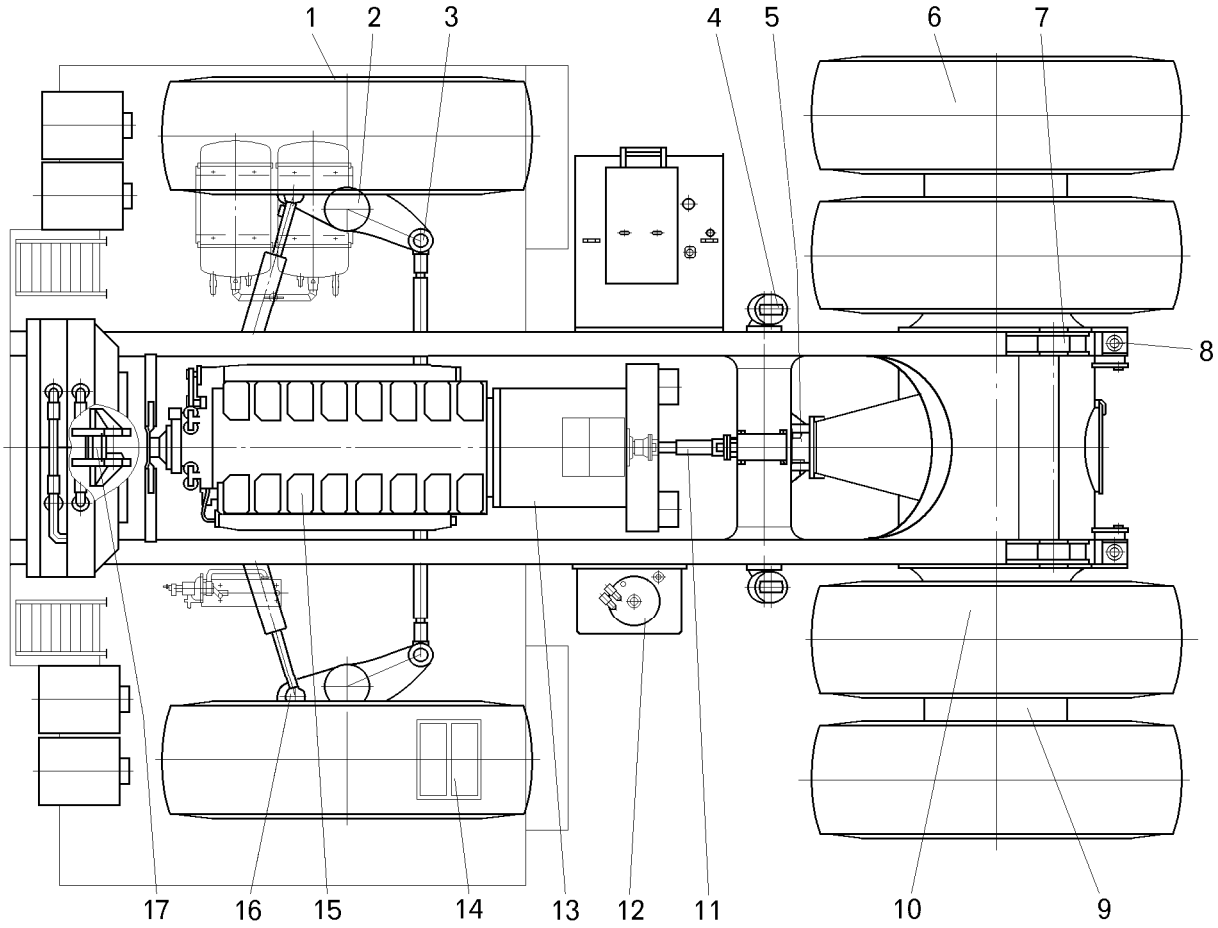


Figure 17.1 – Layout of the lubrication points

Table 17.2 – List of lubricants to be used

Pos. No. in Fig. 17.1	Description of the lubrication points (unit, joint, vessel)	Number of lubrication points	Description and brand of the lubricant	Periodicity of the operations	Instructions for performing the operations
15	Engine	Universal all seasons motor oil BELAZ G-Profi Mining 15W-40 or one in accordance with the operating manual for the engine			
–	Tank of the pneumatic engine starting system	1	Tank of the pneumatic engine starting system	DM	Oil level should be of 15020 mm below the upper edge of the tank body
12	Oil tank of the integrated hydraulic system	1	For applying the oils in the hydraulic system and periodicity of the operations, see section 14 “Dumping Mechanism”		
10	Reduction gears of the motor-wheels	2	Transmission oil	M-1	Check the oil level
			SAE 80W–140 API:GL-5 SAE 85W–140 API:GL-5 The temperature of oil flash in the open crucible shall be no less than 210^0C (GOST 4333 or ASTM D 92)	2500 h	Replace oil
9	Cups of the housing of the motor-wheel reduction gear (intercup cavity)	4	Grease Lithol-24 Grease Лита (Lita)	M-1	Add 100 g of the grease into each lubricator
	Cups of the housing of the motor-wheel reduction gear (intercup cavity)	4	Grease Lithol-24 Grease Лита (Lita)	While tires replacing or redactor repair	Add 150 g of the grease into each lubricator
8	Suspension cylinders	4	Shock absorber fluid LUKOIL-AZh Alternates: Shock absorber fluid МГП-12; Shock absorber fluid ГРЖ-12	M-2	Add the fluid each time when recharging the cylinder if necessary
–*	Ball joints of the suspension cylinders	8	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate through the lubricators until fresh grease appears from the safety valves
17* 5*	Central joints of the suspension: – of the front axle – of the rear axle	2	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita))	M-1	Lubricate through the lubricators until fresh grease appears from the protective valves
–*	Joints of the longitudinal rods of the suspension of the front and rear axle	4	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate through the lubricators until fresh grease appears from the safety valves
1	Bearings of the hubs of the front wheels	4	Grease MC-1000	1500 – 2000 h	Place 100 g of grease through each lubricator (6 pcs) of the outer bearings, and 200 g grease through each lubricator (6 pcs) of the inner bearings
				SM (once three years)	Remove the hubs, wash the bearings, mating parts and put the fresh lubricant
2*	Bushings of the front axle pivots	4	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate the bushings through the lubricators in the quantity of 0.2-0.35 kg per each ear of the knuckle

Continuation of Table 17.2

Pos. No. in Fig. 17.1	Description of the lubrication points (unit, joint, vessel)	Number of lubrication points	Description and brand of the lubricant	Periodicity of the operations	Instructions for performing the operations
11	Cardan shaft joints of the integrated hydraulic system pump drive	2	Grease No. 158M	M-1	Lubricate through the lubricators until fresh grease appears from the seals
	Splined joint of the cardan shaft of the integrated hydraulic system pump drive	1	Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate through a lubricator until fresh lubricant appears from the hole in the choke
–	Splined joint of the cardan shaft of the steering control	1	Greases Lithol-24 Grease Лита (Lita)	SM (once a year)	Lubricate with a thin layer of grease when assembling the unit
–	Cardan shaft joints of the steering control	2	Grease No. 158M	SM (once a year)	Disassemble the units and put the grease
3*	Joints of the steering linkage	2	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate through the lubricators until fresh grease appears from the seals
16*	Joints of the turning cylinders of the steering	4	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-2	Lubricate through the lubricators until fresh grease appears from the seals
–	Steering column shaft bearings	2	Grease Lithol-24 Grease Лита (Lita)	SM (once two years)	Disassemble the bearing units, wash them and put the fresh lubricant
4*	Supports of the dumping mechanism cylinders	4	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-1	Lubricate through the lubricators until fresh grease appears from the gaps
7*	Axles of the rear body supports	2	Grease MC-1000 Grease Lithol-24 Grease Лита (Lita)	M-1	Lubricate through the lubricators until fresh grease appears from the clearances
–	Bearings of electric motor of Braking System Ventilation Unit fan	2	Grease Lithol-24	1000 h	Lubricate through lubricators. When dismounting wash bearing units and put fresh grease
–	Traction controller bearings	2	Grease Lithol-24 Grease Лита (Lita)	–	Lubricate when disassembling the units
	Bearing units of the traction electric equipment	In accordance with the documentation for the traction electric drive			
–	Slip connectors and connecting panels of the low-voltage electric equipment conductors	20	Grease Lithol-24	–	Lubricate the metallic surfaces with thin layer each time when disassembling the units
14	Terminals of the storage batteries	4	Grease Lithol-24 Grease Лита (Lita)	–	Lubricate with a thin layer of the grease when installing the batteries
–	Electric motor of the fuel priming pump	2	Grease Lithol-24	Once a year	Disassemble and wash the bearing units and put the fresh grease

Continuation of Table 17.2

Pos. No. in Fig. 17.1	Description of the lubrication points (unit, joint, vessel)	Number of lubrication points	Description and brand of the lubricant	Periodicity of the operations	Instructions for performing the operations
	Bearings of pneumatic starter	6	Grease Lithol-24 Grease Лита (Lita)	–	Disassemble bearing units, wash and put fresh grease when repairing the unit
–	Bearings of the low-voltage alternator	See operation manual for the generator			
–	Heater cock	1	Grease Lithol-24 Grease Лита (Lita)	SM (once a year)	Lubricate after preliminary cleaning (in autumn)
–	Cab door lock	2	Grease Lithol-24 Grease Лита (Lita)	–	Lubricate if necessary
–	Cab door lock actuator	2	Grease Lithol-24 Grease Лита (Lita)	–	Lubricate if necessary
–	Hinge pins of the cab doors	6	Grease Lithol-24 Grease Лита (Lita)	–	Lubricate if necessary

Note:

1. The "*" mark designates the units to be lubricated by the centralized automatic lubrication system. Should the units be lubricated by the centralized automatic lubrication system, the lubricants of the brands specified in Table 17.3 shall be used.

In case of the lubrication system malfunction look schedule and directions on the operations for units being lubricated by centralized lubrication system in the table.

2. It is only allowed to use substitutes of the lubricants in case of unavailability of the main brands of the lubricants. In case of changing the lubricant brands, the old lubricant shall be removed completely. Mixing the lubricants of different brands is not allowed.

17.3 Centralized Automatic Lubrication System

DURING OPERATION AND MAINTENANCE OF THE LUBRICATION SYSTEM, IT IS NECESSARY TO FOLLOW ATTACHED OPERATION MANUALS FOR "LINCOLN" OR "VOGEL" SYSTEMS.

The centralized automatic lubrication system is intended for lubricating of the units of suspension, steering control, dumping mechanism cylinders supports, body supports and pivot bushings.

The dump trucks are equipped with the Lincoln or Vogel lubrication systems. Both the systems provide the automatic lubrication of the dump truck units and have only some construction differences of the system units.

17.3.1 Specification of the lubrication systems

For the specification of the lubrication systems see Table 17.3.

Table 17.3 – Specification of the lubrication systems

Parameter, unit of measurement	Parameter value	
	Lincoln	Lincoln
Pump:		
Operating voltage, V	24	24
Oil tank charge capacity, l	8	10
Maximum working pressure, MPa	35	30
Number of the lubrication outlets	2	2
Volume supply by a single pumping element, cm^3/min	4	2,5
Control unit:		
Specified time of the pump running, minutes	8	4
Specified time of the pause in the pump running, minutes	180	60
NLGI 2 plastic greases to be used:		
до температуры минус 25 ^{0}C	MC-1000, lubricants specified in the operating manuals for the Lincoln or Vogel systems	
при температуре ниже минус 25 ^{0}C	MC-1400 (NORD), Лита (Lita), greases specified in the operating manuals for the Lincoln or Vogel systems	
Note: It is allowed to use the Lithol-24 grease of the class NLGI 3 in the spring and summer period with replacement when performing the seasonal maintenance (SM)		

17.3.2 Construction and Operating Principle of the Centralized Automatic Lubrication System

The lubrication system consists of the pump (Figure 17.2) with the vessel for lubrication and control unit, safety valves, measurers, pipelines and illuminated pushbutton on the instrumentation panel. The metering pumps II, III, IV, V are located on the beam of the front axle of the dump truck and the measurers I, VI, VIII – on the left side member of the dump truck frame.

The pump VII switches on automatically on starting the engine. From the pump tank the lubricant is fed via pipelines to the main measurers IV and VI, from the main measurer – to the additional measurers I, II, III, V, VIII and then to the lubrication points. During the pump operation, each lubrication point receives a certain quantity of the lubricant based on the volume in the friction unit to be filled with the lubricant and periodicity of its change. When the pump is running, the pushbutton lamp is lit steadily.

The tank shall be filled through the cover or filler valve on the pump casing. Filling through the filler valve is more preferable because it excludes the contamination of the lubricant.

The pump is driven from the electric motor located in a single casing with the pump. The lubricant is fed by two pumping elements. The pump elements are fitted with the safety valves. They limit the pressure in the system and operate at the pressure of 30 – 35 MPa.

If the lubricant is exuded from the valve, it means that the system is blocked. The time of the pump running and pause in the running are to be set by the switches located on the pump.

The pump is fitted with a button for starting the additional lubrication cycle. The additional lubrication cycle can be also started by means of the pushbutton located on the instrumentation panel. To start the additional lubrication cycle, it is necessary to press the button and hold down for two seconds.

The direction of the pump vane rotation is shown by the arrow on the pump tank

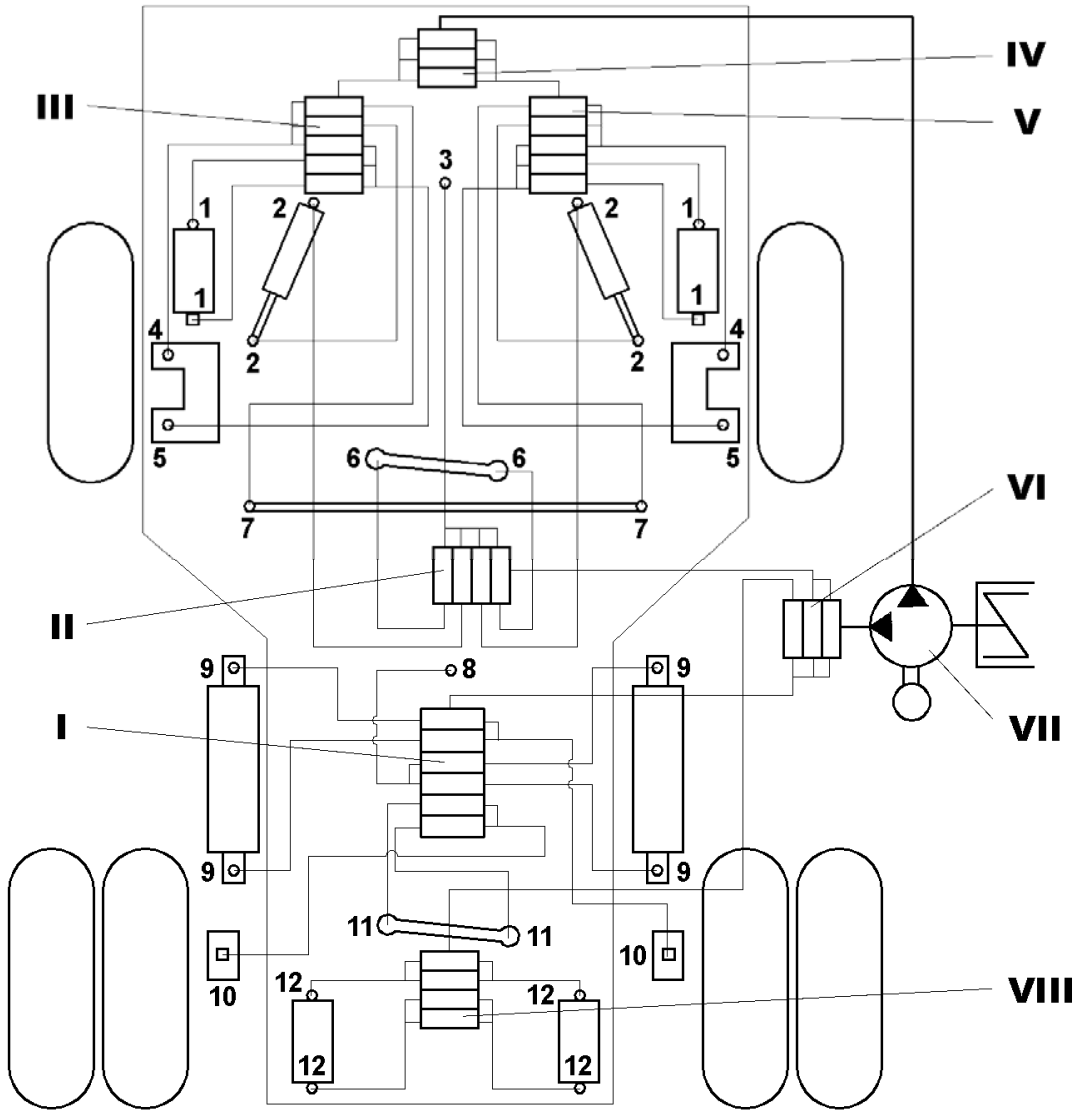


Figure 17.2 – Layout of the centralized automatic lubrication system:

1, 12 – Ball joints supports of the front and rear suspension cylinders; 2 – joints of the steering cylinders; 3, 8 – central suspension joints of front and rear axles; 4, 5 – bushings of the front axle pivots; 6, 11 – joints of the cross rods of the suspension of the front and rear axles; 7 – joints of the steering control arm; 9 – supports of the dumping mechanism cylinders; 10 – axles of the rear supports of the body

IV, VI – main measurers; I, II, III, V, VIII – additional measurers; VII – electric pump with the tank

17.3.3 Maintenance of the Centralized Automatic Lubrication System

When performing the DM:

– Carry out external inspection of the system.

During the inspection, make sure that the pump, measurers and pipelines are free from damages and discharge of lubricant from the connections. Check the presence of the lubricant in the pump tank and if the lubricant is discharged from the safety valves. Never allow the tank to be discharged; fill it with the lubricant. The lubricant level shall not be below the mark of the minimum level on the tank. The lubricant shall be clean and free of contaminants and/or air bubbles. Otherwise the system can be blocked. Only the lubricants of the recommended brands shall be used. Check regularly the oil feed to the rubbing units. The discharge of the lubricant from the valves or clearances shall be visible.

When performing the M-3:

– Check the serviceability of the pumping elements of the lubrication system pump according to the operating manual delivered with the Lincoln or Vogel systems.

IF DURING THE DUMP TRUCK OPERATION A UNIT LUBRICATED BY THE LUBRICATION SYSTEM HAS BEEN DEMOUNTED, AFTER ITS MOUNTING AND PRIOR TO CONNECTION OF THE LUBRICATING SYSTEM THE UNIT SHALL BE FILLED OBLIGATORILY WITH GREASE BY MEANS OF A MANUAL BOOSTER UNTIL THE GREASE APPEARS FROM THE VALVES OR GAPS.

WHEN PERFORMING THE MAINTENANCE AND REPAIR OF THE DUMP TRUCK AS WELL AS WELDING WORKS, THE PROTECTION OF THE PIPELINES OF THE LUBRICATION SYSTEM SHALL BE ENSURED.

WHEN MOVING ON THE CHASSIS, IT IS PROHIBITED TO LEAN AGAINST THE MEASURERS, PIPELINES, ANGLE PIECES AND NIPPLES OF THE LUBRICATION SYSTEM.

17.3.4 Troubleshooting of the Lubrication System

The procedures of Troubleshooting of the Lubrication System are given in Table 17.4.

Table 17.4 – Troubleshooting of the Lubrication System

Failure and its external signs	Possible cause	Remedy
The electric motor of the pump does not operate	No voltage supplied	Check the power supply unit, fuses and wires. Eliminate the fault, replace the fuses
	Electric motor failure	Replace electric motor
	Control unit failure	Replace the control unit
The pump fails to feed the lubricant	The pump tank is empty	Fill the pump with clean lubricant. Switch the pump by starting the additional lubrication cycle. To do this, press the illuminated button on the instrumentation panel or on the pump and hold it down for 2 s. Perform a few additional lubrication cycles until the lubricant reach all the points
	Presence of the air bubbles in the lubricant	Ease of the fastening of the pipelines from the pump to the main measurers. Start additional lubrication cycle. As soon as the lubricant without bubbles is exudated, connect the pipelines
	Use of the lubricant which is not recommended	Replace the lubricant with the specified one
	The suction hole of the pumping element is clogged	Cleanse the suction hole
	The pumping element piston is worn out	Replace the pumping element
	The check valve or pumping element is faulty	Replace the pumping element
Uneven (either excessive or insufficient) lubrication of the lubrication points. The lubricant is exudated through the valves or clearances from some friction units in larger quantity than from the others	The time of running and pause of the pump is set incorrectly	Check the time setting on the pump

Continuation of Table 17.4

Failure and its external signs	Possible cause	Remedy
Blocking of the system: the lubricant is exudated from the safety valve	Measurers, pipelines or lubrication points are clogged	*To locate and eliminate the blocking, proceed as follows:* 1. Check the protective valve. To do this, connect a pressure gauge to the valve, start the additional lubrication cycle and check the pressure at which the valve is opened. The check can be also performed using a manual pump with a pressure gauge. The safety valve shall open at the pressure of 35 MPa for the Lincoln system and at 30 MPa for the Vogel system. If necessary, replace the valve. 2. Disconnect the pipeline between the pump and the main measurer from the latter. Switch on the pump and check if the lubricant is discharged from the pipeline. Connect the pipeline to the main measurer. 3. Disconnect the pipelines between the main measurer and the additional ones. If the lubricant is discharged from the measurer hole, the blocking should be sought in the additional measurer circuit. 4. Connect the pipelines to the main measurer and disconnect sequentially the pipelines connecting the additional measurer with the lubrication points from the additional measurer. If the lubricant is discharged from the measurer hole, the blocking should be sought in the pipeline or lubrication point. 5. Connect the pipelines with the additional measurer and disconnect sequentially the pipelines from the lubrication points. If the lubricant is discharged from the pipeline, the lubrication point is blocked. 6. Screw the lubricator into the blocked lubrication point and fed the lubricant using a lubrication gun until the fresh lubricant starts to be discharged. Then connect the pipeline to the lubrication point and make sure that the blocking is eliminated and the system operates normally. Should it be detected that the pipeline is blocked, pump the lubricant through it using a manual pump. 7. If it is found when checking the system that no lubricant is discharged from the measurer hole, the measurer is blocked. 8. Disconnect all the pipelines from the measurer. Screw out the plugs of the measurer pistons and remove the pistons using an elastic ramrod to exclude the damage of the working surfaces. Wash the measurer holes and pistons with a fat-decomposing detergent and blow compressed air through them. Re-assemble the measurer and fill it with the lubricant by means of a manual pump prior to connecting the pipelines. The pressure in the measurer shall not exceed 2.5 MPa. Otherwise, the measurer shall be replaced. **ATTENTION**! *The pistons are not interchangeable. It is necessary to mark the pistons and the holes, into which they are mounted*

18 OPERATIONAL MATERIALS

AT OPERATION OF THE DUMP TRUCK IT IS NECESSARY TO APPLY ONLY RECOMMENDED MARKS OF OPERATIONAL MATERIALS, THE QUALITY OF WHICH SHALL BE CONFIRMED BY DOCUMENTATION.

18.1 Fuel

Fuel for the engine shall be applied in accordance with the recommendations, stated in the Engine operation manual.

In order to prevent the breakdown of fuel supply devices due to the presence of water in fuel it is recommended to fill a tank by fuel that sediment at least 10 days.

18.2 Lubricants

Universal all seasons motor oil BELAZ G-Profi Mining 15W-40 or one in accordance with the operating manual should be be used for the engine.

Transmission oils, operating fluids for hydraulic systems (hydraulic oils) and grease lubricants shall be applied in accordance with seasons and climatic conditions of dump trucks operation.

The lubricants and recommendations for their use depending on the temperature of the ambient temperature are listed in Table 18.1.

The brands of the lubricants and their equivalents are listed in Table 18.2.

Table 18.1- Using the lubricants depending on the ambient temperature

Lubricant brand	State Standard (ГОСТ), Technical Specifications (ТУ)	Temperature range of using the lubricants
Shock absorber fluid LUKOIL-AZh	Technical Specification (ТУ) 0253-025-00148599	Above minus 50°C
Shock absorber fluid МГП-12	Technical Specification (ТУ) 0253-052-00148843	Above minus 40°C
Shock absorber fluid ГРЖ-12	Technical Specification (ТУ) 0253-048-05767924	Above minus 50°C
Grease No. 158M	ТУ 38.301-40-25	Above minus 30°C
Grease Lithol-24	ГОСТ 21150	Above minus 40°C
Grease Лита (Lita)	ТУ 38.101808	Above minus 50°C
Grease MC-1000	Technical Specification (ТУ) 0254-003-45540231	Above minus 40 °C
Grease MC 1400 (NORD)	Technical Specification (ТУ) 0254-028-45540231	Above minus 50°C
Note: For using the oils in the hydraulic system depending on the ambient air temperature, see the chapter “Dumping Mechanism”		

Table 18.2 – List of equivalent lubricants

Lubricant brands	Equivalent lubricants		
	Classification and specification	Manufacturer	Description
Lithol-24	MIL-G-18709A MIL-G-10924C	Shell Mobil BP	Alvania EP 2; Retinax EP 2 Mobilux EP 2, Mobilux EP 3 Energrease L2

Continuation of Table 18.2

Lubricant brands	Equivalent lubricants		
	Classification and specification	**Manufacturer**	**Description**
Лита (Lita)	SM-1C-4515A (Ford)	Shell Mobil BP	AeroShell Grease 6 Mobilux EP 2 Energrease LT2
МС-1000	MIL-G-18709A MIL-G-10924C	Shell Mobil BP	Alvania EP 2; Retinax EP 2 Mobilux EP 2, Mobilux EP 3 Energrease L2
МС 1400 (NORD)	–	BP	Energrease LT2 Energrease L2
ЖРО	MIL-G-10924C	Shell Mobil BP	Alvania RL 3 Mobilux EP 3 Energrease LS2
158М	–	Shell BP	Alvania RL 1 Energrease LS-EP2
Note: For the equivalents of oils for the hydraulic system, refer to chapter “Dumping Mechanism”.			

18.3 Cooling fluid

For engine cooling system it is recommended within the whole year to use special antifreeze solutions according to the Engine operation manual.

COOLING FLUIDS ARE TOXIC!

18.4 Nitrogen

Technical gaseous nitrogen (GOST 9293 “Gaseous and liquid nitrogen”) is used for charging of suspension cylinders and hydro-pneumatic accumulators of service brake system and steering.

Technical gaseous nitrogen is supplied in steel seamless balloons under the pressure (15,0±0,5) MPa. Balloons are painted in black colour. At the top of the balloon there is marking «NITROGEN» of yellow colour and circular brown color band.

18.5 Commercial Ethylic alcohol

Commercial rectified ethylic alcohol under GOST 18300 is used for washing of parts of electric machines and devices.

THE RECOMMENDED ALCOHOL IS PRODUCED FROM NON-FOOD VEGETABLE RAW MATERIAL. AS REGARDS THE SEVERITY OF THE HUMAN HEALTH IMPACT, IT IS RELATED TO THE FORTH CLASS OF DANGER TO THE STATE STANDARD (ГОСТ) 12.1.007.

19 STORAGE RULES. TRANSPORTATION

The dump trucks that are not planned to be operated within three months and more, and within the transportation period as well, shall be subject to preservation.

The preservation protects the details, units and assemblies against corrosion and allows keeping the dump truck in the serviceable condition during the storage period on the transportation fleet territory.

General requirements to chose means for temporary anti-corrosion protection, preservation and depreservation of dump trucks during storage period and transportation are given in standard (GOST) 9.014.

19.1 Preservation materials

As protective (preservation) greases use plastic grease ПВК grease (State Standard (GOST) 19537) (Substitute is The Lithol-24 (State Standard (GOST) 21150), and liquid grease К-17 (State Standard (GOST) 10877) (Substitute is corrosion-preventing oil Белакор of A grade ТУ РБ 600125053.020).

The К-17 grease (Substitute is corrosion – preventing oil Белакор) is used for long-term preservation of the parts. The dump truck assemblies are preserved without dismantling: drain the standard oil, pump the protective grease through it and drain the excess grease out. To put the assembly into operation, it is sufficient to fill it with the standard oil.

The grease ПВК (Substitute is The Lithol-24) are used for preservation of the external and easily accessible internal surfaces.

To remove preservation grease from the parts and units surfaces use white spirit GOST 3134 (substitute – Solvent GOST 8505 or Solvent 646 GOST 18188).

19.2 Preservation and represervation

Manufacturer exposes dump trucks to preservation during transporting period.

Following units (assemblies) and design elements are subjects to be preserved:

19.2.1 Engine, apparatuses and machines of traction electric drive, dump truck systems – operations are to be performed with intervals and in accordance with the requirements set out in the relevant operational documentation (manuals, instructions, certificates, etc.).

19.2.2 Perform preservation of steering hydraulic drive pipelines by means of serial rotation of wheels to both end positions.

19.2.3 Following parts and units are to be coated with lubricant К-17:

– terminals of transient panels, of low-voltage generator, contactors, wires to batteries (except for parts of the cabin electrical equipment);

– seats of body, unpainted surfaces of the dumping gear cylinders heads, holes of supports of body and frame, if the body is not installed;

– fingers, bonnet hinges, door hinges, batteries box hinges, power cabinets hinges, tool box hinges;

– fingers of radiators shutters drive;

– axle fastening the windshield wiper arm and other parts having decorative metallic coating.

19.2.4 Following parts and units are to be coated with lubricant ПВК:

– the inner surface of supports of the dumping mechanism cylinders, bearings, rods of steering cylinders. After coating, wrap parts with plastic film in two layers and tie colorless adhesive tape;

– open chrome surfaces of the dumping mechanism hydraulic cylinders, pivots of front suspension, chrome-plated surfaces of the suspension cylinders and all unpainted threaded joints;

– wheel studs (if wheels are removed).

19.2.5 Unscrew bolts fastening cover of bearings of pneumatic starter rotor, remove the cover, disconnect pipeline supplying air to the pneumatic motor and pour from 30 to 50 g of spindle oil into it. Through the hexagonal hole (S = 8 mm) in the end of the rotor shaft perform rotation of the pneumatic starter rotor (for trucks with pneumatic starter).

19.2.6 Install protective gaskets made of waxed paper БП 3-35 GOST9569 in two layers between the brushes and synchronous traction generator slip rings, brushes and collector of traction motors.

Immediately before starting the engine remove gaskets between the brushes and synchronous traction generator slip rings, brushes and collector of traction motors.

Vent windows of traction generator are to be sealed by waxed paper БП 3-35.

19.2.7 Seal with plastic film in two layers with tying by adhesive colorless tape following parts:

– breathers of oil tank and reduction gears of motor-wheels;

– filler neck of the expansion tank, the engine (for oil), fuel and oil tanks;

– the air intakes of air filters, vent windows of low-voltage generator, air intakes of the ventilation system and cooling system of the traction motor electric drive, air intake connection pipe of the engine pneumatic start-up from an external source, a pressure gauge and a safety valve of the engine pneumatic start-up.

19.2.8 The ends of the exhaust tubes are to be sealed by cover or technological plugs (it is admitted to seal the end of the exhaust tube by plastic film).

IF AT THE END OF THE LAST PRESERVATION TERM DUMP TRUCK IS NOT PUT INTO OPERATION (INFORMATION FOR PRESERVATION, DURATION OF PRESERVATION, PERFORMED BY THE MANUFACTURER, IS GIVEN IN TRUCK CERTIFICATE), THEN AFTER THAT PERIOD IT MUST BE REPRESERVED.

TERM OF TRUCK STORAGE WITHOUT REPRESERVATION SHOULD NOT EXCEED TWELVE MONTHS.

Represervation – is depreservation of truck, which leads to removing of the conservation grease from surfaces, removing the sealing materials (polyethylene film or wax paper) from components and units, and repeated its preservation (see above).

Preservation works should be carried out indoors in well-ventilated areas, protected from atmospheric precipitation, free of dust and aggressive vapors and liquids leading to corrosion with the air temperature not lower than 15 oC.

When storing the dump trucks in the outdoor area or in the unheated facility, the works for preservation are allowed to be carried out only when dry weather and with the air temperature not lower than 5 oC.

The surface of products subjected to preservation, must be free of corrosion, oil and other contaminants, dried and greased by solvent.

Ingress of dust, metal chips and sand on the surfaces to be preserved is not allowed. The whole preservation process should be carried out carefully and in a quality manner to prevent the damage of the lacquer coating. All the oil spots, leaks and splashes of preservation grease shall be removed by means of clean rugs.

IF TRUCK IS NOT IN OPERATION MORE THAN THREE MONTHS IT SHOULD BE PRESERVED, AND IN TWELVE MONTHS IT IS TO BE SUBJECTED TO BE REPRESERVED.

In this case, in addition to the above mentioned in paragraphs 19.2.1 – 19.2.8, perform the following operations:

– carry out the regular maintenance;

– carefully inspect all hoses and rubber products. Replace all the hoses and rubber products with cracks and delamination;

– take samples of oil (oil tank, reduction gears of motor-wheels, suspension cylinders) and fuel and check for compliance with GOST. In case of noncompliance with standard performance replace all;

– replace lubricant in units and components according to the layout of lubrication points;

– place wooden beams between the axles and the frame in the area of suspension cylinders aiming to unload ones;

– glue over cab windows with lightproof paper from outside;

– remove the storage batteries and prepare it to be stored according to the battery manufacturer instructions.

If the truck is not planned to be used within one year it is necessary to:

– remove the wheels from the dump truck and demount the tires (see Chapter “Assembly and disassembly of wheels and tires”).

– derust the parts of wheels and paint them;

– wash the tires and wipe dry;

– before assembly it is necessary to powder the inner surface of tires;

– assemble the wheels, mount it on the dump trucks and adjust the air pressure to the standard level.

19.3 Storage Rules

Set the dump truck for storage having evidence that it is technically sound, fully completed and the preserved.

IT IS PROHIBITED TO SET TRUCK FOR STORAGE WITH CORROSION, DAMAGED PAINTS AND CHROME COATS.

When storing the dump truck it is necessary to place it onto supports, the wheels should be located at a distance of 80 – 100 mm from the ground.

It is admitted to store the truck on tires on the storage area without placing it onto supports with further rolling the truck every three months (to change the tire contact spot with the surface).

TRUCK PARKING IS PROHIBITED UNLESS TYRE PRESSURE DOES NOT MEET REQUIRED STANDARDS.

Dump truck should be stored without batteries.

Storage area should be equipped with fire-fighting appliances and devices.

The dump trucks that are left for storage should be subject to servicing. The following operations should be carried out once a month – clean truck from dust, moisture or snow.

The dump trucks that are left for storage should be subject performing following operations once every three months:

– check the position of the truck on supports;

– check the tire pressure (when storing on wheels).

The dump trucks that are left for storage should be subject performing following operations once every six months:

– check the condition of the external surfaces of units and assemblies;

– check the condition of paint coatings;

– check the condition of the sealing materials;

– check visually condition of rubber products (window seals, high pressure hoses, hoses connecting air ducts, rubber protective covers, and so on).

Eliminate the identified faults.

19.4 Depreservation of the dump truck

For depreservation remove the dump truck from supports, remove from external surfaces protective grease and sealing means, replace the grease in aggregates and components, install the batteries.

Remove the gaskets between the brushes and slip rings of the synchronous generator, brushes and collector of traction electromotors.

Perform depreservation of the engine, apparatuses and machines of traction drive, truck systems in accordance with the operational documentation for the product.

Check the technical condition of the truck with control mileage.

19.5 Transportation

Dump trucks can be transported by railway, water and air transport.

The dump truck is being shipped from the manufacturer's facility in partially disassembled state.

When transporting the dump truck by the railway transport, follow ДЧ-1835 Instruction for Carrying the Oversized and Heavy Cargoes by Railways with the Track Width of 1520 mm.

Accommodation and fastening of dump trucks in partially disassembled condition on an open railway rolling stock should be carried out within the limits of bulkiness: lower – third, side – fourth, upper – second grade.

When carrying the dump truck, the label with the following information shall be attached in the cab at a visible place:

– water removing from systems or refilling them with antifreeze coolant;

– disconnection and condition of the storage batteries (either with or without electrolyte);

– grease information in units and mechanisms.

20 DISPOSAL

For performing the disposal of dump trucks the priority shall be given to specialized companies having a license on the territory of this country for carrying out the activities for neutralization and disposal of the I – IV hazard class wastes produced as a result of useful qualities loss by wheeled vehicles.

Final decommissioning and disposal of a truck require complete disassembling of the truck and its individual components.

All units and assemblies of the truck should be disposed in such a way that would exclude the possibility of health and environmental damage.

20.1 Preparing for disposal

1 *Processes for preparing truck for disposal:*

– Dismantling storage batteries and liquefied gas containers (prior to dismantling all the pressurized apparatuses shall be discharged);

– Removal or neutralization of explosive components;

– Separate drainage and storage of liquids: fuel, engine oil, transmission oils, hydraulic drive systems working fluids, cooling fluids, brake fluids, battery acid, air-conditioning system fluids and other fluids contained in decommissioned wheeled vehicles unless it would hamper following restoration of parts, units and assemblies;

– dismantling of all the components containing environment-damaging materials and having corresponding marking.

2 *Processes for decommissioned dump truck dismantling when preparing materials for recycling:*

– Dismantling of metallic parts containing iron, copper, aluminium and other non-ferrous metals if these materials can not be separated at materials reduction stage;

– Dismantling of parts and connecting fittings having chromium coating and subject to production process disposal of parts containing hexavalent chromium;

– Dismantling of tire casings and large plastic parts and units (instrument clusters, fluids containers, etc.) if these materials can not be separated at the materials reduction stage ensuring facilitating the their further recycling process;

– Waste type classification, its accumulation and transfer to specialized processing or burial (destruction) companies.

ATTENTION! ELECTRIC MACHINES DISMANTLING WORKS SHALL BE PERFORMED BY QUALIFIED STAFF ONLY.

3 *Requirements for areas (including temporary) of receipt and storage of dump trucks subject to disposal as well as for other outdoor production and storage areas:*

– The area shall be equipped with concrete pavement, rainwater withdrawal and collection system with sideways over the perimeter for the purpose of guaranteed withdrawal of rainwater into the rainwater sewer system;

– The area shall be equipped with means for preventing liquids leakage, sedimentation tanks and treatment facilities for sewage waters degreasing.

4 Storage of dump trucks to be disposed shall be in such a way that would prevent damage of components (parts and units) as well as technical fluids spillage.

5 Technical fluids drained from dump trucks shall be stored in special underground or surface reservoirs located outdoors or in production facilities. All the technical liquids shall be stored separately. Separate reservoirs shall be provided for fuel, engine oil, transmission oils, working fluids of the hydraulic drive systems, cooling fluids, brake fluids, battery acids, air-conditioning systems fluids and other fluids contained in trucks to be disposed.

6 Solid waste shall be stored in containers located outdoors or in production facilities.

7 Storage batteries, oil filters and chromium coated parts shall be stored in separate special containers.

8 Transportation and burial of disposal waste of dump trucks' components and operational materials (storage batteries, oil filters, fuel filters, engine and transmission oils, battery acid, engine cooling system and cab heating system liquids, hydraulic drive systems working fluids, shock-absorber fluid, brake fluid, air-conditioning systems fluids, all the components having marking indicating the presence of environmentally-dangerous components, tires) together with household and industrial garbage are not allowed, as well as technical fluids or oils drainage into the sewage system.

21 APPENDICES

21.1 APPENDIX A – Tightening torque for most critical screw joints (for reference)

Tightening torques for most critical screw joints are shown in the table A

Table A – Tightening torques for most critical screw joints

№	Description of screw joint	Tightening torque, N.m
1	Bolts of fastening of traction electric motor to the housing of reducing gear of electric motor-wheel	800 – 1000
2	Bolts of fastening of electric motor-wheel to the rear –axle housing	2950 – 3150
3	Bolts of fastening of flanges to the traction electric motor shaft	260 – 320
4	Bolts of fastening of thrust ring of reducing gear of motor-wheel	400 – 450
5	Adjusting bolts of front wheel hub	110 – 160
6	Nuts of fastening of pivoted levers to the rolling cam	800 – 1200
7	Bolts of fastening of front brake gears housing	2500 – 3000
8	Nuts of fastening of front and rear wheels	1265 – 1565
9	Nuts of terminal connections of hydraulic swing cylinder and trapezoid steering rod	125 – 150
10	Bolts of swing cylinder pins and trapezoid steering rod	600 – 740
11	Bolts of fastening of inner jaws of service and parking brake gears of rear wheels	550 – 700
12	Crown nuts of fastening of outer jaws of service and parking brake gears of rear wheels	370 – 450
13	Bolts of fastening of drive pump cardan shaft of joint hydraulic system	102 – 126
	Tightening torque of most important suspension screw joints are shown in the section «Suspension», table 8.1	

21.2 APPENDIX B – The order for oil control of reducing gears of motor-wheels (for reference)

Periodicity of tests:

– During regular checks when performing each TM –1;
– prior to oil change;
– more often, in case of irregular wear.

Test procedure:

– collect oil in 10 – 15 minutes after dump truck stopping, and before stop the dump truck shall operate at least an hour;

– turn off the plug of filler opening on the part of outer cover;

– through the opening by means of sampling instrument take from each reducing gear 150-200 ml.of oil at the depth of 50 mm from the bottom of oil chamber, tests of each reducing gear shall be put in separate reservoir (bottle) and marked;

– oil analysis and results analysis shall be performed immediately, precisely carry out:

a) spectrum analysis for ferrum, chrome and silicon content;

b) measure coefficient of kinematic viscosity;

c) insolubles content.

– measured content of ferrum, chrome, nickel, cuprum and silicon compare with previous results.

If there is an insignificant increase of any element, test the gear wheels, spline joints and bearings. If only the silicon content was significantly changed, the oil shall be changed. The oil change shall be performed in case of gradual accumulation of metal particles with its concentration exceeding 5 g/l (0,5%)

The presence of cuprum is provided by use of first row bearings with brass divider. The cuprum concentration in oil is up to 0,1 g/l (0,01%) that corresponds to the normal wear. The cuprum concentration of abovementioned value proves the intensive wear of divider, and the cuprum particles can be visually seen in test-glass as golden glitter. In such cases it is required to perform the oil change and check of bearings and change them if needed.

The oil check shall be performed in case of oil viscosity change at 30% in comparison with the viscosity of new oil and in case of insolubles content more than 1%.

All abovementioned changes of oil do not release from the performance of oil change according to the scheduled maintenance of reducing gears of motor-wheels.

BELAZ OJSC – Management Company of BELAZ–HOLDING
BelAZ-75180 Mining Dump Trucks
Operating Manual
Republic of Belarus