

## 3.2 Technical maintenance of engine and its parts

### *3.2.1 Maintenance of cooling system*

#### *3.2.1.1 Check of cooling fluid level in cooling system*

Carry out a shift-time check of cooling fluid level before engine start.

Remove radiator cap and check the cooling fluid level which shall reach the upper end of the filler neck. Do not let the level drop beyond 40 mm from the upper end of the filler neck.

#### *3.2.1.2 Maintenance and washing of cooling system*

Fill the cooling system with low-freezing-point cooling fluid.

Watch the cooling fluid temperature, the normal temperature shall be 85-95°C. If the temperature goes higher than the normal, check the level of the cooling fluid in the radiator, radiator integrity and fan belt tension.

Wash dirt out the cooling system if necessary but not less than every 2000 hours of engine work. Use solution of 50-60 g of calcined soda per 1 l of water for washing.

Wash the system in the following order:

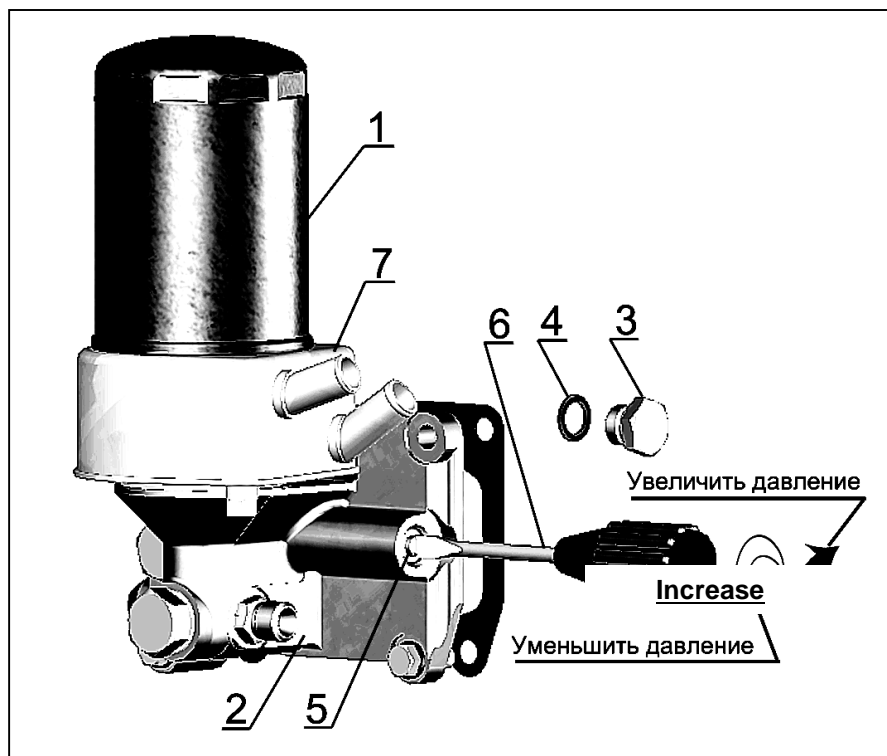
pour 2 l of kerosene to the radiator and fill the system with the prepared solution;  
start the engine and let it work for 8-10 h or 350-400 km of kilometrage, after that drain the solution and wash the cooling system with clean water.

### *3.2.2 Maintenance of lubrication system*

To ensure engine normal operation follow the instructions for maintenance of the lubrication system:

- fill the oil sump only with the oil, recommended for use in the present Manual (Annex A, "Chimmotology list");
- timely replace oil and oil filter in conformity with periods, provided in clause 3.1.3;
- constantly watch the values of oil pressure on pressure indicator, located on the dashboard (when the engine works with rated speed and 85...95°C of coolant temperature, oil pressure shall be at 0.25...0,35 MPa, with the hot engine 0,8 MPa of pressure value is admitted);
- pressure value is adjusted in accordance with figure 11 in the following way:
- unscrew plug 3, remove gasket 4;
- using screwdriver 6 turn the adjusting plug 5 in the channel of oil filter casing 2 by one revolution to the side of increasing or decreasing of pressure (depending on the real pressure)
- mount gasket 4 and screw the gasket 3;
- repeat the abovementioned adjustment actions if necessary.

**Making adjustments with the working engine is FORBIDDEN.**



1 – oil filter; 2 – oil filter body; 3 – valve plug; 4 – plug gasket;  
5 – adjusting plug; 6 – screwdriver; 7 – liquid-oil heat exchanger;

Figure 11 – Oil pressure adjustment.

### ***3.2.3 Check of oil level in the engine crankcase***

Carry out a shift-time check before starting the engine using oil dipstick, located on the engine cylinder block. The level of oil shall be between lower and upper marks of the dipstick in accordance with figure 12. The check is made not earlier than 3-5 min. after the engine stop, when oil fully drains to the crankcase.

It is forbidden to run the engine with oil level in the crankcase below the lower and above the upper marks of the dipstick.

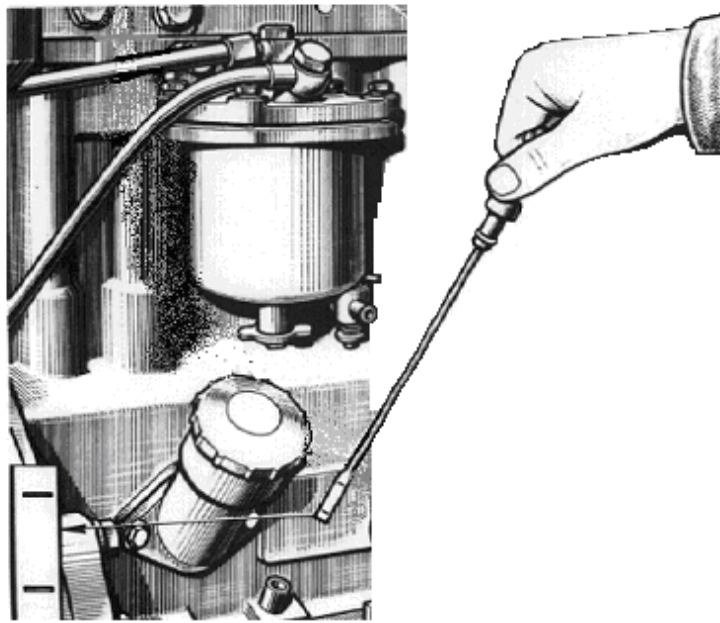


Figure 12 – Check of oil in the engine crankcase

### ***3.2.4 Replacement of oil in the engine crankcase***

Oil in the engine crankcase is replaced in every 250 hours of work and in the case of using duplicate types of oil and fuel with high sulfur concentration every 125 hours of work. Drain used oil only from the hot engine. To drain the oil unscrew oil sump plug. After the oil has leaked out of the crankcase, screw the plug back. Fill oil in the engine through oil filler pipe until it reaches upper mark on the dipstick. Fill in only the oil, recommended by this manual, according to the operation period.

### ***3.2.5 Replacement of oil filter***

Replace oil filter according to figure 13 simultaneously with replacement of oil in engine crankcase in the following order:

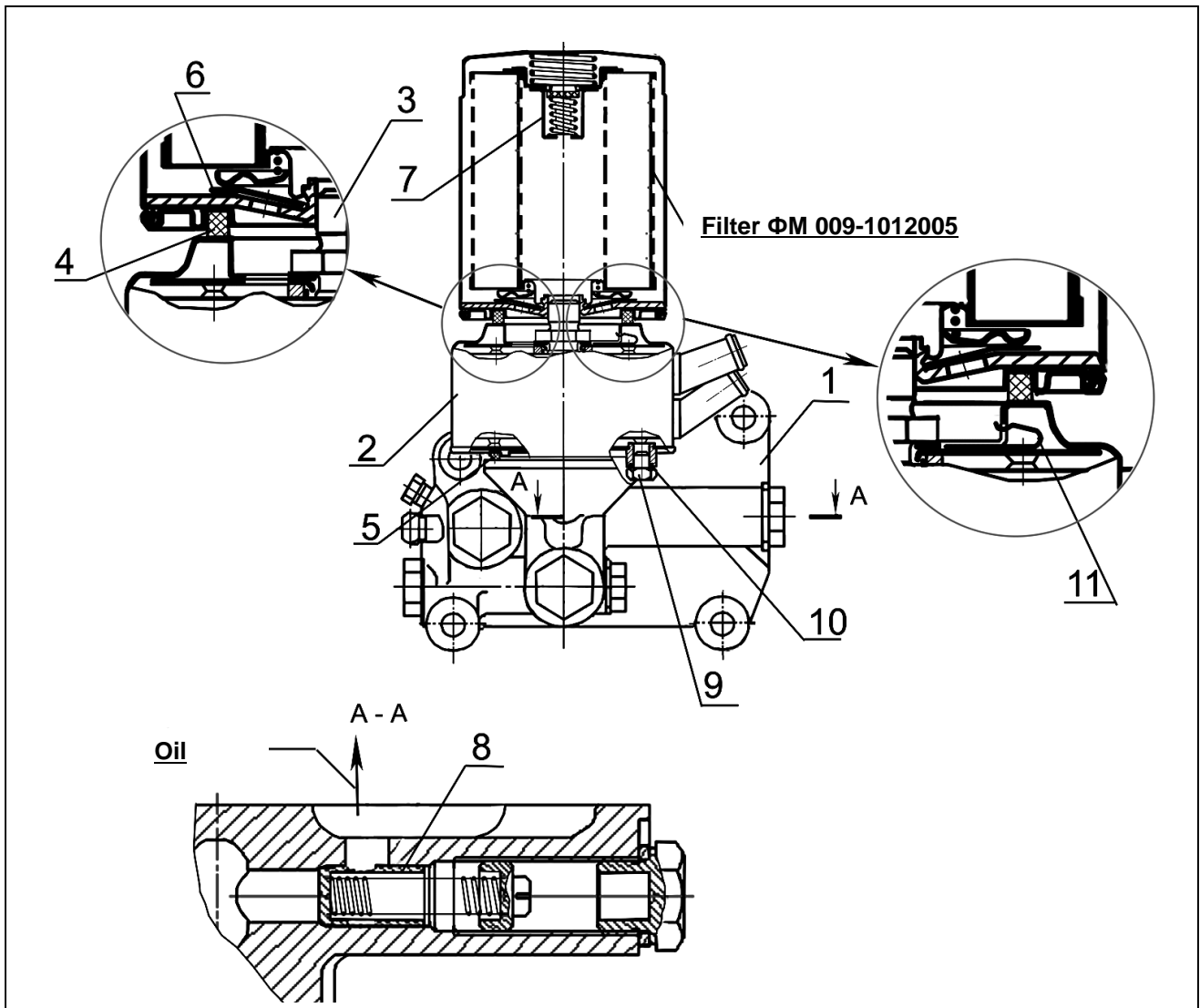
- unscrew filter  $\Phi$ M 009-1012005 from the fitting, using a special wrench or any other materials at hand;
- screw a new filter  $\Phi$ M 009-1012005 (JSC “Avtoagregat”, city of Livny, Russia) or M5101 (EJSC “DIFA”, Grodno, Republic of Belarus) on the fitting.

When mounting the filter, lubricate gasket 4 with motor oil. As soon as the gasket touches the mounting surface of filter gasket 1, turn the filter by 3/4 revolutions. Mount the filter in the body only by force of hands.

In future order the following oil filters:

- a)  $\Phi$ M 009-1012005 at the address: JSC “Avtoagregat”, 303858, 2a Industrialnaya Street, Livny, Orlovskaya oblast, Russia;
- b) M5101 at the address: EJSC “DIFA” 230019, 45 Belusha Street, Grodno, Republic of Belarus

It is possible to install element filters of solid type: modification X149 by company



1-filter body; 2 – liquid-oil heat exchanger (LOHE); 3 – fitting; 4 – filter gasket; 5 – LOHE gasket; 6 – contra-discharge valve; 7 – overflow valve; 8 – protection valve; 9 – plug for coolant drain; 10 – seal ring; 11 – LOHE protective valve.

Figure 13 – oil filter with LOHE

### 3.2.6 Drain of sediment form coarse fuel filter

Drain sediment in every 125 hours of engine operation.

Unscrew sediment drain plug, located in the lower part of the filter bowl in accordance with figure 14, and drain sediment until clean fuel remains. Screw the plug.

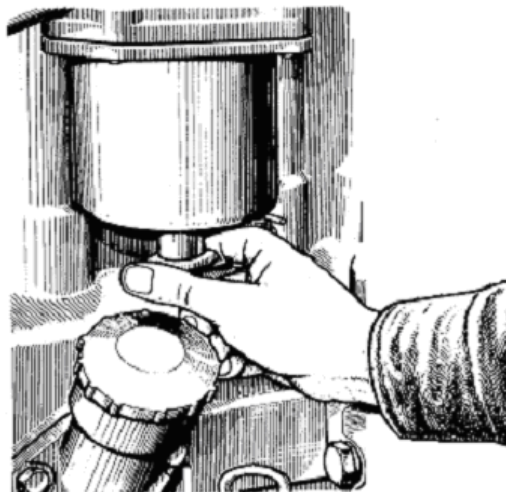


Figure 14– Drain of sediment from coarse fuel filter.

### *3.2.7 Washing of coarse fuel filter*

Wash the filter in every 1000 hours of engine operation in the following order:

turn off the fuel tank valve;

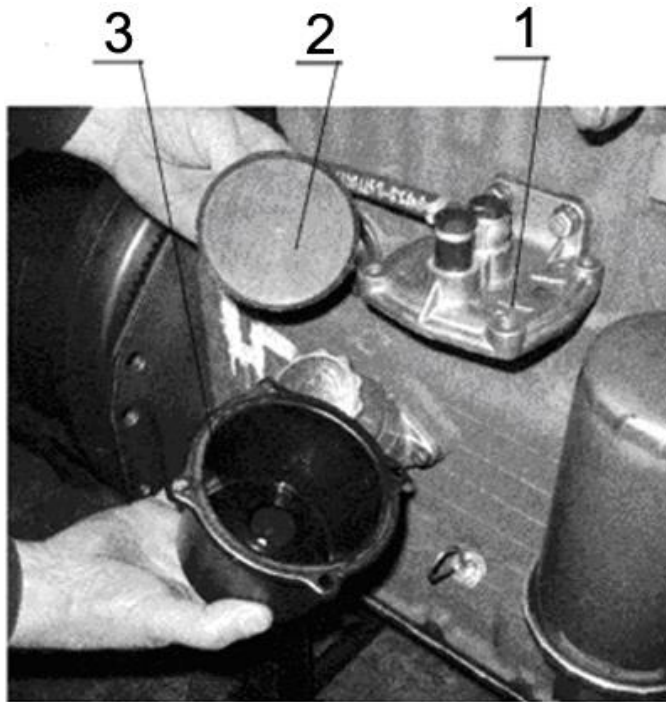
unscrew nuts of bowl attachment bolts;

remove the bowl 3 in accordance with figure 15;

using a wrench unscrew a deflector with net 2;

remove a diffuser;

wash the deflector with the net, the diffuser and the filter bowl with diesel fuel and mount them back.



1 – filter body; 2 – deflector with net; 3 – bowl

Figure 15 – Washing of coarse fuel filter

After the filter is assembled, fill the system with fuel.

### *3.2.8 Drain of sediment from fine fuel filter*

Drain sediment in every 250 hours of engine operation.

Unscrew plug 4 in the lower part of fine fuel filter by 2...3 revolutions in accordance with figure 16 and drain sediment until clean fuel remains. Screw the plug.

### *3.2.9 Replacement of fine fuel filter*

Life time of fine fuel filter depends on cleanliness of the fuel used.

Replace filter  $\Phi$ T020-1117010 when conducting TM-3 according to figure 16, for this purpose:

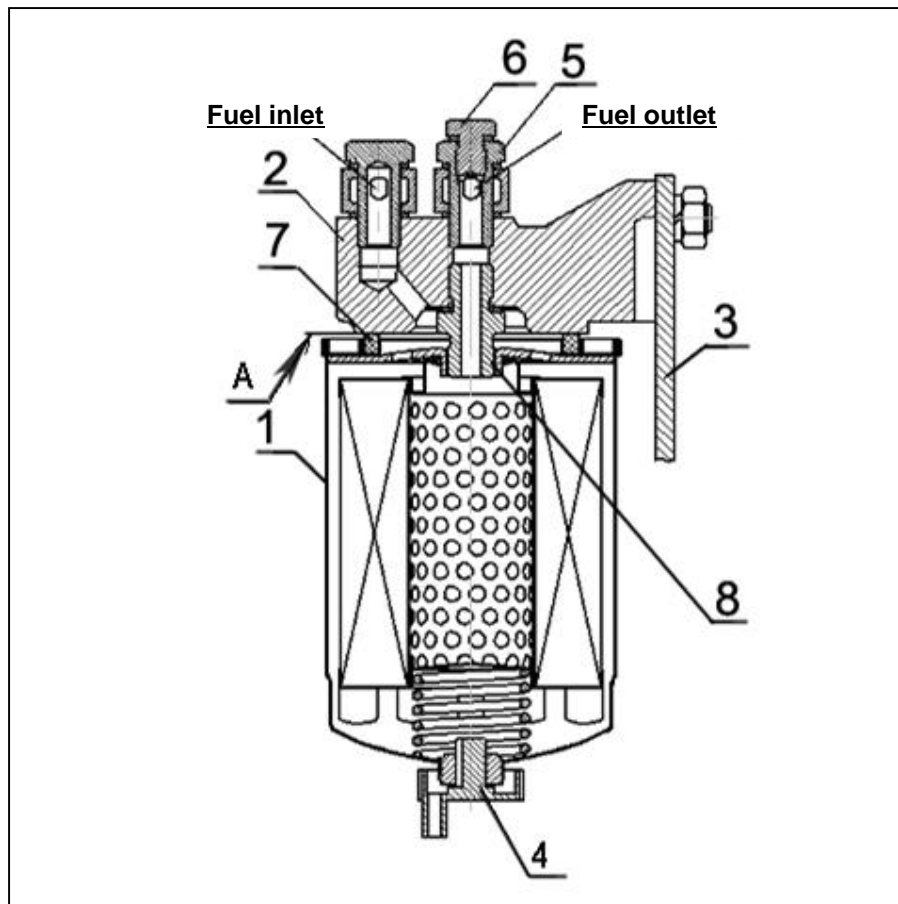
- drain fuel from the filter, having unscrewed plug 4 in the lower part of the body;

Do not let the fuel spill, drain the fuel only to a container.

- unscrew filter 1 from fitting 8 in body 2 and replace it with a new filter  $\Phi$ T020-1117010 (JSC "Avtoagregat", Livny, Russia) or T6101 (EJSC "DIFA", Grodno, Republic of

Belarus), supplied in assembly with gasket 7, which shall be previously lubricated with motor oil;

- as the gasket 7 touches mounting surface A on the body 2, turn the filter by  $\frac{3}{4}$  revolutions more. Herewith, turn the filter only by force of hands;
- turn on the fuel tank valve and fill the system with fuel.



1 – filter  $\Phi$ T020-1117010; 2 – body; 3 – bracket; 4 - plug (for drain of sediment); 5-outlet union; 6 – plug (for air outlet); 7 – gasket; 8 – fitting.

Figure 16 – Replacement of fine fuel filter.

In future order the following oil filters:

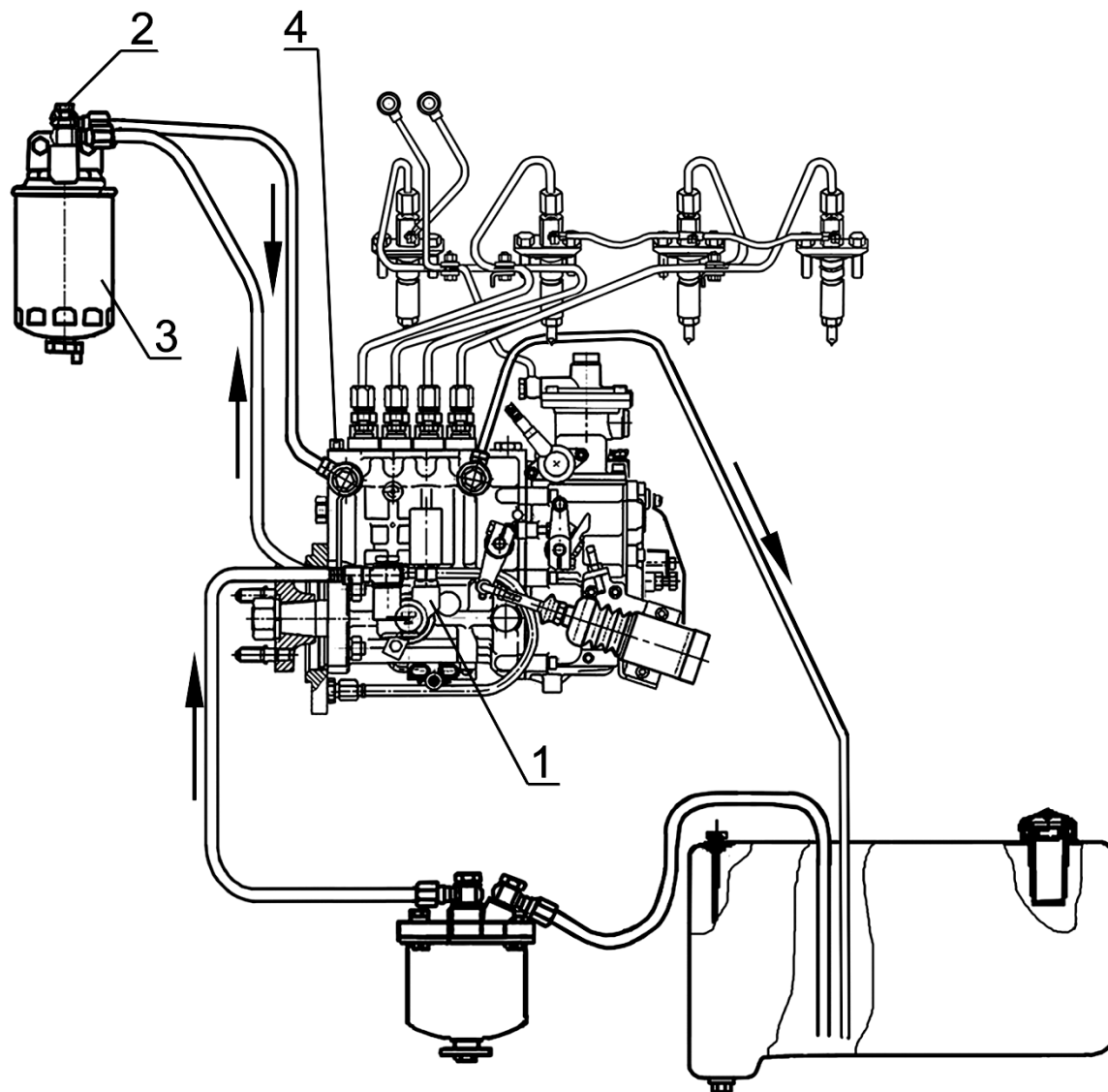
a)  $\Phi$ T020-1117010 at the address: JSC “Avtoagregat”, 303858, 2a Industrialnaya Street, Livny, Orlovskaya oblast, Russia;

b) T6101 at the address: EJSC “DIFA” 230019, 45 Belusha Street, Grodno, Republic of Belarus

### ***3.2.10 Filling the fuel system***

To de-aerate the system, unscrew plug 2 (Figure 17), located on bolt of outlet union attachment, by 2...3 revolutions. Bleed the system with manual purge pump 1, screwing in the plug when the fuel without air bubbles appears.

Unscrew the plug 4 on the body of fuel pump. Bleed the system with the boost pump until fuel without air bubbles appears, herewith screwing in the plug 4.



1- purge pump 2 - plug (for air outlet); 3-fine fuel filter;  
4 - plug;

Figure 17 – De-aerating fuel supply system.

### ***3.2.11 Maintenance of air cleaner***

Carry out maintenance of air cleaner with paper filtering elements of special high-porous cardboard in every 500 hours of engine work or, if necessary, by indications of impurity annunciator. Maintenance of air cleaner consists in bleeding the main filtering

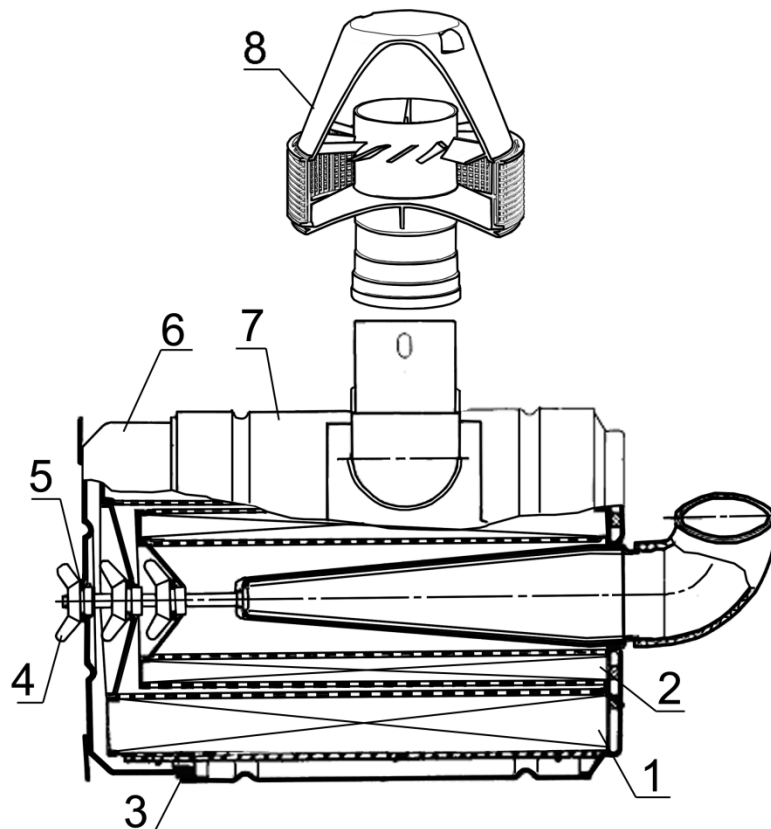
element that captures dust entering the air cleaner. Contamination of the control filtering element points to failure of the main filtering element (tear of paper curtain, bedplates coming unstuck). In this case it is necessary to bleed the control filtering element and to replace the main one.

Carry out maintenance of the air cleaner in accordance with figure 18 in the following order:

- remove the monocyclone, clean the net, swirler and monocyclone discharging slits from dust and dirt;
- remove bottom 6;
- remove the main filtering element 1.

It is not recommended to remove the control filtering element 2 from the body.

Bleed the main filtering element with compressed air, first outside and then inside, until dust is fully removed. To prevent tearing of the paper curtain, air pressure should be not higher than 0,2-0,3 MPa.



1 – main filtering element; 2 – control filtering element;  
3 – gasket; 4 – wing nut; 5 – ring; 6 – bottom; 7 – body, 8 – monocyclone

Figure 18 – Air cleaner

Air jet must be directed at an angle to the filtering element surface. During maintenance it is required to protect the filtering element from mechanical damages and oiling.

It is forbidden to bleed the filtering element with exhaust gases or to wash with diesel fuel.

Clear out the delivery pipe, inner surfaces of the air cleaner body and bottom.

Before assembling the air cleaner check the state of seal rings. When assembling make sure that all filtering elements are correctly mounted in the body and firmly tighten the wing nut manually.



3.2.12 Check of air cleaner and inlet channel for connections tightness  
Check air cleaner and inlet channel for connections tightness when conducting TM-2.  
Use a devise КИ-4870 ГОСНИТИ for tightness check.  
If the devise is not available, check tightness of connections visually.

### ***3.2.13 Washing of the engine breather***

Maintenance of breather of the engine Д-245S3A M and its modifications is not required.

### ***3.2.14 Check of cylinder head bolt tightening***

Check cylinder head bolts for tightening after running-in and in every 1000 hours of operation on hot engine in the following order:

- remove a cap and a cover of the cylinder head;
- remove a rocker arm shaft with rockers and brackets;
- using a torque wrench check all cylinder head bolts for tightness in the order, given in figure 19, and if necessary tighten them.

Bolt torque is  $200 \pm 10$  N·m

After checking of cylinder head bolt tightening mount the rocker arm shaft back and adjust the clearance between valves and rockers.

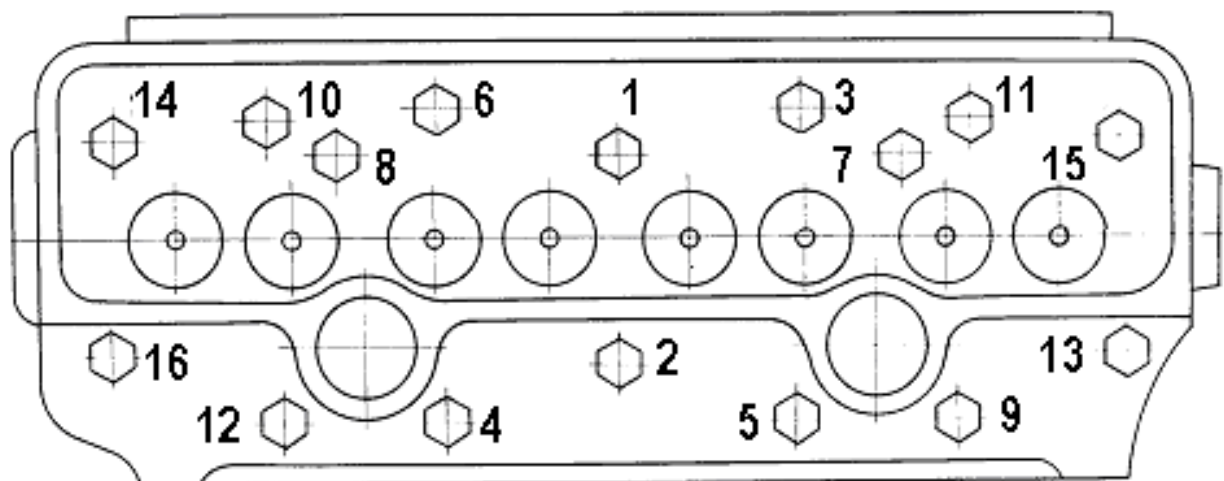


Figure 19 – Sequence diagram of cylinder head bolt tightening

### ***3.2.15 Check of clearance between valves and rockers***

Check clearance between valves and rockers and adjust, if necessary, in every 500 hours of work and also after removing cylinder head, tightening of cylinder head bolts and when there is knocking of valves.

When checked on cold engine (oil and water temperature not higher than 60°C), clearance between the rocker poll and valve-stem end shall be the following:

inlet valves –  $0,25^{+0.05}_{-0.10}$  mm;

outlet valves -  $0,45^{+0.05}_{-0.10}$  mm.

When making adjustments, set the following clearance between valve-stem end and the rocker poll:

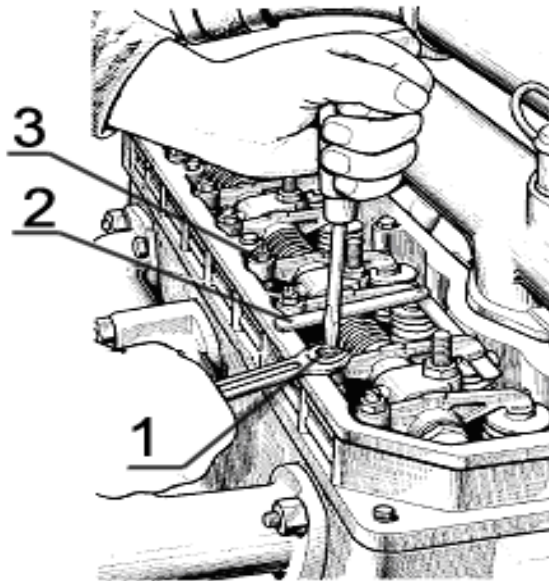
inlet valves -  $0,25_{-0.05}$  mm;

outlet valves -  $0,45_{-0.05}$  mm;

Make adjustments in the following order:

- remove the cap of cylinder head cover and check the attachment of rocker arm shaft bracket;
- turn the crankshaft up to the moment of valve overlapping in the first cylinder (the first cylinder inlet valve starts to open and the outlet valve finishes to close) and adjust clearances in the forth, sixth, seventh and eighth valves (counting from the fan), then turn the crankshaft by one revolution, having set the overlapping in the forth cylinder, and adjust clearances in the first, second, third and fifth valves.

To adjust the clearance loose the screw locknut on the rocker of the valve being adjusted in accordance with figure 20 and turning the screw set a required clearance against the probe between the rocker poll and valve-stem end. Having set the clearance tighten the locknut. After finishing the adjustment of valve clearance, put back the cap of the cylinder head cover.



1 – adjusting screw; 2 – probe; 3 – locknut.

Figure 20- Valve clearance adjustment.

### 3.2.16 Maintenance of high-pressure fuel pump

During the operation of high-pressure fuel pump and upon wearing of the main parts, the adjustment parameters of the high-pressure fuel pump get violated.

Lubrication of high-pressure fuel pump is centralized from the engine lubrication system through a special oil pipeline.

If the high-pressure fuel pump is left without lubrication, it will break down!

Necessary level of oil in the pump crankcase is set automatically.

To reduce wears of precision parts operation of high pressure fuel pump without filtering element or with clogged fine fuel filter is not permitted. Neither operation with fuel having enhanced water concentration is permitted.

If necessary and when conducting engine technical maintenance 2TM-3 it is required to remove the high-pressure fuel pump from the engine and check the fuel pump on the stand for compliance with the adjustment parameters, presented in annex D, and also fixed fuel injection advance angle. If necessary, make appropriate adjustments.

Fuel pump shall be checked and if necessary adjusted by a qualified specialist in a workshop on a special adjustment stand equipped with instruments according to GOST 10578-96, in conformity with requirements of the fuel pump manufacturing works.

Fuel pump adjustment parameters for stand check are presented in Annex D.

#### 3.2.16.1 High-pressure fuel pump sealing

After adjustment fuel pumps shall be sealed in a manner, which excludes the possibility of making adjustments without seal removing.

### 3.2.17 Check and adjustments of the fixed fuel injection advance angle

When it is difficult to start the engine or the exhaust is smoky and also when replacing, mounting the fuel pump after check on a stand through 2TM-3 or when repairing the engine, check the fixed fuel injection advance angle.

Parameters for the fixed fuel injection advance angle are presented in table 13.

Table 13

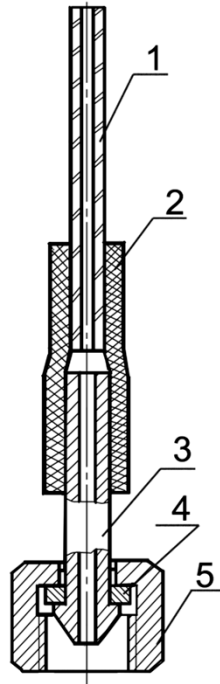
High-pressure fuel pump	Diesel			
	Д-245S3A M	Д-245.2S3A M	Д-245.5S3A M	Д-245.43S3A M
	Fixed fuel injection advance angle, degrees of crankshaft turn			
PP4M10Uli-3794	3,5±0,5			
PP4M10Uli-3793	3,5±0,5			
PP4M10Uli-3795	4,0±0,5			
PP4M10Uli-3796	4,0±0,5			

The fixed fuel injection angle is checked in the following sequence:

a) for high-pressure fuel pump without camshaft position detent:

-set a governor control lever to the position of max. fuel supply;

-detach a high-pressure pipe from the fitting of pump first section and connect an ignition tester instead (a captive nut with short pipe, to which a glass pipe with inner diameter 1-2mm is connected through a rubber pipe, fig.21);



1 – glass pipe; 2 – rubber adapting pipe; 3 – segment of high-pressure pipe;  
4 – washer; 5 – nut

Figure 21 – Ignition tester

- turn the engine crankshaft clockwise with a wrench until fuel without air bubbles appears outside the ignition tester glass pipe;
- release some air from the glass pipe by shaking it;
- turn the crankshaft back (contraclockwise) by 30°-40°;
- turning the crankshaft clockwise slowly, watch fuel level in the pipe, as the fuel starts going up stop turning the crankshaft;
- screw the detent out of threaded hole of rear plate and insert it with its back side in the same hole until it stops against the flywheel (Figure 22), herewith the detent shall coincide with the hole in the flywheel (this means that the first cylinder piston is set in a position, corresponding to the fixed fuel injection angle given in table 13);

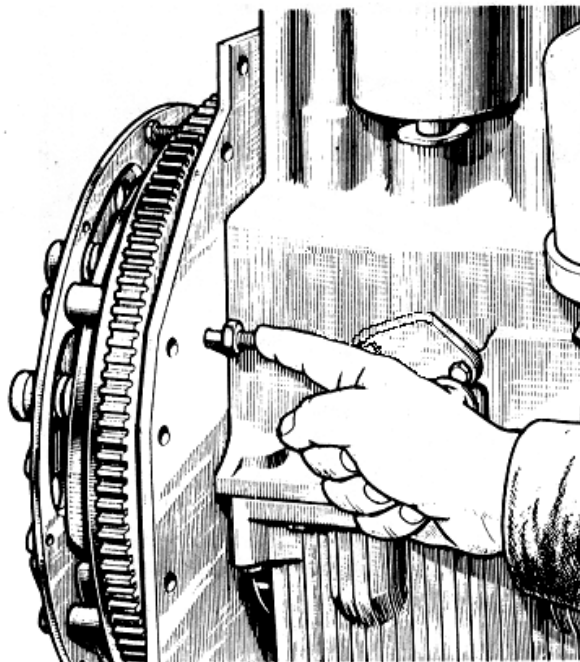


Figure 22 – Mounting a detent in the hole of rear plate and flywheel.

If the detent does not coincide with the hole in the flywheel, make adjustments, for this do the following:

- mate the detent with the hole in the flywheel, turning the crankshaft to this or that side;
- remove a hatch cover (Figure 23);

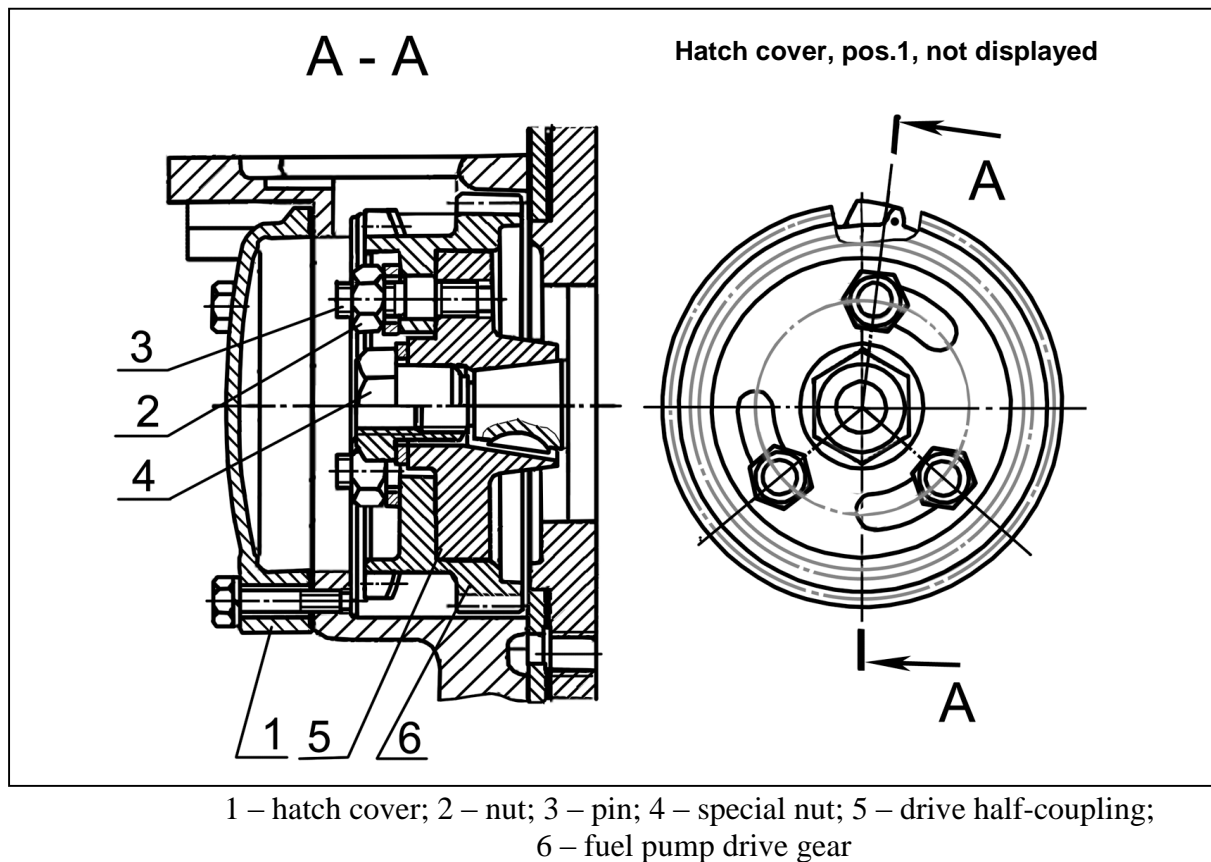
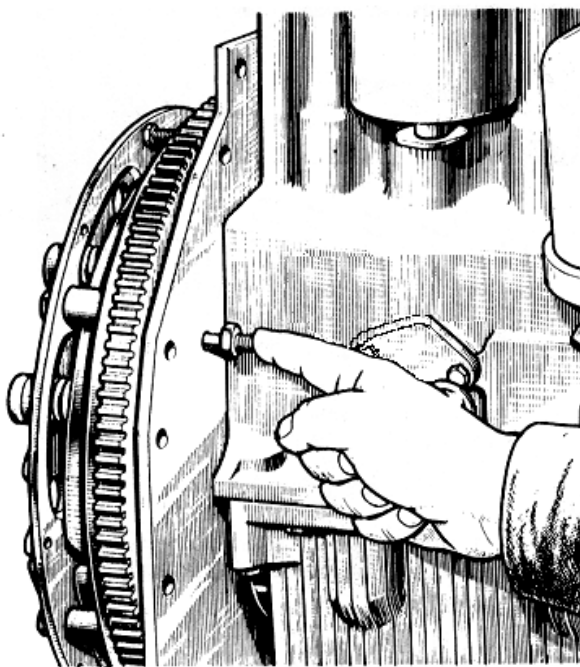
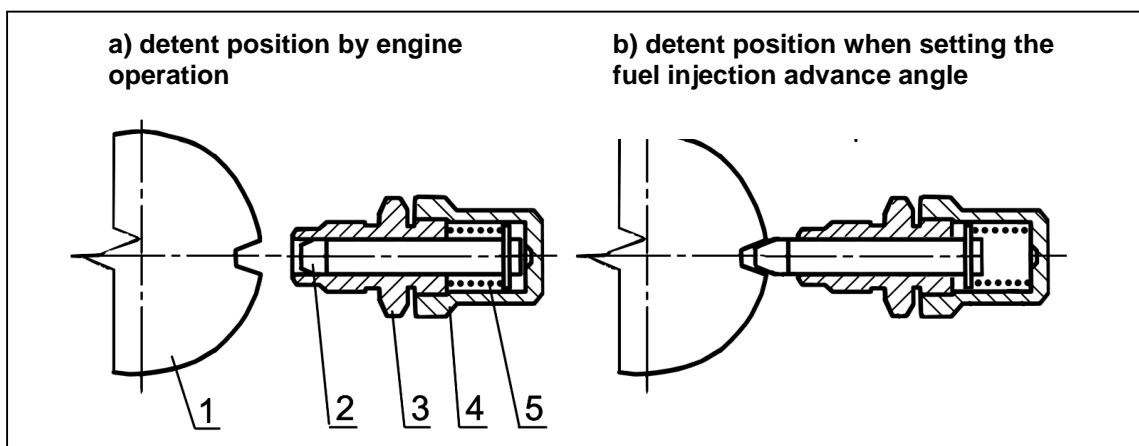


Figure 23 – Fuel pump drive

- release nuts of fuel pump drive gear attachment by 1...1,5 revolutions;
  - remove some fuel from the ignition tester glass pipe if any;
  - using a wrench turn the roller of fuel pump by the special nut forward and backward within the slots positioned on the end surface of the fuel pump drive gear until the ignition tester glass pipe gets filled up with fuel.
  - set the fuel pump roller to the farthest (contraclockwise) position within the slots;
  - remove some fuel from the glass pipe;
  - slowly turn the fuel pump roller clockwise until the fuel goes up in the glass pipe;
  - as the fuel starts going up in the glass pipe, stop turning the roller and tighten the gear attachment nuts;
  - carry out a repeated check of fuel supply starting moment;
  - disconnect the ignition tester and mount back the high-pressure pipe and hatch cover;
  - screw the detent in the hole of rear plate.
- 6) for high-pressure fuel pump with camshaft position detent (pos.27, Figure 5):
- screw the detent out of threaded hole of rear plate and insert it with its back side in the same hole until it stops against the flywheel (Figure 22);



- slowly turn the engine crankshaft clockwise until the detent coincides with the hole in the flywheel;
- remove the hatch cover 1 (Figure 23);
- release nuts 2 of the fuel pump drive gear attachment by 1...1,5 revolutions;
- unscrew cap 4 (Figure 23a) of the position detent of the high-pressure fuel pump camshaft 27 (Figure 5);



1 – camshaft segment disk; 2 – detent bar; 3 – detent body; 4 – cap; 5 – spring.

Figure 23a – Detent of position of high-pressure fuel pump camshaft

- remove spring 5 and sink in the detent bat until it touches the camshaft segment disk;

- turn the high-pressure fuel pump camshaft to one and other side using special nut 4 (Figure 23) within the slots of the fuel pump drive gear 6 until the detent bar 2 coincides with a hollow in the segment disk 1;

*If the detent bar 2 has not coincided with the hollow in the segment disk 1:*

- remove the detent bar 2 from the detent body 3;
- remove the detent from the hole in the flywheel and turn the crankshaft by one revolution (360°) until the detent coincides with the hole in the flywheel;
- turn the high-pressure fuel pump camshaft to one and other side using a special nut 4 (Figure 23) within the slots of the fuel pump drive gear 6 until the detent bar 2 coincides with a hollow in the segment disk 1;
- fix the camshaft position, screwing cap 4 with spring 5 on detent body 3 (Figure 23a, position b));

*(such fixation of crankshaft and camshaft positions means that the first cylinder piston is set to a position corresponding to the fixed fuel injection advance angle, given in table 13, and section 1 of the fuel pump is set to the position of start fuel geometric delivery);*

- tighten nuts 2 of fuel pump drive gear attachment;
- unscrew cap 4 and set spring 5 and detent bar 2 to the position a), shown in picture 23a;
- mount the hatch cover back and screw the detent to the rear plate hole;

### *3.2.18 Check of injectors for pressure at the beginning of injection and quality of fuel atomization*

Check injectors in every 2000 hours of engine operation.

Take the injectors off the engine and inspect them on a stand.

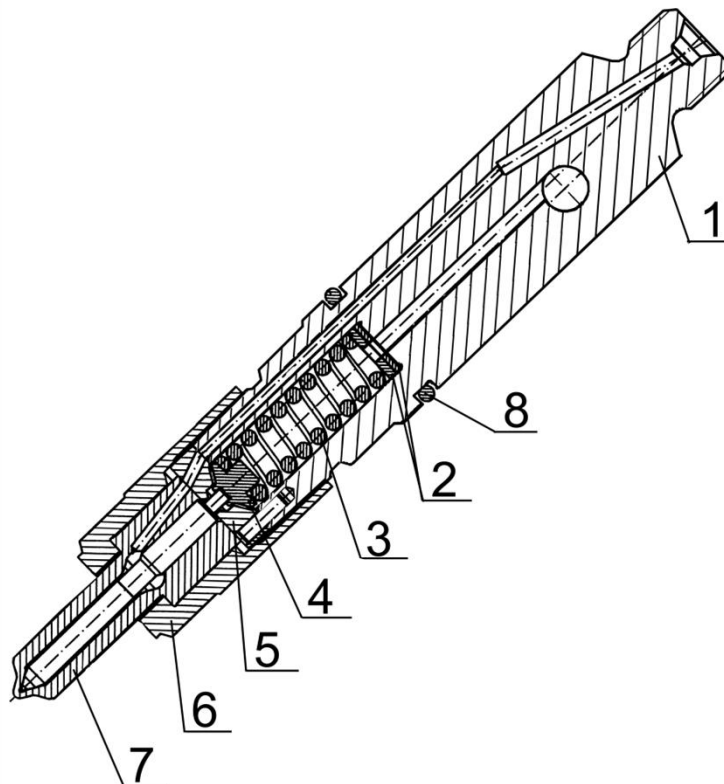
The injector is considered in good order if it atomizes fuel in the form of fog from all five atomizer holes, without separately outcoming drops, solid streams and concentrations. Beginning and end of injection shall be clear, appearing of drops on atomizer tip is not permitted.

Check atomization quality at frequency of 60-80 injections per minute.

If necessary adjust the injectors changing the total thickness of adjusting washers 2 (Figure 24): increase of total thickness of adjusting washers (increase of spring compression) enhances the pressure, their decrease reduces the pressure. Change of the washer thickness by 0,1 mm results in change of pressure of injector needle rise start by 1,3...1,5 MPa.

Value of injection start pressure for injectors is  $28,0^{+1,2}$  MPa;

Mount injectors on the engine. Tighten bolts of injectors attachment evenly in 2-3 in 2-3 steps. Final tightening torque is 20...25 N·m.



1 – injector body; 2 – adjusting washer; 3 – spring; 4 – injector plunger; 5 – spacer;  
6 – atomizer nut; 7 – atomizer; 8 – seal ring.

Figure 24 - Injector

### ***3.2.19 Alternator maintenance***

During engine operation special maintenance of alternator is not required. Seasonal adjustment of alternator voltage in accordance with figure 26 is made by a screw of voltage seasonal adjustment “winter-summer”, positioned at the alternator rear wall.

Engines can be completed with alternators with automatic seasonal voltage adjustment. Herewith there is no screw 1.

During operation watch the security of alternator and wires attachment as well as cleanness of the outside surface and terminals.

Check alternator working order with voltmeter or control lamp and ampere-meter, installed on instruments dashboard of a tractor (machine).

If the alternator is functioning properly a control lamp lights up when switching the ground switch before engine start.

After the engine has been started and is operating with mean speed, the control lamp goes out (for engines started on electric starter) or dims (for engines started on pony motor), the voltmeter point shall be in green zone and the ampere-meter shall indicate some charge current, the value of which drops as the battery charge recovers.

### ***3.2.20 Check of belts tension***

Poly-V belt of Д-245S3A engines is equipped with automatic tensioner and doesn't require tension adjustment.



### ***3.2.21 Check of starter state***

Every 1000 hours of engine operation do the following:

- check fastening bolts for tightening, tighten them if necessary;
- scrape wire lugs coming to starter terminals and accumulator battery and tighten their attachments.
- Carry out preventative inspection and maintenance every 2000 hours of engine operation

Remove the cap on commutator side and check the state of brush-commutator group. The working surface shall be smooth and without significant burning. If the commutator is contaminated or has significant burning traces, clean it with a napkin, soaked in gasoline. When it is not possible to eliminate dirt or burning by cleaning, peel it with fine emery cloth. If there some significant burnings on the commutator which are impossible to clear, turn down the commutator.

Brushes shall freely move in brushholders and bear against the commutator. When the brushes are worn out up to the height of 13 mm and when there are significant spalls, replace them with new ones.

Bleed the brush-commutator group and cover on commutator side with compressed air.

Check the state of contact structure of the starter relay. In case of significant burning, peel contact bolts and contact plate with fine emery cloth or rasp-file, removing asperity caused by burning and herewith not infringing flatness of copper bolt contact surfaces. If the plate and bolts are significantly worn out, turn the contact plate over and turn the contact bolts through 180°.

Check the drive for ease of moving on rotor shaft. At the moment when the relay is being engaged and disengaged, the drive group shall smoothly move on rotor shaft splines.

Inner surfaces of the drive guide bushing (splined and flush), adjacent shaft parts shall be cleared from thickened grease with chips getting from the crankcase which hinder drive axial movement on the shaft splines when the gear engages flywheel gear rim. The cleared surfaces shall be covered with thin layer of grease ЦИАТИМ-221 (ЦИАТИМ-203, ЦИАТИМ-201).

Check the state of drive gear and thrust washers visually. The spacing between gear face and thrust washers at engaged condition shall be 2...4 mm.

### ***3.2.22 Maintenance of turbocharger***

During operation it is not required to carry out a special maintenance of turbocharger, its disassembly and repair are not permitted. Partial or complete

disassembly as well as repair are only possible in a specialized enterprise and after the turbocharger has been removed from the engine.

Reliable and durable operation of turbocharger depends on compliance with rules and maintenance periodicity of lubrication system and system of air purification, type of oil recommended by manufacturing works, oil pressure control in the lubrication system, replacement and cleaning of oil and air filters.

Damaged pipelines of oil delivery and drain and also turbocharger attachment pipelines shall be immediately replaced. When replacing a turbocharger, pour clean engine oil to the oil delivery hole up to the flange level and do not use joint sealants when mounting gaskets under flanges.

### ***3.2.23 Maintenance of compressor***

During operation, maintenance of compressor is not required.

In case of fault inception the compressor shall be sent to a repair shop where qualified specialists will spot the cause of trouble and eliminate it.