
BELARUS

510/512

510-0000010 P3

OPERATING MANUAL

2009

This Operating Manual is compiled by Engineer of Minsk Tractor Works Leading Specialized Design Office I.N. Korobeynik in collaboration with top-level specialists of the Leading Specialized Design Office of Republican Unitary Enterprise Minsk Tractor Works

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Belarus-510/512 tractors Operating manual

This Operation and Service Manual contains a brief description and specifications of Belarus 510/512 tractors manufactured at the Minsk Tractor Works. Basic rules of machine operation are presented, as well as information on adjustments and technical servicing of tractor units and assemblies, are given.

This Operating Manual is intended for operators (tractor drivers) operating the Belarus tractors.

In view of the RUE MTW policy of constant improvement of its products, changes in the design of certain assemblies and components of the Belarus tractor may be introduced without notice, that are not represented in this edition.

Some specifications and illustrations found in this Manual may differ from those actually found on your tractor. The dimensions and weights are approximate (for information purposes only). For more detailed information, please contact your local Belarus dealer. General note: References to the “left-hand” or “right-hand” terms in the text of this Manual are given from the point of view of an observer viewing the moving forward tractor from behind.

TO OPERATOR'S ATTENTION!

1. Before you start operating the tractor, carefully read this Manual and strictly follow all instructions herein.
2. Use the climatic diesel fuel according to the Manual. Reduce the motor oil changeover intervals by half, if the sulfur content in the fuel is below 1%.
3. Do not operate the diesel engine at the idle speed more than 15 minutes.
4. Remember that the engine can be only started when the GB lever is in the extreme left position (in the position of engaging the I or II gear range).
5. Use the synchronous drive of the rear PTO only when the tractor unit speed does not exceed 8 km/h. Otherwise, severe damages in the tractor power train are possible.
6. Operate the tractor on the direct gear only with the high gear range engaged (range II).
7. The tractor cab is equipped with a single seat, only operator is allowed to be in it.
8. When the tractor is shipped from the manufacturer factory, some parts of the tractor are put into the SPTA box, tool box or cab. Install them onto the tractor on your own.
9. When commissioning new batteries, remove the sealing film from the vent holes or cut off the bosses on the plastic caps.
10. Do not operate the tractor when the clutch is not totally disengaged or is engaged.
11. When starting movement, make sure that the hand-operated reserve parking brake is disengaged.
12. When using the tractor without driveshafts, shift the FDA lever to the position "forced".
13. Do not work on the tractor in closed rooms without adequate ventilation (air exchange). Exhaust gases can kill you!
14. Towing the tractor with front wheels lifted is strictly forbidden. Failure to observe this rule may result in a FDA drive failure and emergency situation.
15. Never lift the front part of the tractor by the towing shackle. Use the shackle for towing only.
16. The manufacturer continually improves the tractor, due to which there could be some modifications of the design of some components and their operating rules, which are not reflected in this Manual.

INTRODUCTION

The BELARUS 510/512 wheeled universal tilling tractors belong to the drawbar category 1.4 and are designed to perform a wide range of agricultural works: from soil preparation for sowing to harvesting and transporting operations; they can be used in forestry, municipal servicing, construction and industry.

This Manual contains a description of the design features, brief technical data and recommendations for operation and maintenance of the BELARUS 510/512 tractors:

BELARUS-510/512 (4×2) and (4×4) with a Д244 diesel engine (41.9 kW at 1700 rpm), a 9F/2R manual gearbox.

Re-equipment or modifications to the tractor design without approval from the Manufacturer is forbidden.

































Abbreviations and designations

SB	— storage battery
DL	— differential lock
PCU	— pre-heater control unit
UDC	— upper dead center of engine piston
PTO	— power take-off shaft
HLL	— hydraulic list linkage
HSU	— hydrostatic steering unit
LOHE	— liquid-oil heat exchanger
RHL	— rear hitch linkage
GB	— gearbox
C	— clutch
OECD	— Organization for Economic Cooperation and Development (OECD)
FDA	— front driving axle
ADCS	— automatic tilling depth control system
MS	— maintenance service
HDC	— haul-and-draw coupler
SRU	— speed reducer

International symbols

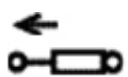
The manufacturer uses standard international symbols concerning application of the devices and controls.

Below are given the symbols with their respective meanings.

	— see Manual		— controls manipulations
	— brake		— forward
	— park brake		— back
	— horn		— battery charging
	— fault signaling		— interior lamp
	— fuel		— clearance lights
	— coolant		— turn signal lamp
	— pre-heater glow plug		— upper beam
	— engine speed		— low beam
	— engine oil pressure		— working lights
	— engine coolant temperature		— differential lock
	— off/stop		— power take-off shaft on
	— on/start		— front driving axle on
	— gradual change		— fan
	— lever down		— windshield washer
	— lever up		— windshield wiper



— “lift” position of the distributor slide valve



— “drop” position of the distributor slide valve



— “float” position of the distributor slide valve



— GB oil pressure



— air pressure in pneumatic system



— air filter clogging



— rear window wiper



— tractor trailer turn signal



— HSU oil pressure

Section A. Safety precautions

Strict observance of the safety precautions and closed following the rules of tractor operation and management ensures full safety safe of its operation.

Safety regulations for operation of the tractor

ATTENTION! When starting the diesel-engine and manipulating with the controls, always be in the cab, sitting in the driver's seat.

General instructions

- Carefully read the operator's manual before using the tractor. Insufficient knowledge on the control and operation of the tractor may result in accidents.

- Only specially trained and qualified operators are allowed to operate the tractor.

- If the tractor equipped with a safety belt, use it for work. If the tractor is not equipped with a safety belt, contact your dealer.

- The tractor cab is for one man, no passengers are allowed.

- Keep clean all the warning signs. If the signs are damaged or lost, replace them with new ones.

- Before you start your work, carefully inspect the tractor and the towed machine. Get started only after you make sure they are fully serviceable. Towed agricultural machines and transport trailers must have rigid hitches precluding them from swinging and hitting the tractor during transportation.

- Before starting the diesel engine, the parking brake must be engaged, the gear-box shifter must be shifted to the neutral position, the PTO engaging lever to the off position.

- Before you start movement, horn to warn other persons and persons working on the towed machines.

- Do not leave the tractor in motion.

- Before leaving the cab, disengage the PTO, stop the diesel engine, engage the parking brake, take out the starter key and turn off the ground switch.

- Do not turn off the electrical system with the ground switch before the diesel engine is stopped.

- Do not work on the tractor in a closed room without adequate ventilation. Exhaust gases can kill you!

- In case of a fault, immediately stop the tractor and fix the fault.

- In case of a diesel engine or a steering gear failure, immediately stop the tractor. Remember that with the diesel engine stopped, you have to apply a much greater force to the steering wheel to control the tractor.

- Do not work under raised agricultural implements. During long stops, do not leave toolbar implements in a raised position.

- If the front of the tractor takes off the ground when mounting heavy machinery and implements to the mechanism, attach front counterweights.

- When working with a front-end loader, fill the rear tires with liquid ballast.

- Before lifting and lowering an agricultural implement, as well as when making turns, make sure that there is no hazard to hit someone or run over an obstacle.

- During transport journeys with mounted machines or implements, always use the mount lock in the raised position (for tractors with an autonomous power cylinder).

- The driveshaft transmitting rotation from the tractor PTO shaft to the aggregated tools of the unit must be guarded.

- Ensure the correct installation of any additional equipment or auxiliary devices, and make sure that they are designed for use with your tractor. Remember that your tractor, if improperly used, can be dangerous both for you and for other persons. Do not use equipment that is not intended for installation on the tractor.

- To avoid a tipover, exercise caution when driving the tractor. Choose a safe speed appropriate to road conditions, especially when driving on rough terrains, when driving over ditches, slopes and making sharp turns.

- When working on slopes, increase the tractor wheel track to the maximum.

- Do not make sharp turns with a full load and at a high speed.

- When using the tractor for transportation works:

- increase the tractor wheel track to 1,800 mm (70") min.;

- interlock the brake pedals, check and adjust as necessary the brakes for simultaneous action;

- check operation of the parking brake;

- check the condition of light and sound signal equipment;

- transportation trailers must have a solid connection and, in addition, connect a safety chain or rope;

- never drive downhill by coasting (out of gear), drive at the same gear both downhill and uphill;

- do not work with a trailer without independent brakes if its weight exceeds half of the total actual weight of the tractor. The faster you drive and the greater is the towed weight, the greater must be the safe distance;

- disconnect the FDA in order to avoid excessive wear of the drive parts and tires;

- do not use the rear axle DL at a speed exceeding 10 km/h and when making turns;

- the PTO must be off and the simultaneous/independent drive shifter arm must be in the neutral position;

- do not stop the tractor on slopes. If you want to stop, engage the 1st gear and fully engage the parking brake.

- When working with equipment driven from the PTO, disengage the PTO before disconnecting the equipment, stop the diesel engine, make sure the PTO shaft end is fully stopped.

- Do not wear loose clothing when working with the PTO or near rotating equipment.

- When working with stationary machines driven from the PTO, always engage the parking brake and chock rear wheels from the front and from the rear. Make sure that the machine is reliably secured.

- Make sure that the PTO shaft end guard is installed, and when the PTO is not used, install the PTO shaft end cap to place.

- Do not clean up, adjust or service the equipment driven from the PTO with the diesel engine running.

Safety requirements for maintenance service

- Never refuel the tractor with the diesel engine running.
- Do not smoke when refueling the tractor.
- Do not fill the fuel tanks completely. Leave a space for fuel expansion.
- Never add gasoline or blends to diesel fuel. Such combination may result in higher hazard of flame or explosion.
- Make proper use of summer and winter grades of fuel. To reduce the amount of night condensate, refill the fuel tank at the end of each working day.
- Refill the tractor only with oils and greases recommended by the manufacturer. Use of other lubricants is **strictly prohibited!**
- All operations related to cleaning the engine and the tractor, preparation to work, maintenance, etc. must be performed with the engine off and the tractor brake engaged.
- The cooling system operates under pressure maintained by a valve installed on the filler cap. **It is dangerous to remove the cap on a hot engine.** To avoid burns of face and hands, take special care when opening the radiator cap on a hot engine, put a thick cloth onto the cap first and put on a glove.
- To avoid burns, be careful when draining the coolant from the cooling system, hot oil from the diesel engine, hydraulic system and transmission.
- Exercise caution while servicing storage batteries as electrolyte causes burns in case of skin contact.
- To avoid risk of explosion, do not allow a source of open fire near the fuel system of the engine and batteries.
- Keep your tractor and its equipment, especially the brakes and steering

equipment, in good condition to ensure your safety and that of the surrounding people.

- Do not modify the tractor or any of its constituent parts without approval from you dealer and manufacturer.

Safety requirements for operation and maintenance of electrical equipment

- To avoid damages to semiconductor devices and resistors, observe the following precautions:
 - do not disconnect the storage battery terminals when the diesel engine is running. This will result in peak voltage in the charging circuit and unavoidable damage of diodes and transistors.
 - do not disconnect the electrical wires until the diesel engine stops and all electrical switches are switched off;
 - do not cause a short circuit due to faulty connection wires. A short circuit or wrong polarity will cause damage to the diodes and transistors;
 - do not connect the storage battery to the electrical system until terminals and voltage are checked for the polarity;
 - do not check availability of electric current by sparking as it will result in an immediate breakdown of transistors.

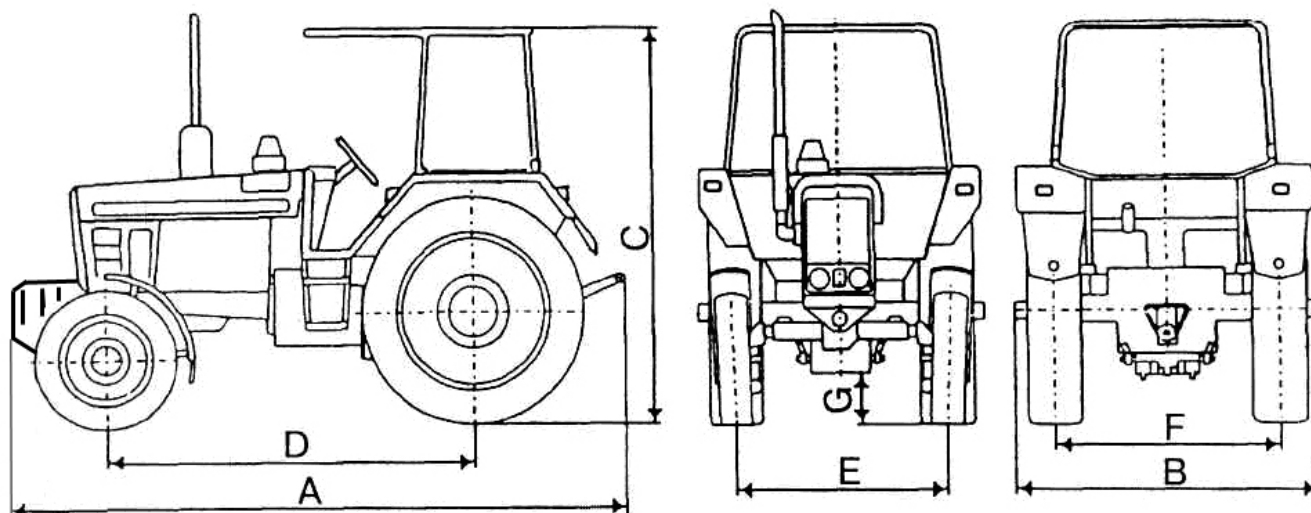
Hygiene requirements:

- If duration of continuous work on the tractor exceeds 2.5 hours per a working shift, use personal protection equipment to muffle noise as per State Standard ГOCT 12,4.051-87 (such as ear protectors, ear plugs)

Fire safety requirements

- The tractor must have firefighting tools such as a shovel and a fire extinguisher. Working on the tractor without fire-fighting equipment is prohibited.
- The tractor park sites, fuel and lubricant storage places must have a surrounding plowed strip with a width of 3 m min. and be provided with fire-fighting means.
- Avoid contamination of the manifold and silencer with dust, fuel, straw, etc.

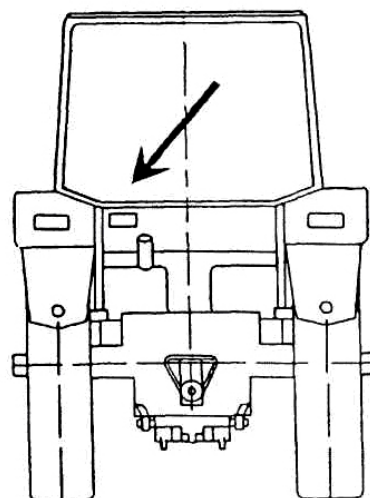
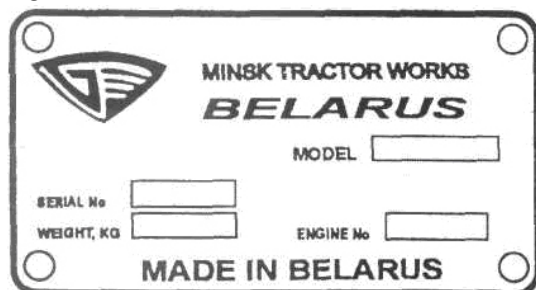
- Do not allow straw to be taken up by rotating parts of the machines attached to the tractor.
- When rinsing parts and assemblies with kerosene or gasoline, take precautions to exclude ignition of vapors of the rinsing fluid.
- Do not operate the tractor in places of high fire hazard with the hood and other protective devices removed from hot parts of the engine.
- Do not use open fire to heat up oil in the diesel engine pane, to burn out contamination of the radiator core.
- If there appears a seat of fire, dump sand over it, cover with tarpaulin, sackcloth or any other dense cloth. Use a carbon-dioxide fire extinguisher. Do not extinguish burning fuel with water.
- When the engine is running, keep inflammable materials away from the exhaust manifold and muffler.
- When making hay and straw or working in places with high fire hazard, use spark arresters in the exhaust system complete with a silencer or separated from it.

Section B. **SPECIFICATIONS****Weight and Overall Dimensions**

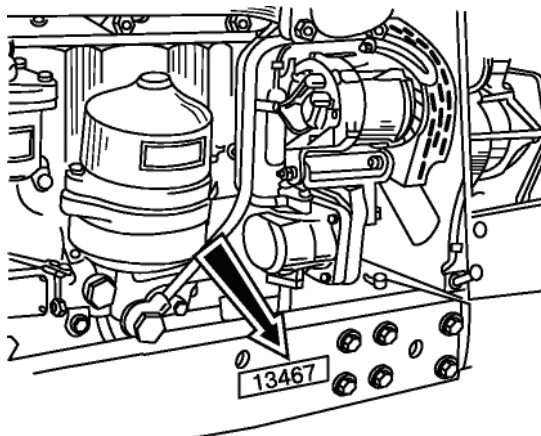
Name	510	512
A Length, mm: total (with counterweights):	4,120	4,120
without counterweights	3,840	3,930
by wheels	3,650	3,740
B Width, mm	1,970	1,970
C Height by cab, mm	2,780	2,800
D Wheelbase, mm	2,370	2,450
F Rear track, mm	1,400 - 1,600	1,800 - 2,100
E Front track, mm	1,350 - 1,850	1,400 - 2,000
G Road clearance, mm	465	465
Tire size: front wheels / rear wheels	9.00-20, 9.00R20/ 15.5R38	11.2-20, 11.2R20/ 15.5R38
Service weight, kg	3,460	3,690

Tractor component Nos.

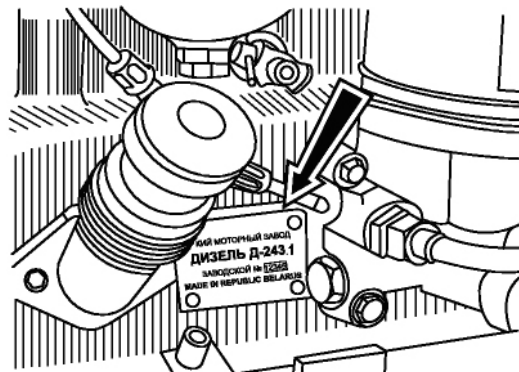
Manufacturer's nameplate with tractor and diesel engine serial Nos. indicated



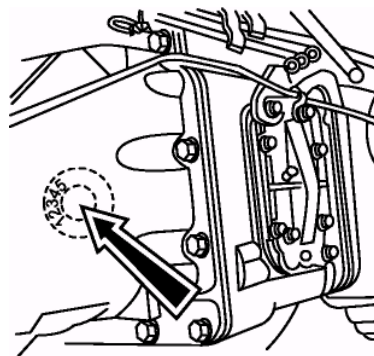
The serial number of the tractor is duplicated on the front part of the right half-frame side member (or on the right plate of the front counterweights).



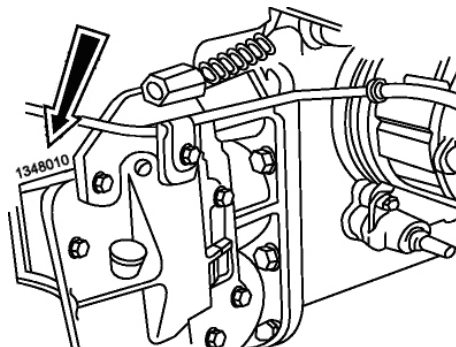
Diesel engine serial No. (duplicated on the manufacturer's nameplate of the engine attached to the cylinder block, on the left-hand side).

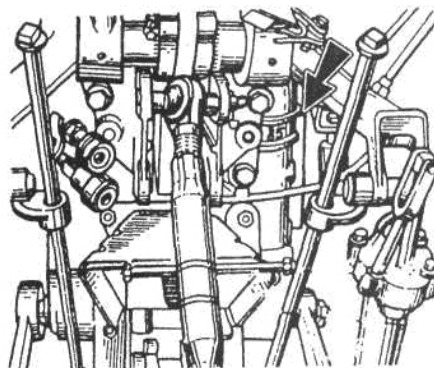


Clutch No. (on the left-hand side of the clutch housing).

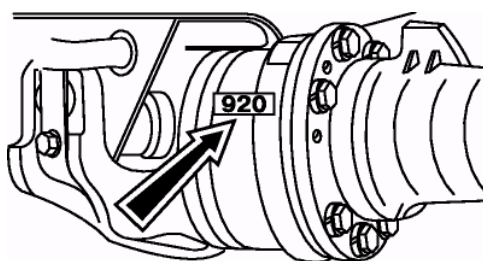


Gearbox No. (on the left-hand side of the GB housing)





Transmission number (on the rear axle housing from behind).



Front driving axle number (on the front part).

Diesel engine

Engine model	Д-244
Type	four-stroke, in-line, naturally aspirated
Number of cylinders	4
Mixing method	Direct injection
Compression (calculated)	16
Cylinder bore, mm (")	110 (4.32)
Stroke, mm (")	125 (4.92)
Cylinder displacement, l (cu. in.)	4.75 (290)
Operation order	1—3—4—2
Cooling system;	liquid
Rated speed, rpm	1,700
Maximum speed, rpm	1,850
Minimum speed, rpm	600
Rated power, kW	41.9 at 1,700 rpm
Maximum torque, N•m	271 at 1,400 rpm
Clearance between intake and exhaust valves and rockers at cold engine, mm	0.20...0.35
Advance angle of fuel injection before upper dead center (UDC), degrees	20 ± 1
Fuel injection pressure, MPa (kgf/cm ²)	21.6...22.4 (220 ... 228)

Engine lubrication system

Type: combined with oil radiator.

Minimum oil pressure:

0.08 MPa (0.8 kgf/cm²) at 600 rpm.

Normal oil pressure:

0.2...0.3 MPa (2...3 kgf/cm²).

Max. pressure at cold diesel engine: up to 0.6 MPa (6 kgf/cm²).

Capacity of lubrication system: 12 l

Motor oil grades:

- -40 °C to +5 °C: M-8ДМ; M-8Г₂, M-8Г_{2К} or M4₃/8Г₂ (SAE-20, SAE 10W-20);
- +5 °C to +50 °C: M-10ДМ; M-10Г₂; M-10Г_{2К} (SAE-30);
- multigrade oil: SAE 15W-40.

Engine feed system

Fuel pump: 4-plunger type, in-line, with booster pump.

Governor: mechanical, variable-speed.

Fuel filters: coarse and fine filter (with a replaceable filter element ΦT 020 - 1117010).

Fuel grade: Diesel fuel: summer grade Л-0.2-40, Л-0.5-40; winter grade 3-0.2, 3-0.5.

Fuel tanks capacity: 120 l

Air cleaner: combined with dry centrifugal and oil-bath air cleaning.

Air cleaner oil bath capacity: 1.5 l.

Steering

Booster type: hydromechanical.

Steering mechanism: worm, helical gear sector and steering booster.

Pump type: gear pump
НШ10-3-Л.

Pump capacity: 21 l/min

Maximum working pressure in system:
9.0 ± 0.05 MPa.

Oil grades:

- -40 °C to +5 °C: M-8ДМ; M-8Г₂, M-8Г_{2К} or M4₃/8Г₂ (SAE-20, SAE 10W-20);
- +5 °C to +50 °C: M-10ДМ; M-10Г₂; M-10Г_{2К} (SAE-30);
- multigrade oil: SAE 15W-40.

Steering wheel position control limits:

- by tilt: from 25° to 40° with fixation through 5°;
 - by height within 100 mm.
- Steering wheel free play: 25° max.

Engine start system

12 V electric starter.

Engine cooling system

Type: closed with forced coolant circulation, temperature controlled by thermostatic regulator.

Normal operating temperature: 80 °C to 100 °C.

Cooling system capacity: 20 l.

Clutch

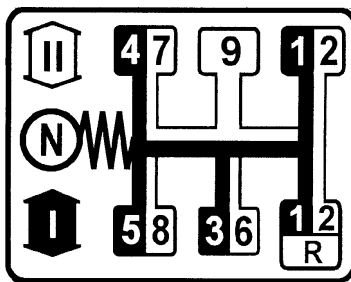
Type: friction, dry, single-disk, spring-loaded.

Driven disk diameter — 340 mm.

Gearbox

Type: (standard) 9F/2R, mechanical.

Gear and range shift pattern



Rated speeds (km/h) of the BELARUS — 510/512 tractors

Rated engine speed, rpm	1,700
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R k, m	0.75		I zm	18.1346
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Motion	No. of gear	No. of range	Gear ratio			V tr, km/h
			range	GB	transmission	
front	1	I	2.2500	5.9298	241.9512	1.9866
	2	II	1.3214	5.9298	142.0983	3.3826
	3	I	2.2500	2.0476	83.5488	5.7531
	4		2.2500	1.6667	68.0048	7.0681
	5		2.2500	1.4074	57.4263	8.3701
	6	II	1.3214	2.0476	49.0683	9.7958
	7		1.3214	1.6667	39.9393	12.0348
	8		1.3214	1.4074	33.7265	14.2518
	9		1.0000	1.0000	18.1346	26.5053
reverse	1R	I	2.2500	2.8166	114.9268	4.1823
	2R	II	1.3214	2.8166	67.4967	7.1213

(standard, equipped with 15.5R38 tires)

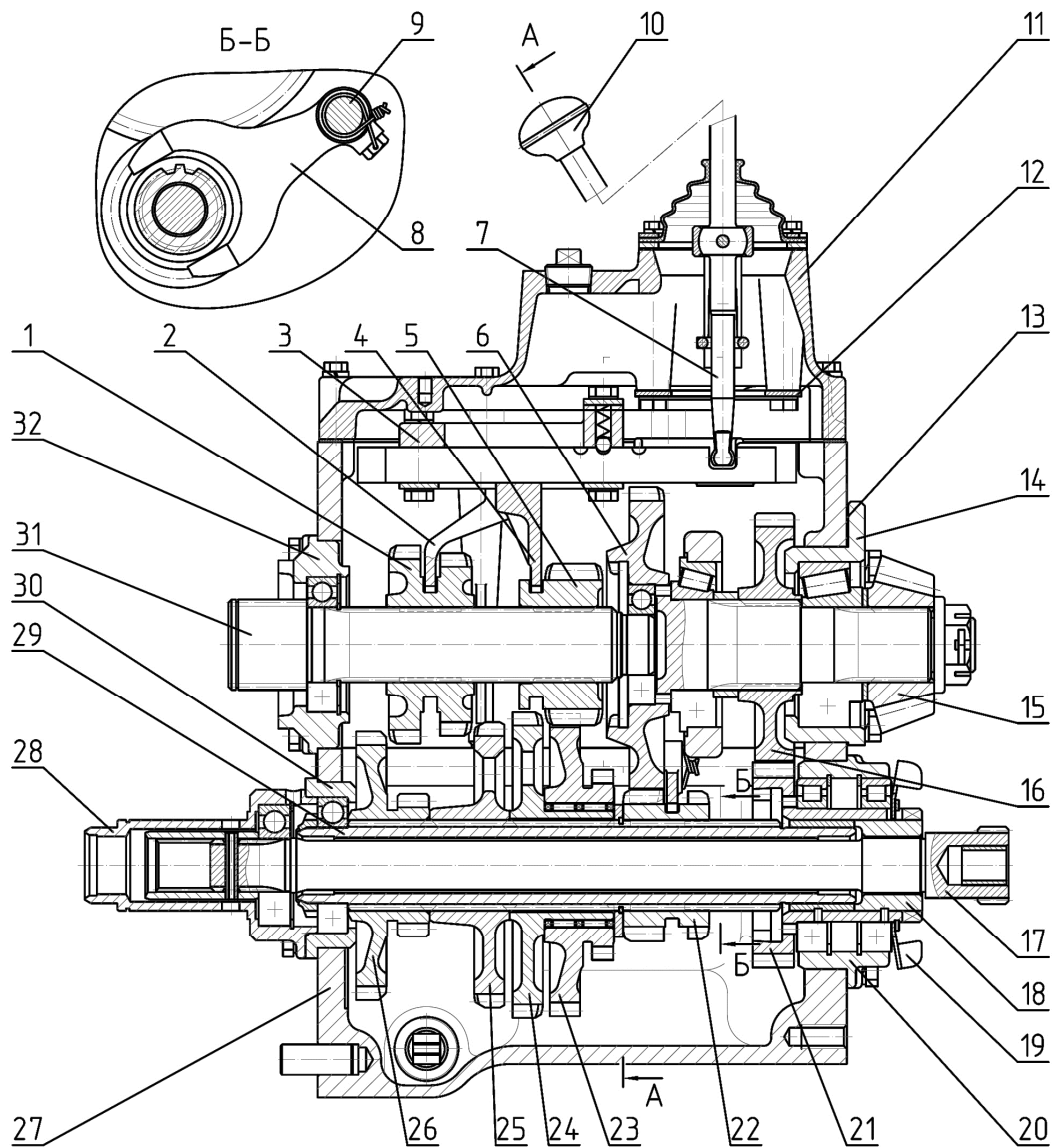


Fig. 1. Gearbox of BELARUS-510/512 tractor (9F/2R)

1 — drive pinion of 4th and 5th gears; 2 — fork of 4th and 5th gears; 3 — forks housing; 4 — fork of 3rd and 6th gears; 5 — drive pinion of 3rd and 6th gears; 6 — output shaft with driven pinion of 1st stage of range reducer; 7 — gear shifter lever; 8 — reducer fork; 9 — reducer shaft; 10 — GB lever handle; 11 — GB control cover; 12 — restrictive plate; 13 — adjustment shims; 14 — body; 15 — drive pinion of rear axle final drive; 16 — driven pinion of 1st stage of range reducer; 17 — inner shaft; 18 — seat with bronze bushings; 19 — impeller; 20 — body; 21 — drive pinion of 1st stage of range reducer; 22 — drive pinion of 1st stage of range reducer; 23 — intermediate pinion; 24 — driven pinion of 3rd and 6th gears; 25 — driven pinion of 4th and 7th gears; 26 — driven pinion of 5th and 8th gears and reverse gears; 27 — GB housing; 28 — seat; 29 — intermediate shaft; 30 — body; 31 — input shaft; 32 — glass

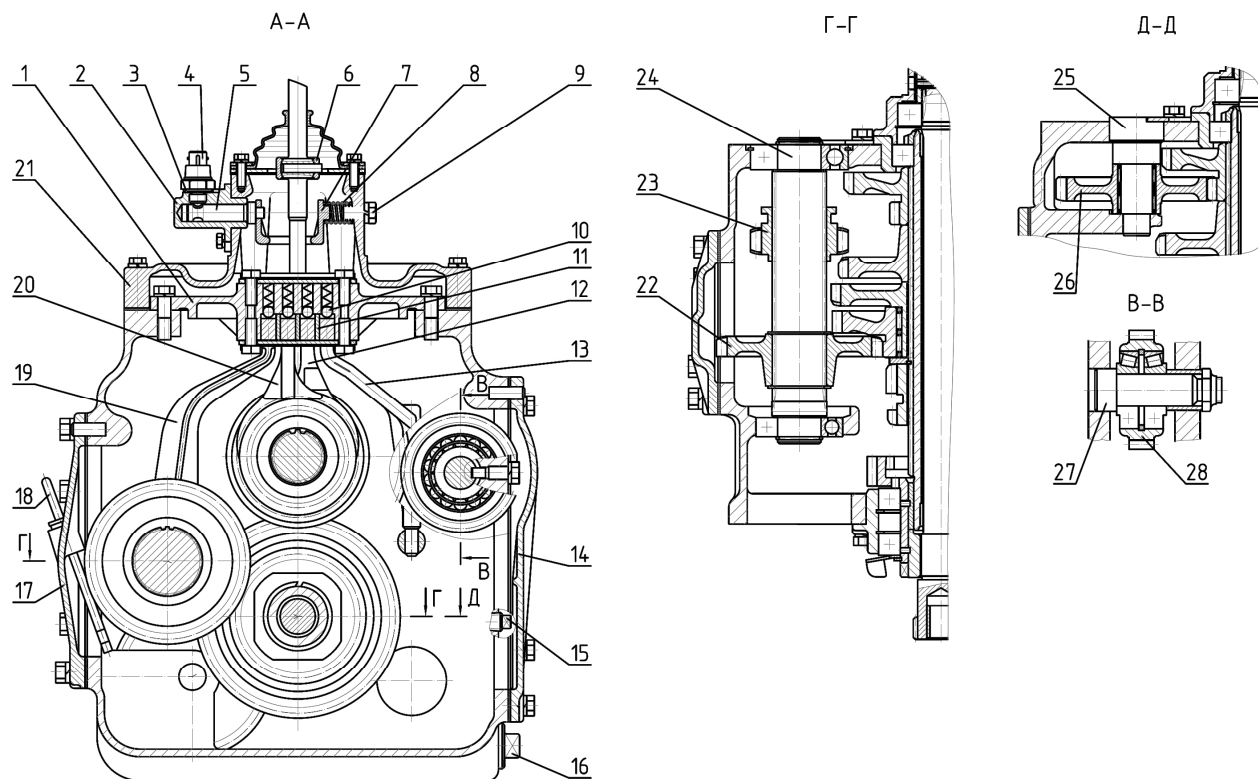


Fig. 2. Gearbox of BELARUS-510/512 tractor (9F/2R)

1 — forks housing; 2 — housing; 3 — adjustment shims; 4 — engine start lock sensor; 5 — axle of frame; 6 — ball bearing; 7 — frame; 8 — spring; 9 — bolt; 10 — lever; 11 — ball; 12 — lock strips; 13 — fork of 4th and 5th gears; 14 — range reducer rod; 15 — cover; 16 — check plug; 17 — drain plug; 18 — cover; 19 — oil dipstick; 20 — fork of 1st gear and reverse gears; 21 — fork of 3rd and 6th gears; 22 — GB cover; 23 — driven pinion of hill-climbing gears and reverse gears; 24 — pinion of hill-climbing gears and reverse gears; 25 — shaft of 1th gear and reverse; 26 — FDA drive pinion axle; 27 — reverse intermediate gear; 28 — FDA drive pinion axle; 29 — FDA drive pinion

Gearbox

The gearbox (GB) is an element of the tractor transmission serving to change the transmission gear ratios and reverse the tractor movement, thus achieving the required speed range of the tractor (see Table 1), as well as for long-term disengagement of the engine and the tractor propeller.

Besides, the GB design provides driving the front drive axle (FDA) of the tractor and synchronous rear power take-off shaft (PTO).

The BELARUS-50/52 tractors and their modifications have a mechanical fixed-ratio dual-range 9F/2R GB with a central position of the GB control lever, the design and operation of which are described below.

1.1 GB design

The GB (Fig. 1 and 2) consists of the mechanical gears unit and GB control.

1.1.1 Mechanical gears unit

The mechanical gears unit of the GB consists of the concentric input (31) and output (6) shafts located in the GB housing (27) (Fig. 1)*, as well as an intermediate shaft (29) parallel to them and the shaft of 1st gear and reverse (24) (Fig. 2).

The input shaft (31) (Fig. 1) is mounted on two ball bearings one of which is placed in the body (32) on the front wall of the GB housing (27). The second one is in the boring of the output shaft (6). On the input shaft, a double-wheel drive pinion of 4th and 5th gears (1) and a drive pinion of 3rd and 6th gears (5) with possibility of axial sliding movement along the shaft splines are installed.

The output shaft supports (6) (Fig. 1) are two tapered roller bearings, one located in the GB housing boring (27), and the second in the body (14) installed in the boring of the rear wall of the GB housing (27). Structurally, the output shaft is made as one piece with the driven pinion of 1st stage of the range reducer. The gear ring is located cantilevered in front of the output shaft (6). Between the supports of the output shaft, the driven pinion of 11nd stage of the range reducer (16) is installed fixed on the splines, which is also the drive pinion of the rear PTO synchronous drive. On the rear arm of the output shaft, the drive gear (15) of the rear axle final drive (small bevel pinion) is installed fixed on the splines.

On the intermediate shaft (29), fixed on the splines are installed the double-wheel driven pinion of 5th and 8th gears and reverse gears (26), driven pinion of 4th and 7th gears (25), and driven pinion of 3rd and 6th gear (24), on the hub of which the double-wheel intermediate pinion (23) is freely rotating on needle roller bearings, being in constant mesh with the pinion (22) (Fig. 2) installed on the shaft of 1st gear and reverse gears (24). On the intermediate shaft (29) (Fig. 1), with the possibility of axial movement the drive pinion (22) of 1st stage of the range-reducer is installed.

The front support of the intermediate shaft (29) is a ball bearing located in the body (30) of the front wall of the GB housing (27). The rear support of the intermediate shaft is a bronze bushing installed in the boring of the drive pinion (21) of 11nd stage of the range-reducer.

The driven pinion of 11nd stage of the range-reducer (21) is freely rotating on two bearings located in the body (20) installed in the boring of the rear wall of the GB housing (27). The pinion (21) has an inner and outer gear rings, as well as cams located on its rear end, which serve to synchronously drive the rear PTO. In the boring of the pinion (21), the seat (18) with bronze bushing is fixed with a pin, which is the rear support of the inner shaft (17). Outside on the pinion (21), the impeller (19) is fixed, which by intensive spraying improves lubrication of the pinions of the final drive and the rear axle differential of the tractor.

The 1st gear and reverse shaft (24) (Fig. 2) is installed on two ball bearings located in the GB housing borings. In the front of the shaft (24) on splines, the sliding pinion (23) of hill-climbing gears and reverse gears is installed. Backward movement of the sliding pinion (23) up to meshing with the pinion (25) (Fig. 1) provides forward hill-climbing gears, and forward movement up to meshing with the intermediate pinion of reverse motion (26) (Fig. 2) provides reverse gears. The intermediate reverse pinion (26) is installed on the axle (25) and is freely rotating on it on a needle roller bearing. The pinion (26) is in constant mesh with the smaller gear ring of the double-wheel gear (26) (Fig. 1).

* Hereinafter, a position designation refers to the figure with the number indicated in parentheses immediately after the position designation; if such an indication of the figure is absent, the position designation refers to the last figure mentioned in the preceding text.

At the rear part of the shaft (24) (Fig. 2), fixed on its splines, the driven pinion of hill-climbing gears and reverse gears (22) installed, which is constantly meshed with the smaller gear ring of the pinion (23) (Fig. 1) of the intermediate shaft (29).

On the right side of the GB of the tractors with FDA drive, the axle (27) is installed in the GB housing borings, on which on two tapered roller bearings the FDA drive pinion (28) is freely rotating. Power is taken off at the FDA from the driven pinion of 1st stage of the range reducer (6) (Fig. 1), with which the pinion (28) (Fig. 2) is constantly meshed.

On the front wall of the GB housing (27) (Fig. 1), concentrically to the intermediate shaft (29), the seat (28) is installed, inside of which the inner shaft front bearing (17) is located.

On the right and left sides of the GB housing, there are windows (Fig. 2). The left window is closed with the cover (17), in which there is a dipstick (18) to control the oil level. The tractors without an FDA drive have the right window closed with the cover (14), and the tractors with the FDA drive have the cover (14) removed and the window closed by the FDA drive transfer box housing (see section).

To drain oil when changing it, a hole is provided in the bottom of the GB housing, closed with the plug (16).

1.1.2 GB control

The GB control consists of the forks housing (3) (Fig. 1) and the GB control cover (11) that are installed on the upper plane of the GB housing (27) and bolted to it.

The forks housing (3) (Fig. 1) consists of the fork of 1st gear and reverse gears (19) (Fig. 2), the fork of 3rd and 6th gears (20), the fork of 4th and 5th gears (12) and the range reducer rod (13), the rails of which are installed in the groove of the housing (1) and can move along the groove. On the upper surfaces of the rails, there are transverse holes in which the spring-loaded balls of the latches (10) are inserted, which provide locking of the forks rails and reducer rail in the desired positions, as well as prevent spontaneous disengagement of the gears under load.

The rod (13) is connected with the shaft (9) (Fig. 1), on which the fork (8) is fixed that moves the drive pinion of 1st stage of the range reducer (22).

The forks and range reducer rails are separated by three lock strips (11) (Fig. 2). The strips (11) are installed in the housing (1) fixed and exclude simultaneous movement of several rails by the gear shifter lever (7) (Fig. 1). When a gear is engaged, the lock strips (11) lock the gear shifter lever (7) (Fig. 1) in the rail groove of the fork of the gear engaged.

The GB control cover (11) consists of the cover (21) (Fig. 2), on the upper surface of which the spherical bearing (6) of the gear shifter lever (7) (Fig. 1) is bolted. When swinging, the gear shifter lever (7) directly affects the rails in the forks housing (3), causing their displacement and, consequently, engagement or disengagement of the selected gear or range in the GB.

To avoid excessive swinging of the gear shifter lever (7), as well as to clearly direct its motion, the restrictive plate serves (12), which is bolted to the cover (11).

The GB design provides an engine start lock when a gear is engaged in the GB. On the right side of the cover (21) (Fig. 2), the housing is installed (2) bolted to it. In the housing (2), the axle (5) of the spring-loaded rocking frame (7) is located. The ring hole of the frame (7) envelops the gear shifter lever (7) (Fig. 1). At that, rocking of the lever (7) results in a corresponding movement of the frame (7) (Fig. 2), the axle flat (5) of which affects the diesel start lock sensor (4) mounted in the threaded hole of the housing (2).

Triggering of the engine start lock is adjusted by the shims (3) located under the

sensor (4).

1.2 GB operation

The 9F/2R GB design provides 4 forward gears and one reverse gear, each of them can be engaged on the both range reducer stages, and one direct forward gear, at engagement of which the input (31) (Fig. 1) and output (6) shaft are rigidly linked by the drive pinion of 3rd and 6th gears (5) acting as a gear-type coupling at that.

The GB gears and ranges are engaged by a single GB control lever (7) as per the diagram (Fig. 3). Selection of gears in the GB is preceded by selection of the desired range of the reducer.

Gears and ranges are switched only when the tractor stopped and the clutch pedal is pressed on.

To select and engage a reducer range, the operator shifts the gear shift lever (7) (Fig. 1) from the neutral position to the range-reducer position (Fig. 3). Further, to engage the 1st reducer stage, the operator shifts the GB control lever (7) (Fig. 1) backwards (Fig. 3). At that, the gear shifter lever (7) (Fig. 1), acting on the reducer rail (13) (Fig. 2), moves it and its associated roller (9) (Fig. 1) with the fork (8) forward. The drive pinion of 1st reducer stage (22) controlled by the fork (8) moves along the intermediate shaft splines (29) and engages with the driven pinion (6) of 1st range reducer stage.

To engage the 11nd reducer stage, the operator shifts the GB control lever (7) (Fig. 1) in the range reducer position forward (Fig. 3). At that, the gear shifter lever (7) (Fig. 1), acting on the reducer rail (13) (Fig. 2), moves it and its associated roller (9) (Fig. 1) with the fork (8) forward. The driven pinion of 1st reducer stage (22) controlled by the fork (8) moves along the intermediate shaft splines (29) and engages with the inner gear ring of the drive pinion (21) of 11nd range reducer stage, linking it to the intermediate shaft (29). The pinion (21) is in constant mesh with the driven pinion of the 11nd range reducer stage (16).

At the 11nd range reducer stage, rotation from the intermediate shaft (29) is transmitted to the output shaft (6) with deceleration less than at the 1st stage.

In the GB range reducer, there is no neutral position of the drive pinion of the 1st reducer stage (22) (Fig. 1), therefore either the 1st or the 11nd stage is always turned on in the range reducer.

To engage the 1st or 2nd forward or reverse gear, the operator shifts the GB control lever (7) (Fig. 1) to the extreme left position (Fig. 3) being the position of hill-climbing gears and reverse gears. Further, to engage the 1st or 2nd forward gear, the operator shifts the GB control lever (7) (Fig. 1) forward (Fig. 3). At that, the gear shifter lever (7) (Fig. 1), acting on the rail of the fork of the 1st gear and reverse gear, moves the fork (19) (Fig. 2) backward. The sliding pinion of 1st gear and reverse motion (23) controlled by the fork (19) engages with the driven pinion of 4th and 7th gears (25) (Fig. 1), and power in the GB is transmitted to the ?GB intermediate shaft (29) through the pinions (5), (23), (22) (Fig. 2), (23) and (25) (Fig. 1).

To engage the 1st or 2nd reverse gear, the operator shifts the GB control lever (7) (Fig. 1) to the position of hill-climbing gears and reverse gears backward (Fig. 3). At that, the gear shifter lever (7) (Fig. 1), acting on the rail of the fork of the 1st gear and reverse gear, moves the fork (19) (Fig. 2) forward. The sliding pinion of 1st gear and reverse motion (23) controlled by the fork (19) engages with the intermediate pinion of reverse gear (26) being in constant mesh with the lesser gear ring of the double-wheel pinion of 5th and 8th gears (26) (Fig. 1). At the reverse gear, power flow in the GB is transferred to the intermediate shaft (29) through the pinions (5), (23), (22) (Fig. 2), (23), (26) and (26) (Fig. 1).

To engage the 3rd and 6th, or 9th (direct) gear, the operator shifts the GB control

lever (7) (Fig. 1) to the respective positions of those gears (Fig. 3). Further, to engage the 3rd (6th) gear, the operator shifts the GB control lever (7) (Fig. 1) to the position of the said gears backward (Fig. 3). At that, the gear shifter lever (7), acting on the rail of the fork of 4th and 5th gears, moves the fork (20) (Fig. 2) forward. The sliding pinion of 3rd and 6th gears (5) controlled by the fork (20) (Fig. 1) engages with the driven pinion of 3rd and 6th gears (24). By the emerged mesh, power is transferred to the GB intermediate shaft (29).

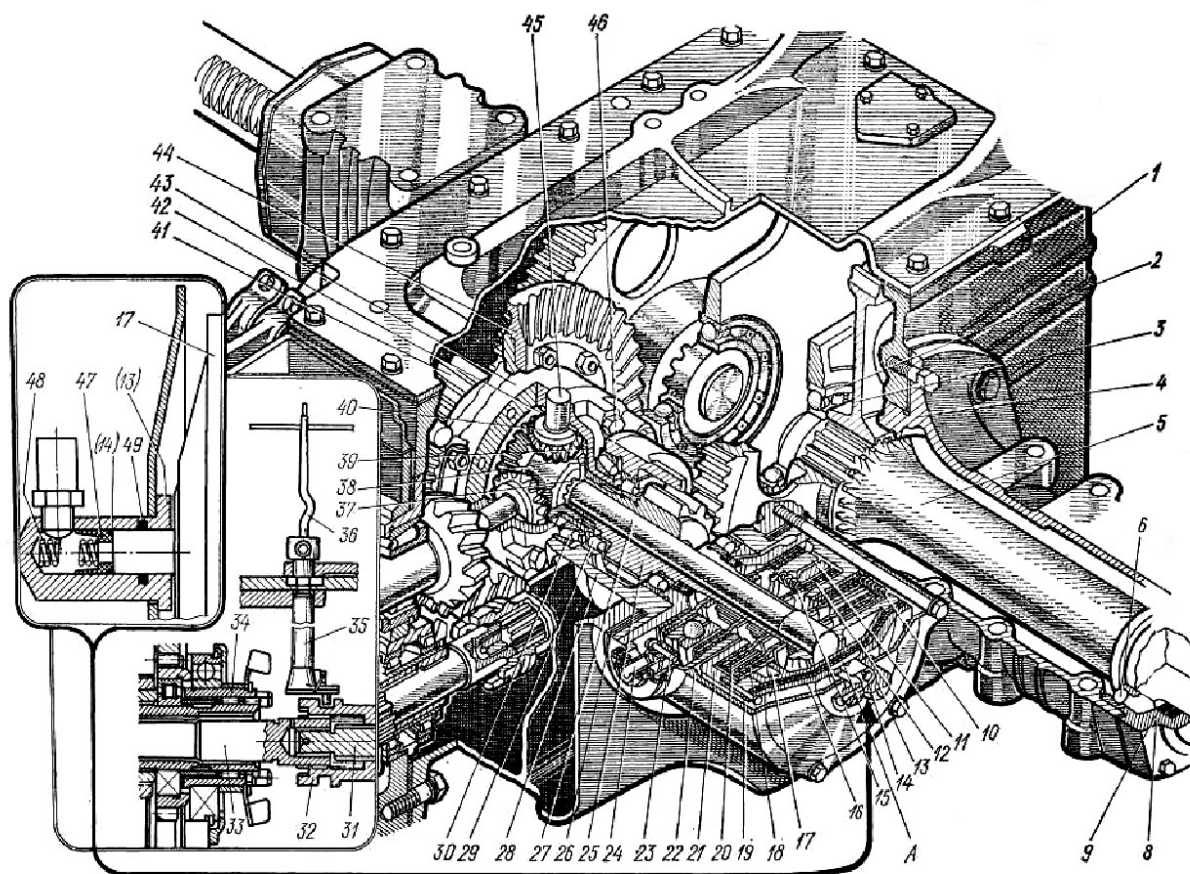
To engage the 9th (direct) gear, the operator moves the GB control lever (7) (Fig. 1) from the position of the 3rd (6th) and 9th (direct) forward gears (Fig. 3). At that, the gear shifter lever (7), acting on the rail of the fork of 3rd and 6th gears, moves the fork (20) (Fig. 2) forward. The sliding pinion of 3rd and 6th gears (5) controlled by the fork (20) (Fig. 1) engages with the inner gear ring of the output shaft (6), rigidly linking the input (31) and output (6) shafts.

The 9th (direct) gear must be engaged when the IInd range reducer stage is engaged (Fig. 3). This will avoid a loud noise in the GB, since the IInd reducer stage has an intermediate shaft speed (29) (Fig. 1) less than the Ist stage.

To engage the 4th (7th) or 5th (8th) gear, the operator shifts the GB control lever (7) (Fig. 1) to the respective positions of those gears (Fig. 3). Further, to engage the 4th or 7th gear, the operator shifts the GB control lever (7) (Fig. 1) to the position of the said gears forward. At that, the gear shifter lever (7), acting on the rail of the fork of 4th and 5th gears, moves the fork (12) (Fig. 2) and the drive pinion unit of 4th and 5th gears (1) controlled by it (Fig. 1) backward. The smaller gear ring of the unit (1) engages with the driven pinion of 4th and 7th gears (25). By the created mesh, power from the input shaft (31) is transferred to the GB intermediate shaft (29).

To engage the 5th or 8th gear, the operator shifts the GB control lever (7) (Fig. 1) to the position of the said gears backward (Fig. 3). At that, the gear shifter lever (7), acting on the rail of the fork of 4th and 5th gears, moves the fork (12) (Fig. 2) and the drive pinion unit of 4th and 5th gears (1) controlled by it (Fig. 1) forward. The larger gear ring of the unit (1) engages with the driven pinion of 5th and 8th gear (26). By the created mesh, power from the input shaft (31) is transferred to the GB intermediate shaft (29).

Table 1 shows rated speeds of the BELARUS-510/512 tractor and its modifications at all GB gears.



Rear axle:

1 — housing; 2 — half-axle bearing (217); 3 — final drive driven pinion; 4 — half-axle tube; 5 — half-axle; 6 — half-axle bearing (217); 8 — cover; 9 — cup; 10 — expansion springs; 11 — pressure plate; 12 — brake disk; 13 — adapter; 14 — ring; 15 — return springs; A — working cavity of lockup clutch; 16 — diaphragm cover; 17 — plate; 18 — pressure plate; 19 — diaphragm; 20 — intermediate disk; 21 — clutch housing of DL; 22 — DL clutch casing; 23 — brake casing; 24 — fork; 25 — left drive pinion of final drive; 26 — adjustment shims; 27 — DL clutch shaft; 28 — left bearing body; 29 — bearings of drive pinion of final drive; 30 — left bearing of differential (7215A); 31 — crown pinion shaft; 32 — clutch; 33 — inner shaft; 34 — pinion of synchronous PTO; 35 — control roller; 36 — PTO lever; 37 — half-axle pinion; 38 — support washer of half-axle pinion; 39 — differential cap; 40 — pinion; 41 — right drive pinion of final drive; 42 — ball washer of pinions; 43 — differential housing; 44 — driven pinion of final drive; 45 — cross; 46 — tight-fitting bolts of differential housing; 47 — bushing; 48 — spring; 49 — ring.

Rear axle:

Main drive: a pair of bevel gears with circle-arc tooth.

Differential: bevel, four-pinion.

Final drive: pair of spur pinions.

Differential lock:: hydraulically operated dry friction clutch

Brakes

Sevice: on rear wheels: two-disk type, dry, with mechanical drive.

Disk diameter: 204 mm.

Parking: disk-type, dry, with mechanical hand drive.

Disk diameter: 180 mm.

Pneumatic system**Compressor**

Type: single cylinder, air cooling.

Front driving axle

Type: portal, with retractable housings of bevel wheel reduction gears.

Main drive: pair of bevel pinions with circle-arc teeth.

Differential type: bevel, self-locking, limited-slip with friction clutches.

Final drives: with bevel reduction gears.

Transmission oils: Тар-15В, ТСп-15К or ТСп-10 (SAE 80W-90); ТАД-17И.

Drive: from transfer case with two driveshafts with intermediate bearing.

FDA control: mechanical, lever under operator's right hand. Has 3 operating modes:

FDA disengaged;

FDA engaged/disengaged automatically;

FDA engaged forced.

Power take-off shaft drive (PTO)

Type: independent one-speed and synchronous.

Master clutch: planetary gear reducer with belt brakes.

PTO control: mechanical.

PTO end speed:

Independent drive:

• 540 rpm at 1,630 rpm of engine;

Synchronous drive: 3.4 revolutions per meter when rear tires 15.5 R38 are installed.

Removable PTO end: as per SAE with 6 and 8 splines for 540 rpm

Direction of rotation: clockwise as viewed from the end butt.

Hydraulic system

Type: universal, modular, with autonomous power cylinder.

Maximum pressure in hydraulic system 180...200 kgf/cm².

Distributor:

spool-type valve:

• P80-3/1-222-3Гр (P80-3/1-111-3Гр) — for tractors without a power governor;

Hydraulic system outlets: two side and two rear outlets.

The RHL control system has an operating mode:

• height.

Hydraulic system oil grades:

• -40 °C to +5 °C - M-8Г2К

(SAE 15W-40); BECHEM STAROIL No. 32;

• +5 °C to +50 °C - M-10Г2, M-10Г2К

(SAE 15W-40); BECHEM STAROIL No. 32;

Rear hitch linkage

Type: three-point mounted system of category 2

Lifting capacity: 3200 kg at ends of longitudinal rods.

Electric equipment

Electrical system voltage: 12 V.

Start system voltage: 12V.

Power system: two batteries, 12 V each, connected in parallel.

Alternator

14 V, 1,150 W

Emergency and light signaling system:

• front headlights with upper and lower beams;

• rear operating headlights;

• clearance lights and brake lights;

- instrument panel, number plate illumination;
- emergency light.

1,000 rpm

Wheels

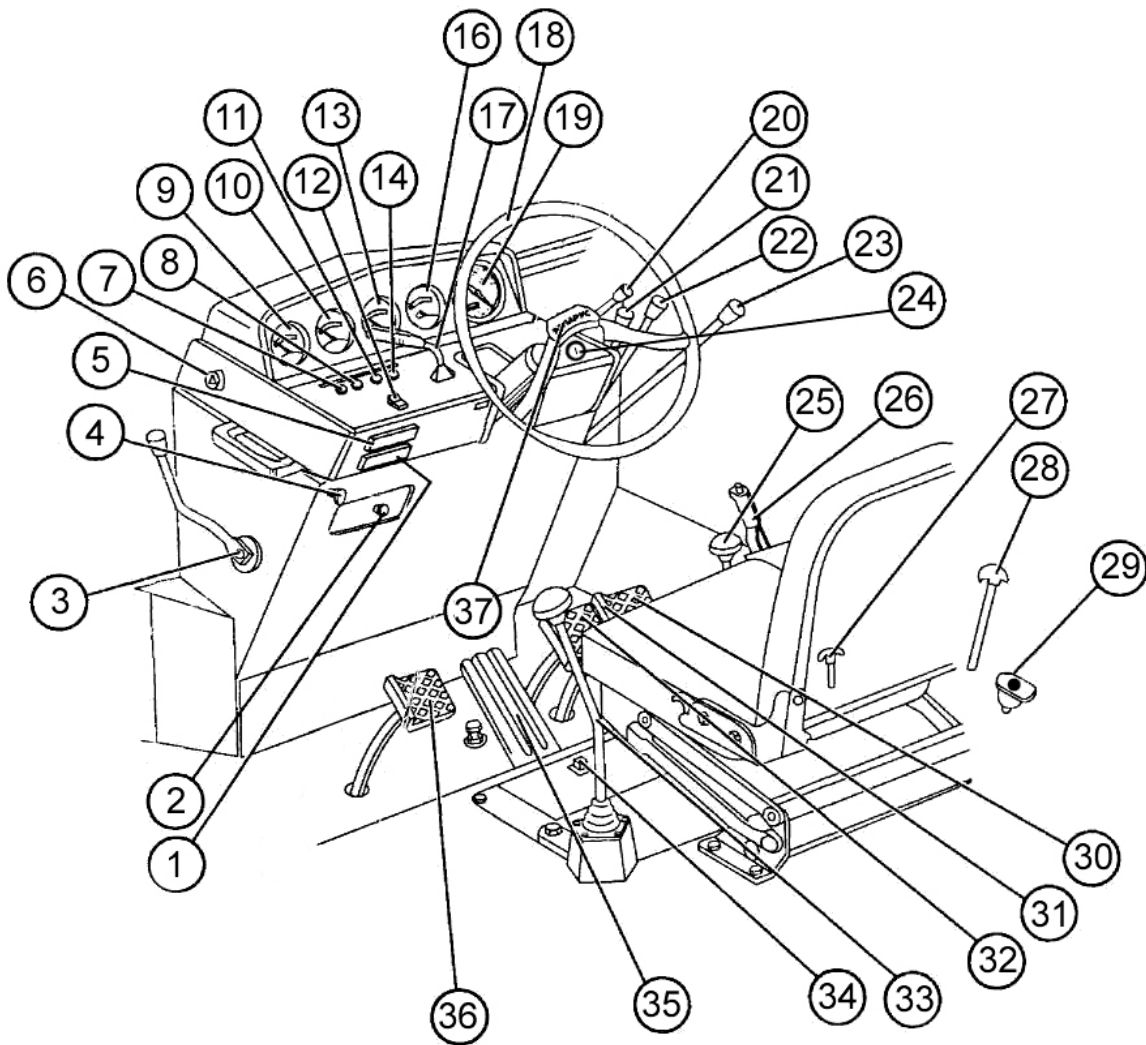
Front:

9.00-20 (9.00R20) with a front axle,
11.2-20 (11.2R20) with PTO - 72,

Rear:

15.5R38;

Section C. Controls and Instrumentation



- | | |
|---|---|
| 1. Lower fuse block; | 24. Starter switch; |
| 2. Engine stop lever; | 25. Rear PTO control lever. Has two positions: |
| 3. Fuel control lever; | lower – PTO off, upper — PTO on. |
| 4. Differential lock control knob; | 26. Parking brake control lever; |
| 5. Upper fuse block; | 27. Transfer case control rod; |
| 6. Emergency stop signaling switch; | 28. Mount lock control lever; |
| 7. Alarm lamp of emergency oil pressure drop | 29. Battery disconnect switch; |
| in engine (red); | 30, 32. Brake pedals; |
| 8. Alarm lamp of air filter clogging (red); | 31. Brake pedal connection plate; |
| 9. Engine coolant temperature indicator; | 33. Gear shifter lever; |
| 10. Voltage indicator; | 34. PTO drive mode shifter arm. Has three posi- |
| 11. Turn signal pilot lamp (green); | tions: Synchronous drive – Neutral — Inde- |
| 12. Central light switch; | pendent drive; |
| 13. Tank fuel level indicator; | 35. Fuel control pedal; |
| 14. Upper beam pilot lamp (blue); | 36. Clutch pedal; |
| 15. Multifunctional understeering switch, (turn | 37. Steering wheel height control mechanism |
| indicators, upper/lower beam, horn, upper | cover. |
| beam signaling); | |
| 18. Steering wheel; | |
| 19. Tachometer/speedometer; | |
| 20. Steering wheel inclination control; | |
| 21, 22, 23. Hydraulic system distributor con- | |

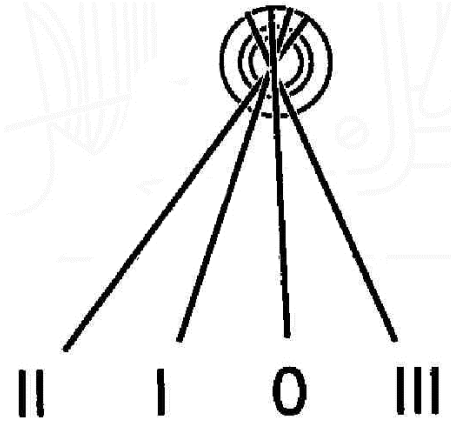
IMPORTANT! Before you start operating the tractor, study the controls and instrumentation and their functions.

Instruments and switches

Starter and instrument switch

The switch (1) has four positions:

- **0** — OFF;
- **I** — Instruments ON;
- **II** — Starter ON (unfixed position);
- **III** — Radio ON (key turned counterclockwise).



Autonomous instruments

Coolant temperature indicator (1)

The indicator (1) shows the engine coolant temperature in degrees. The scale has three zones:

- operating: 80 to 100°C - green;
- warning: 40 to 80°C - yellow;
- emergency: 100 to 120°C - red;

Fuel level indicator (3)

The indicator (3) shows the amount of fuel in the tank. Do not let the fuel tanks to be fully emptied in order to avoid ingress of air to the fuel system.

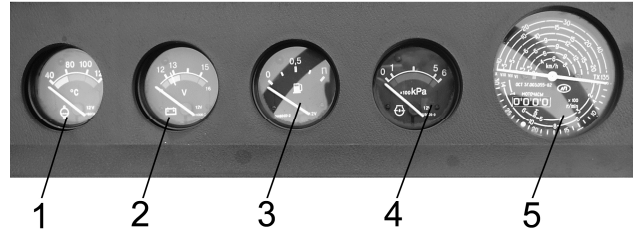
The instrument has a mark-up:

0 - 0.5 – П

Voltage indicator (2)

The device indicates SB voltage on a dead engine when the starter key (1) is in position "I". When the engine is running, the voltage indicator shows voltage in the tractor electric system.

Scale zone, color	Feed system condition	
	when engine is running	when engine is off
13.2 – 15.2 V green	normal charging mode	
10.0 – 12.0 V red	generator not operating	battery discharged
12.0 – 13.2 V yellow	no SB charging (low charging voltage)	SB has normal charging
15.2 – 16.0 V red	SB recharged	
12.7 – 12.0 yellow		SB charging start
white hairline in yellow zone		SB rated EMF – 12.7 V



IMPORTANT! If the instrument shows no SB charging, check the condition and tension of the fan driving belt.

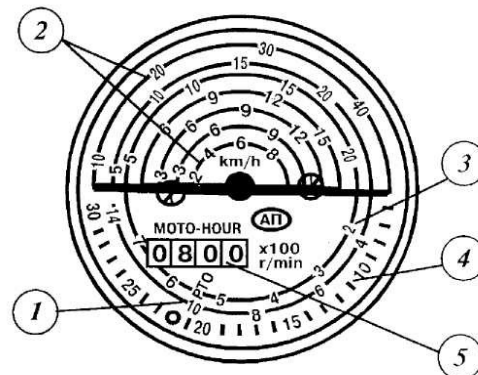
Engine oil pressure indicator (4)

When the engine is running, monitor the instrument readings. The normal oil pressure is 1 to 5 kgf/cm² (green zone of scale). On a cold engine, the pressure can rise to 6 kgf/cm².

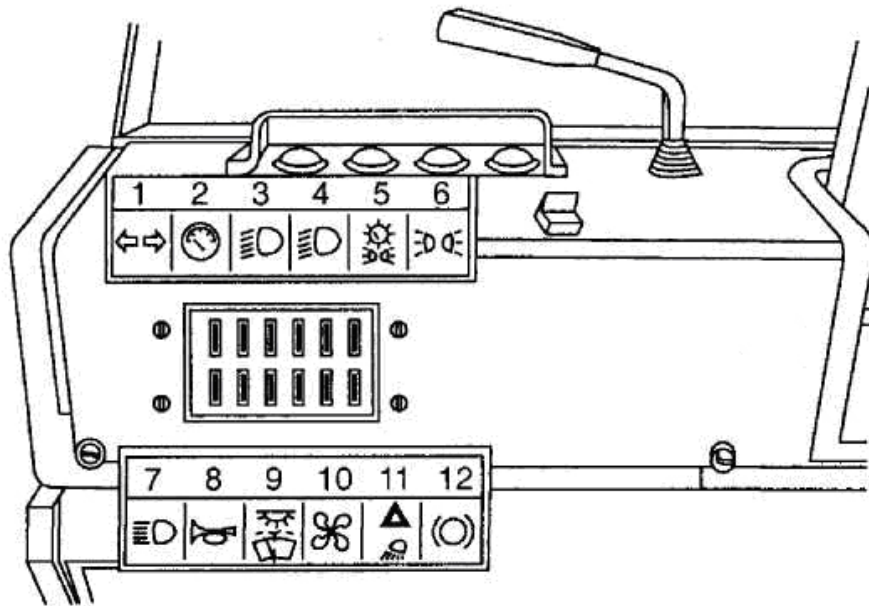
IMPORTANT! Do not let the engine operate when the instrument readings are in the red zones at the rated mode. If the oil pressure is too low or absent, immediately stop the engine, find and correct the fault.

Tachometer/speedometer (5)

1. White background — tractor speed scale (km/h) at II, III, IV GB ranges (5 to 16 gears).
- 2 and 3. Green background — rear independent PTO speed scale (rpm);
4. Black background — engine speed mode scale (rpm);
5. Engine service hours scale.



Fuses



In the instrument panel, two electric circuit fuses are mounted.
12 fuses protect the following tractor circuits from overloads:

- 1 — turn indicators, 15 A;
- 2 — instrumentation power, 7.5 A;
- 3 — left headlight lower beam, 7.5 A;
- 4 — right headlight lower beam, 7.5 A;
- 5 — right-side clearance lights, number plate illumination, instrument illumination, 15 A;
- 6 — left-side clearance lights, 7.5 A;
- 7 — headlight upper beam, 25 A;
- 8 — horn, 15 A;
- 9 — backup, 25 A;
- 10 — backup, 15 A;
- 11 — emergency stop signaling, rear working lights, 15 A;
- 12 — stop lights, portable lamp power, 15 A;

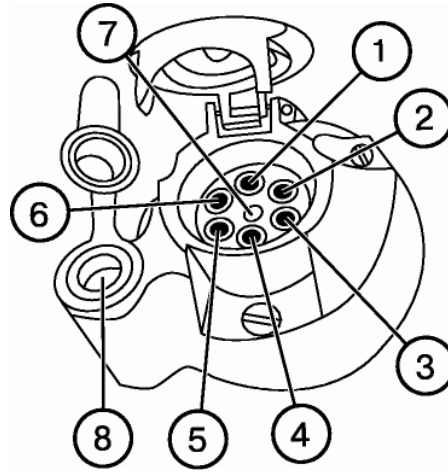
Besides, a block with a 60 A fuse is installed on the hydraulic system oil tank to protect the SB charge circuits.

Electric equipment connectors

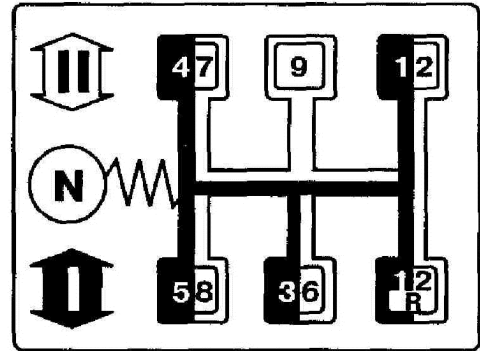
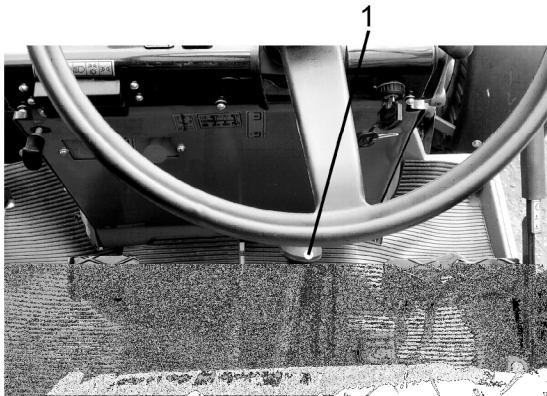
A **standard 7-pin socket** is intended to connect consumers of current of a transportation machine or attached implement. It is installed on the cab rear support. To the socket, the plug of the wire harness of attached machines is connected.

Socket terminal designations:

- 1 — Left turn indicator;
- 2 — Horn
- 3 — Ground;
- 4 — Right turn indicator;
- 5 — Right clearance light;
- 6 — Stop signal;
- 7 — Left clearance light;
- 8 — Connection of portable lamp and other consumers with a current load up to 8 A.



Gearbox control



The gearbox is a 9/2 mechanical one.

The lever (1) shifts the gears as per the shift pattern. Before engaging a gear, engage the required range (stage).

IMPORTANT! Ranges and gears are engaged by the same lever (1), a range is engaged first (1st or 2nd).

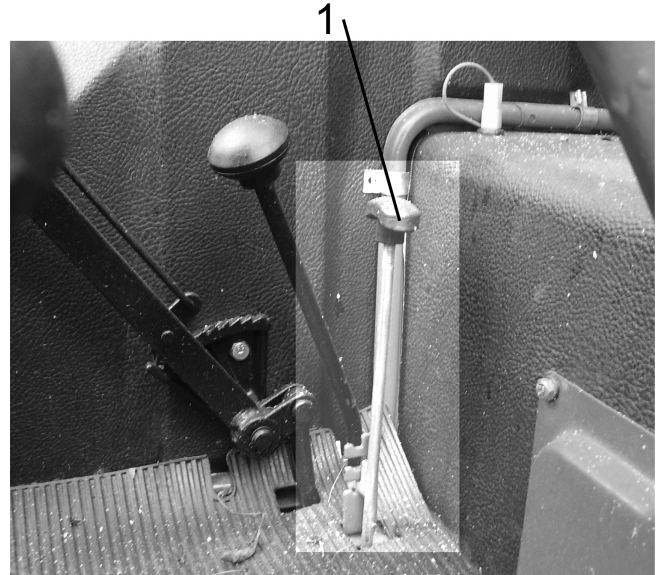
Attention! Use of the R gear in traction mode is not allowed.

Front drive axle control

The control lever (1) has three fixed positions:

- FDA off — lowermost position. Use on transport when moving on hard surface roads;
- FDA forcedly ON — uppermost position. Use this mode for a short time when working on loose and wet soils and, as necessary, during reverse movement.
- FDA automatically ON (OFF) – mid position. In this mode, the FDA is engaged and disengaged automatically by the free running coupling depending on rear wheel skidding. Use this mode for different field works.

ATTENTION! When using the tractor without driveshafts, shift the control lever (1) to the uppermost position (FDA forcedly ON).

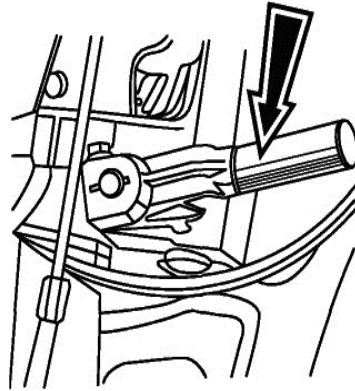


Hydraulic system pump control

The control lever has two positions:

- Pump ON — upper position;
- Pump OFF — lower position.

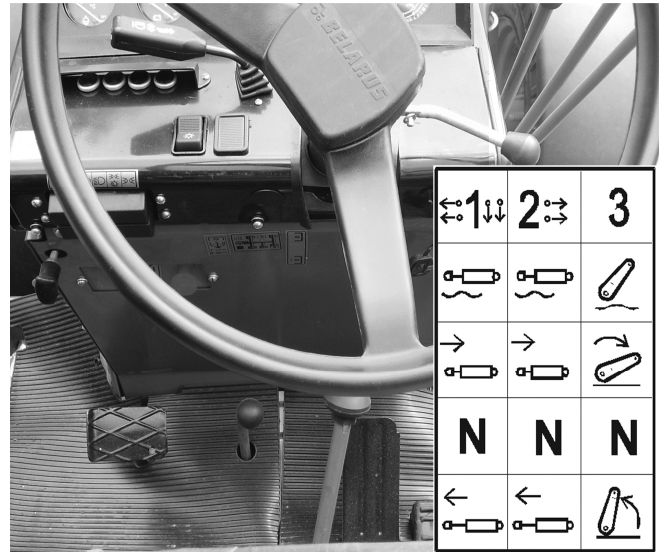
IMPORTANT! Turn on the pump only at the engine minimum idle speed. Turn off the pump for engine cold start or maintenance.



Control of hydraulic system distributor (external cylinder)

Each of the four levers controls the external cylinders and has four positions:

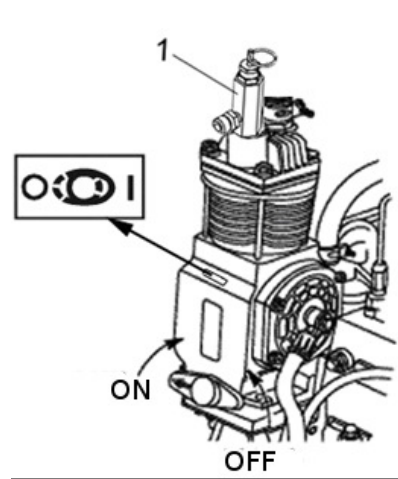
- Neutral — lower mid position (fixed);
- Lifting — lower non-fixed position. When the cylinder rod reaches its extreme positions, the lever automatically returns to the Neutral position.
- Forced lowering — upper mid non-fixed position between the Floating and Neutral positions. After lowering, the lever automatically returns to the Neutral position.
- Floating — upper fixed position.



Compressor control

The handle has two positions:

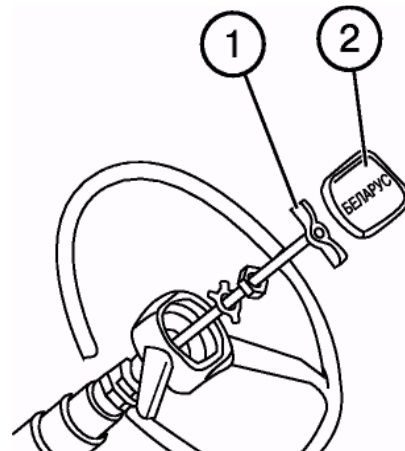
- Compressor ON — when the handle is turned so that the arrow on the arm would be directed backwards with respect to tractor motion;
- Compressor OFF — when the handle is turned by 180°C so that the arrow on the arm would be directed backwards with respect to tractor motion;
- The valve 1 screwed into the compressor is intended to take air to inflate tires as well as for other purposes when energy of compressed air is required.



Changing steering wheel position

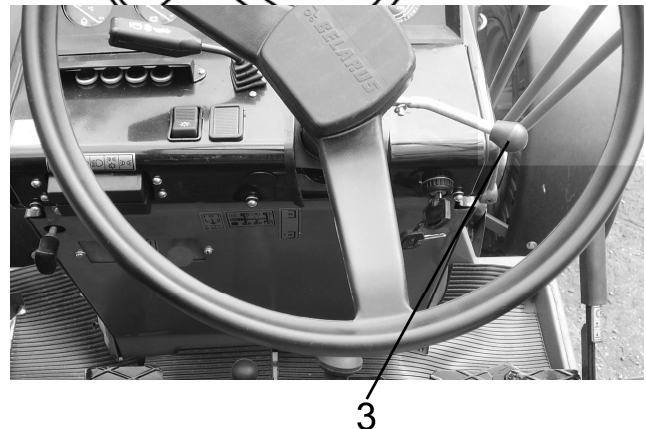
To change the position of the steering wheel by height:

- Remove the cover (2);
- Unscrew the clamp (1) by 3...5 turns;
- Move the wheel to the desired position;
- Tighten up the clamp (1) by hand and install the cover (2) to place.



NOTE: The range of steering wheel adjustment by height is 100 mm.

To change inclination of the steering column, pull up the rod (3). The steering column has four inclined fixed positions from 25° to 40° with a step of 5°.



Seat

The driver's seat is one-piece, cushioned on a mechanical suspension with a hydraulic shock-absorber, is fixed to the cab floor with four bolts. The seat can be adjusted by driver's weight from 60 to 120 kg, within ± 75 mm in the longitudinal horizontal plane. Correct adjustment of the seat by driver's weight greatly reduces vibration from the tractor. A correctly adjusted seat must go down under driver's weight by a half of its travel (60 to 65 mm approximately).

Attention! After adjustments of the seat, all handles (latches) must be returned to their initial positions.



1 — handle for seat longitudinal adjustment;

2 — handle for seat adjustment by driver's weight;

Section D. OPERATING INSTRUCTIONS

Tractor pre-operation

When preparing a new tractor for operation, depreserve it proceeding as follows:

- remove protective covers and plugs fitted on the engine;
- install peacocks of the radiator and cylinder block;
- fill in all the refill tanks;
- unpack the muffler put in the cab and install it onto the exhaust manifold so that exhaust pipe outlet cut would be directed forward along the tractor motion. Install the retaining clip at a distance of 8 to 12 mm from the muffler pipe end. Tighten the clip nuts to a torque of 44 to 54 Nm;
- drain sediment from the coarse and fine fuel filters and fuel tank;
- fill the fuel supply system with fuel and bleed the system to remove air from it;
- check the fan belt tension;
- check and adjust the air pressure in the tires;
- perform servicing of the storage battery;
- tighten the fasteners;
- grease all the lubrication points using a gun;
- check and adjust, if necessary, the front wheel toe-in.

WARNING! To avoid injuries, make sure that all protective guards are in their places prior to starting the diesel engine.

ATTENTION! Starting a new engine, which is not run-in, by towing is not allowed to avoid the intense wear of the engine parts.

Running-in

Your new tractor will work reliably and for long time, provided that running-in is made properly and necessary maintenance is provided within the recommended terms. When executing the 30-hour running-in, observe the following rules:

1. Constantly monitor the instrument readings and operation of the lubricating, cooling and feed systems. Monitor the oil and fluid levels in refill tanks.
2. Check tightening and retighten the external fastening junctions.
3. Run in the tractor on light transport and field works (harrowing, cultivation, sowing, etc.), gradually increasing the load at different gears.
4. Do not overload the engine, do not allow fuming or drop of the rotational speed. The overload symptoms are abrupt drop of the engine speed, fuming and failure to respond to higher fuel feed.
5. The operation of the tractor at very low gear with small load at high engine speeds will result in excessive fuel consumption. Correct selection of a gear for each particular work provides fuel saving and reduces engine wear.
6. Regularly perform time-shift maintenance in accordance with recommendations stated in this Manual.
7. After running-in the tractor, perform the maintenance works.

Starting engine

Starting under normal conditions:

Check the oil level in the engine crankcase and the coolant level in the radiator, as well as fuel in the tank.

IMPORTANT! Start the engine and check the instrument operation while sitting in the operator's seat only.

IMPORTANT! Never start the engine with an empty cooling system!

Warning: Never operate the tractor indoors.

1. Engage the parking brake (1);
2. Switch on the ground switch;
3. Shift the fuel feed lever to the middle position;
4. Shift the PTO control lever to the OFF position;
5. Step on the clutch pedal;
6. Shift the gear shifter lever to its neutral position, shift and hold it in the left-most positions.
7. Turn the starter key to the position II (Start) and hold it until the engine starts, but not more than 15 s. If the engine fails to start, repeat starting after at least 30 to 40 s.
8. After the engine starts, release the clutch pedal and the gear shifter lever. Check the operation of all indicating lamps and instrument readings (coolant temperature, oil pressure in the engine and storage battery charge).
9. Let the engine run at 1,000 rpm until the oil pressure stabilizes in the operating range.

Starting at low temperatures (+4°C and below)

normal conditions”.

Important! To avoid damage of the power gear, do not push or pull the tractor to start the engine by towing.

Warning:

Never use ether means to aid engine start with an electric torch pre-heater installed. Application of ether can result in an explosion of the intake manifold and severe injuries.

When low temperatures are steady, use winter-grade oils in the engine crankcase, gearbox and hydraulic system according to the recommendations in this Manual.

Keep the batteries fully charged.

Use clean, without water winter-grade diesel fuel.

To avoid failures, every day drain sediment from the coarse fuel filter and fuel tanks.

IMPORTANT! Refill the fuel tanks at the end of each working day to prevent condensation in the tanks.

Note: When starting the engine at low temperatures, a circulation pre-heater can be used for a cooling system filled with antifreeze agent. Contact your dealer for more details on pre-heater installation.

Procedure of starting the engine at low temperatures:

1. Turn off the drive of the hydraulic system oil pump to reduce resistance to crankshaft rotation.
2. Perform the actions 1 to 9 as indicated in the Section “Start under

Getting tractor moving

ATTENTION! When selecting the required gear, use the gear shift pattern.

To start the movement, proceed as follows:

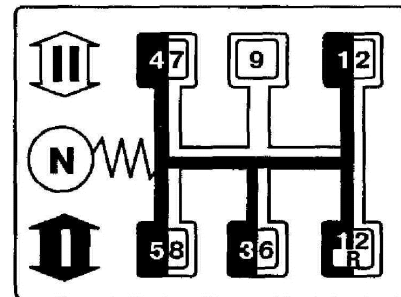
- engage the required gear as per the gear shift pattern;
- step on the clutch pedal;
- in the neutral position shift the gear shifter lever (1) to the leftmost position and set the range II or I respectively by moving the lever forward or backward;
- return the lever to the neutral position and then set the required speed by moving the lever (1) forward or backward as per the pattern;

Release the parking brake and release smoothly the clutch pedal while increasing slightly the fuel feed. After starting the motion, increase the fuel feed.

Avoid getting moved with a high traction load (e.g. a plough deepened into the soil).

ATTENTION! Always step on the clutch pedal prior to engaging the range (step) and a gear.

Do not hold the foot on the clutch pedal during operation on the tractor, since this can lead to clutch slipping, its overheating and failure.



Stopping tractor

To stop the tractor:

- reduce the engine crankshaft speed;
- use the service brakes to stop the tractor;
- step on the clutch pedal;
- shift the gear shifter lever to the neutral position;
- engage the parking brake.

IMPORTANT! To stop the tractor in case of emergency, step on the clutch pedal and twinned service brakes pedal at the same time.

Shutting down engine

IMPORTANT! Prior to shutting down the engine, lower the implement onto the ground and let the engine operate at 1,000 rpm for 1 to 2 min. This will decrease the engine temperature.

To shut down the engine, proceed as follows:

- set manual fuel feed lever to minimal feed position (back to the stop);
- disengage the PTO and shift all distributor levers to their neutral positions;
- lower the implement onto the ground;
- pull engine shut-off lever cord handle to fully stop the engine;
- turn off the ground switch to avoid storage battery run-down.

Hydraulic system

The hydraulic system controlling the three-point rear attachment ensures system operation in the height control mode.

Height control

When working with attached tillers, they must have a supporting wheel.

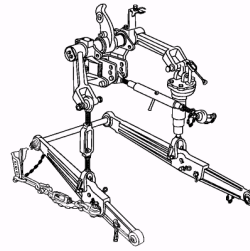
Steering

IMPORTANT! The tractors are equipped with the hydrostatic steering booster. If the engine is stopped, the pump does not supply the system and it starts automatically operating in the manual mode where turning the tractor requires a greater force to be applied to the steering wheel.

Section E. UNITIZING

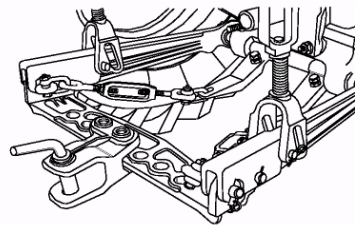
Working equipment for attaching agricultural machines to the tractor

(for tractors with power regulator)



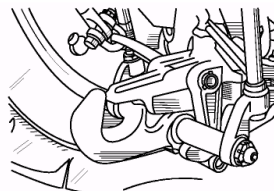
Rear three-point hitch linkage — to attach mounted and semi-mounted machines such as plows, seeders, cultivators, spraying machines etc.

Haul-and-draw coupler (cross-piece) TCY-1Ж — to work with trailed machines, potato harvesters etc. (except for one-axle trailers) with a speed of up to 15 km/h.



ATTENTION! Use of TCY-1Ж for transportation works is strictly forbidden!

Haul-and-draw coupler TCY-2 (hydraulic hook) — for operation with one-axle trailers and other machines.



Rear hitch linkage

The three-point rear hitch linkage of category 2 ensures attaching mounted and semi-mounted agricultural machines and implements to the tractor with the following connecting pieces:

- length of suspension axis L (distance between the joints A and C) is 870 mm;
- height of machine post is 510 mm; 610 mm
- diameters of fingers for connection to the lower rod joints (1) is 28.7 mm;
- diameter of finger for connection to the upper rod (2) is 25 mm.

ATTENTION! Before connecting machines, carefully read this section.

The lower rods consist of two parts:

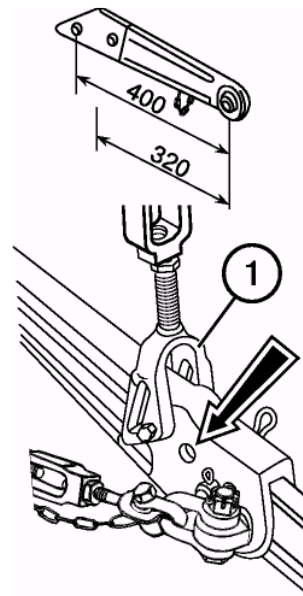
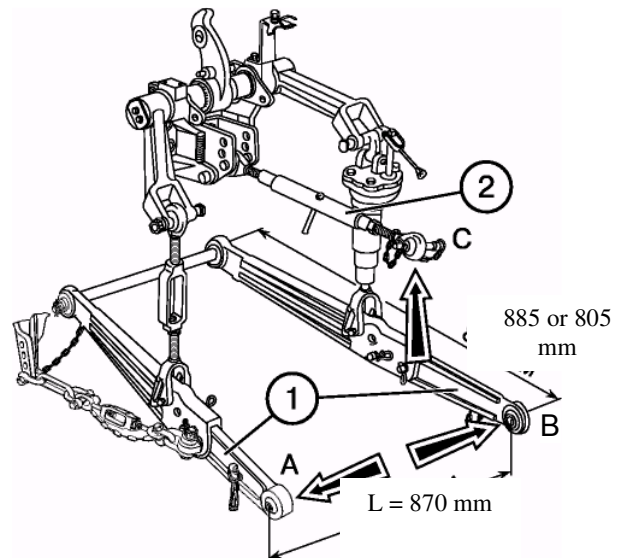
- the front part or the rod itself;
- the back end with a ball joint. Rated

length of lower rods is 885 mm.

To increase the suspension length, set the rod ends with the bent front joints (F70-4605050-01/055-01).

To increase the carrying capacity of the suspension, replace the rod back ends (400 mm length) with rod ends with a distance between the joint axle and the front hole of 320 mm (N50-4605040A2/045A2). The total length of the lower rod becomes 805 mm.

ATTENTION! With the rod length of 805 mm the carrying capacity of the suspension increases by 10% with a simultaneous decrease of the lift height by 10%. The same increase in the carrying capacity can be achieved by installing the brace (1) to additional points (the lift height also decreases by 10%).



To increase the road clearance when processing long-stalk crops, install the front ends of the lower rods to additional suspension axles located by 110 mm above the lower rod axle. To copy the floor profile in the transverse direction while working with wide-cut implements, link the braces (1) with the lower rods (2) through the longitudinal grooves.

IMPORTANT! The brace forks must be behind the hole to avoid damage to the brace.

Upper rod and braces

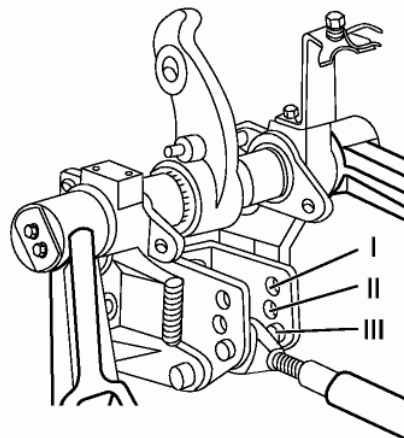
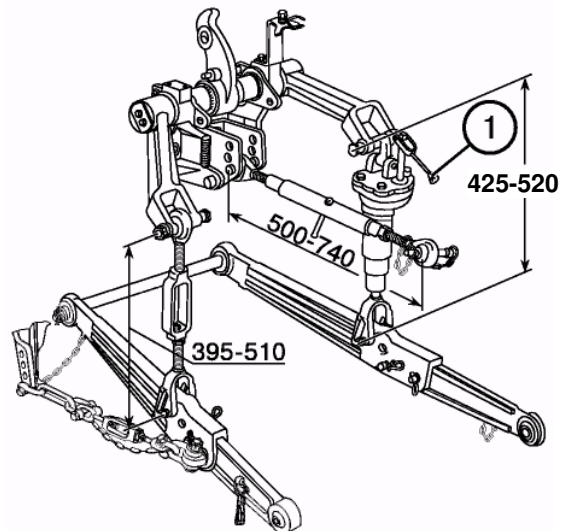
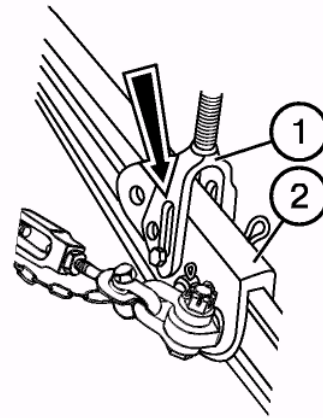
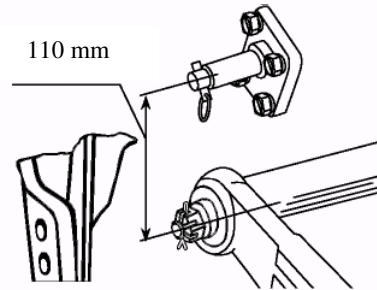
The upper rod length can be adjusted from 500 to 740 mm. The length of the adjustable right brace can be adjusted from 425 to 520 mm by turning the handle (1). When shipped from the factory, the right brace length is set to the standard value of 475 mm. The length of the right (unadjustable) brace is also set to the standard value of 475 mm when the tractor is shipped from the factory.

During operation, the left brace length can be changed from 395 to 510 mm depending on the tractor delivery set and kind of attached machines and equipment.

IMPORTANT! Adjust an implement in the transverse plane only with the right brace.

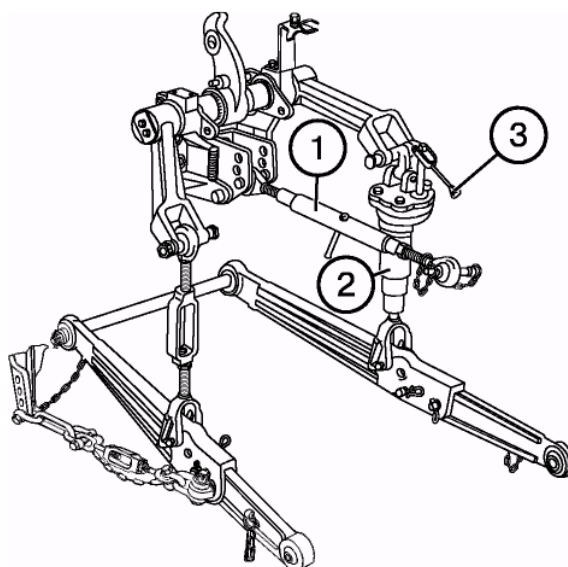
Depending on the plowing depth and soil nature, set the upper rod in one of the three positions:

- I — light soils and small plowing depth at power control;
- II — medium soils and medium plowing depth at power control;
- III — heavy soils at a bid plowing depth, as well as at position control or without use of power regulator.



Mounting machines to the tractor

1. When mounting machines to the tractor, first make sure that no one is present in the zone of mounting the machine.
2. Using the handle of the power regulator (if available), lower the suspension to the lower position, drive the tractor back and attach the machine to the lower rods. Splint the fingers. Stop the engine.
3. Lengthen or shorten the upper rod (1) and link the rod ball joint to the machine. Splint the finger.
4. If necessary, adjust the upper rod to the initial or desired length.
5. If necessary, adjust the transverse tilt of the machine using the right adjustable brace (2). To increase the brace length, turn the lever (3) clockwise and vice versa.
6. Before you start working, make sure that:
 - the tractor don't be in dangerous proximity to the machine elements;
 - the upper rod do not touch the PTO guard at the lowermost position of the machine;
 - the PTO cardan drive be not too long, with large joint angles, and that there be no thrust forces;
 - the PTO guard do not touch the machine cardan drive guard.
7. Slowly lift the machine and check availability of clearances of 100 mm min. between the wheel and the machine in the raised position.
8. Check availability of the required side oscillation of the lower rods and, as necessary, adjust with the braces.



Attach machines (implements) to the tractor also using the automatic coupling CA-1, connected to the hitch linkage of the tractor in three points (two rear joints of the lower rods and the rear joint of the upper rod).

To prevent spontaneous disconnection of the machine from the tractor, fix the latch of the automatic coupling with a spring catch pin.

Limit (telescopic) rods (1)

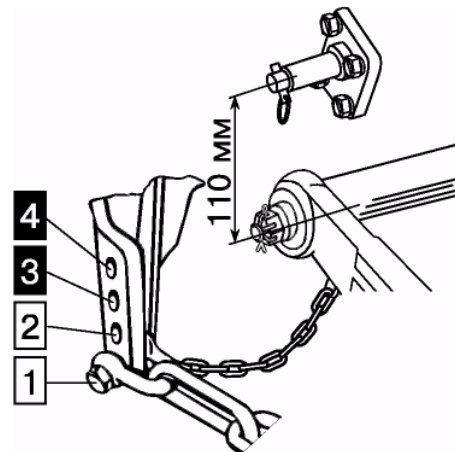
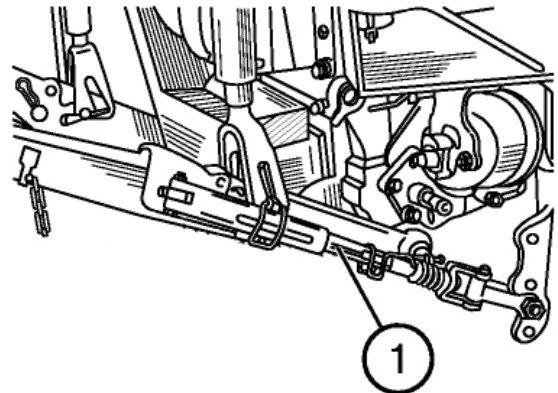
The rods are used to limit side oscillation of the suspension lower rods both in the transportation, and in the working position. This is especially necessary when working on slopes, close to ditches, walls etc.

The back end of the rod is connected to the lower rod, and the front end is connected to the bracket in one of the four positions depending on the job.

- Position 1. The rods prevent side oscillation of the implement in the transportation position.
- Position 2. The rods prevent side oscillation of the implement both in the transportation and in working positions.

IMPORTANT! Use the positions 3 and 4 only when installing the lower rods to additional suspension axles (upper axles).

- Position 3. The rods prevent side oscillation of the implement in the transportation position.
- Position 4. The rods prevent side oscillation of the implement both in the transportation and in working positions.



ATTENTION! The rods must be installed only to the bracket holes that are second from the bottom (position 2) to prevent damage to the rods.

ATTENTION! The rods must be installed only to the bracket holes that are second from the bottom (position 2) to prevent damage to the rods.

Partial lock of telescopic rods

ATTENTION! The telescopic rods must be installed only to the hole that is second from the bottom.

To ensure the desired side movement of the machine, ex. plow, in the working position, adjust the rods as follows:

- turning the screw (2), set the handle (3) to the middle of the flat “B”;
- remove the cotter (5) from the rod;
- attach the machine to the lower rods (7) and lift it off the ground;
- aligning the hole in the inner pipe (4) with the groove of the pipe (6), insert the cotter (5) in the middle of the groove.

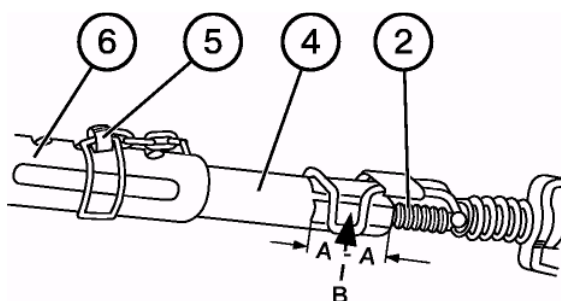
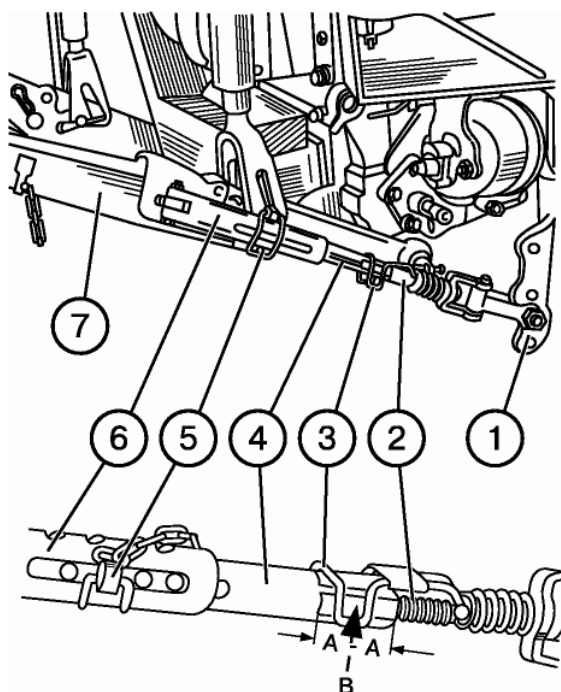
IMPORTANT! Install the cotter (5) so that it be in the middle of the groove or slightly closer to the tractor. Otherwise the rods may be damaged.

Before a transportation journey, raise the machine to the upper position and check its side oscillation that must not exceed 20 mm to any side. If necessary, adjust the oscillation magnitude turning the screw (2).

Fully locking rods

To fully lock machines, ex. a cultivator or a trailed device, in the working position adjust the rods similarly to the partial lock, except for the last operation, at which align the hole of the inner pipe (4) with the hole of the outer pipe (6) and insert the cotter (5) into the holes.

Ensure a full lock in the transportation position (with the machine lifted) by screwing the screw (2) into the pipe (4) to the maximum extent possible.



Inner rods (2)

Used also to limit side oscillation of machines both in the working and in transportation positions.

NOTE: The telescopic rods are installed only outside.

Partial lock (for plowing)

Adjust at the machine working position as follows:

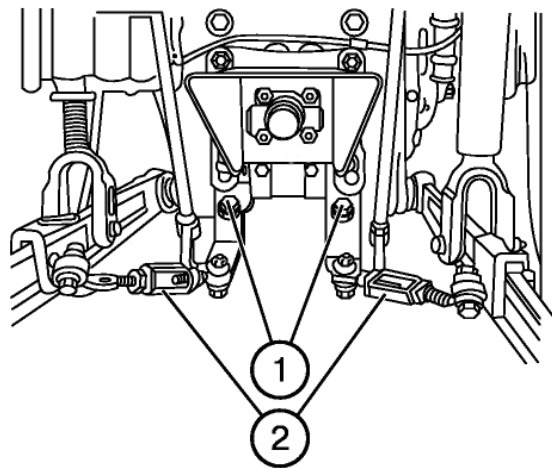
- screw the adjustment bolts (1) into the brackets up to stop;
- lift the machine so that its tools take off the ground;
- adjust the right bracket length to the desired plowing depth (when working with a plow);
- by rotating the braces (2), adjust the length of the limit chains ensuring machine movement in the horizontal plane by 125 mm to each side from the middle position or according to the machine operating manual.

When installing the machine to the transportation position, screw out the bolts (1) for its partial lock. Oscillation of the machine to the both sides to 20 mm max. is allowed.

A full lock (for cultivation, sowing etc.) is set as follows:

- fully screw in the adjustment bolts (1);
- shorten the rods (2) to the maximum extent possible.

IMPORTANT! When changing the right brace length, always re-adjust the rods.



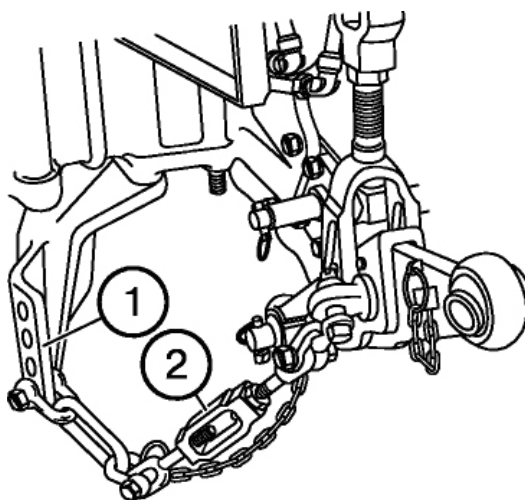
Outer chain binders (2)

Partial lock

Ensure horizontal movement of the machine in the working position by connecting the limit chains to the lower holes of the brackets (1) and adjusting the chain length using the rods (2), to obtain oscillation of the tool to each side by 125 mm min. or according to the machine operating manual.

When working with plows, adjust the right bracket length to the desired plowing depth.

ATTENTION! Always maintain the oscillation of the machine of 125 mm min. to avoid break of chains when the machine is lifted to the transportation position.

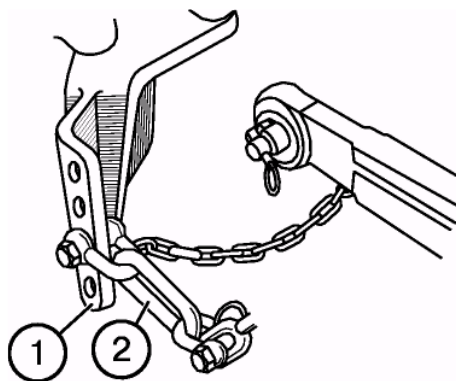


When installing the machine to the transportation position, tension the chains with the rods (2). Oscillation of the machine of 20 mm max. to the both sides is allowed.

Full lock

To fully lock the machine in the transportation position, attach the limit chains (2) to the hole of the bracket (1) second from the bottom and shorten the chains (2) to the maximum extent possible.

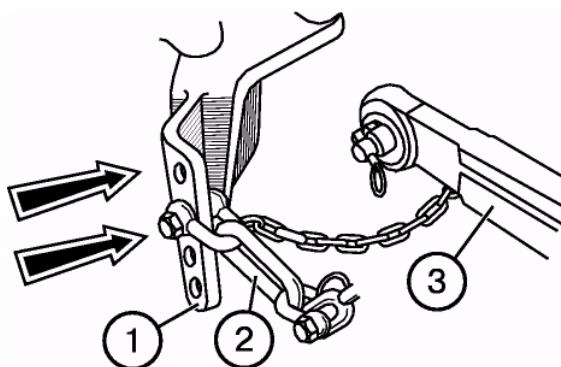
In the transportation position, lock is provided automatically.



Additional suspension axles of lower rods of hitch mechanism

When processing high-stalk crops, install the lower rods (3) to additional suspension axles. At that, to partially lock the machine in the working position, attach the limit chains (2) to the hole of the bracket (1) third from the bottom and to fully lock — to the fourth hole.

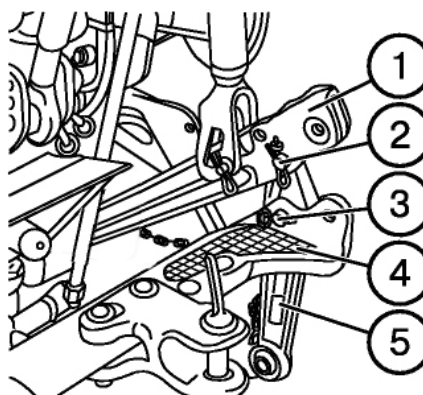
In the transportation position, lock is provided automatically.



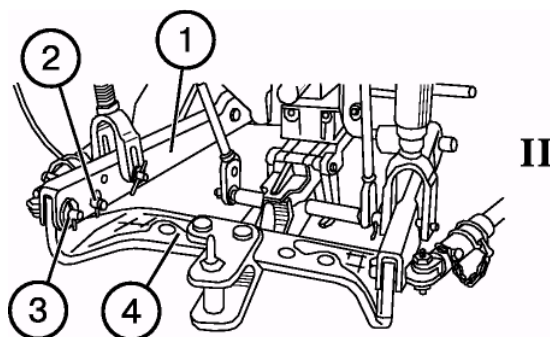
Haul-and-draw coupler TCY-1Ж (cross-piece) (4)

The haul-and-draw coupler is used to attach machines working at speeds not exceeding 15 km/h/ Tractors are shipped from the factory with the cross-piece installed as shown in Fig. I. To re-set from the transportation position (I) to the working position (II), proceed as follows:

1. Unsplint and take out the eye (3), remove the cross-piece (4).
2. Unsplint and take out the finger (2), remove the back ends of the lower rods (5).
3. Install the cross-piece (4) to the front ends of the lower rods (1), fasten it with the eye (3) of the limit chains, fingers (2) and splints (see Fig. II).



With outer or inner installation of limit chains, ensure a full lock of the haul-and-draw coupler. When installing a haul-and-draw coupler with telescopic rods, attach them to the bracket hole second from the bottom and ensure a full lock.



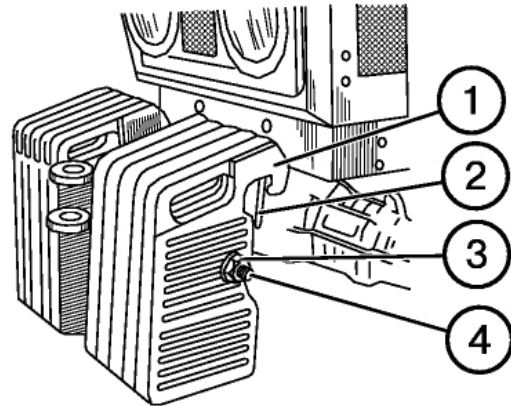
ATTENTION! It is forbidden to use the haul-and-draw coupler forks to work with trailers at a speed exceeding 15 km/h.

IMPORTANT! Make sure that the haul-and-draw coupler is locked from side oscillation by adjusting the inner or outer rods.

IMPORTANT! Make sure that the haul-and-draw coupler is locked from side oscillation by adjusting the inner or outer rods.

Front counterweights.

When working with heavy implements and tools, to preserve normal controllability of the tractor under conditions of significant unloading of the front axle, install additional counterweights (1) (10 pcs. 20 kg each). The counterweights are installed on the special bracket (2) attached to the front bar of the tractor and braced with the string (4) and nut (3).

**Mechanism of locking attachment in transportation position**

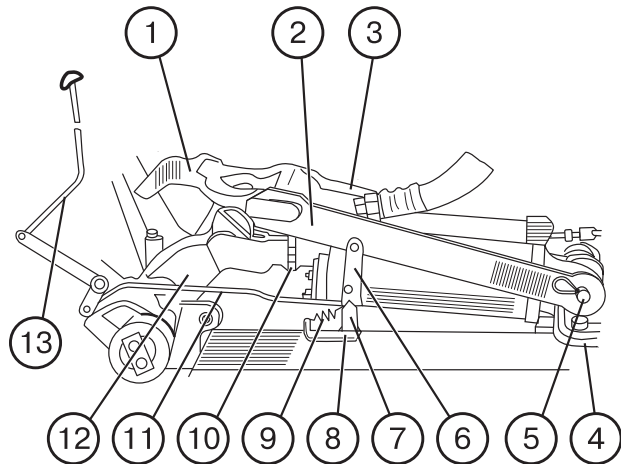
- a) lift the attachment to the uppermost position, shifting the distributor lever to the lift position.

The stop 10 of the cylinder hydromechanical valve must be in the rearmost position on the cylinder rod.

- b) bring the handle 13 and the lock mechanism with it to the lower position;
- c) shift the distributor handle to the floating position. Under action of the attachment, the pivot lever 12 turns, and the tooth must engage with the catch 1.

To unlock the attachment, proceed as follows:

- a) lift the attachment to the uppermost position, shifting the distributor lever to the lift position.
- b) lift the handle 13 to the upper position.



Mechanism of locking an attachment of a tractor with a small cab: 1 — catch; 2, 3 — rods; 4 — cylinder brackets; 5 — axle; 6, 7 — levers; 8 — bracket; 9 — spring; 10 — stop; 11 — control rod; 12 — pivot lever; 13 — control handle.

Control of hydraulic system and hitch linkage of tractor

On tractors, the hitch linkage is controlled by the extreme right lever of the distributor.

Working with implements, use only the lift and floating positions of the lever.

It is forbidden to shift the lever to the lowering position when working with soil processing implements!

Use the lowering position only to control the extension cylinders installed on a machine and intended to control positions of tools (such as reel, haeder, sharers etc.) of harvesting, sowing and other machines. If after completion of a cylinder stroke, the distributor lever does not return to the neutral position automatically, bring it there manually. And on the contrary, in case of an early return of the lever, hold it with hand to let the operation be completed.

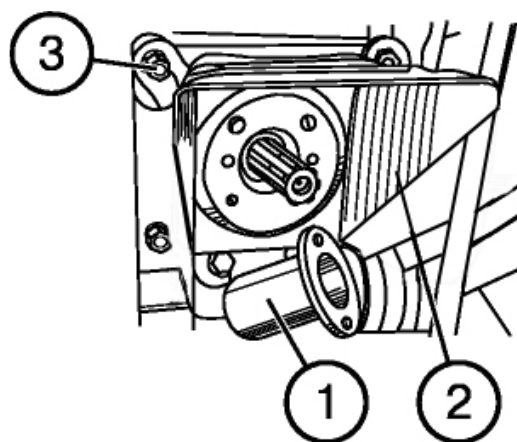
Specifics of operating tractor with machines requiring drive from rear PTO

General recommendations:

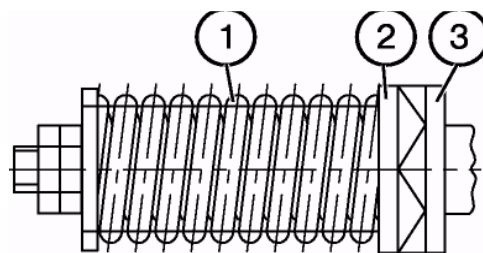
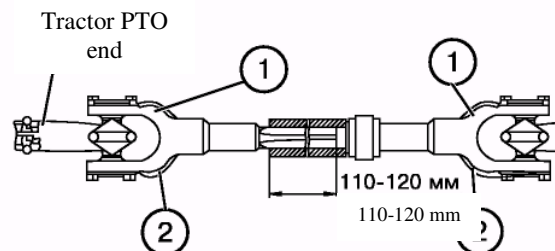
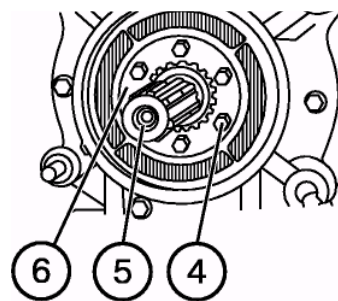
- a) before attaching a machine, make sure that the PTO control is correctly adjusted;
- b) install and secure the required (6-, 8- or 21-spline) PTO shank and engage the respective speed drive, at that set 540 rpm for the 6-, 8-spline one and 1,000 rpm for the 21-spline one.

To replace the PTO shank, proceed as follows:

1. Unscrew four bolts and remove the cap (1).
2. Unscrew the four nuts (3) and remove the casing (2).



3. Unscrew the six bolts (4), remove the lock plate (6) and remove the shank (5).
4. Install another shank into the spline hole and install the plate (6), screwing in the bolts (4) to a torque of 50 Nm.
5. Assemble the other parts in the order reverse to disassembling.
- c) lubricate the shaft and pipe of the telescopic joint of the cardan drive with solid oil. Install the cardan drive joint to the PTO shank, secure it in the fixing groove. Make sure that the forks (1) of the joints of intermediate (telescopic) shaft lay with the ears (2) in the same plane. Failure to observe this requirement results in overloads of the cardan drive and PTO.
- d) install the casing of the agricultural machine driveshaft;
- e) after installing the cardan drive, make sure, that the elements of the cardan drive telescopic joint do not stop against the tractor in the extreme positions of the machine; the minimum overlap of the cardan drive telescopic part must be 110 to 120 mm as in case of a lesser value the drive may disengage.
- f) adjust the safety coupling of the agricultural machine by changing the length of the spring (1). It must be adjusted so that in case of overloads the cam clutches 2 and 3 rotate each relative to the other. A too strong tension of the spring results in maloperation of the clutch and overloads of the cardan drive and PTO.
- g) engage the PTO independent drive at minimum engine speed or when the engine is off. Engage the synchronous PTO drive when the engine is running by gradually engaging the clutch.
- h) disengage the PTO when making turns with the machine (for trailer machines) as well as when lifting the machine to the transportation position (for mounted and semi-mounted machines);



- i) after detaching the machine from the tractor do not leave the cardan drive joint on the PTO shank;
- j) when installing the drive pulley on the PTO rear cover, as well as drive reduction gears of the special machine drive (cotton-growing, excavating machines etc.), make sure that they be centered relative to the shank (fit into the bore Ø162 mm on the rear cover), and their fastening nuts are tightened up securely.

When working with rotation machines for tilling:

- a) monitor serviceability and normal operation of safety devices;
- b) do not engage the PTO with a tool put down to the ground;
- c) bring down the machine with rotating tools smoothly during tractor movement;
- d) do not engage the PTO when the refraction angle in one of the cardan drive joints exceeds 22 degrees;
- e) when working on hard soils, process transverse strips to enter the enclosure, only then work the field in the longitudinal direction.

ATTENTION!

When operating the tractor without use of the PTO, always shift the PTO control lever to the PTO ON position, set the shift clutch of the PTO two-speed drive to the position 1 (540 rpm), and set the shifter lever from the independent to the synchronous PTO drive to the middle (neutral) position.

When the PTO synchronous drive is engaged, do not drive faster than 8 km/h. At a speed higher than specified, rotation of the PTO parts exceeds the allowable values, which results in early failures of the unit.

Working with mounted and semi-mounted machines

Single-axle machines such as semi-trailers are attached to the tractor by TCY-2 (hydraulic hook). Transportation of the machines using TCY-1Ж (cross-

piece) is allowed only at a speed not exceeding 15 km/h without driving on public roads and when performing agricultural works.

ATTENTION!

Attaching machines such as trailers and semi-trailers through TCY-1Ж (cross-piece) is strictly forbidden.

When working with single-axle trailers, install additional counterweights to add additional load to the tractor front axle.

When a towing gear is installed on the tractor, do not attach semi-trailers (single-axle trailers) as well as non-standard towbars.

Use of rear attachment with a tow gear installed on the tractor is strictly forbidden!

The trailers work at speeds determined by road conditions. With 2ПТС-4-887А with 20 and 45 m³ bodies, operating at speeds up to 15 km/h is allowed, as they have lower stability. Avoid making sharp turns for such trailers and 1ПМГ-4 spreaders to avoid damages to rear fenders.

The hinge of trailers (2ПТС-4-785А etc.) must be fixed to prevent its rotation in order to avoid its pinching.

During operation, the fork of the ТСУ-1Ж haul-and-draw coupler must be fastened on the trailer cross-member with two pins. Working with the fork fastened with one pin is forbidden.

Before work, make sure that the pins and pivot of the hitch fork are securely splinted. Connect all signaling devices of the trailers (stop signal, turn indicators, plate illumination) using the socket installed on the tractor.

Use of tractor auxiliary equipment

As auxiliary equipment on the tractor, the drive pulley, additional counterweights to the front axle, the SA-1 automatic coupler, the spacer for mounting coupled rear wheels and other equipment can be installed.

The drive pulley is installed on the cover of the rear PTO reduction gear and is driven from the PTO splined shank. To avoid deformation of the PTO shank, necessarily install the housing on four studs with centering the flange in the PTO cover. Engage and disengage the pulley using the PTO control lever.

Additional counterweights of a total weight of 220 kg are installed on a special bracket fastened to the tractor front bar.

Tires

IMPORTANT!

1. Never exceed tire pressures as recommended by the manufacturer.
2. Don't weld the disk or perform any other repairs with a tire inflated. To unmount and repair tires, contact a shop with specially trained personnel.

Tires used on 510/512 tractors

Tires	When FDA 72 is installed	When front axle is installed
		Main
front	11.2 – 20;	9.00 – 20; (9.00R20)
rear	15.5R38	15.5R38

IMPORTANT! For tractors with FDA, correctly select a combination of front and rear tires. Use of a correct combination of front and rear tires ensures maximum performance of the tractor, increases the service life of the tires and decreases wear of the power gear parts. Use of worn and new tires, or tires of different diameters or rolling radius can result in misobservance of requirements to kinematic compliance and excessive wear of the tire.

For normal operation of the tractor, set the tire pressure as indicated in the table below. Set the pressure in “cold” tires. When performing jobs that require high tractive forces, set the pressure as for the speed of 30 km/h.

For transportation jobs on roads with hard surfaces, increase the pressure by 30 MPa.

When working with a front lift, set the maximum pressure specified for front tires.

Table of loads for tires used on 510/512 tractor

Tire size	Load index	Speed symbol	Volume of liquid filled in, l	Allowable load, kgf (N) at pressure, MPa										
				0.08	0.1	0.12	0.14	0.16	0.18	0.2	0.22	0.24	0.26	0.28
9.00-20	112	A6		-	640	715	780	840	900	960	1,020	1,070	1,120	-
9.00R20	112	A8		580	640	715	780	840	900	960	1,020	1,070	1,120	-
15.5R38	134	A8	250	1,420	1,620	1,810	1,975	2,120	-	-	-	-	-	-
11.2-20	114	A6		-	765	850	930	1000	1080	1145	1180 (2.1)	-	-	-

For tires with the A6 speed symbol, the loads are indicated for the speed of 30 km/h.

For tires with the A8 speed symbol, the loads are indicated for the speed of 40 km/h.

Allowable changes in loads to tires of guide wheels and drive wheels depending on speed

Table

Speed, km/h	Change in load, %, on tires of guide wheels with speed symbol	
	A6, 30 km/h	A8 (40 km/h)
10*	+50	+67
15	+43	+50
20	+35	+39
25	+15	+28
30	0	+11
35	-10	+4
40	-20	0
45	-	-7

* For tires with ply rating of 6 and more, the inner pressure must be increased by 25%. When using tires with ply rating of 6 and more on front loaders, the load on tire can be increased to 100% only in loading mode.

Table

Speed, km/h	Change in load, %, on tires of drive wheels with speed symbol	
	A6, 30 km/h	A8 (40 km/h)
10*	+40	+50
15	+30	+34
20	+20	+23
25	+7	+11
30	0	+7
35	-10	+3
40	-20	0
45	-	-4
50	-	-9

* The inner pressure must be increased by 25%.
 A short-time increase in load is allowed for 10% of the shift time max.
 Note. Changes of loads depending on the speed are used in cases when the tire is not operated for a long time at high torques. During field works and other conditions of long-time operation at high torques, the values are applied corresponding to the speed of 30 km/h.
 For transportation jobs on roads with hard surfaces, increase the pressure by 30 Mpa (0.3 kgf/cm²).
 When wheels are twinned, their total carrying capacity must not exceed the carrying

capacity of a single tire by more than 1.7 time.

Under normal conditions, set the minimum allowable pressure in tires for operation with trailed machines.

When working with attached machines, set a higher tire pressure.

When using twin tires, the pressure in the outer tire must be 1.2 to 1.25 times lower than in the inner tire.

Allowable loads on front and rear axles

Tractor model:	Allowable load, kN	
	On front axle	On rear axle
90	17.5	50.0
92	24.0	50.0

Notes.

1. Loads on axles must not exceed the total carrying capacity of single tires of the front or rear wheels.
2. When setting a wheel track exceeding 1,000 mm, the loads on the axles must be decreased from calculation of 5% by each 100 mm of track increase.

Liquid ballast

Filling tires with liquid ballast is used only in case of weak grip of the wheels to the ground under unfavorable conditions (such as wetlands etc.).

NOTE: Ballasting the front tires is not recommended as this worsens the tractor controllability.

During the cold season, it is recommended to apply an aqueous solution of calcium chloride of the following concentrations:

Ambient temperature, °C	Quantity of calcium chloride, g per l of water
up to –15 °C	200
up to –25 °C	300
up to –35 °C	435

This ensures a low freezing temperature, results in an increase of the solution density and produces a safe and economical ballast. At correct its use, it won't damage tires, tubes or rims.

When a tire is filled with liquid, the tire valve must be in the highest point of the wheel.

The table below specifies volumes of solution filled into the rear tires

Tire size	Volume of solution filled in, l per tire
15.5R38	250

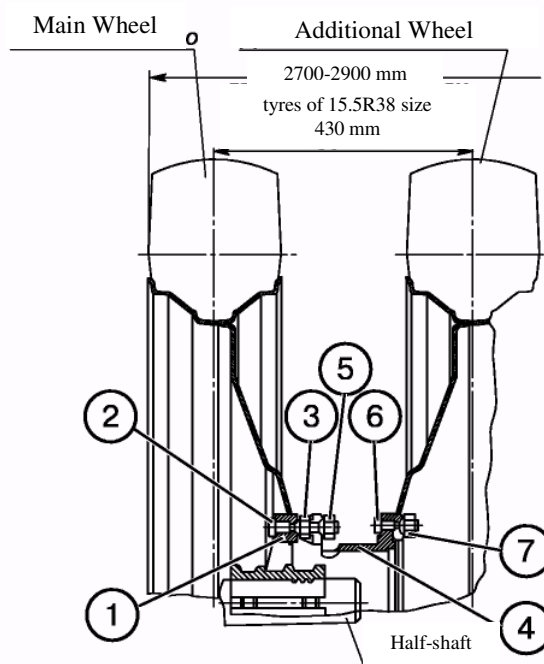
IMPORTANT! Radial tires must not be filled with liquid ballast to more than 40 to 50 per cent of the volume. If the volume filled in is too large, the remaining air volume won't be sufficient to absorb shocks, which may result in tire damage. The reason of it is a lower air pressure for the radial tires. Diagonal tires may be filled up to 75 per cent of their volume.

WARNING: When mixing a solution, add flakes of calcium chloride to water and stir the solution up to full dissolving of calcium chloride CaCl_2 . **Never add water to calcium chloride.** When preparing the solution, wear protective goggles. In case of eye contact with the solution, wash the eyes with pure water immediately for 5 minutes. As soon as possible, call the doctor.

Installing twin rear wheels

To improve the passing ability, the tractors can be equipped with twin rear tyres of 15.5R38 size with use of additional spacers. To install an additional wheel, unmount the main wheel, press off the short bolts from the hub (1) and press in the long bolts (2) supplied with the spacers. To the bolts (2), install the main wheel and fasten it with the nuts (3). Then install the spacer (4) on the same bolts and fasten with the nuts (5). After that, install the additional wheel on the bolts (6) of the spacer and fasten it with the nuts (7). The tightening torque of the nuts fastening the rear wheels is 300 to 350 N•m (30 to 35 kgf•m).

ATTENTION! *Installing twin wheels to increase the hauling capacity is forbidden.*

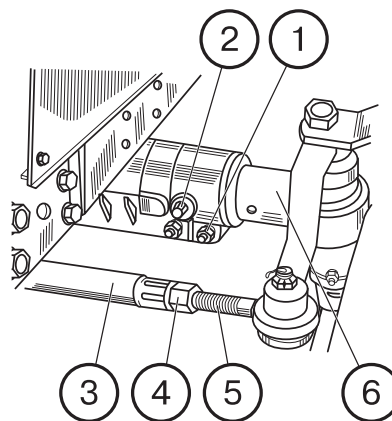


Section F. Adjustments

Adjusting front wheel track of steering booster without cylinder in steering linkage

The front wheel track can be adjusted from 1,350 to 1,850 mm with 100 mm increments in case of symmetrical position of wheels and 50 in case of asymmetrical position. To adjust the track, proceed as follow:

- a) put a jack under the front of the tractor and lift the tractor until the wheels take off the ground. Put a support under the tractor front to provide secure and safe tractor position;
- b) loosen the bolts (1), remove the pins (2) fastening retractable knuckles in the front axle tube;
- c) move first one, then the other retractable knuckle (6). At the same time, change the length of steering rods by rotating the tube (3) in the tips (5), first unscrewing the locknuts (4) to an extent corresponding to the wheel track to set. Fasten the knuckles in the front axle tube.
- d) lower the tractor. Check the wheel toe-in and adjust as necessary.



**PTO with bevel gear speed reducers.
Steering booster without cylinder in
steering linkage**

The front wheel track is adjusted stepless by a screw mechanism located on the front axle sleeves in three ranges: 1,350-1,500 mm, 1,500-1,600 mm, 1,600-1,800 mm.

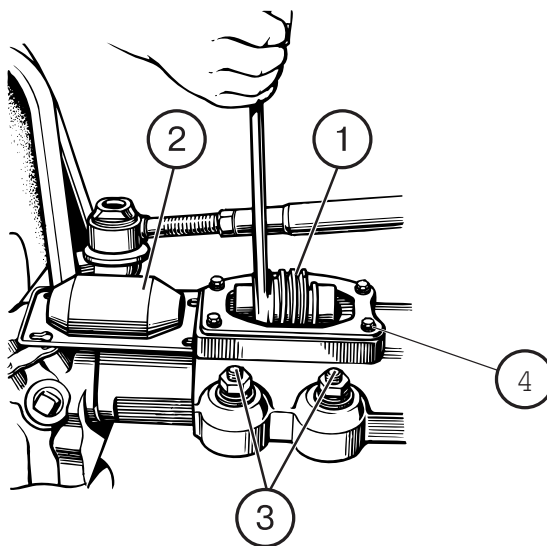
To obtain the required wheel track, set the mutual bracing of the wheel rim relative to the disk as shown on the figure below.

For wheels with constant disk offset, the track is adjusted stepless within 1,400 to 1,600 mm and 1,750 to 1,950 mm.

To change the track, raise the tractor front (or front wheels in turn), providing a clearance between the wheels and soil, brake the rear wheels. Put a support under the tractor front to provide secure and safe tractor position, after that;

- a) unscrew the bolts (4) and remove the cover (2);
- b) release the wedges of sleeves (3) unscrewing the nuts by an extent ensuring free movement of conical pair housings.

Rotating the adjustment screw (1) with a wrench ensures movement of final reduction gear housings with wheels in the front axle sleeves and obtaining the desired wheel track in the specified ranges. Rotation of the adjustment screw must result in changes of the steering rod length.



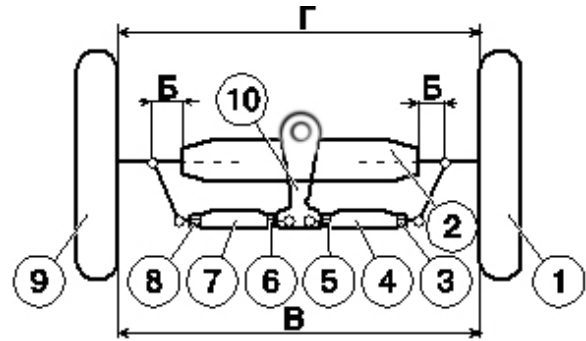
Adjusting front wheel toe-in on tractors with steering booster

Manufacturer sets the front wheel toe-in withing the range of 0 to 8 mm.

Periodically after each 250 service hours as well as at each change of front wheel track check and as necessary adjust the wheel toe-in. Before checking, adjust clearances in the wheel bearings and steering rod joints.

To adjust the wheel toe-in, proceed as follows:

- a) install the tractor on a horizontal hard surface;
- b) set the pitman arm (10) to the middle position, to do that, turning the steering wheel, set it to a position when the dipstick in the steering booster housing is buried to a maximum extent;
- c) check that the conical pair housings (for tractors with FDA) or steering knuckles (for tractors without FDA) be extended to the length "Б" from the front axle housing or front axle tube respectively;
- d) adjust the left and right steering rods, lengthening or shortening them to the same value, to do that, loosen the locknuts (3, 5, 6, 8) and by rotating the left and right tubes (7, 4), set the required length;
- e) determine the wheel toe-in by measuring the distance (measurement "Г") between the inner flanges of wheel rims in front (at the wheel center height) and chalk marks in the measurement points. Then drive the tractor ahead by a distance, when the marks be at the rear at the same height and measure the distance between the marked points (measurement "Б"). The second measurement must

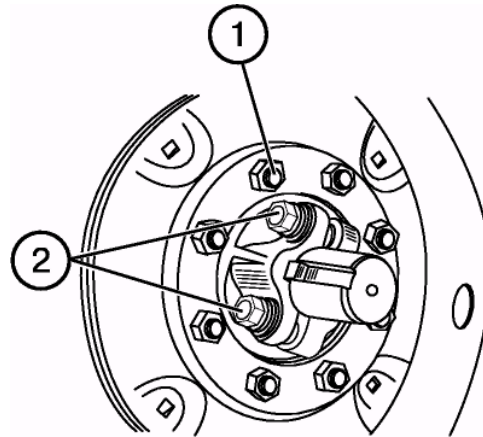


be greater than the first; the difference between the second "Б" and first "Г" measurements is equal to the wheel toe-in and must be 0 to 8 mm. As necessary, adjust the toe-in by changing the steering rod length. At that, lengthen or shorten the left and right rods by the same amount.

- f) again check setting of the pitman arm to the middle position (by dipstick) and the difference between the measurements "Б" and "Г";
- g) lock the steering rod tubes after final adjustment of wheel toe-in.

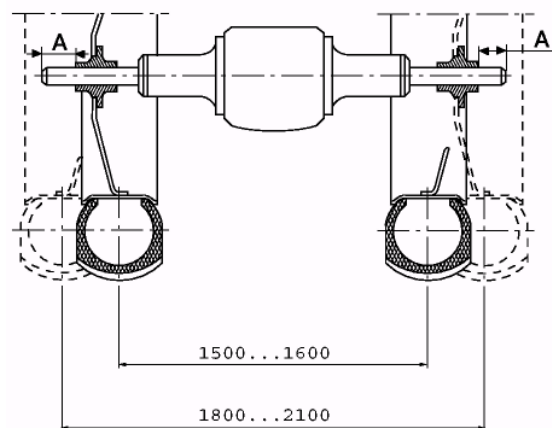
Adjusting rear wheel track

1. Jack-lift the tractor rear part to separate the wheels from the ground. Put a support under the tractor rear part to provide secure and safe tractor position;
2. Unscrew the nuts (1) fastening the wheels and remove the wheels.
3. Loosen the four bolts (2) of the rear wheel hubs by 3 to 5 turns.
4. Move the hub in one or other direction to obtain the track width (use the table given below to determine the track width by measuring the distance "A" from the half-axle end to the hub face.
5. Tighten the four hub fastening bolts to a torque of 280 to 300 N•m.
6. Mount the wheel and tighten the fastening nuts to a torque of 210 to 260 N•m.
7. Repeat these operations on the opposite wheel.



NOTE: A track width of up to 1,600 mm can be obtained without changing the wheel disk position. To obtain a track width up to 2,100 mm, transpose the rear wheels assembled with the hubs as shown in the figure.

Wheel track, mm	Distance "A", mm
1,500	50
1,600	0
1,800	164
1,900	114
2,000	64
2,100	14



When transposing the rear wheels, observe the wheel rotation direction as indicated by the arrow on the tire sidewall.

Adjusting power take-off shaft

Adjusting rear PTO control mechanism

When assembled by the manufacturer, or after a repair (for example, after replacement of brake bands), the control mechanism is adjusted as follows:

- ### Adjusting rear PTO control mechanism
- When assembled by the manufacturer, or after a repair (for example, after replacement of brake bands), the control mechanism is adjusted as follows:
1. Set the eccentric axle 15 to its initial position so that the flat "C" (Fig. 2) be at the right side vertically and fasten it with the lock bar 17 and bolt 16.
 2. Disconnect the rod 4 (Fig. 1);
 3. Unscrew the bolt 9 to release the spring 6; To safely disassemble the unit, watch that when unscrewing the bolt 9 the upper barrel be in constant contact with it up to a full release of the spring.
 4. Remove the rear axle hatch cover to gain access to the screws 13;
 5. Fix the lever 11 in the neutral position introducing the bolt 10 (M10×60) to the hole on the lever 11 and the hole on the rear axle housing corresponding to it;
 6. Remove the lock bar 26 (Fig. 2), screw in turn the adjusting screws 21 to a torque of 8 to 10 N·m, then unscrew each screw by two turns, at that screw the screws so that the screw heads be parallel to the tractor centerline;
 7. Remove the bolt 10 (M10×60) retaining the lever 11 in the neutral position;
 8. Screw the bolt 9 directing its tip to the recess in the barrel cover стакана 7 to the dimension "A" equal 26^{+2} mm and lock it with the nut 8;
 9. Shift the lever 11 back to the ON position;

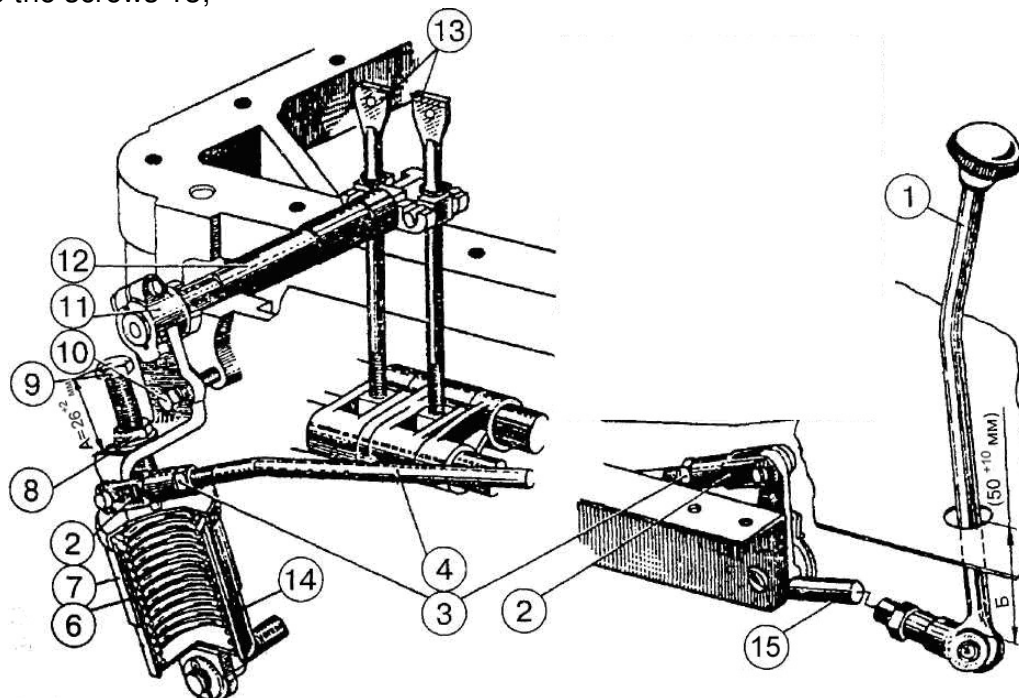


Fig. 1 Rear PTO control:

1 - control lever; 2 — adjusting fork; 3, 8 — nuts; 4 — rod; 6 — spring; 7 — outer barrel; 9 — stop bolt; 10 — adjusting bolt (only for adjustment); 11 — control roller arm; 12 — control roller; 13 — adjusting screws; 14 — inner barrel; 15 — lever.

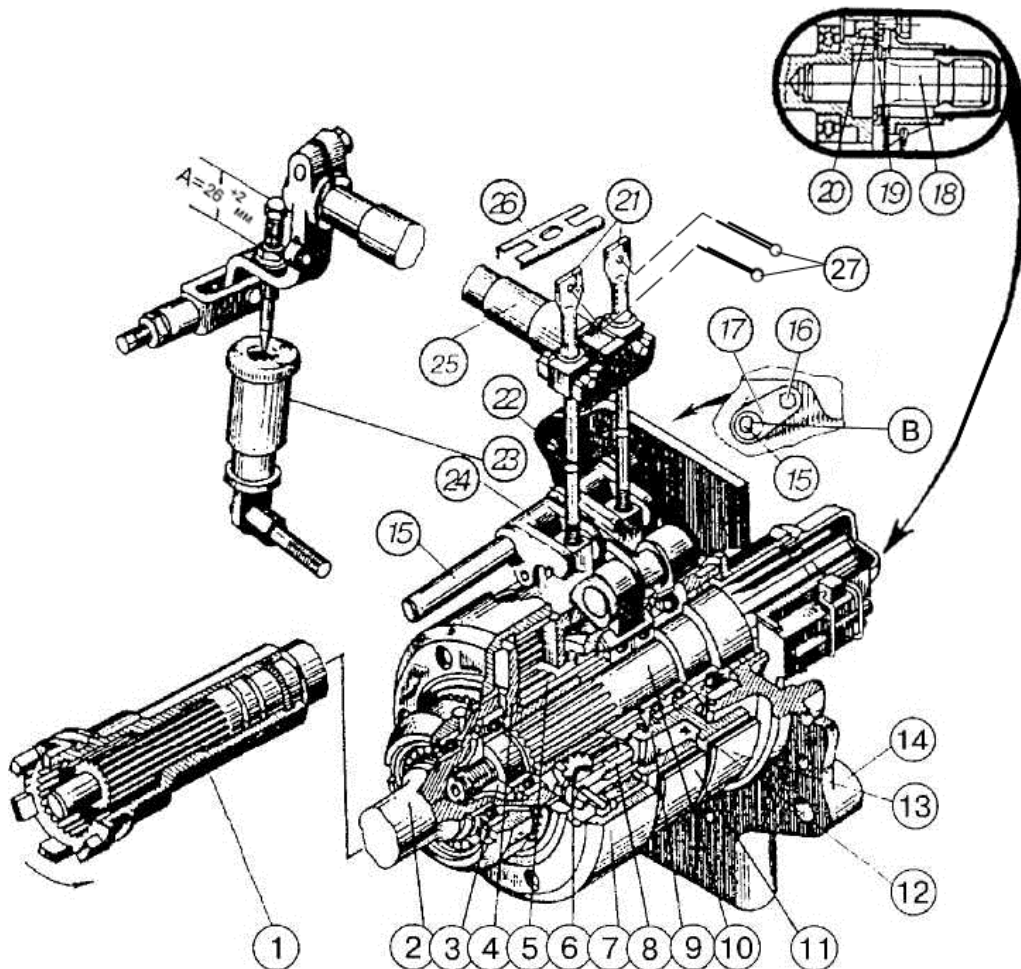


Fig. 2 Rear PTO planetary gear:

1 - drive strike clutch; 2 - crown pinion shaft; 3 - nut; 4 - spider; 5 - sun pinion; 6 - planetary pinion; 7 - crown pinion; 8 - planetary pinion shaft; 9 - brake drum; 10 - PTO shaft; 11, 13 - brake band; 12 - engagement drum; 14 - rear cover; 15 - crank axle; 16 - bolt fastening lock bar; 17 - lock bar; 18 - replaceable shank; 19 - replaceable shank lock bar; 20 - shank fastening bolt; 21 - adjusting screws; 22, 24 - arm; 23 - spring mechanism; 25 - control roller; 26 - lock bar; 27 - splints.

10. Set the rod 4 (Fig. 1) changing the length of the rod 4 and arm 15 adjust the dimension "B" (50^{+10} mm).

After adjustment, install the lock bar 26 and splints 27 (Fig. 2) on the adjusting screws 21, the rear axle hatch cover, lock the rod 4 and arm 15 (Fig. 1) as well as the bolt 9.

During operation, external readjustment is performed when:

- PTO slips;
- the control lever 1 stops against the cab floor when shifted;
- the engagement force on the lever 1 exceeds 12 to 15 kgf;
- the lever 1 cannot be clearly fixed

in its extreme positions.

Readjustment is performed as follows:

- Shift the PTO lever 1 to the PTO ON position;
- Remove the PTO guard.
- Unscrew the bolt (16), remove the lock bar (17) from the eccentric axle shank (15) and rotate the axle clockwise to select a clearance between the brake band and drum (in such a case, the PTO shank cannot be rotated by hand).
- Fix the axle with the lock bar (17) and bolt (16).
- Install the PTO guard to place.

IMPORTANT! In case of significant wear of brake bands, turn the eccentric axle by 180°, removing excessive clearances between the brake band and drum (flat on the left). After that, fix the shaft with the lock bar (17) and bolt (16).

After several external readjustments, the eccentric axle 15 (Fig. 2) takes the left-most position (the flat "B" is on the left vertically), which indicates that no more reserve of external adjustment is available. In such a case, set the eccentric axle to initial position by rotating it counter-clockwise (the flat is on the right vertically), after that perform adjustments as described for PTO control adjustment for assembly by manufacturer or PTO repair.

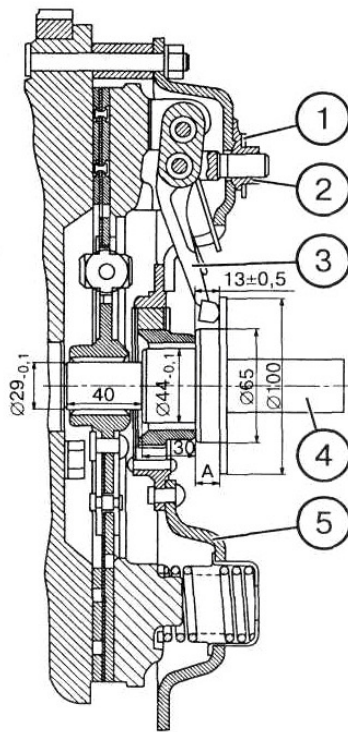
When adjustment is correct, the lever 1 (Fig. 1) in the ON position must be at least 50 mm away from the cab floor (dimension "B").

availability of vacant spaces around it and the levers connected with it. PTO slipping means that the spring mechanism or the levers meet additional resistance when moved over due to lack of lubricant in joints, high contamination, touching adjacent tractor parts etc.

ATTENTION!

Perform all adjustments with the engine off.

On tractors of earlier make, the PTO external readjustment mechanism may not be available (pos. 15, 16, 17, Fig. 2). In such a case, adjust as specified above for adjustment of PTO control after repair or in assembly by manufacturer. On small-cab tractors, the dimension "B" is 50 to 60 mm. PTO brake efficiency, absence of slipping depends only on the spring mechanism and first of all on



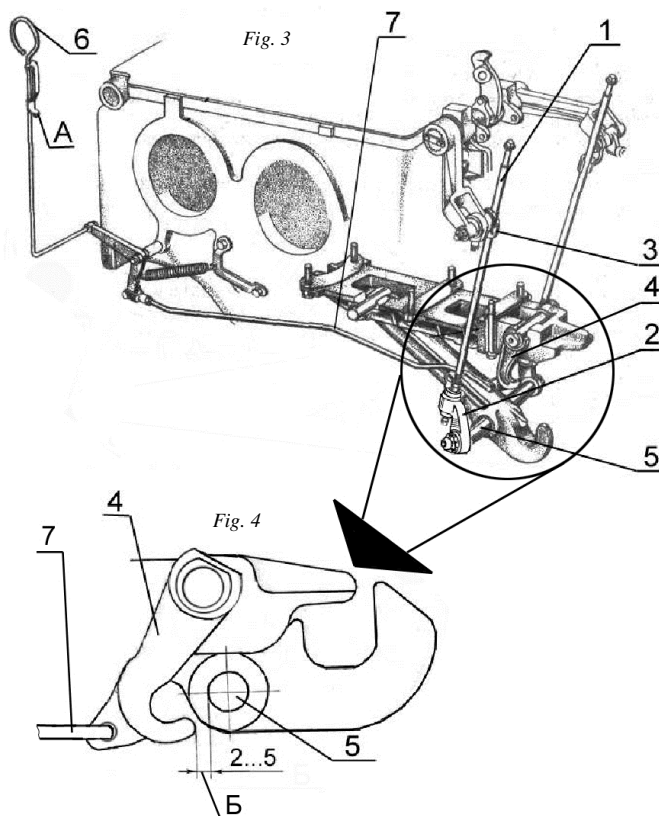
ADJUSTMENT OF RELEASE LEVER POSITION

After installing the clutch onto the flywheel and removing the mounting bolts, adjust the position of the release levers 3 with the special mandrel 4 that is based on the inner diameter of the hub splines of the backing plate 5 resting against the hub end. The mandrel has an end face for rest of release levers. The Figure shows the mandrel dimensions. With the adjusting nuts 2 bring the release levers to stop against the mandrel end, first removing the lock washers 1.

ADJUSTING COUPLING HOOK CONTROL MECHANISM

ATTENTION! Before adjusting the HDC, first unscrew the screws 1 from the shackles 2 to ensure free travel of the levers in order to avoid damage to the brace pins.

To adjust the control mechanism, proceed as follows:



1. Raise the implement levers to the maximum possible height and adjust the lifting rod with the screw 1 (see Fig. 3) screw the screws into the shackles 3 up to stop of the screw heads against the surfaces of the shackles 2 and lock them with locknuts. At that the catches 4 must go under the axis of the hook 5 without touching it.

2. Lift the handle 6 and install the element A of the clamp 6 into the hole in the cab floor.

3. By adjusting the length of the rod 7, ensure the clearance B between the catches 4 and the axis of the hook 5 when it is lowered or raised (see Fig. 4).

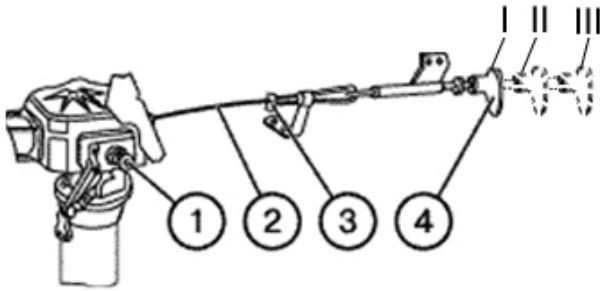
4. Raise the levers to the upper position and lower the handle 6. At that the catches 4 must settle under the hook axis.

5. Make sure that when the levers are lowered, the catches ensure locking the hook in the working position.

ADJUSTING REAR AXLE DIFFERENTIAL LOCK CONTROL

For normal operation of the differential lock control, correctly adjust the relationship of

the handle 4 and the cock 1 of the lock sensor, proceeding as follows:

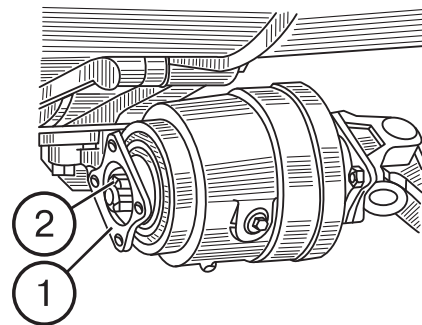


- fasten the free end of the cable 2 in the clamp with the screw 3, at that the cable end must protrude from the clamp to 5 to 10 mm max.;
- shift the handle 4 to the position I. Stretch the cable until the cock starts turning and lock the coupling with the screws 3; lead the second clamp up against the coupling and fasten it with the screw.

To check correctness of the adjustment, shift the handle to the fixed position II, at that the mark on the cock 1 must align with the mark "вкл." ("on") on the lock sensor cover. The handle and the cock must return to the position I from the positions II and III under action of the spring.

Adjust the safety coupling to transfer of a torque of 40 to 80 kgf•m (400 to 800 N•m). Adjust the coupling by tightening the nut 2 of the rear shaft shank of the intermediate support to ensure transfer of the required torque. Periodically check the side play in the universal joint cross bearings. If any play is present, disassemble the joint and check condition of the bearings and crosses, replace worn parts. When assembling the gland holders, press them in up to stop against the bearing.

The driveshaft is balanced dynamically. Do not disassemble the driveshaft without a special need. When replacing parts such as pipe with joint forks and flange during operation, balance the driveshaft assembly with two joints again dynamically by welding plates to the both ends of the pipe. Unbalance must not exceed 55 g•cm. Do not crank the driveshafts with tire levers, keys or other devices to avoid damage to sealings and failures of cross bearings.



ADJUSTING FDA CARDAN DRIVE

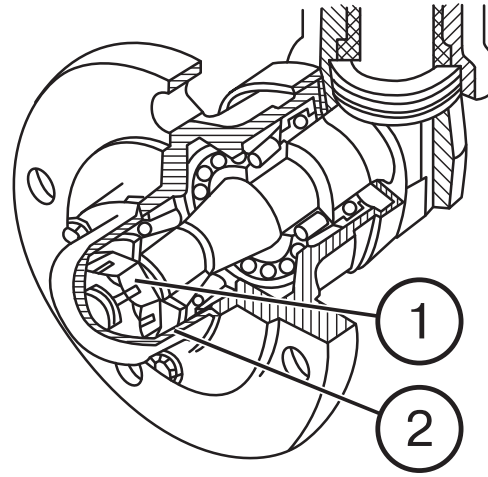
In the cardan drive, adjust the safety coupling in the intermediate support and check the side play in the cardan bearings.

Adjusting tapered roller bearings of wheel guides of Belarus 510 tractors

When adjusting bearings of wheel guides, set the axial clearance of 0.08 to 0.20 mm. Check it after each 1,000 service hours. To do that, raise the wheel and slightly rocking it in the direction perpendicular to the rotation plane, determine the bearing clearance.

If a high clearance is determined, adjust proceeding as follows:

- a) unscrew the bolts and remove the cap 2;
- b) unsplint the castle nut 1 and, rotating the wheel by hand, tighten the nut 1 until a high resistance to wheel rotation appears. Then unscrew the nut only to an extent allowing to obtain alignment of the nearest slot of the nut with the cotter-pin hole in the half-axle.
- c) check easy rotation of the wheel;
- d) fasten the nut with a cotter pin, install the cap to place first filling it with grease.



Section G. Maintenance

KINDS OF MAINTENANCE OF THE TRACTORS

Kind of maintenance	Frequency or term of maintenance organization in tractor service hours
Maintenance during the tractor pre-operation:	
MS during the tractor preparation for running-in	Prior to running-in preparation
MS during running-in	MS during running-in
MS after completion of the running-in	After 30 service hours
Scheduled maintenance:	
shift-time maintenance (STM)	8-10
maintenance No. 1 (MS-1)	125
maintenance No. 2 (MS-2)	500
maintenance No. 3 (MS-3)	1000
Special maintenance	2000
General maintenance	As necessary
Seasonal maintenance (M-SS and M-FW)	When transferring to fall-winter operation (M-FW) and spring-summer operation (M-SS)
Maintenance under special application conditions	When preparing to operation under special conditions
Maintenance during storage	During long-time storage

MAINTENANCE WHEN PREPARING THE TRACTOR FOR OPERATION

Maintenance during the tractor preparation for running-in

- clean the tractor from dust and dirt, remove preservative grease (if any);
- check oil level and add as necessary: engine crankcase; air cleaner tray; tank of the hydraulic mounted system; power train housing; steering booster housing; FDA and intermediate support housings;
- Lubricate steering knuckle bearings; pinion of the right angle brace; bushings of the rear attachment mechanism;
- check the storage battery and, if necessary, clean the terminals from oxides and grease them with technical petroleum, clean the vents and check the charge;
- check and adjust as necessary tension of the fan belt; the tractor control units; air pressure in the tires; and the toe-in of the front wheels;
- check and tighten, if necessary, outer threaded joints;
- fill the radiator with coolant;
- listen to the engine operation and check readings of the instruments for conformance to prescribed norms.

Maintenance during the running-in:

- check the level of and add as necessary oil into the engine crankcase and coolant into the radiator;
- monitor clogging of the air cleaner against the pilot lamp;
- check serviceability of the engine, controls, lighting and signalling systems, and brakes.

Maintenance on completion of running-in (after 30 service hours):

- inspect and wash the tractor;
- listen to operation of the major parts of the tractor;
- check and adjust as necessary tension of the fan and alternator belt, free travel of the clutch and brake pedals;
- check storage batteries and as necessary clean the battery surfaces, terminals, wire lugs and vents in the plugs;
- change oil in the engine crankcase, air cleaner tray, housings of power train, FDA and intermediate support;
- lubricate the clutch shifter bearing;
- clean the centrifugal oil filter;
- replace the filtering element of the hydraulic system;
- flush the screen oil pre-filter of the engine;
- check and tighten as necessary external fastenings of the tractor components, including the bolts of the engine cylinder head and the bolts fastening the driveshaft intermediate support holder to the transmission housing (for tractors with FDA), the bolts of power train housings, rear wheel hubs, pivoting shaft holder and the nuts of the front and rear wheels;
- check and adjust clearances between the engine valves and rockers;
- check coolant level and add it as necessary to the radiator;
- drain sediment from the fuel coarse filter;
- check and restore, if necessary, air tightness of the air cleaner and engine inlet pipelines;
- check serviceability of the engine, illumination and signalling systems.

SCHEDULED MAINTENANCE TABLE

Pos. No.	Object of maintenance	Check	Clean	Lubricate	Replace	Adjust	Drain	Flush	Note
Shift-time maintenance (STM) after each 10 service hours									
1	Oil in engine	+							
2	Coolant	+							
3	Oil in hydraulic system tank	+							
3 _a	Steering	+							
Maintenance No. 1 (MS-1) after each 125 hours of operation									
4	Oil in air cleaner tray	+							
5	Oil level in casings of upper bevel pairs of the FDA with bevel reducing gears	+							
6	Sediment of fuel coarse filter and fuel tanks							+	
7	Fan and alternator belt	+				+			
8	Hub and wheel fastening	+				+			
9	Air pressure in tires	+				+			
10	Clutch shifter bearing			+					
11	Storage batteries	+				+			
12	Oil level in FDA cardan drive intermediate support	+							
13*	Play in steering rod joints	+				+			
13 _a	Steering booster	+							
14*	Clutch pedal free travel	+				+			
Maintenance No. 2 (MS-2) after each 500 service hours									
15	Rotor of engine centrifugal oil filter		+						
16	Oil in engine**				+				
17	Clearances in engine valves	+				+			
18	Steering wheel play	+				+			
19	Brakes (service and parking)	+				+			

- Perform the operation after each 250 service hours.

** When using summer grade diesel fuel with sulfur content of 1%, intervals for crankcase oil change are reduced by half.

End of Table

No.	Object of maintenance	Check	Clean	Lubricate	Replace	Adjust	Drain	Flush	Note
20	Front wheels (toe-in)	+				+			
21	Engine air cleaner		+						
22	Hydraulic system filter*							+	
23	Alternator		+						
24	Deposit of fuel fine filter						+		
25	Transmission oil	+							
26	Oil in the FDA housings	+							
27	Maintenance of steering drive	+				+			
28	Flushing steering booster drain filter							+	
29	Lubricating front axle steering knuckles			+					
Maintenance No. 3 (MS-3) after each 1000 service hours									
30	Bolts fastening cylinder head	+				+			
31	Fuel coarse filter								+
32	Filtering element of fuel fine filter				+				
33	Alternator	+							
34	Steering rod joints**	+			+	+			
35	Angle brace of mounted attachment mechanism			+					
36	Shaft bushings of mounted attachment mechanism			+					
37	External boltings of tractor	+							
38	Oil in hydraulic system tank				+				
39	Transmission oil				+				
40	Oil in FDA housings and intermediate support				+				
41	Engine oil pre-filter		+					+	
42	Engine breather							+	
43	Adjustment of steering booster					+			

*) First change after 500 hours, subsequent changes after 1,000 service hours as well as during seasonal maintenance.

**) After each 250 service hours.

End of Table

No.	Object of maintenance	Check	Clean	Lubri- catie	Replace	Adjust	Drain	Flush	Note
Maintenance after each 2,000 service hours									
44	Engine injectors	+				+			
45	Fuel pump. Injection lead angle	+				+			
46	Fuel pump. Adjustment at test bench	+				+			
47	Engine cooling system		+					+	
General maintenance									
48	Valve of centrifugal oil filter	+							
Seasonal maintenance									

Shift-time maintenance (STM) after each 10 service hours or daily

Operation 1. Oil level in engine crankcase.

Stop the engine, wait for 15 minutes and check the oil level. The oil level must be between the upper and lower marks of the dipstick (3). If necessary, remove the cover (2) of oil filler neck (1) and add oil to the upper mark of the dipstick (3)

IMPORTANT! Do not operate the engine with oil below the lower mark of the oil dipstick.

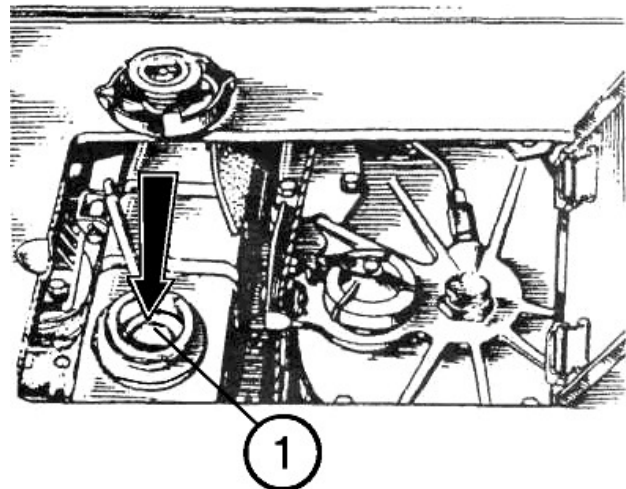
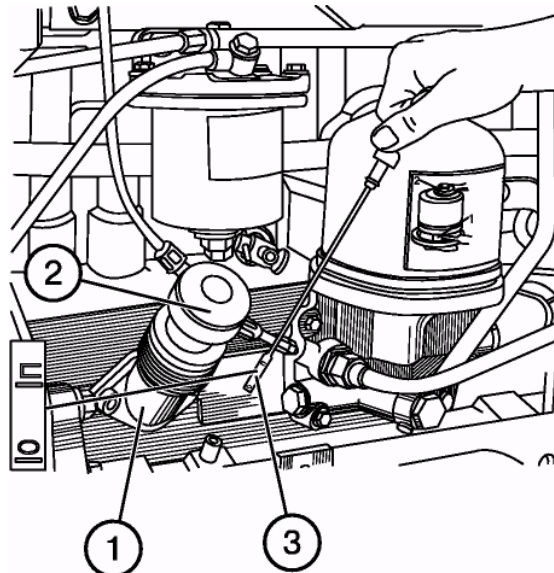
IMPORTANT! Do not fill up oil above the upper dipstick mark. Excessive oil will burn, giving the false impression of high oil consumption for burning.

Operation 2. Coolant level in engine radiator.

Remove the radiator cap away and check the cooling fluid level, which shall be below the upper edge of the filler neck (1) by 50-60 mm. If necessary, add coolant to the level.

IMPORTANT! Do not allow the level to drop below 100 mm from the filler neck upper edge.

WARNING! The engine cooling system operates under pressure maintained by the valve in the radiator cap. It is dangerous to remove the cap from a hot engine. Let the engine cool down, put thick cloth on the cap and turn it slowly to reduce the pressure before removing the plug fully. Beware of burns caused by hot liquid!

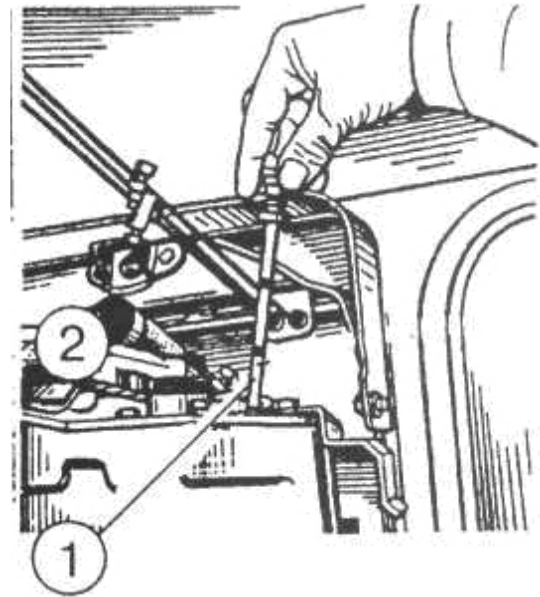


Operation 3. Checking the oil level in the hydraulic system tank

NOTE: Prior to checking the oil level, place the tractor on an even horizontal surface. Stop the engine and engage the parking brake.

Check the oil level by the oil dipstick (1) on the left side of the hydraulic system tank. The level shall be between the marks “O” and “П” (Full). If necessary, add oil to the mark “П±5mm” removing the threaded plug (2).

NOTE: When using machines requiring high amount of oil taking, add oil to the level corresponding to the upper mark “C”. When doing this, the hydraulic cylinders must be with plungers retracted.



Operation 3a. Steering

Check serviceability of the steering. Inspect, listen to, check on run.

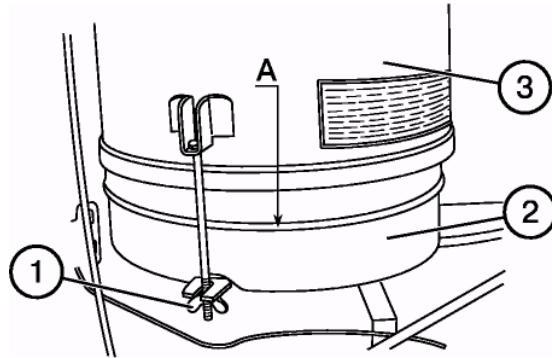
Maintenance No. 1 (MS-1) after each 125 service hours

Perform the previous actions plus as follows:

Operation 4. Oil level and condition in engine air cleaner tray

Loosen the two nuts (1) and remove the tray (2) of the air cleaner (3). Check the oil level in the tray, which shall be at the level of the ring collar "A".

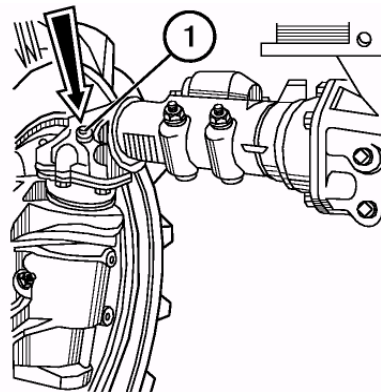
Add oil, if necessary. If oil is contaminated with dirt or in oil, change oil.



ATTENTION! Do not overfill the tray with oil above the ring collar "A", since it can result in oil ingress into the engine combustion chambers and development of false impression about increased oil consumption for burning.

Operation 5. Oil level in housings of upper bevel pairs of FDA with bevel reducing gears

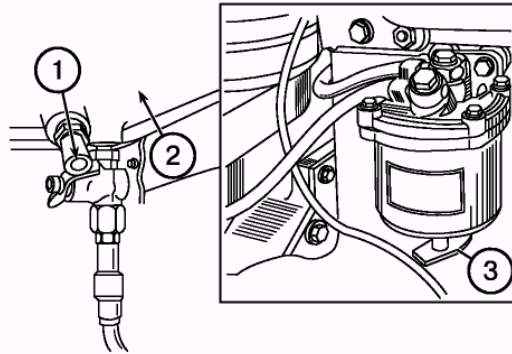
Check that the oil level coincides with the lower edge of the oil-filling hole (1). If necessary, add oil.



Operation 6. Draining sediment from fuel tanks and fuel coarse filter

Open the drain plugs (1) of the fuel tanks (2) and the drain plug (3) of the filter and drain sediment until clean fuel appears. Drain sediment into a special container and dispose of it properly.

Close the drain valves after appearance of clean fuel without water and dirt.

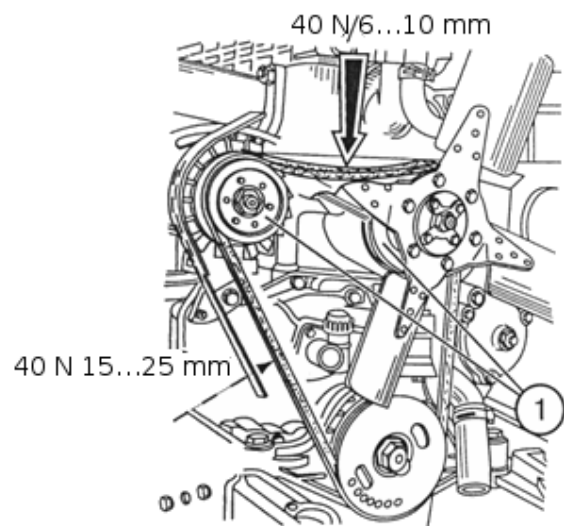


Operation 7. Checking tension of fan belt of engine cooling system

Check the belt for traces of wear or damage. If necessary, replace it.

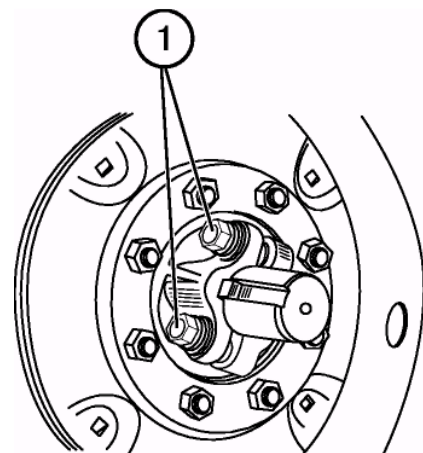
To check tension of the belt of the engine alternator with an elongated shield, apply a force of 40 N approx. to the middle pint of the belt section “alternator pulley to water pump pulley” (1). The deflection must be 6 to 10 mm. If necessary, adjust the belt tension by rotating the alternator body, having loosened the lath fixing bolt and the alternator fixing nuts, and then tighten them.

NOTE: When fitting a normal alternator shield, check the belt tension on the section “alternator pulley – crankshaft pulley”. The belt deflection shall be within the range 15...20 mm under a force of 40 N approx. applied to the middle of the section.



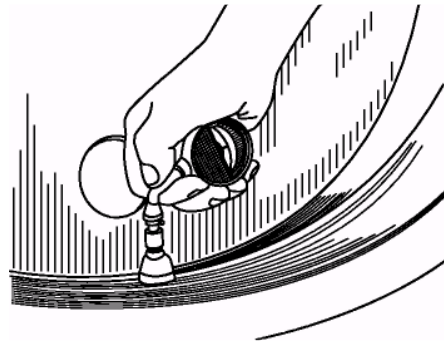
Operation 8. Rear wheel hubs

- Check tightening and, if necessary, tighten the bolts (1) fastening the rear wheel hubs (four bolts on each hub) with a torque spanner. The tightening torque must be 300 to 400 N•m (30 to 40 kgf•m).
- Check and adjust as necessary the nuts of:
- front wheels to a torque of 200 to 250 N•m
- rear wheels to a torque of 300 to 350 N•m
- fastening of the disks to the rims to a torque of 180 to 240 N•m.



Operation 9. Air pressure in tires

Check the tread condition and air pressure in the tires. If necessary, adjust the pressure ac-



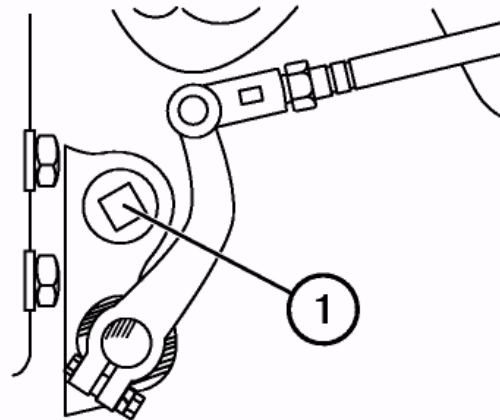
ording to the recommendations given in this Manual.

Operation 10. Lubricating clutch shifter bearing

Remove the plug (1) from the left side of the clutch housing.

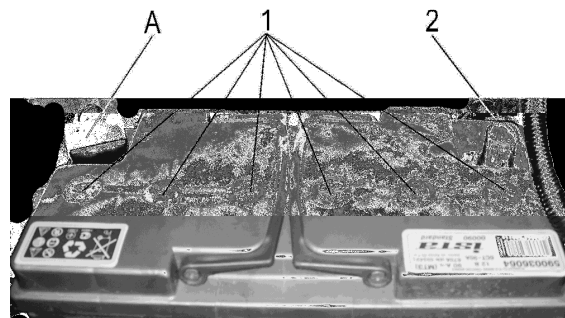
Insert the injector of the lever-plunger pressure gun into the opening and make 4 to 6 injections of Litol-24 grease through the oil feeder screwed into the shifter body to lubricate the release bearing.

NOTE: Do not inject excess grease, since it will be accumulated inside the clutch housing and can get on the friction surfaces of the driven disk friction facings.



Operation 11. Storage batteries

WARNING: Batteries contain sulfuric acid that causes severe burns when getting onto open parts of the body. Beware of the acid getting onto the skin, into eyes and onto clothes. When the acid gets onto external body parts, wash them with plenty of pure water. In case of ingestion, drink plenty of water or milk.



In case of contact with the mucous membrane of an eye, wash it with plenty of water for 15 minutes and then call for medical assistance. Do not allow spark

of flame getting into electrolyte zone; this can result in explosion. Charge the batteries in a ventilated room. When servicing the batteries, wear protective goggles and gloves. Keep the batteries dry and clean. Make sure that the batteries are fixed re-

liably. Before you remove the plugs, clean the adjacent surfaces. Check the electrolyte level. It must be above the protective mesh by 12 to 15 mm (or between the level marks on the battery transparent body).

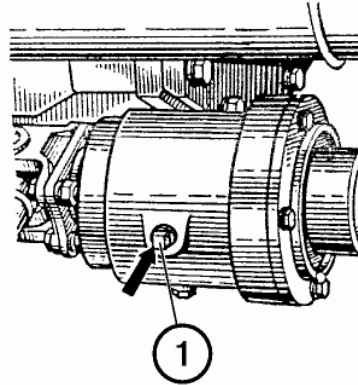
Prior to adding distilled water, check the

electrolyte density in each cell jar. If necessary, add distilled water.

Check that terminals (2) under the jackets (A) and plugs (1) are clean. If necessary lubricate the terminals (2) with technical petrolatum.

Operation 12. Checking oil level in intermediate support of FDA cardan drive

Check the oil level in the intermediate support. If necessary, add oil to the level of the lower edge of the filler opening closed with plug (1).

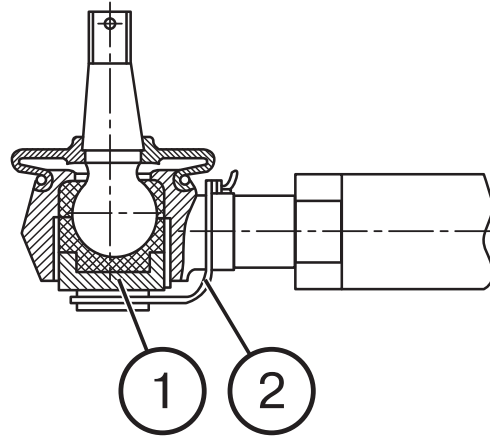


Operation 13*. Checking backlashes in steering rod joints

After each 250 service hours, check the joints by shaking them by hand or rotating the steering wheel.

To adjust a steering rod joint, proceed as follows:

- a) remove the safety wire (3) from the tip (3);
- b) tighten the plug (1) with a wrench to eliminate a clearance in the rotary joint;
- c) lock the plug with safety wire.

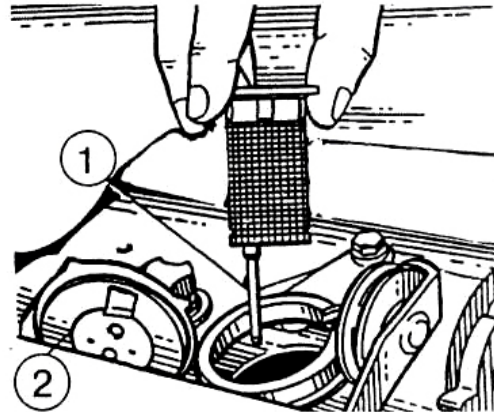


NOTE: If backlashes in the joints cannot be eliminated by tightening the threaded plugs, disassemble the joint and replace worn-out parts.

Operation 13a*. Check oil level in steering booster housing

Remove the plug 2 and take the dipstick 1 from the steering booster housing. Oil must be at the level of the upper mark on the dipstick 1.

In case of low oil level, add oil to the mark.



* Perform MS after each 250 service hours.

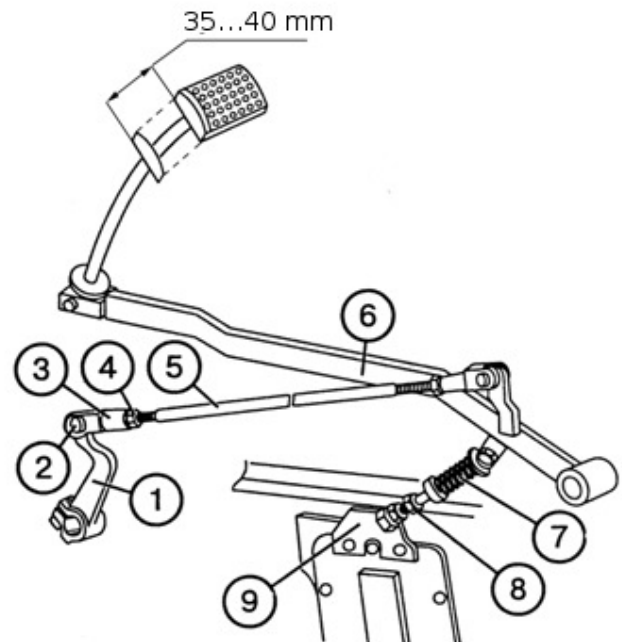
Operation 14*. Adjusting free travel of clutch pedal

IMPORTANT! A too long pedal travel will not allow to the clutch to be fully disengaged and will make the gear switching difficult. Absence of a free pedal travel will cause slipping of clutch disks, quick wear of friction facings and overheating of the clutch parts.

To adjust free clutch pedal travel:

- Unsplint and remove the pin (2), having disconnected the rod (5) from the lever (1).
- Loosen the locknut (4).
- Unscrew the bolt (8) so that the pedal rod (6) would move upwards to the stop against the cab floor.
- Turn the lever (1) counterclockwise to the stop, i.e. when the release bearing touches pressing arms.
- By unscrewing the fork (3), align the openings in the fork with those in the lever (1), and then screw the fork into the rod (5) by 5 to 5.5 turns (i.e. make the rod shorter). Link the fork (3) with the lever (1) with the pin (2).
- Assemble the leverage of the clutch pedal in reverse order.

IMPORTANT! Make sure that the clutch pedal returns reliably to the stop against the floor at the distance of free pedal travel. Otherwise, adjust the servo-unit springs (7) by means of the bolt (8) or reposition the holder (9) by turning it relatively to the fastening bolt axis.



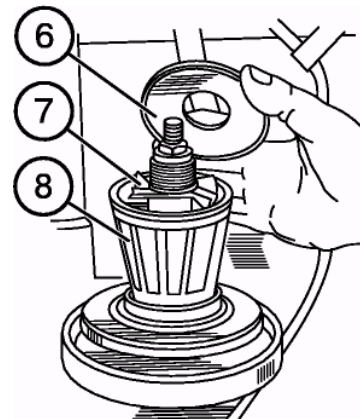
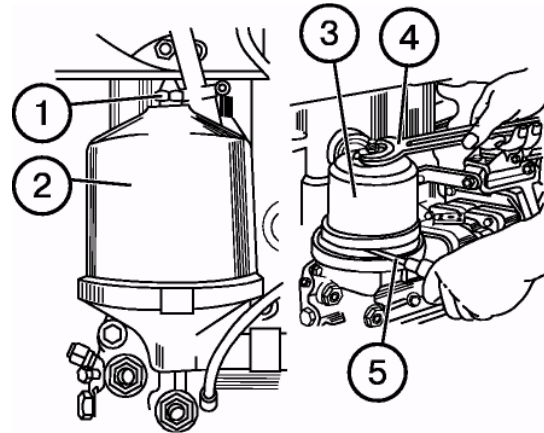
* Perform MS after each 250 service hours.

Maintenance No. 2 (MS-2) after each 500 service hours

Perform the previous MS actions plus as follows:

Operation 15. Centrifugal oil filter of engine

- Unscrew the nut (1) and remove the cap (2).
- Insert the screwdriver (5) or a rod between the filter body and the rotor bottom to lock the rotor (3) against rotation and remove the rotor barrel (3) by turning the rotor nut with spanner (4).
- Remove the cover (6), impeller (7) and filtering grid (8) of the rotor. If necessary, clean and flush the grid.
- Remove deposits from the inner walls of the rotor barrel using a non-metallic scraper.
- Clean all the parts in a detergent solution and blow with compressed air.
- Reassemble the filter by performing the same operations in the reverse order. Prior to assembling the barrel with the rotor casing, lubricate the seal ring with motor oil.
- Align the balancing marks of the barrel with those on the rotor casing. Tighten the barrel-fastening nut with a slight force until the barrel is fully set on the rotor.
- The rotor must rotate freely, without jamming.
- Install the cap (2) to place and tighten nut (1) to a 35 to 50 N•m (3.5 to 5.0 kgf•m) torque.



NOTE: After stopping the engine, the noise of a turning rotor must be heard for 30-60 s. This indicates that the filter operates properly.

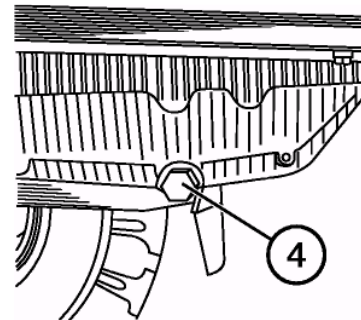
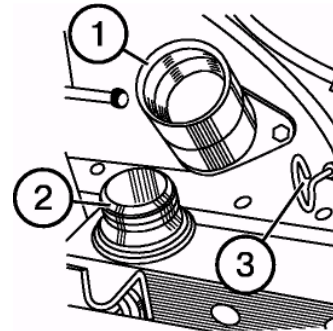
Operation 16. Changing oil in engine

- Warm up the diesel engine to the normal operating temperature (70°C min.).
- Place the tractor on an even surface, stop the engine and engage the parking brake.
- Remove the cap (2) of the oil filler neck and unscrew the drain plug (4).

ATTENTION! Be careful to avoid contact with hot oil.

Drain oil into a container for waste oil storage.

- Place the drain plug (4) to place and fill in fresh motor oil through the oil filler neck (1) (M-8ДМ, M-8Г₂, M-8Г_{2К} during winter and M-10ДМ, M-10Г₂, M-10Г_{2К} during summer to the upper mark of the dipstick (3).
- Install the filler neck cap (2) to place.
- Start the engine and let it run for 1-2 minutes.
- After 10 minutes from the moment of stopping the engine, check oil level with the dipstick.
- If necessary, add oil.

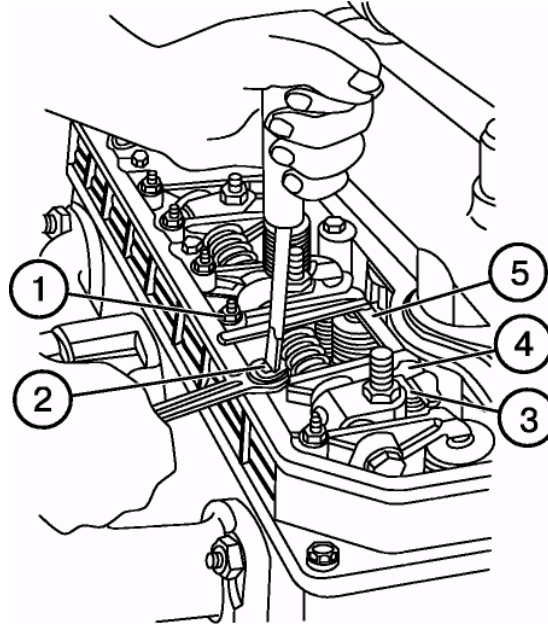


Operation 17. Checking clearances between valves and rockers

NOTE: Check the clearances on a cold engine, first checking tightening of the cylinder head bolts.

To perform the adjustment, proceed as follows:

- remove the cylinder head cover cap and check the fastening of the rocker axle rests. The nut tightening torque must be 60 to 90 N•m (6 to 9 kgf•m);
- crank the engine crankshaft until the moment of closing of the valves of the 1st cylinder (the intake valve starts opening, the exhaust valve finishes closing) and adjust clearances in the 4th, 6th, 7th and 8th valves (counting from the fan);
- to adjust the clearance, loosen the locknut (1) of the screw (2), insert the feeler (5) between the face of valve rod (3) and the rocker head (4) and set the required clearance against the feeler by turning in or out the screw (2).



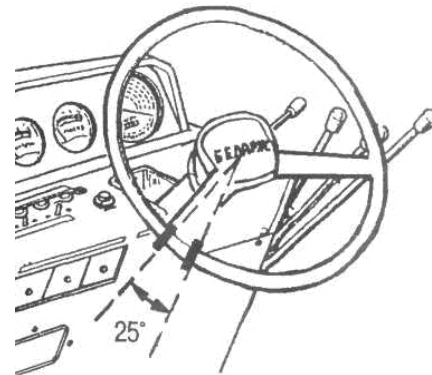
- turn the crankshaft through 360°, set the valve closing at the 4th cylinder and adjust clearances in 1st, 2nd, 3rd and 5th valves as shown above;
- after adjustment of the clearances, tighten the locknuts (1) and refit the removed parts.

The clearances between the rocker head and the valve rod face on a cold engine for intake and exhaust valves are specified in the table below:

Belarus 510/512	
Intake valves	Exhaust valves
0,20.. 0,35	0,20.. 0,35

Operation 18. Steering wheel play

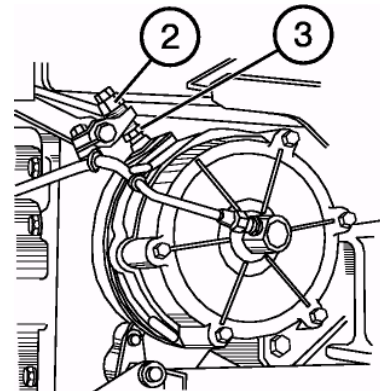
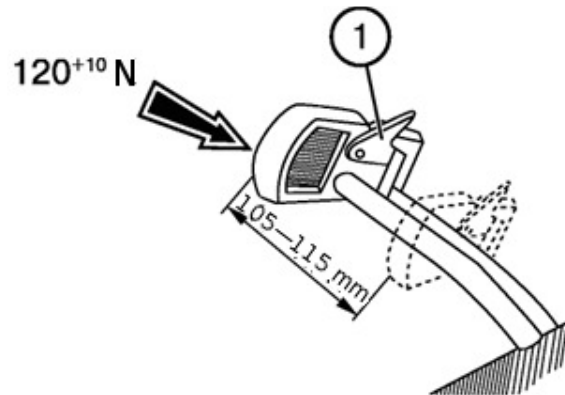
When the engine is running, the steering wheel play must not exceed 25° . If no so, check and eliminate plays in the joints of the hydraulic cylinders and the steering rod.



Operation 19. Adjusting service and parking brakes. Adjustment of the brake valve and pneumatic system pressure regulator

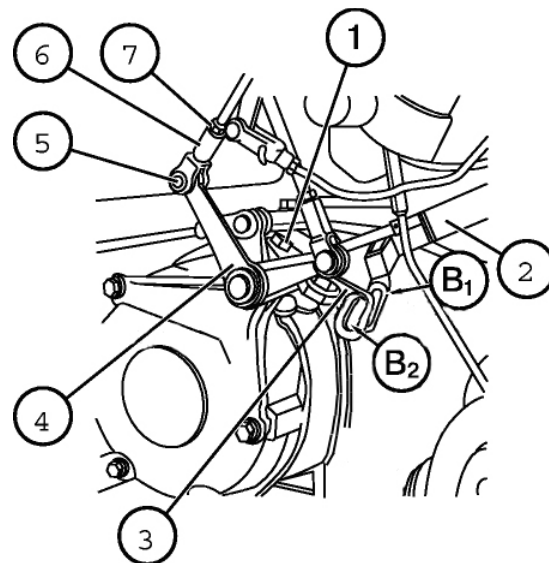
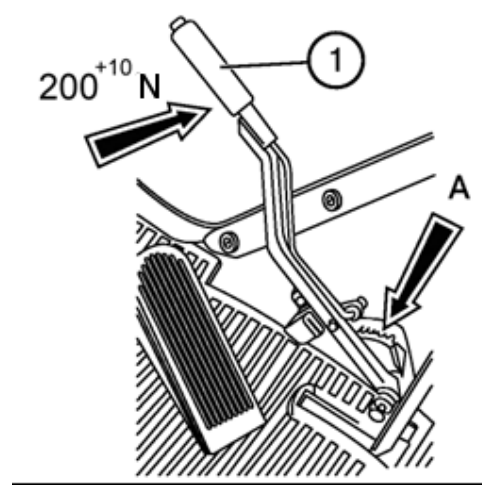
To adjust the brake control, proceed as follows;

- a) unscrew the locknuts (3) of the adjusting bolts (2);
- b) screw the bolts (2) into the adjustment forks or unscrew them so that the full brake right pedal travel would be 105 to 115 mm under a force of 120 to 130 N. The travel of the left brake pedal must be less by 5 to 20 mm to provide a simultaneous brake actuation in interlocked condition. Reduction of brake pedal travel below the values specified below is not allowed as it results in premature wear of brake linings and brake overheating;
- c) tighten the locknuts (3). Interlock the pedals with the lock strip (1) and check simultaneous action of the right and left brakes in motion (1 m max. by the footprint). Ingress of lubricant into the brake causes the disk oiling and reduces the friction between their working surfaces, brakes do not act. In such a case, disassemble the brake, eliminate the oil leakage, wash the oiled disks with gasoline and let them dry for 5 to 8 minutes. After assembly, adjust the brake control.



To adjust the parking brake, install the tractor on an even surface, stop the engine, wedge the rear wheels from the front and behind, and proceed as follows:

- shift the parking brake control lever (1) to the front position (from yourself);
- loosen the tightening of adjusting bolt locknut (1) (see the lower figure below), as well as the locknut (7) and remove the pin (5);
- turn the arm (4) and align the upper edge of the slot "B₁" of the arm (2) with the upper edge of the slot "B₂" of the arm (3) of the right brake pedal and then align the openings of the arm (4) with those of the fork (6) by rotating the fork (6) and then insert the pin (5);
- screw the bolt (1) in or out so that when moving the control lever towards yourself with the force of 200^{+10} N, the latch would be retained in the dent between the third and the forth teeth of sector "A", and the tractor would be held on 18% slope. After adjustment, tighten the loosened locknuts.



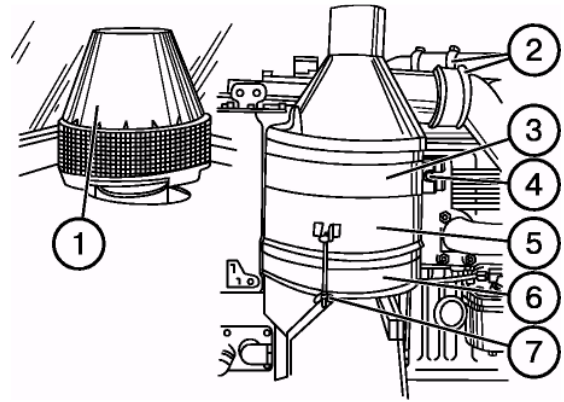
Operation 20*. Front wheel toe-in.

The front wheel toe-in must be 0 to 8 mm. If necessary, perform the adjusting operations according to the recommendations given in the section "Adjustments".

* Perform MS after each 250 service hours.

Operation 21. Checking air-tightness of air cleaner and inlet duct joints

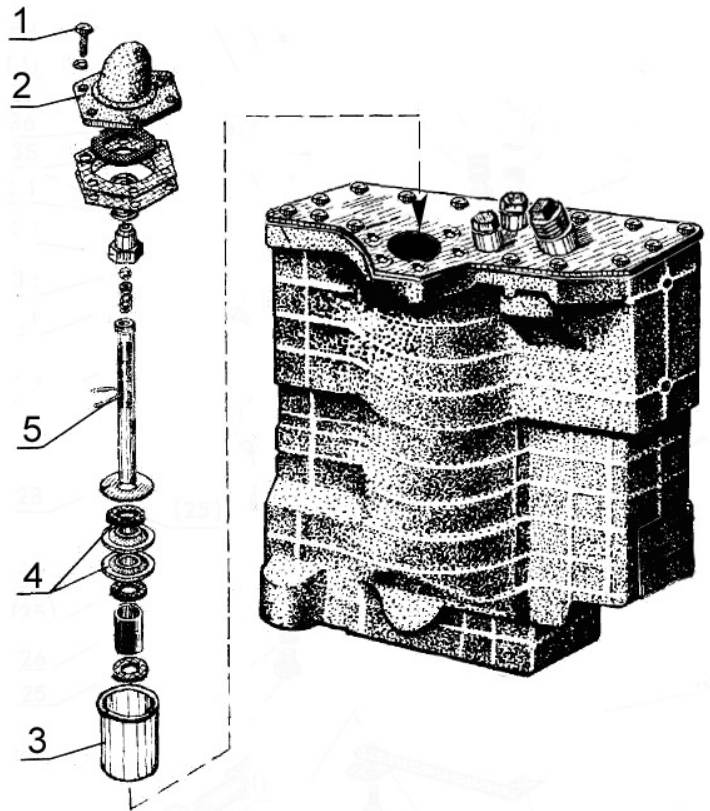
- Remove the monocyclone (1) and clean its inner surface.
- Loosen the clamps (2), remove the bolt (4), release the clamp (3) and remove the air cleaner (5).
- Disassemble the air cleaner, having loosened the nuts (7) and removed the tray (6).
- Clean the inner tray cavity and fill in fresh motor oil.
- Extract three filtering elements, rinse them in diesel fuel and blow with compressed air. Clean the central pipe. Reassemble the air cleaner and install it onto the engine.
- Check air-tightness of all joints and, if necessary, tighten them up. An engine operating at a medium crankshaft speed (1000 rpm) must stop when shutting off the air intake pipe.



Operation 22. Flushing hydraulic system oil filter

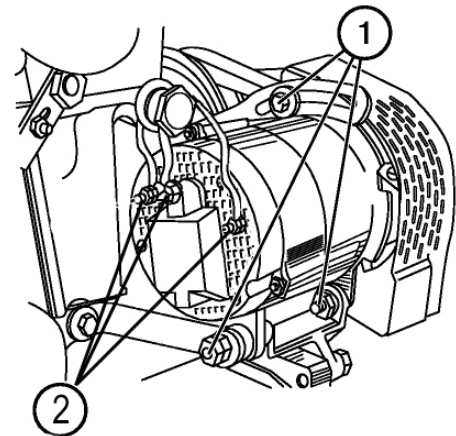
NOTE: Subsequent flushings of the hydraulic system oil filter must be performed after each 1,000 service hours.

- Unscrew the bolts (1) and remove the cover (2), take out the filter housing assembly (3).
- To flush the filtering elements (4), take them out of the housing (3) by removing the wire (5).
- Flush the elements in detergent solution and after flushing perform the operations in the reverse order.
- Install the filter assembly into the hydraulic system tank, close it with the cover (2) and screw the bolts (1).



Operation 23. Cleaning alternator

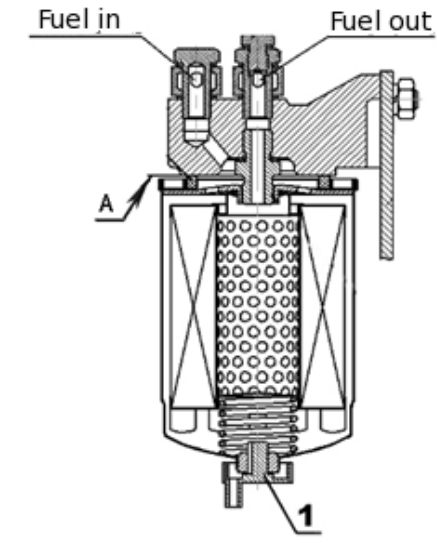
Clean the alternator from dust and dirt. Check and tighten, if necessary, the alternator fastening bolts (1). Check the condition and firmness of the alternator clamped connections (2).



Operation 24. Draining sediment from fuel fine filter

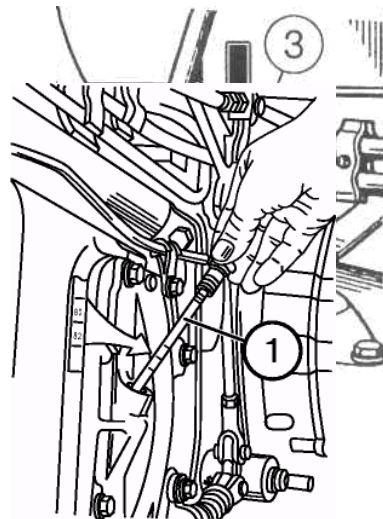
Drain sediment after each 250 service hours of the engine.

Remove the plug 1 in the lower part of the fuel fine filter by 2 to 3 turns as per the figure and drain sediment until clean fuel free of water and dirt appears. Tighten the plug.

**Operation 25. Oil level in transmission**

Check oil level by using the oil dipstick (1) on the left side of the gearbox. The normal working oil level must be between the upper and lower marks on the dipstick.

If you have to correct oil level, remove the plug (3) on the upper cover of the gearbox and add oil to the level.



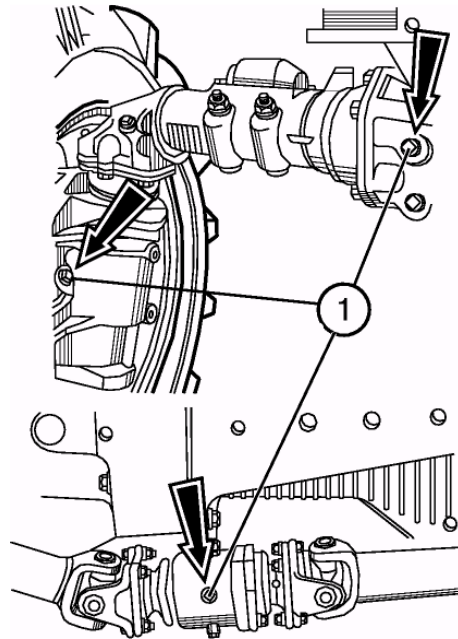
Operation 26. Oil level in FDA housing.**FDA with bevel reducing gears**

Check the oil level in the:

1. wheel reducing gears (lower bevel pairs);
2. main gear (front differential) housing;
3. cardan drive intermediate support;
4. upper bevel pair housings.

The oil level must be up to the lower edges of threaded check holes (1).

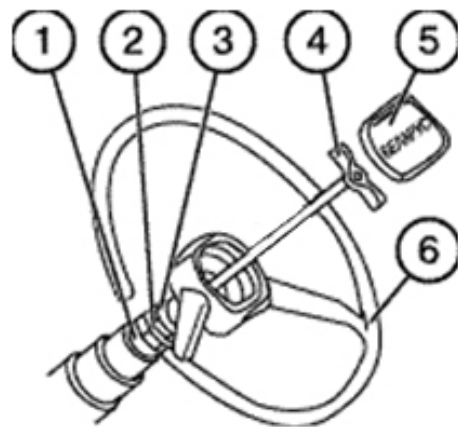
If necessary, add oil to the level through the check holes.

**Operation 27. Maintenance of steering drive**

Maintenance of the steering drive consists of periodical checks of tightening of the threaded connections.

To ensure minimum vibration of the steering wheel, adjust the steering column as follows:

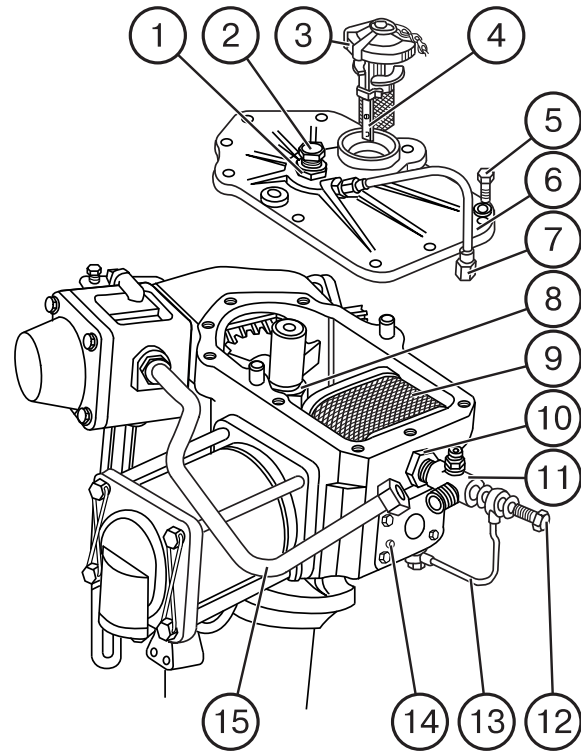
- remove the cover (5);
- unscrew the screw 4 and remove the steering wheel 6;
- loosen the locknut 3.
- screw in the nut 2 until it touches the bushing 1 so that clearances in connections be chosen;
- unscrew the nut 2 by 1.5 turns and lock it with the locknut 3;
- install the steering wheel 6 adjusting its height and screw in the clamp 4.



Operation 28. Flushing steering booster drain filter

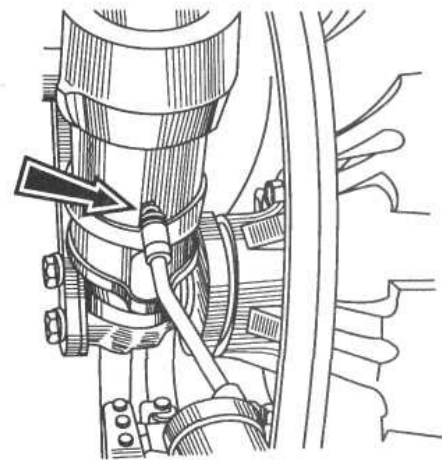
To flush the oil filter, proceed as follows:

- a) raise the facing;
- b) disconnect the oil ducts 7, 13 and 15, unscrew the bolts 5 fastening the cover 6 to the housing, remove the cover using two unmounting bolts.
- c) screw out the relief valve 11 and remove the drain filter 9;
- d) flush the filter in detergent solution;
- e) tighten the nut 8 of the pivoting shaft;
- f) install the filter and perform the operations in the order reverse to disassembling.
- g) at the same time, adjust end play of the steering shaft, proceeding as follows:
loosen the locknut 1 and screw in the adjustment bolt 2 up to stop against the shaft end, then unscrew it by 1/8 to 1/10 turn and lock with the locknut 1.



Operation 29. Lubricating front axle steering knuckles (Belarus 510)

With a gun, make 10 to 12 injections of grease through pressure lubricators (one lubricator per each knuckle). The Litol-24 grease must be used.



Maintenance No. 3 (MS-3) after each 1,000 service hours

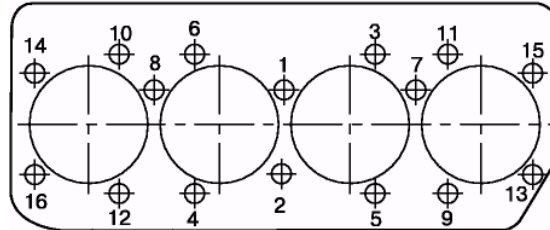
Perform the previous MS actions plus the following operations:

Operation 30. Tightening torque of engine head bolts

NOTE! This operation must be only performed on a warmed up engine.

Remove the rocker cover, cylinder head cover and rocker axle assembly.

Using a torque spanner, check and tighten the cylinder head bolts in the order shown in the figure on the right. Bolt tightening torque must be 160 to 180 N•m (16 to 18 kgf•m).

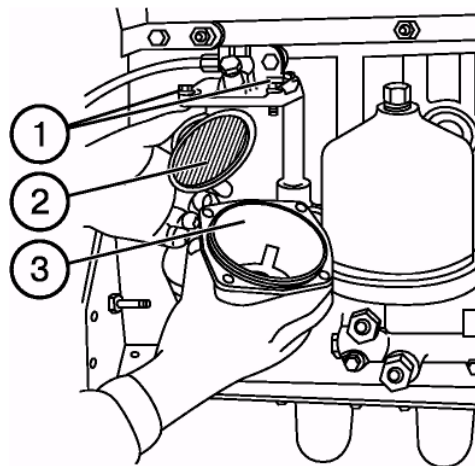


Operation 31. Engine fuel coarse filter

Wash the fuel coarse filter proceeding as follows:

- Shut off the fuel tank valve.
- Unscrew the fastening bolts (1) of the barrel (3) and remove the barrel.
- Unscrew the deflector with the mesh (2) and remove the diffuser.
- Wash the deflector with the mesh, the diffuser and filter barrel in diesel fuel.
- Assemble the filter parts in the reverse order.
- Fill the system with fuel.

Bleed the system and remove air from fuel system as shown below (action 40).

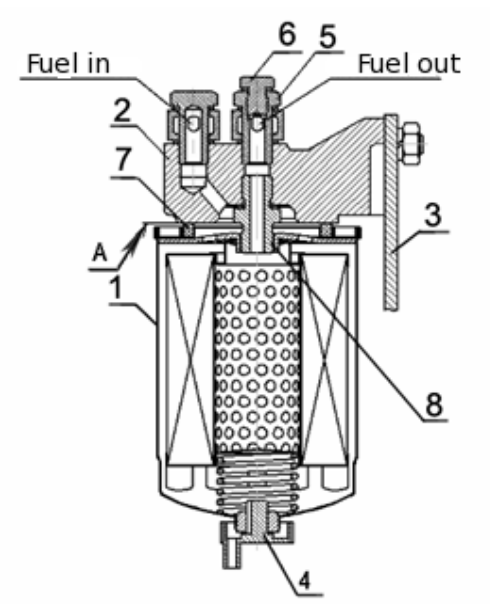


Operation 32. Replacing filtering element of fuel fine filter

- Service life of a fuel fine filter depends on purity of fuel applied.
- Replace the filter as per the figure proceeding as follows:
 - - drain fuel from the filter by unscrewing the plug 4 in the lower part of the housing

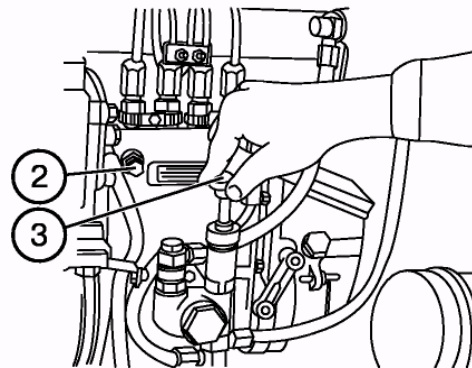
Do not let the fuel to spill over, drain it only to a container.

- - unscrew the filter 1 from the adapter 8 in the housing 2 and install a new filter instead of it, which is supplied assembled with the gasket 7 that must be first lubricated with motor oil;
- - after the gasket 7 touches the installation seat A on the housing 2, screw in the filter by an additional $\frac{3}{4}$ turn. At that, screw in the filter only by force of the hands;
- - open the fuel tank valve and fill the system with fuel.



1 - filter Φ TO20-1117010; 2 – housing; 3 — holder; 4 — plug (to drain sediment); 5 — return line pipe; 6 — plug (to bleed air); 7 — gasket; 8 — adapter.

- To bleed air from the system:
- To bleed air from the system, unscrew the plug 6 on the bolt fastening the return line pipe by 2 to 3 turns. Purge the system with the hand purge pump 3, screwing in the plug when fuel without air bubbles emerges.
- Unscrew the plug 2 on the fuel pump housing. Purge the system with the hand purge pump until fuel without air bubbles emerges, screwing in the plug 2 at that.
- Instead of the FT020-1117010 filter other sealed fuel filters can be installed with basic specifications and dimensions as follows:
 - screening capacity 90% min.;
 - conditional throughput capacity at a pressure difference of 0.01 MPa of 150 l/h min.;
 - diameter 95 to 105 mm;
 - height 140 to 160 mm;
 - connection thread M16×1.5;
 - gasket outer diameter 70 to 75 mm.

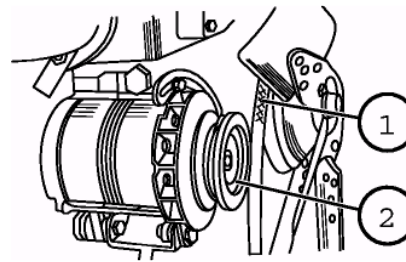


Operation 33. Alternator

Remove the driving belt (1) from the alternator pulley (2).

Check the easy rotation of the alternator rotor and presence of plays in the bearings.

If there are any plays or jamming of the rotor, remove the alternator and send it to the shop for repair.



Operation 34. Steering rod joints

When the engine is running, turn the steering wheel in both direction to check free travel and plays in the joints (1) of the steering rod (4).

If there are any plays in the joints, proceed as follows:

- remove the lock wire (3);
- tighten up the threaded plugs (2);
- lock the plugs with the wire (3).

NOTE: If plays in in the joints cannot be eliminated by tightening the threaded plugs, disassemble the joint and replace worn-out parts.

Operation 35. Lubricating RHL right angle brace bearing

Lubricate the adjustment mechanism of the right angle brace through the pressure lubricator (one point of greasing) using a gun. Make 4...6 injections with the gun. The Litol-24 grease must be used.

Operation 36. Lubricating bushings of RHL pivoting shaft

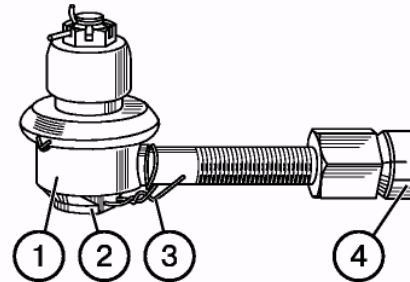
Apply grease using a gun through the pressure lubricators in the mounted attachment holder until grease appears from the gaps. The Litol-24 grease must be used.

Operation 37. Outside bolted connections

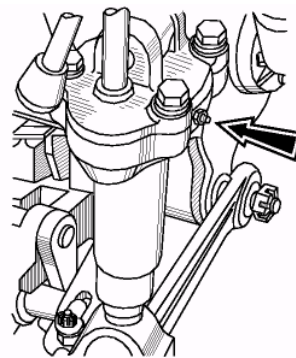
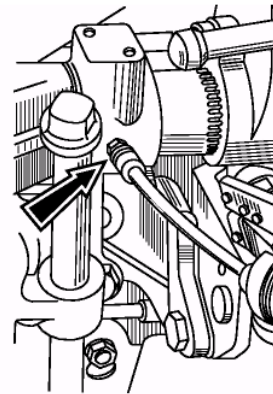
Check and tighten, if necessary, the critical bolted connections:

- front and rear wheel nuts and rear wheel hub bolts;
- front beam — semi-frame side members;
- half-frame side members — clutch casing;
- HDC plate fastening;
- diesel engine — clutch casing;
- clutch casing — gearbox casing;

gearbox casing — rear axle casing;
rear axle casing — RHL and HDC



holders;
front and rear cab supports, holders
and pins of the steering hydraulic cyl-



inder;
rear axle casing — semi-axle
sleeves;
FDA casing - sleeves — wheel re-
ducing gears;

nuts of the cardan shaft collars;
nuts of the FDA casing wedges;
casing of the cardan drive intermediate

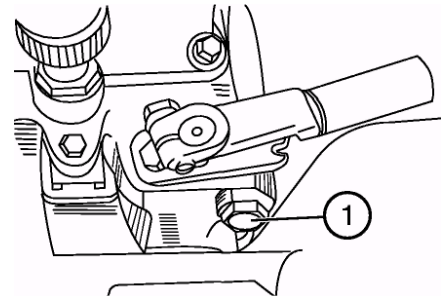
support — clutch casing;
fastening of the holders of the lifting
HDC and hydraulic lift.

Operation 38. Changing oil in hydraulic system

- Prior to changing oil, warm up oil in the hydraulic system.
- Place the tractor on an even surface, lower and detach the mounted machine.
- Brake the tractor and stop the engine.
- Unscrew the filler cap and the drain plug (1) from hydraulic system tank and drain oil into a waste oil container.

ATTENTION! Be careful to avoid contact with hot oil. Dispose of waste oil properly.

- Install the drain plug (1) to place and fill the system with fresh oil. Refit the filler cap.

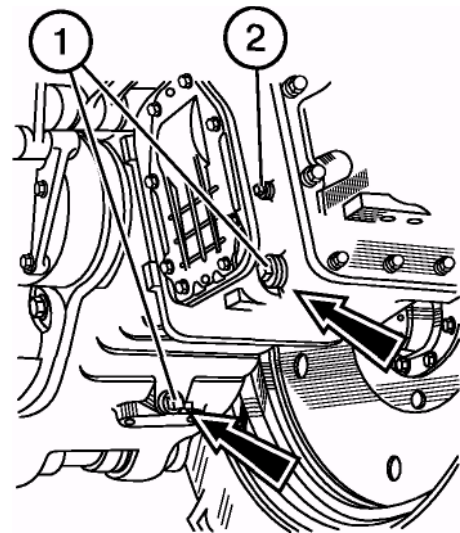


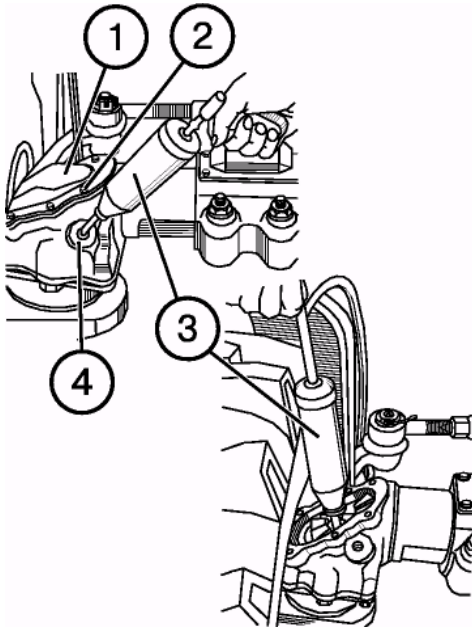
Operation 39. Changing oil in transmission

- Prior to changing oil, warm up the transmission.
- Install the tractor on an even surface, lower the mounted machine and stop the engine.
- Engage the parking brake and lock the wheels against movement by using wedges.
- Unscrew the plug (2) and drain plugs (1) from the casings of rear axle and gearbox, and drain oil into a special waste oil container. Dispose of waste oil properly.

ATTENTION! Be careful to avoid contact with hot oil.

- Fill the transmission with fresh oil. Install the plug (2) to place.





Operation 40. Changing oil in FDA and intermediate support housings

FDA with bevel reducing gears

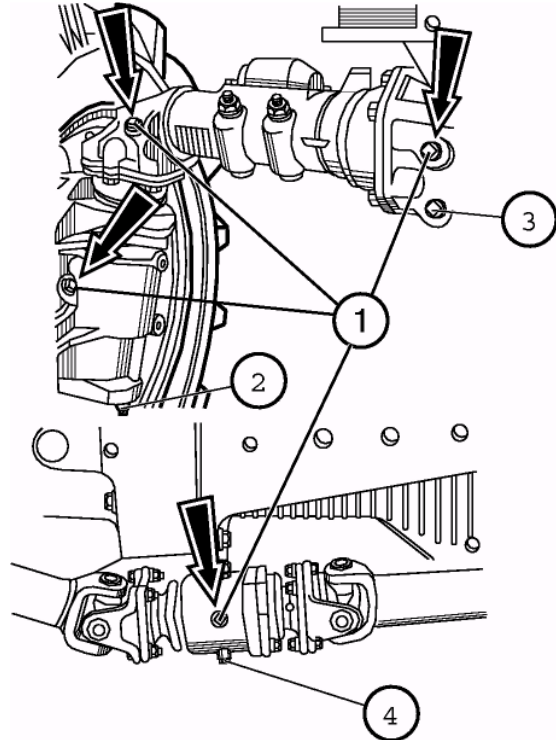
- Prior to changing oil, warm up oil in the FDA housings.
- Install the tractor on an even horizontal surface. Engage the parking brake and wedge the rear wheel from the front and behind.
- Unscrew the check filler caps (1) and drain plugs (2, 3, 4) from the casings of wheel reducing gears, main gear and intermediate support, respectively. Drain oil into a special container.

ATTENTION! Be careful to avoid contact with hot oil. Dispose of waste oil properly.

- Install and tighten up the

drain plugs.

- Fill the casings with fresh transmission oil Tan-15B, Тсн-15К, Тсп-10, ТАД-17и or their analogues to the level of lower edges of the filler openings.



To drain oil from upper bevel pair casing:

- using the gun (3) for liquid lubricant, pump out some oil through the filler opening (4);
- unscrew the bolts (2), remove the cover (1) and drain the remaining oil;
- install the cover (1) and bolts (2) to place;
- fill the spaces of upper bevel pairs up to the lower edges of the opening (4) using a gun for liquid lubricant.
- install and tighten up all the check/fill plugs.

Operation 41. Engine oil pre-filter

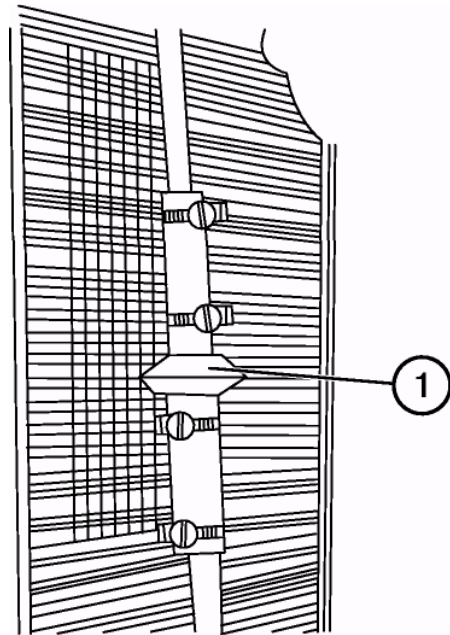
- Loosen four clamps of connector sleeves and remove the filter from the oil line located in front of the engine oil radiator.

IMPORTANT! Note the filter orientation in the oil line. Arbitrary installation of the filter is not allowed.

Wash the filter in diesel fuel and blow it with compressed air in the direction of the arrow on the filter body.

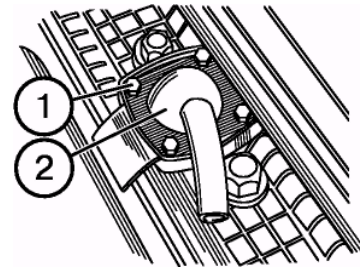
Install the filter to place, paying attention to its correct orientation in the oil line.

Tighten the sleeve clamps.



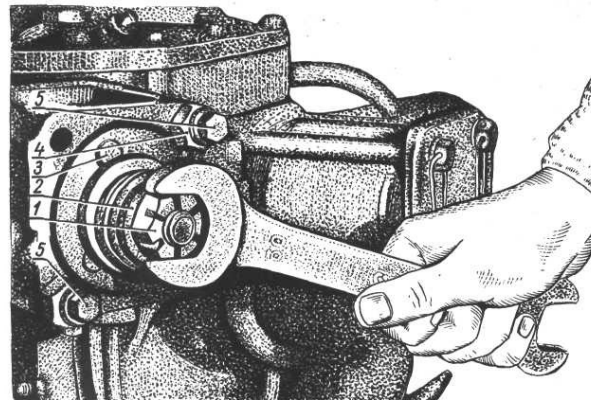
Operation 42. Washing the engine breather

- Unscrew the bolts (1) and remove the breather casing (2).
- Remove the breather from the casing, wash it in diesel fuel and blow it with compressed air. Pour some motor oil into the breather filter and letting the oil to flow down, fit it back.



Operation 43. Adjustment of steering booster

In the steering booster, the following items are adjusted: worm to sector mesh, sector to rack mesh, tightening of worm nut, pivoting shaft axial stroke, safety valve, as well as differential lock valve.



1 – spherical nut; 2 – washer; 3 – slider;
4 – mounting washers; 5 – bolts.

To adjust the worm to sector mesh, loosen the bolt 5, introduce a wrench to the flange groove, turn the bushing clockwise (to tractor motion direction) up to stop at the middle position of the pitman arm 18, then turn counterclockwise by 10 to 12 mm as per the outer flange diameter. Tighten up the bolt 5, start the engine and make sure that the steering wheel rotates in the both directions up to stop without jamming.

If necessary, increase the clearance in the mesh by turning the bushing counterclockwise to eliminate jamming.

To adjust the sector to rack mesh, reduce the thickness of the adjustment shim pack 24 under the flange of the stop 24 to obtain a clearance of 0.1 to 0.3 mm between the stop and the rack. When checking the clearance, press the rack against the sector.

The worm spherical nut 30 ensures tightening of the thrust bearings 28. Correct tightening of thrust bearings is a crucial condition of normal operation of the steering booster. A too tightened nut can cause a skewness of the distributor slide valve and uneven force of turning. Before tightening the nut, fasten the distributor slide valve with two bolts, first putting washers under the bolt heads up to the thickness of the cover flange (Fig. 117). Tighten the worm nut to a torque of 2

kgf•m (20 N•m), unscrew it by 1/12 to 1/10 turn to align the hole in the worm with the cut for the nut splint and splint the nut. Unscrew the two bolts fastening the distributor slide valve to the housing, install the cover and secure the distributor slide valve.

To adjust the axial stroke of the pivoting shaft 21, loosen the locknut 12, screw in the adjustment bolt 10 up to stop against the shaft end, then unscrew it by 1/8 to 1/10 turn and lock with the locknut.

To adjust the safety valve, connect a pressure gauge with a scale to 100 kgf/cm² (10 MPa) min. to the discharge manifold or to the valve cover instead of the plug 1. Turn the steering wheel to stop, engage the engine maximum speed and rotate the adjustment screw 3 of the relief valve until the pressure gauge reading is 88 kgf/cm² (8.8 MPa). After adjusting the valve, lock the cap with wire. Make adjustment at an oil temperature of 50±5 °C.

Check the steering wheel free travel with the engine running while the tractor is stopped. The free travel must be 20 °C max. in such a case. In case of a too long free travel check plays in the steering drive joints, tighten up the nuts fastening the pitman arm, sector and pivot rods, adjust the steering rod joints, check tightening of the worm, worm to sector mesh, sector to rack mesh and axial stroke of the steering booster pivoting shaft.

Special maintenance

After each 2,000 service hours.

Operation 44. Checking engine injectors

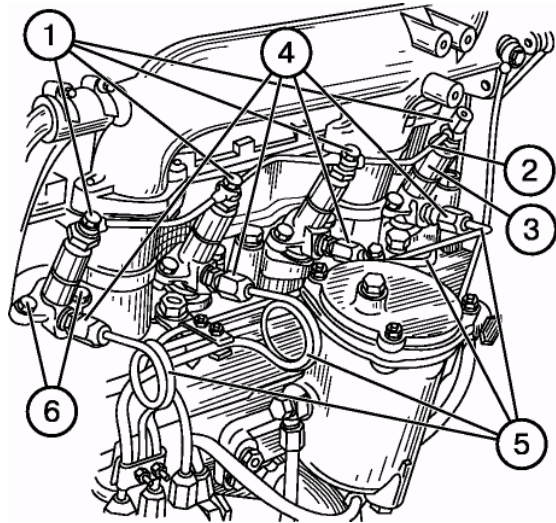
IMPORTANT! The injectors must be cleaned and adjusted in a dealer's specialized workshop.

WARNING: Diesel fuel is injected under high pressure and can result in serious injuries, if the injector atomization is checked by hand. Use a piece of paper or cardboard for this purpose. Wear protective goggles. Prior to connection or disconnection of fuel lines, stop the engine to take pressure down. Prior to starting the engine, tighten all connections of fuel lines. In case of fuel injection on the hand skin, immediately apply for medical aid, otherwise blood poisoning is possible.

NOTE: It is convenient to have a spare set of injectors verified and adjusted for quick installation into the engine.

Take the injectors out and replace them proceeding as follows.

- Prior to disconnection or loosening of any fuel system parts, thoroughly clean the adjacent working surfaces.
- Unscrew the nuts (4) and disconnect the high-pressure fuel piping (5) from the injectors (3) and fuel pump.



- Remove the fuel piping.
- Unscrew the four bolts (1) of the drain line and take the rundown fuel piping (2) away. Discard copper sealing washers (two washers per each banjo bolt).
- Unscrew the bolts (6) fastening the injectors and remove the injectors (3).
- Send the injectors for servicing to dealers workshop.
- Install the verified, cleaned and adjusted injectors by performing the above specified step in the reverse order.
- Remove air from the system.

IMPORTANT! During each injector installation, use new copper washers.

Operation 45. Fuel pump injection advance angle

Setup advance angle of the fuel pump injection must be 19° to 21° to UDC (Д-243 engine and its modifications).

The fuel injection advance angle is checked and adjusted in a specialized dealer shop.

- check the cleanness of the radiator core. If necessary, wash the radiator and blow the core with compressed air (blowing direction from the engine side).

ATTENTION! Radiator clogging, insufficient fan belt tension and impurities inside the cooling system can lead to diesel engine overheating and its failure.

IMPORTANT! Adjustment of the fuel equipment by the tractor operator (owner) is the ground for rendering the manufacturer's warranties void.

Operation 46. Adjusting the fuel pump on the bench

Adjusting the fuel pump shall be performed made by the dealer in a specialized shop using special equipment.

Operation 47. Flushing the engine cooling system

To flush the system, use a solution of 50 to 60 g of soda ash per 1 l of water.

To flush the system, proceed as follows:

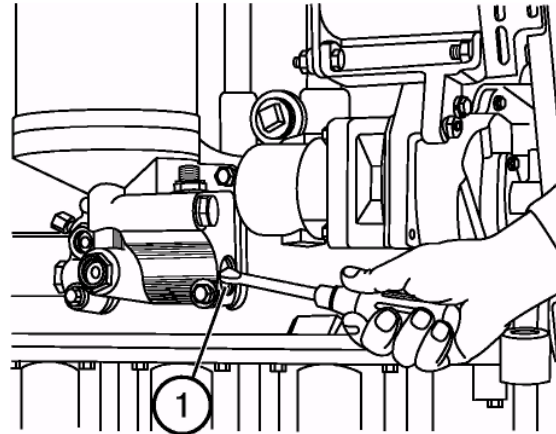
- pour 2 l of kerosene into the radiator and fill the system with the prepared solution;
- start the engine and operate the tractor for 8-10 hours; then drain the solution and flush the cooling system with clear water;

General maintenance

Operation 48. Adjusting drain valve of centrifugal oil filter of engine

If during the engine operation within the rated mode at normal temperature (80 to 100 °C), the oil pressure has dropped below 0.1 MPa, stop the engine and correct the fault.

One of the ways to increase pressure is readjustment of the centrifuge drain valve. To do this, remove the thread plug (not shown) and readjust oil pressure by screwing the adjustment screw (1) with a screw-driver into the body. If this method does not eliminate the defect, contact the dealer.



Seasonal maintenance

Combine the seasonal maintenance with the action under regularly scheduled maintenance

Work content	
<p>When transferring to the fall and winter period (at constant mean daily temperature below +5 °C)</p> <p>Replace the summer oil brands with winter ones (see lubrication table):</p> <ul style="list-style-type: none"> in the engine crankcase; in the casings of the hydraulic units; in the transmission casing; in the FDA casing; in the steering booster casing; in the FDA final drive reducing gear casings; in the FDA drive intermediate support <p>Replace grease in front wheel hubs</p> <p>Change lubricant in the steering rod joints</p> <p>Fill engine cooling system with a fluid not freezing at low temperatures, having pre-liminary flushed the cooling system</p> <p>Remove the driveshafts and check tightness of the flange seating axially on the distribution box shafts, intermediate support and main gear driving pinion (of the tractors with the FDA). Eliminate axial plays by tightening the nuts.</p>	<p>When transferring to the spring and summer period (at constant mean daily temperature above +5 °C)</p> <p>Replace the winter oil brands with the summer ones:</p> <ul style="list-style-type: none"> in the engine crankcase; in the casings of the hydraulic units; in the transmission casing; in the FDA casing; in the FDA final drive reducing gear casings; in the FDA drive intermediate support in the steering booster casing

Tractor maintenance under special operation conditions

When operating the tractor under special conditions (low temperatures, in the desert, on sand, swampy and rocky soils), customary regularity and volume of maintenance are preserved.

Besides, below listed works are introduced additionally or carried out more often.

When operating the tractor in the desert, on sand soils, at higher temperatures and air dustiness conditions.

Fill the engine with oil and fuel by closed method. After each three shifts, change oil in the air cleaner tray.

When performing MS-1, check:

- oil in the engine; no mechanical impurities in oil are allowed. Change, if necessary;
- central air cleaner pipe (the pipe shall be clean). Wash and service the air cleaner after each 20 hours;
- flush the water radiator core with water jet or blow with air. The radiator shall be clean; there shall be no oil traces on its surface. When performing MS-2, wash fuel tank plug.

When operating the tractor at low temperatures, perform the pre-start heating of the engine to 20-30°C. At the end of the shift fully refuel the tanks) at the temperatures of minus 30°C use arctic fuel) and drain condensate from the bottle. Fill the cooling system with anti-freeze.

When operating the tractor on rocky soil, as well as under mountainous conditions.

Every shift inspect the running gear and other components of the tractor for damages, as well as check tightening of plug of

the engine crankcase, rear axle and FDA as well as fastening of driving wheels. Check the air-tightness of engine cooling system radiator plug.

under mountainous operating conditions, adjust the fuel pump to reduce its output capacity to avoid disturbance of the engine working process within the following limits:

- at 1,500 to 2,000 m above sea level, reduce output capacity by 10%;
- at 2,000 to 2,500 m - by 15%;
- at 2,500 to 3,000 m - by 20 %;
- operation at more than 3,000 m is not recommended.

Maintenance of the tractor when preparing it for storage, during storage and returning to operation

The tractor is maintained under stated conditions according to regulations stipulated in Chapter "Tractor Storage"

LUBRICATION TABLE

Units and points of lubrication	Standard, name, brand and description of lubricating materials and liquids				Amount of lubricating points
	Lubricant at operation temperature		Refill at operation, l	Greasing at storing (up to 6 months)	
	From −40°C to +5°C	From +5°C to +50°C			
Crankcase		Motor oil	12.0	12.0	
Power steering casing	M-8ДМ	M-10ДМ			1
		Backup			
	M-8Г _{2К} , M-8Г ₂	M-10Г _{2К} , M-10Г ₂	6	6	
Air cleaner tray	Pre-settled and filtered waste motor oil		1.5	1.5	1
Power train casing (transmission)		Standard			
	Transmission oil ТАп-15В*; ТСп-15К; ТСп-10	ТСп-15К	40	40	1
		Backup			
Upper bevel pair casings of FDA reducing gears	Transmission oil ТАД-17и	Transmission oil ТАД-17и			
		Standard			
	ТАп-15В	ТСп-15К	0.25	0.25	2
FDA drive intermediate support	ТАп-15В	ТСп-15К	0.15	0.15	1
		Backup			
	Transmission oil ТАД-17и	Transmission oil ТАД-17и			
FDA final drive reducing gear casings	-//-	-//-	1.8	1.8	2
FDA casing	Ditto	Ditto	1.6	1.6	1
Upper bevel pair casings of FDA reducing gears	-//-	-//-	0.25	0.25	2
FDA drive intermediate support	-//-	-//-	0.15	0.15	1
Driving pulley	-//-	-//-	0.50	0.50	1

* At temperatures of –15°C to –20°C, dilute 30% of the refilling volume with spindle oil AU as per State Standard ГОСТ 1642-75 or machinery oil I-12A as per State Standard ГОСТ 20799-75. At temperatures below –55°C, dilute up to 15% of the refilling volume with winter diesel fuel.

Units and points of lubrication	Standard, name, brand and description of lubricating materials and liquids			Amount of lubricating points
	Lubricant at operation temperature		Refill at operation, l	
	From –40°C to +5°C	From +5°C to +50°C		
Oil tank of hydraulic system	Hydraulic oil Bechem Staroil 32 HLP TY P5 903.201.042-05 ADDINOL Hydraulikol HLP - 32 TY P5 903.201.044-05 THK Hydraulic HLP - 32 TY 236.915.052-08		17.5	-//-
Clutch shifter bearing	Standard grease Litol-24 Backup grease Bechem LCP-GM multi-purpose grease		4-6 injections with gun (0.02)	-//-
Adjustable angle brace pinion	-//-		0.005	
Rotary shaft sleeves of rear mounted attachment	Ditto		Until grease appears from the gaps (0.01)	-//-

Refill capacities, l

Engine cooling system	20
Engine lubrication system	13.3
Transmission casings	40
Casing of FDA with bevel reducing gears	1.6
Casing of reducing gear with bevel transmission (each)	1.8
Hydraulic system oil tank	17.5
Fuel tank	127
Casing of FDA cardan drive intermediate support	0.15
Steering booster casing	6.0

Adjustment values of 4YTHH and 4YTHH-T fuel pumps for bench tests

Table 1

Parameter name	Unit	4YTHH
		Д-244
Geometric start of injection	mm	3,3±0,1
Angle of fuel injection start by menisci of other sections relative to the 1st 3 4 2	deg.	90±30' 180±30' 270±30'
Rated speed of pump camshaft	rpm	850±5
Fuel delivery per stroke at rated speed	mm ³ per stroke	72±1,4
Speed at governor action start	rpm	865-880
Unevenness of fuel delivery among sections at rated speed, max.	%	6
Speed corresponding to engine idle running	rpm	900
Delivery per stroke at maximum idle speed, max.	mm ³ per stroke	22,5
Unevenness of fuel delivery per stroke between sections at maximum idle speed, max.	%	35
Speed corresponding to of maximum torque	rpm	700...750
Fuel delivery per stroke at speed corresponding to of maximum torque	mm ³ per stroke	82±2
Speed corresponding to full automatic disengagement of fuel delivery through injectors, max.	rpm	990
Fuel delivery per stroke at pump camshaft speed of 40 to 50 rpm, min.	mm ³ per stroke	140
Pressure in fuel pump head at rated camshaft speed	MPa (kgf/cm ²)	0,07-0,12 (0,7-1,2)

Section H. TROUBLESHOOTING

Table H-1

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
ENGINE	
Engine does not start	
Air in the fuel system. Faulty fuel pump.	Pump the system with manual priming pump. If necessary, eliminate air inflow. Remove the fuel pump from the engine and send it to the shop for repair.
Engine fails to develop full power	
There is no full fuel feed due to misalignment of fuel pump control rods.	Adjust control rods.
Filtering element of fuel fine filter is clogged.	Replace filtering element.
Faulty injectors.	Locate the faulty injectors, wash and adjust them.
Wrong fuel injection advance angle.	Set the recommended injection advance angle.
Engine air cleaner clogged.	Perform MS for air cleaner.
Engine runs unstably at idle speed	
Ingress of air into the fuel system.	Remove air from fuel system.
Idling springing the fuel pump is not adjusted.	Adjust idling spring (for engines with fuel pump 4UTNM or 4UTNI).
Fuel pump failure.	Remove the fuel pump from the engine and send it to the shop for repair.
The engine fumes at all the operation modes	
A. Black fume is emitted from the exhaust pipe	
Engine air cleaner clogged.	Perform maintenance service for air cleaner.
Injector atomizer needle sticking.	Detect the faulty injector, wash or replace the atomizer, if necessary adjust the injector.
Poor quality of fuel.	Replace fuel with the recommended one.
Fuel pump failure.	Remove the fuel pump from the engine and send it to the shop for repair.
B. White fume is emitted from the exhaust pipe	
Engine not warmed up.	Warm up the engine; maintain the coolant temperature at 75 to 95°C during operation.
Clearances between the valves and the rockers not adjusted.	Adjust clearances.
Water in fuel.	Change fuel.
Fuel injection advance angle setting is disturbed.	Set the recommended fuel injection advance angle.

Table H-1, continued

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
C. Blue fume is emitted from the exhaust pipe	
Ingress of oil into the combustion chamber as a result of wear of cup-piston group components	Replace the worn-out parts of the cup-piston group.
Excess of oil in the diesel engine crankcase.	Drain the excessive oil, having set the level against the upper mark of oil-measuring rod.
Engine overheating	
Coolant boiling in radiator.	Clean the radiator from dirt and dust, if necessary, clean cooling system from scale; adjust the fan belt tension.
Poor fuel atomization by the injectors.	Locate the faulty injectors, wash, clean and adjust them.
Engine suddenly stops	
No fuel delivery.	Check fuel in the fuel tank, check condition of fuel lines, filter and booster pump.
Oil pressure in warmed-up engine below allowable level	
Pressure sensor or indicator failure.	Replace.
Engine lubrication system pump is faulty.	Eliminate the failure or replace the pump.
Oil level in the crankcase is below the allowable level.	Add oil to the upper mark of the oil dipstick.
Sticking of the drain valve of centrifugal oil filter.	Rinse the valve and adjust the pressure.
Maximum wear of crankshaft journal to bearings junction.	Send the engine for repair.
POWER GEAR	
CLUTCH	
Clutch does not transfer full torque	
No pedal free travel.	Adjust pedal free travel.
Driven plate linings are worn out.	Replace the linings of the driven plate as an assembly.
Oil on driven plate linings.	Eliminate causes of oil ingress to dry compartment of clutch, if necessary, replace friction linings or plate assemblies.
Clutch cannot be fully disengaged	
Too large pedal free travel.	Adjust pedal free travel.
Misadjusted position of release levers.	Adjust position of release levers as per this Manual.
Oil in dry compartment of clutch housing	
Worn cup sealing crankshaft.	Replace cup.
Worn sealings of clutch housing.	Replace sealings.
REAR AXLE FINAL DRIVE	
High noise in bevel gear and pinion	
Misadjustment of mesh of the final drive pinion teeth with differential bearings.	Adjust mesh of pinions and clearance in bearings.

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
BRAKES	
Inefficient brakes (brakes do not hold)	
Misadjusted brake control. Brake disk linings are oiled or worn out.	Adjust brake control. Eliminate oil leak. If necessary, replace disks.
REAR PTO	
Rear PTO does not transfer full torque (slips)	
Misadjusted control mechanism due to considerable wear of the friction linings of the brake band or owing to other reason.	Adjust PTO control mechanism.
FRONT DRIVING AXLE	
Front axle fails to engage automatically when rear wheel are slipping during forward motion of tractor	
Parts of the free running coupling of the transfer case are worn out.	Replace the free running coupling.
Catch slots of the external casing of the free running coupling are clogged with the products of oil oxidation and part wear.	Remove the coupling and wash its parts.
The springs of the roller pressing mechanism are deformed.	Replace springs.
The safety coupling in the intermediate support does not transfer the required torque.	Adjust the coupling for transferring the torque of 40 to 80 kgf•m (400 to 800 N•m) by tightening the collar nut from the transfer case side.
The driving and driven plates of the safety coupling are worn out.	Replace plates.
The disk springs have lost resilience or got broken.	Replace springs.
Transfer case control rod has increased length.	Adjust the rods length as described in Chapter F. Adjustments.
Quick wear and ply separation of front tires	
Non-compliance of air pressure in the tyres of the front and rear wheels with the recommended norms.	To prevent faults, maintain the air pressure in the tyres of the front and rear wheels according to the recommended norms.
Misalignment of the wheel toe-in. The FDA is constantly engaged due to breakage or jamming in transfer box control,	Adjust. Check the forced engagement of the FDA. Eliminate the fault. Adjust transfer case control mechanism.

Table H-1, continued

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
STEERING	
High force on steering wheel	
Oil foaming in booster system. a) insufficient oil in booster housing; b) air in system	Check oil level, add to the required level if necessary. Check suction line and eliminate leakage.
Misadjusted safety valve. High oil leak in pump.	Adjust valve Replace pump
Jamming in worm to sector mesh	Adjust mesh
High vibration of steering wheel	Screw in round nut until it touches bushing, unscrew it by 1.5 turn and lock.
Increased instability of front wheels	
Weak tightening of worm nut	Screw in the nut to a torque of 2 kgf•m (20 N•m), unscrew it by 1/12-1/10 turn to align the slot in the nut with the hole in the worm for pin
Increased backlash in tapered bearings of front wheels or steering rod joints, misadjusted front wheel toe-in	Adjust.
Weak tightening of nuts fastening sector pitman arm or pivot arms	Tighten up the nuts.
Increased axial movement of pivoting shaft	Adjust axial movement of shaft with bolt.
Steering wheel free play increased (exceeds 25°)	
Increased clearance in worm to sector mesh	Adjust clearance
Increased backlash in cardan joints of steering wheel drive	Replace worn parts
Weak tightening of worm nut	Screw in the nut to a torque of 2 kgf•m (20 N•m), unscrew it by 1/12-1/10 turn to align the slot in the nut with the hole in the worm for cotter pin

Table H-1, continued

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
HYDRAULIC LIFT LINKAGE	
Hinge does not lift or its lifting capacity sharply reduced.	<ol style="list-style-type: none"> 1. Low oil level in tank — add oil to level. 2. Air sucked into the suction line of the pump — eliminate air suction (oil foaming). 3. Sticking of distributor relief valve (take out valve parts, rinse and install to place).
Lifting capacity drops when oil warms up. When oil cools down, lifting capacity restores.	Worn or broken oil pump — replace pump.
Hydraulic system oil too hot	<ol style="list-style-type: none"> 1. Insufficient oil in hydraulic system housing (add oil to the mark “П”). 2. The distributor arm is in the lifting position (return the arm to the neutral position, find and eliminate the cause of jamming). 3. Pump lost its capacity (replace pump).
Spontaneous lowering of implement	<ol style="list-style-type: none"> 1. Oil leakage over sealings of cylinder piston (replace sealing). 2. Leaky pilot-operated check valve of distributor (rinse or replace valve).

End of Table H-1

TROUBLE, EXTERNAL MANIFESTATION	REMEDY
ELECTRIC EQUIPMENT	
Low charge of storage battery	
Low level of controllable voltage.	Replace the alternator voltage regulator.
Slipping of the alternator driving belt.	Adjust belt tension.
Increased transient resistance between the storage battery terminals and wire lugs due to oxidation and loosening.	Clean terminals, tighten and grease non-contact parts with technical petrolatum. Tighten up the fastening of the SB switch and the "ground" jumper.
Storage battery failure.	Replace.
Storage battery "boils" and requires frequent adding of distilled water	
High level of controllable voltage.	Replace the alternator voltage regulator.
Storage battery failure.	Replace.
Starter fails to turn on and crank engine crankshaft	
One of wire lugs at the storage battery is disconnected.	Tighten firmly the lugs on the battery terminals.
Heavy oxidation of wire lugs and terminals of the storage battery.	Clean battery terminals and wire lugs, grease their non-contact parts with technical petrolatum.
Engine start locking unit triggered or its switch is faulty.	Set gear shifter lever to leftmost or replace the switch.
Low starter starting moment due to storage battery discharging.	Charge the battery to the norm.
Starter failure.	Remove the starter and send it to shop for repair.
Alternator does not develop full power	
Slipping of alternator driving belt.	Adjust.
Alternator failure.	Remove the alternator and send it to shop for repair.
Noise in alternator	
Slipping or excessive tension of fan belt.	Adjust.
Bearings worn.	Remove the alternator and send it to shop for repair.

Section H. TRANSPORTING TRACTOR AND TOWING IT

The tractors can be transported by rail-road transport, on trucks and their trailers, as well as by towing or under its own power.

When transporting the tractors:

- Shift the GB shifter to the first gear;
- Engage the reserve parking brake.
- Fasten the tractor to the platform with a wire Ø6 mm, chains and guy ropes.

When handling the tractors, use hoist mechanisms with a lifting capacity of 10 tf min.

The ropes should be fastened at the beam or eye nut of the front axle (1) and at the eye nut (1) of the rear wheels as shown in the diagram below. When fas-

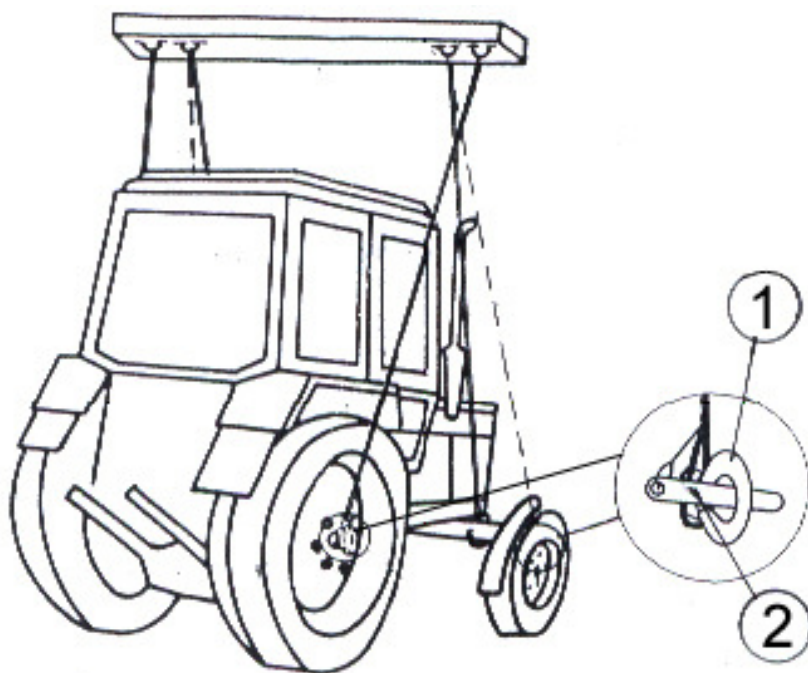
tening the ropes by the eye nut (1), draw the hoisting device through the eye nut body and fix it with the stopper (2) through the eye of the eye nut.

To attach a tow rope, an eye is provided lug attached to the front ballast weights and to the weight bracket.

During transportation of the tractor, rules of road must be strictly observed.

Attention! When the tractor is lifted by the eye nuts, it can move forward (backward) up to 1.5 m.

Do not use the towing shackle to lift the tractor.



Section J. **STORING TRACTOR**

Store tractors as per recommendations of GOST 7751-85 indoors or under shed.

When no closed room is available, tractors can be stored on open equipped areas subject to mandatory works for preservation, sealing and removing parts that require warehousing.

Put the tractors to storage between shifts if a break in operation is up to 10 days, to short-time storage if the idle period is 10 days to two months and to long-time storage if the idle period exceeds two months. Prepare to short-time storage after completion of works and to long-time storage no later than 10 days after completion of works. Before putting to storage, check condition of the tractor. The tractor must undergo the scheduled maintenance service.

Maintenance during preparation to long-time storage includes:

- cleaning and washing, removing from the tractor and preparing to storage of parts that must be stored in specially equipped warehouses; sealing holes, cavities to prevent moisture, dust; preservation of the tractor, its parts; putting the tractors on supports (blocks).

After operation, the tractor is cleaned of dust, dirt, oil leaks, plant and other remains. Parts, to which no water is allowed (generators, relay switches etc.), are protected with protective casings. After cleaning and washing, the tractors are blown with compressed air to remove moisture.

Damaged paint is restored by applying paint or protective grease.

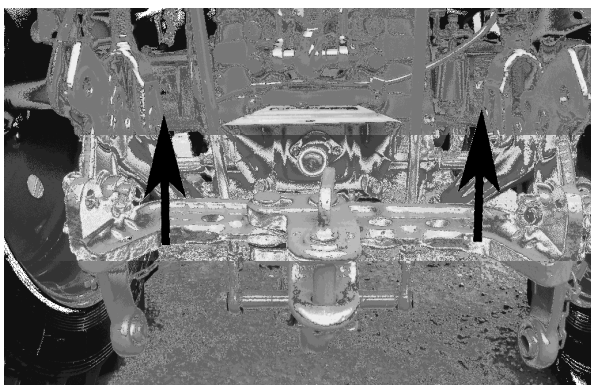
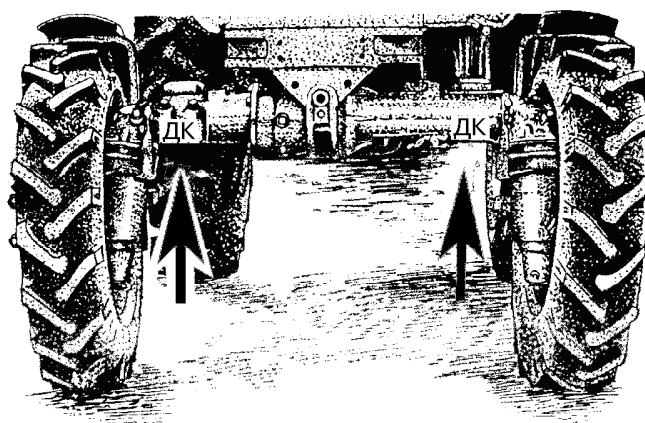
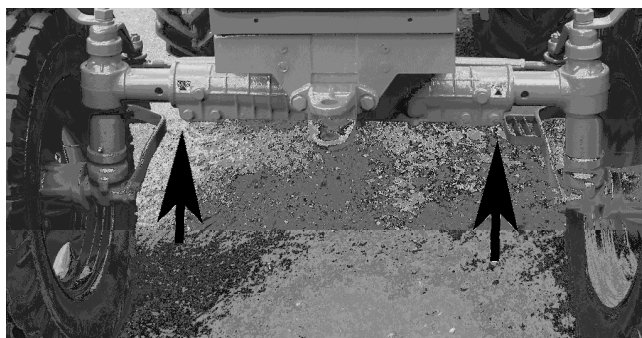
Paint as per GOST 6572-91.

In case of long-time storage of the tractors outdoors, electric equipment, parts of rubber, plastics materials from textile (hoses of hydraulic systems etc.), tools are removed and put to storage. Parts fastening the removed parts of the tractor are installed to their places. The electric equipment (headlights, alternator, starter, batteries) are cleaned, blown with compressed air, the terminals are covered with protective grease.

When preparing the tractor to long-time storage, clean from scale and wash the engine cooling system, lubricate all tractor parts according to the lubrication table. Drain the oil and add fresh oil with adding an additive to the required oil quantity to the control level to the engine crankcase, the air cleaner tray, the housings of the gearbox and rear and front axles, the wheel reduction gear, the intermediate support, to the hydraulic system oil tank. Run the tractor for 10 to 15 minutes. Drain the coolant from the cooling system, the cab heating and air cooling system. Drain fuel from the fuel system, rinse the inner surfaces of the tanks with inhibiting lubricant and tightly close the filler neck. Carry out preservation of the fuel system and engine cylinders with rust-preventing agent. Put the batteries to long-time storage after carrying out the check and conditioning cycle as per GOST 9590-76. Preserve the open joints, bolted and threaded connections of the hitch mechanism, steering linkage, spline surfaces of the PTO shank, extended parts of cylinder and shock absorber rods, mechanisms adjusting the front and rear wheel track. Using covers, polyethylene film bags or other special devices, tightly close the fuel tank

filler neck, holes of the engine breathers and the air cleaner intake pipe, the respective holes remained after removal of the starter and other cavities through which atmospheric precipitate can ingress to the inner cavities of the units of the tractor. Set the control levers and pedals to position preventing spontaneous engagement of tractor parts and units.

Pneumatic tires can be stored outdoors in unloaded state on tractors installed on supports. Jacklift the tractor so that the tires take off the supporting surface by 8 to 10 cm. Put supports under the rear half-axle bodies, the front axle or the FDA final drive bodies (see points indicated by arrows on the figure).



The tire surfaces are covered with protective agent. The tire pressure in case of outdoors or indoors storage is decreased to 70 per cent of the normal. The outer surfaces of the hydraulic system flexible hoses are cleaned of dirt and oil. Hoses can be stored on the machine. At that they are covered with protective agent or wrapped into insulating material (waxed paper, polyethylene film etc.). All holes, slots, cavities (the filler necks of the tanks and transmission, the holes of the hydraulic system breathers, the engine exhaust pipe and other), through which atmospheric precipitate can ingress to the tractor inner cavities, are tightly closed with covers or blanking plugs. To ensure free drainage of water from the cooling system and condensate, the drain devices are left open. The hoods and cab doors must be left closed.

When doing maintenance service during storage, the following items are checked: correct installation of the machines on supports or pads (no skew), completeness,

air pressure in the tires, reliability of sealing, condition of the rust-preventing coatings (availability of protective grease, integrity of paint, no rust), condition of the protective devices (integrity and strength of fastening of the casings, covers). Eliminate all found faults.

Servicing the tractor when removing it from storage includes taking the tractor from the supports, cleaning and as necessary depreservation of the tractor, its parts, removing all sealing devices, installing the removed parts, tools to the tractor, checking operation and adjusting the tractor and its parts.

Requirements to inter-shift storage of machines

Tractors can be stored on areas and places of inter-shift storage or on the work site. All holes, through which atmospheric precipitate can ingress the inner cavities of the tractor, must be tightly closed with covers. The batteries must be disconnected.

Requirements to short-time storage of machines

Put the tractor to storage complete without removing units and assemblies from the tractor.

Disconnect the batteries. The level and density of electrolyte must meet recommendations on servicing and checking batteries. In case of storing the tractors at low temperatures or longer than one month, remove the batteries and deliver them to warehouse.

Requirements to long-time storage of machines outdoors

Preparing the engine to long-time storage includes preservation of part surfaces located inside the engine (inner preservation) and flushing the cooling system, sealing the inner surfaces, preservation of the outer unpainted engine surfaces (outer

preservation), if no hood is available, packing the engine into a plastic film casing.

When the fuel tanks have no fuel, carry out preservation with use of volatile inhibiting agents. Clean and wash the air cleaner, pour working preservation oil to the tray.

Clean and grease the threaded connections of the hitch mechanism, hydraulic systems, steering linkages etc.

Preservation

Temporary rust protection of the tractor units and systems from action of the environment during transportation and storage of the tractor is provided by preservation.

The tractor surfaces to preserve are cleaned of mechanical impurities, degreased and dried. Subject to preservation are unpainted inner and outer galvanized surfaces, viewed units of the tractor and in the cab with rust-protection oil RUST BAN 397. SUMIDERA 397. Material consumption is 0.02 to 0.03 kg per tractor.

The engine inner surfaces are preserved after running-in of the tractor by pouring rust-preventive additive PFINDER AP 241. CORTEK VCI 329 through the coarse filter to fill the cavities with the preservation agent. Material consumption is 0.05 kg per tractor.

The inner surfaces of the fuel tank are preserved by spraying RUST BAN 335 after their making before painting. ML – 5588, the instrument panel after assembly by spraying RUST BAN 397, SUMIDERA 397 rust-preventive oil on the inner surfaces of the panel. The PTO shanks are preserved by lubricating them with RUST BAN 335, ML -5888 rust-preventive oil. Material consumption is 0.1 kg per tractor.

The units (the radiator and fuel tank filler neck, breathers, cylinder rods) are preserved with polyethylene film casings. Material consumption is 0.66 kg per tractor.

The applied materials provide protection of the tractor and its parts for the storage and transportation period during a year.

Before putting the tractor to operation, take off the polyethylene casings, remove the preservation material from the tractor outer surfaces by wiping with rags wetted in a solvent as per GOST 3134-78.

Perform outer preservation of the tractor and its parts by greasing the surfaces with a brush and by spraying to the surfaces with a paint sprayer.

Perform inner preservation of the tractor by filling the cavities with the preservation agent with subsequent processing the engine.

Depreservation

Choose the depreservation method depending on the applied preservation materials. Wipe the preserved surfaces with rags wetted in low-viscosity oils, solvents or wash with water-soluble detergent solutions. Remove all insulating materials (film, paper) from the sealed units. Preserved inner surfaces require no depreservation.

Re-preservation

Re-preserve the tractor when preservation faults are found during storage or when the protection period expires.

During operation of the tractor, at inter-shift, short-term and long-time storage, the means and methods of preservation, storage conditions are provided by the enterprises operating the tractor as per GOST 7751-85. The inner surfaces are also preserved using the universal preservation grease KS-U as per TU RB

600125053.019-2004. When storing outdoors, preserve the viewed surfaces with BELA-KOR grease of grade A as per TU RB 600125053-020-2004.

Preparing tractor to operation after long storage

Remove the grease from preserved outer surfaces. Remove the mounting protective covers, plugs, special devices, and install the previously removed part to place. Before installation, clean the parts of dirt and dust. Drain sediment from all tanks, fill them with working fluids and add to the check mark as necessary.

Lubricate all tractor gears as per the lubrication table. Fill the fuel tanks with fuel. Depreserve the fuel system and engine cylinders by starting the engine. Fill the system with coolant. Perform scheduled maintenance Crank the engine crankshaft without fuel delivery by some revolutions and, after making sure the the crankshaft normally rotates, start the engine for 5 to 10 minutes, gradually bringing the crankshaft speed from the minimum to the rated one. Run the tractor for 15 to 20 minutes. Eliminate all found faults.

Safety requirements for preservation works

Only persons older than 18 years, subject to medical examination, introduction brief on labor and fire safety, primary brief on the workplace, are allowed to perform works of the preservation process consisting of preparing the surfaces, applying the preservation means, marking up and cutting paper, packing. Rooms and sites of preservation must be separated from other industrial rooms and equipped with forced-air-exhaust ventilation. The applied preservation materials are flammable substances with a flash point of 170 to 270 °C and must meet the state standards, specifications and have a quality certificate.

Supplied preservation materials must carry the material name. Perform preservation works in special apparel and footwear, always use personal protection equipment.

When carrying out preservation works, observe the personal hygiene rules, timely deliver the protective overalls to cleaning, do not wash them in emulsion, solvents, kerosene. By their impact on human organism, the preservation materials are moderately hazardous, thus, use the recommended personal protection equipment when working with the materials.

In case of a long action of preservation oils, greases and liquids on the hand skin, it can be damaged. White spirit vapors act as a weak drug in low concentrations and can poison in high concentrations. The rust-preventive paper contains rust inhibitors that cause irritation and inflammation of the skin and mucuous coatings of the nose, eyes. Before you start working, put on a cotton robe or suit, apron, prepare personal protection equipment depending on the work conditions and toxicity of the substances applied. Grease your hands with protective paste (cream) or put on cotton and rubber gloves. Before you start any work for which safe labor practices are not known to you, require a brief on safety measures.

Section K. DISPOSAL OF TRACTOR

When disposing of the tractor after expiration of its service (operation) life, is necessary to:

- discharge waste oil from the lubrication system of the diesel engine, rear axle housing and wheel reducers, gearbox, front driving axle, reducers of front wheel final drives, hydraulic system oil tank and send it for recycling according to the established procedure;
- discharge coolant from the engine cooling system and put it into containers designated for storage ;
- discharge diesel fuel from the fuel tank and put it into containers designated for storage;
- discharge sediment from the coarse and fine fuel filters;
- discharge electrolyte from the battery of the tractor, put it into containers designated for storage and send it to recycling according to the established procedure;
- completely disassemble the tractor to parts, sort them out to non-metal, steel, cast iron, aluminum, non-ferrous and precious metal items, and send them to recycling according to the established procedure;
- trained personnel can unmount parts and assembly units, do maintenance work for the air-conditioning system with use of equipment for servicing freon-based refrigerating units.
- When carrying out maintenance and minor repairs, the fuels and oils to change, if necessary, parts and assembly units, are to be sent to recycling with assembling units to parts and sorting them by composition of the materials.

ANNEX L. ELECTRIC CIRCUIT DIAGRAM

List of parts of the electric circuit diagram

Designation	Description	Qty.	Note
BK1	Coolant temperature indicator sensor	1	
BP1	Engine oil pressure sensor	1	
BN1	Fuel level indicator sensor	1	
E1, E2	Road headlight	2	
E3, E5	Working headlight	2	
E4	Number plate light	1	
EL1, EL2	Lamp A12-45+40	2	Supplied with E1, E2
EL4...EL2	Lamp A12-1	5	Supplied with P2...P6
EL9, EL12, EL13, EL15, EL16, EL18	Lamp A12-21-1	6	Supplied with HL5...HL8
EL10, EL11, EL20	Lamp A12-5	3	Supplied with HL5, HL6, E4
EL14, EL17	Lamp A12-10	2	Supplied with HL7, HL8
EL19, EL21	Lamp AKG12-55-1	2	Supplied with E1, E2
EP2...EP6	Socket with plug	5	Supplied with P2...P6
F1...F3	Fuse blocks	3	
G1	Alternator	1	
GB1, GB2	Storage battery	2	
HA1	Horn	1	
HL1	Headlight upper beam pilot lamp	1	
HL2	Turn indicator pilot lamp	1	
HL3	Air cleaner filter clogging pilot lamp	1	
HL4	Alarm lamp of emergency pressure drop in engine	1	
HL5, HL6	Front light	2	
HL7, HL8	Rear light	2	
K1	Starter relay switch	1	
K2	Starter lock relay switch	1	
KH1	Turn indicator flasher	1	
M1	Starter	1	

Annex L. Belarus-510/512 Operating manual

Designation	Description	Qty.	Note
P2	Tachometer/speedometer	1	
P3	Engine oil pressure indicator	1	
P4	Fuel level indicator	1	
P5	Voltage indicator	1	
P6	Engine coolant temperature indicator	1	
QS1	Battery disconnect switch	1	
SA1	Understeering multifunctional switch	1	
SA2	Starter and instrument switch	1	
SA3	Central light switch	1	
SB1	Start lock switch	1	
SB2	Fault signaling switch	1	
SB3	Stop-light switch	1	
SP1	Air cleaner clogging sensor	1	
SP2	Emergency oil pressure sensor	1	
XA9.1	Socket for trailer	1	
XP1.1...XP1.3	Single-pin terminal block	3	
XS1.1...XS1.3	Single-pin female receptacle	3	
XS2.1...XS2.2	Two-pin female receptacle	2	
XS3.1	Three-pin female receptacle	1	
XS4.1	Four-pin female receptacle	1	
XS5.1	Five-pin female receptacle for relay switch	1	
XS6.1	Six-pin female receptacle	1	
XS8.1	Eight-pin female receptacle of fault signaling switch	1	
XS8.2	Eight-pin female receptacle of key switch	1	
XP12.1	12-pin plug	1	
XP15.1	15-pin plug	1	
XS12.1	12-pin socket	1	
XS15.1	15-pin socket	1	
XT2.1, XT2.2	Two-terminal backplane	2	
XT3.1	Three-terminal backplane	1	
XT4.1	Four-terminal backplane	1	

Electric circuit diagram of 90/92 tractor

